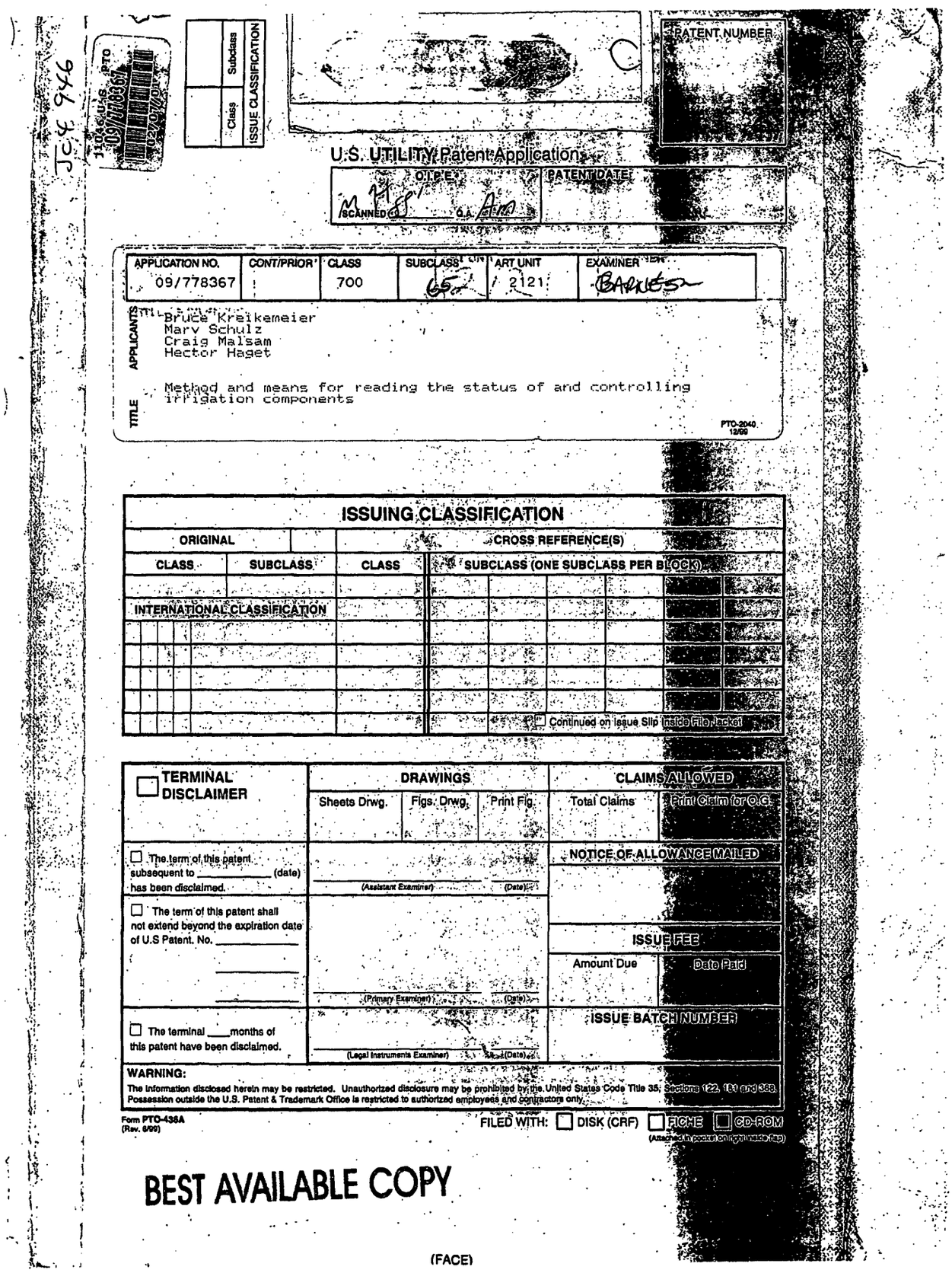
FILE HISTORY

US 6,853,883

PATENT:	6,853,883
INVENTORS:	Kreikemeier, Bruce
	Schulz, Marv
	Malsam, Craig
	Haget, Hector
TITLE:	Method and means for reading the status of and controlling irrigation components
APPLICATION NO:	US2001778367A
FILED:	07 FEB 2001
ISSUED:	08 FEB 2005
COMPILED:	30 JAN 2015



PATENT NUMBER

ISSUE CLASSIFICATION: Class | Subclass

U.S. UTILITY Patent Application

TYPE | PATENT DATE

SCANNED | O.A.

APPLICATION NO.	CONT/PRIOR	CLASS	SUBCLASS	ART UNIT	EXAMINER
09/778367		700	65	2121	BARNES

APPLICANTS
Bruce Kreikemeier
Marv Schulz
Craig Malsam
Hector Haget

TITLE
Method and means for reading the status of and controlling irrigation components

PTO-2040 12/89

ISSUING CLASSIFICATION

ORIGINAL CLASS	ORIGINAL SUBCLASS	CROSS REFERENCE(S) CLASS	CROSS REFERENCE(S) SUBCLASS (ONE SUBCLASS PER BLOCK)

INTERNATIONAL CLASSIFICATION

☐ Continued on Issue Slip inside File Jacket

☐ TERMINAL DISCLAIMER	DRAWINGS: Sheets Drwg. / Figs. Drwg. / Print Fig.	CLAIMS ALLOWED: Total Claims / Print Claim for O.G.
☐ The term of this patent subsequent to _____ (date) has been disclaimed.	(Assistant Examiner) (Date)	NOTICE OF ALLOWANCE MAILED
☐ The term of this patent shall not extend beyond the expiration date of U.S Patent. No. _____	(Primary Examiner) (Date)	ISSUE FEE: Amount Due / Date Paid
☐ The terminal ___ months of this patent have been disclaimed.	(Legal Instruments Examiner) (Date)	ISSUE BATCH NUMBER

WARNING:
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Form PTO-436A (Rev. 6/99)

FILED WITH: ☐ DISK (CRF) ☐ FICHE ☐ CD-ROM
(Attach with paper on right inside flap)

(FACE)

6,853,883

METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS

Transaction History

Date	Transaction Description
02-07-2001	Initial Exam Team nn
03-08-2001	IFW Scan & PACR Auto Security Review
03-13-2001	Correspondence Address Change
03-15-2001	Application Dispatched from OIPE
04-19-2001	Case Docketed to Examiner in GAU
02-20-2002	Case Docketed to Examiner in GAU
02-26-2002	Case Docketed to Examiner in GAU
04-10-2002	Correspondence Address Change
04-10-2002	Change in Power of Attorney (May Include Associate POA)
06-05-2002	Preliminary Amendment
09-09-2003	Case Docketed to Examiner in GAU
09-26-2003	Non-Final Rejection
10-03-2003	Mail Non-Final Rejection
11-17-2003	Response after Non-Final Action
11-20-2003	Date Forwarded to Examiner
11-25-2003	Non-Final Rejection
11-28-2003	Mail Non-Final Rejection
03-01-2004	Response after Non-Final Action
03-05-2004	Date Forwarded to Examiner
04-19-2004	Final Rejection
04-20-2004	Mail Final Rejection (PTOL - 326)
05-21-2004	Request for Continued Examination (RCE)
05-21-2004	Workflow incoming amendment IFW
05-21-2004	Workflow - Request for RCE - Begin
06-24-2004	Date Forwarded to Examiner
06-24-2004	Date Forwarded to Examiner
06-24-2004	Disposal for a RCE / CPA / R129
07-19-2004	Non-Final Rejection
07-20-2004	Mail Non-Final Rejection
08-23-2004	Response after Non-Final Action
08-23-2004	Workflow incoming amendment IFW
08-30-2004	Date Forwarded to Examiner
09-23-2004	Examiner's Amendment Communication
09-23-2004	Notice of Allowance Data Verification Completed
09-24-2004	Mail Notice of Allowance
09-24-2004	Mail Examiner's Amendment
10-05-2004	Workflow - File Sent to Contractor
10-06-2004	Receipt into Pubs
11-17-2004	Receipt into Pubs
12-27-2004	Issue Fee Payment Verified
12-27-2004	Issue Fee Payment Received
01-04-2005	Dispatch to FDC
01-04-2005	Application Is Considered Ready for Issue
01-05-2005	Receipt into Pubs
01-19-2005	Issue Notification Mailed
02-08-2005	Recordation of Patent Grant Mailed
02-08-2005	Patent Issue Date Used in PTA Calculation

Issue Classification	Application No.	Applicant(s)	
	09/778,367	KREIKEMEIER ET AL.	
	Examiner	Art Unit	
	Crystal J. Barnes	2121	

ISSUE CLASSIFICATION

ORIGINAL		CROSS REFERENCE(S)						
CLASS	SUBCLASS	CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					
700	284	700	65					
INTERNATIONAL CLASSIFICATION		702	188					
G05D 11/00		340	3.1	3.71	3.9			
G05D 7/00								
/								
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/								

Crystal J. Barnes 21 Sept. 2004
(Assistant Examiner) (Date)

(Legal Instruments Examiner) (Date)

Anthony Knight
Supervisory Patent Examiner
Group 3600
(Primary Examiner) (Date) 9/22/04

Total Claims Allowed: 4

O.G. Print Claim(s)	O.G. Print Fig.
3	1

☒ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		31		61		91		121		151		181
	2		32		62		92		122		152		182
	3		33		63		93		123		153		183
	4		34		64		94		124		154		184
	5		35		65		95		125		155		185
	6		36		66		96		126		156		186
	7		37		67		97		127		157		187
	8		38		68		98		128		158		188
	9		39		69		99		129		159		189
	10		40		70		100		130		160		190
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	29		59		89		119		149		179		209
	30		60		90		120		150		180		210

ISSUE SLIP STAPLE AREA (for additional cross references)

POSITION	INITIALS	ID NO.	DATE
FEE DETERMINATION			
O.I.P.E. CLASSIFIER		8	03/07/01
FORMALITY REVIEW	Sha	946	03-13-01
RESPONSE FORMALITY REVIEW			

INDEX OF CLAIMS

✔	Rejected	N	Non-elected
=	Allowed	I	Interference
—	(Through numeral)... Canceled	A	Appeal
÷	Restricted	O	Objected

Claim	Date	Claim	Date	Claim	Date
Final / Original		Final / Original		Final / Original	
1	✓ ✓ ✓	51		101	
2	✓ ✓ ✓	52		102	
3	✓ ✓ ✓	53		103	
4	✓ ✓ ✓	54		104	
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50		100		150	

If more than 150 claims or 10 actions staple additional sheet here

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Index of Claims

Application No.	Applicant(s)	
09/778,367	KREIKEMEIER ET AL.	
Examiner	**Art Unit**	
Crystal J. Barnes	2121	

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim		Date
Final	Original	7/16/04
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Index of Claims	Application No.	Applicant(s)
	09/778,367	KREIKEMEIER ET AL.
	Examiner	Art Unit
	Crystal J. Barnes	2121

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	+	Restricted	I	Interference	O	Objected

Claim		Date								
Final	Original	7/16/04	9/21/04							
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[redacted]

SEARCHED

Class	Sub.	Date	Exmr.
700	83 17 19 65 264 284	9/24/03	CJB
340	8.1 3.9		
UPDATE SEARCH		11/24/03	CJB
340	825.72	09 Apr 2004	CJB
UPDATE SEARCH		09 Apr 2004	CJB

INTERFERENCE SEARCHED

Class	Sub.	Date	Exmr.

SEARCH NOTES
(INCLUDING SEARCH STRATEGY)

	Date	Exmr.
EAST Text Search (SEE ATTACHED)	9/26/03	CJB
EAST Text Search (SEE ATTACHED)	11/24/03	CJB
EIC PLUS Search (SEE attached)	09 Apr 2004	CJB
EAST Text Search (SEE attached)	09 Apr 2004	CJB

(RIGHT OUTSIDE)

Search Notes	Application No.	Applicant(s)	
	09/778,367	KREIKEMEIER ET AL.	
	Examiner	Art Unit	
	Crystal J. Barnes	2121	

SEARCHED			
Class	Subclass	Date	Examiner
700	17	7/13/2004	CJB
700	65	7/13/2004	CJB
700	83	7/13/2004	CJB
700	264	7/13/2004	CJB
702	188	7/13/2004	CJB
340	3.1	7/13/2004	CJB
340	3.9	7/13/2004	CJB
340	3.71	7/13/2004	CJB

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner
see abo	ve search	7/13/2004	CJB

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
EAST Text Search	7/13/2004	CJB
Inventor Search	7/13/2004	CJB

U.S. Patent and Trademark Office

Part of Paper No. 20040713

Search Notes

Application No.	Applicant(s)	
09/778,367	KREIKEMEIER ET AL.	
Examiner	**Art Unit**	
Crystal J. Barnes	2121	

SEARCHED

Class	Subclass	Date	Examiner
700	17, 65, 83, 284	9/21/2004	CJB
702	188	9/21/2004	CJB
340	3.1, 3.9	9/21/2004	CJB
340	3.71	9/21/2004	CJB

INTERFERENCE SEARCHED

Class	Subclass	Date	Examiner
see search above		9/21/2004	CJB

SEARCH NOTES (INCLUDING SEARCH STRATEGY)

	DATE	EXMR
EAST Text Search (see attached)	9/21/2004	CJB
IEEE Text Search (see attached)	9/21/2004	CJB
Inventor Search	9/21/2004	CJB

L Number	Hits	Search Text	DB	Time stamp
1	193	(ancillary irrigat$) AND wireless AND remote AND (handheld portab$) AND (user interface) AND display AND (keyboard keypad) AND monitor$ AND (control controlling) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/25 13:36
2	0	(ancillary AND irrigat$) AND wireless AND remote AND (handheld portab$) AND (user interface) AND display AND (keyboard keypad) AND monitor$ AND (control controlling) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/25 13:37
3	165	ancillary AND wireless AND remote AND (handheld portab$) AND (user interface) AND display AND (keyboard keypad) AND monitor$ AND (control controlling) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/25 13:36
4	0	(auxilary AND irrigat$) AND wireless AND remote AND (handheld portab$) AND (user interface) AND display AND (keyboard keypad) AND monitor$ AND (control controlling) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/25 13:38
5	4	(auxiliary AND irrigat$) AND wireless AND remote AND (handheld portab$) AND (user interface) AND display AND (keyboard keypad) AND monitor$ AND (control controlling) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/25 13:49
6	0	(auxiliary AND irrigat$) AND wireless AND remote AND (handheld portab$) AND (user interface) AND display AND (keyboard keypad) AND (monitor$ WITH (control controlling)) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/25 13:49
7	3	irrigat$ NEAR (component equipment) AND wireless AND remote AND (handheld portab$) AND (user interface) AND display AND (keyboard keypad) AND (monitor$ WITH (control controlling)) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/25 13:50
-	487	700/83 AND (wireless remote) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/24 17:19
-	12	700/83 AND irrigat$ AND status AND (wireless remote) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/24 17:27
-	3	700/83 AND irrigat$ AND wireless AND remote AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/24 17:30

-	11	700/17 AND irrigat$ AND status AND (wireless remote) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/24 17:31
-	7	700/17 AND irrigat$ AND wireless AND remote AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/24 17:32
-	3	700/65 AND irrigat$ AND status AND (wireless remote) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/24 17:32
-	2	700/65 AND irrigat$ AND wireless AND remote AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/24 17:37
-	2	700/19 AND irrigat$ AND status AND (wireless remote) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/24 17:37
-	1	700/19 AND irrigat$ AND wireless AND remote AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/24 17:37
-	1	700/264 AND irrigat$ AND status AND (wireless remote) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/24 17:50
-	1	700/264 AND irrigat$ AND wireless AND remote AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/24 17:38
-	12	700/284 AND irrigat$ AND wireless AND remote AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/24 18:00
-	20	700/284 AND irrigat$ AND status AND (wireless remote) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/24 17:58
-	7	340/3.1 AND irrigat$ AND status AND (wireless remote) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/24 17:59

-	1	340/3.9 AND irrigat$ AND status AND (wireless remote) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/24 17:59
-	4	340/3.1 AND irrigat$ AND wireless AND remote AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/24 18:00
-	30	irrigat$ AND wireless AND remote AND (handheld portable) AND (user interface) AND display AND (keyboard keypad) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/24 18:02
-	28	irrigat$ AND wireless AND remote AND (handheld portable) AND (user interface) AND display AND (keyboard keypad) AND monitor$ AND (control controlling) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/09/25 13:35

L Number	Hits	Search Text	DB	Time stamp
4	19	irrigat$ and (wireless remote) SAME (handheld portable) and ((user adj interface) (display and (keyboard keypad))) and status AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 11:15
5	3	irrigat$ and (wireless and remote) SAME (handheld portable) and ((user adj interface) (display and (keyboard keypad))) and status AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 12:03
6	4	irrigat$ and (wireless and remote) SAME (handheld portable) and ((user adj interface) (display and (keyboard keypad))) and (monitor status) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 12:04
7	8	irrigat$ and (wireless remote) SAME (handheld portable) and ((user adj interface) (display and (keyboard keypad))) same (monitor status) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 12:08
8	0	irrigat$ and (wireless remote) SAME (handheld portable) same ((user adj interface) (display and (keyboard keypad))) same (monitor status) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 12:08
9	1	irrigat$ and (wireless remote) and (handheld portable) same ((user adj interface) (display and (keyboard keypad))) same (monitor status) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 12:09
10	7	irrigat$ and (wireless remote) same (handheld portable) same (monitor status) and ((user adj interface) (display and (keyboard keypad))) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 12:09
11	2	4244022.pn.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 13:28
12	21	700/83 AND (wireless remote) AND (@ad<20010207 @rlad<20010207) and @pd>20030920	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 13:39
13	0	700/83 AND (wireless remote) and irrigat$ AND (@ad<20010207 @rlad<20010207) and @pd>20030920	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 13:38

14	0	700/83 and irrigat$ AND (@ad<20010207 @rlad<20010207) and @pd>20030920	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 13:38
16	0	700/17 AND (wireless remote) and irrigat$ AND (@ad<20010207 @rlad<20010207) and @pd>20030920	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 13:40
15	1	700/17 and irrigat$ AND (@ad<20010207 @rlad<20010207) and @pd>20030920	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 13:39
17	0	700/65 and irrigat$ AND (@ad<20010207 @rlad<20010207) and @pd>20030920	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 13:39
18	4	700/65 AND (wireless remote) AND (@ad<20010207 @rlad<20010207) and @pd>20030920	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 13:39
19	0	700/264 and irrigat$ AND (@ad<20010207 @rlad<20010207) and @pd>20030920	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 13:40
20	2	700/284 and irrigat$ AND (@ad<20010207 @rlad<20010207) and @pd>20030920	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 13:40
21	0	700/65 AND (wireless remote) and irrigat$ AND (@ad<20010207 @rlad<20010207) and @pd>20030920	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 13:40
22	0	700/264 AND (wireless remote) and irrigat$ AND (@ad<20010207 @rlad<20010207) and @pd>20030920	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 13:40
24	1	700/284 AND (wireless remote) and irrigat$ AND (@ad<20010207 @rlad<20010207) and @pd>20030920	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 13:42
25	0	700/19 AND (wireless remote) and irrigat$ AND (@ad<20010207 @rlad<20010207) and @pd>20030920	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 13:42

26	3	700/$ AND (wireless remote) and irrigat$ AND (@ad<20010207 @rlad<20010207) and @pd>20030920	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 13:43
27	0	340/3.1 AND (wireless remote) and irrigat$ AND (@ad<20010207 @rlad<20010207) and @pd>20030920	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 13:43
28	0	340/3.9 AND (wireless remote) and irrigat$ AND (@ad<20010207 @rlad<20010207) and @pd>20030920	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 13:43
29	0	340/3.1-3.9.ccls. AND (wireless remote) and irrigat$ AND (@ad<20010207 @rlad<20010207) and @pd>20030920	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/11/24 13:43

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5	37	700/17 and (@ad<20010207 @rlad<20010207) and @pd>20031124	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:32
6	0	700/17 and irrigat$ and (@ad<20010207 @rlad<20010207) and @pd>20031124	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:32
7	1	700/19 and irrigat$ and (@ad<20010207 @rlad<20010207) and @pd>20031124	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:33
8	1	700/65 and irrigat$ and (@ad<20010207 @rlad<20010207) and @pd>20031124	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:33
9	2	700/83 and irrigat$ and (@ad<20010207 @rlad<20010207) and @pd>20031124	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:34
10	2	700/264 and irrigat$ and (@ad<20010207 @rlad<20010207) and @pd>20031124	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:34
11	2	700/284 and irrigat$ and (@ad<20010207 @rlad<20010207) and @pd>20031124	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:42

12	3	700/$ and irrigat$ and wireless and (@ad<20010207 @rlad<20010207) and @pd>20031124	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:36
13	39	700/$ and irrigat$ and wireless and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:35
14	21	700/$ and irrigat$ and wireless and status and display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:45
15	8	700/$ and irrigat$ and wireless and status with display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:39
16	2	700/$ and irrigat$ same wireless and status with display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:40
17	0	700/$ and irrigat$ same wireless same status with display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:40
18	0	irrigat$ same wireless same status with display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:40
19	2	irrigat$ same wireless and status with display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:40
20	2	irrigat$ same wireless and status same display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 20:11
21	2	irrigat$ and wireless same status same display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 20:05
22	0	340/3.1 and irrigat$ and (@ad<20010207 @rlad<20010207) and @pd>20031124	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:42

23	0	340/3.9 and irrigat$ and (@ad<20010207 @rlad<20010207) and @pd>20031124	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:43
24	0	340/825.72 and irrigat$ and (@ad<20010207 @rlad<20010207) and @pd>20031124	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:43
25	11	340/825.72 and irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:43
26	3	340/825.72 and irrigat$ and wireless and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:44
27	35	137/$ and irrigat$ and wireless and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:44
28	14	137/$ and irrigat$ and wireless and status and display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:46
29	11	137/$ and irrigat$ and wireless and status with display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:47
30	1	137/$ and irrigat$ same wireless and status with display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:47
31	0	137/$ and irrigat$ and wireless same status with display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:47
32	1	137/$ and irrigat$ and wireless same status same display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:47
33	1	137/$ and irrigat$ same wireless and status same display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 19:48

41	1		USPAT	2004/04/09 19:55
44	0	irrigat$ same wireless same status same display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 20:05
49	28	irrigat$ same (wireless rf cellular) and stat$2 same display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 20:12
50	4	irrigat$ same (wireless rf cellular) same stat$2 same display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 20:17
51	2	irrigat$ and (wireless rf cellular) and (portable (hand adj held) handheld) same stat$2 same display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 20:19
54	161	irrigat$ and (wireless rf cellular) and (portable (hand adj held) handheld) and stat$2 and display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 20:21
55	9	700/284 and irrigat$ and (wireless rf cellular) and (portable (hand adj held) handheld) and stat$2 and display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 20:19
57	8	700/$ and irrigat$ and (wireless rf cellular) and (portable (hand adj held) handheld) and stat$2 with display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 20:22
56	23	irrigat$ and (wireless rf cellular) and (portable (hand adj held) handheld) and stat$2 with display and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/09 20:25

L Number	Hits	Search Text	DB	Time stamp
3	24	(single integrated) with remote with (interface user) and irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:38
4	2	(single integrated) with remote with (interface user) with (handheld display keyboard portable) and irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:43
5	0	((single integrated) and remote) near4 (interface user) with (handheld display keyboard portable) and irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:44
6	35	remote near4 (interface user) with (handheld display keyboard portable) and irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:44
7	10	remote near4 (interface user) with (handheld portable) and (display keyboard) and irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:44
8	10	remote near4 (interface user) with (handheld portable) and (display and key$5) and irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:46
9	2	remote same (interface user) with (handheld portable) with (display and key$5) and irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:47
10	0	remote same irrigat$ and (interface user) with (handheld portable) with (display and key$5) and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:47
11	1	remote same irrigat$ and (handheld portable) with (display and key$5) and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:49
12	0	700/17 and remote same irrigat$ and (handheld portable) with (display and key$5) and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:49

13	0	700/17 and remote same irrigat$ and (handheld portable) same (display and key$5) and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:49
14	0	700/17 and remote$ same irrigat$ and (handheld portable) same (display and key$5) and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:50
15	2	700/17 and remote$ and irrigat$ and (handheld portable) same (display and key$5) and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:50
17	6	700/17 and remote$ and irrigat$ and (handheld portable wireless) and (display and key$5) and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:50
16	2	700/17 and remote$ and irrigat$ and (handheld portable wireless) same (display and key$5) and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:51
18	0	700/17 and remote$ same irrigat$ and (handheld portable wireless) same (display and key$5) and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:51
19	0	700/83 and remote$ same irrigat$ and (handheld portable wireless) same (display and key$5) and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:52
20	0	700/284 and remote$ same irrigat$ and (handheld portable wireless) same (display and key$5) and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:52
21	1	700/$ and remote$ same irrigat$ and (handheld portable wireless) same (display and key$5) and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:55
22	0	340/3.9 and remote$ same irrigat$ and (handheld portable wireless) same (display and key$5) and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:55

23	0	340/3.1 and remote$ same irrigat$ and (handheld portable wireless) same (display and key$5) and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:55
24	3	340/$ and remote$ same irrigat$ and (handheld portable wireless) same (display and key$5) and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:57
25	1	702/188 and remote$ same irrigat$ and (handheld portable wireless) same (display and key$5) and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:57
26	3	702/$ and remote$ same irrigat$ and (handheld portable wireless) same (display and key$5) and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:57
27	4	remote$ same irrigat$ and (handheld portable wireless) same (display and key$5) and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:58
28	7	remote$ same (handheld portable wireless) same (display and key$5) and irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 11:01
29	16	(remote$ handheld portable wireless) same (display and key$5) same irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 10:59
30	1	(remote$ wireless) same (hand$5 portable mobile) same (display and key$5) same irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 11:07
31	9	(remote$ wireless) same (hand$5 portable mobile) same (display and key$5) and irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 11:08
32	1	(remote$ wireless) same (hand$5 portable mobile) same (display and key$5) same status same control$5 and irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 11:11

34	2	(hand$5 portable mobile) same (display and key$5) same status same control$5 same irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 11:14
33	5	(hand$5 portable mobile) same (display and key$5) same status same control$5 and irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 11:14
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37	2	(hand$5 held hold palm$5 portable mobile) same ((display panel) and key$5) same (status and control$5) same irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 11:34
38	2	(hand$5 $5held $5hold palm$5 portable mobile) same ((display panel) and key$5) same (status and control$5) same irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 11:37
40	25	(hand$5 held hold palm$5 portable mobile) same ((display panel) and key$5) and (status and control$5) same irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 11:42
41	23	(hand$5 held hold palm$5 portable mobile) same ((display panel) and key$5) and (status same control$5) same irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 13:09
44	0	700/65 and (hand$5 held hold palm$5 portable mobile) same ((display panel) and key$5) and (status same control$5) same irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 13:10
42	4	700/17 and (hand$5 held hold palm$5 portable mobile) same ((display panel) and key$5) and (status same control$5) same irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 13:10

45	5	700/284 and (hand$5 held hold palm$5 portable mobile) same ((display panel) and key$5) and (status same control$5) same irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 13:10
47	1	340/3.1 and (hand$5 held hold palm$5 portable mobile) same ((display panel) and key$5) and (status same control$5) same irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 13:11
48	0	340/3.9 and (hand$5 held hold palm$5 portable mobile) same ((display panel) and key$5) and (status same control$5) same irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 13:11
51	0	702/188 and (hand$5 held hold palm$5 portable mobile) same ((display panel) and key$5) and (status same control$5) same irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 13:13
43	1	700/83 and (hand$5 held hold palm$5 portable mobile) same ((display panel) and key$5) and (status same control$5) same irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 13:13
46	6	700/$ and (hand$5 held hold palm$5 portable mobile) same ((display panel) and key$5) and (status same control$5) same irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 13:14
49	3	340/$ and (hand$5 held hold palm$5 portable mobile) same ((display panel) and key$5) and (status same control$5) same irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 13:16
50	1	702/$ and (hand$5 held hold palm$5 portable mobile) same ((display panel) and key$5) and (status same control$5) same irrigat$ and (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/13 14:01
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L Number	Hits	Search Text	DB	Time stamp
15	325	integrat$ with ($phone and pager) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/16 09:39
16	251	integrat$ with ($phone with pager) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/16 09:39
17	106	integrat$ near4 ($phone near4 pager) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/16 09:39
18	79	integrat$ near3 ($phone near3 pager) AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/16 09:39
19	12	integrat$ near3 ($phone near3 pager) same wireless AND (@ad<20010207 @rlad<20010207)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/07/16 09:39

L Number	Hits	Search Text	DB	Time stamp
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129	0	340/3.71 and (hand$5 held hold palm$5 portable mobile remote) same ((display panel) and key$5) same irrigat$ and (@ad<20010207 @rlad<20010207) and @pd>20040716	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/09/21 17:16
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131	0	340/3.9 and (hand$5 held hold palm$5 portable mobile) same remote same ((display panel) and key$5) same irrigat$ and (@ad<20010207 @rlad<20010207) and @pd>20040716	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/09/21 17:16
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137	0	700/284 and (hand$5 held hold palm$5 portable mobile) same remote same ((display panel) and key$5) same irrigat$ and (@ad<20010207 @rlad<20010207) and @pd>20040716	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/09/21 17:19

138	0	700/$ and (hand$5 held hold palm$5 portable mobile) same remote same ((display panel) and key$5) same irrigat$ and (@ad<20010207 @rlad<20010207) and @pd>20040516	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/09/21 17:20
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140	0	340/$ and (hand$5 held hold palm$5 portable mobile) same remote same ((display panel) and key$5) same irrigat$ and (@ad<20010207 @rlad<20010207) and @pd>20040516	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/09/21 17:20
141	0	(hand$5 held hold palm$5 portable mobile) same remote same ((display panel) and key$5) same irrigat$ and (@ad<20010207 @rlad<20010207) and @pd>20040516	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/09/21 17:21
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09778367_CLS
Most Frequently Occurring Classifications of Patents Returned
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Original Classifications

3	210/739
3	700/284

Cross-Reference Classifications

4	137/78.3
3	137/624.2
3	239/69
3	239/70
3	700/17
2	137/3
2	137/624.11
2	137/624.18
2	137/78.2
2	137/88
2	210/101
2	210/96.1
2	239/145
2	239/63
2	239/64
2	340/825.72
2	366/152.1
2	366/160.1
2	405/36
2	604/27
2	700/16

Combined Classifications

4	137/78.3
4	239/69
4	700/284
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3	210/739
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Pages:1301 - 1303 vol.3

[Abstract] [PDF Full-Text (260 KB)] IEEE CNF

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1 **Fault-tolerant solar array control using digital signal processing for power tracking**
Griesbach, C.R.;
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Pages:260 - 265 vol.1

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2 **Mapping field crop evapotranspiration using airborne multispectral imagery**
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[Abstract] [PDF Full-Text (524 KB)] IEEE CNF

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US006853883B2

(12) **United States Patent**
Kreikemeier et al.

(10) **Patent No.: US 6,853,883 B2**
(45) **Date of Patent: Feb. 8, 2005**

(54) **METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS**

(75) Inventors: **Bruce Kreikemeier**, West Point, NE (US); **Marv Schulz**, Omaha, NE (US); **Craig Malsam**, Omaha, NE (US); **Hector Haget**, Omaha, NE (US)

(73) Assignee: **Valmont Industries, Inc.**, Valley, NE (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 539 days.

(21) Appl. No.: **09/778,367**

(22) Filed: **Feb. 7, 2001**

(65) **Prior Publication Data**

US 2002/0107586 A1 Aug. 8, 2002

(51) **Int. Cl.**[7] **G05D 11/00**; G05D 7/00

(52) **U.S. Cl.** **700/284**; 700/65; 702/188; 340/3.1; 340/3.71; 340/3.9

(58) **Field of Search** 700/17, 65, 83, 700/284, 264, 19; 702/188; 340/3.1, 3.9, 3.71, 825.72

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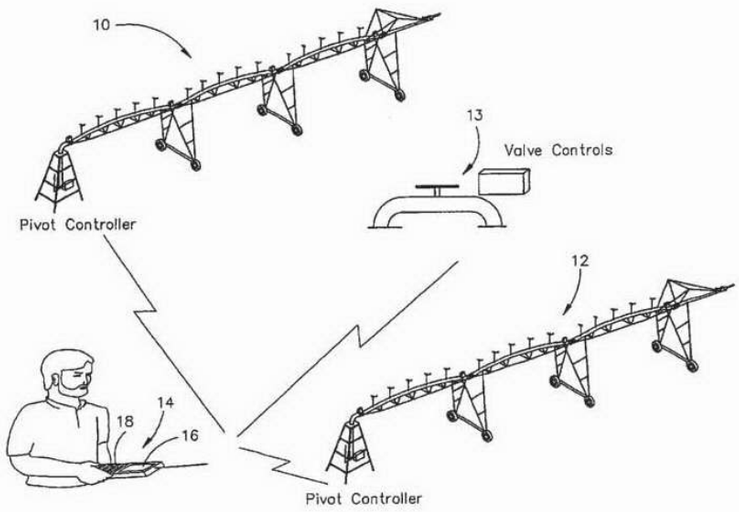
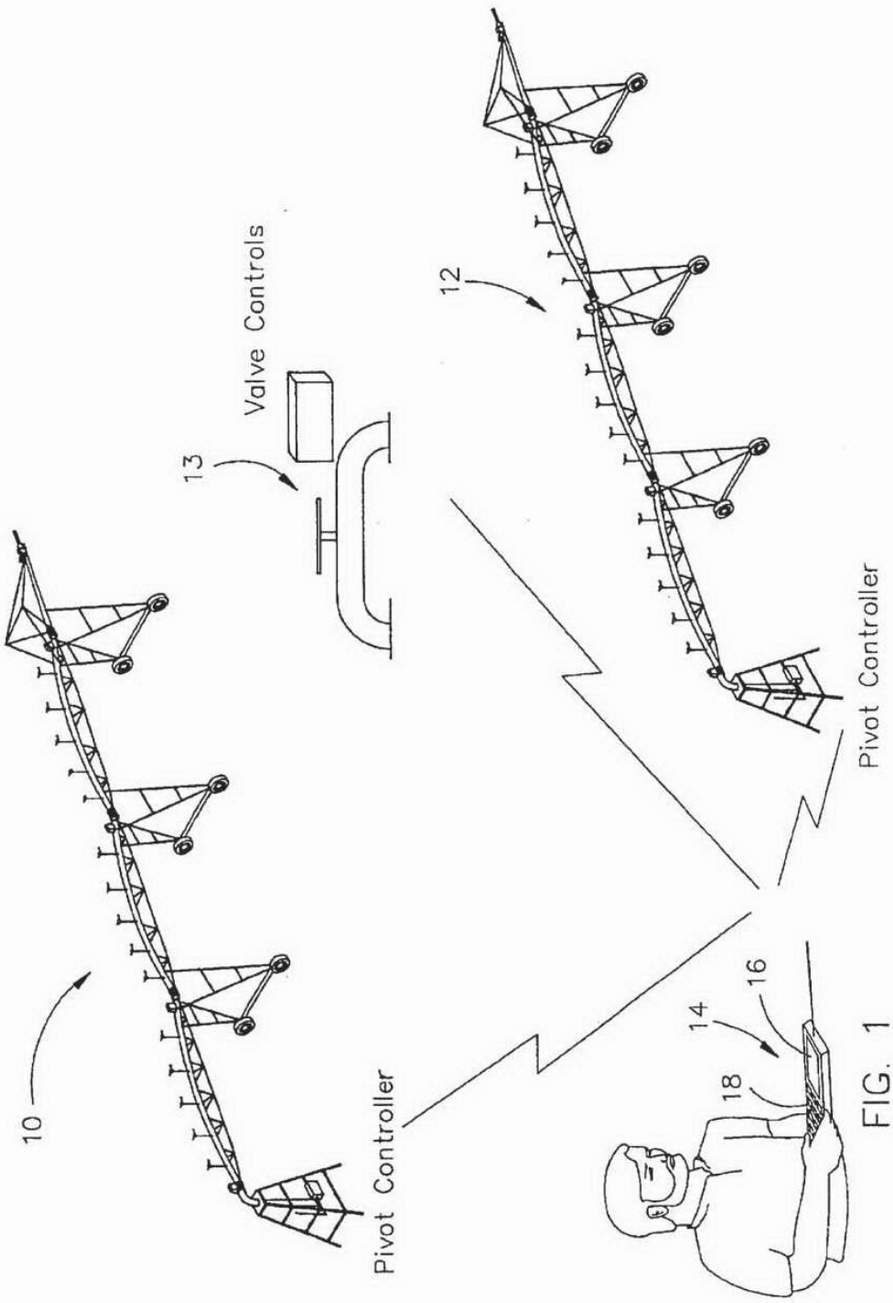
Primary Examiner—Anthony Knight
Assistant Examiner—Crystal J. Barnes
(74) *Attorney, Agent, or Firm*—Thomte, Mazour & Niebergall; Dennis L. Thomte

(57) **ABSTRACT**

A method and means is disclosed for remotely reading the status of and controlling irrigation components and ancillary equipment. A handheld remote user interface (RUI) is provided which includes a display and a keypad. The RUI has the ability to communicate with and control the irrigation components using built-in wireless telemetry technology. The RUI allows the user to read the status of and control the irrigation components and ancillary equipment from any location in the field, without requiring the user to be at the irrigation component controls or at a specific location in the field.

4 Claims, 1 Drawing Sheet

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Pivot Controller
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Valve Controls
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Pivot Controller
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FIG. 1

METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a method and means for reading the status of and remotely controlling irrigation components and ancillary equipment including, but not limited to, center pivots, linears, drip sectors, pumps, engine generators, valves, pressure sensors, etc., by means of a remote, handheld controller.

2. Description of the Related Art

Devices have been previously provided for the remote control of irrigation systems and components thereof. One prior art device for remotely controlling irrigation systems is the base station control. The base station control utilizes RF telemetry or cell phone telemetry to read the status of and control irrigation components from a personal computer (PC). The disadvantage of this method is that the user needs to be at the PC. Situations arise whereby after viewing the operation of the irrigation components, immediate action is needed. The base station control system requires the user to go back to the PC, which may be located miles away, for remote control capability.

A second type of system is known as the remote mount control panel system. Remote mount control panels consist of mounting the control panels of the components at a location in the field away from the components to thereby provide relatively easy access to the control panels. This requires burying the power and control wires in the field. This method also limits access to the control panels to one particular location, that being the location of the remote mounted control panel.

SUMMARY OF THE INVENTION

A method and means is disclosed for reading the status of and remotely controlling irrigation components and ancillary equipment. The means for remotely reading the status of and controlling irrigation components and ancillary equipment comprises a remote user interface (RUI) which is a separate unit from the irrigation component controller. The RUI consists of a handheld display and keypad. The RUI has the ability to communicate with and control the irrigation components using built-in wireless telemetry technology. The RUI allows the user to read the status of, communicate with, and control irrigation components from any location in the field, without requiring the user to be at the irrigation component controls or at a specific location in the field. The method of this invention enables a person to determine the status of irrigation components and ancillary equipment and to control the operation thereof, which comprises the steps of: (1) providing a handheld wireless RUI; (2) utilizing the RUI to read the status of the irrigation components and ancillary equipment; and (3) utilizing the RUI to communicate with the irrigation components and ancillary equipment for controlling the operation thereof.

It is therefore a principal object of the invention to provide a method and means for remotely reading the status of and controlling irrigation components and ancillary equipment by means of a remote user interface (RUI).

Still another object of the invention is to provide a remote user interface for irrigation components which is a separate unit from the irrigation component controller.

Still another object of the invention is to provide a remote user interface for irrigation components which consists of a handheld display and keypad having the ability to communicate with the irrigation components and control the same through the use of built-in wireless telemetry technology.

Still another object of the invention is to provide a method and means for remotely controlling irrigation components and ancillary equipment which allows the user to read the status of, communicate with, and control irrigation components from any location in the field without requiring the user to be at the irrigation component controls or at a specific location in the field.

These and other objects will be apparent to those skilled in the art.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates the RUI of this invention being employed by a user to read the status of irrigation components and ancillary equipment to enable the user to control the operation thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings, the numerals **10** and **12** refer to irrigation components such as center pivot irrigation systems including ancillary equipment **13**. The method and means of this invention is used to control irrigation components and ancillary equipment which may be center pivots, linear systems, drip sectors, pumps, engine generators, valves, pressure sensors, etc.

In an effort to overcome the shortcomings of the base station control systems and the remote mount control panels of the prior art, a remote user interface (RUI) **14** is provided which includes a display **16** and a keypad **18**, as seen in FIG. **1**. The RUI is a handheld device to enable the user to utilize the same in a convenient manner. The RUI **14** has the capability of communicating with and controlling the irrigation components and ancillary equipment using conventional built-in wireless telemetry technology. Through the use of the RUI, the user may remotely read or determine the status of, communicate with, and control the irrigation components and ancillary equipment from any location in the field, without requiring the user to be at the irrigation component controls or at a specific location in the field.

Thus, it can be appreciated that if the user visits a site wherein an irrigation system is located, and visually determines that the system is functioning improperly, the user may use the RUI **14** to determine the status of, communicate with, and control the irrigation components of the system from any location in the field. Further, depending upon the range of the RUI, the user could determine the status of, communicate with, and control the irrigation components from a location other than in or adjacent to the field. However, it is contemplated that the device will normally be used by the user at the particular system location.

Thus it can be seen that the invention accomplishes at least all of its stated objectives.

We claim:

1. In combination with mechanized irrigation components and ancillary equipment therefore for irrigating a field, comprising:

a single wireless RUI comprising a handheld display and keypad for:

(a) reading the status of irrigation components and ancillary equipment; and

(b) directly transmitting telemetry to said irrigation components and ancillary equipment to control said irrigation components and ancillary equipment; and

(c) displaying said status of said irrigation components and ancillary equipment.

2. The combination of claim 1 wherein said wireless RUI has the capability of reading the status of the irrigation components and ancillary equipment and controlling the same from any location in the field.

3. In combination with mechanized irrigation components for irrigating a field, comprising:

a single wireless RUI comprising a handheld display and keypad having the capability of:

(a) reading the status of the irrigation components;

(b) directly transmitting telemetry to said irrigation components to control the operation of the irrigation components; and

(c) displaying said status of the irrigation components.

4. The method whereby a person may remotely determine the status of mechanized irrigation components and ancillary equipment and for controlling the operation thereof, comprising the steps of:

providing a single handheld wireless RUI;

utilizing said RUI to read the status of the irrigation components and ancillary equipment; and

utilizing said RUI to directly transmit telemetry to said irrigation components and ancillary equipment to control the irrigation components and ancillary equipment.

* * * * *

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UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. 20231
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Bib Data Sheet

CONFIRMATION NO. 6849

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
09/778,367	02/07/2001 RULE	700	2121	

APPLICANTS

Bruce Kreikemeier, West Point, NE;
Marv Schulz, Omaha, NE;
Craig Malsam, Omaha, NE;
Hector Haget, Omaha, NE;

** CONTINUING DATA ************************ NONE CJB

** FOREIGN APPLICATIONS ******************** NONE CJB

IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 03/13/2001

Foreign Priority claimed ☐ yes ☑ no 35 USC 119 (a-d) conditions met ☐ yes ☑ no ☐ Met after Allowance Verified and Acknowledged [signature] CJB Examiner's Signature Initials	STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
	NE	1	4	3

ADDRESS

22885

TITLE

Method and means for reading the status of and controlling irrigation components

FILING FEE RECEIVED		
710	FEES: Authority has been given in Paper No. ________ to charge/credit DEPOSIT ACCOUNT No. ________ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other ________ ☐ Credit

PATENT APPLICATION SERIAL NO. _____

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

02/14/2001 MWOLDER1 00000045 09778367
01 FC:101 710.00 OP

PTO-1556
(5/87)
*U.S. GPO: 2000-468-987/39595

02-08-01 A

PTO/SB/05 (08-00)
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	
First Inventor	BRUCE KREIKEMEIER
Title	METHOD AND MEANS FOR READING, ETC.
Express Mail Label No.	EL522534399US

APPLICATION ELEMENTS
See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231

1. [✔] Fee Transmittal Form (e.g., PTO/SB/17) (Submit an original and a duplicate for fee processing)
2. [ ] Applicant claims small entity status. See 37 CFR 1.27.
3. [✔] Specification [Total Pages 6] (preferred arrangement set forth below)
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   - Detailed Description
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   - Abstract of the Disclosure
4. [✔] Drawing(s) (35 U.S.C. 113) [Total Sheets 1]
5. Oath or Declaration [Total Pages 2]
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6. [ ] Application Data Sheet. See 37 CFR 1.76
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   c. [ ] Statements verifying identity of above copies

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9. [ ] Assignment Papers (cover sheet & document(s))
10. [ ] 37 CFR 3.73(b) Statement (when there is an assignee) [ ] Power of Attorney
11. [ ] English Translation Document (if applicable)
12. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations
13. [ ] Preliminary Amendment
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15. [ ] Certified Copy of Priority Document(s) (if foreign priority is claimed)
16. [ ] Other: ....

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Prior application information: Examiner ______ Group / Art Unit: ______

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18. CORRESPONDENCE ADDRESS

[✔] Customer Number or Bar Code Label 22885 (Insert Customer No. or Attach bar code label here) or [✔] Correspondence address below

Name	Dennis L. Thomte				
Address	Zarley, McKee, Thomte, Voorhees & Sease 801 Grand Avenue - Suite 3200				
City	Des Moines	State	IA	Zip Code	50309-2721
Country	U.S.A.	Telephone	402-392-2280	Fax	4023920734

Name (Print/Type)	Dennis L. Thomte	Registration No. (Attorney/Agent)	22,497
Signature	Dennis L. Thomte	Date	2/7/2001

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Attorney Docket No.	
First Inventor	BRUCE KREIKEMEIER
Title	METHOD AND MEANS FOR READING, ETC.
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	801 Grand Avenue - Suite 3200				
City	Des Moines	*State*	IA	*Zip Code*	50309-2721
Country	U.S.A.	*Telephone*	402-392-2280	*Fax*	4023920734

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Signature	Dennis L Thomte	*Date*	2/7/2001

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CERTIFICATE OF MAILING

I hereby declare that the original patent application of BRUCE KREIKEMEIER, MARV SCHULZ, CRAIG MALSAM and HECTOR HAGET entitled METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS, enclosed herewith, was mailed by "Express Mail Post Office to Addressee", mailing label EL522534399US, to Box Patent Application, Assistant Commissioner of Patents, Washington, D.C. 20231, on this 7th day of Feb, 2001.

ZARLEY, McKEE, THOMTE,
VOORHEES & SEASE

Dennis L Thomte

DENNIS L. THOMTE

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FEE TRANSMITTAL for FY 2001

Patent fees are subject to annual revision.

TOTAL AMOUNT OF PAYMENT ($) 710.00

Complete if Known	
Application Number	
Filing Date	
First Named Inventor	BRUCE KREIKEMEIER
Examiner Name	
Group Art Unit	
Attorney Docket No.	

METHOD OF PAYMENT

1. ☑ The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to:

Deposit Account Number: 26-0084

Deposit Account Name: Zarley, McKee, Thomte, Voorhees & Sease

☑ Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17

☐ Applicant claims small entity status. See 37 CFR 1.27

2. ☑ **Payment Enclosed:**

☑ Check ☐ Credit card ☐ Money Order ☐ Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	710	201	355	Utility filing fee	710.00
106	320	206	160	Design filing fee	
107	490	207	245	Plant filing fee	
108	710	208	355	Reissue filing fee	
114	150	214	75	Provisional filing fee	

SUBTOTAL (1) ($) 710.00

2. EXTRA CLAIM FEES

	Extra Claims		Fee from below	Fee Paid
Total Claims	4	-20** = 0	X 0	= 0
Independent Claims	3	- 3** = 0	X 0	= 0
Multiple Dependent				=

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	80	202	40	Independent claims in excess of 3
104	270	204	135	Multiple dependent claim, if not paid
109	80	209	40	** Reissue independent claims over original patent
110	18	210	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 0

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FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for *ex parte* reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	390	216	195	Extension for reply within second month	
117	890	217	445	Extension for reply within third month	
118	1,390	218	695	Extension for reply within fourth month	
128	1,890	228	945	Extension for reply within fifth month	
119	310	219	155	Notice of Appeal	
120	310	220	155	Filing a brief in support of an appeal	
121	270	221	135	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,240	241	620	Petition to revive - unintentional	
142	1,240	242	620	Utility issue fee (or reissue)	
143	440	243	220	Design issue fee	
144	600	244	300	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	240	126	240	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	710	246	355	Filing a submission after final rejection (37 CFR § 1.129(a))	
149	710	249	355	For each additional invention to be examined (37 CFR § 1.129(b))	
179	710	279	355	Request for Continued Examination (RCE)	
169	900	169	900	Request for expedited examination of a design application	

Other fee (specify) _____

* Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($) 0

SUBMITTED BY				Complete (if applicable)	
Name (Print/Type)	DENNIS L. THOMTE	Registration No. (Attorney/Agent)	22,497	Telephone	402-392-2280
Signature	Dennis L Thomte			Date	2/7/2001

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Filing Date	
First Named Inventor	BRUCE KREIKEMEIER
Examiner Name	
Group Art Unit	
Attorney Docket No.	

METHOD OF PAYMENT

1. ☑ The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to:

Deposit Account Number: 26-0084

Deposit Account Name: Zarley, McKee, Thomte, Voorhees & Sease

☑ Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17

☐ Applicant claims small entity status See 37 CFR 1.27

2. ☑ **Payment Enclosed:**

☑ Check ☐ Credit card ☐ Money Order ☐ Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	710	201	355	Utility filing fee	710.00
106	320	206	160	Design filing fee	
107	490	207	245	Plant filing fee	
108	710	208	355	Reissue filing fee	
114	150	214	75	Provisional filing fee	

SUBTOTAL (1) ($) 710.00

2. EXTRA CLAIM FEES

	Extra Claims		Fee from below		Fee Paid
Total Claims	4	-20** =	0	X	0 = 0
Independent Claims	3	- 3** =	0	X	0 = 0
Multiple Dependent					=

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	80	202	40	Independent claims in excess of 3
104	270	204	135	Multiple dependent claim, if not paid
109	80	209	40	** Reissue independent claims over original patent
110	18	210	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 0

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for ex *parte* reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	390	216	195	Extension for reply within second month	
117	890	217	445	Extension for reply within third month	
118	1,390	218	695	Extension for reply within fourth month	
128	1,890	228	945	Extension for reply within fifth month	
119	310	219	155	Notice of Appeal	
120	310	220	155	Filing a brief in support of an appeal	
121	270	221	135	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,240	241	620	Petition to revive - unintentional	
142	1,240	242	620	Utility issue fee (or reissue)	
143	440	243	220	Design issue fee	
144	600	244	300	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	240	126	240	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	710	246	355	Filing a submission after final rejection (37 CFR § 1.129(a))	
149	710	249	355	For each additional invention to be examined (37 CFR § 1.129(b))	
179	710	279	355	Request for Continued Examination (RCE)	
169	900	169	900	Request for expedited examination of a design application	

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid SUBTOTAL (3) ($) 0

SUBMITTED BY				Complete (if applicable)	
Name (Print/Type)	DENNIS L. THOMTE	Registration No. (Attorney/Agent)	22,497	Telephone	402-392-2280
Signature	Dennis L. Thomte			Date	2/7/2001

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

PTO/SB/17 (09-00)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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FEE TRANSMITTAL for FY 2001

Patent fees are subject to annual revision.

TOTAL AMOUNT OF PAYMENT ($) 710.00

Complete if Known	
Application Number	
Filing Date	
First Named Inventor	BRUCE KREIKEMEIER
Examiner Name	
Group Art Unit	
Attorney Docket No.	

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SUBTOTAL (1) ($) 710.00

2. EXTRA CLAIM FEES

		Extra Claims	Fee from below	Fee Paid
Total Claims	4	-20** = 0	X 0	= 0
Independent Claims	3	- 3** = 0	X 0	= 0
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Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
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FEE CALCULATION (continued)

3. ADDITIONAL FEES

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141	1,240	241	620	Petition to revive - unintentional	
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581	40	581	40	Recording each patent assignment per property (times number of properties)	
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149	710	249	355	For each additional invention to be examined (37 CFR § 1.129(b))	
179	710	279	355	Request for Continued Examination (RCE)	
169	900	169	900	Request for expedited examination of a design application	
Other fee (specify)					

*Reduced by Basic Filing Fee Paid **SUBTOTAL (3)** ($) 0

SUBMITTED BY				Complete (if applicable)	
Name (Print/Type)	DENNIS L. THOMTE	Registration No. (Attorney/Agent)	22,497	Telephone	402-392-2280
Signature	Dennis L Thomte			Date	2/7/2001

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PETITION

To the Commissioner of Patents and Trademarks
Washington, D.C. 20231

Your Petitioners, BRUCE KREIKEMEIER, a citizen of the United States and a resident of the State of Nebraska, whose post office address is 1046 D Road, West Point, Nebraska 68788; MARV SCHULZ, a citizen of the United States and a resident of the State of Nebraska, whose post office address is 4929 South 90th Street, Omaha, Nebraska 68127; CRAIG MALSAM, a citizen of the United States and a resident of the State of Nebraska, whose post office address is 17914 Shirley Circle, Omaha, Nebraska 68130; and HECTOR HAGET, a citizen of the United States and a resident of the State of Nebraska, whose post office address is 17914 Pine Street, Omaha, Nebraska 68130, pray that Letters Patent may be granted to them for the improvement in a

METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS

as set forth in the following specification.

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

This invention relates to a method and means for reading the status of and remotely controlling irrigation components and ancillary equipment including, but not limited to, center pivots, linears, drip sectors, pumps, engine generators, valves, pressure sensors, etc., by means of a remote, handheld controller.

2. DESCRIPTION OF THE RELATED ART

Devices have been previously provided for the remote control of irrigation systems and components thereof. One prior art device for remotely controlling irrigation systems is the base station control. The base station control utilizes RF telemetry or

cell phone telemetry to read the status of and control irrigation components from a personal computer (PC). The disadvantage of this method is that the user needs to be at the PC. Situations arise whereby after viewing the operation of the irrigation components, immediate action is needed. The base station control system requires the user to go back to the PC, which may be located miles away, for remote control capability.

A second type of system is known as the remote mount control panel system. Remote mount control panels consist of mounting the control panels of the components at a location in the field away from the components to thereby provide relatively easy access to the control panels. This requires burying the power and control wires in the field. This method also limits access to the control panels to one particular location, that being the location of the remote mounted control panel.

SUMMARY OF THE INVENTION

A method and means is disclosed for reading the status of and remotely controlling irrigation components and ancillary equipment. The means for remotely reading the status of and controlling irrigation components and ancillary equipment comprises a remote user interface (RUI) which is a separate unit from the irrigation component controller. The RUI consists of a handheld display and keypad. The RUI has the ability to communicate with and control the irrigation components using built-in wireless telemetry technology. The RUI allows the user to read the status of, communicate with, and control irrigation components from any location in the field, without requiring the user to be at the irrigation component controls or at a specific location in the field. The method of this invention enables a person to determine the status of irrigation components and ancillary equipment and to control the operation thereof, which comprises the steps of: (1) providing a handheld wireless RUI; (2)

utilizing the RUI to read the status of the irrigation components and ancillary equipment; and (3) utilizing the RUI to communicate with the irrigation components and ancillary equipment for controlling the operation thereof.

It is therefore a principal object of the invention to provide a method and means for remotely reading the status of and controlling irrigation components and ancillary equipment by means of a remote user interface (RUI).

Still another object of the invention is to provide a remote user interface for irrigation components which is a separate unit from the irrigation component controller.

Still another object of the invention is to provide a remote user interface for irrigation components which consists of a handheld display and keypad having the ability to communicate with the irrigation components and control the same through the use of built-in wireless telemetry technology.

Still another object of the invention is to provide a method and means for remotely controlling irrigation components and ancillary equipment which allows the user to read the status of, communicate with, and control irrigation components from any location in the field without requiring the user to be at the irrigation component controls or at a specific location in the field.

These and other objects will be apparent to those skilled in the art.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates the RUI of this invention being employed by a user to read the status of irrigation components and ancillary equipment to enable the user to control the operation thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings, the numerals 10 and 12 refer to irrigation components such as center pivot irrigation systems including ancillary equipment 13. The method and

means of this invention is used to control irrigation components and ancillary equipment which may be center pivots, linear systems, drip sectors, pumps, engine generators, valves, pressure sensors, etc.

In an effort to overcome the shortcomings of the base station control systems and the remote mount control panels of the prior art, a remote user interface (RUI) 14 is provided which includes a display 16 and a keypad 18, as seen in Figure 1. The RUI is a handheld device to enable the user to utilize the same in a convenient manner. The RUI 14 has the capability of communicating with and controlling the irrigation components and ancillary equipment using conventional built-in wireless telemetry technology. Through the use of the RUI, the user may remotely read or determine the status of, communicate with, and control the irrigation components and ancillary equipment from any location in the field, without requiring the user to be at the irrigation component controls or at a specific location in the field.

Thus, it can be appreciated that if the user visits a site wherein an irrigation system is located, and visually determines that the system is functioning improperly, the user may use the RUI 14 to determine the status of, communicate with, and control the irrigation components of the system from any location in the field. Further, depending upon the range of the RUI, the user could determine the status of, communicate with, and control the irrigation components from a location other than in or adjacent to the field. However, it is contemplated that the device will normally be used by the user at the particular system location.

Thus it can be seen that the invention accomplishes at least all of its stated objectives.

We claim:

1.

In combination with irrigation components and ancillary equipment therefore for irrigating a field, comprising:

a wireless RUI comprising a handheld display and keypad for:

(a) reading the status of irrigation components and ancillary equipment; and

(b) controlling the irrigation components and ancillary equipment.

2.

The combination of claim 1 wherein said wireless RUI has the capability of reading the status of the irrigation components and ancillary equipment and controlling the same from any location in the field.

3.

In combination with irrigation components for irrigating a field, comprising:

a wireless RUI comprising a handheld display and keypad having the capability of:

(a) reading the status of the irrigation components; and

(b) controlling the operation of the irrigation components.

4.

