United States Patent [19]

Pickard

[11] Patent Number: 4,682,491

[45] Date of Patent: Jul. 28, 1987

[54] **APPARATUS AND METHOD FOR TESTING PROSTHETIC HEART VALVES**

[76] Inventor: **Murphy L. Pickard,** 3250 Pierce St., Wheatridge, Colo. 80030

[21] Appl. No.: **830,854**

[22] Filed: **Feb. 19, 1986**

[51] Int. Cl.⁴ **G01M 19/00**

[52] U.S. Cl. **73/37;** 73/168; 73/865.6

[58] Field of Search 73/37, 168, 812, 865.6

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,381,663	5/1983	Swanson	73/37
4,450,710	5/1984	Nettekoven	73/37
4,546,642	10/1984	Swanson	73/37
4,598,579	7/1986	Cummings et al.	73/37

FOREIGN PATENT DOCUMENTS

445432	6/1975	U.S.S.R.	73/37
685294	9/1979	U.S.S.R.	73/432 SD
728864	4/1980	U.S.S.R.	73/168

OTHER PUBLICATIONS

Pickard, M. L. et al., *Computer Managed in Vitro Testing of Ventricular Assist Devices,* In Trans. Am. Soc. Artif. Intern. Organs, vol. XXV, pp. 192–196, 1979.
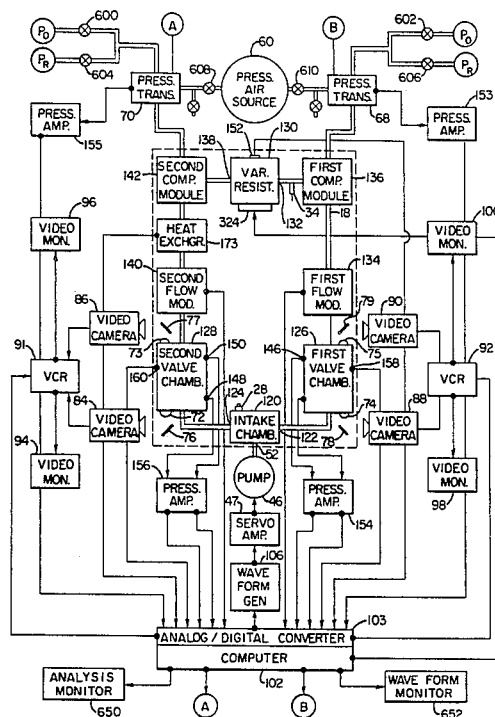
Primary Examiner—Stewart J. Levy

Assistant Examiner—Joseph W. Roskos
Attorney, Agent, or Firm—Timothy J. Martin

[57] **ABSTRACT**

An apparatus and method for testing prosthetic heart valves prior to implant in the human body provides a test chamber having a flow channel therethrough and a passageway which receives a mounting fixture for a heart valve. The test chamber is used in a mock circulatory loop with the flow channel being in the loop. Preferably, the test chamber has a transverse passageway that intersects the flow channel, and the mounting fixture advances completely through the test chamber from an insertion location to a disconnect location while a dynamic seal is maintained. Two such test chambers may be used in a mock loop, and the loop is configured with an intake chamber fluidly interconnecting one side of each test chamber, and a restriction chamber fluidly interconnecting the other sides of the test chambers. The restriction chamber is variable, and pressure compensation is provided between each of test chambers and the restriction chamber. A pump cyclically drives a fluid through the loop, and flow meters and pressure sensors monitor the test. A data processor monitors and processes the flow data and controls the pump to create a desired flow waveform. The test can also be visually and optically monitored.