The method whereby a person may remotely determine the status of irrigation components and ancillary equipment and for controlling the operation thereof, comprising the steps of:

providing a handheld wireless RUI;

utilizing said RUI to read the status of the irrigation components ancillary equipment; and

utilizing said RUI to control the irrigation components and ancillary equipment.

ABSTRACT OF THE DISCLOSURE

A method and means is disclosed for remotely reading the status of and controlling irrigation components and ancillary equipment. A handheld remote user interface (RUI) is provided which includes a display and a keypad. The RUI has the ability to communicate with and control the irrigation components using built-in wireless telemetry technology. The RUI allows the user to read the status of and control the irrigation components and ancillary equipment from any location in the field, without requiring the user to be at the irrigation component controls or at a specific location in the field.

PETITION

To the Commissioner of Patents and Trademarks
Washington, D.C. 20231

Your Petitioners, BRUCE KREIKEMEIER, a citizen of the United States and a resident of the State of Nebraska, whose post office address is 1046 D Road, West Point, Nebraska 68788; MARV SCHULZ, a citizen of the United States and a resident of the State of Nebraska, whose post office address is 4929 South 90th Street, Omaha, Nebraska 68127; CRAIG MALSAM, a citizen of the United States and a resident of the State of Nebraska, whose post office address is 17914 Shirley Circle, Omaha, Nebraska 68130; and HECTOR HAGET, a citizen of the United States and a resident of the State of Nebraska, whose post office address is 17914 Pine Street, Omaha, Nebraska 68130, pray that Letters Patent may be granted to them for the improvement in a

METHOD AND MEANS FOR READING THE STATUS
OF AND CONTROLLING IRRIGATION COMPONENTS

as set forth in the following specification.

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

This invention relates to a method and means for reading the status of and remotely controlling irrigation components and ancillary equipment including, but not limited to, center pivots, linears, drip sectors, pumps, engine generators, valves, pressure sensors, etc., by means of a remote, handheld controller.

2. DESCRIPTION OF THE RELATED ART

Devices have been previously provided for the remote control of irrigation systems and components thereof. One prior art device for remotely controlling irrigation systems is the base station control. The base station control utilizes RF telemetry or

cell phone telemetry to read the status of and control irrigation components from a personal computer (PC). The disadvantage of this method is that the user needs to be at the PC. Situations arise whereby after viewing the operation of the irrigation components, immediate action is needed. The base station control system requires the user to go back to the PC, which may be located miles away, for remote control capability.

A second type of system is known as the remote mount control panel system. Remote mount control panels consist of mounting the control panels of the components at a location in the field away from the components to thereby provide relatively easy access to the control panels. This requires burying the power and control wires in the field. This method also limits access to the control panels to one particular location, that being the location of the remote mounted control panel.

SUMMARY OF THE INVENTION

A method and means is disclosed for reading the status of and remotely controlling irrigation components and ancillary equipment. The means for remotely reading the status of and controlling irrigation components and ancillary equipment comprises a remote user interface (RUI) which is a separate unit from the irrigation component controller. The RUI consists of a handheld display and keypad. The RUI has the ability to communicate with and control the irrigation components using built-in wireless telemetry technology. The RUI allows the user to read the status of, communicate with, and control irrigation components from any location in the field, without requiring the user to be at the irrigation component controls or at a specific location in the field. The method of this invention enables a person to determine the status of irrigation components and ancillary equipment and to control the operation thereof, which comprises the steps of: (1) providing a handheld wireless RUI; (2)

utilizing the RUI to read the status of the irrigation components and ancillary equipment; and (3) utilizing the RUI to communicate with the irrigation components and ancillary equipment for controlling the operation thereof.

It is therefore a principal object of the invention to provide a method and means for remotely reading the status of and controlling irrigation components and ancillary equipment by means of a remote user interface (RUI).

Still another object of the invention is to provide a remote user interface for irrigation components which is a separate unit from the irrigation component controller.

Still another object of the invention is to provide a remote user interface for irrigation components which consists of a handheld display and keypad having the ability to communicate with the irrigation components and control the same through the use of built-in wireless telemetry technology.

Still another object of the invention is to provide a method and means for remotely controlling irrigation components and ancillary equipment which allows the user to read the status of, communicate with, and control irrigation components from any location in the field without requiring the user to be at the irrigation component controls or at a specific location in the field.

These and other objects will be apparent to those skilled in the art.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates the RUI of this invention being employed by a user to read the status of irrigation components and ancillary equipment to enable the user to control the operation thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings, the numerals 10 and 12 refer to irrigation components such as center pivot irrigation systems including ancillary equipment 13. The method and

means of this invention is used to control irrigation components and ancillary equipment which may be center pivots, linear systems, drip sectors, pumps, engine generators, valves, pressure sensors, etc.

In an effort to overcome the shortcomings of the base station control systems and the remote mount control panels of the prior art, a remote user interface (RUI) 14 is provided which includes a display 16 and a keypad 18, as seen in Figure 1. The RUI is a handheld device to enable the user to utilize the same in a convenient manner. The RUI 14 has the capability of communicating with and controlling the irrigation components and ancillary equipment using conventional built-in wireless telemetry technology. Through the use of the RUI, the user may remotely read or determine the status of, communicate with, and control the irrigation components and ancillary equipment from any location in the field, without requiring the user to be at the irrigation component controls or at a specific location in the field.

Thus, it can be appreciated that if the user visits a site wherein an irrigation system is located, and visually determines that the system is functioning improperly, the user may use the RUI 14 to determine the status of, communicate with, and control the irrigation components of the system from any location in the field. Further, depending upon the range of the RUI, the user could determine the status of, communicate with, and control the irrigation components from a location other than in or adjacent to the field. However, it is contemplated that the device will normally be used by the user at the particular system location.

Thus it can be seen that the invention accomplishes at least all of its stated objectives.

We claim:

1.

In combination with irrigation components and ancillary equipment therefore for irrigating a field, comprising:

a wireless RUI comprising a handheld display and keypad for:

(a) reading the status of irrigation components and ancillary equipment; and

(b) controlling the irrigation components and ancillary equipment.

2.

The combination of claim 1 wherein said wireless RUI has the capability of reading the status of the irrigation components and ancillary equipment and controlling the same from any location in the field.

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In combination with irrigation components for irrigating a field, comprising:

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The method whereby a person may remotely determine the status of irrigation components and ancillary equipment and for controlling the operation thereof, comprising the steps of:

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ABSTRACT OF THE DISCLOSURE

A method and means is disclosed for remotely reading the status of and controlling irrigation components and ancillary equipment. A handheld remote user interface (RUI) is provided which includes a display and a keypad. The RUI has the ability to communicate with and control the irrigation components using built-in wireless telemetry technology. The RUI allows the user to read the status of and control the irrigation components and ancillary equipment from any location in the field, without requiring the user to be at the irrigation component controls or at a specific location in the field.

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utilizing the RUI to read the status of the irrigation components and ancillary equipment; and (3) utilizing the RUI to communicate with the irrigation components and ancillary equipment for controlling the operation thereof.

It is therefore a principal object of the invention to provide a method and means for remotely reading the status of and controlling irrigation components and ancillary equipment by means of a remote user interface (RUI).

Still another object of the invention is to provide a remote user interface for irrigation components which is a separate unit from the irrigation component controller.

Still another object of the invention is to provide a remote user interface for irrigation components which consists of a handheld display and keypad having the ability to communicate with the irrigation components and control the same through the use of built-in wireless telemetry technology.

Still another object of the invention is to provide a method and means for remotely controlling irrigation components and ancillary equipment which allows the user to read the status of, communicate with, and control irrigation components from any location in the field without requiring the user to be at the irrigation component controls or at a specific location in the field.

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BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates the RUI of this invention being employed by a user to read the status of irrigation components and ancillary equipment to enable the user to control the operation thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENT

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In an effort to overcome the shortcomings of the base station control systems and the remote mount control panels of the prior art, a remote user interface (RUI) 14 is provided which includes a display 16 and a keypad 18, as seen in Figure 1. The RUI is a handheld device to enable the user to utilize the same in a convenient manner. The RUI 14 has the capability of communicating with and controlling the irrigation components and ancillary equipment using conventional built-in wireless telemetry technology. Through the use of the RUI, the user may remotely read or determine the status of, communicate with, and control the irrigation components and ancillary equipment from any location in the field, without requiring the user to be at the irrigation component controls or at a specific location in the field.

Thus, it can be appreciated that if the user visits a site wherein an irrigation system is located, and visually determines that the system is functioning improperly, the user may use the RUI 14 to determine the status of, communicate with, and control the irrigation components of the system from any location in the field. Further, depending upon the range of the RUI, the user could determine the status of, communicate with, and control the irrigation components from a location other than in or adjacent to the field. However, it is contemplated that the device will normally be used by the user at the particular system location.

Thus it can be seen that the invention accomplishes at least all of its stated objectives.

We claim:

1.

In combination with irrigation components and ancillary equipment therefore for irrigating a field, comprising:

a wireless RUI comprising a handheld display and keypad for:

(a) reading the status of irrigation components and ancillary equipment; and

(b) controlling the irrigation components and ancillary equipment.

2.

The combination of claim 1 wherein said wireless RUI has the capability of reading the status of the irrigation components and ancillary equipment and controlling the same from any location in the field.

3.

In combination with irrigation components for irrigating a field, comprising:

a wireless RUI comprising a handheld display and keypad having the capability of:

(a) reading the status of the irrigation components; and

(b) controlling the operation of the irrigation components.

4.

The method whereby a person may remotely determine the status of irrigation components and ancillary equipment and for controlling the operation thereof, comprising the steps of:

providing a handheld wireless RUI;

utilizing said RUI to read the status of the irrigation components ancillary equipment; and

utilizing said RUI to control the irrigation components and ancillary equipment.

ABSTRACT OF THE DISCLOSURE

A method and means is disclosed for remotely reading the status of and controlling irrigation components and ancillary equipment. A handheld remote user interface (RUI) is provided which includes a display and a keypad. The RUI has the ability to communicate with and control the irrigation components using built-in wireless telemetry technology. The RUI allows the user to read the status of and control the irrigation components and ancillary equipment from any location in the field, without requiring the user to be at the irrigation component controls or at a specific location in the field.

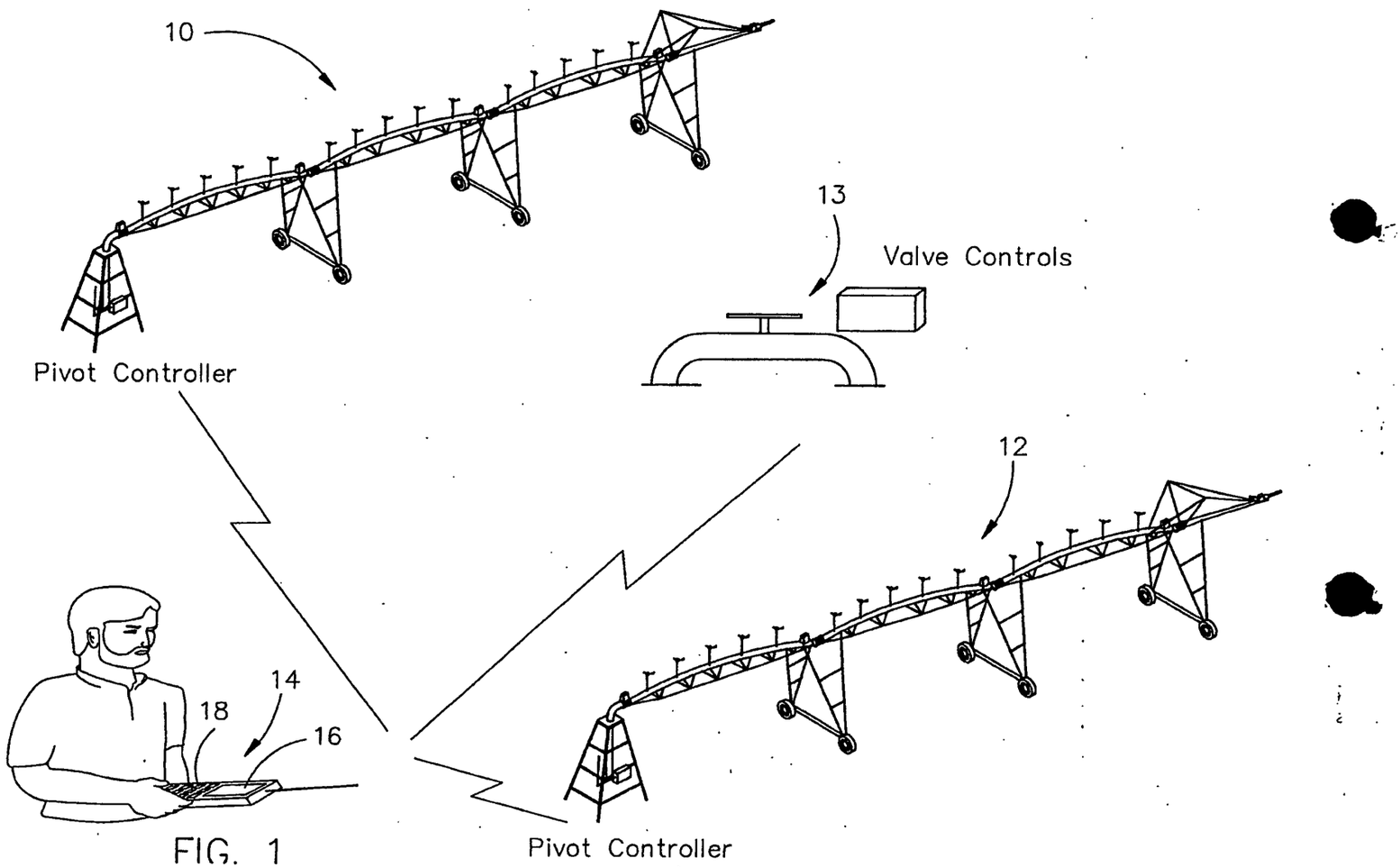

FIG. 1

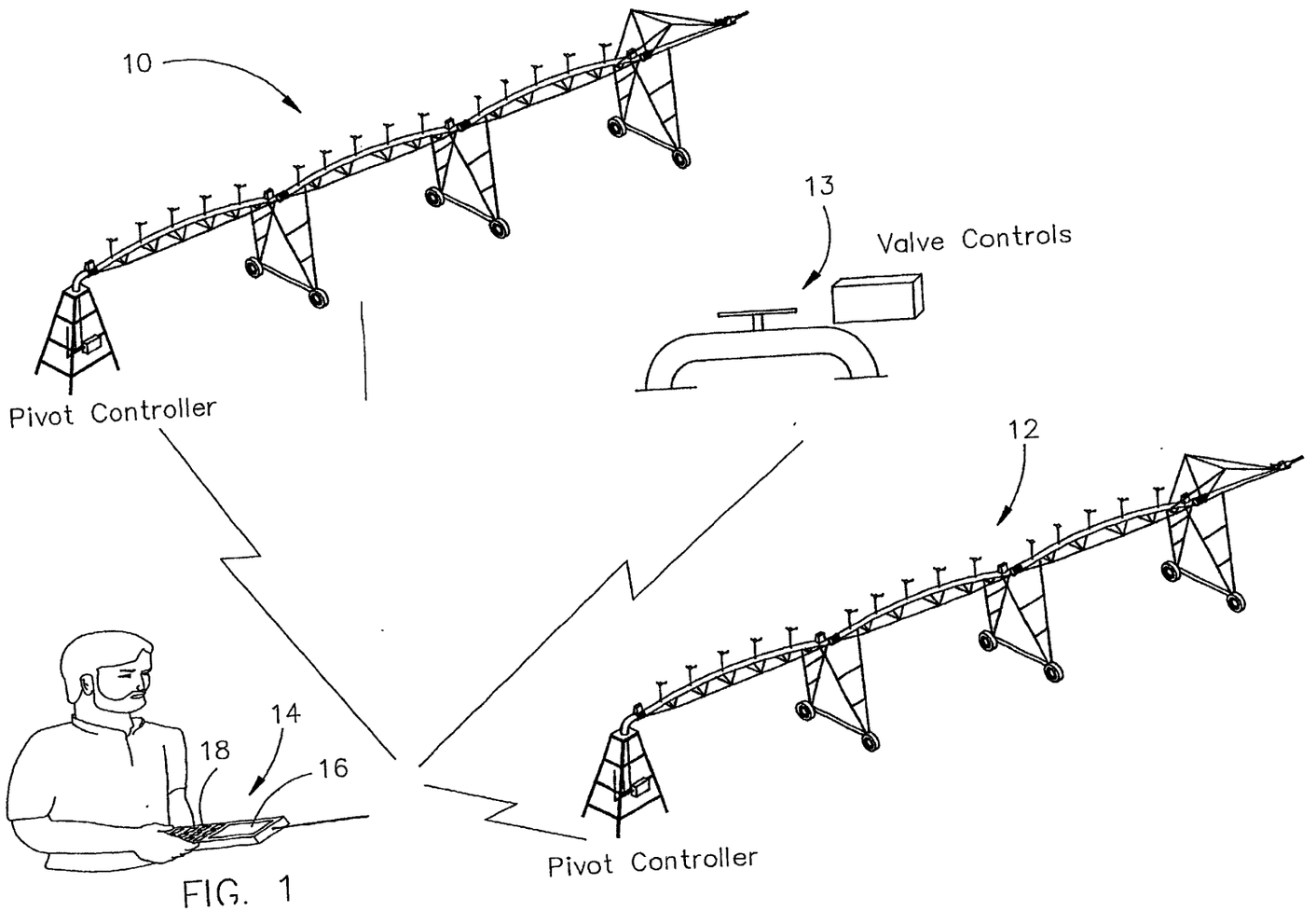

FIG. 1

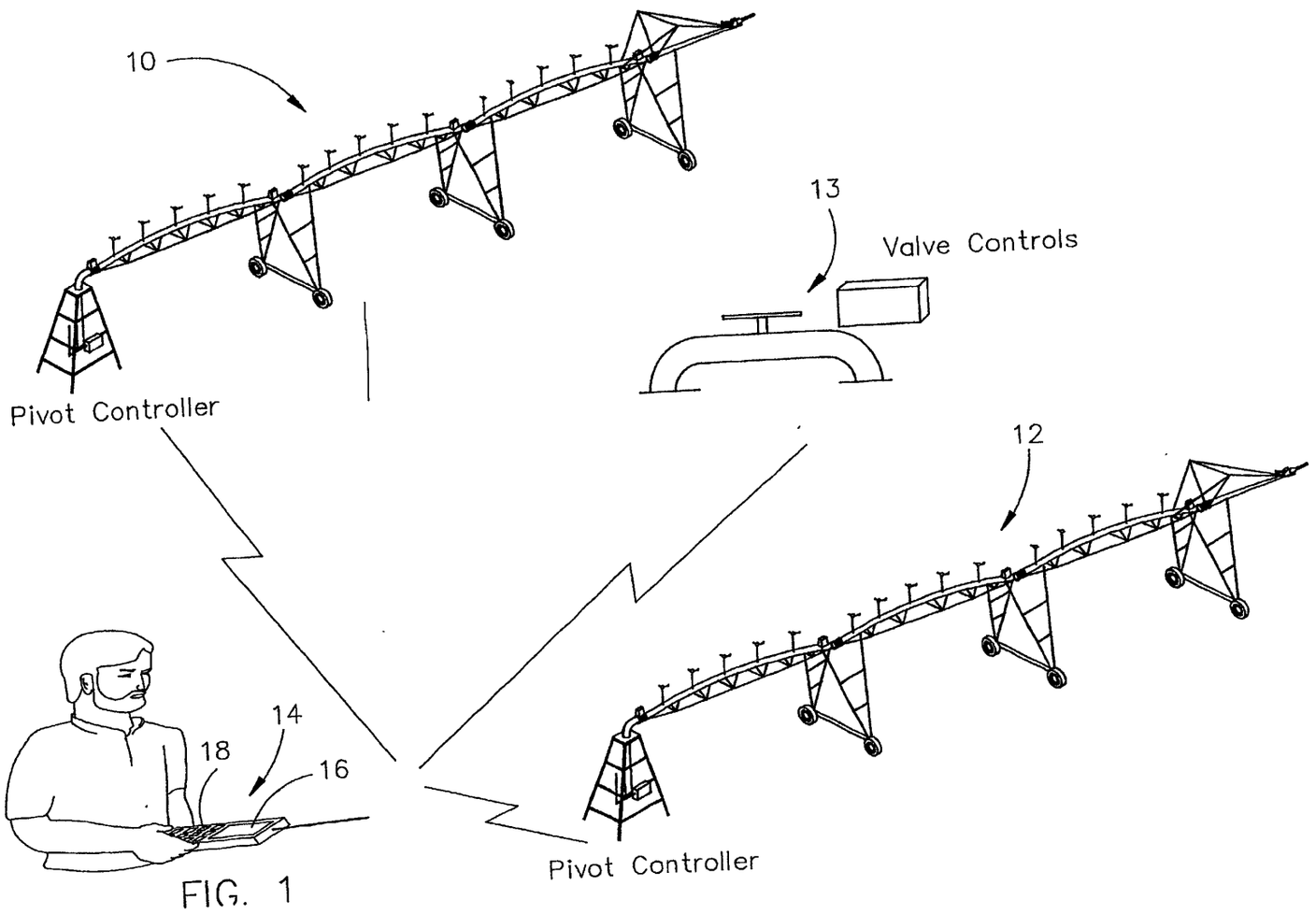

FIG. 1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BRUCE KREIKEMEIER; MARV SCHULZ; CRAIG MALSAM; and HECTOR HAGET, the above-named petitioners, declare that they are citizens of the United States with post office and resident addresses of 1046 D Road, West Point, Nebraska 68788; 4929 South 90th Street, Omaha, Nebraska 68127; 17914 Shirley Circle, Omaha, Nebraska 68130; and 17914 Pine Street, Omaha, Nebraska 68130, respectively; that they verily believe themselves to be the original, first, and co-inventors of the subject matter which is claimed and for which a patent is sought on the invention entitled METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS described and claimed in the annexed specification; that they do not know and do not believe that the same was ever known or used in the United States of America before their invention thereof or patented or described in any printed publication in any country before their invention thereof, or more than one year prior to this application; that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America or an application filed by them or their legal representatives or assigns more than twelve months prior to this application; that they have reviewed and understand the contents of the above-identified specification including the claims, as amended by any amendment specifically referred to in the oath or declaration; that they acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations 1.56(a); and that no application for patent or inventor's certificate on this invention has been filed by them, or their legal representatives or assigns in any country foreign to the United States of America except as identified below.

None.

And they hereby appoint ZARLEY, McKEE, THOMTE, VOORHEES & SEASE, Customer No. 22,885, 801 Grand Avenue, Suite 3200, Des Moines, Iowa 50309, telephone: (402) 392-2280, as their attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

The undersigned petitioners further declare that all statements made herein of their own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application of any patent issuing thereon.

Date 01/30/01

BRUCE KREIKEMEIER
1046 D Road
West Point, NE 68788

Date 30 January 2001

MARV SCHULZ
4929 South 90th Street
Omaha, NE 68127

Date JAN. 30- 2001

CRAIG MALSAM
17914 Shirley Circle
Omaha, NE 68130

Date January 30, 2001

HECTOR HAGET
17914 Pine Street
Omaha, NE 68130

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BRUCE KREIKEMEIER; MARV SCHULZ; CRAIG MALSAM; and HECTOR HAGET, the above-named petitioners, declare that they are citizens of the United States with post office and resident addresses of 1046 D Road, West Point, Nebraska 68788; 4929 South 90th Street, Omaha, Nebraska 68127; 17914 Shirley Circle, Omaha, Nebraska 68130; and 17914 Pine Street, Omaha, Nebraska 68130, respectively; that they verily believe themselves to be the original, first, and co-inventors of the subject matter which is claimed and for which a patent is sought on the invention entitled METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS described and claimed in the annexed specification; that they do not know and do not believe that the same was ever known or used in the United States of America before their invention thereof or patented or described in any printed publication in any country before their invention thereof, or more than one year prior to this application; that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America or an application filed by them or their legal representatives or assigns more than twelve months prior to this application; that they have reviewed and understand the contents of the above-identified specification including the claims, as amended by any amendment specifically referred to in the oath or declaration; that they acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations 1.56(a); and that no application for patent or inventor's certificate on this invention has been filed by them, or their legal representatives or assigns in any country foreign to the United States of America except as identified below.

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Date 01/30/01

Bruce Kreikemeier
BRUCE KREIKEMEIER
1046 D Road
West Point, NE 68788

Date 30 January 2001

Marv Schulz
MARV SCHULZ
4929 South 90th Street
Omaha, NE 68127

Date JAN. 30- 2001

Craig Malsam
CRAIG MALSAM
17914 Shirley Circle
Omaha, NE 68130

Date January 30, 2001

Hector Haget
HECTOR HAGET
17914 Pine Street
Omaha, NE 68130

2121
2133
5-29-01

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT : BRUCE KREIKEMEIER, ET AL. GROUP NO.: 2121

SERIAL NO. : 09/778,367

FILED : February 7, 2001

TITLE : METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS

ELECTION UNDER 37 CFR § 3.71 AND POWER OF ATTORNEY

Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

Dear Sir:

The undersigned, being Assignee of the entire interest in the above-identified application by virtue of an Assignment recorded, or submitted herewith for recording, in the United States Patent and Trademark Office as set forth below, hereby elects, under 37 CFR § 3.71, to prosecute the application to the exclusion of the inventor(s). Assignee hereby certifies that the attached Assignment has been reviewed, and that to the best of Assignee's knowledge and belief, title is in the Assignee.

The Assignee hereby revokes any previous Powers of Attorney and appoints ZARLEY, McKEE, THOMTE, VOORHEES & SEASE, Customer No. 22,885, 801 Grand Avenue, Suite 3200, Des Moines, Iowa 50309, telephone: 402-392-2280, as its attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

Please direct all communications as follows:

DENNIS L. THOMTE
ZARLEY, McKEE, THOMTE, VOORHEES & SEASE
Suite 1111, 2120 South 72nd Street, Omaha, NE 68124
(402) 392-2280

ASSIGNEE:

VALMONT INDUSTRIES, INC.

Date: 4-11-01

By: _____
Name: Terry J. McClain
Title: Senior Vice President & CFO

ASSIGNMENT:

__X__ Enclosed for recording

_____ Previously recorded

Date: _____
Reel: _____
Frame: _____

ASSIGNMENT

In consideration of One Dollar and other good and valuable considerations, the receipt and sufficiency whereof are hereby acknowledged, the undersigned hereby assign to VALMONT INDUSTRIES, INC., a Delaware corporation, having an address of P.O. Box 358, Valley, Nebraska 68064, its successors and assigns, the entire right, title, and interest in the invention or improvements of the undersigned disclosed in an application for Letters Patent of the United States, Serial No. 09/778,367, filed in the United States Patent Office on the 7th day of February, 2001, entitled METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS, and in said application and any and all other applications for United States Letters Patent, which the undersigned may file, either solely or jointly with others, on said invention or improvements, and in any and all Letters Patent of the United States which may be obtained on any of said applications, and in any reissue or extension thereof.

The undersigned hereby authorize and request the Commissioner of Patents to issue said Letters Patent to VALMONT INDUSTRIES, INC.

For said considerations, the undersigned hereby agree, upon the request and at the expense of said assignee, its successors and assigns, to execute any and all divisional, continuation and substitute applications for said invention or improvements, and any necessary oath or affidavit relating thereto, and any application for the reissue or extension of any Letters Patent that may be granted upon said application, and for the said considerations the undersigned further agree, upon the request of said assignee, its successors or assigns, in the event of any application or Letters Patent assigned hereby becoming involved in interference, to cooperate to the best of the ability of the undersigned with said assignee, its successors or assigns in the matter of

File History Content Report

The following content is missing from the original file history record obtained from the United States Patent and Trademark Office. No additional information is available.

Document Date - 2001-04-16

Document Title - Assignee showing of ownership

Page(s) - 2 - End

OIPE JC/52 MAR 26 2002 PATENT & TRADEMARK OFFICE

212 #3 4-10-02

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PTO/SB/82 (10-00)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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REVOCATION OF POWER OF ATTORNEY OR AUTHORIZATION OF AGENT

Application Number	09/778,367
Filing Date	February 7, 2001
First Named Inventor	BRUCE KREIKEMEIER
Group Art Unit	2121
Examiner Name	
Attorney Docket Number	V-01-03

I hereby revoke all previous powers of attorney or authorizations of agent given in the above-identified application:

RECEIVED
MAR 2 9 2002
Technology Center 2100

☑ A Power of Attorney or Authorization of Agent is submitted herewith.

OR

☐ Please change the correspondence address for the above-identified application to:

☐ Customer Number [ ] →

Place Customer Number Bar Code Label here

OR

☐ Firm *or* Individual Name					
Address					
Address					
City					
Country		State		ZIP	
Telephone		Fax			

I am the:

☐ Applicant/Inventor.

☑ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96)

SIGNATURE of Applicant or Assignee of Record

Name	P. THOMAS POGGE, Vice President of Assignee
Signature	
Date	3/19/02

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☑ *Total of 1 forms are submitted.

Burden Hour Statement: This form is estimated to take 3 minutes to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

Express Mail Label No:

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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it display a valid OMB control number.

POWER OF ATTORNEY OR AUTHORIZATION OF AGENT

Application Number	09/778,367
Filing Date	February 7, 2001
First Named Inventor	BRUCE KREIKEMEIER
Group Art Unit	2121
Examiner Name	
Attorney Docket Number	V-01-03

I hereby appoint:

☑ Practitioners at Customer Number 31083 → Place Customer Number Bar Code Label Here
31083
PATENT AND TRADEMARK OFFICE

OR

☐ Practitioner(s) named below:

Name	Registration Number

as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith.

Please change the correspondence address for the above-identified application to:

☑ The above-mentioned Customer Number.

OR

☐ Firm *or* Individual Name					
Address					
Address					
City		State		Zip	
Country					
Telephone		Fax			

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MAR 29 2002
Technology Center 2100

I am the:

☐ Applicant/Inventor.

☑ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96).

SIGNATURE of Applicant or Assignee of Record

Name	P. THOMAS POGGE, Vice President of Assignee
Signature	
Date	3/19/02

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☑ *Total of 1 forms are submitted.

Burden Hour Statement: This form is estimated to take 3 minutes to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

Express Label No.

PTO/SB/96 (08-00)
Approved for use through 10/31/2002. OMB 0651-0031
U.S.Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: BRUCE KREIKEMEIER, ET AL.

Application No./Patent No.: 09/778,367 Filed/Issue Date: February 7, 2001

Entitled: Method and Means for Reading the Status of and Controlling Irrigation Components

VALMONT INDUSTRIES, INC., a corporation,
(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that it is:

1. ☑ the assignee of the entire right, title, and interest; or

2. ☐ an assignee of less than the entire right, title and interest.
The extent (by, percentage) of its ownership interest is _____%

in the patent application/patent identified above by virtue of either:

A. [✓] An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 11717, Frame 757, or for which a copy thereof is attached.

OR

B. [ ] A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as shown below:

1. From:_____ To:_____
The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame_____, or for which a copy thereof is attached.

2. From:_____ To:_____
The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame_____, or for which a copy thereof is attached.

3. From:_____ To:_____
The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame_____, or for which a copy thereof is attached.

[ ] Additional documents in the chain of title are listed on a supplemental sheet.

[ ] Copies of assignments or other documents in the chain of title are attached.
[NOTE: A separate copy *(i.e.,* the original assignment document or a true copy of the original document) must be submitted to Assignment Division in accordance with 37 CFR Part 3, if the assignment is to be recorded in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

3/19/02
Date

P. Thomas Pogge
Typed or printed name

Signature

Vice President of Assignee
Title

UNITED STATES PATENT AND TRADEMARK OFFICE

COMMISSIONER FOR PATENTS
UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. 20231
www.uspto.gov

APPLICATION NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/778,367	02/07/2001	Bruce Kreikemeier	

CONFIRMATION NO. 6849

31083
THOMTE, MAZOUR & NIEBERGALL, L.L.C.
2120 S. 72ND STREET, SUITE 1111
OMAHA, NE 68124

OC000000007840474

Date Mailed: 04/10/2002

NOTICE REGARDING POWER OF ATTORNEY

This is in response to the Power of Attorney filed 03/26/2002.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

LYDIA C DEVE
2100 (703) 305-9637

OFFICE COPY

UNITED STATES PATENT AND TRADEMARK OFFICE

COMMISSIONER FOR PATENTS
UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. 20231
www.uspto.gov

APPLICATION NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/778,367	02/07/2001	Bruce Kreikemeier	

CONFIRMATION NO. 6849

OC000000007840442

22885
MCKEE, VOORHEES & SEASE, P.L.C.
801 GRAND AVENUE
SUITE 3200
DES MOINES, IA 50309-2721

Date Mailed: 04/10/2002

NOTICE REGARDING POWER OF ATTORNEY

This is in response to the Power of Attorney filed 03/26/2002.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

LYDIA C DEVE
2100 (703) 305-9637

OFFICE COPY

2121 #5 2e 6-18-02

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT : BRUCE KREIKEMEIER, ET AL. GROUP NO.: 2121

SERIAL NO. : 09/778,367

FILED : February 7, 2001

TITLE : METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS

PRELIMINARY AMENDMENT

Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

Dear Sir:

In the above-identified application, please enter the following amendment:

IN THE CLAIMS

Please amend claims 1, 3 and 4 as follows:

1. (Amended)

In combination with mechanized irrigation components and ancillary equipment therefore for irrigating a field, comprising:

a wireless RUI comprising a handheld display and keypad for:

(a) reading the status of irrigation components and ancillary equipment; and

(b) controlling the irrigation components and ancillary equipment.

3. (Amended)

In combination with mechanized irrigation components for irrigating a field, comprising:

a wireless RUI comprising a handheld display and keypad having the capability of:

(a) reading the status of the irrigation components; and

(b) controlling the operation of the irrigation components.

4. (Amended)

The method whereby a person may remotely determine the status of mechanized irrigation components and ancillary equipment and for controlling the operation thereof, comprising the steps of:

providing a handheld wireless RUI;

utilizing said RUI to read the status of the irrigation components ancillary equipment; and

utilizing said RUI to control the irrigation components and ancillary equipment.

REMARKS

Approval and entry of this amendment is respectfully solicited.

Respectfully submitted,

Dennis L Thomte

DENNIS L. THOMTE
Registration No. 22,497
THOMTE, MAZOUR & NIEBERGALL
Attorneys of Record

Suite 1111, 2120 South 72nd Street
Omaha, NE 68124
(402) 392-2280

CERTIFICATE OF MAILING

I hereby certify that the original of this PRELIMINARY AMENDMENT for BRUCE KREIKEMEIER, ET AL., Serial No. 09/778,367, was mailed by first class mail, postage prepaid, to the Assistant Commissioner of Patents, Washington, D.C. 20231, on this 24th day of May, 2002.

Dennis L Thomte

DENNIS L. THOMTE

VERSION WITH RKINGS TO SHOW CHANGES M E

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Technology Center 2100

SERIAL NO. 09/778,367

COPY OF PAPERS ORIGINALLY FILED

AMENDMENT - VERSION
WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

Please amend claims 1, 3 and 4 as follows:

1. (Amended)

In combination with mechanized irrigation components and ancillary equipment therefore for irrigating a field, comprising:

a wireless RUI comprising a handheld display and keypad for:

(a) reading the status of irrigation components and ancillary equipment; and

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(b) controlling the operation of the irrigation components.

4. (Amended)

The method whereby a person may remotely determine the status of mechanized irrigation components and ancillary equipment and for controlling the operation thereof, comprising the steps of:

providing a handheld wireless RUI;

VERSION WITH MARKINGS TO SHOW CHANGES MADE

utilizing said RUI to read the status of the irrigation components ancillary equipment; and

utilizing said RUI to control the irrigation components and ancillary equipment.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/778,367	02/07/2001	Bruce Kreikemeier		6849

31083 7590 10/03/2003

THOMTE, MAZOUR & NIEBERGALL, L.L.C.
2120 S. 72ND STREET, SUITE 1111
OMAHA, NE 68124

EXAMINER	
BARNES, CRYSTAL J	

ART UNIT	PAPER NUMBER
2121	6

DATE MAILED: 10/03/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	09/778,367	KREIKEMEIER ET AL.	
	Examiner	Art Unit	
	Crystal J. Barnes	2121	

-- The MAILING DATE of this c mmunication appears on the cover sheet with the c rrespondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 June 2002* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-4* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *07 February 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless -
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-4 are rejected under 35 U.S.C. 102(a) as being anticipated by USPN 6,600,971 B1 to Smith et al.

As per claim 1, the Smith et al. reference discloses in combination with mechanized irrigation components and ancillary equipment therefore for irrigating a field comprising a wireless RUI [central computer 25, satellite controllers 15 (see figure 3 and column 4 lines 44-46, columns 5-6 lines 67-3)] comprising a handheld display and keypad [graphical user interface (see columns 4-5 lines 66-2, column 6 lines 20-24)] for (a) reading the status [monitor] of irrigation components [sprinkler valves 17] and ancillary equipment [various sensors 21] (see column 5

lines 3-7) and (b) controlling [operate] the irrigation components [sprinkler valves 17] and ancillary equipment [various sensors 21] (see column 4 lines 51-61).

As per claim 2, the Smith et al. reference discloses said wireless RUI [central computer 25, satellite controllers 15 (see figure 3 and column 4 lines 44-46, columns 5-6 lines 67-3)] has the capability of reading the status [monitor] of the irrigation components [sprinkler valves 17] and ancillary equipment [various sensors 21] (see column 5 lines 3-7) and controlling [operate] the same from any location [node] in the field [network] (see figure 3 and column 4 lines 41-50).

As per claim 3, the Smith et al. reference discloses in combination with mechanized irrigation components for irrigating a field comprising a wireless RUI [central computer 25, satellite controllers 15 (see figure 3 and column 4 lines 44-46, columns 5-6 lines 67-3)] comprising a handheld display and keypad [graphical user interface (see columns 4-5 lines 66-2, column 6 lines 20-24)] having the capability of (a) reading the status [monitor] of the irrigation components [sprinkler valves 17] (see column 5 lines 3-7) and (b) controlling the operation [operate] of the irrigation components [sprinkler valves 17] (see column 4 lines 51-61).

As per claim 4, the Smith et al. reference discloses the method whereby a person may remotely determine the status of mechanized irrigation components and ancillary equipment and for controlling the operation thereof, comprising the steps of providing a handheld wireless RUI [handheld unit 25 (see figure 3 and column 6 lines 20-24)]; utilizing said RUI [handheld unit 25 (see figure 3 and column 6 lines 20-24)] to read the status [monitor] of the irrigation components [sprinkler valves 17] and ancillary equipment [various sensors 21] (see column 5 lines 3-7); and utilizing said RUI [handheld unit 25 (see figure 3 and column 6 lines 20-24)] to control [operate] the irrigation components [sprinkler valves 17] and ancillary equipment [various sensors 21] (see column 4 lines 51-61).

3. Claims 1-4 are rejected under 35 U.S.C. 102(b) as being anticipated by USPN 4,626,984 to Unruh et al.

As per claim 1, the Unruh et al. reference discloses in combination with mechanized irrigation components and ancillary equipment therefore for irrigating a field comprising a wireless RUI [central computer or base unit 22, portable base unit 32 (see figure1 1-3 and column 4 lines 4-17)] comprising a handheld display and keypad [pivot panel (see figure 5 and column 5 lines 10-14, figure 9 column 6 lines

42-55)] for (a) reading the status [monitor] of the irrigation components [remote units 24, 26, 28 (see figures 1-3 and columns 6-7 lines 68-2, 18-28)] and ancillary equipment [peripherals (see column 8 lines 4-14)] and (b) controlling [control] the irrigation components [remote units 24, 26, 28] 4, 18] (see figures 1-3 and column 7 lines 5-11) and ancillary equipment [peripherals (see column 8 lines 4-14)] (see column 9 lines 6-11).

As per claim 2, the Unruh et al. reference discloses said wireless RUI [central computer or base unit 22, portable base unit 32 (see figure1 1-3 and column 4 lines 4-17)] has the capability of reading the status [monitor] of the irrigation components [remote units 24, 26, 28 (see figures 1-3 and columns 6-7 lines 68-2, 18-28)] and ancillary equipment [peripherals (see column 8 lines 4-14)] and controlling [control] the same from any location [any remote unit] in the field [system] (see figures 1-3 and column 4 lines 10-17).

As per claim 3, the Unruh et al. reference discloses in combination with mechanized irrigation components for irrigating a field comprising a wireless RUI [central computer or base unit 22, portable base unit 32 (see figures 1-3 and column 4 lines 4-17)] comprising a handheld display and keypad [pivot panel (see figure 5 and column 5 lines 10-14, figure 9 column 6 lines 42-55)] having the

capability of (a) reading the status [monitor] of the irrigation components [remote units 24, 26, 28] (see figures 1-3 and columns 6-7 lines 68-2, 18-28) and (b) controlling the operation [control] of the irrigation components [remote units 24, 26, 28] (see figures 1-3 and column 7 lines 5-11).

As per claim 4, the Unruh et al. reference discloses the method whereby a person may remotely determine the status of mechanized irrigation components and ancillary equipment and for controlling the operation thereof, comprising the steps of providing a handheld wireless RUI [portable base 32 (see figure 1 and column 4 lines 10-17)]; utilizing said RUI [portable base 32 (see figure 1 and column 4 lines 10-17)] to read the status [monitor] of the irrigation components [remote units 24, 26, 28 (see figures 1-3 and columns 6-7 lines 68-2, 18-28)] and ancillary equipment [peripherals (see column 8 lines 4-14)]; and utilizing said RUI [portable base 32 (see figure 1 and column 4 lines 10-17)] to control [control] the irrigation components [remote units 24, 26, 28 (see figures 1-3 and columns 6-7 lines 68-2, 18-28)] and ancillary equipment [peripherals (see column 8 lines 4-14)].

Conclusion

4. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The following patents are cited to further show the state of the art with respect remote monitoring and control systems in general:

USPN 4,209,131 to Barash et al.

USPN 4,760,547 to Duxbury

USPN 5,479,338 to Ericksen et al.

USPN 6,108,590 to Hergert

USPN 6,141,614 to Janzen et al.

USPN 6,236,332 B1 to Conkright et al.

USPN 6,437,692 B1 to Petite et al.

USPN 6,553,336 B1 to Johnson et al.

USPN 6,173,727 B1 to Davey

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Crystal J. Barnes whose telephone number is

703.306.5448. The examiner can normally be reached on Monday-Friday alternate Mondays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Anil Khatri can be reached on 703.305.0282. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703.305.3900.

cjb
September 26, 2003

ANIL KHATRI
SUPERVISORY PATENT EXAMINER

Notice of References Cited	Application/Control No. 09/778,367	Applicant(s)/Patent Under Reexamination KREIKEMEIER ET AL.	
	Examiner Crystal J. Barnes	Art Unit 2121	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-6,600,971	07-2003	Smith et al.	700/284
	B	US-4,626,984	12-1986	Unruh et al.	700/3
	C	US-4,209,131	06-1980	Barash et al.	239/68
	D	US-4,760,547	07-1988	Duxbury, Jonathan W.	700/284
	E	US-5,479,338	12-1995	Ericksen et al.	700/16
	F	US-6,108,590	08-2000	Hergert, C. David	700/284
	G	US-6,141,614	10-2000	Janzen et al.	701/50
	H	US-6,236,332	05-2001	Conkright et al.	340/3.1
	I	US-6,437,692	08-2002	Petite et al.	340/540
	J	US-6,553,336	04-2003	Johnson et al.	702/188
	K	US-6,173,727	01-2001	Davey, Donald	137/1
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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TO: TC 2100

FIRM NAME: U.S. Patent & Trademark Office

FROM: SHANE M. NIEBERGALL

FAX NO.: 703-872-9306

Total pages transmitted, including cover page: 8

DATE: November 17, 2003

SENT BY: CMM

CLIENT: Pat. App. Ser. 09/778,367

COMMENTS: Attached please find an amendment for filing in the above-referenced application. Thank you.

Shane Niebergall

IF YOU DO NOT RECEIVE ALL PAGES, PLEASE TELEPHONE US AT (402) 392-2280.

#7
11-19-03

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT	:	BRUCE KREIKEMEIER et al.	GROUP NO.: 2121
SERIAL NO.	:	09/778,367	EXAMINER: C. Barnes
FILED	:	February 7, 2003	
TITLE	:	METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS	

AMENDMENT

Commissioner for Patents
Alexandria, VA 22313-1450

Dear Sir:

In response to the Office Action dated October 3, 2003, Paper No. 6, in the above-entitled application, please enter the following response:

REMARKS

The Examiner rejected claims 1-4 under 35 U.S.C. § 102(a) as being anticipated by U.S. Patent No. 6,600,971 to Smith et al., ("Smith"). Specifically, the Examiner states that the Smith system is comprised of a wireless RUI having a handheld display and keypad for reading the status of and controlling the irrigation equipment. The applicants respectively disagree. Claim 1 of the present invention specifically recites a "wireless RUI comprising a handheld display and keypad for" reading the status of and controlling the irrigation components and ancillary equipment. Smith specifically teaches a central computer 25 for controlling a plurality of satellite controllers 15. The central computer 25 is coupled to the satellite controllers 15 via a communication bus 23, which is described as being implemented with twisted pair wire, radio modems, or analog telephone modems. It is not asserted by the Examiner, nor is it found within the Smith reference, that the central computer 25 is a handheld device. However, Smith teaches that when the central computer 25 is down or the communication bus 23 is disrupted, a handh ld, remote device 25(sic) can be used to communicate with the satellite controller 15 by directly coupling the remote unit 25 to a "node" within the system. In Fig. 3, the node coupled to the handheld unit is a sensor 21, which is coupled to a second sensor 21 that is attached to a satellite controller 15. The remote connection 27 between the two sensors 21 is not described as being wireless. Moreover, the remote device 25 appears to be directly coupled with the first sensor 21 indicating

that the remote device 25 is not communicating in a wireless manner with the first sensor 21. Nowhere within the specification or figures of the Smith reference is the remote device described as having a handheld display or a keypad. To be sure, th display and keypad cited to by the Examiner at Cols. 4-5, lines 66-2, are actually made a part of the satellite controller unit itself and are not a part of the remote device 25 cited by the Examiner at Col. 6, lines 20-24. Claim 1 specifically requires a handheld, wireless RUI having both a display and a keypad. No such reference can be found within the Smith patent.

Anticipation focuses on the question of whether or not a claim reads on the product or process disclosed by a prior art reference, not on what the reference broadly teaches. Kalman v. Kimberly-Clarke Corp., 713 F.2d 760 (Fed. Cir. 1983). "For a prior art reference to anticipate in terms of 35 U.S.C. § 102, every element of the claimed function must be identically shown in a single reference." Diversitech Corp v. Century Steps, Inc., 850 F.2d 675 (Fed. Cir. 1988). To the extent that the claimed elements within claim 1 cannot be found within the Smith reference, claim 1 is believed to be allowable. Claim 2 depends from claim 1 and is comprised of th limitations relating to the handheld, wireless RUI having a keypad and a display. Accordingly, claim 2 is believed to be allowable over the prior art as discussed previously. Moreover, claim 2 further states that the wireless RUI has the capability of reading and controlling the irrigation components "from any location in the field". Smith discloses that, "when operated remotely, the satellite controller 15 can be

monitored and controlled from any node in the network, such as the central computer or any other satellite controller 15." Col. 5, lines 4-7. Accordingly, the Smith system is taught as being controlled from specific locations or nodes within the network and not at "any location in the field," as specifically claimed in claim 2. Accordingly, claim 2 is believed to be allowable in view of the prior art.

Claim 3 is an independent combination claim that is similar to claim 1 but for the fact that the control system is not claimed in combination with "ancillary equipment for irrigation components". However, claim 3 specifically claims the wireless handheld RUI having a keypad and display used to read the status of and control the irrigation components. Claim 3 is therefore believed to be allowable for at least the same reasons set forth hereinabove for claim 1.

Claim 4 describes a method whereby an individual remotely determines th status of and controls irrigation controls. One step in that method is providing a handheld wireless RUI. As discussed hereinabove, the handheld device mentioned within the Smith reference is not specifically taught as being a wireless control unit. The remote device 25 taught by Smith is only disclosed as being able to "communicate". No specific reference is made to monitoring or controlling of the operation of the controllers. Claim 4 specifically claims that the handheld wireless RUI operates to read the status of and control the irrigation component and ancillary equipment. Accordingly, claim 4 is believed to be allowable in view of the Smith reference.

The Examiner rejected claims 1-4 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 4,626,984 to Unruh et al., ("Unruh"). As discussed hereinabove, claim 1 specifically claims a handheld wireless RUI having a display and keypad. The RUI of claim 1 is specifically recited as being capable of reading the status of and controlling the irrigation component and ancillary equipment. The Examiner specifically states that the Unruh reference teaches a wireless RUI comprising a handheld display and keypad. However, this is not the case. The Unruh reference specifically discloses a central computer 22 having a wireless communication link with a plurality of intelligent remote units coupled to the irrigation equipment. The Unruh reference makes reference to a portable base unit 32 and a portable terminal. However, the portable base unit 32 and the portable terminal ar not taught or otherwise suggested as being a handheld wireless unit. Moreover, neither the portable base unit 32 nor the portable terminal are taught or otherwise suggested as having a display or keypad. The portable terminal is merely disclosed as being a control device that is directly connected to the intelligent remote units at each station. Accordingly, it is believed that claim 1 is believed to be patentable in view of the Unruh reference.

Claim 2 depends from claim 1 and is believed to be allowable for the reasons set forth hereinabove over the Unruh reference. Moreover, claim 2 specifically recites that the RUI is capable of reading and controlling the irrigation components and ancillary equipm nt from "any location in th field". Nowhere within the Unruh

reference is a handheld wireless RUI disclosed as being able to control and read the status of the irrigation units from "any location in the field." Accordingly, claim 2 is believed to be allowable over the Unruh reference.

Claim 3 is an independent combination claim that is nearly identical to claim 1 but for the fact that the RUI device is not claimed as being in combination with ancillary equipment. Accordingly, claim 3 is believed to be allowable over the Unruh reference for the same reasons as set forth hereinabove for claim 1.

Claim 4 recites a method for remotely determining the status of and controlling irrigation components with a handheld wireless RUI. As discussed hereinabove, the Unruh reference does not teach or otherwise disclose a handheld wireless RUI device that is specifically capable of determining the status of or controlling irrigation components and ancillary equipment.

Claims 1-4 are believed to be allowable over the cited prior art and the Examiner is respectfully requested to reconsider the aforementioned rejections and allow claims 1-4.

No fees or extensions of time are believed to be due in connection with this amendment; however, please consider this a request for any extension inadvertently omitted, and charge any additional fees to Deposit Account No. 502093.

Respectfully submitted,

SHANE M. NIEBERGALL
Registration No. 44,974
THOMTE, MAZOUR & NIEBERGALL
Attorneys of Record

2120 S. 72nd Street, Suite 1111
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CERTIFICATE OF FACSIMILE TRANSMISSION

I hereby certify that the original of this AMENDMENT for BRUCE KREIKEMEIER, Serial No. 09/778,367, was transmitted to Examiner Crystal J. Barnes (703) 872-9306 on this 17th day of November, 2003.

SHANE M. NIEBERGALL

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/778,367	02/07/2001	Bruce Kreikemeier		6849

31083 7590 11/28/2003

THOMTE, MAZOUR & NIEBERGALL, L.L.C.
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EXAMINER	
BARNES, CRYSTAL J	

ART UNIT	PAPER NUMBER
2121	8

DATE MAILED: 11/28/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	09/778,367	KREIKEMEIER ET AL.	
	Examiner	Art Unit	
	Crystal J. Barnes	2121	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondenc address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *17 November 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-4* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *07 February 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Response to Arguments

1. Applicant's arguments, see Reconsideration (paper no. 7) pages 2-4, filed 17 November 2003, with respect to claims 1-4 rejected under 35 USC 102(a) as being anticipated by USPN 6,600,971 B1 to Smith et al. have been considered but are moot in view of the new ground(s) of rejection.

2. Applicant's arguments, see Reconsideration (paper no. 7) pages 5-6, filed 17 November 2003, with respect to claims 1-4 rejected under 35 USC 102(b) as being anticipated by USPN 4,626,984 to Unruh et al. have been fully considered and are persuasive. The rejection of claims 1-4 under 35 USC 102(b) has been withdrawn.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over USPN 6,600,971 B1 to Smith et al. in view of USPN 6,173,727 B1 to Davey.

As per claim 1, the Smith et al. reference discloses in combination with mechanized irrigation components and ancillary equipment therefore for irrigating a field comprising a wireless RUI (see figure 3 and column 6 lines 20-24, "remote device 25") comprising a handheld display and keypad for (a) reading the status (see column 6 lines 1-3, "monitor") of irrigation components (see column 5 lines 47-51, "sprinkler valves 17") and ancillary equipment (see column 5 lines 52-56, "various sensors 21") and (b) controlling (see column 6 lines 1-3, "operate") the irrigation components "sprinkler valves 17" and ancillary equipment "various sensors 21". Also see column 7 claim 3.

The Smith et al. reference does not expressly disclose a wireless RUI comprising a handheld display and keypad.

The Davey reference discloses

(see column 5 lines 37-40, "The remote communication means 124 ... remote control of actuation of the various sprinkler stations.")

(see column 6 lines 19-25, "By using the remote control means 124, the user is able to actuate the valve ...")

(see column 7 lines 11-15, "The user presses a touch key ... ")

(see column 9 lines 12-18, "The remote control means 124b ... touch pad 234 ... touch keys 238.")

(see column 9 lines 44-47, "... a display screen 250 ...")

At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to modify the hand held unit taught by the Smith et al. reference with the remote control means taught by the Davey reference to illustrate the display and keypad.

One of ordinary skill in the art would have been motivated to illustrate the display and keypad necessary to assume control from the central computer to maintain the capability of monitoring and operating the entire system.

As per claim 2, the Smith et al. reference discloses said wireless RUI (see figure 3 and column 6 lines 20-24, "remote device 25") has the capability of reading the status (see column 6 lines 1-3, "monitor") of the irrigation components (see column 5 lines 47-51, "sprinkler valves 17") and ancillary equipment (see column 5 lines 52-56, "various sensors 21") and controlling (see column 6 lines 1-3, "operate") the same from any location (see column 5 lines 4-16 "node") in the field "network".

As per claim 3, the rejection of claim 1 is incorporated and further claim 3 contains limitations recited in claim 1; therefore claim 3 is rejected under the same rationale as claim 1.

As per claim 4, the rejection of claim 1 is incorporated and further claim 4 contains limitations recited in claim 1; therefore claim 4 is rejected under the same rationale as claim 1.

Conclusion

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The following patents are cited to further show the state of the art with respect to remote monitoring and control of irrigation systems in general:

USPN 4,244,022 to Kendall

USPN 6,337,971 B1 to Abts

USPN 6,633,786 B1 to Majors et al.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Crystal J. Barnes whose telephone number is

703.306.5448. The examiner can normally be reached on Monday-Friday alternate Mondays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Anil Khatri can be reached on 703.305.0282. The fax phone number for the organization where this application or proceeding is assigned is 703.872.9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703.305.3900.

cjb
November 24, 2003

ANIL KHATRI
SUPERVISORY PATENT EXAMINER

Notice of References Cited	Application/Control No. 09/778,367	Applicant(s)/Patent Under Reexamination KREIKEMEIER ET AL.	
	Examiner Crystal J. Barnes	Art Unit 2121	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-4,244,022	01-1981	Kendall, Thomas L.	700/284
	B	US-6,337,971	01-2002	Abts, Gerald L.	340/7.2
	C	US-6,633,786	10-2003	Majors et al.	700/79
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

#9/13
3618
3-5-04

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT : BRUCE KREIKEMEIER, ET AL. GROUP NO.: 3618

SERIAL NO. : 09/778,367 EXAMINER: C. Barnes

FILED : February 7, 2001

TITLE : METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS

AMENDMENT

Commissioner for Patents
Alexandria, VA 22313

Dear Sir:

In response to the Office Action dated November 28, 2003, Paper No. 8 in the above entitled application, please enter the following response:

IN THE CLAIMS

1. (Currently Amended)

In combination with mechanized irrigation components and ancillary equipment therefore for irrigating a field, comprising:

a wireless RUI comprising a handheld display and keypad for:

(a) reading the status of irrigation components and ancillary equipment; and

(b) controlling the irrigation components and ancillary equipment~~.~~;

(c) displaying said status of said irrigation components and ancillary equipment.

2. (Original)

The combination of claim 1 wherein said wireless RUI has the capability of reading the status of the irrigation components and ancillary equipment and controlling the same from any location in the field.

3. (Currently Amended)

In combination with mechanized irrigation components for irrigating a field, comprising:

a wireless RUI comprising a handheld display and keypad having the capability of:

(a) reading the status of the irrigation components; and

(b) controlling the operation of the irrigation components~~.~~;

(c) displaying said status of the irrigation components.

4. (Currently Amended)

The method whereby a person may remotely determine the status of mechanized irrigation components and ancillary equipment and for controlling the operation thereof, comprising the steps of:

providing a handheld wireless RUI;

utilizing said RUI to read the status of the irrigation components and ancillary equipment; and

utilizing said RUI to control the irrigation components and ancillary equipment.

REMARKS

The Examiner rejected claims 1-4 under 35 U.S.C. § 103(a) as being unpatentable over Smith in view of Davey. The Examiner concedes that Smith does not expressly disclose a wireless RUI comprising a handheld display and keypad. The Examiner contends that Davey teaches such a structure. The Examiner argues that at the time the invention was made, it would have been obvious to a person of ordinary skill in the art to modify the handheld unit taught by Smith with the remote control means taught by Davey.

Applicants respectfully disagree with the Examiner's contentions. Even though applicants believe that the claims are allowable as written, applicants have amended the claims to further clarify the present invention and expedite this matter. Independent claims 1, 3 and 4 have been amended to clarify that the RUI is also for displaying the status of the irrigation components.

With regard to the Examiner's 35 U.S.C. § 103(a) rejection, applicants assert that there is absolutely no motivation to combine the prior art references in the manner suggested by the Examiner. Smith teaches a computer system for controlling agricultural irrigation equipment. The type of equipment disclosed in Smith is center pivot irrigation systems and elevated boom-type irrigation systems. Smith specifically teaches a central computer 25 for controlling a plurality of satellite controllers which are located within the agricultural field. The central computer is coupled to the satellite controllers via a communication bus, which is described as being implemented with twisted pair wire, radio modems or analog telephone modems. Smith does not teach or

otherwise assert that the central computer is a handheld device. However, Smith teaches that when the central computer is down or where the communication bus is disrupted, a handheld remote device can be used to communicate with the satellite controllers by directly coupling the remote unit to a node located within the field. The node is comprised of two different sensors coupled to a satellite controller. The connection between the two sensors is not described as being wireless. As correctly pointed out by the Examiner, the specification and figures do not reference the remote device as a handheld display or a keypad.

With regard to the Davey invention, Davey teaches a remote actuator for an individual's yard or a golf course. The Davey device addresses the problems associated with broken sprinkler heads in a subterranean multi-station sprinkler system. The Davey remote allows the user to remotely actuate a sprinkler station to test the same. This eliminates the users need to walk back to a central unit to turn on or off a watering station. Davey does not reference agricultural irrigation equipment or an agricultural field. Davey is merely concerned with broken sprinkler heads and a convenient way of testing the same.

A person of ordinary skill in the art presented with the problems described in Smith would not be inclined on any objective basis to consider the remote sprinkler actuator as described by Davey. Smith is concerned with large-scale agricultural irrigation of crops. The equipment associated with this type of irrigation includes expensive center pivot irrigation equipment and complex software programs to help a farmer get the most yield from a crop. A person of ordinary skill presented with these

problems would not consider Davey who is concerned with subterranean sprinkler heads and conduits for an individual's yard.

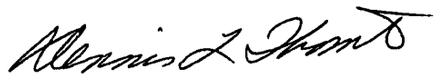
Moreover, even for argument purposes, if the above references were combinable as the Examiner suggests, the Examiner's cited art still fails to teach all of the limitations of independent claims 1, 3 and 4. Claims 1, 3 and 4 recite a wireless RUI in combination with irrigation components and a field. The RUI has three functions; (1) reading the status, (2) controlling, and (3) displaying the status. Neither Smith nor Davey teach or otherwise suggest a wireless handheld device which performs these three functions. Contrary to the Examiner's contention, Davey does not teach a wireless handheld device for reading the status and displaying the status. Davey merely teaches a remote for actuating the sprinkler. In other words, the remote only functions to turn the sprinkler on and off. Accordingly, applicants believe that claims 1, 3 and 4 are clearly allowable over the Examiner's rejection.

With regard to claim 2, claim 2 depends from independent claim 1 and further recites that the wireless RUI has a capability of reading the status of the irrigation components and ancillary equipment, and controlling the same from any location in the field. For the same reasons set forth above in support of independent claims 1, 3 and 4, applicants believe that neither Smith nor Davey teach or otherwise suggest the limitations of these claims. Furthermore, insofar as claim 2 ultimately depends from independent claim 1, the same is also thought to be allowable.

In light of the above amendments and remarks, applicants assert that the claims are in condition for allowance. Applicants respectfully request reconsideration and allowance of the same.

No fees or extensions of time are believed to be due in connection with this amendment; however, please consider this a request for any extension inadvertently omitted, and charge any additional fees to Deposit Account No. 502093.

Respectfully submitted,



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CERTIFICATE OF MAILING

I hereby certify that the original of this AMENDMENT for BRUCE KREIKEMEIER, ET AL., Serial No. 09/778,367, was mailed by first class mail, postage prepaid, to Mail Stop Non-Fee Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on this 26th day of Feb, 2004.

DENNIS L. THOMTE

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/778,367	02/07/2001	Bruce Kreikemeier		6849

31083 7590 04/20/2004

THOMTE, MAZOUR & NIEBERGALL, L.L.C.
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OMAHA, NE 68124

EXAMINER	
BARNES, CRYSTAL J	

ART UNIT	PAPER NUMBER
2121	10

DATE MAILED: 04/20/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

7

Office Action Summary	Application No.	Applicant(s)	
	09/778,367	KREIKEMEIER ET AL.	
	Examiner	Art Unit	
	Crystal J. Barnes	2121	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *01 March 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-4* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *07 February 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. The following is a Final Office Action in response to communication received on 01 March 2004. Claims 1, 3 and 4 have been amended. Claims 1-4 are pending in this application.

Response to Arguments

2. Applicant's arguments with respect to claims 1-4 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless -
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 1-4 are rejected under 35 U.S.C. 102(e) as being anticipated by USPN 6,337,971 B1 to Abts.

As per claim 1, the Abts reference discloses in combination with mechanized irrigation components and ancillary equipment therefore for irrigating a field comprising a wireless RUI (see column 7 lines 43-45, "pager 130"; column 7 lines 52-57, "cellular or touch-tone phone 150") comprising a handheld display (see column 7 lines 47-51, "display 132") and keypad (see figure 1, "pager 130, cellular or touch-tone phone 150") for (a) reading the status (see column 7 lines 47-51, "current status") of irrigation components ("pivots 20") and ancillary equipment (see column 9 lines 1-10, "other field sensors") and (b) controlling (see column 7 lines 52-57, "control signals") the irrigation components ("pivots 20") and ancillary equipment ("other field sensors").

As per claim 2, the Abts reference discloses said wireless RUI ("pager 130, cellular or touch-tone phone 150") has the capability of reading the status ("current status") of the irrigation components ("pivots 20") and ancillary equipment ("other field sensors") and controlling ("control signals") the same from any location (see column 7 lines 45-46, "remote location 140").

As per claim 3, the rejection of claim 1 is incorporated and further claim 3 contains limitations recited in claim 1; therefore claim 3 is rejected under the same rationale as claim 1.

As per claim 4, the rejection of claim 1 is incorporated and further claim 4 contains limitations recited in claim 1; therefore claim 4 is rejected under the same rationale as claim 1.

Conclusion

5. No claims are allowed.

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The following patents are cited to further show the state of the art with respect to remote monitoring and control of irrigation systems in general:

USPN 5,760,706 to Kiss

USPN 6,343,255 B1 to Peek et al.

USPN 6,453,215 B1 to Lavoie

USPN 6,529,589 B1 to Nelson et al.

USPN 6,701,665 B1 to Ton et al.

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Crystal J. Barnes whose telephone number is 703.306.5448. The examiner can normally be reached on Monday-Friday alternate Mondays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Anthony Knight can be reached on 703.308.3179. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

cjb
10 April 2004

Anthony Knight
Supervisory Patent Examiner
Group 3600

Notice of References Cited	Application/Control No. 09/778,367	Applicant(s)/Patent Under Reexamination KREIKEMEIER ET AL.	
	Examiner Crystal J. Barnes	Art Unit 2121	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-5,760,706	06-1998	Kiss, Michael Z.	340/825.69
	B	US-6,343,255	01-2002	Peek et al.	702/3
	C	US-6,453,215	09-2002	Lavoie, Nathan	700/284
	D	US-6,529,589	03-2003	Nelson et al.	379/102.01
	E	US-6,701,665	03-2004	Ton et al.	47/17
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
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	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
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	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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$ RCE 2121

PTO/SB/30 (09-03)
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Request for Continued Examination (RCE) Transmittal

Address to:
Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Application Number	09/778,367
Filing Date	February 7, 2001
First Named Inventor	Bruce Kreikemeier
Art Unit	2121
Examiner Name	Crystal J. Barnes
Attorney Docket Number	

RECEIVED
MAY 25 2004
Technology Center 2100

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. See Instruction Sheet for RCEs (not to be submitted to the USPTO) on page 2.

1. Submission required under 37 CFR 1.114 Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

   a. ☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.
      i. ☐ Consider the arguments in the Appeal Brief or Rely Brief previously filed on _____
      ii. ☐ Other _____

   b. ☑ Enclosed
      i. ☑ Amendment/Reply
      ii. ☐ Affidavit(s)/ Declaration(s)
      iii. ☐ Information Disclosure Statement (IDS)
      iv. ☐ Other _____

2. Miscellaneous

   a. ☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of _____ months. (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)
   b. ☐ Other _____

3. Fees The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.

   a. ☐ The Director is hereby authorized to charge the following fees, or credit any overpayments, to Deposit Account No. _____
      i. ☐ RCE fee required under 37 CFR 1.17(e)
      ii. ☐ Extension of time fee (37 CFR 1.136 and 1.17)
      iii. ☐ Other _____
   b. ☑ Check in the amount of $ 770.00 enclosed
   c. ☐ Payment by credit card (Form PTO-2038 enclosed)

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED			
Name (Print/Type)	DENNIS L. THOMTE	*Registration No. (Attorney/Agent)*	22,497
Signature	Dennis L. Thomte	*Date*	5/16/04

CERTIFICATE OF MAILING OR TRANSMISSION

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Mail Stop RCE, Commissioner for Patents, P. O. Box 1450, Alexandria, VA 22313-1450 or facsimile transmitted to the U.S. Patent and Trademark Office on the date shown below.

Name (Print/Type)	DENNIS L. THOMTE		
Signature	Dennis L. Thomte	Date	5/16/04

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Mail Stop RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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RESPONSE UNDER 37 C.F.R. 1.116(a)
EXPEDITED PROCEDURE EXAMINING
GROUP 2121

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT : BRUCE KREIKEMEIER, ET AL. GROUP NO.: 2121

SERIAL NO. : 09/778,367 EXAMINER: C. Barnes

FILED : February 7, 2001

TITLE : METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS

AMENDMENT AFTER FINAL REJECTION

Commissioner for Patents
Alexandria, VA 22313

Dear Sir:

In response to the Office Action dated April 20, 2004, Paper No. 10, in the above-entitled application, please enter the following response:

IN THE CLAIMS

1. (Currently Amended)

In combination with mechanized irrigation components and ancillary equipment therefore for irrigating a field, comprising:

a single wireless RUI comprising a handheld display and keypad for:

(a) reading the status of irrigation components and ancillary equipment; ~~and~~

(b) ~~controlling the~~directly transmitting telemetry to said irrigation components and ancillary equipment to control said irrigation components and ancillary equipment; and

(c) displaying said status of said irrigation components and ancillary equipment.

2. (Original)

The combination of claim 1 wherein said wireless RUI has the capability of reading the status of the irrigation components and ancillary equipment and controlling the same from any location in the field.

3. (Currently Amended)

In combination with mechanized irrigation components for irrigating a field, comprising:

a single wireless RUI comprising a handheld display and keypad having the capability of:

(a) reading the status of the irrigation components; ~~and~~

(b) ~~controlling~~directly transmitting telemetry to said irrigation components to control the operation of the irrigation components; and

(c) displaying said status of the irrigation components.

4. (Currently Amended)

The method whereby a person may remotely determine the status of mechanized irrigation components and ancillary equipment and for controlling the operation thereof, comprising the steps of:

providing a single handheld wireless RUI;

utilizing said RUI to read the status of the irrigation components and ancillary equipment; and

utilizing said RUI to directly transmit telemetry to said irrigation components and ancillary equipment to control the irrigation components and ancillary equipment.

(b) ~~controlling~~directly transmitting telemetry to said irrigation components to control the operation of the irrigation components; and

(c) displaying said status of the irrigation components.

4. (Currently Amended)

The method whereby a person may remotely determine the status of mechanized irrigation components and ancillary equipment and for controlling the operation thereof, comprising the steps of:

providing a single handheld wireless RUI;

utilizing said ~~single handheld wireless~~ RUI to read the status of the irrigation components and ancillary equipment; and

utilizing said ~~single handheld wireless~~ RUI to directly transmit telemetry to said irrigation components and ancillary equipment to control the irrigation components and ancillary equipment.

CJB 21 September 2004

REMARKS

In the Examiner's Office Action dated April 20, 2004, the Examiner entered a final rejection of claims 1-4 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,337,971 B1 to Abts. Even though applicants believe that the claims are allowable as written, applicants have amended the claims as set forth above to clarify the invention for the Examiner and expedite this matter. Claims 1, 3 and 4 have been amended to recite a single wireless RUI. Claims 1, 3 and 4 have been further amended to recite the step of directly transmitting telemetry.

Applicants' attorney conducted a telephonic interview with the Examiner on May 13, 2004. During that interview, the Examiner indicated that the proposed changes overcome the prior art of record. The Examiner also indicated that such changes would require further consideration of the prior art. Accordingly, applicants submit herewith a Request for Continued Examination and a check in the amount of $770.00.

In light of the above amendments and remarks, applicants assert that the claims are in condition for allowance. Applicants respectfully request consideration of this amendment and allowance of the claims.

No fees or extensions of time are believed to be due in connection with this amendment; however, please consider this a request for any extension inadvertently omitted, and charge any additional fees to Deposit Account No. 502093.

Respectfully submitted,

DENNIS L. THOMTE
Registration No. 22,497
THOMTE, MAZOUR & NIEBERGALL
Attorneys of Record

2120 South 72nd Street - Suite 1111
Omaha, Nebraska 68124
(402) 392-2280

CERTIFICATE OF MAILING

I hereby certify that the original of this AMENDMENT AFTER FINAL REJECTION for BRUCE KREIKEMEIER, ET AL., Serial No. 09/778,367, was mailed by first class mail, postage prepaid, to Mail Stop AF, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on this 19 day of May, 2004.

DENNIS L. THOMTE

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/778,367	02/07/2001	Bruce Kreikemeier		6849

31083 7590 07/20/2004

THOMTE, MAZOUR & NIEBERGALL, L.L.C.
2120 S. 72ND STREET, SUITE 1111
OMAHA, NE 68124

EXAMINER	
BARNES, CRYSTAL J	

ART UNIT	PAPER NUMBER
2121	

DATE MAILED: 07/20/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	09/778,367	KREIKEMEIER ET AL.	
	Examiner	Art Unit	
	Crystal J. Barnes	2121	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 May 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-4* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *07 February 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. The following is a Non-Final Rejection in response to the Request for Continued Examination (RCE) received on 21 May 2004. Claims 1, 3 and 4 have been amended. Claims 1-4 remain pending in this application.

Claim Rejections - 35 USC § 103

2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

3. Claims 1-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over USPN 6,337,971 B1 to Abts in view of USPN 5,737,707 to Gaulke et al., and further in view of USPN 6,600,971 B1 to Smith et al.

As per claim 1, the Abts reference discloses in combination with mechanized irrigation components and ancillary equipment therefore for irrigating a field comprising a single wireless RUI (see column 7 lines 43-45, "pager 130"; column 7 lines 52-57, "cellular or touch-tone phone 150") comprising a handheld display (see column 7 lines 47-51, "display 132") and keypad (see figure 1, "pager 130, cellular or touch-tone phone 150") for (a) reading the status (see column 7 lines 47-51, "current status") of irrigation components ("pivots 20") and ancillary equipment

(see column 9 lines 1-10, "other field sensors") and (b) directly transmitting telemetry to said irrigation components and ancillary equipment to control (see column 7 lines 52-57, "control signals") said irrigation components ("pivots 20") and ancillary equipment ("other field sensors").

The Abts reference does not expressly disclose a single wireless RUI for directly transmitting telemetry to said irrigation components and ancillary equipment to control said irrigation components and ancillary equipment.

The Gaulke et al. reference discloses

(see Abstract, "An integrated pager and cellular phone ...")

(see column 1 lines 40-42, "Many users of cellular phones have continued to use pagers ... combine both devices into a single unit.")

(see column 2 lines 1-5, "... an integrated pager and wireless radiotelephone ...")

The Smith et al. reference discloses

(see column 4 lines 52-54, "The satellite controllers 15 control the solenoid operated valves 17 and interface with various sensors 21.")

(see column 4 lines 57-59, "The satellite controller 15 can be operated both locally ... and remotely ...")

(see column 5 lines 3-7, "... When operated remotely, the satellite controller 15 can be monitored and controlled from any node in the network ...")

(see column 6 lines 20-25, "... a remote device 25, here a hand held unit ... communications can occur via bus 23 and the remote device 25 via a remote connection 27.")

At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to modify paging system taught by the Abts reference with the integrated phone and pager taught by the Gaulke et al. reference and the distributed control network taught by the Smith et al. reference to operate controllers in a local mode via a user interface and in a remote mode via a wireless hand held unit.

One of ordinary skill in the art would have been motivated to operate controllers in a local mode via a user interface or in a remote mode via a wireless hand held unit for stability, reliability, and convenience.

As per claim 2, the Abts reference discloses said wireless RUI ("pager 130, cellular or touch-tone phone 150") has the capability of reading the status ("current status") of the irrigation components ("pivots 20") and ancillary

equipment ("other field sensors") and controlling ("control signals") the same from any location (see column 7 lines 45-46, "remote location 140").

As per claim 3, the rejection of claim 1 is incorporated and further claim 3 contains limitations recited in claim 1; therefore claim 3 is rejected under the same rationale as claim 1.

As per claim 4, the rejection of claim 1 is incorporated and further claim 4 contains limitations recited in claim 1; therefore claim 4 is rejected under the same rationale as claim 1.

Response to Amendment

4. Applicant's request for continued examination (RCE) is timely; therefore, the finality of the last Office action is withdrawn.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Crystal J. Barnes whose telephone number is 703.306.5448. The examiner can normally be reached on Monday-Friday alternate Mondays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Anthony Knight can be reached on 703.308.3179. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Anthony Knight
Supervisory Patent Examiner
Group 3600

cjb
16 July 2004

RESPONSE UNDER 37 C.F.R. 1.116(a)
EXPEDITED PROCEDURE EXAMINING
GROUP 2121

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT : BRUCE KREIKEMEIER, ET AL. GROUP NO.: 2121

SERIAL NO. : 09/778,367 EXAMINER: C. Barnes

FILED : February 7, 2001

TITLE : METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS

"OK to ENTER"
CJB
13 July 2004

AMENDMENT AFTER FINAL REJECTION

Commissioner for Patents
Alexandria, VA 22313

Dear Sir:

In response to the Office Action dated April 20, 2004, Paper No. 10, in the above-entitled application, please enter the following response:

Notice of References Cited	Application/Control No. 09/778,367	Applicant(s)/Patent Under Reexamination KREIKEMEIER ET AL.	
	Examiner Crystal J. Barnes	Art Unit 2121	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,337,971	01-2002	Abts, Gerald L.	340/7.2
	B	US-5,737,707	04-1998	Gaulke et al.	455/556.1
*	C	US-6,600,971	07-2003	Smith et al.	700/284
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

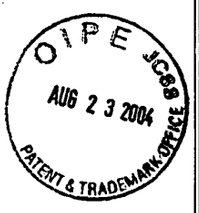
FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.



2121

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT : BRUCE KREIKEMEIER, ET AL. GROUP NO.: 2121

SERIAL NO. : 09/778,367 EXAMINER: C. Barnes

FILED : February 7, 2001

TITLE : METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS

AMENDMENT

Commissioner for Patents
Alexandria, VA 22313

Dear Sir:

In response to the Office Action dated July 20, 2004, in the above entitled application, please enter the following response:

REMARKS

The Examiner has rejected claims 1-4 under 35 U.S.C. § 103(a) as being unpatentable over Abts (U.S. 6,337,971) in view of Gaulke, et al. (U.S. 5,737,707) and further in view of Smith et al. (U.S. 6,600,971). Specifically, the Examiner states that the Abts reference does not expressly disclose a single wireless RUI for directly transmitting telemetry to the irrigation components and ancillary equipment to control the same. The Examiner states that it would have been obvious to a person of ordinary skill in the art to modify the paging system taught by the Abts reference with the integrated phone and pager taught by the Gaulke, et al. reference and the distributed control network taught by the Smith et al. reference to operate controllers in a local mode via a user interface and in a remote mode via a wireless handheld unit.

In determining the difference between the prior art and the claims, the question under 35 U.S.C. § 103 is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious. Stratoflex, Inc. v. Aeroquip Corp., 713 F.2d 1530, 218 USPQ 871(Fed. Cir. 1983). A prior art reference and the claimed invention must be considered in their entireties. Distilling an invention down to the "jist" or "thrust" of an invention disregards the requirement of analyzing the subject matter "as a whole." W. L. Gore & Associates, Inc. v. Garlock, Inc., 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984). Obviousness can only be established by combining or modifying the teachings of the prior art to produce a claimed invention where there is some teaching, suggestion, or motivation to do so, found either explicitly or implicitly in the references

themselves or in the knowledge generally available to one of ordinary skill in the art. The test for an implicit showing is what the combined teachings, common knowledge of one of ordinary skill in the art, and the nature of the problem to be solved as a whole would have suggested to those of ordinary skill in the art. In re Kotzab, 217 F.3d 1365, 55 USPQ 2d 1313 (Fed. Cir. 2000). In the Kotzab case, the Federal Circuit decided that the control of multiple valves by a single sensor, rather than by multiple sensors, was a technologically simple concept. However, the Federal Circuit held that there was no finding as to the specific understanding or principle within the knowledge of the skilled artesian that would have provided the motivation to use a single sensor as the system to control more than one valve.

Claims 1, 3 and 4 are independent claims. Each claim is comprised of a limitation requiring a single, handheld, wireless RUI that directly transmits telemetry to the irrigation components to control the same. None of the cited prior art provide a single wireless RUI that directly transmits telemetry to irrigation components. The Abts reference clearly discloses a pair of wireless components that must first communicate with a paging terminal 110 that communicates with a central computer 90, which then communicates with a remote terminal unit, which communicates with the pivot control 40. No direct wireless telemetry transmission occurs between the handheld device and the irrigation component. Similarly, in the Smith et al. reference, the handheld device 25 is coupled with a sensor 21 that is coupled with a second sensor 21, which is coupled to the satellite controller, which is coupled with the sprinkler valve. Accordingly, no direct wireless telemetry transmission occurs between the handheld device and the

irrigation equipment. The Gaulke et al. reference is cited by the Examiner as teaching a single handheld device that combines a pager device and a cellular telephone. However, the Gaulke et al. reference does not teach that the device is capable of wireless telemetry transmission directly to an irrigation component for control of the same. Accordingly, none of the references teach or otherwise describe this limitation within independent claims 1, 3 or 4. Reviewing these prior art references provides no indication as to the specific understanding or principle within the knowledge of the skilled artesian that would have provided the motivation to directly transmit telemetry to an irrigation component using a single wireless RUI. In re Kotzab, 217 F.3d 1365, 55 USPQ 2d 1313 (Fed. Cir. 2000). Accordingly, the claimed invention as a whole in claims 1, 3 and 4 cannot be considered to be obvious. Stratoflex, Inc. v. Aeroquip Corp., 713 F.2d 1530, 218 USPQ 871(Fed. Cir. 1983).

Even if a prior art reference can be found that teaches remote, wireless transmission of telemetry to control some device, the mere fact that references can be modified and combined with one another does not render the resulting modified structure as "obvious" unless the prior art also suggests the desirability of the combination. In re Mills, 916 F.2d 680, 16 USPQ 2d 1430 (Fed. Cir. 1990). A statement that modifications of the prior art to meet the claimed invention would have been "well within the ordinary skill in the art at the time the claimed invention was made because the references relied upon teach that all aspects of the claimed invention were individually known in the art" is not sufficient to establish a *prima facie* case of obviousness without some objective reason to combine the teachings of the references.

Ex parte Leavengood, 28 USPQ 2d 1300 (Bd. Pat. App. & Inter. 1993). The very nature of the handheld units described within the cited prior art and the distributed control network taught by the Smith et al. reference indicate a lack of motivation in the art for creating a single, wireless, hand-held unit that transmits telemetry directly to irrigation components for controlling the same. To be sure, a person of ordinary skill in the art would not have looked, on any objective basis, to the cited prior art for solving the problem of a simplified method and means for reading the status of and controlling irrigation components. The Examiner is respectfully requested to reconsider the aforegoing rejections and allow claims 1, 3 and 4.

Claim 2 depends from claim 1 and is believed to be allowable for at least the reasons set forth hereinabove with respect to claim 1. Moreover, claim 2 provides the limitation that the "wireless RUI has the capability of reading the status of the irrigation components and ancillary equipment and controlling the same from any location in the field." The prior art fails to teach or otherwise suggest a wireless RUI having such a capability. Accordingly, claim 2 is believed to be allowable and the Examiner is respectfully requested to reconsider the aforementioned rejection and allow claim 2.

No fees or extensions of time are believed to be due in connection with this amendment; however, please consider this a request for any extension inadvertently omitted, and charge any additional fees to Deposit Account No. 502093.

Respectfully submitted,

SHANE M. NIEBERGALL
Registration No. 44,974
THOMTE, MAZOUR & NIEBERGALL
Attorneys of Record

2120 South 72nd Street - Suite 1111
Omaha, Nebraska 68124
(402) 392-2280

CERTIFICATE OF MAILING

I hereby certify that the original of this AMENDMENT for BRUCE KREIKEMEIER, ET AL., Serial No. 09/778,367, was mailed by first class mail, postage prepaid, to Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on this 19th day of August, 2004.

SHANE M. NIEBERGALL

Notice of Allowability	Application No.	Applicant(s)	
	09/778,367	KREIKEMEIER ET AL.	
	Examiner	Art Unit	
	Crystal J. Barnes	2121	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *Request for Reconsideration received 23 August 2004*.

2. ☒ The allowed claim(s) is/are *1-4*.

3. ☒ The drawings filed on *07 February 2001* are accepted by the Examiner.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).
   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

EXAMINER'S AMENDMENT

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Dennis L. Thomte, Reg. No. 22,497 on 21 September 2004.

The application has been amended as follows:

IN THE CLAIMS:

Claim 4, lines 5 and 7, deleted "said RUI" and inserted --said single handheld wireless RUI--.

REASONS FOR ALLOWANCE

2. The following is an examiner's statement of reasons for allowance:

As per claim 1, the prior art of record taken alone or in combination fail to teach a single wireless RUI comprising a handheld display and keypad for directly transmitting telemetry to irrigation components and ancillary equipment to control the irrigation components and ancillary equipment.

As per claim 3, the prior art of record taken alone or in combination fail to teach a single wireless RUI comprising a handheld display and keypad having the capability of directly transmitting telemetry to irrigation components to control the operation of the irrigation components.

As per claim 4, the prior art of record taken alone or in combination fail to teach utilizing a single handheld wireless RUI to directly transmit telemetry to irrigation components and ancillary equipment to control the irrigation components and ancillary equipment.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Crystal J. Barnes whose telephone number is 703.306.5448 or 571.272.3679 after 14 October 2004. The examiner can normally be reached on Monday-Friday alternate Mondays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Anthony Knight can be reached on 703.308.3179 or 571.272.3687 after 14 October 2004. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

CJB
21 September 2004

Anthony Knight
Supervisory Patent Examiner
Group 3600

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

31083 7590 09/24/2004

THOMTE, MAZOUR & NIEBERGALL, L.L.C.
2120 S. 72ND STREET, SUITE 1111
OMAHA, NE 68124

EXAMINER	
BARNES, CRYSTAL J	
ART UNIT	PAPER NUMBER
2121	

DATE MAILED: 09/24/2004

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/778,367	02/07/2001	Bruce Kreikemeier		6849

TITLE OF INVENTION: METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1330	$300	$1630	12/27/2004

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE REFLECTS A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE APPLIED IN THIS APPLICATION. THE PTOL-85B (OR AN EQUIVALENT) MUST BE RETURNED WITHIN THIS PERIOD EVEN IF NO FEE IS DUE OR THE APPLICATION WILL BE REGARDED AS ABANDONED.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL should be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). Even if the fee(s) have already been paid, Part B - Fee(s) Transmittal should be completed and returned. If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PTOL-85 (Rev. 09/04) Approved for use through 04/30/2007.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (703) 746-4000

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

31083 7590 09/24/2004

THOMTE, MAZOUR & NIEBERGALL, L.L.C.
2120 S. 72ND STREET, SUITE 1111
OMAHA, NE 68124

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (703) 746-4000, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/778,367	02/07/2001	Bruce Kreikemeier		6849

TITLE OF INVENTION: METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1330	$300	$1630	12/27/2004

EXAMINER	ART UNIT	CLASS-SUBCLASS
BARNES, CRYSTAL J	2121	700-065000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are enclosed:
☐ Issue Fee
☐ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s):
☐ A check in the amount of the fee(s) is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☐ The Director is hereby authorized by charge the required fee(s), or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

The Director of the USPTO is requested to apply the Issue Fee and Publication Fee (if any) or to re-apply any previously paid issue fee to the application identified above.
NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/778,367	02/07/2001	Bruce Kreikemeier		6849

31083 7590 09/24/2004

THOMTE, MAZOUR & NIEBERGALL, L.L.C.
2120 S. 72ND STREET, SUITE 1111
OMAHA, NE 68124

EXAMINER	
BARNES, CRYSTAL J	
ART UNIT	**PAPER NUMBER**
2121	

DATE MAILED: 09/24/2004

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 542 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 542 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (703) 305-1383. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at (703) 305-8283.

PTOL-85 (Rev. 09/04) Approved for use through 04/30/2007.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/778,367	02/07/2001	Bruce Kreikemeier		6849

31083 7590 09/24/2004

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2120 S. 72ND STREET, SUITE 1111
OMAHA, NE 68124

EXAMINER	
BARNES, CRYSTAL J	
ART UNIT	**PAPER NUMBER**
2121	

DATE MAILED: 09/24/2004

Notice of Fee Increase on October 1, 2004

If a reply to a "Notice of Allowance and Fee(s) Due" is filed in the Office on or after October 1, 2004, then the amount due will be higher than that set forth in the "Notice of Allowance and Fee(s) Due" because some fees will increase effective October 1, 2004. See Revision of Patent Fees for Fiscal Year 2005; Final Rule, 69 Fed. Reg. 52604, 52606 (May 10, 2004).

The current fee schedule is accessible from WEB site (http://www.uspto.gov/main/howtofees.htm).

If the fee paid is the amount shown on the "Notice of Allowance and Fee(s) Due" but not the correct amount in view of the fee increase, a "Notice of Pay Balance of Issue Fee" will be mailed to applicant. In order to avoid processing delays associated with mailing of a "Notice of Pay Balance of Issue Fee," if the response to the Notice of Allowance is to be filed on or after October 1, 2004 (or mailed with a certificate of mailing on or after October 1, 2004), the issue fee paid should be the fee that is required at the time the fee is paid. See Manual of Patent Examining Procedure (MPEP), Section 1306 (Eighth Edition, Rev. 2, May 2004). If the issue fee was previously paid, and the response to the "Notice of Allowance and Fee(s) Due" includes a request to apply a previously-paid issue fee to the issue fee now due, then the difference between the issue fee amount at the time the response is filed and the previously-paid issue fee should be paid. See MPEP Section 1308.01.

Effective October 1, 2004, 37 CFR 1.18 is amended by revising paragraphs (a) through (c) to read as set forth below.

Section 1.18 Patent post allowance (including issue) fees.

(a) Issue fee for issuing each original or reissue patent, except a design or plant patent:
- By a small entity (Sec. 1.27(a)) $685.00
- By other than a small entity $1,370.00

(b) Issue fee for issuing a design patent:
- By a small entity (Sec. 1.27(a)) $245.00
- By other than a small entity $490.00

(c) Issue fee for issuing a plant patent:
- By a small entity (Sec. 1.27(a)) $330.00
- By other than a small entity $660.00

Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at (703) 305-8283.

PTOL-85 (Rev. 09/04) Approved for use through 04/30/2007.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (703) 746-4000

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

31083 7590 09/24/2004

THOMTE, MAZOUR & NIEBERGALL, L.L.C.
2120 S. 72ND STREET, SUITE 1111
OMAHA, NE 68124

12/28/2004 AADOFD2 00000039 09778367

01 FC:1501 1400.00 OP
02 FC:1504 300.00 OP
03 FC:8001 30.00 OP

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (703) 746-4000, on the date indicated below.

DENNIS L. THOMTE	(Depositor's name)
Dennis L Thomte	(Signature)
DECEMBER 22, 2004	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/778,367	02/07/2001	Bruce Kreikemeier		6849

TITLE OF INVENTION: METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS

$1,400 XXXXXX$1,700

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	XXXXXX	$300	XXXXXX	12/27/2004

EXAMINER	ART UNIT	CLASS-SUBCLASS
BARNES, CRYSTAL J	2121	700-065000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
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1 THOMTE, MAZOUR & NIEBERGALL.
2 DENNIS L. THOMTE
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: VALMONT INDUSTRIES, INC.
(B) RESIDENCE: (CITY and STATE OR COUNTRY): VALLEY, NE

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are enclosed:
☒ Issue Fee
☒ Publication Fee (No small entity discount permitted)
☒ Advance Order - # of Copies 10

4b. Payment of Fee(s):
☒ A check in the amount of the fee(s) is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
any underpayment
☒ The Director is hereby authorized by charge the required fee(s), or credit any overpayment, to Deposit Account Number 502093 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

The Director of the USPTO is requested to apply the Issue Fee and Publication Fee (if any) or to re-apply any previously paid issue fee to the application identified above.
NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature Dennis L Thomte Date December 22, 2004

Typed or printed name DENNIS L. THOMTE Registration No. 22,497

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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File History Content Report

The following content is missing from the original file history record obtained from the United States Patent and Trademark Office. No additional information is available.

Document Date - 2005-02-08

Document Title - USPTO Grant

ARTIFACT SHEET

Enter artifact number below. Artifact number is application number + artifact type code (see list below) + sequential letter (A, B, C ...). The first artifact folder for an artifact type receives the letter A, the second B, etc..
Examples: 59123456PA, 59123456PB, 59123456ZA, 59123456ZB

09778367ZZ

Indicate quantity of a single type of artifact received but not scanned. Create individual artifact folder/box and artifact number for each Artifact Type.

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- pages of specification and/or sequence listing and/or table ☐ — Doc Code: Artifact — Artifact Type Code: S
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Doc Code: Artifact Artifact Type Code: C

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☐ Model(s)
Doc Code: Artifact Artifact Type Code: M

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Doc Code: Artifact Artifact Type Code: B

☐ Confidential Information Disclosure Statement or Other Documents marked Proprietary, Trade Secrets, Subject to Protective Order, Material Submitted under MPEP 724.02, etc.
Doc Code: Artifact Artifact Type Code

☒ Other, description: FLOPPY DISK
Doc Code: Artifact Artifact Type Code: Z

March 8, 2004

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2000

Application or Docket Number

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	4	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	4 minus 20=	* 0
INDEPENDENT CLAIMS	3 minus 3 =	* 0
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☐		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	355.00	OR	BASIC FEE	710.00
X$ 9=		OR	X$18=	0
X40=		OR	X80=	0
+135=		OR	+270=	
TOTAL		OR	TOTAL	710

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
***If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

FORM PTO-875
(Rev. 8/00)

Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE
*U.S. GPO: 2000-460-706/30103

3-1-04

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2000

Application or Docket Number: 09/778367

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	4	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	4 minus 20=	* 0
INDEPENDENT CLAIMS	3 minus 3 =	* 0
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☐		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	355.00	OR	BASIC FEE	710.00
X$ 9=		OR	X$18=	0
X40=		OR	X80=	0
+135=		OR	+270=	
TOTAL		OR	TOTAL	710

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 4	Minus	** 4	= \
Independent	* 3	Minus	*** 3	= \
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 4	Minus	** 4	= \
Independent	* 3	Minus	*** 3	= \
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 4	Minus	** 4	= \
Independent	* 3	Minus	*** 3	= \
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

FORM PTO-875
(Rev. 8/00)

Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE
*U.S. GPO: 2000-450-708/30103

Best Available Copy

CLAIMS ONLY

SERIAL NO.	FILING DATE
09728367	02-07-01

APPLICANT(S)

CLAIMS

	AS FILED		AFTER 1st AMENDMENT		AFTER 2nd AMENDMENT			*		*		*	
	IND.	DEP.	IND.	DEP.	IND.	DEP.		IND.	DEP.	IND.	DEP.	IND.	DEP.
1	1						51						
2		1					52						
3	1						53						
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46							96						
47							97						
48							98						
49							99						
50							100						
TOTAL IND.	3	⬇		⬇		⬇	TOTAL IND.		⬇		⬇		⬇
TOTAL DEP.	1	⬅		⬅		⬅	TOTAL DEP.		⬅		⬅		⬅
TOTAL CLAIMS	4						TOTAL CLAIMS						

* *MAY BE USED FOR ADDITIONAL CLAIMS OR ADMENDMENTS*

FORM PTO-2022 (1-99)

U.S.DEPARTMENT OF COMMERCE
Patent and Trademark Office

*U.S. GPO: 1999-443-533/69152

Thomson Innovation Patent Export, 2015-01-30 02:56:24 -0600

Table of Contents

1. US6853883B2 Method and means for reading the status of and controlling irrigation components

Family 1/1

6 record(s) per family, collapsed by 5 record(s)

Record 1/5 AU200151879A Method and means for reading the status of and controlling irrigation components

Publication Number: AU200151879A 20020808

Title: Method and means for reading the status of and controlling irrigation components

Title - DWPI: Remote control system for irrigation system, receives status information of irrigation components and ancillary equipments using remote user interface to perform suitable control

Priority Number: US2001778367A

Priority Date: 2001-02-07

Application Number: AU200151879D

Application Date: 2001-06-12

Publication Date: 2002-08-08

IPC Class Table:

IPC	Section	Class	Subclass	Class Group	Subgroup
G05B0019042	G	G05	G05B	G05B0019	G05B0019042

IPC Class Table - DWPI:

IPC - DWPI	Section - DWPI	Class - DWPI	Subclass - DWPI	Class Group - DWPI	Subgroup - DWPI
A01G002516	A	A01	A01G	A01G0025	A01G002516
B05B001212	B	B05	B05B	B05B0012	B05B001212
G05B001918	G	G05	G05B	G05B0019	G05B001918
G05D001100	G	G05	G05D	G05D0011	G05D001100
G05D000706	G	G05	G05D	G05D0007	G05D000706
G05D000700	G	G05	G05D	G05D0007	G05D000700
G08B000108	G	G08	G08B	G08B0001	G08B000108

Assignee/Applicant: VALMONT INDUSTRIES

JP F Terms:

JP FI Codes:

Assignee - Original:

Any CPC Table:

Type	Invention	Additional	Version	Office
Current	**G05B 19/0423**	G05B 2219/23051	20130101	EP
Current		G05B 2219/23178	20130101	EP
Current		G05B 2219/25187	20130101	EP
Current		G05B 2219/25196	20130101	EP
Current		G05B 2219/2625	20130101	EP

ECLA: G05B0019042N | S05B021923051 | S05B021923178 | S05B021925187 | S05B021925196 | S05B02192625

Abstract:

Language of Publication: EN

INPADOC Legal Status Table:

Gazette Date	Code	INPADOC Legal Status Impact
2004-04-22	MK1	-
Description: APPLICATION LAPSED SECTION 142(2)(A) - NO REQUEST FOR EXAMINATION IN RELEVANT PERIOD		

Post-Issuance (US):

Reassignment (US) Table:

Maintenance Status (US):

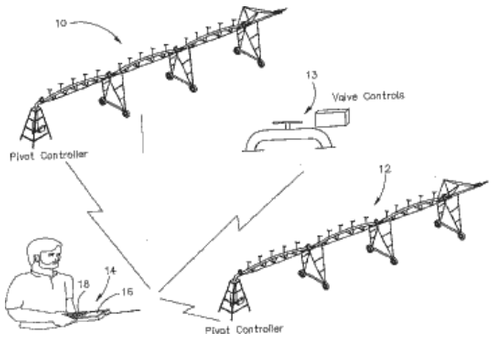
Litigation (US):

Opposition (EP):

License (EP):

EPO Procedural Status:

Front Page Drawing:


10
13
Valve Controls
Pivot Controller
12
14
18
16
Pivot Controller

Record 2/5 CN1367996A Method and device for judging state of irrigation component and controlling it | Method and device used for reading the irrigation component and controlling the state of air outlet

Publication Number: CN1367996A 20020911

Title: Method and device for judging state of irrigation component and controlling it | Method and device used for reading the irrigation component and controlling the state of air outlet
Title - DWPI: Remote control system for irrigation system, receives status information of irrigation components and ancillary equipments using remote user interface to perform suitable control
Priority Number: US2001778367A
Priority Date: 2001-02-07
Application Number: CN2001119747A
Application Date: 2001-05-25
Publication Date: 2002-09-11
IPC Class Table:

IPC	Section	Class	Subclass	Class Group	Subgroup
G05B0019042	G	G05	G05B	G05B0019	G05B0019042

IPC Class Table - DWPI:

IPC - DWPI	Section - DWPI	Class - DWPI	Subclass - DWPI	Class Group - DWPI	Subgroup - DWPI
A01G002516	A	A01	A01G	A01G0025	A01G002516
B05B001212	B	B05	B05B	B05B0012	B05B001212
G05B001918	G	G05	G05B	G05B0019	G05B001918
G05D001100	G	G05	G05D	G05D0011	G05D001100
G05D000706	G	G05	G05D	G05D0007	G05D000706
G05D000700	G	G05	G05D	G05D0007	G05D000700
G08B000108	G	G08	G08B	G08B0001	G08B000108

Assignee/Applicant: VALMONT IND CO LTD,US
JP F Terms:
JP FI Codes:
Assignee - Original: VALMONT IND CO LTD
Any CPC Table:

Type	Invention	Additional	Version	Office
Current Current	**G05B 19/0423**	G05B 2219/23051 G05B 2219/23178	20130101 20130101	EP EP

Current Current Current		G05B 2219/25187 G05B 2219/25196 G05B 2219/2625	20130101 20130101 20130101	EP EP EP

ECLA: G05B0019042N | S05B021923051 | S05B021923178 | S05B021925187 | S05B021925196 | S05B02192625

Abstract:

The invention claims a remote reading irrigation component and the state of the auxiliary device, and remote control of the said method and device. It provides a display and keyboard of handheld remote user interface (RUI). The RUI comprising using a built-in wireless telemetry technology with the irrigation component, and carry out control for the ability to target pore size production. The RUI capable of making user for judging irrigation element and the state of the auxiliary device from any position of the ground, and to control, without user on the irrigation component control device, or at the place a certain special position.

Language of Publication: ZH

INPADOC Legal Status Table:

Gazette Date	Code	INPADOC Legal Status Impact
2004-10-27	C02	-
Description: DEEMED WITHDRAWAL OF PATENT APPLICATION AFTER PUBLICATION (PATENT LAW 2001)		
2002-09-11	C06	+
Description: PUBLICATION		

Post-Issuance (US):

Reassignment (US) Table:

Maintenance Status (US):

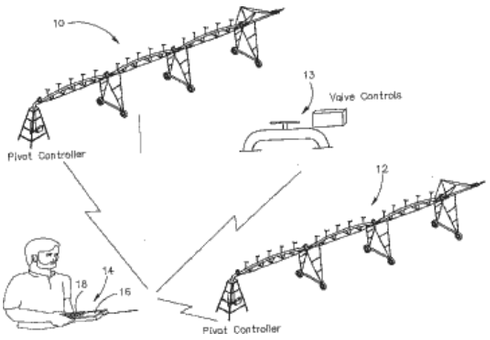
Litigation (US):

Opposition (EP):

License (EP):

EPO Procedural Status:

Front Page Drawing:



Record 3/5 BR200103882A Método e dispositivo para a leitura do estado e controle dos componentes de irrigação

Publication Number: BR200103882A 20021001

Title: Método e dispositivo para a leitura do estado e controle dos componentes de irrigação
Title - DWPI: Remote control system for irrigation system, receives status information of irrigation components and ancillary equipments using remote user interface to perform suitable control
Priority Number: US2001778367A
Priority Date: 2001-02-07
Application Number: BR20013882A
Application Date: 2001-06-18
Publication Date: 2002-10-01
IPC Class Table:

IPC	Section	Class	Subclass	Class Group	Subgroup
G05B0019042	G	G05	G05B	G05B0019	G05B0019042

IPC Class Table - DWPI:

IPC - DWPI	Section - DWPI	Class - DWPI	Subclass - DWPI	Class Group - DWPI	Subgroup - DWPI
A01G002516	A	A01	A01G	A01G0025	A01G002516
B05B001212	B	B05	B05B	B05B0012	B05B001212
G05B001918	G	G05	G05B	G05B0019	G05B001918
G05D001100	G	G05	G05D	G05D0011	G05D001100
G05D000706	G	G05	G05D	G05D0007	G05D000706
G05D000700	G	G05	G05D	G05D0007	G05D000700
G08B000108	G	G08	G08B	G08B0001	G08B000108

Assignee/Applicant: VALMONT INDUSTRIES
JP F Terms:
JP FI Codes:
Assignee - Original:
Any CPC Table:

Type	Invention	Additional	Version	Office
Current	**G05B 19/0423**	G05B 2219/23051	20130101	EP
Current		G05B 2219/23178	20130101	EP
Current		G05B 2219/25187	20130101	EP
Current		G05B 2219/25196	20130101	EP
Current		G05B 2219/2625	20130101	EP

ECLA: G05B0019042N | S05B021923051 | S05B021923178 | S05B021925187 | S05B021925196 | S05B02192625

Abstract:

Language of Publication: PT

INPADOC Legal Status Table:

Gazette Date	Code	INPADOC Legal Status Impact
2010-08-24	B08K	-
Description: LAPSE AS NO EVIDENCE OF PAYMENT OF THE ANNUAL FEE HAS BEEN FURNISHED TO INPI (ACC. ART. 87) REFERENTE AO DESPACHO 8.6 DA RPI 2008 DE 30/06/2009.		
2009-06-30	B08F	-
Description: APPLICATION FEES: DISMISSAL - ARTICLE 86 OF INDUSTRIAL PROPERTY LAW REFERENTE A 7A E 8A ANUIDADES.		

Post-Issuance (US):

Reassignment (US) Table:

Maintenance Status (US):

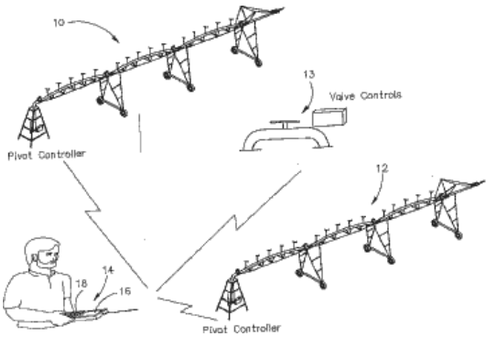
Litigation (US):

Opposition (EP):

License (EP):

EPO Procedural Status:

Front Page Drawing:



Record 4/5 US6853883B2 Method and means for reading the status of and controlling irrigation components

Publication Number: US6853883B2 20050208
US20020107586A1 20020808

Title: Method and means for reading the status of and controlling irrigation components
Title - DWPI: Remote control system for irrigation system, receives status information of irrigation components and ancillary equipments using remote user interface to perform suitable control
Priority Number: US2001778367A
Priority Date: 2001-02-07
Application Number: US2001778367A
Application Date: 2001-02-07
Publication Date: 2005-02-08
IPC Class Table:

IPC	Section	Class	Subclass	Class Group	Subgroup
G05B0019042	G	G05	G05B	G05B0019	G05B0019042

IPC Class Table - DWPI:

IPC - DWPI	Section - DWPI	Class - DWPI	Subclass - DWPI	Class Group - DWPI	Subgroup - DWPI
A01G002516	A	A01	A01G	A01G0025	A01G002516
B05B001212	B	B05	B05B	B05B0012	B05B001212
G05B001918	G	G05	G05B	G05B0019	G05B001918
G05D001100	G	G05	G05D	G05D0011	G05D001100
G05D000706	G	G05	G05D	G05D0007	G05D000706
G05D000700	G	G05	G05D	G05D0007	G05D000700
G08B000108	G	G08	G08B	G08B0001	G08B000108

Assignee/Applicant: Valmont Industries Inc.,Valley,NE
JP F Terms:
JP FI Codes:
Assignee - Original: Valmont Industries Inc.
Any CPC Table:

Type	Invention	Additional	Version	Office
Current	**G05B 19/0423**	G05B 2219/23051	20130101	EP
Current		G05B 2219/23178	20130101	EP
Current		G05B 2219/25187	20130101	EP

Current Current		G05B 2219/25196 G05B 2219/2625	20130101 20130101	EP EP

ECLA: G05B0019042N | S05B021923051 | S05B021923178 | S05B021925187 | S05B021925196 | S05B02192625

Abstract:

A method and means is disclosed for remotely reading the status of and controlling irrigation components and ancillary equipment. A handheld remote user interface (RUI) is provided which includes a display and a keypad. The RUI has the ability to communicate with and control the irrigation components using built-in wireless telemetry technology. The RUI allows the user to read the status of and control the irrigation components and ancillary equipment from any location in the field, without requiring the user to be at the irrigation component controls or at a specific location in the field.

Language of Publication: EN

INPADOC Legal Status Table:

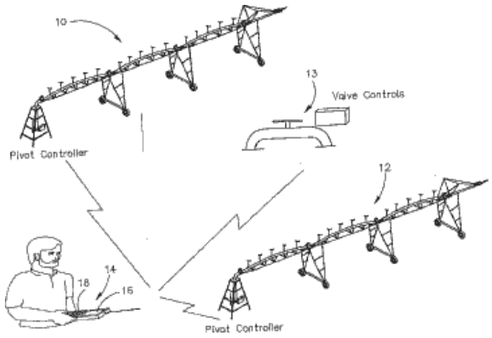
Gazette Date	Code	INPADOC Legal Status Impact
2012-08-08	FPAY	+
Description: FEE PAYMENT		
2008-06-30	FPAY	+
Description: FEE PAYMENT		
2001-04-16	AS	-
Description: ASSIGNMENT VALMONT INDUSTRIES, INC., NEBRASKA ASSIGNMENT OF ASSIGNORS INTEREST; ASSIGNORS:KREIKEMEIER, BRUCE; SCHULZ, MARV; MALSAM, CRAIG; AND OTHERS; REEL/FRAME:011717/0757 2001-01-30		

Post-Issuance (US):

Reassignment (US) Table:

Assignee	Assignor	Date Signed	Reel/Frame	Date
VALMONT INDUSTRIES INC.,VALLEY,NE,US	KREIKEMEIER, BRUCE	2001-01-30	011717/0757	2001-04-16
	SCHULZ, MARV	2001-01-30		
	MALSAM, CRAIG	2001-01-30		
	HAGET, HECTOR	2001-01-30		
Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).				
Corresponent: DENNIS L. THOMTE SUITE 1111, 2120 SO. 72ND ST. OMAHA, NE 68124				

Maintenance Status (US):
Litigation (US):
Opposition (EP):
License (EP):
EPO Procedural Status:
Front Page Drawing:



Record 5/5 US7003357B1 Method and means for reading the status of and controlling irrigation components

Publication Number: US7003357B1 20060221

Title: Method and means for reading the status of and controlling irrigation components
Title - DWPI: Remote user interface for irrigation equipment e.g. center pivot irrigation system, receives commands from user for controlling equipment through manipulation of graphical user interface containing status information on display
Priority Number: US2001778367A
Priority Date: 2001-02-07
Application Number: US2002187925A
Application Date: 2002-07-01
Publication Date: 2006-02-21
IPC Class Table:

IPC	Section	Class	Subclass	Class Group	Subgroup
G05B001101	G	G05	G05B	G05B0011	G05B001101
G05B0019042	G	G05	G05B	G05B0019	G05B0019042

IPC Class Table - DWPI:

IPC - DWPI	Section - DWPI	Class - DWPI	Subclass - DWPI	Class Group - DWPI	Subgroup - DWPI
G05B001101	G	G05	G05B	G05B0011	G05B001101

Assignee/Applicant: Valmont Industries Inc.,Valley,NE,US
JP F Terms:
JP FI Codes:
Assignee - Original: Valmont Industries Inc.
Any CPC Table:

Type	Invention	Additional	Version	Office
Current	**G05B 19/0423**	G05B 2219/23051	20130101	EP
Current		G05B 2219/23178	20130101	EP
Current		G05B 2219/25187	20130101	EP
Current		G05B 2219/25196	20130101	EP
Current		G05B 2219/2625	20130101	EP

ECLA: G05B0019042N | S05B021923051 | S05B021923178 | S05B021925187 | S05B021925196 | S05B02192625
Abstract:
A method and means is disclosed for remotely reading the status of and controlling irrigation

components and ancillary equipment. A handheld remote user interface (RUI) is provided which includes at least a display. The RUI has the ability to communicate with and control the irrigation components using built-in wireless telemetry technology. The RUI allows the user to read the status of and control the irrigation components and ancillary equipment from any location, without requiring the user to be at the irrigation component controls or at a specific location in the field. Software operational of the RUI generates one or more user screens with graphic user interfaces for quickly and easily monitoring and controlling the irrigation components and ancillary equipment.

Language of Publication: EN

INPADOC Legal Status Table:

Gazette Date	Code	INPADOC Legal Status Impact
2013-08-21	FPAY	+
Description: FEE PAYMENT		
2009-07-12	FPAY	+
Description: FEE PAYMENT		
2002-09-03	AS	-
Description: ASSIGNMENT VALMONT INDUSTRIES, INC., NEBRASKA ASSIGNMENT OF ASSIGNORS INTEREST; ASSIGNORS:KREIKEMEIER, BRUCE; SCHULZ, MARV; MALSAM, CRAIG; REEL/FRAME:013246/0338 2002-06-27		

Post-Issuance (US):

Reassignment (US) Table:

Assignee	Assignor	Date Signed	Reel/Frame	Date
VALMONT INDUSTRIES INC.,VALLEY,NE,US	KREIKEMEIER, BRUCE	2002-06-27	013246/0338	2002-09-03
	SCHULZ, MARV	2002-06-27		
	MALSAM, CRAIG	2002-06-27		
Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).				
Corresponent: SHANE M. NIEBERGALL 2120 S. 72ND ST., SUITE 1111 OMAHA, NE 68124				

Maintenance Status (US):

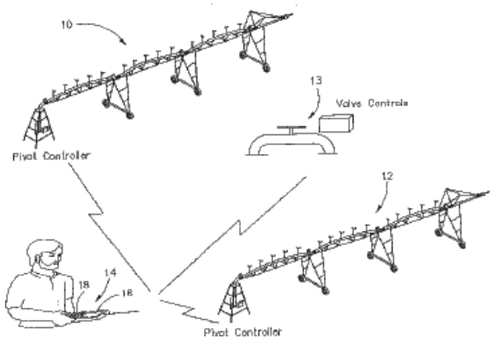
Litigation (US): 2015-01-14 2015 Valmont Industries Inc. Lindsay Corporation Delaware 1:15cv00042

Opposition (EP):

License (EP):

EPO Procedural Status:

Front Page Drawing:



USPTO Maintenance Report					
Patent Bibliographic Data			01/30/2015 12:22 AM		
Patent Number:	6853883		Application Number:	09778367	
Issue Date:	02/08/2005		Filing Date:	02/07/2001	
Title:	METHOD AND MEANS FOR READING THE STATUS OF AND CONTROLLING IRRIGATION COMPONENTS				
Status:	12th year fee window opens: 02/08/2016			Entity:	LARGE
Window Opens:	N/A	Surcharge Date:	N/A	Expiration:	02/08/2013
Fee Amt Due:	Window not open	Surchg Amt Due:	Window not open	Total Amt Due:	Window not open
Fee Code:					
Surcharge Fee Code:					
Most recent events (up to 7):	08/08/2012 06/30/2008	Payment of Maintenance Fee, 8th Year, Large Entity. Payment of Maintenance Fee, 4th Year, Large Entity. --- End of Maintenance History ---			
Address for fee purposes:	THOMTE LAW OFFICE, L.L.C. 2120 S. 72ND STREET, SUITE 1111 OMAHA NE 68124				

United States Patent [19]

Barash et al.

[11] **4,209,131**

[45] **Jun. 24, 1980**

[54] **COMPUTER-CONTROLLED IRRIGATION SYSTEM**

[75] Inventors: **Sorin Barash**, Petach-Tikva; **Yigal Brandman**, Ramat-Hasharon; **Yitzhak Cohen**, Yahud; **Shaul Shporn**, Doar Petach-Tikva; **Joseph Vishnipolsky**, Netanya; **Elisha Yanai**, Giv'at Shmuel, all of Israel

[73] Assignee: **Motorola, Inc.**, Schaumburg, Ill.

[21] Appl. No.: **905,303**

[22] Filed: **May 12, 1978**

[51] **Int. Cl.**[2] **B05B 12/04**

[52] **U.S. Cl.** **239/68**; 239/69; 137/624.2

[58] **Field of Search** 239/63, 64, 66–72, 239/74; 137/624.18, 624.2; 222/14

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,529,618	9/1970	Rinkewich	239/68 X
3,843,056	10/1974	Nye	239/68 X
3,964,685	6/1976	Chauvigne	239/68 X
4,015,366	4/1977	Hall	239/69

FOREIGN PATENT DOCUMENTS

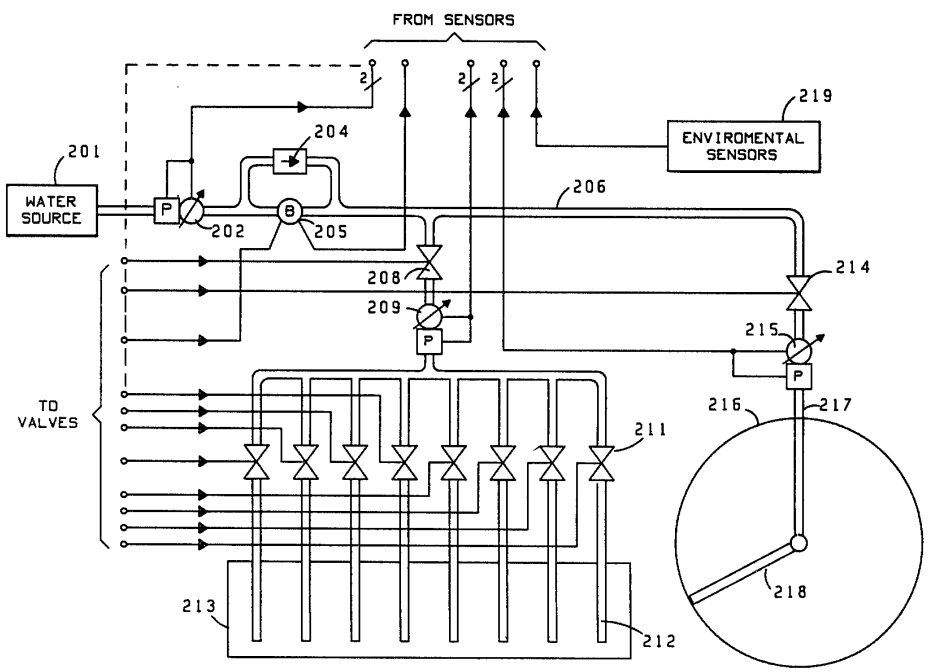
868990	1/1953	Fed. Rep. of Germany	239/74

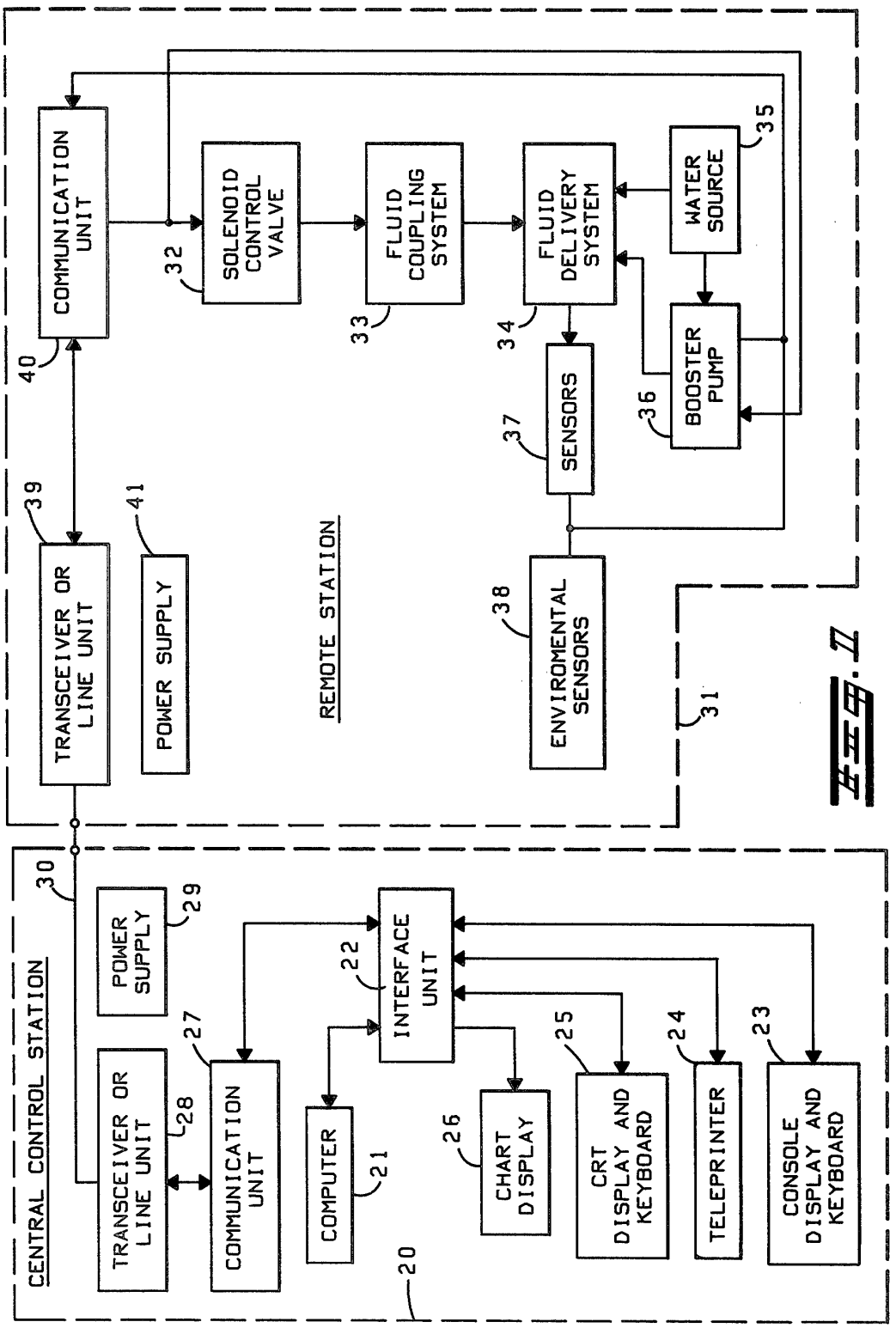
Primary Examiner—Robert W. Saifer
Attorney, Agent, or Firm—Rolland R. Hackbart; James W. Gillman

[57] **ABSTRACT**

A irrigation system for automatically irrigating an agricultural area having a plurality of fields for producing various crops includes a central station and a plurality of remote stations located in the fields. A computer with associated peripherals in the central station is loaded with an irrigation program defining a predetermined schedule for delivery of pre-established quantities of water to each field, the delivery of water can further be dependent on environmental conditions such as wind speed, temperature, humidity, and other factors. The computer via a communication path, such as a radio channel or three-wire circuit, sends coded command messages to selected remote stations for activating valves and pumps for delivering the pre-established quantities of water to the respective fields and continuously interrogates the remote stations for flow meter, water-pressure meter, environmental conditions and alarm information to diagnose proper operation and to monitor the delivery of water. The irrigation system can equally well control solid-set, pivot sprinklers, or any other suitable sprinkler systems.

30 Claims, 12 Drawing Figures




COMMUNICATION UNIT
SOLENOID CONTROL VALVE
FLUID COUPLING SYSTEM
FLUID DELIVERY SYSTEM
WATER SOURCE
BOOSTER PUMP
SENSORS
ENVIROMENTAL SENSORS
TRANSCEIVER OR LINE UNIT
POWER SUPPLY
REMOTE STATION
CENTRAL CONTROL STATION
INTERFACE UNIT
COMPUTER
CHART DISPLAY
CRT DISPLAY AND KEYBOARD
TELEPRINTER
CONSOLE DISPLAY AND KEYBOARD
COMMUNICATION UNIT
TRANSCEIVER OR LINE UNIT
POWER SUPPLY
20
21
22
23
24
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27
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30
31
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33
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39
40
41

Fig. 1

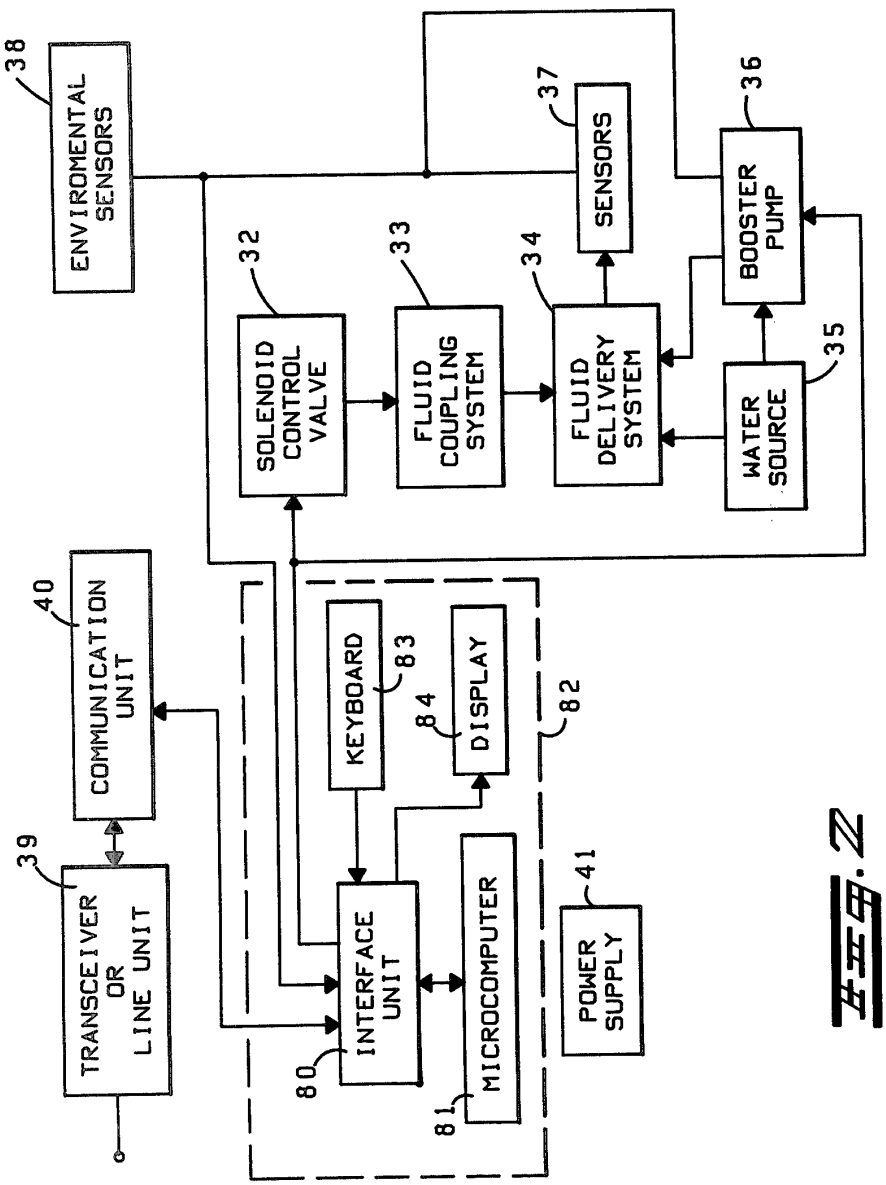
38
ENVIROMENTAL SENSORS
37
SENSORS
36
BOOSTER PUMP
32
SOLENOID CONTROL VALVE
33
FLUID COUPLING SYSTEM
34
FLUID DELIVERY SYSTEM
35
WATER SOURCE
40
COMMUNICATION UNIT
KEYBOARD
83
84
DISPLAY
82
39
TRANSCEIVER OR LINE UNIT
INTERFACE UNIT
80
MICROCOMPUTER
81
41
POWER SUPPLY

FIG. 2

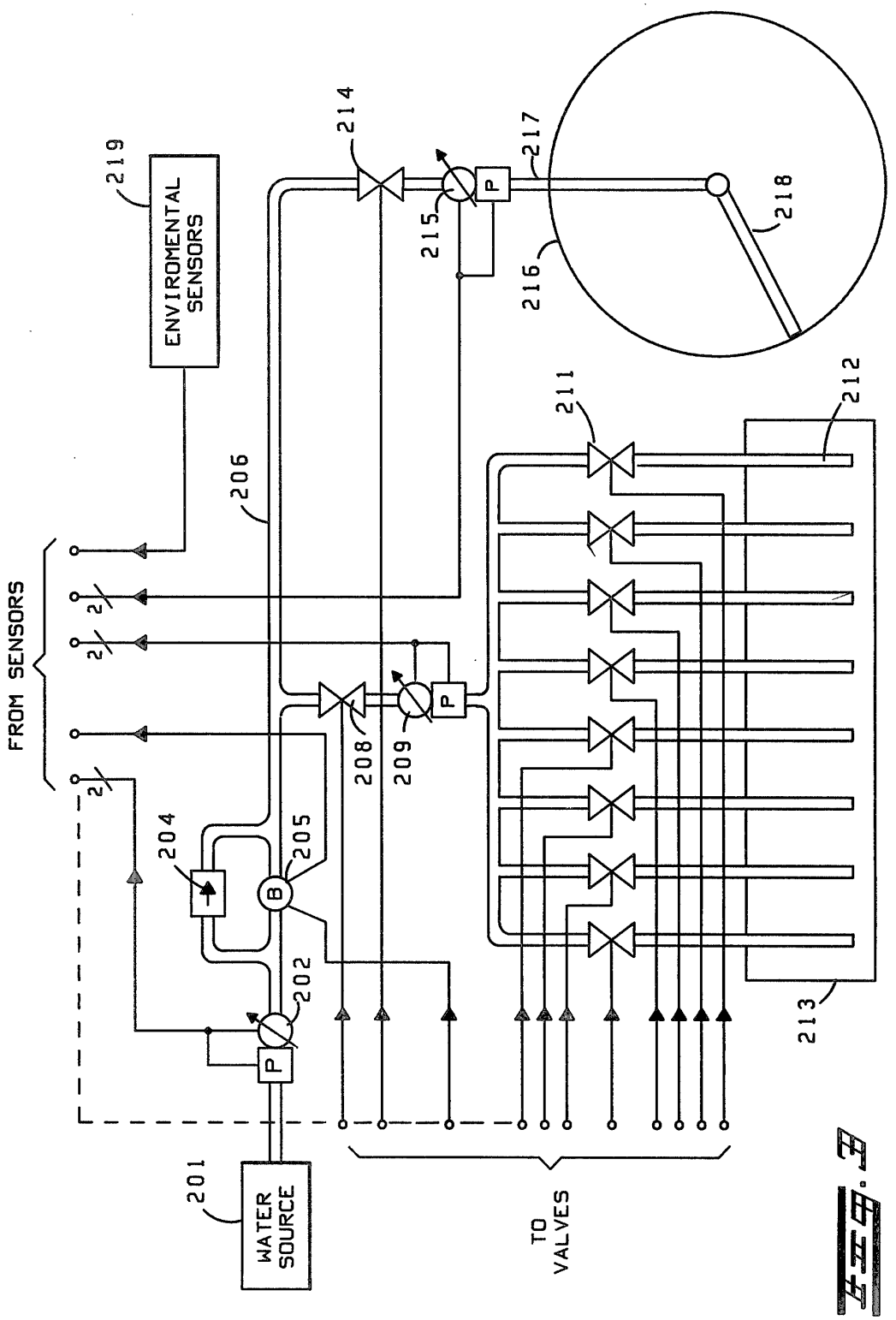
ENVIROMENTAL SENSORS
219
214
217
218
215
216
211
212
206
FROM SENSORS
208
209
204
205
202
213
201
WATER SOURCE
TO VALVES
P
B

Fig. 3

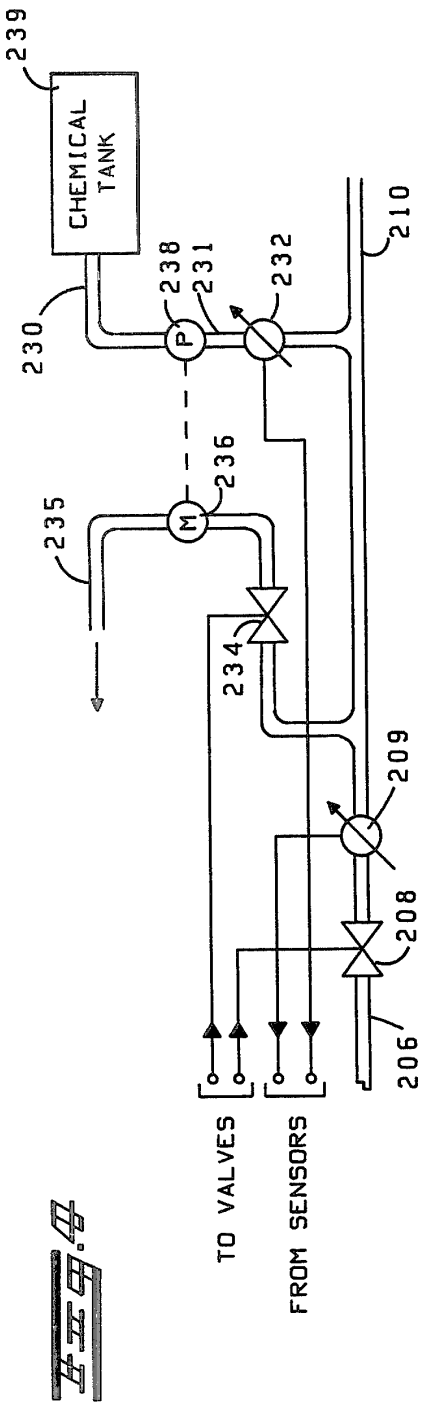
239
CHEMICAL TANK
230
238
231
232
210
P
235
236
M
234
209
208
206
TO VALVES
FROM SENSORS

Fig. 4

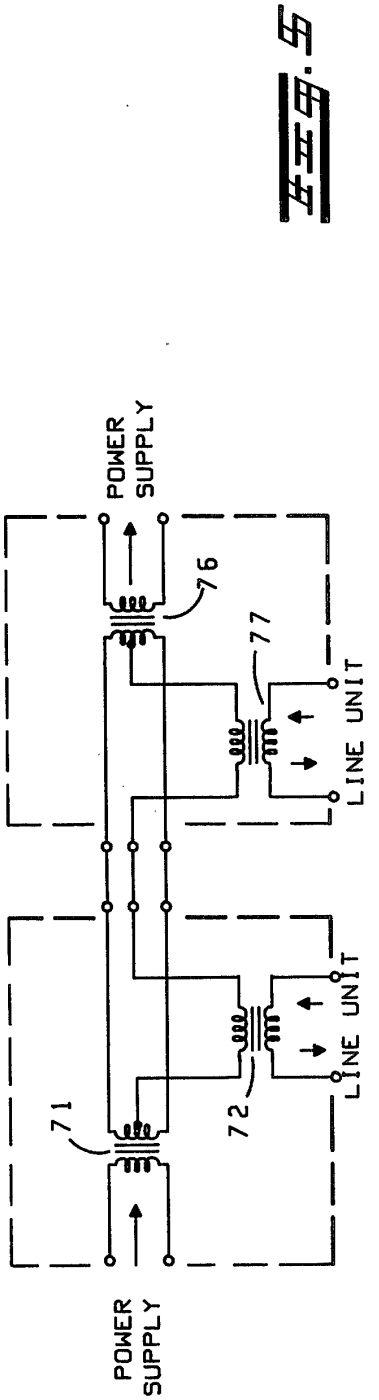
POWER SUPPLY
76
77
LINE UNIT
71
72
LINE UNIT
POWER SUPPLY

Fig. 5

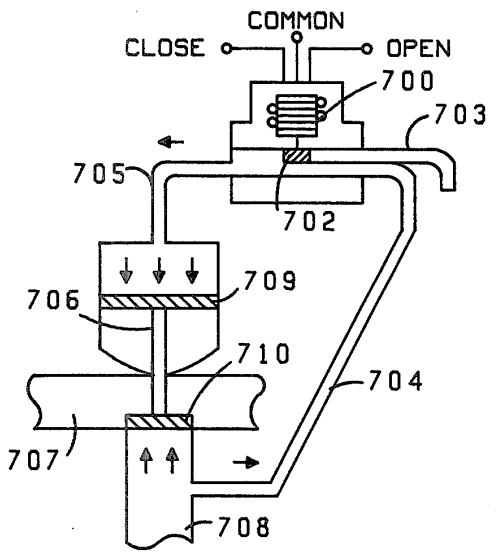

Fig. 6

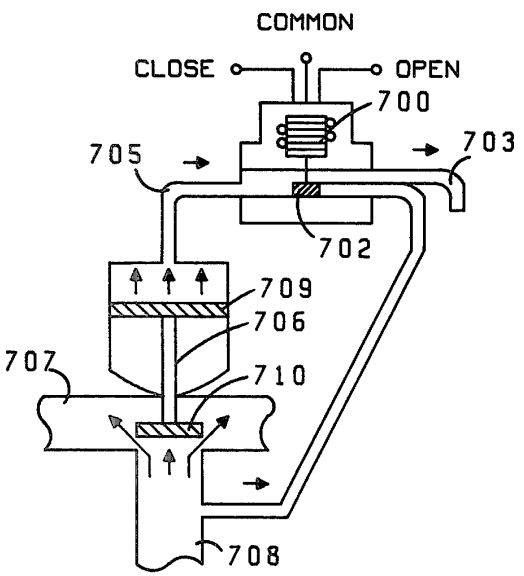

Fig. 7

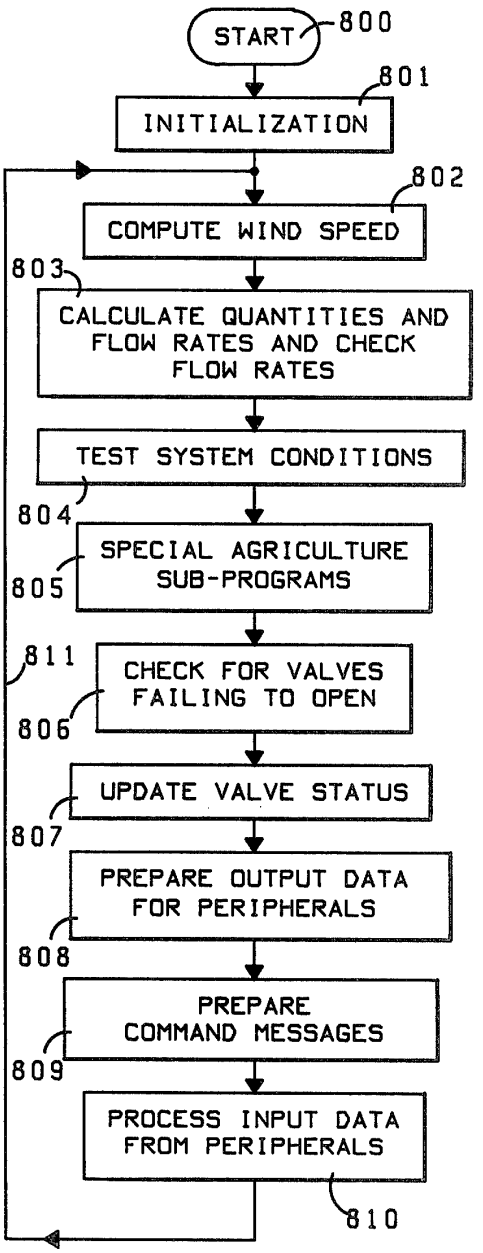

Fig. 8

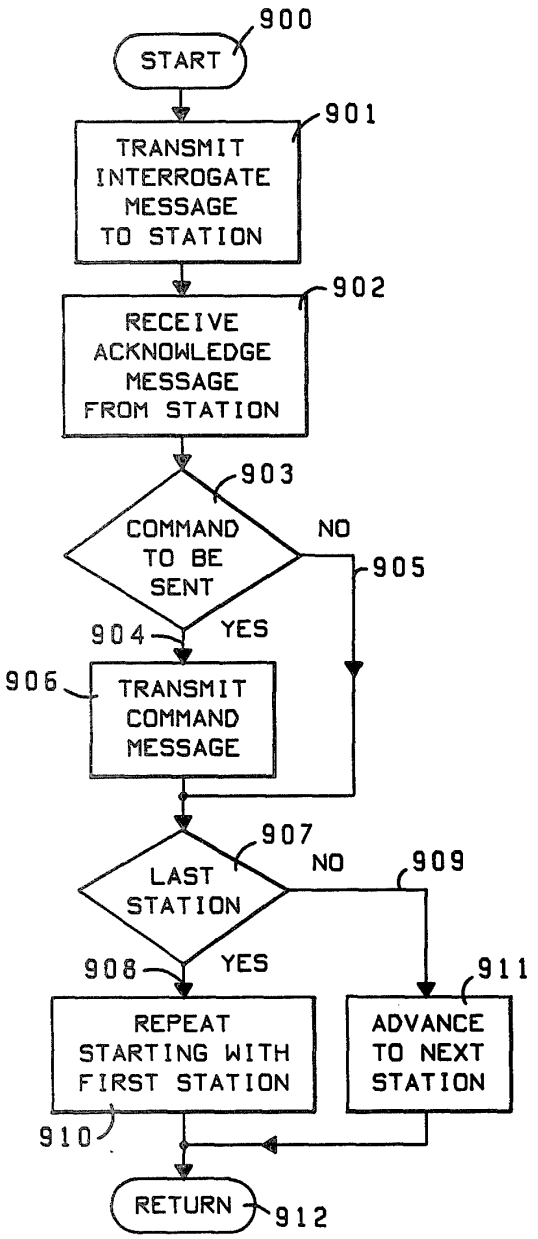
900
START
901
TRANSMIT INTERROGATE MESSAGE TO STATION
902
RECEIVE ACKNOWLEDGE MESSAGE FROM STATION
903
COMMAND TO BE SENT
NO
905
YES
904
906
TRANSMIT COMMAND MESSAGE
907
LAST STATION
NO
909
YES
908
911
REPEAT STARTING WITH FIRST STATION
ADVANCE TO NEXT STATION
910
RETURN
912

Fig. 9

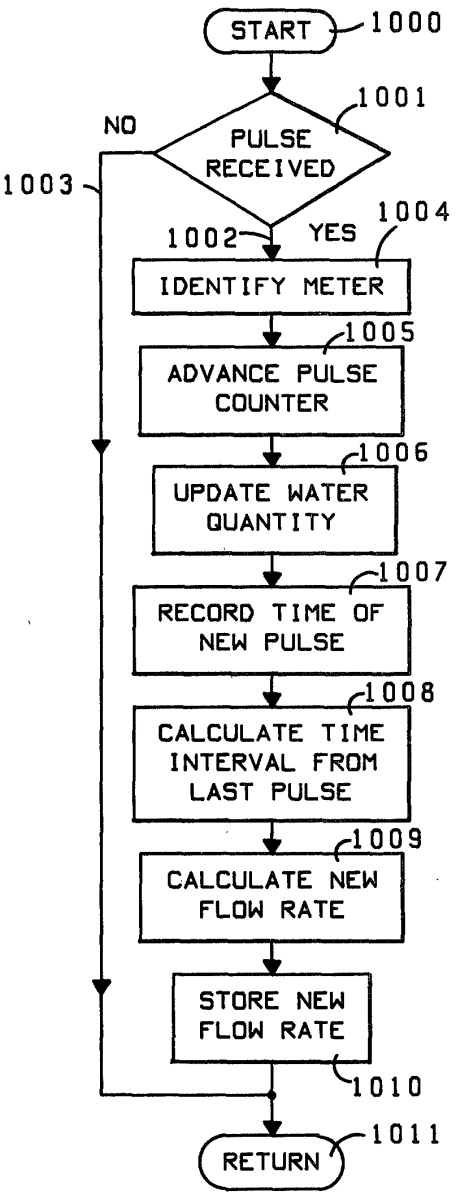
START
1000
1001
PULSE RECEIVED
NO
1003
1002
YES
1004
IDENTIFY METER
1005
ADVANCE PULSE COUNTER
1006
UPDATE WATER QUANTITY
1007
RECORD TIME OF NEW PULSE
1008
CALCULATE TIME INTERVAL FROM LAST PULSE
1009
CALCULATE NEW FLOW RATE
STORE NEW FLOW RATE
1010
RETURN
1011

Fig. 10

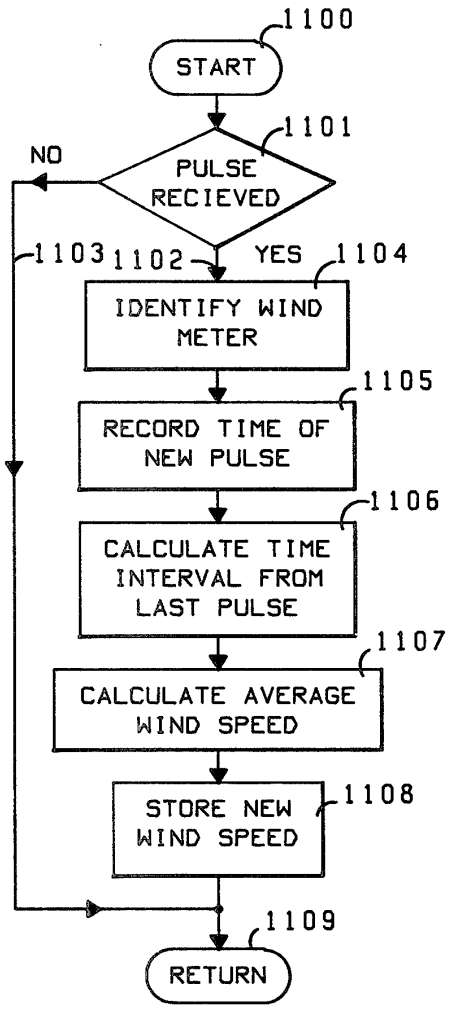
1100
START
1101
PULSE RECIEVED
NO
1103
1102
YES
1104
IDENTIFY WIND METER
1105
RECORD TIME OF NEW PULSE
1106
CALCULATE TIME INTERVAL FROM LAST PULSE
1107
CALCULATE AVERAGE WIND SPEED
1108
STORE NEW WIND SPEED
1109
RETURN

Fig. 11

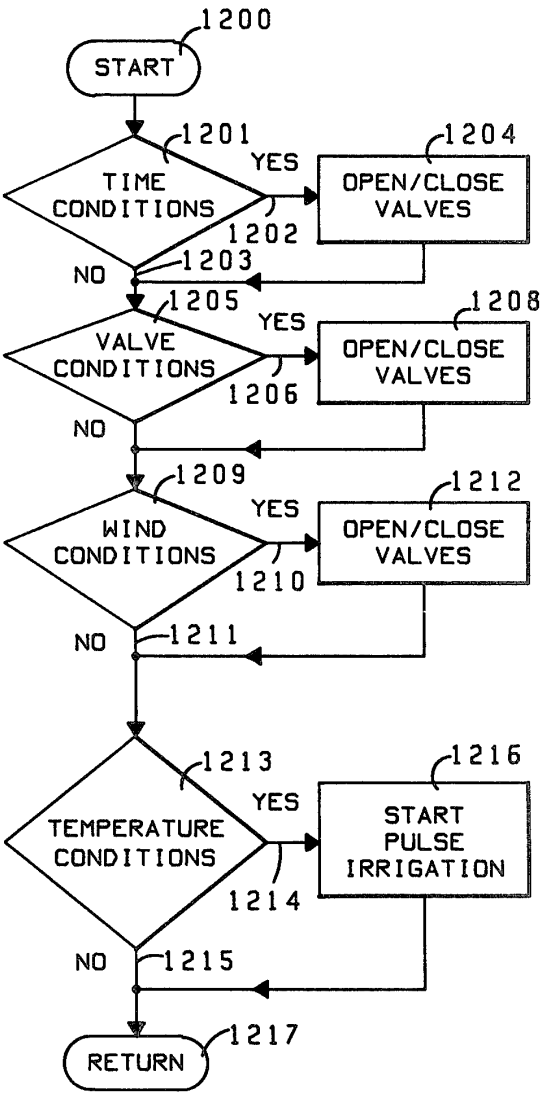
1200
START
1201
TIME CONDITIONS
YES
1202
1204
OPEN/CLOSE VALVES
NO
1203
1205
VALVE CONDITIONS
YES
1206
1208
OPEN/CLOSE VALVES
NO
1209
WIND CONDITIONS
YES
1210
1212
OPEN/CLOSE VALVES
NO
1211
1213
TEMPERATURE CONDITIONS
YES
1214
1216
START PULSE IRRIGATION
NO
1215
1217
RETURN

Fig. 12

COMPUTER-CONTROLLED IRRIGATION SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an irrigation system for an agricultural area, and more particularly, to an improved computer-controlled irrigation system.

2. Description of the Prior Art

In prior-art automatic irrigation systems, an agricultural area is irrigated, for example, once a week for a predetermined time interval. Operating in an open-loop mode does not insure that an exact quantity of water has been delivered to the agricultural area. The same would be true for the distribution of chemicals to the agricultural area in an open loop system.

Other automatic irrigation systems have sensed the moisture level in the soil of the agricultural area and irrigated whenever necessary to maintain a predetermined moisture level in the soil. However, these systems have no way of determining or adequately controlling the quantity of water delivered to the agricultural area and therefore cannot provide the capability of conserving limited water resources. In addition, such a system may fail to provide an adequate amount of water since the moisture level of the soil may be sampled at a place that is not representative of the entire agricultural area. In short, the prior-art automatic irrigation systems do not provide an accounting of the exact amount of water and chemicals that have been distributed. Without the aforementioned accounting, there is no way to determine the history of the irrigation system, or to factor in the availability of water resources.

For the foregoing and other shortcomings and problems, there has been a long felt need for an improved computercontrolled irrigation system.

SUMMARY OF THE INVENTION

It is a general object of the present invention to provide an improved computer-controlled irrigation system that automatically distributes a pre-established quantity of water to an agricultural area.

It is a further object of the present invention to provide an improved computer-controlled irrigation system that automatically controls the irrigation operation to prevent damage to an agricultural area from extreme environmental conditions.

It is a still further object of the present invention to provide an improved computer-controlled irrigation system that automatically diagnoses breaks in the water distributing apparatus to prevent resultant water losses.

It is a still further object of the present invention to provide an improved computer-controlled irrigation system that dynamically optimizes the irrigation operation in response to the ambient environmental conditions in the agricultural area.

It is a still further object of the present invention to provide an improved computer-controlled irrigation system that can be modularly expanded to accommodate additional fields in the agricultural area.

It is yet a further object of the present invention to provide an improved computer-controlled irrigation system that can cycle the irrigation operation to provide a pulse irrigation mode in which the irrigation operation in the fields of the agricultural area is repeated at relatively short time intervals.

In accordance with the present invention, the aforementioned problens and shortcomings of the prior art are overcome and the stated and other objects are attained by an improved system for irrigating an agricultural area that includes means for distributing water to the agricultural area from a water source, main valve means for controlling the flow of water from the water source to the distributing means, main metering means for measuring the quantity of water flowing from the main valve means to the distributing means, and automatic control means for controlling the opening and closing of the main valve means. The automatic control means opens the main valve means to allow water to flow from the water source to the distributing means and closes the main valve means when the distributed quantity of water measured by the main metering means is substantially the same as a pre-established quantity of water for the agricultural area. The operation of the main valve means can be scheduled over a period of time, for example the growing period of a particular crop, to deliver a totalized quantity of water sufficient for production in the agricultural area and also in accordance with the availability of water from the water source. The totalized quantity of water delivered is obtained by totalizing the pre-established quantities of water for each operation of the main valve means.

According to another feature of the present invention, an improved system for irrigating an agricultural area having a plurality of agricultural fields for producing different kinds of crops is provided that includes communication means; a plurality of remote stations, each remote station having control means for receiving via the communication means start and stop messages for controlling the distribution of water from a water source to at least one of the fields, receiving via the communication means interrogate messages, and sending via the communication means in response to each received interrogate message a status message representing the quantity of water that has been distributed since the previously received interrogate message; and a central control station having control means for sending via the communication means the start message to enable selected ones of the remote stations to start distributing water continuously, sending via the communication means the interrogate message for successively enabling selected ones of the remote stations to send the status message, receiving via the communication means the status messages from the selected remote stations, totallizing the distributed quantity of water for each of the selected remote stations as indicated by the corresponding received status messages, and sending via the communication means the stop message to enable ones of the selected remote stations to stop distributing water when the totallized quantity of water distributed by each selected remote station is substantially the same as a preestablished quantity of water for the particular selected remote station. The functions of the control means of the central control station can be provided by a computer or microcompuer having a stored program including a plurality of sub-programs for enabling the computer to provide the various functions and features.

Additional features, objects and advantages of the computer-controlled irrigation system in accordance with the present invention will be more clearly apprehended from the following detailed description together with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a functional black diagram of a computercontrolled irrigation system embodying the present invention.

FIG. 2 shows a functional block diagram of a computercontrolled remote station.

FIG. 3 shows a block diagram of a water distributing system for a remote station.

FIG. 4 shows a block diagram of a chemical distributing system for a remote station.

FIG. 5 shows a circuit diagram of the three-wire circuit between the lihne unit of the central station and the line unit of the remote station of FIG. 1.

FIGS. 6 and 7 show the open and closed conditions, respectively, of the solenoid-activated hydraulic valve in the remote station of FIG. 1.

FIG. 8 is a flow chart of the main irrigation program for the computer of the central control station in FIG. 1.

FIG. 9 is a flow chart of the communication program for the computer of the central control station in FIG. 1.

FIG. 10 is a flow chart of the flow rate sub-program for the computer of the central control station of FIG. 1.

FIG. 11 is a flow chart of the wind speed sub-program for the computer of the central control station of FIG. 1.

FIG. 12 is a flow chart of the field conditions subprogram for the computer of the central control station of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a computer-controlled irrigation system embodying the present invention is shown that includes a central control station 20 and a plurality of remote stations 31. The computer-controlled irrigation system provides for the irrigation of an agricultural area including a plurality of fields for producing various crops. The central control station 20 is coupled to the various remote stations 31 by means of communication path 30. The communication path 30 may be a duplex radio channel or a wire line and provides for communication of coded messages between the central control station 20 and the remote station 31. The central control station 20 controls and monitors the irrigation operation in the various remote station 31 by means of coded messages via the communications path 30. The central control station 20 utilizes the feed-back information provided from the remote stations 31 to insure that the irrigation operation delivers pre-established quantities of water to each of the various fields.

The central control station 20 includes a computer or microcomputer 21 having a stored program for controlling the irrigation operation of the various remote stations 31. The computer 21 may be any of a number of commercially available computers or microcomputers such as the Motorola M6800 microcomputer system, which is described in the publication, "M6800 Microcomputer System Design Data," by Motorola, Inc., 1976 and in U.S. Pat. No. 4,030,079 entitled "Processor Including Incrementor and Program Register Structure," by Thomas H. Bennett et al, filed on June 14, 1977 and assigned to Motorola, Inc.

The computer 21 is coupled by interface unit 22 to communication unit 27 and the various peripheral units, the chart display 26, the CRT display and keyboard 25, the teleprinter 24, and the console display and keyboard 23. The console display and keyboard 23 includes a digital display and a keyboard for entering or modifying parameters stored in the computer 21. The digital display of the console display and keyboard 23 provides a visual display of parameters entered into or read out of the computer 21. The teleprinter 24 provides for the printing out of both status and alarm messages from the computer 21. The teleprinter 24 can also be utilized for loading the stored program in the computer 21. The CRT display and keyboard 25 can be alternately used to replace the console display and keyboard 23. The chart display 26 provides a scaled geographical representation of the agricultural area detailing the particular lay-out of the irrigation system. The lay-out includes, for example, the various remote stations and the associated water pipes and valves located in the corresponding fields. In addition, the lay-out includes visual indicators for showing which valves are currently opened or closed and the status of the irrigation operation for the particular valves. For example, four indicator lights may be provided for each valve, a yellow light indicating that the valve is standing by for its turn in a currently running irrigation program, a first green light indicating that the valve is open and water is flowing through the valve, a second green light indicating that operation of the valve is complete, and a red light indicating a failure of the valve.

The communication unit 27 receives data from the computer 21 by way of the interface unit 22 and codes the data for transmission over the communication path 30. In the preferred embodiment, the communication unit 27 is a frequency-shift-keying (FSK) transmitter and receiver. Messages are coded into 32 bit data words by the communication unit 27 and applied to the transceiver or wire line unit 28 for transmission over the communication path 30. The communication unit 27 and transceiver or line unit 28 may be provided by apparatus similar to that described in co-pending application Ser. No. 807,850 by Cohen et al, entitled "Supervisory Control System", filed on June 20, 1977 and assigned to the instant assignee, which has subsequently matured into U.S. Pat. No. 4,161,718. The communication unit 27 transmits command messages from the computer 21 and receives status messages from the remote stations 31.

The communication path 30 may be either a duplex radio channel or a wire line circuit. The transmission of data over the communication path 30 is more fully described in the above referenced application Ser. No. 807,850 by Cohen et al. If a wire line is used, all the remote stations 31 are connected in parallel to a three-wire circuit as further illustrated in FIG. 5. The three-wire circuit couples AC power to the remote stations 31 in addition to the FSK coded messages. The transceiver or line unit 28 and power supply 29 are coupled to the three-wire circuit in the central control station 20 and the transceiver or line unit 39 and power supply 41 are coupled to the three-wire circuit 30 in the remote station 31.

Referring to FIG. 5, the three-wire circuit 30 is more clearly shown where transformer 71 is coupled to power supply 29 and transformer 72 is coupled to line unit 28, transformer 76 is coupled to power supply 41 and transformer 77 is coupled to line unit 39. The FSK messages introduced through transformers 72 and 77 are longitudinally balanced with respect to transformers

71 and 76. The longitudinal balance is achieved by coupling one side of transformers 72 and 77 to the center tap of transformers 71 and 76, respectively. Longitudinal balance insures that the AC power carried by the three-wire circuit does not interfere with the transmission of FSK messages between the central control station 20 and remote station 31.

Referring back to FIG. 1, the remote station 31 controls the irrigation for and is located in or near one or more adjacent fields. The transceiver or line unit 39 receives command messages from the central control station 20 via the communication path 30. If communication path 30 is a three-wire circuit, AC power is also received from the three-wire circuit. In systems which include a transceiver in 28 and 29 of FIG. 1 instead of a line unit, the power to the remote station is obtained from a local source, such as, for example, local AC means or batteries. The command messages are coupled by transceiver or line unit 39 to communication unit 40 for decoding. The communication unit 40 decodes the command messages and appropriately activates solenoid-controlled hydraulic valves 32 or the booster pump 36.

The solenoid-controlled hydraulic valves 32 are connected to the fluid delivery system 34 by means of a fluid coupling system 33. The fluid delivery system 34 distributes water from the water source 35 to the particular field or fields. The booster pump 36 may be enabled if the water pressure from the water source 35 is inadequate for proper distribution of the water by the fluid delivery system 34.

The fluid delivery system 34 includes water pipes, valves and sprinklers for distribution of water over the particular fields. Sensors 37 are coupled to the fluid delivery system 34 for measuring the water pressure from the water source 35 and for measuring the flow of water in the various valves. Outputs from the sensors 37, the environmental sensors 38 and the booster pump 36 are coupled to the communication unit 40 for transmission in status messages to the central control station 20.

Referring to FIG. 2, the remote station may be provided with a microcomputer 81 having a stored program for controlling the irrigation of an agricultural area having a plurality of fields. Command messages are coupled from the communication unit 40 to the microcomputer 81 by the interface unit 80. The microcomputer 81 is responsive to the command messages from the central control station for controlling the irrigation of the respective fields. The microcomputer 81 activates the solenoid-controlled hydraulic valves 32 and the booster pump 36 by way of the interface unit 80. Outputs from the environmental sensors 38, the fluid delivery sensors 37 and the booster pump 36 are coupled to the microcomputer 81 by the interface unit 80. The microcompuer 81 reports the outputs from the sensors and the status of the irrigation of the operation by way of the interface unit 80 to the communication unit 40 for transmission to the central control station 20. The microcomputer 81 may also be associated peripheral units, a keyboard 83 and a display 84. The keyboard 83 may be used to enter parameters into the microcompuer 81 relating to the irrigation operation. The display 84 provides for an indication of the status of the irrigation operation in the agricultural area.

Referring, to FIG. 3, the water distributing system for a remote station controlling the irrigation of two fields is shown. One field 213 is irrigated by solid-set sprinkler system, while the other 216 is irrigated by a pivot sprinkler system. A solid-set sprinkler stream may be any of a number of pressurized systems including drip, gum, tow-line, handmove and traveller systems. For example, a solid-set sprinkler system may include eight water pipes 212 are having sprinklers spaced along them. A pivot sprinkler system consists essentially of a radial pipe 218 having sprinklers spaced along it radial pipe 218 being mounted wheels and driven such that it may rotate through a full 360°. Pivot and solid-set sprinkler systems are typically utilized to irrigate a field which covers 160 acres or one-quarter of a section. An irrigation system in accordance with the present invention may be configured to control a plurality of fields of which some have solid-set sprinkler systems and others have pivot sprinkler systems.

Water source 21 is coupled by a pipe to pressure, which are actually separate devices, and flow meters 202. Pressure meter and flow meters 202 provides an indication of the water pressure and also provides an output pulse for each predetermined quantity of water, for example, 10 gallons, that flows pass the meter. The pressure and flow meters 202 are coupled by pipes to booster pump 205 and to a unidirectional valve 204. The booster pump 205 is activated in response to an indication from pressure and flow meters 202 that the water pressure is less than a predetermined water pressure. Otherwise, water flows by way of uni-directional valve 204 to a main water pipe 206.

Water from the water source 201 is carried by a main water pipe 206 to main valves 208 and 214. Main valves 208 feeds the solid-set sprinkler system of field 213, while main valve 214 feeds the pivot sprinkler system of field 216. Main valves 208 and 214 are coupled to pressure and flow meters 209 and 215, respectively.

Main valve 208 is coupled to a number of secondary water pipes 212 which each have a secondary valve 211. After the main valve 208 is opened, water may be directed to the secondary water pipes individually by opening the corresponding secondary valve or may be directed to groups of secondary water pipes 212 or to all of the secondary water pipes 212. Although not necessary for the operation of the irrigation system, additional pressure and flow meters may be provided in each of the secondary water pipes 212 following the corresponding secondary valves 211.

Main valve 214 is coupled to a secondary pipe 217 for providing water to the radial pipe 218 of the pivot sprinkler system of field 216.

The pressure and flow meters 202, 209 and 215 provide separate outputs for the sensed pressure and the sensed quantity of water flowing past the meters. For example, a pressure output may be provided by a pressure sensor that closes or opens a relay contact in response to water pressure that exceeds a predetermined pressure. Suitable pressure sensors of this type are commercially available from a number of sources. Another type of pressure sensor may be utilized that provides an output voltage which is directly proportional to the water pressure. A suitable converter may be provided that converts the output voltage of the pressure sensor to a pulse train, whose frequency is directly proportional to the output voltage. The pulse train is further coupled to the coil of a relay to enable the momentary closing of the relay contacts in response to each pulse of the pulse train.

The pressure and flow meters 202, 209 and 215 also provide an indication of the quantity of water flowing

past the meters. A momentary pulse for each predetermined quantity of water that flows through the pressure and flow meter is provided by converting each full rotation of a water quantity meter into a single pulse. This can be accomplished by attaching a radial arm to the shaft of the water quantity meter. A magnet is placed at the end of the radial arm, and a pair of reed contacts are fixedly attached to the water quantity meter such that each time the radial arm is aligned with the reed contacts, the reed contacts close momentarily. Thus each rotation of the shaft is converted into a momentary closing of the reed contacts when the radial arm passes over the read relay. Also, each momentary closing of the reed contacts corresponds to one complete revolution of the water quantity meter indicating that a predetermined quantity of water, for example, **10** gallons, has flowed past the meter.

The momentary closings of the reed contacts from the pressure, and flow meter are coupled to the communication unit **40** (see FIG. **1**) of the remote station **41** for transmission to the central control station **20**. In addition, environmental sensors **219**, which likewise may provide closings of relay contacts in response to pre-established environmental conditions, are coupled to the communication unit **40** (see FIG. **1**) for transmission to the central control station **20**. For example, an environmental sensor **219** for sensing a predetermined minimum temperature may provide the closing of relay contacts when the ambient temperature and the agricultural area is less than the predetermined minimum temperature.

Referring to FIGS. **6** and **7**, a solenoid-controlled hydraulic valve is shown in the closed condition in FIG. **6** and the open condition in FIG. **7**. The control of such a valve which may be remotely located in the agricultural area requires a substantial amount of power. The piston **706** which opens to allow water to flow from water pipe **708** to water pipe **707** is relatively heavy and must work against hydro-static pressures of several atmospheres. The solenoidcontrolled hydraulic valve utilizes the water pressures of the water distributing system to operate the piston **706**. The use of hydraulic valves and remote control interconnected to the hydraulic valves by water hoses not only conserves electricity but also provides more reliable operation.

For the closed condition of FIG. **6**, water from water pipe **708** is coupled by hose **704** through solenoid valve **700** to hose **705** and exerts pressure on the top surface **709** of piston **706**. Since the area of the top surface **809** of the piston **706** is greater than the area of the bottom surface **710**, a greater force is applied to the top surface **709** that the bottom surface **710** causing the piston **706** to close water pipe **708**.

Referring to FIG. **7**, the open condition is provided by applying an open-pulse to solenoid valve **700** which causes piston **702** to block hose **704**. When hose **704** is blocked, a force is no longer applied to top surface **709** of piston **706**. The force on the bottom surface **710** causes the piston **706** to open the water pipe **708** to allow water to flow to water pipe **707**. The top surface **709** of piston **706** causes water to be expelled through hose **705** and solenoid valve **700** to hose **703**. The piston **706** may be returned to the closed condition of FIG. **6** by application of a close-pulse to the solenoid valve **700**, which causes piston **702** to open hose **704** and block hose **703**.

Referring to FIG. **4**, chemical application apparatus for use in applying fertilizer or pesticides via the water distributing system of FIG. **3** is shown. The fertilization apparatus may be placed, for example, in the water pipe immediately following secondary valve **208** (see FIG. **3**) such that the chemicals from the chemical tank **239** are directed only to field **213**. Likewise, the fertilization apparatus may be placed in water pipe **206** immediately following booster pump **205** such that chemicals from the chemical tank **239** may be applied to either field **213** or field **216**.

To initiate a cycle during which chemicals, such as fertilizers, are applied to a field, valve **208** is opened by a command message from the central control station. Water then flows from water pipe **206** to water pipe **210**. After a predetermined time interval, valve **234** is opened by a command message from the central control station. Water then flows to hydraulic or electric motor **236** which is mechanically coupled to pump **238**. After passing through hydraulic pump **236**, water is expelled by way of pipe **235**. Pump **238** draws chemicals from the chemical tank **239** and injects the chemicals into water pipe **210** at relatively high pressure. The injected chemicals throughly mix with the water flowing in water pipe **210** to form an even concentration before application to the particular agricultural area. The quantity of chemical applied is measured by flow meter **232**. When a pre-established quantity of chemical has flowed past the flow meter **232** as determined by the central control station, valve **234** is closed to terminate the chemical-application cycle. In addition, valve **208** is kept opened for at least a predetermined time interval after the chemical-application cycle has been terminated in order to flush the chemicals from the water distributing system. Flushing the chemicals from the water distributing system prevents chemical damage to the water distributing system and the crops. In some cases, for example, for the application of pesticides, flushing may be eliminated from the chemical-application cycle since it is desired that the chemicals remain on the crops.

Monitoring the chemical-application cycle is accomplished by means of the flow meter **232** and insures that a preestablished quantity of chemical is delivered to the agricultural area. The chemical is uniformly injected into the water pipe **210** where the chemical is thoroughly mixed with the water flowing in the water pipe **210** before application to the agricultural area. The chemical-application apparatus of FIG. **4** enables the computer-controlled irrigation system of the present invention to automatically dispense exact quantities of chemical to an agricultural area.

The control functions of the central control station may be provided by a computer having a stored program. The stored program of the computer provides all the functions necessary for the irrigation operation. The computer of the central control station may be any of a number of commericially available computers or microcomputers, such as the Motorola M6800 microcomputer system. Programming of the M6800 microcomputer system is described in "M6800 Programming Reference Manual," by Motorola, Inc., 1976.

The stored program of the computer-controlled irrigation system of the present invention is designed for controlling two primary operations, the irrigation operation of the remote stations and the communications between the central control station and the remote stations. The main irrigation program of FIG. **8** together with a number of sub-programs controls the irrigation operation of the remote stations. The communication

program of FIG. 9 provides for the communication of messages between the central control station and the remote stations. The messages transmitted between the central control station and the remote stations are organized and coded according to the signalling format described in the aforementioned U.S. patent application, Ser. No. 807,850, by Cohen et al.

The majority of the processing time of the computer of the central control station is spent in the main irrigation program, being interrupted at periodic intervals for the processing of the communication program. Referring to FIG. 8, the main irrigation program is entered at start box **800** and proceeds to the initialization box **801**. During program initialization, the specific field connections and configuration of the water distributing system are entered. For example, the structure of the agricultural area is defined in terms of the number of valves, sensors and pumps and the various interconnections between these elements. Matrices or tables are set up in the memory of the computer for the foregoing information. An interactive program is provided which prompts and directs an operator as to the entry, by way of a keyboard (see FIG. **1**), of the necessary information for defining the field connections for the particular agricultural area.

Once the necessary field configuration and parameters have been entered into the main irrigation program, the program proceeds to box **802** and commences the irrigation operation. In box **802**, the wind speed is calculated from information received from the wind speed sensor at the remote station. Proceeding to box **803**, flow rates are calculated for each valve at the remote stations from the present quantity indication received and the time since the last received quantity indication. The quantity indications are totalized for each valve at the remote stations. The calculated flow rates and totalized quantities are compared with pre-established parameters for each of the valves in the water distributing system. When the totalized quantity of water for a valve is substantially the same as the preestablished quantity of water for the valve, a command message to close the valve is prepared for transmission. The calculated flow rates are utilized to diagnose failures occurring in the valves. For example, a flow rate that is higher than a pre-established flow rate for a valve provides an indication of a broken water pipe or a broken sprinkler. Flow rates that are less than a preestablished minimum flow rate for a valve indicate a blockage in a water pipe or sprinkler. Flow rates for a valve that are substantially zero indicate the valve that has failed to open. In addition, a calculated flow rate for a valve which is supposed to be closed indicates a malfunction where the valve has spontaneously opened. Thus, calculation of the flow rate for each of the valves is a very important feature of the computer-controlled irrigation system of the present invention that provides for automatic diagnosis of malfunctions in the water distributing system.

Proceeding to box **804**, system conditions, for example, environmental conditions and conditions dependent on time schedules or operations of related valves, are checked and appropriate action is taken. The irrigation operation of particular valves may be initiated at particular times. For example, it may be desirable to irrigate a field having a particular crop only during the night time hours. In addition, the opening of particular valves may be made dependent on the opening of another valve. The environmental conditions in the particular fields may necessitate the interruption of the irrigation operation until the particular environmental condition has disappeared. For example, high winds will result in excessive evaporation of the water that is being applied to the fields. The irrigation operation may be halted until the wind subsides and then started again. Also, temperature conditions in the agricultural area may necessitate termination or initiation of the irrigation cycle. For example, it is preferable to irrigate during the cooler part of the day to prevent frost. Thus, irrigation operation may be halted when the ambient temperature rises above a predetermined maximum temperature and started again when the ambient temperature drops or vice versa. Likewise, irrigation operation may be started to prevent cold temperature damage to the crops in the fields when the ambient temperature is less than a predetermined minimum temperature.

Proceeding to box **805**, special agricultural sub-programs, are executed next. The special agricultural sub-programs provide for a number of options, including the operation of booster pumps, preparation of bookkeeping data for the irrigation operation, the application of chemicals to the fields, the determination of the requisite quantities of water for the next irrigation operation, and the determination of the time of the next irrigation operation based on environmental conditions. In addition, special sub-programs may be provided for tailoring the irrigation operation to the needs of the growing cycle for a particular crop.

Proceeding to box **806**, a check is made to verify that water is flowing in all valves that have been commanded to open. If a valve has failed to open, the flow rate for the particular valve will be substantially zero. A second command message may then be provided to open the unresponsive valve a second time, since the first command message may not have been received due to interferenee. In addition, an alarm message is printed by the teleprinter that the particular valve has failed to open. If the unresponsive valve fails to open after the second command message, the valve may be considered to be faulty and scheduled for repair.

Proceeding to box **808**, data is adapted to the particular format necessary for the peripheral units. The status of the irrigation operation is outputted to the chart display for visual monitoring. Various messages as to the status of the irrigation operation is directed to the teleprinter. For example, the start, stop and flow rates of each valve and the corresponding time of the operations may be printed by the teleprinter. Likewise, any detected malfunction in the valves may also be printed by the teleprinter.

Proceeding to box **809**, command messages for controlling the irrigation operation are prepared and formatted into the **32** bit format for transmission by the communication program.

Proceeding to box **810**, input requests received from the various peripheral units are processed and appropriate action is taken. Path **811** is then taken back to box **802** and the foregoing is repeated.

Referring to FIG. **9**, the communication program is entered at start box **900** and proceeds to box **901** where interrogate messages are transmitted to the remote stations. Each of the remote stations is interrogated in succession. Once the last remote stations has been interrogated, the cycle is started again with the first.

Proceeding to box **902**, the acknowledge message from the interrogated remote station is received. A time interval sufficient for reception and transmission of the status message by the remote station is allowed before

proceeding to the next box in the communication program. The received status message provides an indication of the status of the various sensors at each of the remote stations. The received status for each remote station is stored in corresponding tables of the computer memory.

Proceeding to decision box **903**, a check is made to see if any command messages are to be sent. If command messages, previously prepared for transmission to the remote stations by the main irrigation program, are to be sent, YES branch **904** is taken to box **906** where the command messages are transmitted to the remote stations. Otherwise, NO branch **905** is taken to the decision box **907**.

Decision box **907** checks to see if the last remote station has been interrogated. If the last remote station has not been interrogated, no branch **909** is taken to box **911** where the communication program is indexed to the next remote station. Otherwise, YES branch **908** is taken to box **910** where the communication program is indexed back to the first remote station for repeating the interrogation cycle. Proceeding from boxes **910** and **911**, the communication program proceeds to return box **912**. From return box **912** operation of the computer is returned to the main irrigation program. The communication program is re-entered by an interrupt in response to receipt of a status message or at the expiration of a predetermined time interval when the next remote station is to be interrogated.

FIGS. **10**, **11** and **12** provide flow charts for the flow rate, wind speed and field conditions sub-programs which are executed when called from appropriate boxes of the main irrigation program. Referring to FIG. **10**, the flow rate sub-program is called from box **803** of the main irrigation program and is entered at start box **1000**. Proceeding to decision box **1001**, a check is made to see if a pulse, indicative of a predetermined quantity of water, has been received from a remote station. If a pulse has not been received from a remote station, NO branch **1003** is taken to return box **1011**. Otherwise, YES branch **1002** is taken to box **1004**.

In box **1004**, the flow meter from which the pulse has been received is identified. Proceeding to box **1005**, the totalized number of pulses from the identified flow meter is incremented. Next, at box **1006**, the quantity of water corresponding to the totalized number of pulses for the identified meter is also incremented by a corresponding amount for the received pulse.

Proceeding to box **1007**, the time at which the new pulse has been received is recorded for the identified meter. Next, at box **1008**, the time interval between the newly received pulse and the previously received pulse is calculated. Then, at box **1009**, a new flow rate for the identified meter is calculated from the time interval and the quantity of water corresponding to a pulse. Proceeding to box **1010**, the newly calculated flow rate for the identified meter is stored in an appropriate table in the memory of the computer. Next, the flow rate program proceeds to return box **1011** and operation of the computer returns to the main irrigation program.

Referring to FIG. **11** the wind speed program called from box **802** of the main irrigation program is entered at start box **1100**. First, at decision box **1101**, a check is made to see if a pulse has been received from a wind meter in a remote station. If a pulse has not been received, NO branch **1103** is taken to return box **1109**. Otherwise, YES branch **1102** is taken to box **1104**.

In box **1104**, the wind meter from which the pulse has been received is identified. Next, the time at which the new pulse has been received from the identified wind meter is recorded in box **1105**. Proceeding to box **1106**, the time interval between the newly received pulse and the previously received pulse is calculated. Next, at box **1107**, the average wind speed for the identified wind meter is calculated from the previously received pulses and the time interval therebetween. For example, the instantaneous wind speed is calculated from the time interval between the last two pulses and the distance equivalent to each pulse. An average wind speed can be calculated by averaging over a number of calculated instanteous wind speeds. Proceeding to box **1108**, the calculated average wind speed for the identified wind meter is stored in the memory of the computer. Next, the wind speed program proceeds to return box **1109** for returning control of the computer to the main irrigation program.

Pressure meters providing pulse outputs may also be processed by sub-program similar to that of the wind speed sub-program of FIG. **11**.

The field conditions sub-program of FIG. **12** is called from box **804** of the main irrigation program and is entered at start box **1200**. Proceeding to decision **1201**, time conditions which may be specified for controlling the operation of various valves are checked. If any of the time conditions are satisfied, YES branch **1202** is taken to box **1204** where corresponding valves are opened or closed. The irrigation operation of a valve may be specified to start at a given time, and the irrigation operation may be specified to stop at a specific time. Otherwise, NO branch **1203** is taken to decision box **1205**.

In decision box **1205**, valve conditions, which may set forth a desired sequence of operation of a group of valves, are checked. If a particular valve condition is found, YES branch **1206** is taken to box **1208**. In box **1208**, specific valves are opened or closed in response to the corresponding valve conditions. For example, valve No. **19** may be scheduled to open when valve No. **18** closes. Thus when a pre-established quantity of water has been delivered to valve No. **18**, the irrigation operation of valve No. **19** will be initiated. Otherwise, NO branch **1207** is taken to decision box **1209**.

In decision box **1209**, wind conditions in the agricultural area are checked. If the wind speed exceeds a predetermined wind speed, YES branch **1210** is taken to box **1212**. In box **1212**, the valves in the agricultural area are closed to prevent rapid evaporation of the water due to the high wind speeds. When the wind subsides, the valves will be opened again and the irrigation operation will be continued. Otherwise, No branch **1211** is taken to decision box **1213**.

Proceeding to decision box **1213**, if temperature conditions below a predetermined minimum temperature are detected in the agricultural area, YES branch **1214** is taken to box **1216**. In box **1216**, the irrigation operation of the various valves in the water distributing system are operated in a pulse irrigation mode for preventing cold temperature damage to the crops by applying warm water, warm water being water whose temperature is above the freezing point. The pulse irrigation mode successively opens the various valves for short periods of time to apply warm water over the entire agricultural area. The warmth and frequent application of the water prevent cold temperature damage to the crops.

The pulse irrigation mode may also be organized to distribute pre-established quantities of warm water over the entire agricultural area that is sufficient to prevent cold temperature damage to the crops. The pre-established quantity distributed at predetermined time intervals is only that quantity of water necessary to protect the crops, thereby minimizing the waste of water resources. The quantity of water and repetition rate can be varied depending on the particular crop and cold temperature conditions.

If temperature conditions are not satisfied, NO branch **1215** is taken to return box **1217** to return control of the computer to the main irrigation program.

Many other conditions may be incorporated into the field-conditions sub-programs to accommodate the particular requirements of an agricultural area. In addition, pressure sensors and alarm conditions such as booster pump alarms may also be accommodated by the field conditions sub-program.

The foregoing embodiments have been intended as illustrations of the principles of the present invention. Accordingly, other modifications, uses and embodiments can be devised by those skilled in the art without departing from the spirit and scope of the principles of the present invention.

What is claimed is:

1. A system for irrigating an agricultural area comprising:

means for distributing water to the agricultural area from a water source;

main valve means for controlling the flow of water from the water source to said distributing means;

main metering means for measuring the quantity of water flowing from said main valve means to said distributing means and providing an output pulse each time that a predetermined quantity of water flows past the main metering means; and

automatic control means including means for opening the main valve means to allow the water to flow from the water source to said distributing means, means for totallizing the output pulses from said main metering means to provide a measured quantity of water distributed to the agricultural area, and means for closing the main valve means when the measured quantity of water is substantially the same as a pre-established quantity of water for the agricultural area.

2. The irrigation system according to claim **1**, including a booster pump for pumping water from the water source to said main valve means and a water pressure sensor for sensing the pressure of the water flowing from said main valve means to said distributing means and providing a low pressure indication when the sensed water pressure is less than a predetermined water pressure, said automatic control means including means for activating the booster pump in response to the low pressure indication for building up the water pressure.

3. The irrigation system according to claim **1**, wherein said automatic control means includes means for controlling the opening and closing of said main valve means to control the quantity of water applied to the agricultural area to suit the particular agricultural area and environmental conditions.

4. The irrigation system according to claim **1**, wherein said automatic control means includes means for scheduling the operation of said main valve means at a predetermined time.

5. The irrigation system according to claim **1**, wherein the agricultural area produces a crop, said automatic control means including means for scheduling the operation of said main valve means at time intervals in accordance with the growing cycle of the crop.

6. The irrigation system according to claim **1**, wherein said automatic control means includes means for repetitively enabling the operation of said main valve means for maintaining a pre-established moisture level in the soil of the agricultural area.

7. The irrigation system according to claim **1**, wherein said automatic control means includes a computer having a stored program therein for providing control functions.

8. A system for irrigating an agricultural area comprising:

means for distributing water to the agricultural area from a water source;

main valve means for controlling the flow of water from the water source to the distributing means;

main metering means for measuring the quantity of water flowing from the main valve means to the distributing means and providing an output pulse each time that a predetermined quantity of water flows past the main metering means; and

automatic control means including means for opening the main valve means to allow the water to flow from the water source to the distributing means, means for calculating the flow rate from the elapsed time between successive output pulses from the main metering means, and means for closing the main valve means when the distributed quantity of water measured by the main metering means is substantially the same as a pre-established quantity of water for the agricultural area.

9. The irrigation system according to claim **8**, wherein said automatic control means includes means for comparing the calculated flow rate to a pre-established maximum flow rate and closing said main valve means and providing an alarm indication signal when the calculated flow rate is greater than the pre-established maximum flow rate.

10. The irrigation system according to the claim **8**, wherein said automatic control means includes means for comparing the calculated flow rate to a pre-established minimum flow rate and closing said main valve means and providing an alarm indication signal when the calculated flow rate is less than the pre-established minimum flow rate.

11. The irrigation system according to claim **8**, wherein said automatic control means includes means for providing an alarm indication signal when the flow rate is substantially zero.

12. The irrigation system according to claim **8**, wherein said automatic control means includes means for totalizing the output pulses from said main metering means to provide the measured quantity of water distributed to the agricultural area.

13. The irrigation system according to claim **8**, wherein said automatic control means includes a computer having a stored program therein, the stored program including a first subprogram for receiving the output pulses from the main metering means, recording the time when the output pulses are received, and calculating the flow rate from the elapsed time between successive received output pulses.

14. The irrigation system according to claim **13**, wherein the stored program of the computer includes a

second subprogram for totalizing the received output pulses, converting the totalized output pulses into a totalized quantity of water and closing the main valve means when the totalized quantity of water is substantially the same as the pre-established quantity of water for the agricultural area.

15. The irrigation system according to claim **13**, wherein the stored program of the computer includes a third subprogram for comparing the calculated flow rate to a predetermined range of allowable flow rates and providing an alarm indication when the calculated flow rate is not in the predetermined range of allowable flow rates.

16. A system for irrigating an agricultural area comprising:

means for distributing water to the agricultural area from a water source;

main valve means for controlling the flow of water from the water source to said distributing means;

means for dispensing a pre-established quantity of chemical into the water flowing between said main valve means and said distributing means;

main metering means for measuring the quantity of water flowing from said main valve means to said distributing means; and

automatic control means including means for opening the main valve means to allow the water to flow from the water source to said distributing means, means for activating the chemical providing means a predetermined time interval after the main valve means is opened, means for deactivating the chemical providing means when the pre-established quantity of chemical has been dispensed, and means for closing the main valve means when the distributed quantity of water measured by the main metering means is substantially the same as a pre-established quantity of water for the agricultural area.

17. The irrigation system according to claim **16**, wherein said automatic control means closes said main valve at least a predetermined minimum time interval after said chemical dispersing means is deactivated.

18. The irrigation system according to claim **16**, wherein said chemical providing means includes a chemical source, a hydraulic pump for dispensing the chemical from the chemical source into the water flowing to said distributing means, pump valve means for activating the hydraulic pump, and chemical metering means for measuring the quantity of chemical dispensed into the water; said automatic control means including means for opening the pump valve means to activate the hydraulic pump for dispensing the chemical from the chemical source into the water and closing the pump valve means when the quantity of chemical measured by the chemical metering means is substantially the same as the pre-established quantity of chemical.

19. The irrigation system according to claim **18**, wherein the chemical metering means includes means for providing an output pulse each time that a predetermined quantity of chemical flows past the chemical metering means, said automatic control means including means for totalizing the output pulses from the chemical measuring means to provide the measured quantity of chemical dispensed into the water.

20. A system for irrigating an agricultural area having a plurality of agricultural fields for producing different kinds of crops, said irrigation system comprising:

communication means;

a plurality of remote stations, each remote station having first control means for receiving via the communication means start and stop messages for controlling the distribution of water from a water source to at least one of the fields, receiving via the communication means interrogate messages, and sending via the communication means in response to each received interrogate message a status message representing the quantity of water that has been distributed since the previously received interrogate message; and

a central control station having second control means for sending via the communication means the start message to enable selected ones of the remote stations to start distributing water continuously, sending via the communication means the interrogate message to each remote station for enabling the remote stations to send the status message, receiving via the communication means the status messages from the interrogated remote stations, totalizing the distributed quantity of water for each of the remote stations as indicated by the corresponding received status messages, and sending via the communication means the stop message to enable selected ones of the remote stations to stop distributing water when the totalized quantity of water distributed by the remote station is substantially the same as a pre-established totalized quantity of water for that remote station.

21. The irrigation system according to claim **20**, wherein said second control means includes means for sending via the communication means the interrogate message to each of the remote stations in succession, the successive interrogate messages being separated by a predetermined time interval during which the corresponding status messages are sent by the interrogated remote stations.

22. The irrigation system according to claim **21**, wherein said second control means includes means for queuing the start and stop messages and sending via the communication means the queued start and stop messages after receiving status messages and before interrogating succeeding remote stations.

23. The irrigation system according to claim **20**, wherein the messages are digital messages, each having a predetermined number of binary bits, that are coded according to frequency-shift keying (FSK), and the central control station and remote stations include encoder/decoder means for coding and decoding the FSK coded messages.

24. The irrigation system according to claim **23**, wherein the communication means is a radio channel, and the central control station and remote stations include a radio transceiver for transmitting and receiving via the radio channel the FSK coded messages.

25. The irrigation system according to claim **23**, wherein the communication means is a three-wire circuit, all remote stations being transformer coupled in parallel to the three-wire circuit from the central control station, the first and second wires carrying AC power from the central control station to the remote stations, and the FSK coded messages being longitudinally impressed between the third wire and the first and second wires.

26. A system for irrigating an agricultural area, comprising:

means for distributing water to the agricultural area from a water source;

main valve means for controlling the flow of water from the water source to said distributing means;

main metering means for measuring the quantity of water flowing from said main valve means to said distributing means and providing an output pulse each time that a predetermined quantity of water flows past the main metering means; and

automatic control means for opening said main value means when the ambient temperature in the agricultural area is below a predetermined minimum temperature and closing said main valve means in response to the output pulse from said main metering means for applying a predetermined quantity of water to the agricultural area as measured by said main metering means to prevent cold temperature damage to the agricultural area.

27. A system for irrigating an agricultural area having a plurality of agricultural fields for producing different kinds of crops, said irrigation system comprising:

communication means;

a plurality of remote stations, each remote station having first control means for receiving via the communication means start and stop messages for controlling the distribution of water from a water source to at least one of the fields, measuring the quantity of water distributed, and sending via the communication means a status message for each predetermined quantity of water measured; and

a central control station having second control means for sending via the communication means the start message to enable selected ones of the remote stations to start distributing water continuously, receiving via the communication means the status messages from the remote stations, totalizing the measured quantity of water for each of the remote stations as indicated by the corresponding received status messages, and sending via the communication means the stop message to enable selected ones of the remote stations to stop distributing water when the totalized quantity of water distributed by the remote station is substantially the same as a pre-established totalized quantity of water for that remote station.

28. The irrigation system according to claim **27**, wherein the second control means includes means for sending via the communication means an interrogate message to selected ones of the remote stations, the first control means of the selected remote stations receiving via the communication means the interrogate message and sending via the communication means in response to the received interrogate message the status message.

29. A system for irrigating an agricultural area having a plurality of fields for producing different kinds of crops, said irrigation system comprising:

for each of the agricultural fields:

(a) main distributing means for distributing water to the field from a water source, said main distributing means further including a plurality of secondary distributing means, each secondary distributing means for distributing water to a portion of the field;

(b) main valve means for controlling the flow of water from said water source to said main distributing means, said main valve means further including a plurality of secondary valve means interposed between the main valve means and corresponding ones of the secondary distributing means for controlling the flow of water to the corresponding portions of the field; and

(c) main metering means for measuring the quantity of water flowing from said main valve means to said main distributing means and providing an indication for each predetermined quantity of water flowing; and

automatic central control means for opening selected main valve means and opening selected corresponding secondary valve means thereafter, closing the open secondary valve means when the distributed quantity of water measured by the corresponding main metering means is substantially the same as a preestablished quantity of water for the corresponding portions of each field, totalizing the measured quantity of water distributed in the respective portions of each field, and closing the open main valve means when the totalized quantity of water is substantially the same as the pre-established quantity of water for each field.

30. A system for irrigating an agricultural area having a plurality of fields for producing different kinds of crops, said irrigation system comprising:

for each of the agricultural fields:

(a) main distributing means for distributing water to the field from a water source;

(b) main valve means for controlling the flow of water from said water source to said main distributing means; and

(c) main metering means for measuring the quantity of water flowing from said main valve means to said main distributing means and providing an output pulse each time that a predetermined quantity of water flows past the main metering means; and

automatic central control means for opening selected ones of the main valve means of the fields, totallizing the output pulses from each of the respective main metering means to provide a measured quantity of water distributed to each field, and closing ones of the open main valve means when the measured quantity of water is substantially the same as a pre-established quantity of water for each field.

* * * * *

United States Patent [19]

Kendall

[11] **4,244,022**

[45] **Jan. 6, 1981**

[54] **IRRIGATION CONTROL SYSTEM**

[75] Inventor: **Thomas L. Kendall**, Big Bear City, Calif.

[73] Assignee: **The Toro Company**, Minn.

[21] Appl. No.: **9,304**

[22] Filed: **Feb. 5, 1979**

[51] **Int. Cl.**[3] **G01V 1/00**

[52] **U.S. Cl.** **364/420**; 137/624.2; 239/70; 364/104; 364/120; 364/510

[58] **Field of Search** ..... 364/420, 107, 104, 120, 364/509, 510, 479, 101, 102, 103, 200 MS File, 900 MS File; 367/141, 141.4, 141.8, 41; 239/69, 70; 137/624.11, 624.12, 624.13, 624.16, 624.18, 624.19, 624.2; 340/147 R, 309.1, 309.3, 309.4, 310 R, 150, 151

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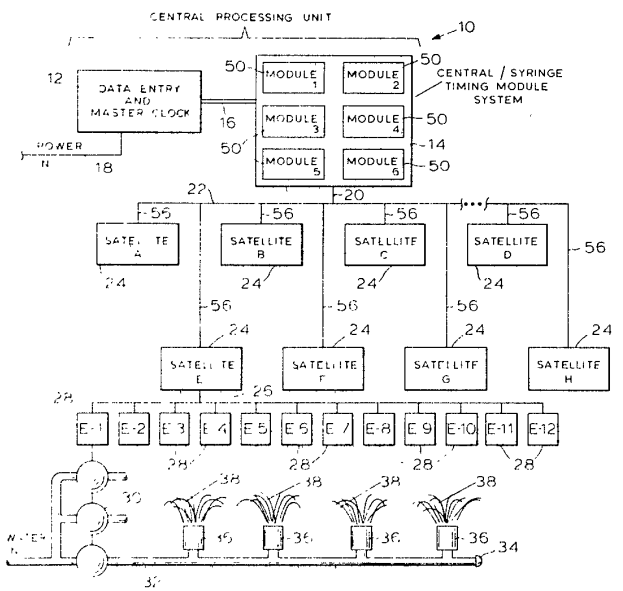
Primary Examiner—Joseph F. Ruggiero
Attorney, Agent, or Firm—Poms, Smith, Lande & Rose

[57] **ABSTRACT**

A solid state control system for large-scale irrigation is disclosed. The system incorporates a central processing unit having a master clock and a central/syringe timing module system connected to a plurality of satellite controllers which are, in turn, connected to control irrigation solenoid valves. The satellites are operable on an individual basis from internal clocks and data or externally in response to multiplexed signals from the central processing unit generated by the comparison of the master clock to unique individually identified groups of data.

4 Claims, 8 Drawing Figures



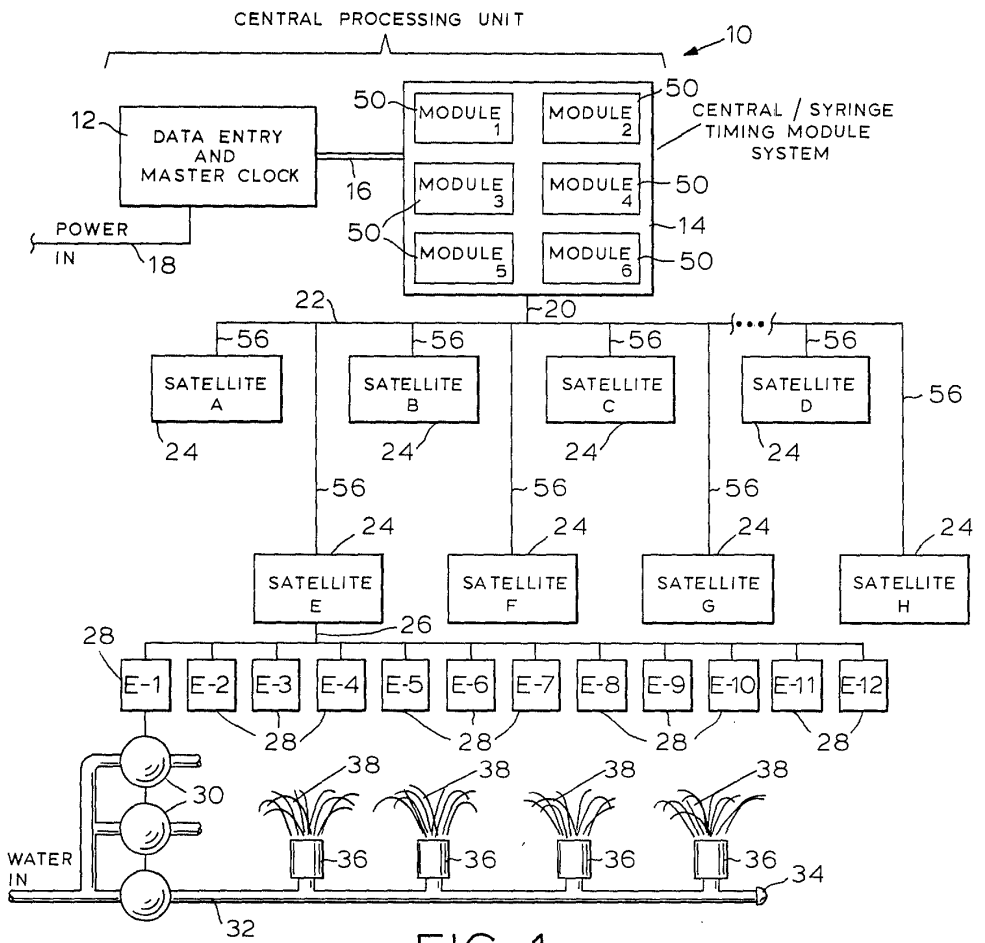

CENTRAL PROCESSING UNIT
10
12
DATA ENTRY AND MASTER CLOCK
16
POWER IN
18
50
MODULE 1
MODULE 2
MODULE 3
MODULE 4
MODULE 5
MODULE 6
CENTRAL / SYRINGE TIMING MODULE SYSTEM
14
22
20
56
SATELLITE A
SATELLITE B
SATELLITE C
SATELLITE D
24
SATELLITE E
SATELLITE F
SATELLITE G
SATELLITE H
26
28
E-1
E-2
E-3
E-4
E-5
E-6
E-7
E-8
E-9
E-10
E-11
E-12
30
32
WATER IN
34
36
38

FIG 1

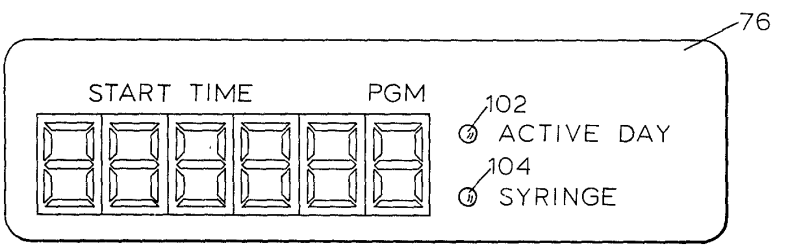

76
START TIME
PGM
102
ACTIVE DAY
104
SYRINGE

FIG 6

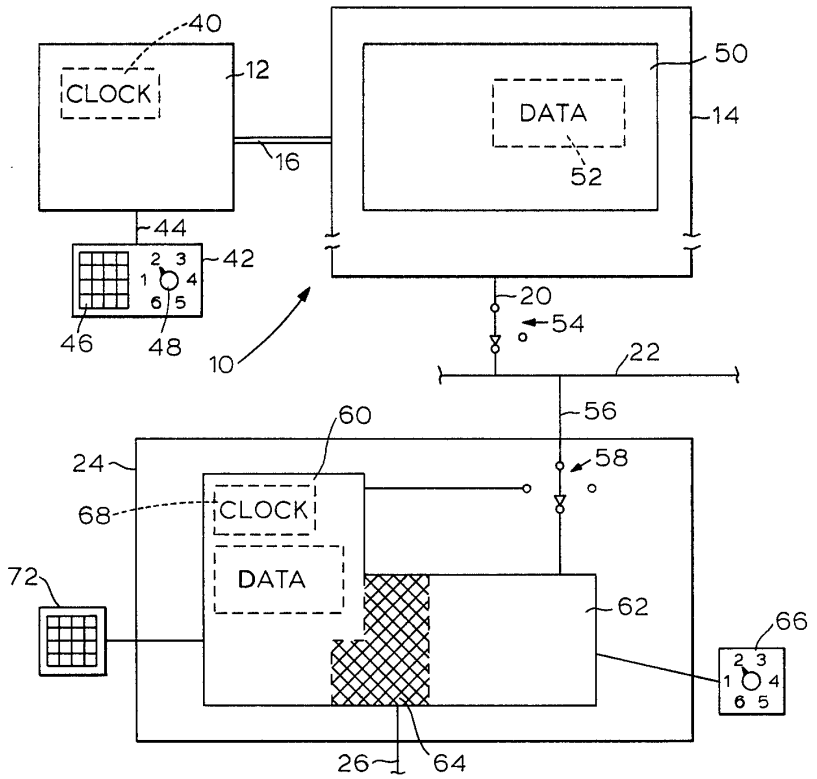

40
CLOCK
12
50
DATA
14
16
52
44
42
2 3
1 4
6 5
46
48
10
20
54
22
56
60
24
58
68
CLOCK
DATA
72
62
66
2 3
1 4
6 5
26
64

FIG 2

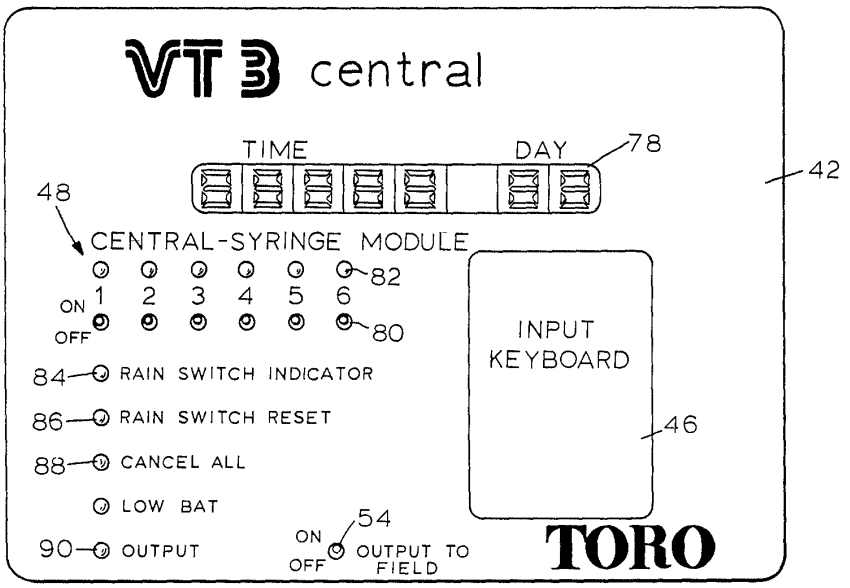


FIG 3

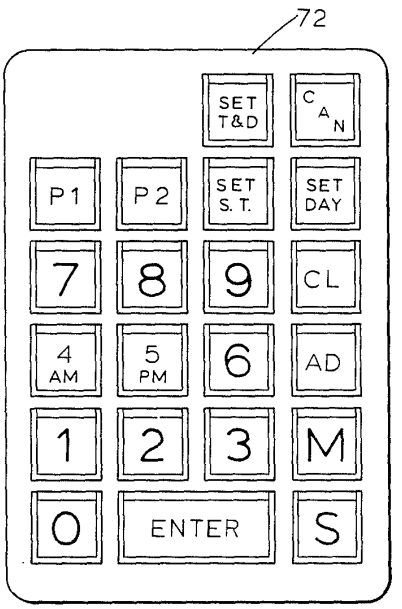


FIG 8

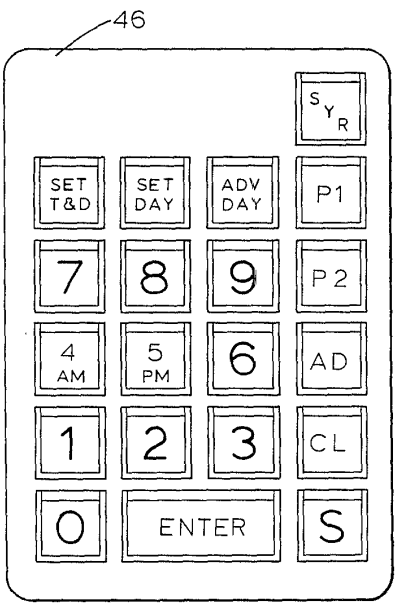


FIG 4

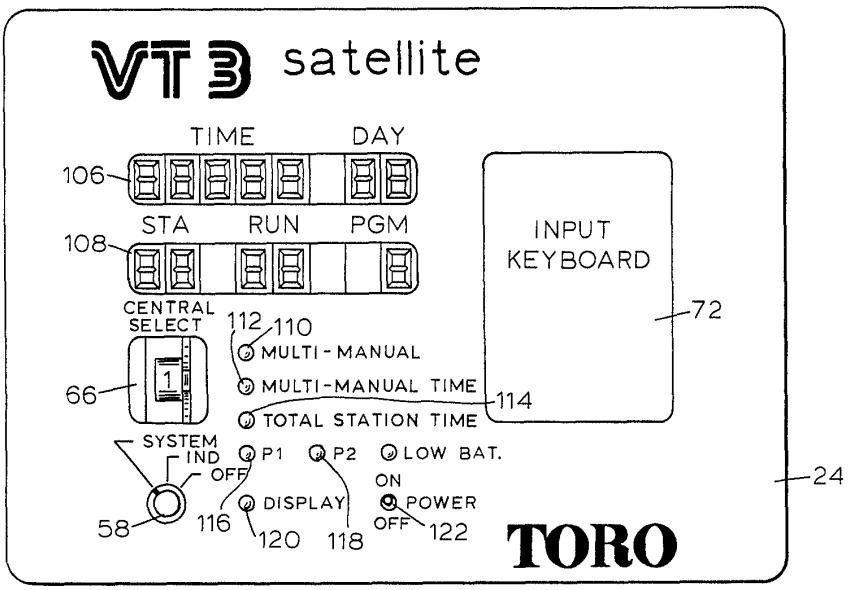

VT 3 satellite
TIME
DAY
106
STA
RUN
PGM
108
INPUT KEYBOARD
72
CENTRAL SELECT
112
110
MULTI - MANUAL
MULTI-MANUAL TIME
114
TOTAL STATION TIME
66
SYSTEM IND
OFF
P1
P2
LOW BAT.
ON
DISPLAY
POWER
OFF
58
116
120
118
122
24
TORO

FIG 7

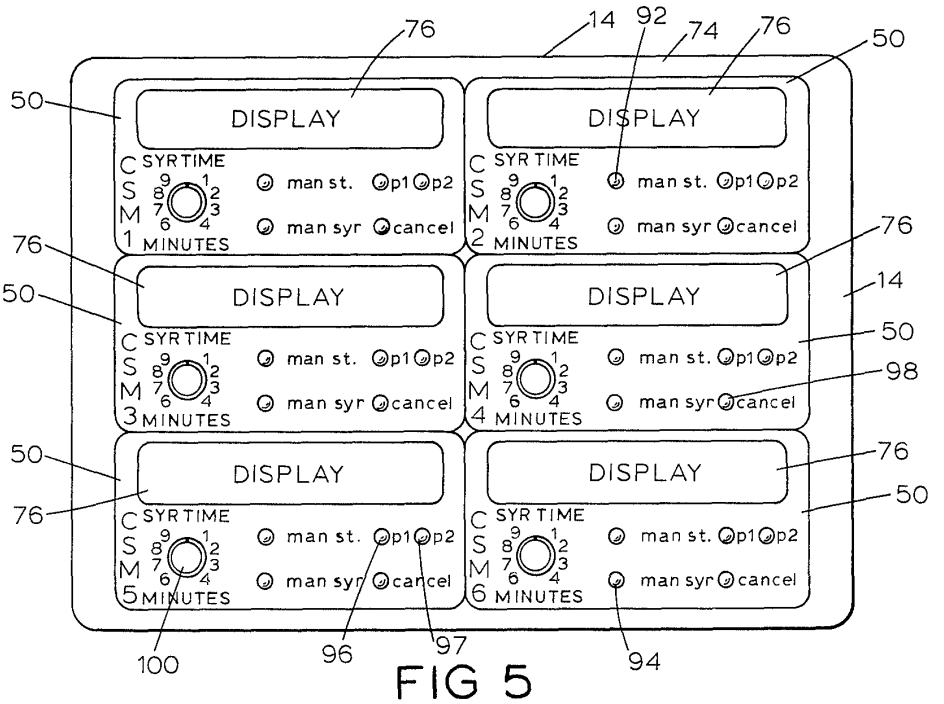

76
14
92
74
76
50
DISPLAY
C SYR TIME
S
M
man st. p1 p2
man syr cancel
1 MINUTES
2 MINUTES
3 MINUTES
4 MINUTES
5 MINUTES
6 MINUTES
98
100
96
97
94

FIG 5

IRRIGATION CONTROL SYSTEM

BACKGROUND OF THE INVENTION

The present invention relates to irrigation controllers and, more particularly, to solid-state electronic controllers used for the sophisticated control of irrigation systems.

Controlled irrigation of large turf areas is a complicated matter. While it is possible to accomplish the function manually, this mode of operation is highly consumptive of time both as to duration and in man hours. Through the years, as technology increased, the function has been transferred to automated control systems. The area to be irrigated is provided with a network of underground piping with strategically placed sprinkler heads connected thereto. Various branches of the system are controlled by interposing solenoid operated values between the branch and the source of pressurized irrigation water.

In the copending United States Patent Application No. 866,049, U.S. Pat. No. 4,165,532, entitled "Automatic Irrigation Sprinkler System Controller" by T. L. Kendall et al, assigned to the common assignee of this application, a solid-state irrigation controller is disclosed employing a number of features heretofore unavailable in such controllers. The controller disclosed therein is well-adapted for its particular scope of use and the specific teachings of the application are incorporated herein by reference.

The controller of said application is limited to a mid-range usage. That is, the features and, therefore, the attendant cost are such as to make it more sophisticated and costly than the normal homeowner might be readily willing to pay for. On the opposite end, the output capability is not sufficient for very large-scale turf applications such as found in the control of irrigation systems for golf courses and the like.

Golf courses, in particular, provide a unique environment for irrigation control. A syringe mode must be provided to allow the groundskeeper to quickly prepare the course for daily play by, for example, eliminating the morning dew from the grass, which otherwise interferes with optimum playing conditions. The amount of ground being irrigated and, therefore, the number of branch lines is such that it is highly desirable to provide a centralized and easily accomplished means for cancelling an entire watering cycle in the event of rain and/or selectively providing irrigation in areas requiring additional water without overwatering other areas. What is required is a large-scale system which can be readily modified by a groundskeeper to conform the irrigation being accomplished to the ever-changing requirements of the landscape.

Wherefore, it is the object of the present invention to provide such a large-scale irrigation control system having a high degree of flexibility while at the same time being simple to learn and easy to use.

SUMMARY

The foregoing objectives have been accomplished by the irrigation control system of the present invention comprising master controller means for maintaining a master real-time clock, continuously comparing the value of the master real-time clock to uniquely identified groups of pre-stored start-time values, and outputting a control signal including an identifier of the unique group wherein the matching one of the values was found when a match is found; and, a plurality of satellite controller means each connected to selectively receive the output from the master controller means and each adapted for maintaining a satellite real-time clock, continuously comparing the value of the satellite real-time clock to a group of prestored start-time values, selectively recognizing output signals from the master controller means having an identifier associated with a particular one of the groups of prestored values, and selectively outputting a control signal for operating an irrigation solenoid valve in response to a match between the satellite real-time clock value and the satellite group of prestored values or receipt of an output signal from the master controller means associated with the particular group of values, the satellite controller means each including means for causing the satellite controller means to output the signal in response to matches of the satellite real-time clock values, the unique group identified signals, or neither, and each further including an output whereat the output signal appears adapted for operable connection to an irrigation solenoid valve.

To further accomplish the foregoing objective, each satellite controller means includes means for changeably designating the one of the unique group identifiers recognized by the satellite controller means; the master controller means includes keyboard means for changeably storing the prestored values compared to the master real-time clock and further includes means for changeably designating the one of the groups values input through the keyboard means are added to; and, each of the prestored satellite start-times has a run-time associated therewith, each satellite controller means maintains an output signal caused by a match of one of the satellite prestored values for the associated run time thereof, and each satellite controller means further includes means for calculating and displaying the sum of all the run times presently associated with the group of satellite run-times of the particular satellite.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a simplified block diagram of the irrigation control system of the present invention.

FIG. **2** is a more detailed block diagram of portions of the irrigation control system of the present invention.

FIG. **3** is a detailed drawing of the front panel of the master controller employed in the present invention exclusive of the data entry keyboard thereof.

FIG. **4** is a detailed drawing of the data entry keyboard of the master controller of FIG. **3**.

FIG. **5** is a detailed drawing of the front panel of the central/syringe timing module system employed in the present invention exclusive of the displays thereof.

FIG. **6** is a detailed drawing of the display employed in the central/syringe time modules of FIG. **5**.

FIG. **7** is a detailed drawing of the front panel of a satellite controller employed in the present invention exclusive of the data entry keyboard thereof.

FIG. **8** is a detailed drawing of the data entry keyboard of the satellite controller of FIG. **7**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. **1**, the control system of the present invention is shown in simplified block diagram form. The heart of the system is a central processing unit generally indicated as **10**. The central processing unit **10** is intended to be mounted in a central location

such as the groundskeeper's office. The central processing unit **10** comprises a master controller **12** which provides the data entry and master clock functions and a central/syringe timing module system **14** which maintains uniquely group identified functions to be described more fully hereinafter. Controller **12** and module system **14** are interconnected by control cable **16** and power is provided by power cable **18** connected to master controller **12** on one end and to an appropriate source of power (not shown) on the opposite end.

The output of central processing unit **10** appears at output **20** of central/syringe module system **14** which, in turn, is connected to bus **22** to which a plurality of satellite controllers **24** are connected.

Each satellite controller **24** is adapted to function in the manner of the satellite controller **24** labeled "E". As can be seen, the output **26** of each satellite controller **24** can be connected to up to 12 output stations **28** such as those labeled E-**1** through E-**12**. Each output station **28** is adapted to control up to four solenoid valves **30** such as those shown connected to the output station **28** labeled "E-**1**". As can be seen, the solenoid valves **30** are disposed in series with an irrigation line **32** connected to a source of pressurized water (not shown) on one end, being closed on the opposite end as by cap **34** and having a plurality of sprinkler heads **36** disposed therebetween such that upon the opening of solenoid valve **30** water **38** is emitted from the sprinkler heads **36** in an appropriate irrigation pattern and quantity.

Turning now to FIG. **2**, portions of the system of the present invention are shown in greater detail but still in simplified block form to make the approach of the present invention more readily apparent.

In particular, the master controller **12** contains a master real-time clock logic **40**. Additionally, master controller **12** has a master data input panel **42** operably connected thereto as with cable **44**. The master data input panel **42** contains an input keyboard **46** and a module selector switch **48**, both of which will be discussed in greater detail hereinafter. As shown in FIG. **1**, the central/syringe module system **14** contains a plurality of uniquely identified modules **50**. As shown in FIG. **2**, each module **50** contains its own data matrix **52** containing values of start times, run times, etc. The logic of master controller **12** and central/syringe module system **14** is such that the value of the real-time clock **40** is constantly compared against the various prestored start times contained within the data matrices **52** of the individual modules **50**. Each time a match is found, therefore, it can be associated with a particular module **50** for purposes to be discussed hereinafter. The prestored data within each data matrix **52** can be individually set and/or changed by use of the master data input panel **42**. As shown in FIG. **1**, each module **50** has a unique identifying number associated therewith as, for example, the numbers **1**–**6** affixed to respective ones of the modules **50** in FIG. **1**. By positioning the module selector switch **48** to the number associated with the module **50** to be programmed, the values input through input keyboard **46** are taken by the logic of master controller **12** and central/syringe module system **14** and placed in the appropriate data matrix **52** of the selected module **50**.

As previously stated, the output **20** of central/syringe module system **14** is connected to bus **22**. To provide ultimate system control from the central processing unit **10**, a master output switch **54** is placed in series with output **20**. By opening master output switch **54**, all outputs to the system are, thereby, disabled.

Each satellite controller **24** is connected to bus **22** by an input line **56**. Input line **56** connects to the wiper arm of a mode selector switch **58**. Each satellite controller **24** contains two major sub-logic systems. The first is a stand-alone controller logic **60** substantially identical with that described in the aforementioned co-pending Kendall et al application. The second is a satellite interfacing logic **62**. The two logic portions **60**, **62** share an output logic portion **64** (shown cross-hatched in FIG. **2**) in common. The mode selector switch **58** has three positions. In one position, the individual satellite **24** is off and, therefore, produces no outputs to the output stations connected thereto. When connected to satellite interfacing logic **62**, the satellite controller **24** responds to signals produced by the central processing unit **10**. A module selector switch **66** is connected to the satellite interfacing logic **62** of each satellite **24**. By setting the switch **66**, each satellite controller **24** is made responsive to outputs associated with one of the unique modules **50**. As the central processing unit **10** finds a match between the value of the master real-time clock **40** and start time data within the data matrix **52** of the module **50** having the identifier selected by the particular module selector switch **66**, a signal is sent from output **20** along bus **22** through input line **56** to satellite interfacing logic **62** containing a unique identifying signal portion associated with the particular module. Satellite interfacing logic **62** is adapted to recognize signals bearing this unique identifying number and respond thereto. An appropriate output is then made through output logic portion **64** at output **26**.

When mode selector switch **58** is positioned to connect to stand-alone controller logic **60**, the satellite clock **68** and data matrix **70** are used to generate output signals at output **26** associated with preselected data input through a satellite keyboard **72** in the manner of the apparatus discussed in detail in the aforementioned co-pending Kendall et al application.

Referring now to FIGS. **3**–**6**, the central processing unit **10** will be discussed in greater detail. FIG. **3** shows the master data input panel **42** in detail with the exception of the input keyboard **46**, which is shown in detail in FIG. **4**. In similar manner, the control panel **74** of the central/syringe module system **14** is shown in FIG. **5** in detail with the exception of the displays **76** thereof, which are shown in detail in FIG. **6**.

Referring first to FIG. **3**, the master data input panel can be seen to have the following main elements:

1. A keyboard **46** for data entry.

2. A seven digit light emitting diode (LED) read-out **78** which maintains the time of day and day designation of a 14 element program. As indicated, five digits are designated to time. The first four digits represent the time of day and the fifth digit is an A or a P for the a.m. and p.m. designations. The latter two digits indicate the day of the 14-day sequence. This concept is discussed in detail in the aforementioned co-pending Kendall et al application and reference should be made thereto for a detailed explanation of this method of operation.

3. A row of LEDs and toggle switches generally indicated as **48** represent the module selector switch previously discussed. While a rotary switch as employed in the foregoing drawings for simplicity could be employed, in the preferred embodiment, individual toggle switches **80** with individual associated LEDs **82** are employed.

4. A rain switch indicator **84** (i.e. an LED) and an associated rain switch reset button **86** (which is a push

button) whereby the operator can reset a rain condition in a manner to be discussed hereinafter.

5. A master cancel button **88**.

6. An output monitor neon lamp **90**.

7. A switch which activates the signal line to the field (being switch **54** previously discussed).

Referring now to FIG. **5**, the control panel **74** of central/syringe module system **14** comprises six individual display panels of the six modules **50**. Each individual module display panel is comprised of the following items:

1. An LED display **76** which indicates the start times and program designation.

2. A MANUAL START control button **92**.

3. A MANUAL SYRINGE control button **94**.

4. A pair of control buttons **96** for selecting program **1** or program **2** in the manual modes.

5. A CANCEL control button **98**.

6. A selector switch **100** for establishing syringe times in minutes.

Turning now to FIG. **4**, the keyboard **46** can be seen to comprise a 20-key panel set in a 4×6 matrix preferably employing positive tactile actuation. The key functions are as follows:

(a) The ten keys labeled numeric "0" through "9" are used for digital data entry. As will be seen, the "4" and "5" keys are also labeled "AM" and "PM" respectively and are used to establish a time as either a.m. or p.m. in a manner to be discussed hereinafter.

(b) Set time and day (SET T&D) is used to enter the real time of day and day of the week.

(c) Set active day (SET DAY) is used to establish active start times to the central/syringe module.

(d) Advance day (ADV DAY) is used to index from one day to another while programming start times to the central/syringe module **14**.

(e) ENTER is a double wide key used to enter information into memory.

(f) Syringe (SYR) is used to set a syringe mode to active start times while programming.

(g) Program **1** (P1) is used to set Program **1** to active start time while programming.

(h) Program **2** (P2) is used to set Program **2** to active start time while programming.

(i) Advance (ADV) is used to advance from one active start time to another.

(j) Clear (CL) is used to clear a false entry or erase from memory.

(k) Start (S) is used to establish a program sequence into memory.

Referring once again to FIG. **3** and, more specifically, to display **78**, it will be remembered that the first five digits of the display **78** are the clock. This clock displays the real-time in a.m. or p.m. AM is designated by an "A" and PM is designated by a "P". The clock changes from a.m. to p.m. at the minute change following 11:59 P and from p.m. to a.m. at the minute change following 11:59 A. The sixth digit position is a one character blank. The last two digits keep the sequence of days represented by a numeric read-out. The numeric read-out is **1** through **14**. When the display reads **1** through **9**, the number is preceded by a zero. The numeric day displays correspond to a 14-day two-week function. At the end of the fourteenth day, the display changes from **14** back to **01**. In order to provide a realistic work day, a day is not defined as from midnight of one day to midnight of the next day. Rather, the transition period from one day to the next occurs at 6:00 a.m. That is, **559A 04** next becomes **600A 05**.

As previously mentioned, the module selector switch **48** in the preferred embodiment comprises six light emitting diodes **82** and six double pole-double throw toggle switches **80**. The LEDs and switches are matched in rows. Each pair (LED and switch) is in a column and numbered **1** through **6**. The switch row is labeled "ON" and "OFF". This system is used to address each central/syringe module **50** while in a programming sequence. If, for example, central/syringe module #**3** is to be programmed, toggle switch #**3** is placed in the "ON" position. The LED #**3** then illuminates indicating module #**3** is now directly interfaced with the keyboard and memory system. The appropriate toggle switch **80** for each central/syringe module **50** must be activated for any programming to be accomplished. The programming characteristics are based on a priority format via the LED-toggle switch array **48**. If all the switches **80** (or any grouping over one) are in the "ON" position, the lowest number has priority over all others for programming. That is, if switch #**2** and **4** are "ON", only central/syringe module number **2** will be addressable until the #**2** switch is placed in the "OFF" position.

The rain switch indicator **84** and RAIN SWITCH RESET button **86** previously referred to are used in combination with a third element (not shown) being a remote rain switch unit responsive to rainfall and having an internal normally opened switch. The remote rain switch unit is designed to have its normally opened switch contacts closed in the presence of a preselectable amount of rainfall. When this occurs, the central processing unit **10** enters into the rain switch mode. The rain switch indicator **84** is then illuminated and a total system cancel operation is initiated. This cancel sequence terminates all programs in existence. When the cancel sequence has been completed, the system enters a standby mode. No signals to the field can be output either manually or automatically and all automatic program sequences are ignored. While in this mode, any automatic or manual program sequence will not be stored. The RAIN SWITCH RESET push button **86** must be manually actuated to terminate the rain switch mode. Additionally, a complete power failure (line and battery) will also terminate the mode. When the RAIN SWITCH RESET button **86** is depressed, the system logic is such as to resume normal operation and cease illumination of the rain switch indicator **84**. Note that the time keeping mode and display functions must remain active with the system in the rain switch mode.

The CANCEL ALL button **88** is a normally opened single pole, single throw momentary push button switch. When it is manually activated, the central processing unit **10** enters into a master cancel program sequence. This sequence establishes a paired priority cancel program to all satellites that are established in the system mode and active. The cancel signal is a signal train to the satellites and is repeated **12** times to assure that any electro-mechanical satellite clocks are returned to the "OFF" position. The cancel signal sequence is based on a paired priority sequence. If, for example, central/syringe modules **1, 2, 4, 5,** and **6** are operational, the system sends the cancel signal in the following sequence until the last central/syringe module group of satellites is off: **1–2** . . . (repeated 12 times) then **4–5** . . . (repeated 12 times) then **6** . . . (repeated 12 times). The cancel sequence always establishes the first two active

central/syringe modules **50**, then the next two consecutive modules, etc.

The OUTPUT monitor **90** is a **117** VAC neon lamp that is connected in parallel with the signal line to the field. Whenever a signal is being output by the central processing unit **10**, the neon lamp **90** monitors the line. As the signal train progresses through its sequence, the monitor lamp **90** will illuminate, blink as the signal passes, and stay on as the line stays on. It goes out as the system terminates the output signal.

Referring once again to FIG. **6**, the display **76** of each module **50** is shown. The first five digits of the display **76** show the start times that are assigned to the module via the keyboard **46** and module selector switch grouping **48** of the master data input panel **42**. Note that each module **50** has the capability of being programmed with eight independent automatic start times for each dey of the fourteen-day program cycle. The sixth digit position represents the automatic program that has been assigned to the start time. A "1" represents satellite program **1**. A "2" represents satellite program **2**. These two numbers are the only two digits that can be entered without creating an error. The seventh digit section is composed of two LED indicators **102** and **104** for indicating active day and syringe mode respectively. When the displayed start time has been assigned as active to the designated day on the master clock, the active day indicator **102** is illuminated. Consequently, when indicator **102** is not illuminated, the start time displayed has not been assigned as active to the day displayed on the master clock. When the displayed start time has been assigned as an automatic syringe start time, the syringe indicator **104** is illuminated.

Turning once again to FIG. **5**, the syringe time selector switch **100** referred to briefly hereinbefore can be seen to be a ten-position single pole rotary switch. Each position is labeled with a number (**0–9**) which corresponds to the time lapse between output syringe signals to the field satellites. In the "0" position, no syringe time is possible and no syringe signal will be transmitted to the field satellite.

The manual start function is a one-time start signal to the field satellites. It is accomplished by use of the three normally opened single pole, single throw momentary push button switches associated with the manual start control button **92** and the P**1** and P**2** buttons **96**, **97**. Actuation of the manual start button **92** sets up the manual program and actuation of the P**1** or P**2** button **96** transmits the appropriate command to the field satellites. If the field satellites are in a run-time sequence, the manual program command is ignored.

The manual syringe function is a one-time syringe program to the field satellites. In a manner similar to the manual start function it is accomplished with three normally opened single pole, single throw momentary push button switches associated respectively with the manual syringe control button **94** and, once again, the P**1** and P**2** buttons **96**, **97**. Actuation of the manual syringe control button **94** sets up the syringe program and actuation of either the P**1** or P**2** button **96** or **97** transmits the appropriate command to the field satellites. If the field satellites are in a run-time sequence, the manual syringe program will override the program that is in operation.

The cancel control button **98** is associated with a normally opened single pole, single throw push button switch. Upon actuation, it establishes the cancel program sequence that is transmitted to the field which is a one-time program terminating all run-time programs that are in existence via the field satellites.

Turning now to FIGS. **7** and **8**, the operation of the satellite controllers **24** will be discussed in greater detail. The data functions and independent operation of the satellites **24** are substantially identical to those described in the aforementioned co-pending application of Kendall et al. Reference should be made thereto for a detailed explanation. For example, the input keyboard **72** and two displays **106** and **108** are well-described therein.

In addition to the embodiment described in said Kendall et al application, however, the satellites **24** contain module selector switch **66**. In the preferred embodiment, selector switch **66** employs a seven-position thumb-wheel switch. This is easily accomplished by employing a normal ten-position thumb-wheel switch with stops at "0" and "6". Switch **66** interfaces with the system and specifies to the central/syringe module system **14** which module **50** the satellite **24** will accept operational commands from. In the "0" position, the satellite **24** will accept no command issued from the central processing unit **10**. When switch **66** is placed in any other position, **1** through **6**, that number indicated represents the central/syringe module **50** the satellite **24** interfaces with and accepts operational commands from. Note that by this method of implementation, each satellite **24** can only be made responsive to one module **50** at a time but that the module **50** to which the satellite **24** is responsive can be easily and readily changed to achieve the objectives of the present invention.

The mode selector switch **58** is a three-position rotary switch. Each position is identified with a mode that the satellite **24** will operate in. In the SYSTEM position, the satellite **24** accepts commands from the central processing unit **10** for all output functions. In the independent (IND) position the satellite **24** operates as an independent twelve-station controller. All output functions are issued via the programming data in memory. Any automatic starts must be entered into memory. In this position, any command from the central processing unit **10** is ignored. In the OFF position the satellite is off. It will not accept any commands from the central processing unit **10**. It will not generate any program starts via memory and the display is off. While in this position, the memory is not altered. Power is still maintained and all information entered into the memory is maintained. The clock is still in operation, but not displayed.

To provide additional functions, each satellite **24** is provided with a MULTI-MANUAL button **110**, a MULTI-MANUAL time button **112**, a TOTAL STATION TIME button **114**, a P**1** button **116**, a P**2** button **118**, a DISPLAY button **120**, and a power switch **122**.

A multi-manual function is accomplished through the actuation of two normally opened momentary push button switches and data entry through the keyboard in a manner to be described in greater detail hereinafter. This function allows for the selection of up to six output stations to be run on a one-time manual basis. All six stations, after programming, will run for the same length of time at the same time.

The TOTAL STATION TIME button **114** allows for the display of the total, programmed, station run-time. Upon actuation of this switch, in conjunction with the P**1** or P**2** switch by pressing the P**1** or P**2** button **116**, **118**, the display shows the total time for all stations programmed for P**1** or P**2** as selected. The display is in hours and minutes. For example, if P**1** has each of the

twelve stations programmed to run for **22** minutes, the display will show **424** (e.g. 4 hours and 24 minutes).

The power switch **122** is a double pole, double throw toggle switch connected in series with the incoming power to the satellite (not shown). In the "ON" position, power is supplied to the system. In the "OFF" position, all power to the system is terminated. All programmed data will be lost when the switch is placed in the "OFF" position.

The DISPLAY button **120** actuates a normally opened single pole, single throw momentary push button switch. Upon actuation, the system logic turns on the display and maintains it in the on condition for approximately 30 seconds.

SPECIFIC LOGIC CONSIDERATIONS

Exemplary logic diagrams for the accomplishment of the majority of the functions of the satellites employed herein are set forth in detail in the aforementioned co-pending application of Kendall et al. Consequently, specific logic flowcharts for the present invention are not included herewith. The specific manner of accomplishing the present invention should be obvious to one skilled in the art with reference to the flowcharts of the aforementioned co-pending Kendall et al application in conjunction with the operational descriptions which follows hereinafter.

CENTRAL PROCESSING UNIT-LOGIC AND PROGRAMMING CHARACTERISTICS

Upon initial power-up after installation or if a complete power loss has occurred, all displays show eights (all segment of all are displays on). The following programming format should be followed for proper operation.

A. SET TIME AND DAY

1. Actuate the set time and day key (SET T&D). All the displays clear. The master clock display **78** shows all bars (center segments of each display) as prompting characters.

1.1 Enter the real time by depressing the digit keys (**0–9**), in numeric order, from left to right. The bars are replaced by digits as they are entered.

1.1.1 If the hour is a single digit, a zero must precede it or an error is generated.

1.1.2 Check the display to verify the correct entry.

1.1.3 The AM or PM key (numeral **4** or **5** key) is then actuated to establish that part of the day.

1.1.3.1 AM is determined by the "4" key. PM by the "5" key.

1.1.3.2 If AM or PM is not entered, the display flashes and an "E" appears in the AM/PM digit of the display indicating an error.

1.2 The day of the week is entered next. It must be entered as a two digit number or an error is created.

1.3 As the time and day are being entered, the bars (prompting characters) are replaced with digits as the keys are actuated.

1.4 When the correct time and day have been entered and verified as correct, actuate the ENTER key and then the start key(s). The master clock **40** starts keeping time.

1.5 If a change is desired while the system is in the program mode, actuation of the clear (CL) key removes the entry from the system and the display returns to the bar readout. Re-entry of the time and day is then necessary.

1.6 If the start key(s) is depressed while the system shows any prompting characters, an error is created.

1.7 If re-setting the clock time is necessary, due to power loss or time change, actuation of the set time and day key (SET T&D) places the system into the time program mode and the display reads all prompting characters.

1.8 While the system is in this program mode, no other display is on, the system is in a standby mode, no pre-established program will activate, and the clock is stopped.

B. PROGRAMMING AUTOMATIC START TIMES

Automatic start times are established in each of the active central/syringe modules **50**. The start times for each module are established to each day of the fourteen day program. Each day can accept thirty start times allocated between the various modules **50** as desired. For example, if all six modules **50** are active, each could have five start times or three could have eight and three could have two, etc.

With the system being capable of accepting thirty start times, anytime of day may be entered in any sequence. The entered data is stored in memory in the data matrix **52** as programmed. The system sorts these start times and automatically initiates start commands in the correct sequence.

1. Select the first central/syringe module **50** to be programmed and establish its program active status by placing the appropriate toggle switch **80** in the "ON" position. The indicator **82** will illuminate and the keyboard address system **46** will become active.

2. Depress the SET DAY key. The master clock clears and the day section shows "**00**". The central/syringe module display **76** shows all prompting characters.

2.1 Depress the advance day (ADV DAY) key. The day portion of display **76** shows "**01**".

2.3 Enter the desired automatic start time.

2.3.1 Enter a four digit number for the time. The prompting characters are replaced by the numbers entered.

2.3.1.1 If the hour is a single digit, it must be preceded by a zero.

2.3.2 Assign an A.M. or P.M. to the time displayed.

2.3.3 Assign a program one or program two to the start time.

2.3.3.1 Depress the P1 button **96** for program one or the P2 button **97** for program two.

2.3.4 If the start time being entered is to be an automatic syringe start, actuate the syringe key (SYR). The indicator labeled SYRINGE **104** is illuminated.

2.3.5 Verify that the displayed time is accurate.

2.3.6 Depress the ENTER key. This establishes that time into memory.

2.3.7 If more than one automatic start time is desired; total of thirty.

2.3.7.1 Actuate the advance key (AD). The display clears and again shows all prompting characters.

2.3.7.2 Repeat steps 2.3.1 through 2.3.6 each additional start time.

2.3.7.3 When all start times have been entered, the next actuation of the advance key (AD) displays the first entered start time.

2.4 Depress the advance day key (ADV DAY). The day display changes to "**02**". The central/syringe module display **76** shows all prompting characters.

2.4.1 If day **02** is to be an active watering day, enter automatic start times as outlined in paragraph 2.3.

2.4.2 If day **02** is to be an inactive watering day, bypass it by actuating the advance day key (ADV DAY). The day display shows day **03**.

2.4.2.1 Either assign start times to day **03** or bypass it.

2.5 When all days that are to be active watering days have been programmed, place the toggle switch **80** in the "OFF" position.

2.5.1 The master clock display returns to the time keeping mode.

2.5.2 The central/syringe module **50** that has been programmed displays the next start time.

2.5.2.1 If the displayed start time is active for the day shown on the master clock, the active day indicator **102** is on.

3. Select the next central/syringe module **50** to be programmed and place the appropriate toggle switch **80** in the "ON" position.

3.1 Repeat the procedure as outlined in sub-section **2**.

4. Repeat this procedure for each of the central/-syringe modules **50** that are to be active.

C. ESTABLISHING SYRINGE TIME

1. Each central/syringe module **50** has a **10** position rotary switch **100** identified as "SYR TIME MINUTES" with numbers around the circumference noted "**0** thru **9**". These numbers represent the time in minutes between syringe output signals to the field when an automatic start time is programmed as syringe or a manual syringe start has to be selected.

2. In the "**0**" position, no syringe signals are generated.

3. The time in minutes selected must be of a shorter duration than the smallest, preset station run time of the satellites **24**.

SATELLITE CONTROLLERS-LOGIC AND PROGRAMMING CHARACTERISTICS

Upon initial power-up after installation or if a complete power loss has occurred, all displays show eights (all segments of all displays on). The following programming format should be followed for proper operation.

A. SET TIME AND DAY

1. Actuate the set time and day key (SET T&D). The display 108 clears. The clock display 106 shows all bars (center segments of each display) as prompting characters.

1.1 Enter the real time by depressing the digit keys, in numeric order, from left to right.

1.1.1 If the hour is a single digit, a zero must precede it or an error is generated.

1.1.2 Check the display to verify the correct entry.

1.1.3 The AM or PM key (numeral 4 or 5 key) is then actuated to establish that part of the day.

1.1.3.1 AM is determined by the "4" key. PM by the "5" key.

1.1.3.2 If AM or PM is not entered, the display flashes and an "E" appears in the AM/PM digit of the display indicating an error.

1.2 The day of the week is entered next. It must be entered as a two digit number or an error is created.

1.3 As the time and day are being entered, the bars (prompting characters) are replaced with digits as the keys are actuated.

1.4 When the correct time and day have been entered and verified as correct, actuate the ENTER key and then the start key(s). The satellite clock **68** starts keeping time.

1.5 If a change is desired while the system is in the program mode, actuation of the clear (CL) key removes the entry from the system and the display returns to the bar read-out. Re-entry of the time and day is then necessary.

1.6 If the start key(s) is depressed while the system shows any prompting characters, an error is created.

1.7 If re-setting the clock time is necessary, due to power loss or time change, actuation of the set time and day key (SET T&D) places the system into the time program mode once again and the display again reads all prompting characters.

1.8 While the system is in this program mode, no other display is on, the system is in a standby mode, no pre-established program will activate, and the clock is stopped.

B. SET START TIME

1. The system has the capability of establishing six independent start times in a 24 hour day. If the station running sequence overlaps into the next programmed start time, that next start time is maintained. All days established as active watering days have the same starting time.

1.1 Actuation of the set start time key (SET S.T.) places the system into a programming mode. The time clock portion of display **106** changes to all prompting characters (bars). The day section of display **106** is blank.

1.2 Enter the desired start time in the same order as used in entering the clock time. A four digit time followed by "A" or "P".

1.3 If an error is made while entering data, the display flashes and actuation of the clear key (CL) is required.

1.4 When the start time has been entered, actuation of the ENTER key sets that time into memory.

1.5 If more than one start time is desired, after the first is entered into memory, actuate the advance key (AD). This indexes to the next available start time.

1.5.1 Enter the next start time, actuate the ENTER key. This process may be repeated for the six start times.

1.6 If a start time is to be changed while in the programming mode, a new start time may be entered in place of the time to be changed (writing over the old start time).

1.6.1 Actuation of the clear key (CL) also removes the old start time. Re-entry of data may then be made.

1.6.2 If the system is out of the program mode, actuation of the set start time key (SET S.T.) is required. Use the advance key (AD) to index to the time that is to be changed and enter the new data.

1.7 With the system capable of accepting six start times, any time of day may be entered in any sequence from one to six starts.

1.7.1 The entered data is stored in memory as programmed. The system sorts these times and automatically initiate starts in the correct sequence.

1.7.2 Unused start times remain as prompting characters and when stepping through the memory to recall data, all six start times are displayed. Those left at bars will be displayed as bars.

1.8 When programming or recalling start times is complete, actuation of the start key(s) establishes memory and the system returns to clock time.

1.9 While programming start times, if seven starts are entered, the seventh start is retained by the system and the first entered start time is dropped.

1.9.1 If eight start times are entered, the first two start times are dropped, etc.

C. SET STATION RUNNING TIME

Establishing station run times for program one and program two is essentially the same procedure. For establishing program one station run times, actuate "P1". For establishing program two station run times, actuate "P2". The sequence outlined below is for both program one and program two.

1. Establishing station running times is accomplished by assigning a time in minutes to each of the 12 stations used. Any running time from 1 to 60 minutes may be established. Times over 60 minutes create a false entry and the display flashes as an indication of an error.

1.1 Actuation of the "P1" key establishes Program One programming mode. The station portion of display **108** reads zeroes, the run time portion reads zeros and the program portion reads "1".

1.2 Actuation of the advance key (AD) indexes the system to station one. The station display reads "01".

1.2.1 Enter a running time in minutes via the numerics keys (0–9). If the running time is from 1 to 9 minutes, that entry must be preceeded by a zero.

1.2.2 Actuation of the ENTER key sets that time into memory. Depress the advance key (AD) to index to the next station number and repeat the data entry process.

1.3 If an error is made (flashing display) or a change is desired, depress the clear key (CL) to remove the information. The run time display shows all zeros at that time.

1.4 If a change is required while stepping through the program to recall information or after a time has been entered into memory, either actuate the "clear" key (CL) or write over the old time. Actuate the ENTER key to set the new time in memory.

1.4.1 This action will erase the previous run time.

1.5 When all station running times are programmed, actuation of the start key (S) sets memory and returns the system to clock time.

1.6 If less than 12 stations are used or a blank station is desired when programming data, those stations should be left at zero run time.

1.6.1 This is accomplished by stepping-by those stations while programming.

D. SET ACTIVE WATERING DAYS

1. Each day of the **14** day cycle is programmed to be either active (water) or inactive (off). Each day is programmed to water stations for program one, program two, or be "off" for that day.

1.1 Actuation of the SET DAY key establishes the program mode. The day portion of display **106** reads zero and the program portion of display **108** reads zero.

1.2 Actuate the advance key (AD) to index to day **01**. Establish that day as program one by depressing the numeric "1" key; as program two by depressing the numeric "2" key; or inactive by indexing to the next day via the advance key (AD).

1.2.1 If that day is active ("1" or "2") depress the ENTER key to set the program into memory. Actuate the advance key (AD) to index to the next station.

1.2.2 If that day is to be inactive, "0", index to the next station by depressing the advance key (AD).

1.3 Use the advance key (AD) to index to each of the 14 days and establish each day as active ("1" or "2") or inactive ("0"), following the procedure outlined.

1.4 An error or a false entry causes the display to flash, actuate the clear key (CL) to delete the error.

1.5 If a day is to change, index to that day and change the data either by writing over or "clearing" the information and re-entry.

E. MANUAL PROGRAMMING

The system of the present invention in its preferred embodiment is set up to allow three types of manual operation. The three are outlined with programming characteristics noted.

1. COMPLETE STATION SEQUENCE

1.1 If a complete station sequence operation is desired, actuation of the manual key (M) sets the system into the manual mode.

1.2 Depress either the "P1" key (program one) or the "P2" key (program two). This establishes the program sequence that will run.

1.3 Actuating the start key (S) initiates the one-time manual program. Each pre-programmed station runs its preset time, in sequence.

1.4 When the last station has completed its timing function, the system reverts to automatic operation.

2. SINGLE STATION OPERATION

2.1 If an individual station is to be run manually, depressing the manual key (M) sets the system into a manual mode.

2.1.1 Use the advance key (AD) to step through each station until the station that is to run manually is reached.

2.1.2 The pre-programmed running time of that station is displayed. Depressing the start key (S) activates the station for the displayed time.

2.1.3 If a run time other than the pre-programmed time is desired, a new time is entered via the numeric keys, after stepping to the desired station. The new run time is displayed in the run portion of display **108**. By depressing the start key (S), the station comes on and runs for the new time.

2.2 Entering manual station run times has no effect upon the pre-programmed run time established in memory.

2.3 When the manual program is complete, the system reverts to the automatic mode.

3. MULTIPLE STATION, MANUAL OPERATION

3.1 The multiple manual is a one time manual program that has the ability to operate up to six output stations concurrently. The system can only achieve this, if one valve load is applied per station. Programming is as follows:

3.1.1 Depress the push button switch **110** labeled "MULTI-MANUAL" to establish the program mode. The clock display **106** is off. The station portion of display **108** shows "00" and the program portion shows "0".

3.1.2 Actuate the advance key (AD) to the first desired station. Actuate the ENTER key to make that station active for the program. The program display changes to a "1".

3.1.3 Actuate the advance key (AD) to the next desired station and actuate the ENTER key. The program display changes to "2".

3.1.4 Repeat this procedure for up to six stations. With each actuation of the ENTER key, the program display increases by one, thus keeping track of the total number of stations activated.

3.1.4.1 If more than six stations are attempted, they are ignored.

3.2 When all desired stations have been programmed as activated, actuate the "MULTI-MANUAL TIME" push button **112**. The station portion of display **108** shows the first activated station, the run time portion shows "**00**", and the program portion shows a "1", indicating the first active station.

3.2.1 Enter a run time, from 1 to 60 minutes, via the keyboard. The time is displayed in the run time portion of display **108**.

3.2.2 Actuation of the start key (S) initiates the one time Multi-Manual Program. All stations programmed as active come on. The station display remains on station **1**. The run time display clocks the time down. The program display remains on "1".

3.2.3 When the start is actuated and the Multi-Manual Program initiated, the clock display resumes its normal function.

F. TOTAL STATION TIME

1.1 This feature allows for the totalizing of all run times programmed into memory for either program one or program two.

1.1.1 Actuation of the "TOTAL STATION TIME" push button **114** clears all displays.

1.1.2 Actuation of either "P1" or "P2" push button totals all run times that are programmed and that total is displayed in the "TIME" section of display **106**.

1.1.2.1 The totalized time is displayed in hours and minutes.

1.1.2.2 After actuation of the "P1" or "P2" key, the displays remain off for approximately 15 seconds while the time is being totalized. Then it is displayed.

1.1.3 Actuation of the start key (S) returns to system to normal operation.

Thus, it can be seen from the foregoing description that the present invention truly provides a large scale irrigation control system combining a high degree of flexibility with ease of modification.

Wherefore, having thus described my invention, I claim:

1. An irrigation control system comprising:

(a) master controller means for maintaining a master real-time clock, for continuously comparing the value of said master real-time clock to entries in uniquely identified groups of pre-stored master start-time values to find matches therebetween, and for outputting at an output thereof a master control signal including an identifier of the unique group wherein the matching one of said values was found when a match is found; and,

(b) satellite controller means connected to selectively receive said output from said master controller means for maintaining a satellite real-time clock, for continuously comparing the value of said satellite real-time clock to entries in a group of satellite pre-stored start-time values to find matches therebetween, for selectively recognizing ones of said output signals from said master controller means having an identifier associated with a particular one of said groups of satellite pre-stored values, and for selectively outputting a satellite control signal for operating an irrigation solenoid valve in response to a match being found between said satellite real-time clock value and an entry in said satellite group of pre-stored values or upon receipt of a said output master control signal from said master controller means associated with said particular group of values, said satellite controller means including means for selectively causing said satellite controller means to output said satellite control signal in response to said matches of said satellite real-time clock values, receipt of said unique group identified master control signals, or neither, and further including an output whereat said output satellite control signal appears, said latter named output being adapted for operable connection to an irrigation solenoid valve.

2. The irrigation control system of claim **1** and additionally comprising:

said satellite controller means including means for changeably designating the one of said unique group identifiers recognized by said satellite controller means.

3. The irrigation control system of claim **1** and additionally comprising:

said master controller means including keyboard means for changeably storing said entries of said master pre-stored values compared to said master real-time clock and further including means for changeably designating the one of said groups the values input through said keyboard means are made entries to.

4. The irrigation control system of claim **1** wherein:

(a) each of said pre-stored satellite start-times has a run-time associated therewith;

(b) said satellite controller means maintains each of said output satellite output control signals caused by a match between said satellite real-time clock and one of said satellite pre-stored start-time values for the associated said run-time thereof; and wherein said satellite controller means further includes,

(c) means for calculating and displaying the sum of all said run-times presently associated with said group of satellite start-times.

* * * * *

United States Patent [19]

Unruh et al.

[11] **Patent Number: 4,626,984**

[45] **Date of Patent: Dec. 2, 1986**

[54] **REMOTE COMPUTER CONTROL FOR IRRIGATION SYSTEMS**

[75] Inventors: **Rudy R. Unruh; James A. Lamb; Richard A. Tejral,** all of Omaha, Nebr.

[73] Assignee: **Valmont Industries, Inc.,** Valley, Nebr.

[21] Appl. No.: **645,481**

[22] Filed: **Aug. 29, 1984**

[51] **Int. Cl.**[4] **G06F 15/46;** G06F 15/16

[52] **U.S. Cl.** **364/132;** 239/69; 340/825.06; 364/420

[58] **Field of Search** ..... 364/140-147, 364/400, 420, 510, 131-135, 200 MS File, 900 MS File; 239/63, 66, 70, 71, 69; 340/825.06, 825.54, 825.55

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Primary Examiner—Joseph Ruggiero
Attorney, Agent, or Firm—Zarley,McKee,Thomte,Voorhees & Sease

[57] **ABSTRACT**

A remote computer system for controlling a plurality of irrigation systems, each of which has a local controller for controlling an individual system, includes an intelligent remote unit associated with each local controller, each intelligent remote unit having a computer with a stored program for fully independently operating the local controller and the irrigation system associated therewith. A central base station controller includes its own computer which is linked by a communications link with each of the intelligent remote units, the stored program in the base station computer permitting operator monitor and control of the various parameters being monitored and controlled by the intelligent remote units.

40 Claims, 33 Drawing Figures

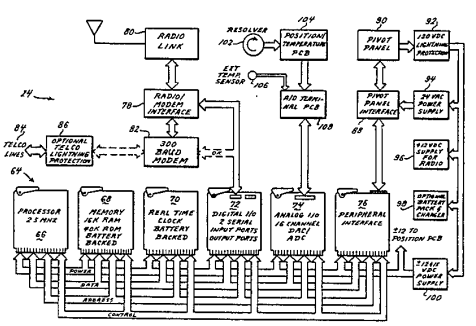

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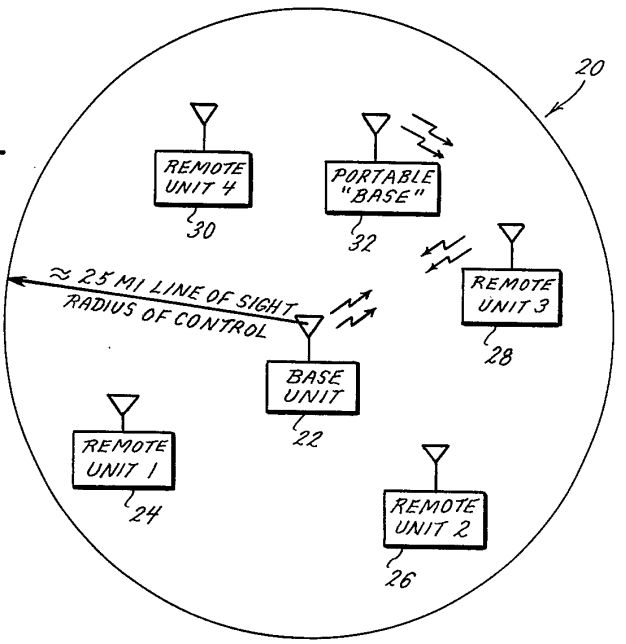
FIG. 1.


20
REMOTE UNIT 4
30
PORTABLE "BASE"
32
REMOTE UNIT 3
28
≈ 25 MI LINE OF SIGHT RADIUS OF CONTROL
BASE UNIT
22
REMOTE UNIT 1
24
REMOTE UNIT 2
26

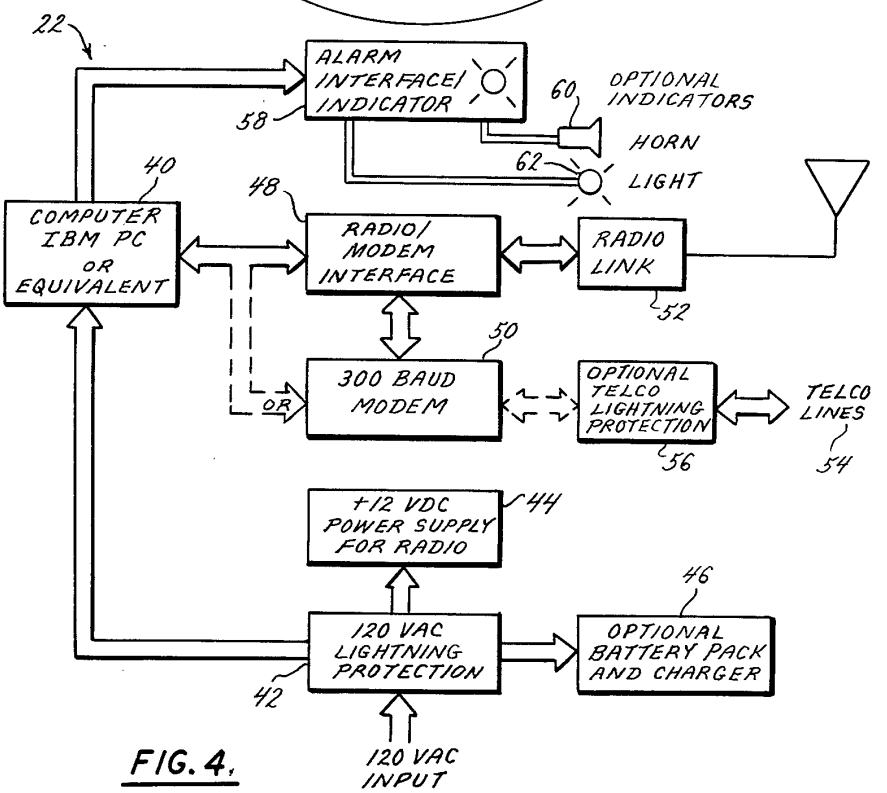

22
ALARM INTERFACE/ INDICATOR
58
60
OPTIONAL INDICATORS
HORN
62
LIGHT
40
COMPUTER IBM PC OR EQUIVALENT
48
RADIO/ MODEM INTERFACE
RADIO LINK
52
50
300 BAUD MODEM
OR
OPTIONAL TELCO LIGHTNING PROTECTION
56
TELCO LINES
54
+12 VDC POWER SUPPLY FOR RADIO
44
46
120 VAC LIGHTNING PROTECTION
42
OPTIONAL BATTERY PACK AND CHARGER
120 VAC INPUT

FIG. 4.

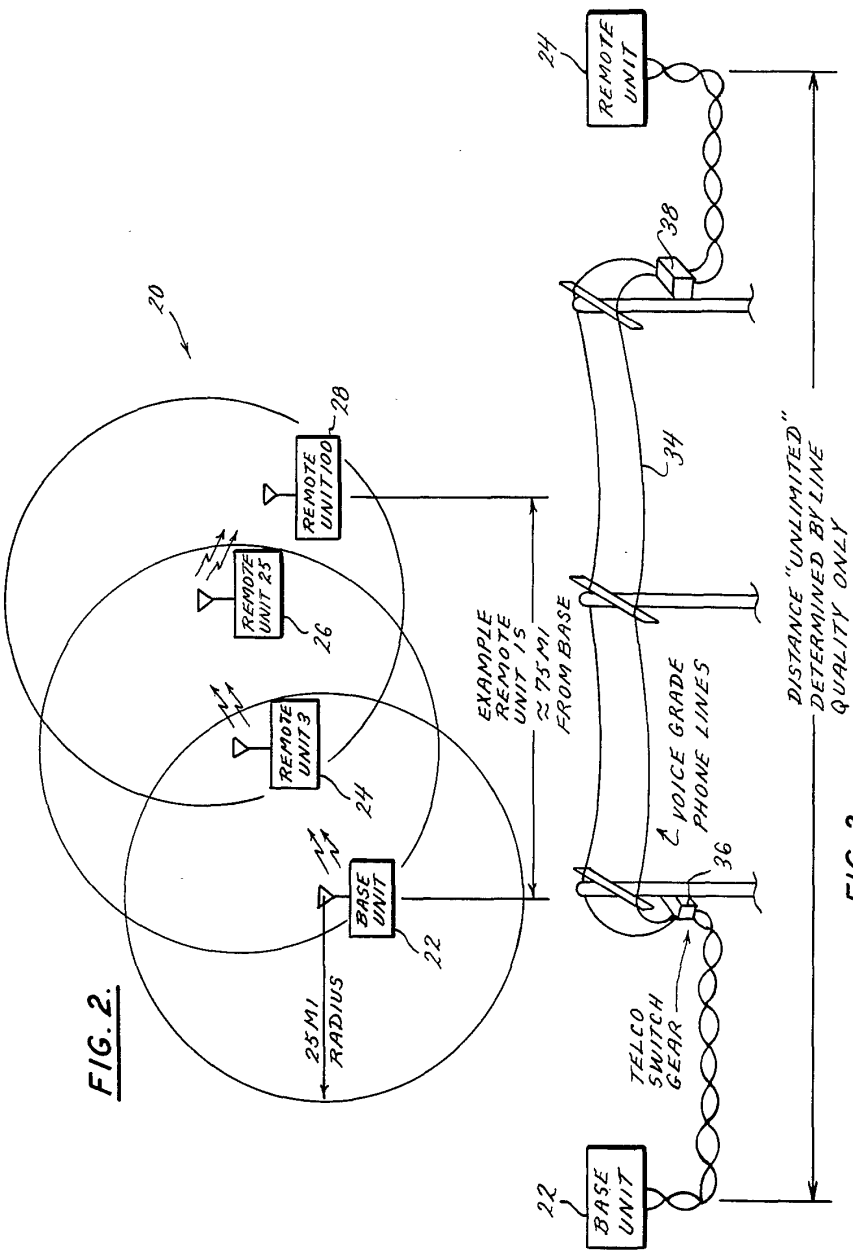

20
REMOTE UNIT 100
28
REMOTE UNIT 25
26
REMOTE UNIT 3
24
BASE UNIT
22
25 MI RADIUS
EXAMPLE REMOTE UNIT IS ≈ 75 MI FROM BASE
REMOTE UNIT
24
38
34
VOICE GRADE PHONE LINES
36
TELCO SWITCH GEAR
BASE UNIT
22
DISTANCE "UNLIMITED" DETERMINED BY LINE QUALITY ONLY

FIG. 2.

FIG. 3.

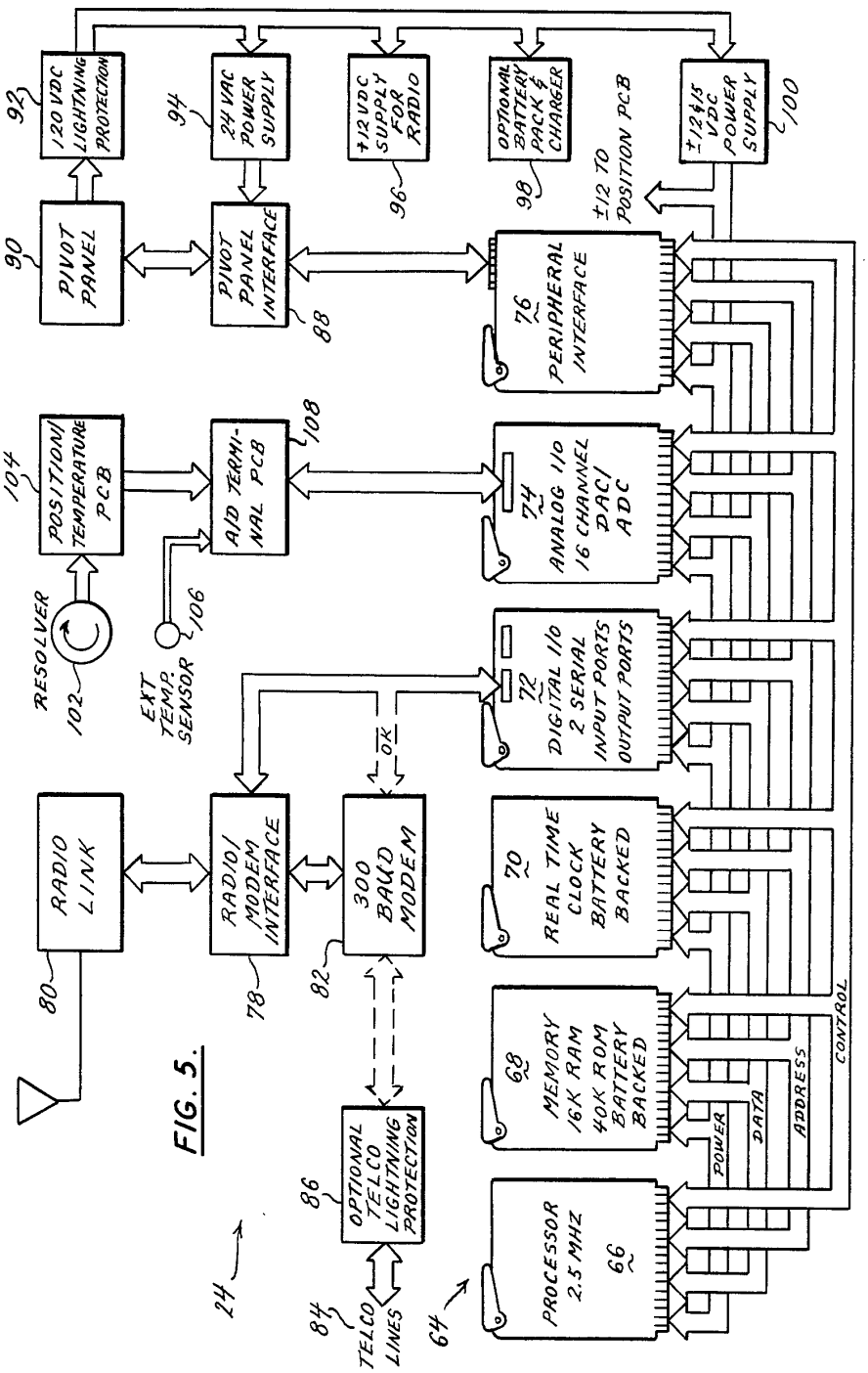

120 VDC LIGHTNING PROTECTION
92
24 VAC POWER SUPPLY
94
+12 VDC SUPPLY FOR RADIO
96
OPTIONAL BATTERY PACK & CHARGER
98
±12 TO POSITION PCB
±12&15 VDC POWER SUPPLY
100
PIVOT PANEL
90
PIVOT PANEL INTERFACE
88
76 PERIPHERAL INTERFACE
POSITION/ TEMPERATURE PCB
104
A/D TERMINAL PCB
108
74 ANALOG I/O 16 CHANNEL DAC/ ADC
RESOLVER
102
EXT TEMP. SENSOR
106
72 DIGITAL I/O 2 SERIAL INPUT PORTS OUTPUT PORTS
OK
RADIO LINK
80
RADIO/ MODEM INTERFACE
78
300 BAUD MODEM
82
70 REAL TIME CLOCK BATTERY BACKED
68 MEMORY 16K RAM 40K ROM BATTERY BACKED
POWER
DATA
ADDRESS
CONTROL
OPTIONAL TELCO LIGHTNING PROTECTION
86
TELCO LINES
84
PROCESSOR 2.5 MHZ 66
64
24

FIG. 5.

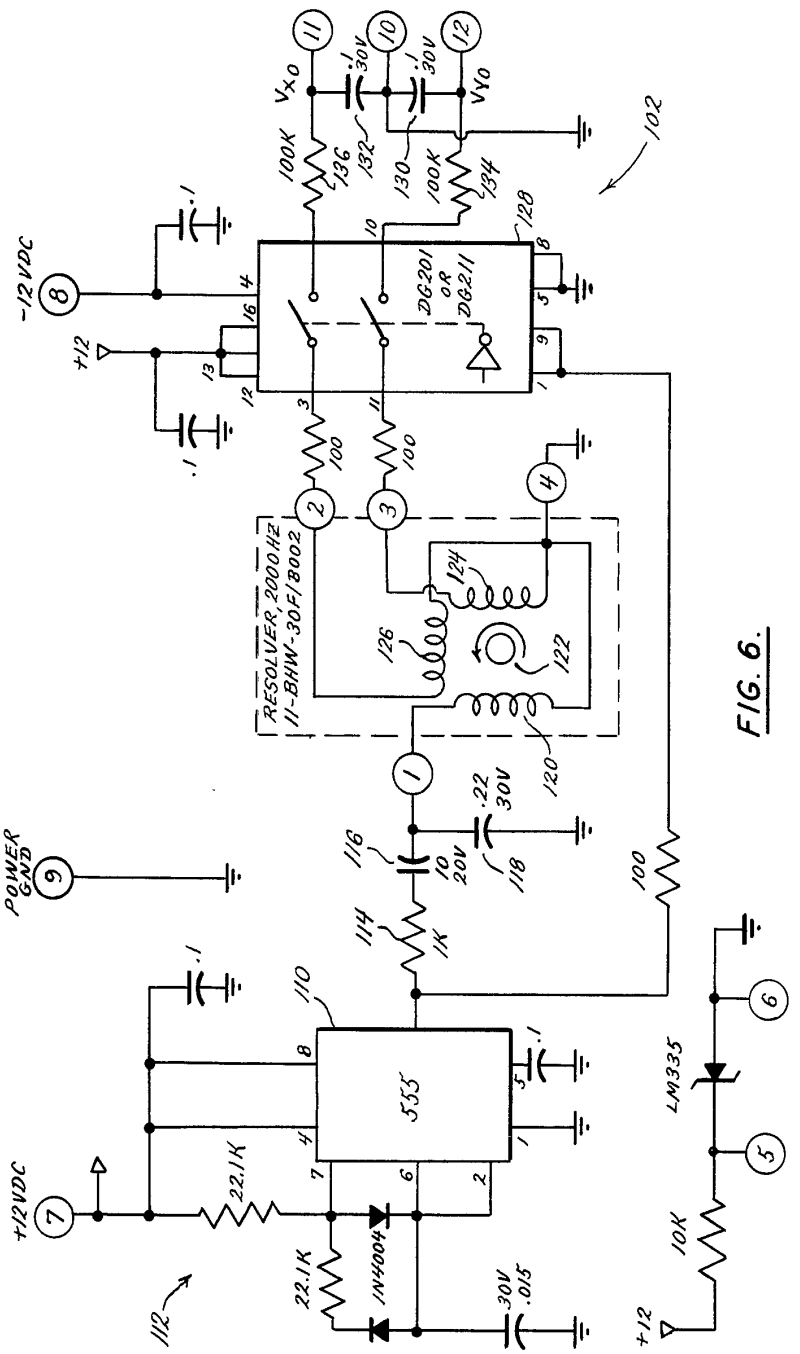

VXO
VYO
100K
136
132
130
100K
134
102
128
DG201 OR DG211
-12 VDC
+12
.1
100
100
RESOLVER, 2000HZ
11-BHW-30F/8002
124
126
122
120
.22 30V
116
10 20V
118
114
1K
100
POWER END
110
555
+12VDC
22.1K
22.1K
1N4004
30V .015
112
LM335
10K
+12

FIG. 6.

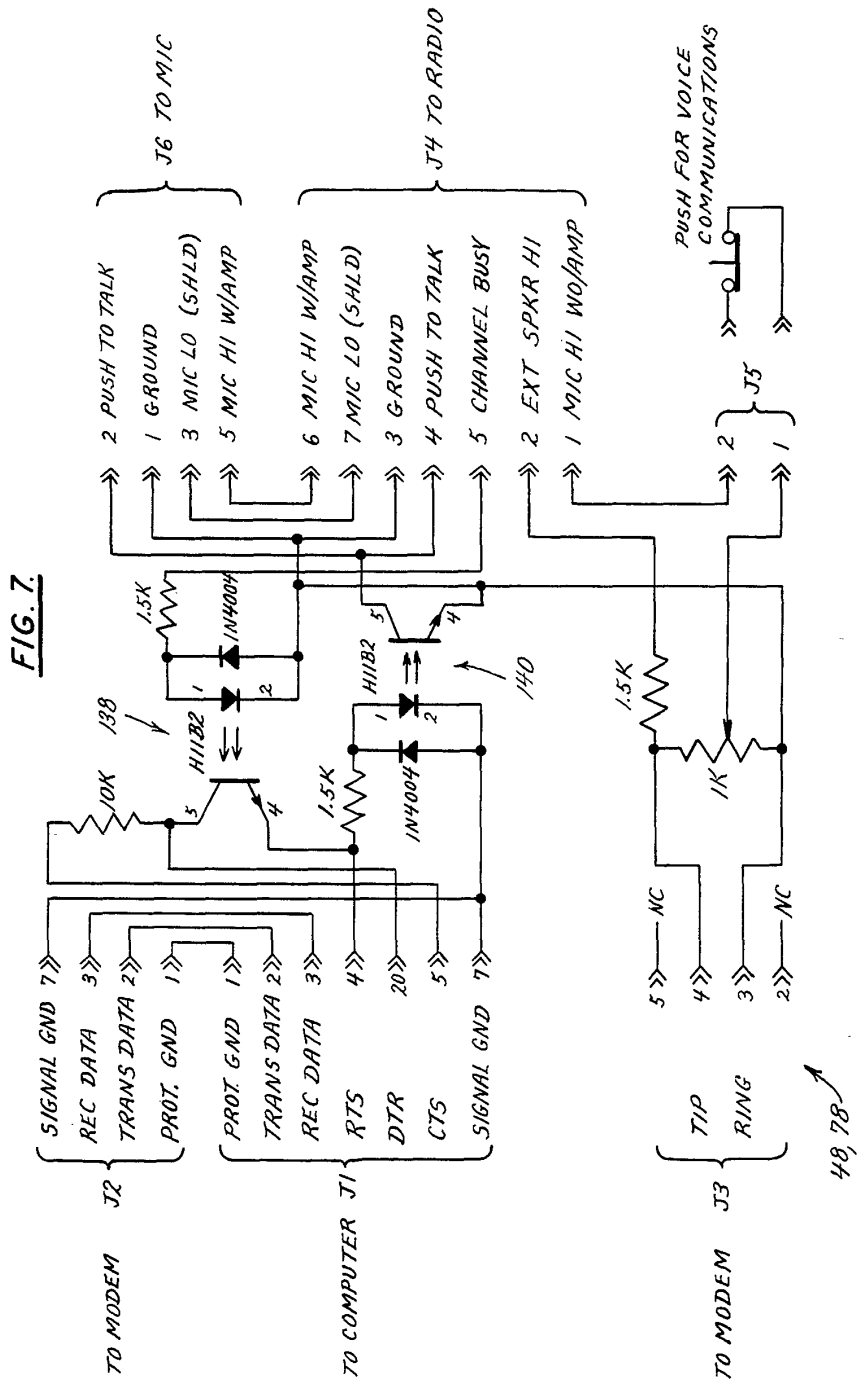

J6 TO MIC
2 PUSH TO TALK
1 GROUND
3 MIC LO (SHLD)
5 MIC HI W/AMP
J4 TO RADIO
6 MIC HI W/AMP
7 MIC LO (SHLD)
3 GROUND
4 PUSH TO TALK
5 CHANNEL BUSY
2 EXT SPKR HI
1 MIC HI WO/AMP
PUSH FOR VOICE COMMUNICATIONS
J5
2
1
1.5K
1N4004
H11B2
138
140
10K
1.5K
1K
SIGNAL GND 7
REC DATA 3
TRANS DATA 2
PROT. GND 1
PROT GND 1
TRANS DATA 2
REC DATA 3
RTS 4
DTR 20
CTS 5
SIGNAL GND 7
NC 5
NC 4
NC 3
NC 2
TIP
RING
J2
J1
J3
TO MODEM
TO COMPUTER
TO MODEM
48, 78

FIG. 7.

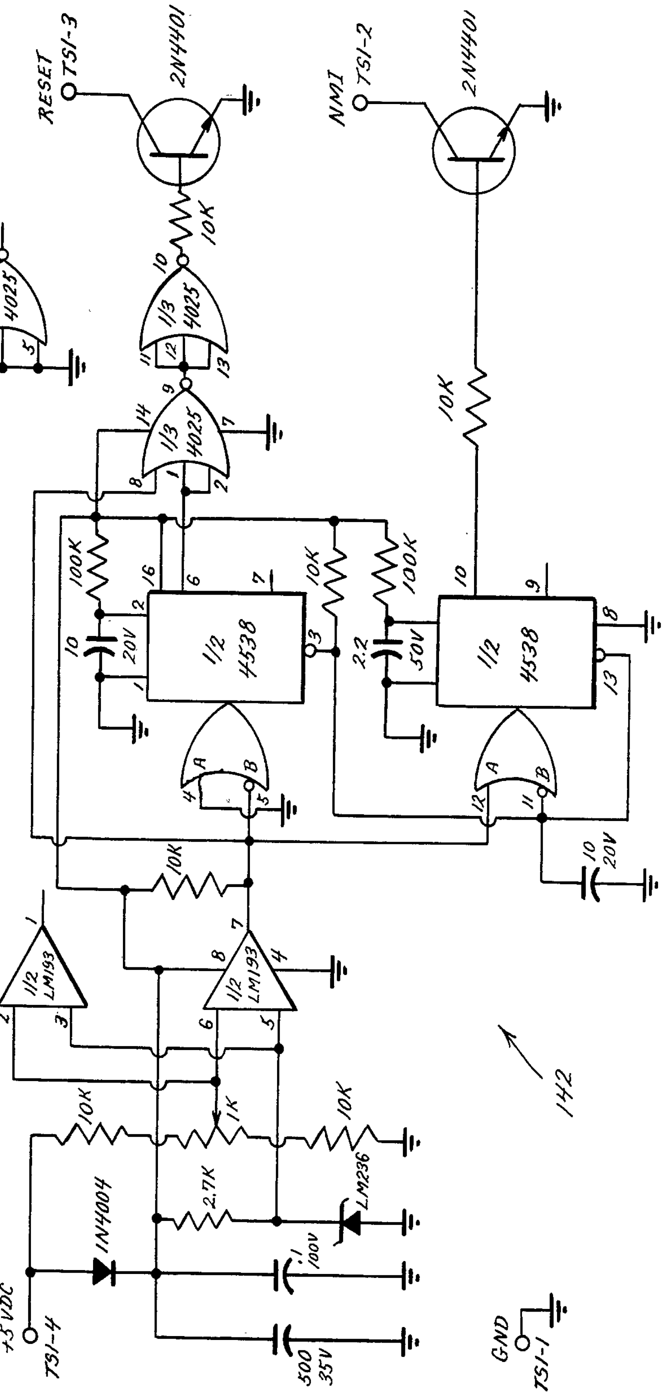

RESET
TS1-3
2N4401
10K
1/3 4025
NMI
TS1-2
1/2 4538
100K
10K
2.2 50V
10 20V
1/2 LM193
1K
2.7K
LM236
1N4004
+5VDC
TS1-4
.1 100V
500 35V
GND
TS1-1
142

FIG. 8.

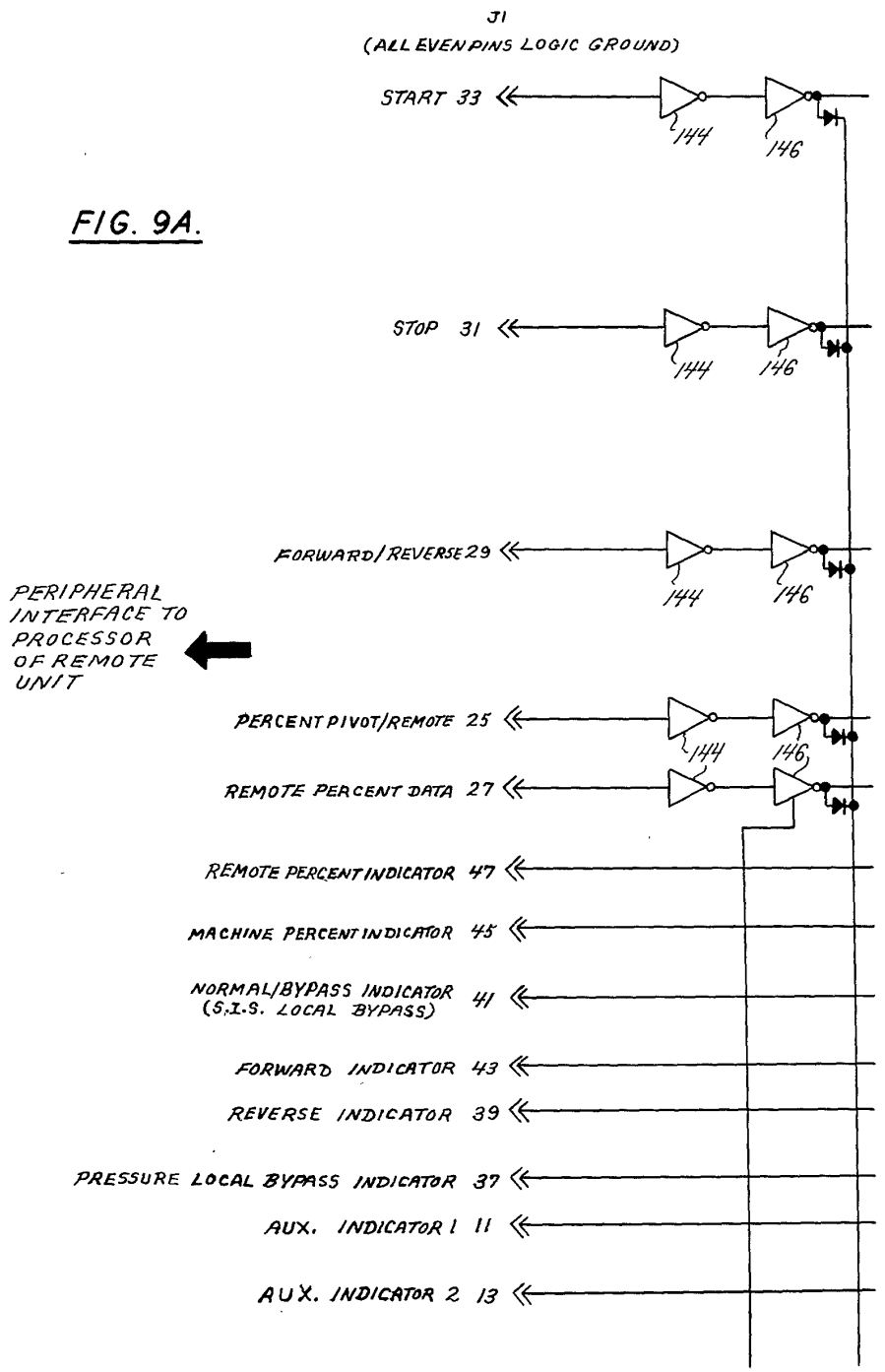
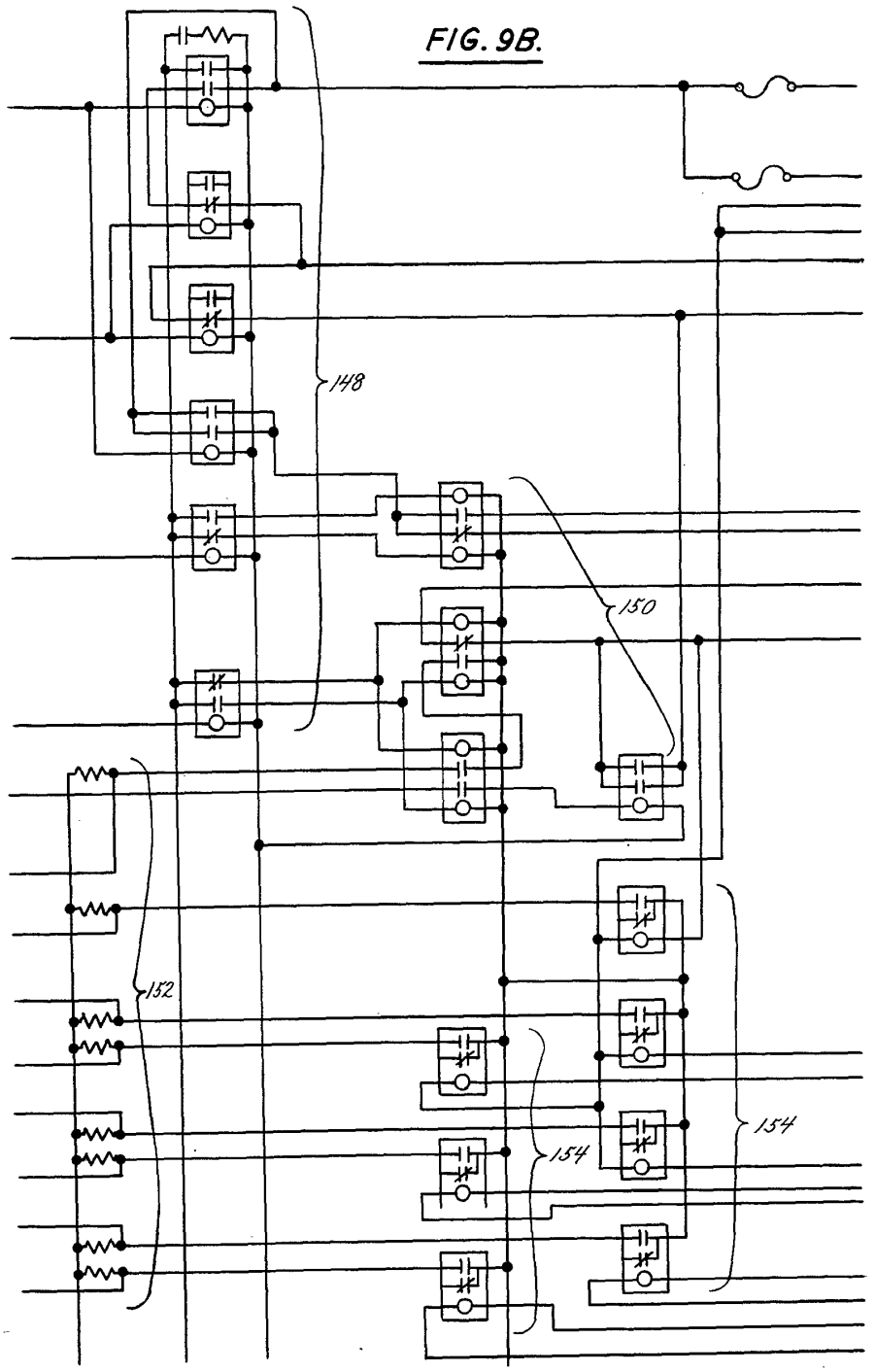

J1
(ALL EVEN PINS LOGIC GROUND)
START 33
144
146
STOP 31
144
146
FORWARD/REVERSE 29
144
146
PERIPHERAL INTERFACE TO PROCESSOR OF REMOTE UNIT
PERCENT PIVOT/REMOTE 25
144
146
REMOTE PERCENT DATA 27
REMOTE PERCENT INDICATOR 47
MACHINE PERCENT INDICATOR 45
NORMAL/BYPASS INDICATOR (S.I.S. LOCAL BYPASS) 41
FORWARD INDICATOR 43
REVERSE INDICATOR 39
PRESSURE LOCAL BYPASS INDICATOR 37
AUX. INDICATOR 1 11
AUX. INDICATOR 2 13

FIG. 9A.

FIG. 9B.



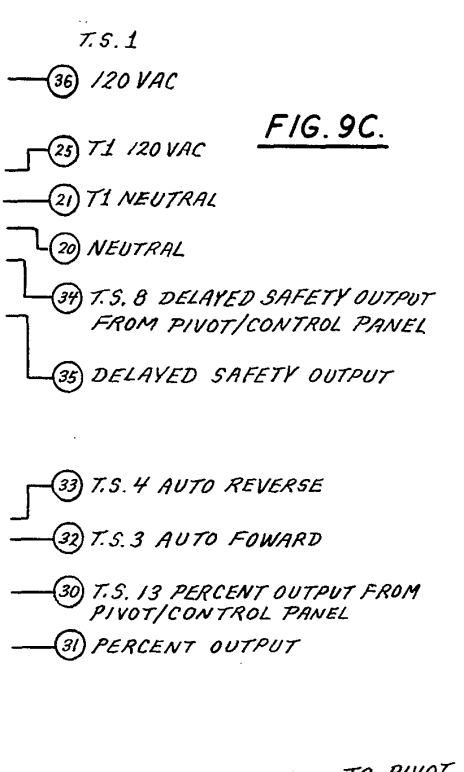


FIG. 9C.

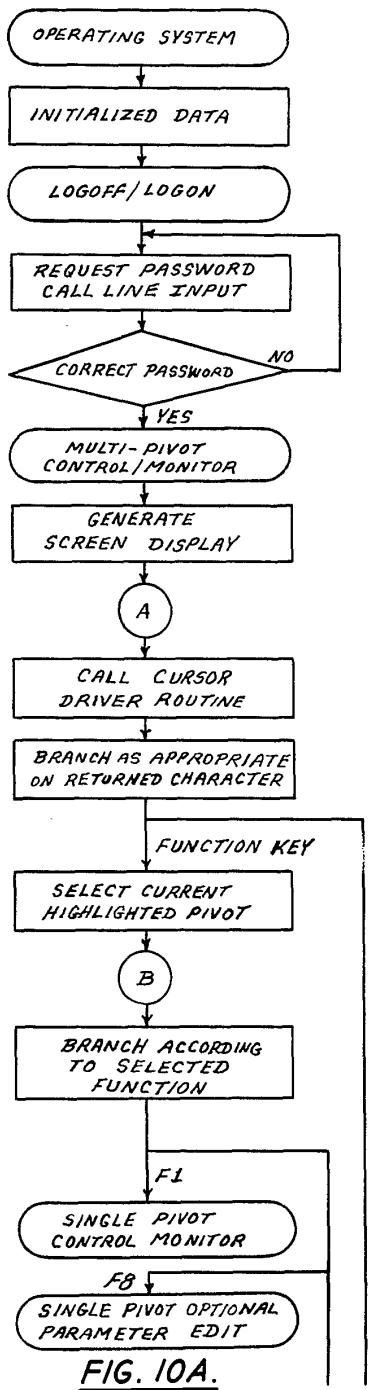


FIG. 10A.

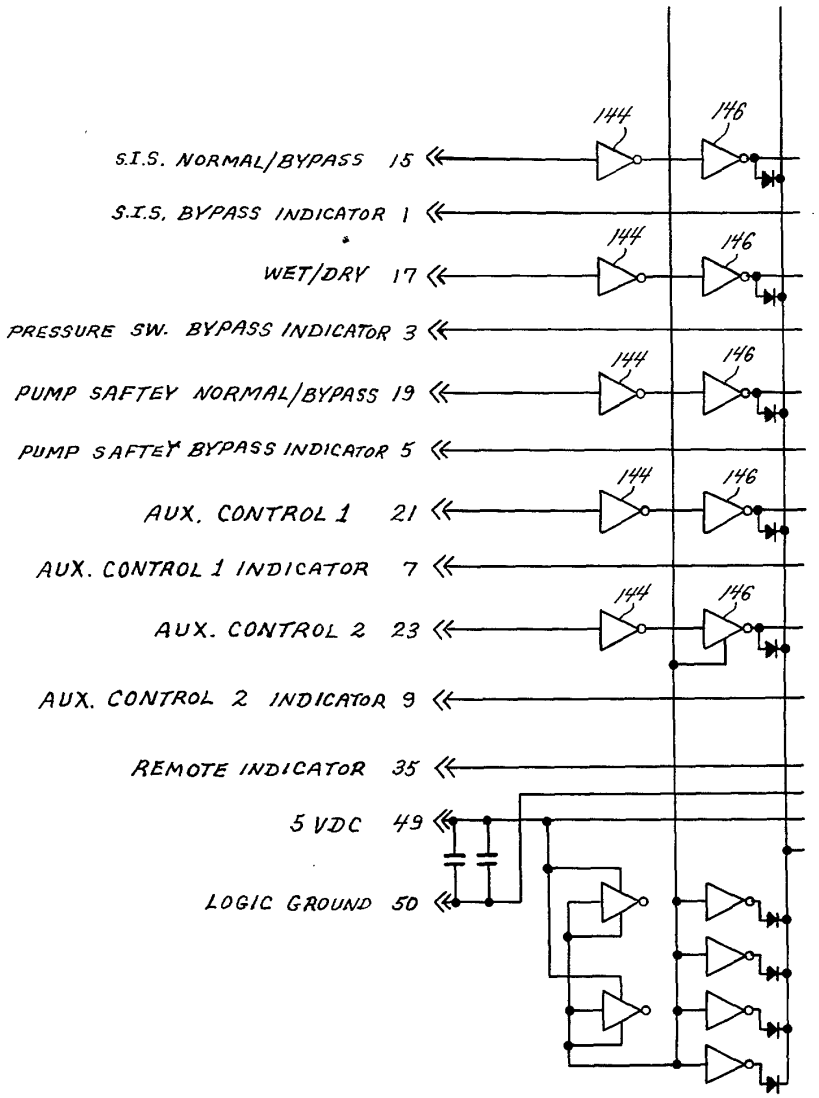

144
146
S.I.S. NORMAL/BYPASS 15
S.I.S. BYPASS INDICATOR 1
WET/DRY 17
PRESSURE SW. BYPASS INDICATOR 3
PUMP SAFTEY NORMAL/BYPASS 19
PUMP SAFTEY BYPASS INDICATOR 5
AUX. CONTROL 1 21
AUX. CONTROL 1 INDICATOR 7
AUX. CONTROL 2 23
AUX. CONTROL 2 INDICATOR 9
REMOTE INDICATOR 35
5 VDC 49
LOGIC GROUND 50

FIG. 9D.

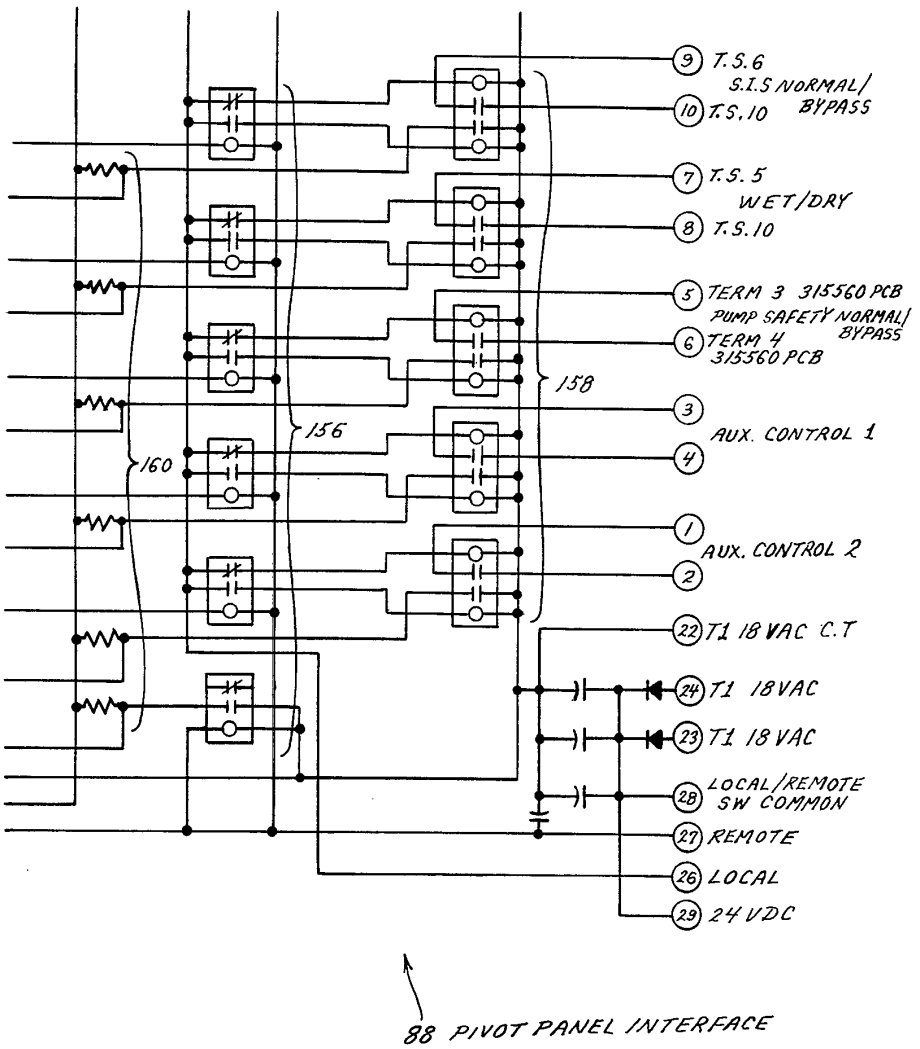

9 T.S.6
S.I.S NORMAL/
10 T.S.10 BYPASS
7 T.S.5
WET/DRY
8 T.S.10
5 TERM 3 315560 PCB
PUMP SAFETY NORMAL/
6 TERM 4 BYPASS
315560 PCB
3
AUX. CONTROL 1
4
1
AUX. CONTROL 2
2
22 T1 18 VAC C.T
24 T1 18VAC
23 T1 18 VAC
28 LOCAL/REMOTE
SW COMMON
27 REMOTE
26 LOCAL
29 24 VDC
158
156
160
88 PIVOT PANEL INTERFACE

FIG. 9E.

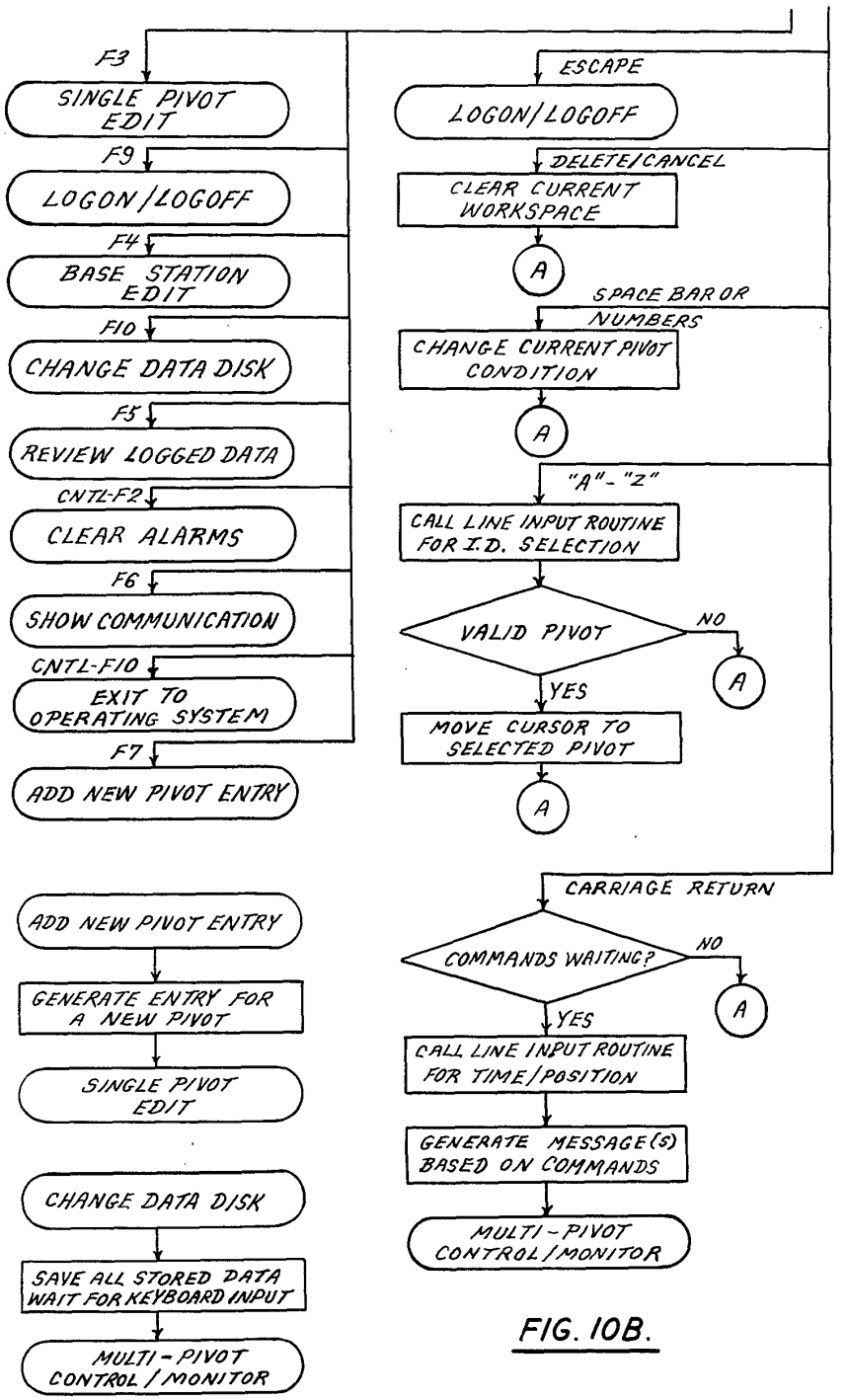

F3
SINGLE PIVOT EDIT
F9
LOGON/LOGOFF
F4
BASE STATION EDIT
F10
CHANGE DATA DISK
F5
REVIEW LOGGED DATA
CNTL-F2
CLEAR ALARMS
F6
SHOW COMMUNICATION
CNTL-F10
EXIT TO OPERATING SYSTEM
F7
ADD NEW PIVOT ENTRY
ESCAPE
LOGON/LOGOFF
DELETE/CANCEL
CLEAR CURRENT WORKSPACE
A
SPACE BAR OR NUMBERS
CHANGE CURRENT PIVOT CONDITION
A
"A" - "Z"
CALL LINE INPUT ROUTINE FOR I.D. SELECTION
VALID PIVOT
NO
A
YES
MOVE CURSOR TO SELECTED PIVOT
A
CARRIAGE RETURN
COMMANDS WAITING?
NO
A
YES
CALL LINE INPUT ROUTINE FOR TIME/POSITION
GENERATE MESSAGE(S) BASED ON COMMANDS
MULTI-PIVOT CONTROL/MONITOR
ADD NEW PIVOT ENTRY
GENERATE ENTRY FOR A NEW PIVOT
SINGLE PIVOT EDIT
CHANGE DATA DISK
SAVE ALL STORED DATA WAIT FOR KEYBOARD INPUT
MULTI-PIVOT CONTROL/MONITOR

FIG. 10B.

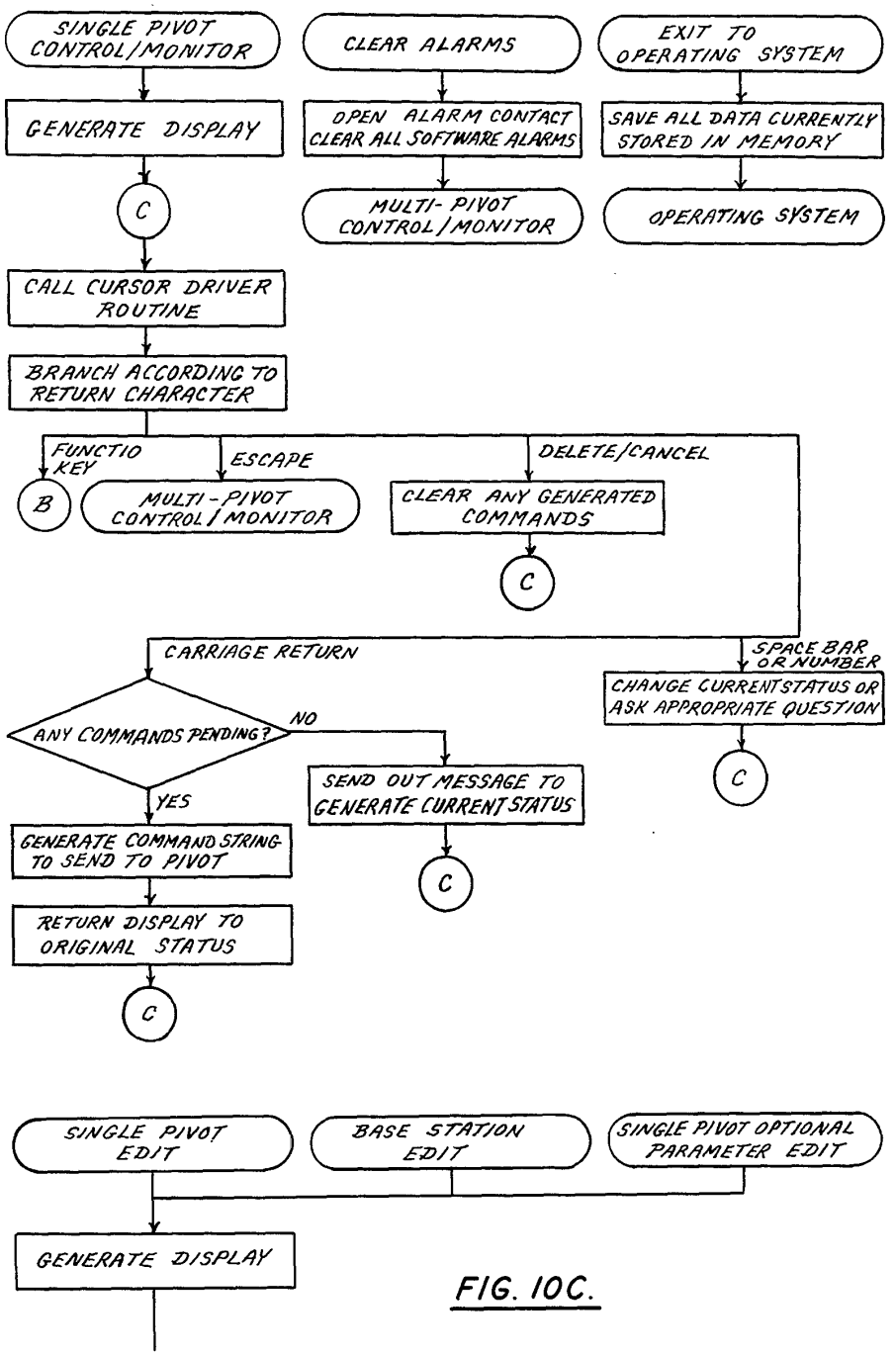

SINGLE PIVOT CONTROL/MONITOR
CLEAR ALARMS
EXIT TO OPERATING SYSTEM
GENERATE DISPLAY
OPEN ALARM CONTACT CLEAR ALL SOFTWARE ALARMS
SAVE ALL DATA CURRENTLY STORED IN MEMORY
C
MULTI- PIVOT CONTROL/MONITOR
OPERATING SYSTEM
CALL CURSOR DRIVER ROUTINE
BRANCH ACCORDING TO RETURN CHARACTER
FUNCTIO KEY
ESCAPE
DELETE/CANCEL
B
MULTI-PIVOT CONTROL/MONITOR
CLEAR ANY GENERATED COMMANDS
C
CARRIAGE RETURN
SPACE BAR OR NUMBER
CHANGE CURRENTSTATUS OR ASK APPROPRIATE QUESTION
ANY COMMANDS PENDING?
NO
C
YES
SEND OUT MESSAGE TO GENERATE CURRENT STATUS
GENERATE COMMAND STRING TO SEND TO PIVOT
C
RETURN DISPLAY TO ORIGINAL STATUS
C
SINGLE PIVOT EDIT
BASE STATION EDIT
SINGLE PIVOT OPTIONAL PARAMETER EDIT
GENERATE DISPLAY

FIG. 10C.

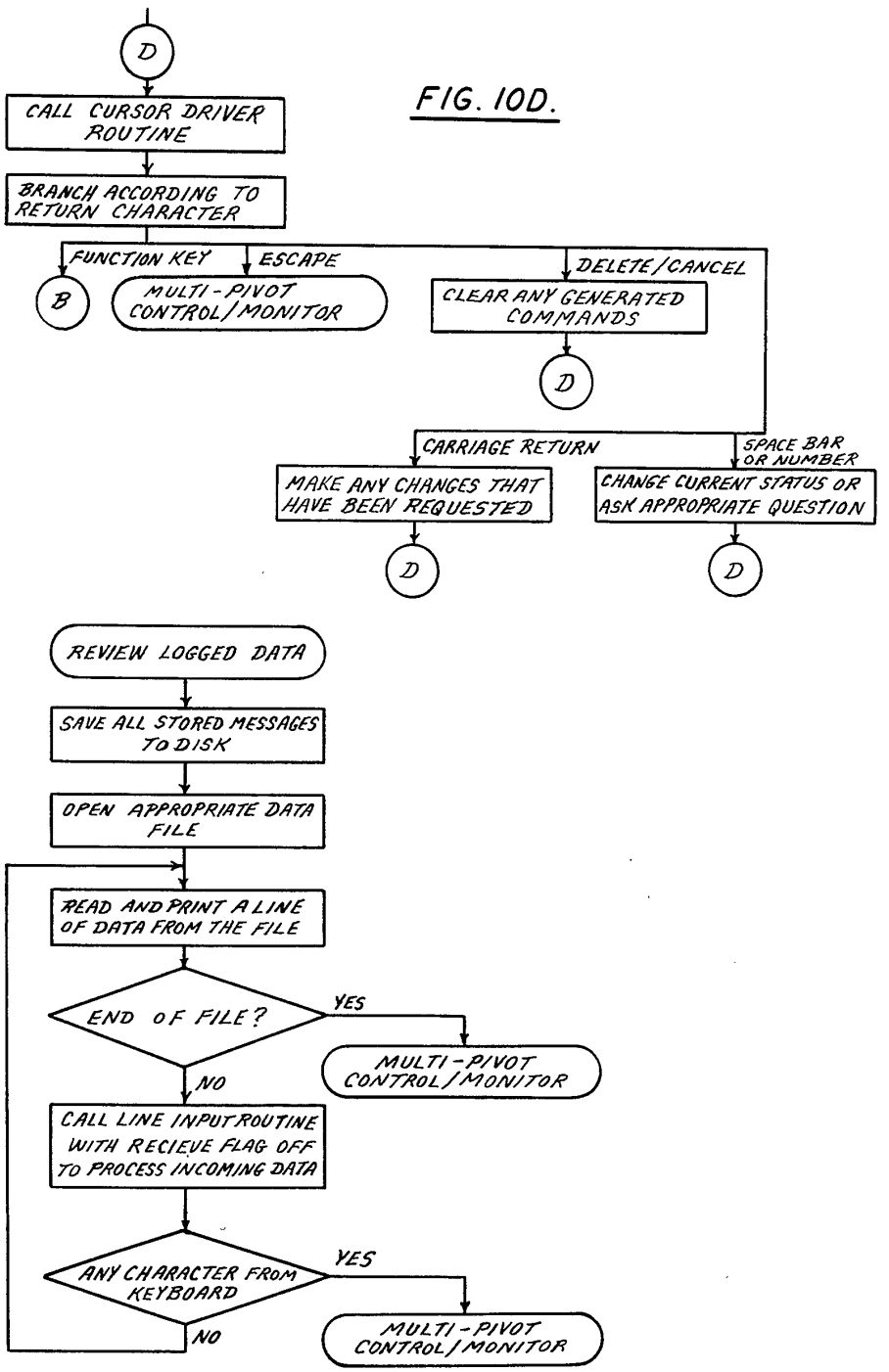

D
CALL CURSOR DRIVER ROUTINE
BRANCH ACCORDING TO RETURN CHARACTER
FUNCTION KEY
ESCAPE
DELETE/CANCEL
B
MULTI-PIVOT CONTROL/MONITOR
CLEAR ANY GENERATED COMMANDS
D
CARRIAGE RETURN
SPACE BAR OR NUMBER
MAKE ANY CHANGES THAT HAVE BEEN REQUESTED
CHANGE CURRENT STATUS OR ASK APPROPRIATE QUESTION
D
D
REVIEW LOGGED DATA
SAVE ALL STORED MESSAGES TO DISK
OPEN APPROPRIATE DATA FILE
READ AND PRINT A LINE OF DATA FROM THE FILE
END OF FILE?
YES
NO
MULTI-PIVOT CONTROL/MONITOR
CALL LINE INPUT ROUTINE WITH RECIEVE FLAG OFF TO PROCESS INCOMING DATA
ANY CHARACTER FROM KEYBOARD
YES
NO
MULTI-PIVOT CONTROL/MONITOR

FIG. 10D.

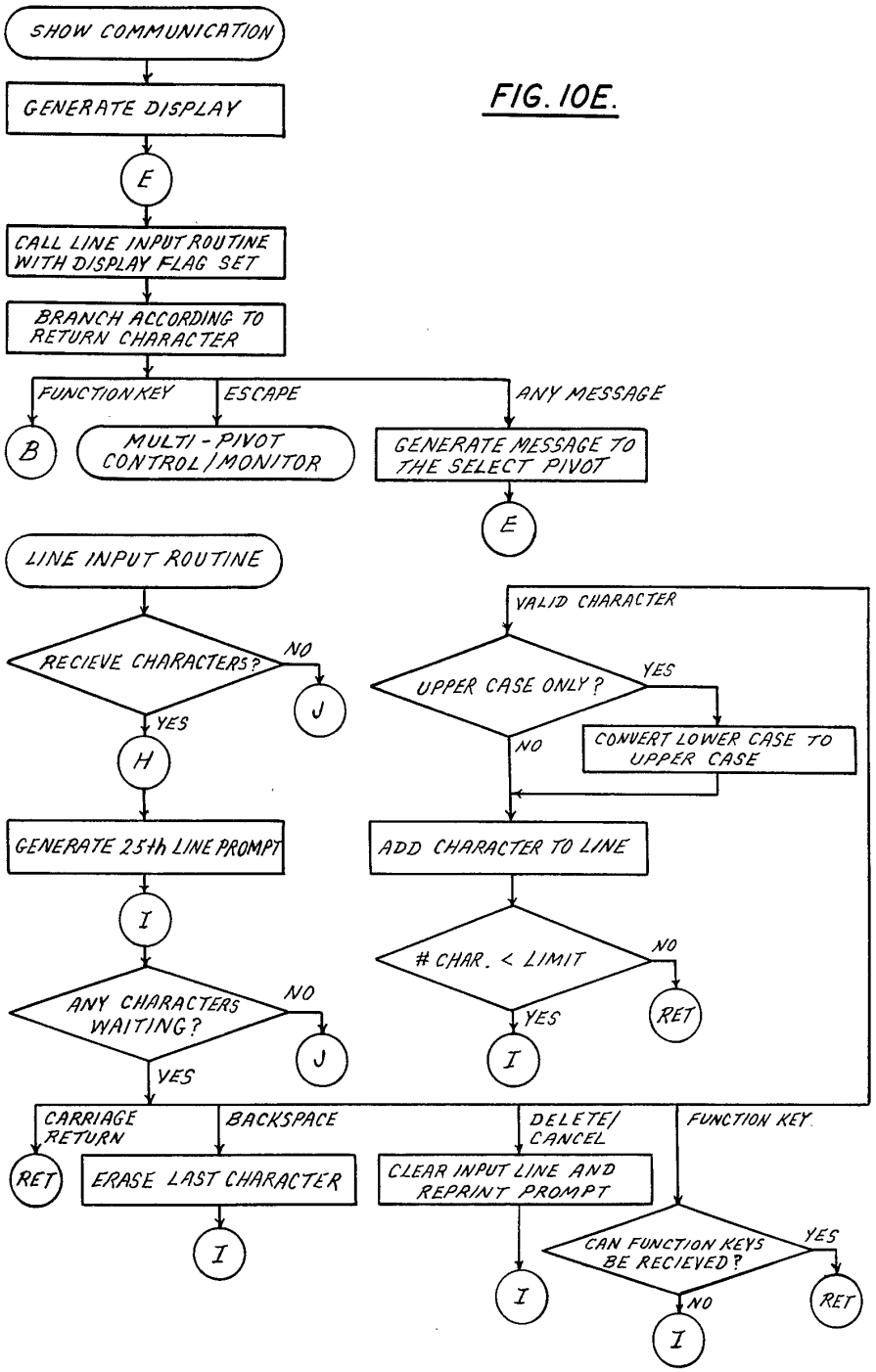

SHOW COMMUNICATION
GENERATE DISPLAY
E
CALL LINE INPUT ROUTINE WITH DISPLAY FLAG SET
BRANCH ACCORDING TO RETURN CHARACTER
FUNCTION KEY
ESCAPE
ANY MESSAGE
B
MULTI-PIVOT CONTROL/MONITOR
GENERATE MESSAGE TO THE SELECT PIVOT
E
LINE INPUT ROUTINE
RECIEVE CHARACTERS?
NO
J
YES
H
GENERATE 25th LINE PROMPT
I
ANY CHARACTERS WAITING?
NO
J
YES
CARRIAGE RETURN
BACKSPACE
RET
ERASE LAST CHARACTER
I
VALID CHARACTER
UPPER CASE ONLY?
YES
CONVERT LOWER CASE TO UPPER CASE
NO
ADD CHARACTER TO LINE
CHAR. < LIMIT
NO
RET
YES
I
DELETE/ CANCEL
FUNCTION KEY
CLEAR INPUT LINE AND REPRINT PROMPT
CAN FUNCTION KEYS BE RECIEVED?
YES
RET
NO
I
I

FIG. 10E.

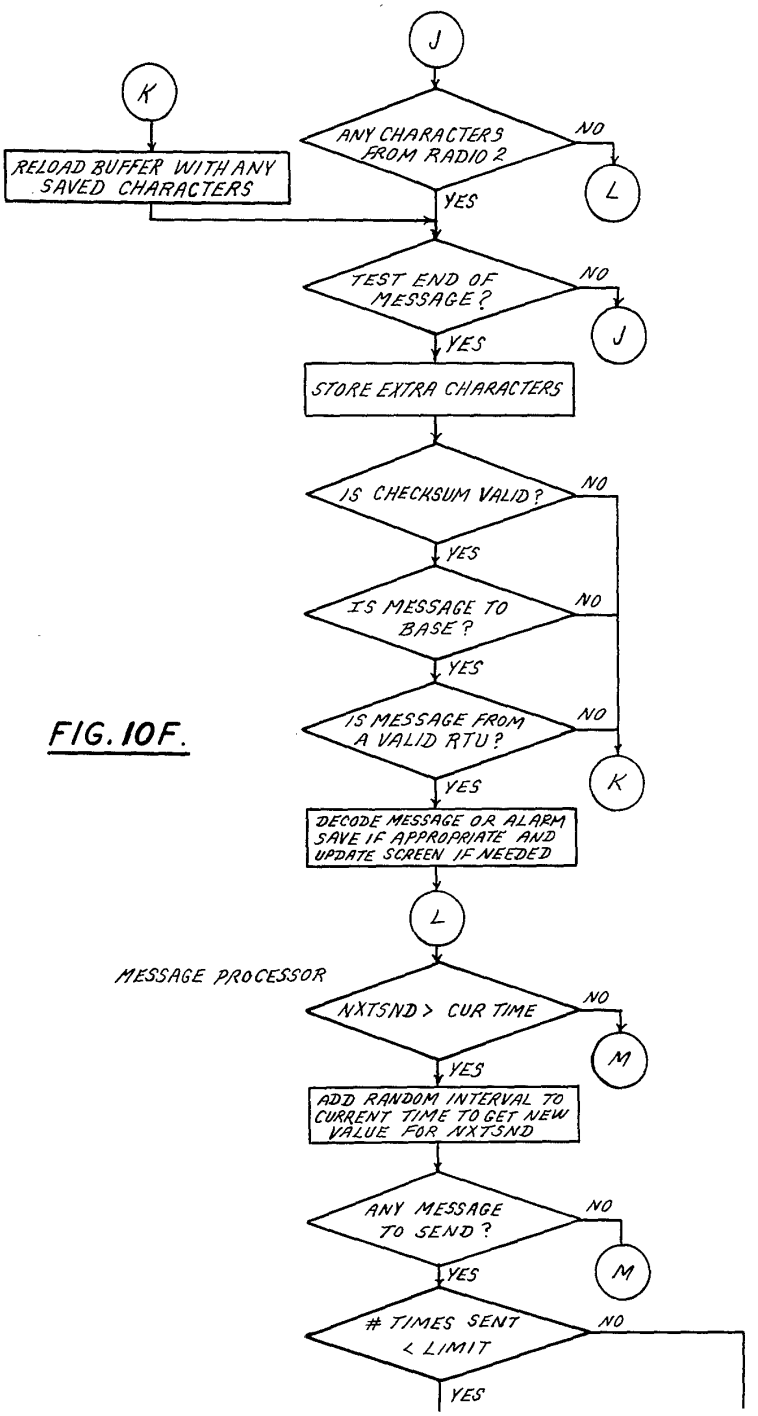

J
K
ANY CHARACTERS FROM RADIO 2
NO
YES
L
RELOAD BUFFER WITH ANY SAVED CHARACTERS
TEST END OF MESSAGE?
NO
YES
J
STORE EXTRA CHARACTERS
IS CHECKSUM VALID?
NO
YES
IS MESSAGE TO BASE?
NO
YES
IS MESSAGE FROM A VALID RTU?
NO
YES
K
DECODE MESSAGE OR ALARM SAVE IF APPROPRIATE AND UPDATE SCREEN IF NEEDED
L
MESSAGE PROCESSOR
NXTSND > CUR TIME
NO
YES
M
ADD RANDOM INTERVAL TO CURRENT TIME TO GET NEW VALUE FOR NXTSND
ANY MESSAGE TO SEND?
NO
YES
M
TIMES SENT < LIMIT
NO
YES

FIG. 10F.

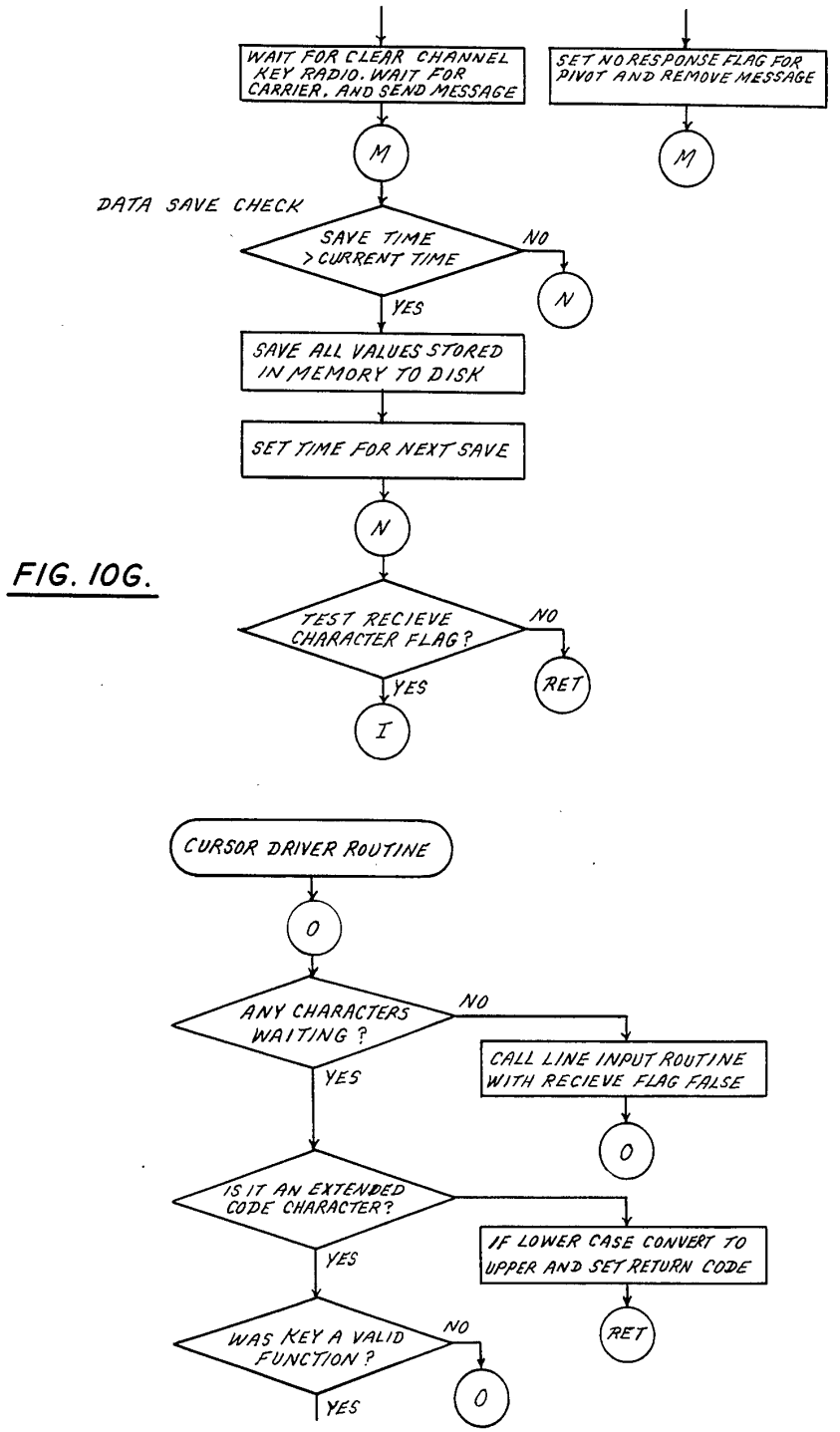

WAIT FOR CLEAR CHANNEL KEY RADIO. WAIT FOR CARRIER, AND SEND MESSAGE
SET NO RESPONSE FLAG FOR PIVOT AND REMOVE MESSAGE
M
M
DATA SAVE CHECK
SAVE TIME > CURRENT TIME
NO
N
YES
SAVE ALL VALUES STORED IN MEMORY TO DISK
SET TIME FOR NEXT SAVE
N
TEST RECIEVE CHARACTER FLAG?
NO
RET
YES
I
CURSOR DRIVER ROUTINE
O
ANY CHARACTERS WAITING ?
NO
CALL LINE INPUT ROUTINE WITH RECIEVE FLAG FALSE
YES
O
IS IT AN EXTENDED CODE CHARACTER?
IF LOWER CASE CONVERT TO UPPER AND SET RETURN CODE
YES
RET
WAS KEY A VALID FUNCTION ?
NO
O
YES

FIG. 10G.

FIG. 10H.

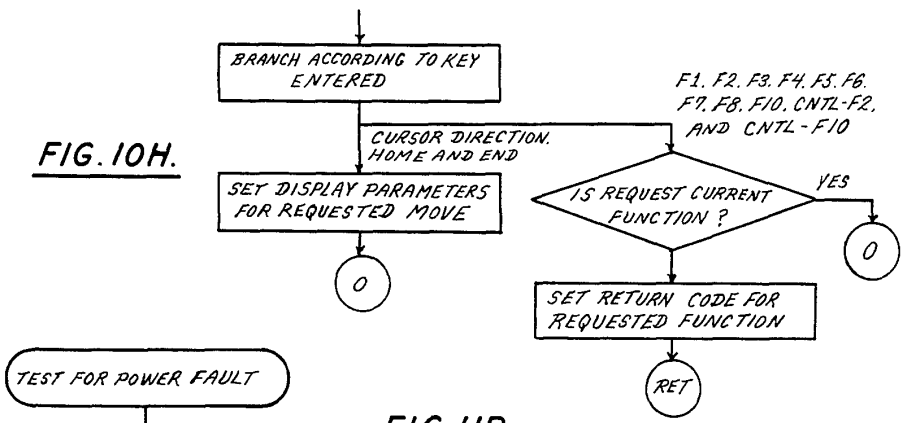
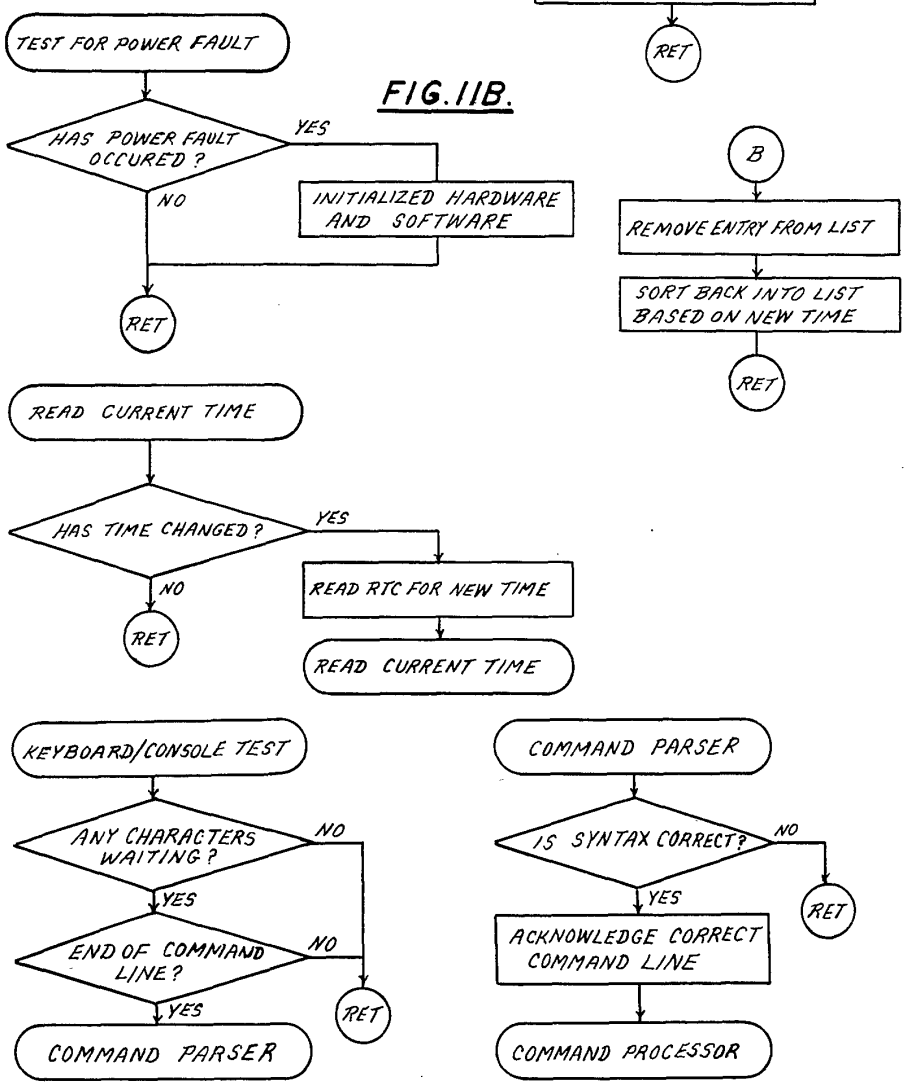


FIG. 11B.



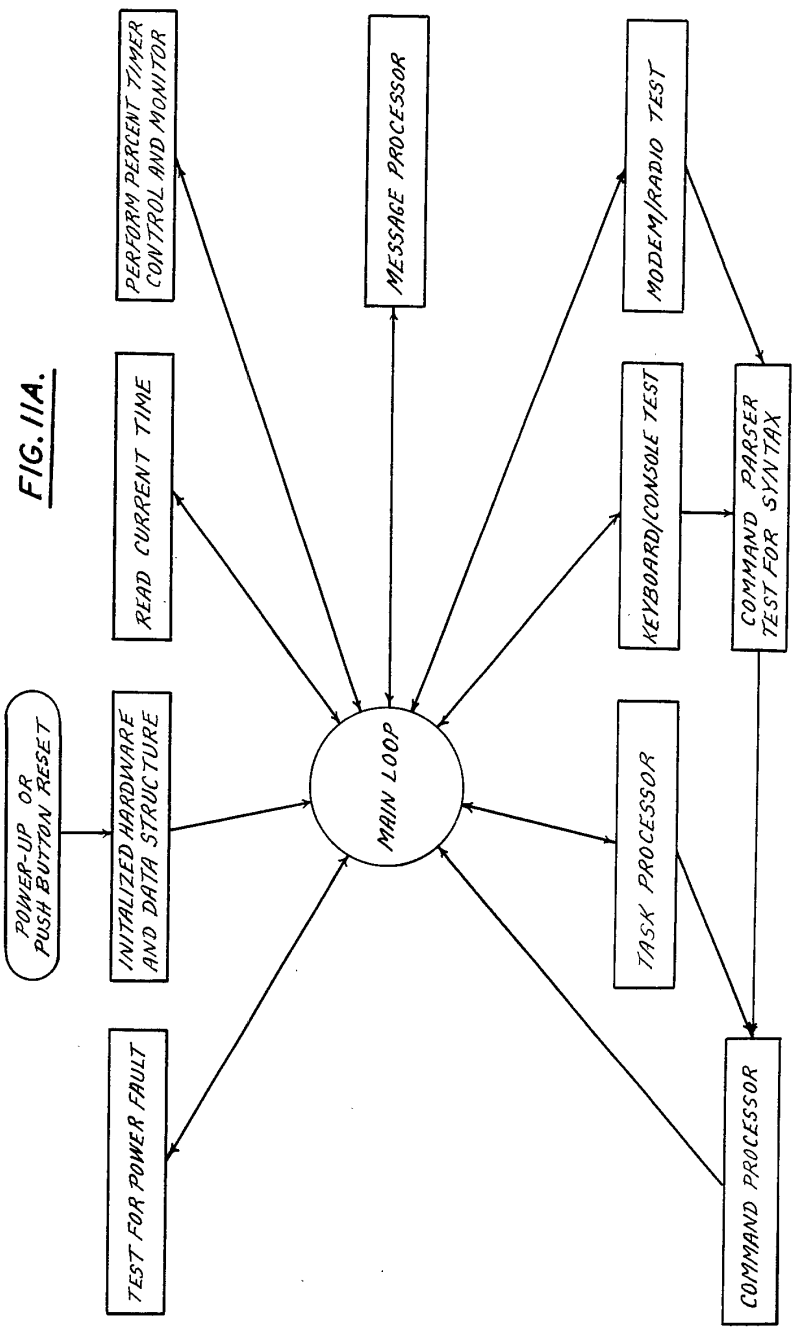
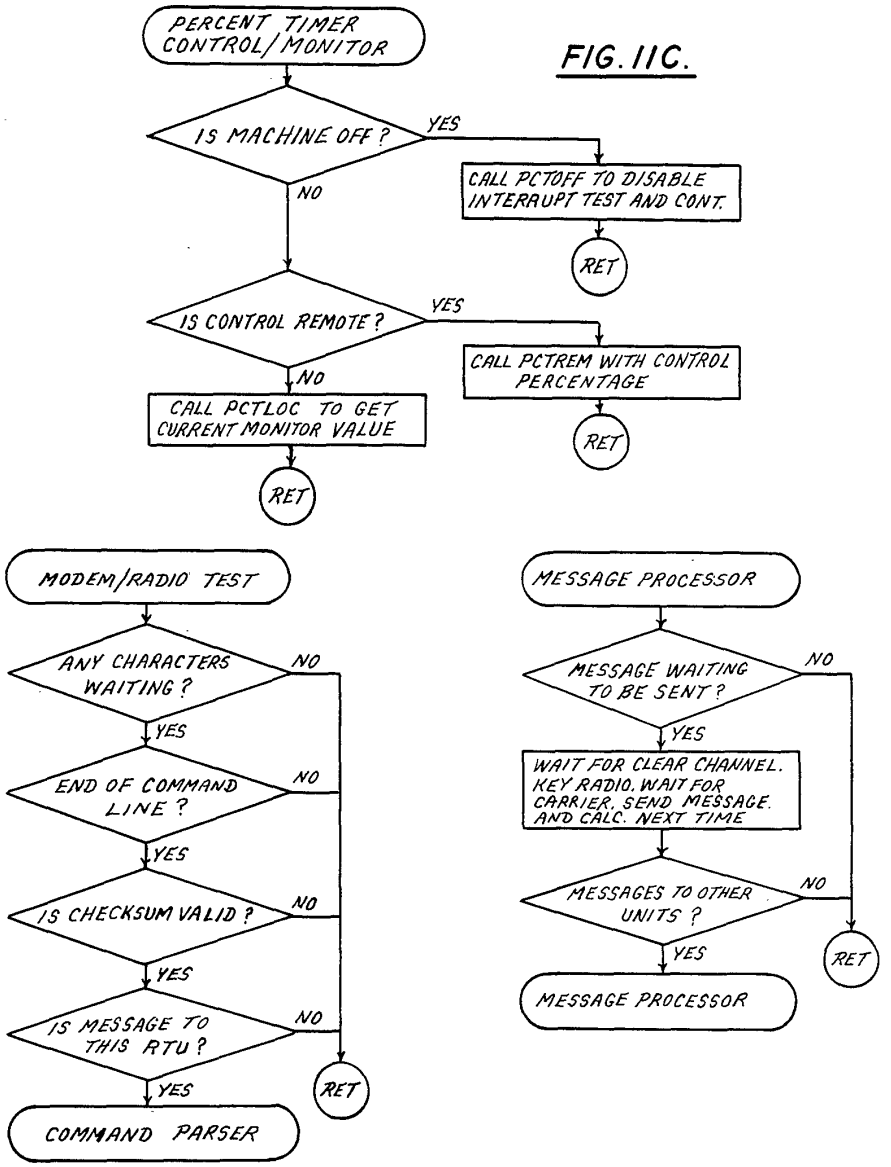

POWER-UP OR PUSH BUTTON RESET
INITALIZED HARDWARE AND DATA STRUCTURE
READ CURRENT TIME
PERFORM PERCENT TIMER CONTROL AND MONITOR
TEST FOR POWER FAULT
MESSAGE PROCESSOR
MAIN LOOP
MODEM/RADIO TEST
KEYBOARD/CONSOLE TEST
COMMAND PARSER TEST FOR SYNTAX
TASK PROCESSOR
COMMAND PROCESSOR

FIG. IIA.

FIG. IIC.


PERCENT TIMER CONTROL/MONITOR
IS MACHINE OFF ?
YES
NO
CALL PCTOFF TO DISABLE INTERRUPT TEST AND CONT.
RET
IS CONTROL REMOTE ?
YES
NO
CALL PCTREM WITH CONTROL PERCENTAGE
RET
CALL PCTLOC TO GET CURRENT MONITOR VALUE
RET
MODEM/RADIO TEST
ANY CHARACTERS WAITING ?
NO
YES
END OF COMMAND LINE ?
NO
YES
IS CHECKSUM VALID ?
NO
YES
IS MESSAGE TO THIS RTU ?
NO
YES
RET
COMMAND PARSER
MESSAGE PROCESSOR
MESSAGE WAITING TO BE SENT ?
NO
YES
WAIT FOR CLEAR CHANNEL. KEY RADIO. WAIT FOR CARRIER. SEND MESSAGE. AND CALC. NEXT TIME
MESSAGES TO OTHER UNITS ?
NO
YES
RET
MESSAGE PROCESSOR

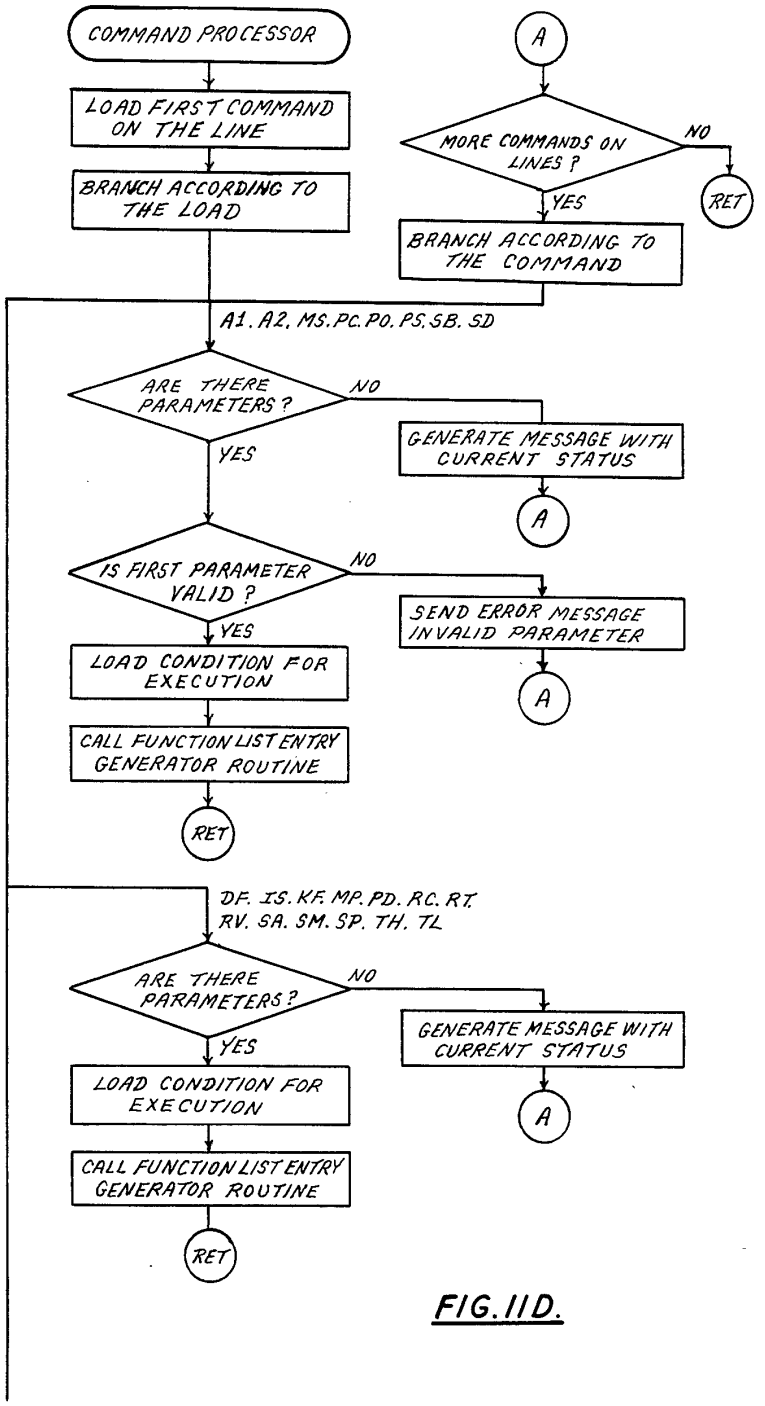

COMMAND PROCESSOR
LOAD FIRST COMMAND ON THE LINE
BRANCH ACCORDING TO THE LOAD
A
MORE COMMANDS ON LINES ?
NO
YES
RET
BRANCH ACCORDING TO THE COMMAND
A1. A2. MS. PC. PO. PS. SB. SD
ARE THERE PARAMETERS ?
NO
YES
GENERATE MESSAGE WITH CURRENT STATUS
A
IS FIRST PARAMETER VALID ?
NO
YES
SEND ERROR MESSAGE INVALID PARAMETER
A
LOAD CONDITION FOR EXECUTION
CALL FUNCTION LIST ENTRY GENERATOR ROUTINE
RET
DF. IS. KF. MP. PD. RC. RT. RV. SA. SM. SP. TH. TL
ARE THERE PARAMETERS ?
NO
YES
GENERATE MESSAGE WITH CURRENT STATUS
A
LOAD CONDITION FOR EXECUTION
CALL FUNCTION LIST ENTRY GENERATOR ROUTINE
RET

FIG. 11D.

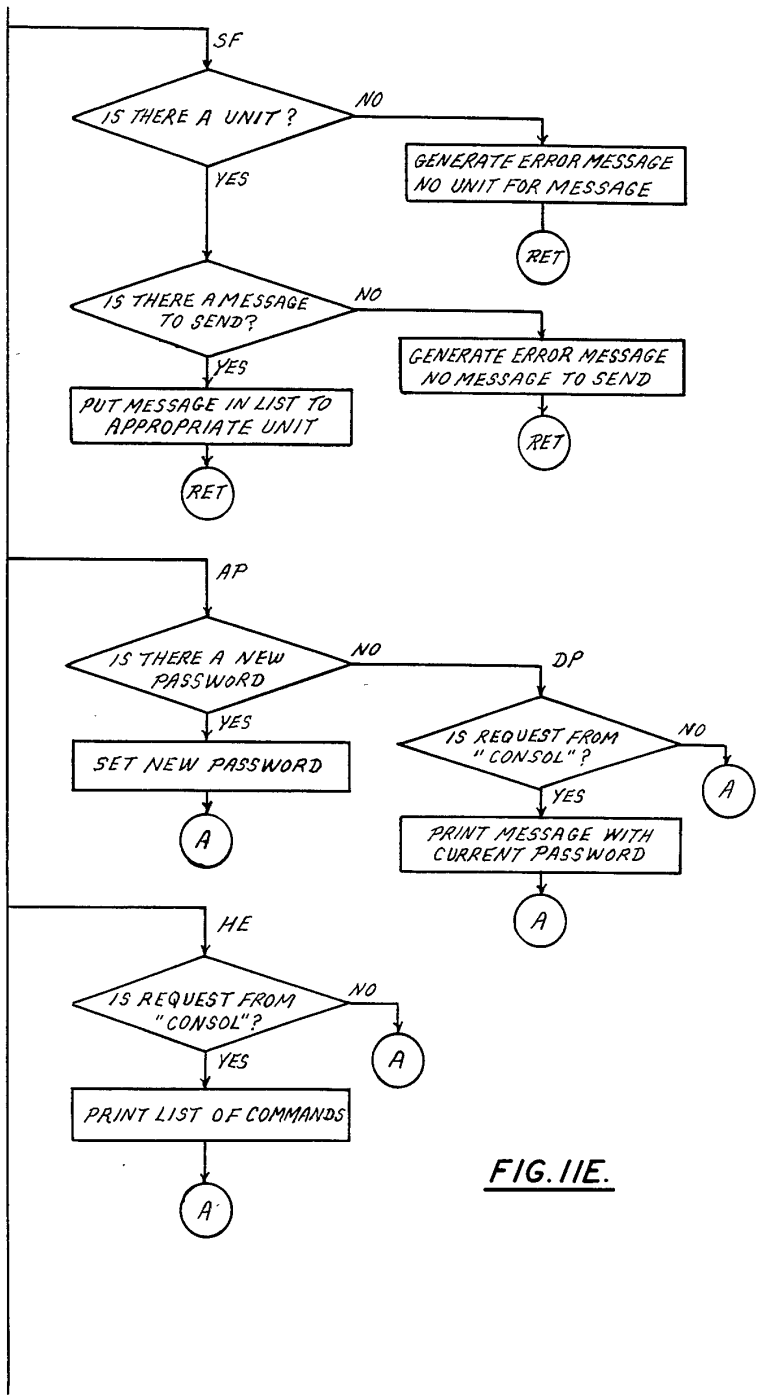

SF
IS THERE A UNIT ?
NO
GENERATE ERROR MESSAGE NO UNIT FOR MESSAGE
RET
YES
IS THERE A MESSAGE TO SEND?
NO
GENERATE ERROR MESSAGE NO MESSAGE TO SEND
RET
YES
PUT MESSAGE IN LIST TO APPROPRIATE UNIT
RET
AP
IS THERE A NEW PASSWORD
NO
DP
YES
SET NEW PASSWORD
A
IS REQUEST FROM "CONSOL"?
NO
A
YES
PRINT MESSAGE WITH CURRENT PASSWORD
A
HE
IS REQUEST FROM "CONSOL"?
NO
A
YES
PRINT LIST OF COMMANDS
A

FIG. IIE.

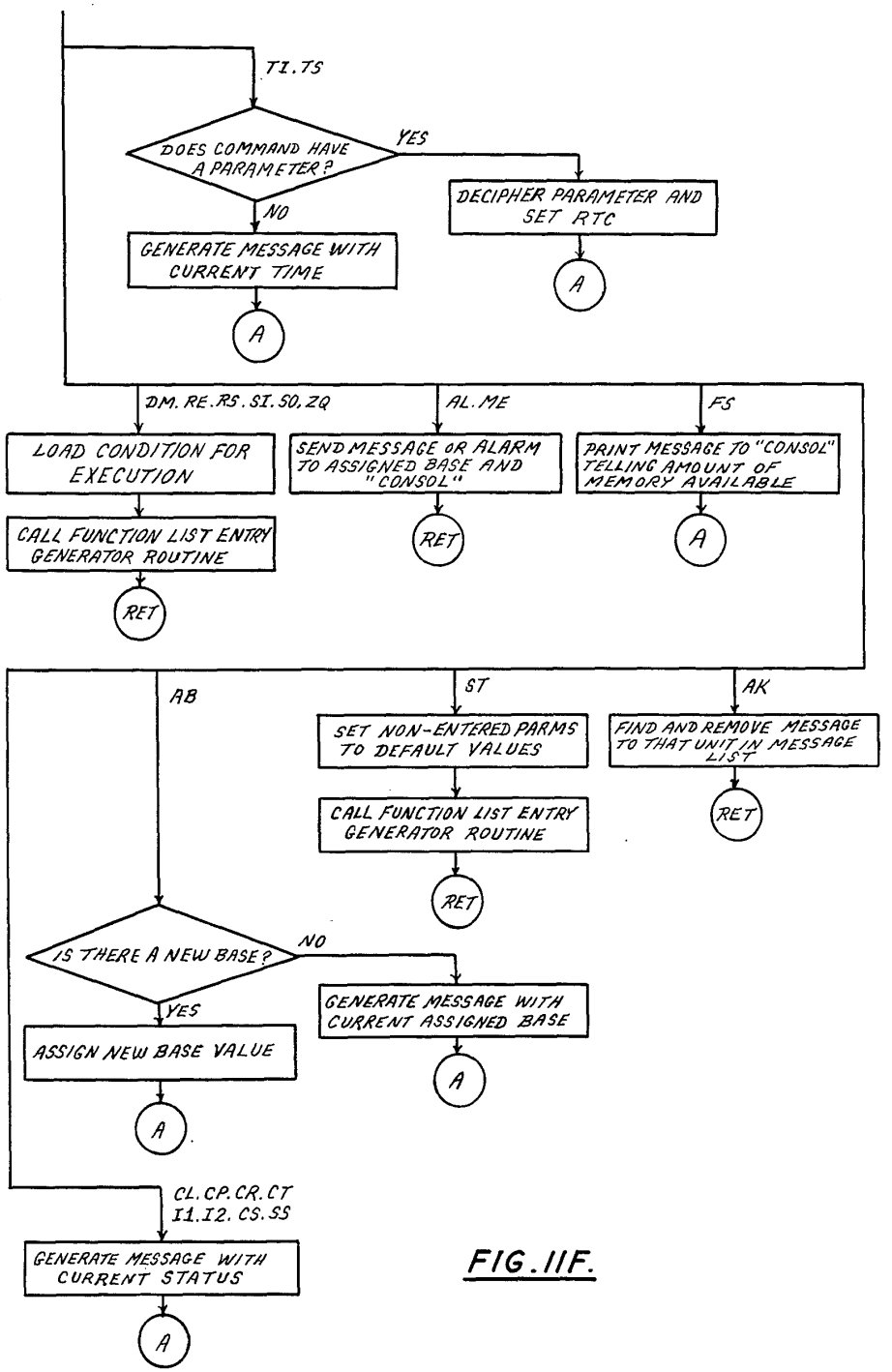

TI.TS
DOES COMMAND HAVE A PARAMETER?
YES
NO
DECIPHER PARAMETER AND SET RTC
GENERATE MESSAGE WITH CURRENT TIME
A
A
DM.RE.RS.SI.SO.ZQ
AL.ME
FS
LOAD CONDITION FOR EXECUTION
SEND MESSAGE OR ALARM TO ASSIGNED BASE AND "CONSOL"
PRINT MESSAGE TO "CONSOL" TELLING AMOUNT OF MEMORY AVAILABLE
CALL FUNCTION LIST ENTRY GENERATOR ROUTINE
RET
RET
A
RET
AB
ST
AK
SET NON-ENTERED PARMS TO DEFAULT VALUES
FIND AND REMOVE MESSAGE TO THAT UNIT IN MESSAGE LIST
CALL FUNCTION LIST ENTRY GENERATOR ROUTINE
RET
RET
IS THERE A NEW BASE?
NO
YES
GENERATE MESSAGE WITH CURRENT ASSIGNED BASE
ASSIGN NEW BASE VALUE
A
A
CL.CP.CR.CT I1.I2.CS.SS
GENERATE MESSAGE WITH CURRENT STATUS
A

FIG. IIF.

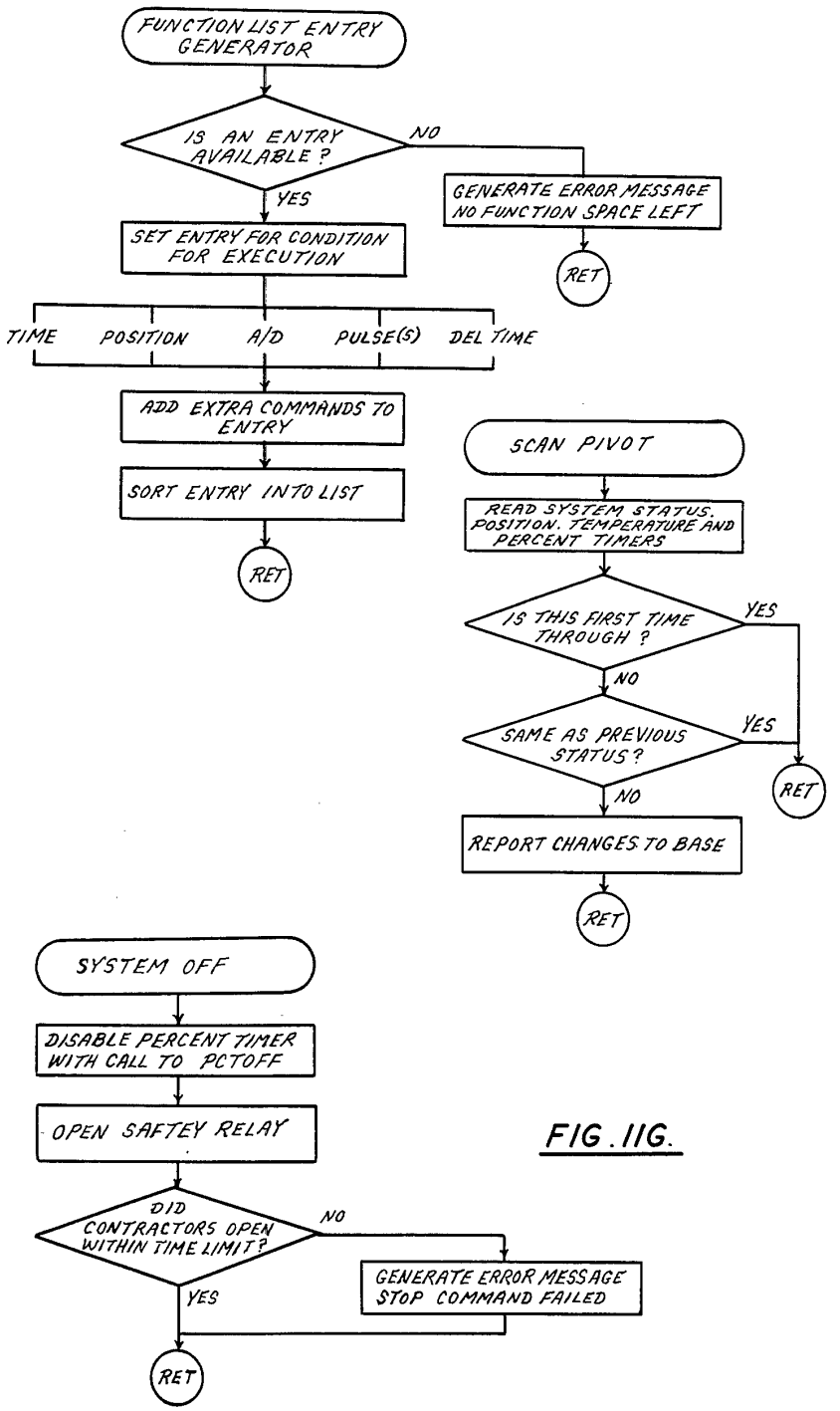
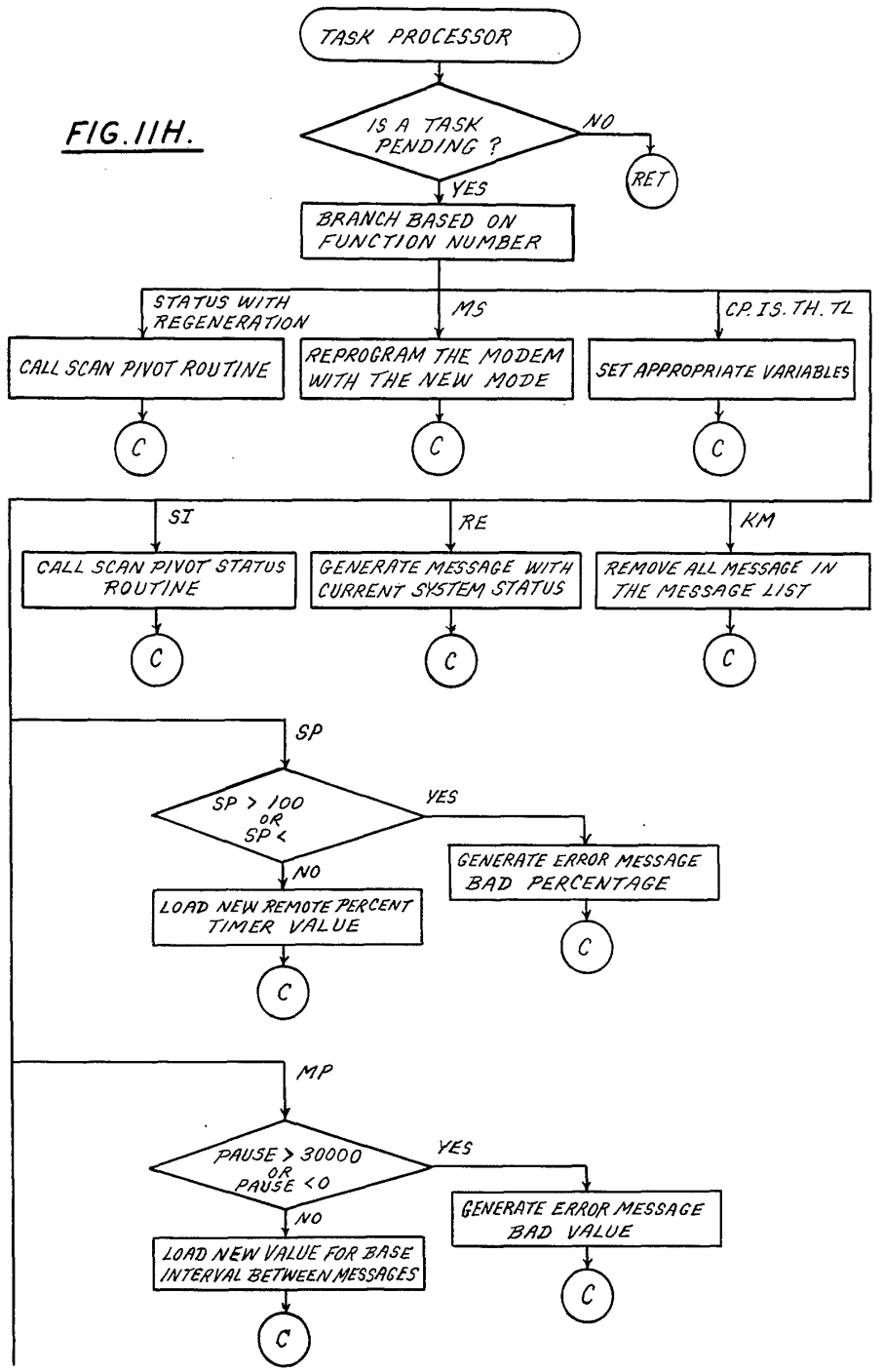

FUNCTION LIST ENTRY GENERATOR
IS AN ENTRY AVAILABLE ?
NO
YES
GENERATE ERROR MESSAGE NO FUNCTION SPACE LEFT
RET
SET ENTRY FOR CONDITION FOR EXECUTION
TIME
POSITION
A/D
PULSE(S)
DEL TIME
ADD EXTRA COMMANDS TO ENTRY
SORT ENTRY INTO LIST
RET
SCAN PIVOT
READ SYSTEM STATUS, POSITION, TEMPERATURE AND PERCENT TIMERS
IS THIS FIRST TIME THROUGH ?
YES
NO
SAME AS PREVIOUS STATUS ?
YES
NO
RET
REPORT CHANGES TO BASE
RET
SYSTEM OFF
DISABLE PERCENT TIMER WITH CALL TO PCTOFF
OPEN SAFTEY RELAY
DID CONTRACTORS OPEN WITHIN TIME LIMIT?
NO
YES
GENERATE ERROR MESSAGE STOP COMMAND FAILED
RET

FIG. IIG.

FIG. 11H.


TASK PROCESSOR
IS A TASK PENDING ?
NO
RET
YES
BRANCH BASED ON FUNCTION NUMBER
STATUS WITH REGENERATION
MS
CP. IS. TH. TL
CALL SCAN PIVOT ROUTINE
REPROGRAM THE MODEM WITH THE NEW MODE
SET APPROPRIATE VARIABLES
C
SI
RE
KM
CALL SCAN PIVOT STATUS ROUTINE
GENERATE MESSAGE WITH CURRENT SYSTEM STATUS
REMOVE ALL MESSAGE IN THE MESSAGE LIST
SP
SP > 100 OR SP <
YES
NO
GENERATE ERROR MESSAGE BAD PERCENTAGE
LOAD NEW REMOTE PERCENT TIMER VALUE
MP
PAUSE > 30000 OR PAUSE < 0
GENERATE ERROR MESSAGE BAD VALUE
LOAD NEW VALUE FOR BASE INTERVAL BETWEEN MESSAGES

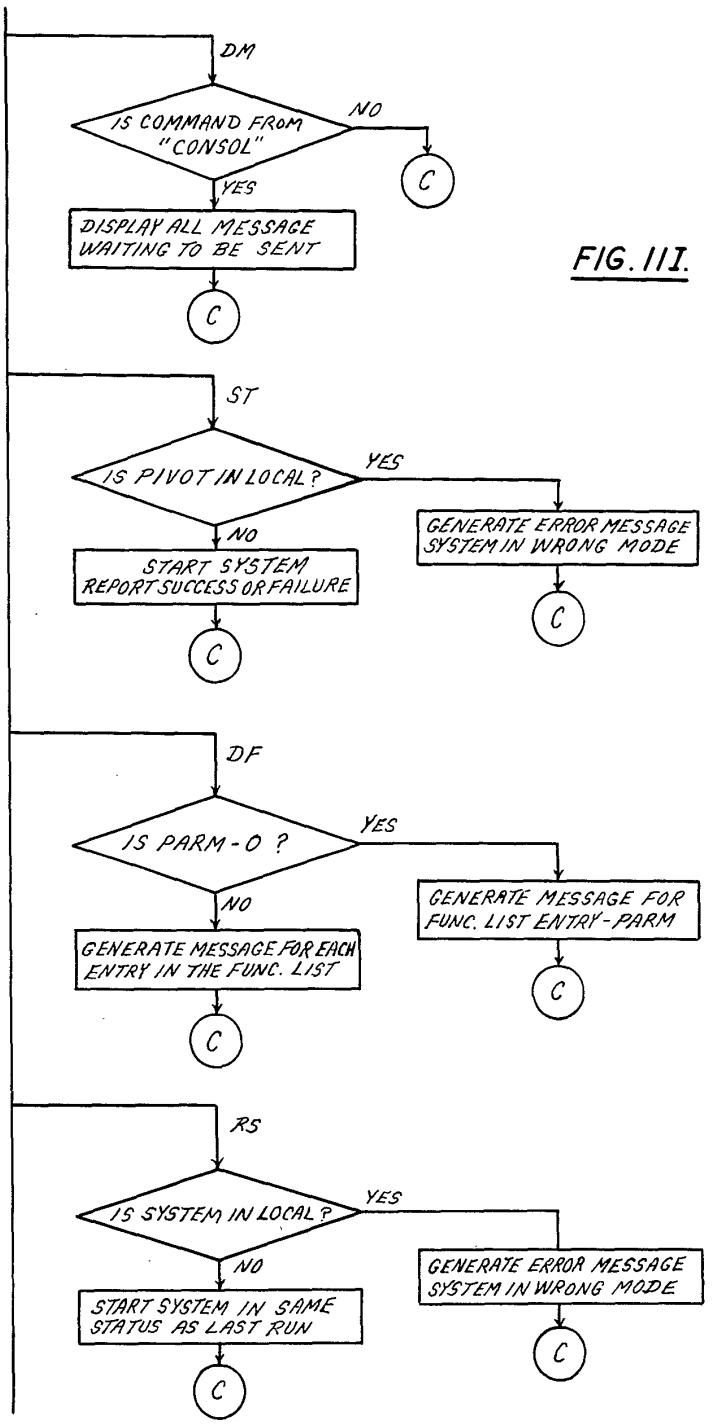

DM
IS COMMAND FROM "CONSOL"
NO
YES
C
DISPLAY ALL MESSAGE WAITING TO BE SENT
C
ST
IS PIVOT IN LOCAL?
YES
NO
GENERATE ERROR MESSAGE SYSTEM IN WRONG MODE
START SYSTEM REPORT SUCCESS OR FAILURE
C
C
DF
IS PARM-O ?
YES
NO
GENERATE MESSAGE FOR FUNC. LIST ENTRY-PARM
GENERATE MESSAGE FOR EACH ENTRY IN THE FUNC. LIST
C
C
RS
IS SYSTEM IN LOCAL?
YES
NO
GENERATE ERROR MESSAGE SYSTEM IN WRONG MODE
START SYSTEM IN SAME STATUS AS LAST RUN
C
C

FIG. III.

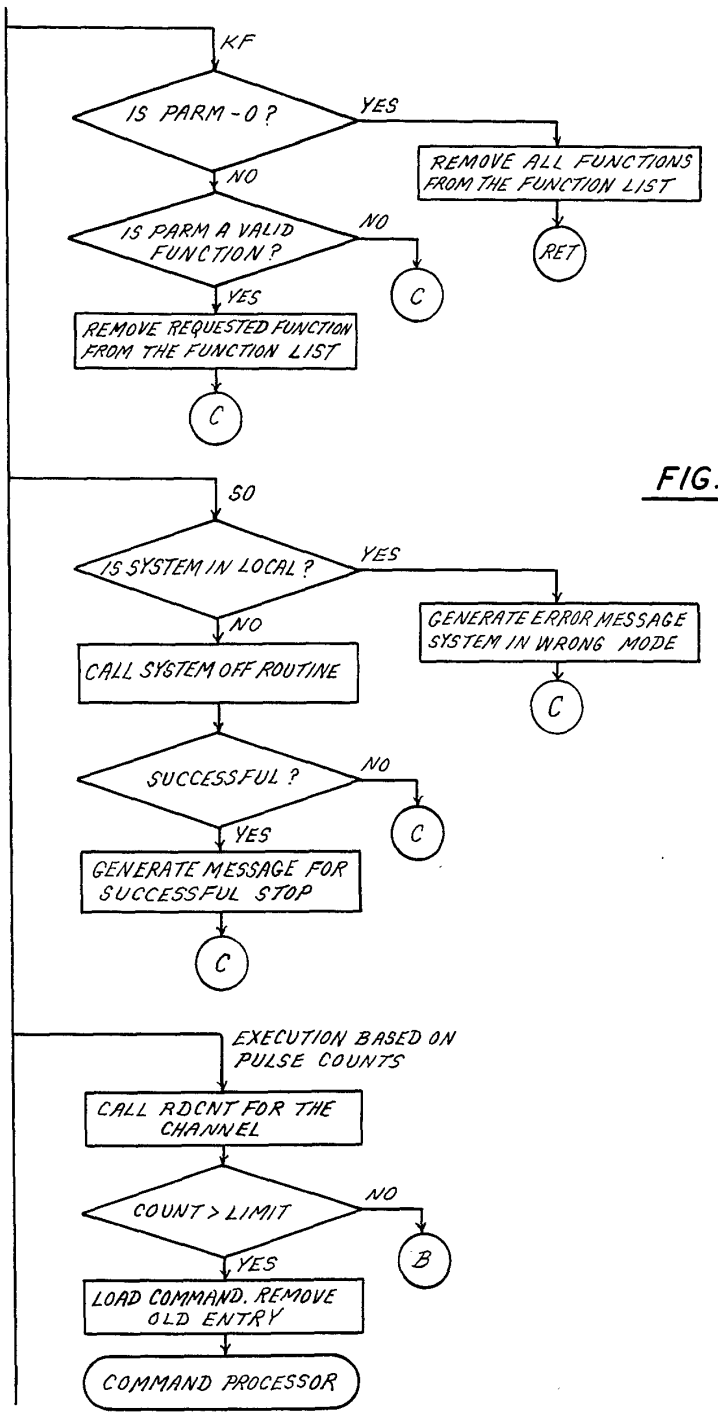

KF
IS PARM - 0 ?
YES
REMOVE ALL FUNCTIONS FROM THE FUNCTION LIST
RET
NO
IS PARM A VALID FUNCTION ?
NO
C
YES
REMOVE REQUESTED FUNCTION FROM THE FUNCTION LIST
C
SO
IS SYSTEM IN LOCAL ?
YES
GENERATE ERROR MESSAGE SYSTEM IN WRONG MODE
C
NO
CALL SYSTEM OFF ROUTINE
SUCCESSFUL ?
NO
C
YES
GENERATE MESSAGE FOR SUCCESSFUL STOP
C
EXECUTION BASED ON PULSE COUNTS
CALL RDCNT FOR THE CHANNEL
COUNT > LIMIT
NO
B
YES
LOAD COMMAND. REMOVE OLD ENTRY
COMMAND PROCESSOR

FIG. IIJ.

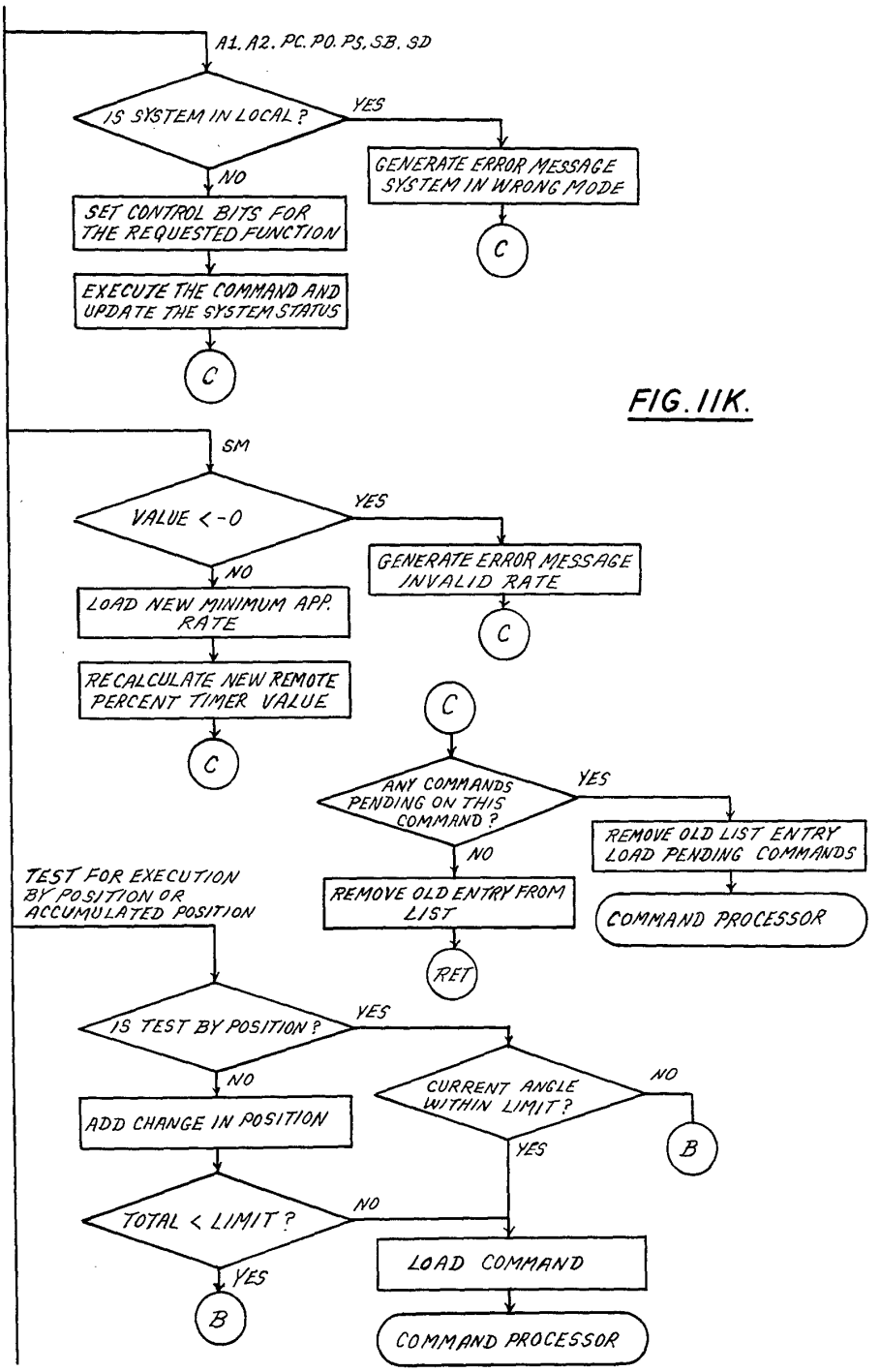

A1. A2. PC. PO. PS. SB. SD
IS SYSTEM IN LOCAL ?
YES
NO
GENERATE ERROR MESSAGE SYSTEM IN WRONG MODE
C
SET CONTROL BITS FOR THE REQUESTED FUNCTION
EXECUTE THE COMMAND AND UPDATE THE SYSTEM STATUS
C
SM
VALUE < -0
YES
NO
GENERATE ERROR MESSAGE INVALID RATE
C
LOAD NEW MINIMUM APP. RATE
RECALCULATE NEW REMOTE PERCENT TIMER VALUE
C
C
ANY COMMANDS PENDING ON THIS COMMAND ?
YES
NO
REMOVE OLD LIST ENTRY LOAD PENDING COMMANDS
COMMAND PROCESSOR
REMOVE OLD ENTRY FROM LIST
RET
TEST FOR EXECUTION BY POSITION OR ACCUMULATED POSITION
IS TEST BY POSITION ?
YES
NO
CURRENT ANGLE WITHIN LIMIT ?
NO
YES
B
ADD CHANGE IN POSITION
TOTAL < LIMIT ?
NO
YES
B
LOAD COMMAND
COMMAND PROCESSOR

FIG. 11K.

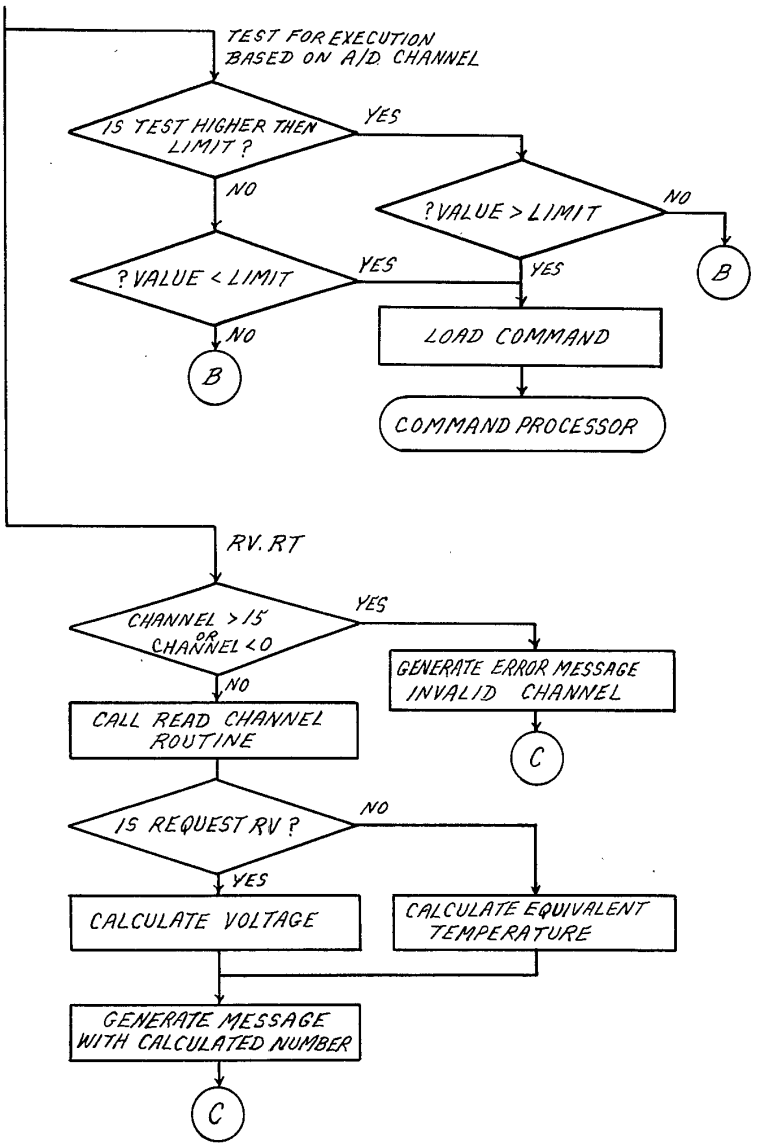

TEST FOR EXECUTION BASED ON A/D CHANNEL
IS TEST HIGHER THEN LIMIT ?
YES
NO
? VALUE > LIMIT
NO
? VALUE < LIMIT
YES
YES
NO
B
B
LOAD COMMAND
COMMAND PROCESSOR
RV. RT
CHANNEL > 15 OR CHANNEL < 0
YES
NO
GENERATE ERROR MESSAGE INVALID CHANNEL
C
CALL READ CHANNEL ROUTINE
IS REQUEST RV ?
NO
YES
CALCULATE VOLTAGE
CALCULATE EQUIVALENT TEMPERATURE
GENERATE MESSAGE WITH CALCULATED NUMBER
C

FIG. 11L.

REMOTE COMPUTER CONTROL FOR IRRIGATION SYSTEMS

BACKGROUND AND SUMMARY OF THE INVENTION

Since the development of the computer, there are many electromechanical systems and devices which have been adapted for computer control. Typically, the computer includes a stored program and is interfaced with the electromechanical device through appropriate interface circuitry to monitor certain operating parameters and to control certain operating parameters of the device. Computers have been used to control single devices, and also to control a plurality of devices which might be spaced geographically.

With the advent of the microcomputer, and the dramatic decrease in cost and size, and the increase in flexibility and power, it has become feasible to automate and computerize many additional kinds of electromechanical devices. For example, computerized systems have been developed and are available in the prior art to control a number of irrigation systems, including center pivot irrigation systems, from a central base station, such as a farmer's house. A center pivot irrigation system generally comprises an elongated water pipeline with sprinklers spaced therealong with one end fixed at a central point about which the pipeline rotates, the sprinklers on the pipeline irrigating the land beneath it as the pipeline sweeps through a circular area. These elongated pipelines or center pivots can be as much as a quarter mile to a half mile long. Therefore, the distance between center pivot irrigation systems may be substantial as a farmer may own quite a number of these center pivot irrigation systems.

The computer based controls presently available in the prior art for center pivot irrigation systems are generally comprised of a central base station which contains a stored program which centrally controls the operation and monitoring of each of the center pivots linked to the base station. Typically, a communications link such as radio or telephone is provided to link the remote center pivot controls at the pivot points with the central computer. An interface and possibly some limited processing capability is provided at each remote location, but these remote processors typically follow the commands and timing determined by the central computer. This type of system can be thought of as a central master base station with slave units located at each pivot which follow the instructions of the master and which have no capability to independently operate the pivot.

At least one system in the prior art does provide a microcomputer in the remote control unit. However, as best understood, the microcomputer in the remote unit has as its principal task the handling of communications back and forth with the main base station, and the base station remains in full control of all of the functions of the remote unit and the center pivot irrigation system connected to it.

Although these systems in the prior art do provide central computer control of a number of geographically spaced irrigation systems, they do have some disadvantages. For example, if a pivot is to be turned on at some time in the future, typically the central computer stores that instruction and sends a command to turn the selected pivot on only at the time at which the turn-on is desired, and not at the time at which the instruction is

entered to the computer. Therefore, if a turn-on time is requested for some time in the future, it is required that the computer be operational and the program be running at that time for the message to be transmitted and the control function to be achieved. This means that the farmer must be cognizant of these command times and ensure that the computer is operational and the program running at the time that these commands are to be executed.

Still another disadvantage is that for a large number of controlled irrigation systems, it may be required that more than just several of the systems be controlled at the same time, thereby resulting in delays in control for those systems near the end of the program execution. For example, a farmer with 100 center pivots may desire that 30 of them be turned on at about the same time. Under a central computer control, there can be an inordinate delay for the last ones of these 30 center pivots to be finally turned on. This results from the time lag required to communicate instructions between the central base station and the remote units. Typically, protocols would require some fixed amount of time to obtain a clear channel, transmit, acknowledge receipt of the transmission, and execute the instruction.

Still another disadvantage of the system of the prior art is that with central intelligence, the farmer is ultimately dependent upon the operation of a single computer. Although computers have become very reliable with increasing technology, it is not uncommon for failures to occur. With central intelligence, failure of the main computer shuts down the entire system resulting in manual control for all of the individual irrigation systems until the central computer is fixed. Should that happen, the farmer must manually control each of his irrigation systems through the pivot panel controls typically provided by manufacturers of irrigation systems which are highly reliable, but do not provide the programmable features inherent with computer control.

To solve these and other problems, and to provide a system with greatly enhanced reliability, flexibility, and ease of operation, the inventors herein have succeeded in developing a computer monitoring and control system which utilizes "intelligent remote units" at each irrigation system with a central computer for collecting and monitoring data transmitted from each of these intelligent remotes, and also having the capability of communicating desired instructions to these intelligent remotes for their processing and execution in accordance with the stored programs contained in each intelligent remote. This is a distributed logic or intelligence type of system in that each intelligent remote is a stand alone controller and can function fully independently of the base computer. To further enhance the versatility and flexibility of the system, the inventors have provided a system which permits a farmer to physically visit the remote unit, observe the operation of the irrigation system, enter any desired changes into the pivot panel with manual action, and then the system will indicate these changes back at the base station by generating an alarm message. Thus, a farmer may manually override the remote intelligent unit and enter changes directly as a result of having observed conditions at the location without having the system override his manual corrections.

At each pivot panel, a local/remote toggle switch is provided which can be used to disable the remote intel-

ligent unit and prevent its control of the pivot panel and irrigation system.

By distributing the intelligence among the remote units, the system has freed itself from dependency upon the operation of the central computer. With the inventors' system as disclosed herein, should the central computer fail, each independent intelligent remote will continue to operate its associated center pivot irrigation system in accordance with the instructions stored therein. Still another advantage is that instructions requested by the base computer are immediately transmitted to the appropriate remote and stored in the remote's memory for execution at the designated time or other condition (either immediately or at some time in the future), the operator upon entering the instruction immediately knows whether the instruction has been transmitted and accepted by the remote unit and will hence be carried out. This eliminates the problems mentioned above with keeping the main computer operational to ensure execution of instructions at preselected times, and also concerns about the future operation of the computer to ensure future execution of present instructions. Additionally, instructions may be conditioned on other parameters for later execution.

In connection with the development of this system, the inventors herein have also succeeded in developing several related circuits which provide unique advantages over circuits in the prior art. An example of this is the resolver circuit which is used to determine the position of the center pivot at any point in its sweep through the field, and generate a voltage with a magnitude and sign directly indicating that position for use by the computer. These and other advantages of the overall system, and individual circuits are more fully shown and described in the drawings and detailed description of the preferred embodiment which follows.

A BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagrammatic representation of a base computer with four intelligent remotes and a portable base unit all within communication range of the main base unit;

FIG. **2** is a diagrammatic representation of an alternate configuration for the present invention showing a base unit and a succession of remote units beyond communication range of the base unit;

FIG. **3** is a diagrammatic representation of the use of telephone cable as a communications link;

FIG. **4** is a block diagram of a base unit;

FIG. **5** is a block diagram of a remote unit;

FIG. **6** is an electrical schematic of a resolver circuit used to generate a signal representative of the position of a center pivot irrigation unit in the field;

FIG. **7** is an electrical schematic of an interface circuit between the radio link, modem, and computer of either the base station or the intelligent remote unit;

FIG. **8** is an electrical schematic of the power fail detect circuit;

FIGS. **9***a* through **9***e* are an electrical schematic of the pivot panel interface board as used in the intelligent remote unit;

FIGS. **10***a* and **10***h* are the base station flow chart; and

FIGS. **11***a* through **11***l* are the intelligent remote flow chart.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The remote monitoring and control system **20** of the present invention is shown diagrammatically in FIGS. **1**, **2** and **3**. In FIG. **1**, the system **20** is shown to include a central computer or base unit **22** with a plurality of intelligent remote units **24**, **26**, **28**, **30**; all of which are within communication range of the central computer or base unit **22**. Alternately, a portable base unit **32** is shown which may be separately transported by the farmer and used to input and monitor the intelligent remote units. Additionally, a portable terminal (not shown) may be carried by the farmer to any intelligent remote unit and connected thereto which permits direct entry of desired instructions and monitoring of the associated irrigation system.

As shown in FIG. **2**, the system **20** includes the same central computer or base unit **22** but remote unit **24** is at the edge of the communication distance for the base unit **22**, a second intelligent remote unit **26** is at the edge of the communication distance for intelligent remote **24** and a third intelligent remote **28** is located at the edge of the communication distance for the intelligent remote **26**. Of course, other intelligent remotes may be spaced anywhere between these shown in FIG. **2**. The system **20** of the present invention provides a capability for transmission of data from the base unit **22** to the first remote unit **24**, and then retransmission of the same data to remove unit **26**, and then retransmission of the same data to remote unit **28**; thereby significantly increasing the overall distance that a remote unit may be located from the base unit **22**.

An alternative way to achieve communication between a base unit **22** and a remote unit **24** is shown in FIG. **3** and includes voice grade telephone lines **34** connected between appropriate switching circuits **36**, **38**, as known in the art. With this arrangement, there is virtually no limitation on the distance between the base unit **22** and a remote unit **24**.

A block diagram of a base unit **22** is shown in FIG. **4** and includes at its heart a "personal computer" **40** such as an IBM PC or any other suitable device. It receives power from a suitable lightning protection circuit **42** which also provides power to a 12 volt D.C. power supply **44** and an optional battery pack and charger **46**. The base station computer **40** is connected for communication with a radio/modem interface circuit **48** which in turn is connected to a modem **50** and a radio link **52**, both of which are well known in the art. Alternatively to the radio link **52**, the modem **50** may be connected to telephone company lines **54** through a lightning protection circuit **56**, as shown by dashed lines. The base station computer **40** has outputs connected to an alarm interface indicator **58** which may drive suitable alarm indicators such as horn **60** and light **62**.

Each intelligent remote unit, such as **24**, is the same and has a block diagram as shown in FIG. **5**. As shown therein, six PC boards comprise the central processor **64** and they are the microprocessor PC board **66**, the memory PC board **68** containing 16k of RAM and 40k of ROM, a real time clock battery pack PC board **70**, a digital I/O board for two serial ports on board **72**, an analog I/O **16** channel board **74**, and a peripheral interface PC board **76**. These boards and this arrangement of boards are commercially available from ProLog and Mostek and is shown on page 1-1 of Pro-Log's Feb. 1983 STD Bus Technical Manual. As further shown in

FIG. 5, the intelligent remote 24 includes a radio/-modem interface board 78 connected between a radio link 80, a modem 82, and the central processor 64 through digital I/O board 72. An alternative means of communication is provided by telephone lines 84 through an optional lightning protection circuit 86 and modem 82 as shown by dashed lines. A pivot panel interface board 88 is connected to the peripheral interface PC board 76 of central processor 64 and provides the interface between the central processor 64 and the local control of pivot panel 90 which is a commercially available electromechanical control panel presently supplied by manufacturers of center pivot irrigation systems. Pivot panel 90 also provides A.C. power to the intelligent remote unit 24 through a suitable lightning protection circuit 92. These power supplies include a 24 volt A.C. power supply 94, a 12 volt D.C. supply for the radio 96, an optional battery pack and charger 98 for central processor 64 and a suitable power supply 100 for central processor 64. Also shown is a resolver 102 which detects the position of a center pivot irrigation system in the field and produces a signal indicative thereof to a position/temperature PC board 104. An external temperature sensor 106 produces a suitable signal and both 104 and 106 are connected to the A/D terminal PC board 108 for ease in connection to the analog I/O board 74.

FIGS. 4 and 5 disclose in block form the hardware configurations for both the base station 22 and a typical intelligent remote unit 24. While portions of these block diagrams are readily available from commercial sources, others represent circuits and devices which have been developed by the inventors herein. These are additionally shown in FIGS. 6–9, and are described as follows.

The resolver 102 is shown in greater detail in FIG. 6 and includes a 555 square wave oscillator 110 with appropriate biasing circuitry 112 to produce a 2000 Hertz square wave frequency at pin 3 of its output. From there, the square wave is fed through a current limit resistor 114, a D.C. blocking capacitor 116 and a filter capacitor 118 to resonate with coil 120. This produces a 2000 Hertz distorted sign wave across coil 120 which is either directly connected to the rotating rotor 122 or transformer coupled to another coil (not shown) mounted on the rotor. A pair of stator coils 124, 126 have their outputs connected to pins 3 and 2, respectively. As shown schematically in FIG. 6, coils 124, 126 are physically mounted at 90° to each other and produce an output voltage at pins 3 and 2, respectively, as induced by coil 120. The square wave output of oscillator 110 is used to trigger an electronic switch 128 and sample the output voltages from coils 124, 126 for a half cycle of each cycle. These output voltages are used to charge capacitors 130, 132 through resistors 134, 136.

The resolver circuit 102 operates as follows. The 2000 Hertz voltage impressed across rotor coil 120 induces a voltage in the stationary stator coils 124, 126 as the rotor 122 rotates and a center pivot system rotates through the field. The magnitude and polarity of the voltage induced in coils 124, 126 are directly related to the physical orientation of coil 120 with respect to each. For example, as coil 120 is perpendicular to either of those coils, then there is no induced voltage. As coil 120 becomes parallel with either coil, then maximum voltage is induced, with a polarity dependent upon the winding of the coil, and which ends of the coil are adjacent. Turning the rotor coil end for end will reverse the polarity of the induced voltage, as is well known in the art. The electronic switch 128 samples out only one-half cycle from each cycle of the induced voltage, and uses this voltage to charge capacitors 130, 132 through an R-C circuit, as shown. As the same output at pin 3 of oscillator 110 is used both to create the input voltage impressed across coil 120 and the trigger voltage used to trigger electronic switch 128, this resolver circuit 102 is frequency insensitive. Furthermore, as only one input voltage is used to induce a voltage in coils 124, 126 which are physically positioned 90° out of phase, the resolver circuit 102 is independent of the actual parameters of the input voltage impressed across coil 120, such as magnitude. As R-C circuits are used to charge capacitors 130, 132 with the output voltage, these output circuits do not provide for accurately following instantaneous movements of the rotor 122. However, as the resolver 122 is adapted for use with a center pivot system which may have a length of a quarter of a mile or more, it is more than accurate for the slow movements usually experienced in center pivot systems. Therefore, the resolver circuit 122 of the present design provides economies of cost and simplicity and yet still provides more than enough accuracy and speed of response to handle the particular application it is designed for.

FIG. 7 discloses in further detail the radio/modem interface circuit 48, 78 as used in both the base station 22 and remote units 24. It permits use of the RS 232 handshake routine, matches signal levels, and utilizes opto-isolators 138, 140 to isolate the computer from the radio. It is believed that this circuit may be easily understood by referring to the drawing.

A power fail detect circuit 142 is shown in FIG. 8 and is utilized to generate a non-maskable interrupt upon loss of 5 volts D.C. power to the computer in the remote unit, and to generate a reset signal upon restoration of power. It is believed that the operation of this circuit may be easily understood by referring to the figure, and type numbers indicated on the electronic packages shown therein.

The pivot panel interface 88 is shown in greater detail in FIGS. 9*a* through 9*e*, with connections to the intelligent remote peripheral interface board 76 being indicated at the left side of FIGS. 9*a* and 9*d*, and connections to the local controller or pivot panel 90 being shown at the right side of FIGS. 9*c* and 9*e*. As shown at the lower right-hand portion of FIG. 9*e*, connections are provided for a remote/local single pole double throw switch to be connected between terminals labeled 26, 27, and 28. This switch is typically located at the pivot panel 90 and permits a farmer to select either local control, i.e. disabling of the intelligent remote unit or a remote control, allowing control by the intelligent remote unit 24. Each of the remote computer 24 outputs is easily identifiable by the pairs of driver amplifiers, 144, 146 associated with each output line. At the top of FIG. 9*a*, output lines are provided for start, stop, forward/reverse, percent pivot/remote, and remote percent data. These outputs are enabled by a first set of relays, collectively labeled 148 (see FIG. 9*b*), which are used to latch a second set of latch relays, collectively labeled 150. A plurality of resistors, collectively labeled 152, in combination with its associated relay contacts, provide an indication back to the computer 64 of the status of latch relays 150, and a second set of relays 154, the second set of relays 154 being under control of the pivot panel 90. Thus, resistors 152 provide a signal to

the computer **64** of the actual operating condition in existence at the pivot panel **90**. Still another set of relays **156** (see FIG. **9***e*) operate another set of latch relays **158** for a second set of outputs at the lower portion of FIG. **9***d*. Still another set of resistors **160**, in combination with their associated relay contacts, provide an indication back to the computer **64** of the condition of latch relays **158**, the condition of latch relays **158** being representative of the computer output condition, and the called for condition of the parameters of this second set of outputs. In operation, latch relays **150** and **158** are reset when the local/remote switch is switched to the local position. Upon return of the local/remote switch to the remote position, control is again returned of these latch relays **150**, **158** to the computer **64**. However, as can be seen in examining FIGS. **9***a* through **9***c*, these latch relays **150**, **158** will not operate until computer **64** once again calls for their operation. However, the changed status of any operating condition will be concurrently reported back to computer **64** through the monitoring resistors **152**, and the resetting of latch relays **158** will also be reported back to computer **64** through resistors **160**. Therefore, the computer **64** will have an indication of both the actual status of the controls in the pivot panel **90** (and hence the center pivot system) as well as the status of the latch relays **158** which represent the operation of the system as called for by the computer **64** in the intelligent remote unit **24**. Thus, the remote/local selector switch (not shown) when switched to the local mode effectively disables control of the pivot panel **90** from the intelligent remote computer **64**, and resets all of the latched computer controlled relays **158**. Upon switching of the remote/local switch back to remote, the intelligent remote computer **64** may be instructed to reinitiate any previous operating conditions, and any changes made in the pivot panel controls **90** will be reported back to the intelligent remote computer **64** through resistors **152**.

The flow chart for the stored program resident in the base station computer **40** is shown in FIGS. **10***a* through **10***h* and explains the operation of the base station computer **40**. To aid in this explanation, representations of sample displays generated by the software are shown in the attached appendix, and will be referred to in describing the flow chart. These displays include sample data to further illustrate the capabilities of the system. Referring to FIG. **10***a*, the system begins by initializing data, and then a logoff/logon generates display **1** and requests a password to be entered by the operator to gain further access to the stored program. As shown in the appendix, a display is generated entitled "Multi-Pivot Monitor" and has several pairs of columns headed ID and Status. The ID number identifies a particular center pivot irrigation system and the Status column identifies whether the system is responding to base station interrogation or not (NR) and whether the system is on or off, and whether the system is in remote or local (L) control. After the correct password is entered by an operator, the stored program generates the display shown in the appendix entitled "Multi-Pivot Monitor" which has the same information as in the first display except that this time the operator is instructed at the bottom of the display to select one of several instructions. These alternative choices are shown in the software of FIGS. **10***a* through **10***e*. If the operator selects one of the function keys provided on the keyboard and labeled **F1**–**F10**, one of the selected subroutines is executed, as shown.

If the operator selects **F1** for single pivot control/monitor, the display is generated and the subroutine labeled single pivot control/monitor is executed by the base station computer. As shown in the appendix, various parameters of the irrigation system are displayed, as well as the status of control parameters as instructed by the intelligent remote computer. Should the operator desire to change any of these controlled parameters, such as stop in slot, pressure, pump safety, or the other parameters controllable by the intelligent remote unit as shown in the pivot panel interface circuitry of FIGS. **9***a* through **9***e*, the operator can enter these changes and request immediate transmission of the desired instruction to the intelligent remote unit.

Should the operator select **F3**, then the software will generate the display of the appendix entitled "Edit Pivot Data Display", and will execute the subroutine identified as single pivot edit, as shown in FIGS. **10***c* and **10***d*. As shown in the appendix, instructions and parameter values determined by the remote computer are listed, and the operator can change any of these and request the desired instruction to be transmitted to the intelligent remote unit.

Should the operator select **F4**, then the display in the appendix is generated entitled "Base Station Edit", and the same subroutine is executed as for **F3**. As shown in the appendix, the display lists the current value of information selected by the operator for the base station, including the password, the time between writing data to storage on the disk, the number of times the radio link is to attempt to send a message to an intelligent remote unit, etc. as shown therein. As before, the operator can initiate changes but these will be executed immediately as the base station computer is the computer being operated by the operator.

Should the operator select **F5**, then information similar to that shown in the appendix will be generated, this information representing the reported messages received from the intelligent remote units, messages transmitted to the intelligent remote units, and such other information as is desired to be stored therein, depending upon the particulars of the software.

Should the operator select **F6**, then the machine will execute the show communication routine and will display communications to or from the base station from a remote unit.

Should the operator select **F7**, then a display similar to the display of the appendix entitled "Edit Pivot Data Display" will be generated to permit the entry of a new pivot to the system.

Should the operator select **F8**, then the display in the appendix entitled "TEST01 Optional Parameter Display" will be generated, and the associated subroutine will be executed permitting the operator to edit the various optional parameters for monitoring or display.

Selecting **F9** will return the operator to the display of the appendix, selecting **F10** will instruct the computer to write all data stored in active memory to disk and prepare the machine for the changing of the diskette on which data is regularly stored, selecting Control **F2** will clear the alarms generated by the intelligent remote units and flashing on the various displays previously described, and selecting Control **F10** will terminate execution of this program.

The line input routine is referred to in the portion of the software previously described, and essentially handles the receipt of data from the intelligent remote units, processes the messages comprising the desired instruc-

tions to be transmitted and transmits those instructions to the appropriate intelligent remote unit, and saves the data by storing it to disk at an appropriate time interval. The cursor driver routine also shown represents the manner in which the cursor is controlled.

From the above description, it should be apparent that the stored program for the base station permits an operator to control information received from intelligent remotes, and to generate and transmit desired instructions for execution by the intelligent remotes to control their associated irrigation system. The stored program resident in the intelligent remote units is completely separate and different from that described above in connection with the base station.

The flow chart for the stored program resident in the intelligent remote computer is shown in FIGS. **11***a* through **11***l* and independently controls its associated irrigation system through the pivot panel interface **88** shown in FIGS. **9***a* through **9***e*. This stored program is best understood by referring to the main loop, and assuming that the program is executed in the order that the subroutines are shown as the main loop is traversed in a clockwise manner. Program execution begins with power up or push button reset which initializes the hardware and the data structure and starts the program around the main loop. The next event is that the program reads the current time by executing the current time subroutine and returns to the main loop. This is followed sequentially as shown in FIG. **11***a*. The main subroutines which handle the desired instructions transmitted by the base station are the task processor subroutine and the command processor subroutine. It is believed that these subroutines are sufficiently detailed that they are self-explanatory, with the understanding that the two character command codes are identified in the appendix, and represent the shorthanded translation of the desired instruction generated by the base station in response to operator input. For certain commands, conditions can be requested by the operator at the base station and these conditions will be tested for before execution of the desired instruction by the stored program resident in the intelligent remote as shown in FIGS. **11***a* through **11***l*.

Various changes and modifications to this invention would be apparent to one of ordinary skill in the art. Those changes and modifications are included as part of this invention which is limited only by the scope of the claims appended hereto.

APPENDIX

Multi-Pivot Monitor

I.D	Status	I.D.	Status	I.D.	Status	I.D.	Status
000000	Off (L)						
TEST01	N.R.						
LAB000	Off (L)						
TEST02	N.R. (L)						
VALMNT	Off						

Enter Password?

Multi-Pivot Monitor

I.D.	Status	I.D.	Status	I.D.	Status	I.D.	Status	I.D.	Status
000000	Off (L)								
TEST01	N.R.								
LAB000	Off (L)								
TEST02	N.R. (L)								
VALMNT	Off								

Select Enter ID	Sp Change	CR Execute	Del Cancel	Esc Log off
1Cont/Mon 2NA 3Piv Ed	4Base Ed	5Review 6Comm	7New Piv 80pt	Ed 9Logoff 10 Data

TEST01 SYSTEM STATUS AND CONTROL
Description: Prototype RTU on Gene Hansen Property.

Control	Remote	Stop in Slot	Normal
Status	No Response	Pressure	Wet
Direction	Forward	Pump Safety	Normal
Speed	16%	Timer Control	Local
Application	1.0(in.)	Time(Last Update)	8/22/84 13:51:58
Position	5.4 Degrees	Temperature	73.4(°F.)
	Optional Parameters		
Hour Meter	348.5	Pressure Switch	Wet
Middle Box Temperature	91.9		

Select	Sp Change	Del Cancel	CR Execute	Esc Exit

Edit Pivot Data Display

CODE	FUNCTION	CURRENT VALUE
A.	Identification	TEST01
B.	Description	Prototype RTU on TEST01 Property.
C.	Base Station Assignment	VALLEY
D.	Low Temperature Limit	40.0
E.	High Temperature Limit	160.0
F.	Minimum Application	0.16
G.	Modem Mode	Answer
H.	Interval Between Reports While Running(min.)	240
I.	Report String	RE
J.	Start Sequence	RS ;
K.	Stop Sequence	SO ;
L.	Hour Meter	348.5
M.	Capture Reported Alarms	Yes
N.	Capture Reported Messages	Yes

APPENDIX-continued

O. Capture Commands Sent out No
P. Delete this Entry

Select Enter Code Sp Change CR Execute Del Cancel Esc Exit

BASE STATION EDIT

Code	Function	Current
A.	Identification	VALLEY
B.	Description	Base Station
C.	Modem Mode	Dial
D.	Interval between data saves (Sec.)	3600
E.	Number of times to send a message	10
F.	Base time between unacknowledged messages	7
G.	Carrier Delay (Sec.)	1.0
H.	One Second Delay Count	2000
I.	Background Color	0
J.	Foreground Color	15
K.	Low Intensity Color	4
L.	Units for Position	1
M.	Units for depth	1
N.	Units for Temperature	1
O.	Change Logon Password.	

Select Enter Code Sp Change CR Execute Del Cancel Esc Exit

```
RE
RE
AL      TEST01 RE 08/10/8415:19:12NWNOOOOLBOBOOLS312.7      84.2  27  50
RE
AL      TEST01 RE 08/10/8415:20:12NWNOOOOLBOBOOLS312.7      84.2  27  50
RE
AL      TEST01 RE 08/10/8415:22:12NWNOOOOLBOBOOLS312.7      84.5  27  50
AL      TEST01 RE 08/10/8415:22:12NWNOOOOLBOBOOLS312.7      84.5  27  50
RE
AL      TEST01 RE 08/10/8415:23:12NWNOOOOLBOBOOLS312.7      84.5  27  50
ME      TEST01 HOUR METER 121.2
SI
AL      TEST01 RE 24 R/C OP. R at 08/10/84 15:26:59
SD      F,;RS ;RE
Al      TEST01 RS System started at 08/10/84 15:27:32
AL      TEST01 RE 08/10/8415:27:12NWNOOOORBOBCOLR312.7      85.1  27  50
SI
AL      TEST01 RE 28 FWRD. O at 08/10/84 15:28:05
AL      TEST01 RE 31 SC S at 08/10/84 15:28:05
AL      TEST01 RE 31 SC S ar 08/10/84 15:28:05
SB      B,;SD F,;RS ;RE
AL      TEST01 RS System started at 08/10/84 15:30:09
SI
```

Esc or Func Key to Exit, Cntl-S to Hold, Cntl-P toggle Printer

TEST01 Optional Parameter Display
Description: Prototype RTU on Gene Hansen Property.

A/D Channels						Pulse Channels				
0.	N	V	1.0	0.0	0.	N			1.0	0.0
1.	N	V	1.0	0.0	1.	N			1.0	0.0
2.	N	V	1.0	0.0	2.	N			1.0	0.0
3.	Y Middle Box Temperatu	T	1.0	0.0	3.	N			1.0	0.0
4.	N	V	1.0	0.0		Hour Meter				
5.	N	V	1.0	0.0		Display Yes				
6.	N	V	1.0	0.0		Auxiliary Monitors				
7.	N	V	1.0	0.0	1.	Y Pressure Switch				
8.	N	V	1.0	0.0		Open	Dry Closed	Wet		
9.	N	V	1.0	0.0	2.	N				
10.	N	V	1.0	0.0		Open	Closed			
11.	N	V	1.0	0.0		Auxiliary Contacts				
12.	N	V	1.0	0.0	1.	N				
13.	N	V	1.0	0.0		Open	Closed			
14.	N	V	1.0	0.0	2.	N				
15.	N	V	1.0	0.0		Open	Closed			

Select Sp Change CR Execute Del Cancel Esc Exit

REMOTE TERMINAL COMMAND LIST

Command	Parameters	Description
A1	[O/C],[Condition]	Auxiliary Contact #1
A2	[O/C],[Condition]	Auxiliary Contact #2
AB	[ID]	Assign Base
AK	No Parameters	Acknowledge Command
AL	[message]	Alarm to Base
AP	[ID]	Assign Password
CL	No Parameters	Current Local Percent Timer

APPENDIX-continued

CP	No Parameters	Current Position
CR	No Parameters	Current Remote Percent Timer
CT	No Parameters	Current Temperature
DF	[Function #],[Condition]	Display Function List
DM	[Condition]	Display Message List
DP	No Parameters	Display Password
FS	No Parameters	Displays the Amount of Free Space Available
HE	No Parameters	Help Message
I1	No Parameters	Auxiliary Input #1
I2	No Parameters	Auxiliary Input #2
IS	[Seconds],[Condition]	Interval Between Status (Sec)
KF	[Function #],[Condition]	Delete Function
KM	[Condition]	Delete Messages
ME	[message]	Message to Screen
MP	[Seconds],[Condition]	Minimum Message Pause
MS	[A/O],[Condition]	Modem Status
PC	[R/L],[Condition]	Percent Timer ControL
PO	[W/D],[Condition]	Pressure Switch Bypass
PS	[N/B],[Condition]	Pump Safety Bypass
RC	Channel,[Condition]	Read Pulse Count Channel
RE	[Condition]	Report System Status
RS	[Condition]	Restart System
RT	Channel,[Condition]	Read A/D Channel Temperature (F)
RV	Channel,[Condition]	Read A/D Channel Voltage (mV)
SA	[value], [Condition]	Set Application Rate
SB	[N/B],[Condition]	Stop in Slot Bypass
SC	No Parameters	System Control
SD	[F/R],[Condition]	System Direction
SF	Unit,Message	Store and Forward
SI	[Condition]	Status Immediate
SM	[value],[Condition]	Set Minimum Application
SO	[Condition]	System Off
SP	[value],[Condition]	Set Remote Percent Timer
SS	No Parameters	System Status
ST	[Condition],[direction(F/R)], [percent],[pressure(W/D)], [pump(N/B)],[sis(N/B)] [aux1(O/C)],(aux2(O/C)]	Start System
TH	[value],[Condition]	Temperature High Limit
TI	[New Time]	System Time
TL	[value],[Condition]	Temperature Low Limit
TS	[New Time]	System Time Set
ZQ	[Condition]	Software Reset

What is claimed is:

1. A system for remotely monitoring and controlling at least one stored program controlled device comprising:

a base computer,

a remote electromechanical device, said device having at lease one parameter to be controlled and monitored,

a remote stored program controller, said controller having a stored program and means to independently monitor said at least one parameter and independently control said device in response to the monitoring of said at least one parameter in accordance with said stored program by monitoring and controlling said at least one parameter,

a communications link between the base computer and the stored program controller,

said base computer having means to request the controller to communicate information associated with said at least one parameter through said communications link to thereby monitor same, and

said base computer having means to generate instructions and communicate same through said communications link to the controller for execution by its stored program to thereby alter the operation of the remote electromechanical device.

2. The system of claim **1** wherein the base computer further comprises means permitting operator input of instructions for execution by said stored program, said base computer having means to communicate upon operator command said desired instructions to the stored program controller and said stored program controller has means to immediately execute said desired instructions.

3. The system of claim **2** wherein the stored program controller has means to acknowledge to the base computer receipt and execution of said desired instruction prior to controlling of said device in accordance with the executed instructions, and the base computer has means to indicate to the operator receipt of the acknowledgement by the base computer.

4. The system of claim **1** wherein the desired instruction may be conditioned in accordance with the operating parameters monitored by the stored program controller.

5. The system of claim **1** wherein the electromechanical device has a local controller, the stored program controller having means to control the local controller, and wherein the local controller has means to accept operator input of desired changes to the at least one parameter, said stored program controller having means to accept and monitor said operator input changes.

6. The system of claim **5** further comprising means to disable the stored program controller for independent control of the electromechanical device by the local controller, and wherein the stored program controller has means to update its monitoring and resume control of the at least one parameter after said stored program

controller has been returned to control of the local controller and the local controller has independently controlled the electromechanical device for a period of time.

7. The system of claim 1 further comprising a remote terminal unit, said remote terminal unit having means to physically connect to the stored program controller and generate desired instructions for execution by the stored program controller.

8. The system of claim 1 wherein the stored program controller is a computer.

9. The system of claim 1 wherein the base computer has means to periodically communicate with the stored program controller to request updated information associated with said at least one parameter.

10. The system of claim 1 wherein the stored program controller has a real time clock means independent of the base computer, and means to execute the stored program in accordance with its real time clock means.

11. The system of claim 1 wherein the means to request information and generate desired instructions includes a stored program in the base computer, the base computer having means to run another stored program without interfering with the independent monitor and control of the electromechanical device by the stored program controller.

12. The system of claim 1 wherein the base computer comprises a microcomputer with CRT display and keyboard.

13. The system of claim 1 wherein a plurality of stored program controllers are connected to the base computer by the communications link, at least one of the stored program controllers having means to relay base computer communication to and from another of said stored program controllers.

14. The system of claim 1 wherein a plurality of stored program controllers are connected to the base computer by the communications link, and each stored program controller has means to independently monitor and control a plurality of parameters associated with its associated electromechanical device.

15. The system of claim 14 wherein the base station has means to permit operator selection of a defined group of stored program controllers from which to request information.

16. The system of claim 15 wherein the base station has means to permit operator selection of a single parameter for a defined group of stored program controllers from which to request information.

17. The system of claim 14 wherein the base station has means to permit operator selection of a defined group of stored program controllers for which to generate desired instructions for execution by their associated stored program.

18. The system of claim 17 wherein the base station has means to permit operator selection of a single parameter for a defined group of stored program controllers for which to generate desired instructions for execution by their associated stored program.

19. A system for remotely monitoring and controlling a plurality of computer controlled irrigation systems by a base computer comprising:

a base computer,

a plurality of irrigation systems, each irrigation system having a plurality of operating parameters to be monitored and a plurality of operating parameters to be controlled,

each irrigation system having an associated computer, each irrigation system computer having means to independently monitor said operating parameters and independently control said irrigation system in response to the monitoring of the operating parameters associated with its associated irrigation system,

a communications link between the base computer and the irrigation system computer, the base computer having means to request the irrigation system computers to communicate information associated with each of its monitored operating parameters through said communications link to thereby monitor same and means to generate desired instructions for execution by the irrigation system computers and communicate said instructions thereto through said communications link to thereby alter the operation of the irrigation systems by altering their associated operating parameters.

20. The system of claim 19 wherein the irrigation system computers each have a stored program for monitoring and controlling said pluralities of operating parameters.

21. The system of claim 20 wherein the base computer further comprises means permitting operator input of desired instructions for execution by said plurality of stored programs, said base computer having means to communicate upon operator command said desired instructions to said plurality of irrigation system computers, and each of said irrigation system computers having means to immediately execute said desired instructions.

22. The system of claim 21 wherein the irrigation system computers have means to acknowledge to the base computer receipt and execution of said desired instruction prior to controlling of the irrigation system in accordance with the executed instructions, and the base computer has means to indicate to the operator receipt of the acknowledgement by the base computer.

23. The system of claim 22 wherein each irrigation system has a local controller, each irrigation system computer having means to control the local controller, and wherein the local controller has means to accept operator input of desired changes to the pluralities of operating parameters, the irrigation system computer having means to accept and monitor said operator input changes.

24. The system of claim 23 further comprising means permitting release of the irrigation system from irrigation system computer control for independent control of the irrigation system by the local controller, and wherein each irrigation system computer has means to update its monitoring and resume control of the pluralities of operating parameters after it has been returned to control of the local controller and the local controller has independently controlled the irrigation system for a period of time.

25. The system of claim 24 wherein at least one of said irrigation systems comprises a center pivot irrigation system.

26. The system of claim 19 further comprising an interface means between each of said irrigation system computers and its associated local controller, said interface means including a latching means to latch in a preselected condition in response to the output of the irrigation system computer, said latching means having means to maintain said preselected condition until said output is changed by said irrigation system computer.

27. The system of claim 26 wherein the interface means further comprises means to indicate the condition of the latching means, said indication means being connected to the irrigation system computer to thereby indicate the condition of the latching means back to the irrigation system computer.

28. The system of claim 27 wherein the latching means comprises a plurality of latching relays and wherein the indicating means comprises a plurality of resistors connected in series with said latching relays.

29. The system of claim 26 wherein the interface means further comprises means to enable the latching means for irrigation system computer control.

30. The system of claim 20 wherein each irrigation system computer has means to receive and store a plurality of base computer generated desired instructions, and means to systematically and independently execute these desired instructions in accordance with its stored program.

31. The system of claim 19 wherein the base computer has means to periodically communicate with the irrigation system computers to request updated information associated with said monitored operating parameters.

32. The system of claim 20 wherein the irrigation system computers each have a real time clock means independent of the base computer, and each irrigation system computer has means to execute its stored program in accordance with its real time clock means.

33. The system of claim 20 wherein the means to request communication of information and to generate desired instructions includes a stored program in the base computer, the base computer having means to run another stored program without interfering with the independent monitor and control of each irrigation system by its associated irrigation system computer.

34. The system of claim 33 wherein the base computer has an associated real time clock means independent of the real time clock means associated with the irrigation system computers.

35. The system of claim 19 wherein at least one of the irrigation system computers has means to relay base computer communications to and from another of said irrigation system computers.

36. The system of claim 19 wherein each irrigation system has an associated local controller, each irrigation system computer effecting control of the irrigation system through the associated local controller, and further comprising interface means connected between each irrigation system computer and its associated local controller, the interface means having means to release the local controller from irrigation system computer control.

37. The system of claim 36 wherein the interface means further comprises latch means, the irrigation system computer having means to set said latch means for desired conditions of operating parameters, and wherein the means to release said local controller from irrigation system computer control includes means to reset said latch means.

38. The system of claim 37 wherein the interface means further comprises means to indicate the condition of said latch means to said irrigation system computer, said irrigation system computer having means to compare the indicated latch condition with the indicated parameter condition and generate an alarm signal in response thereto.

39. The system of claim 19 wherein the communications link comprises a radio tansmitter/receiver and a modem associated with each of the base computer and the irrigation system computers.

40. The system of claim 20 wherein the base computer has means to generate instructions conditioned upon the operating parameters monitored by the irrigation system computer, and the irrigation system computer stored program has means to execute said instructions in accordance with the occurrence of the condition.

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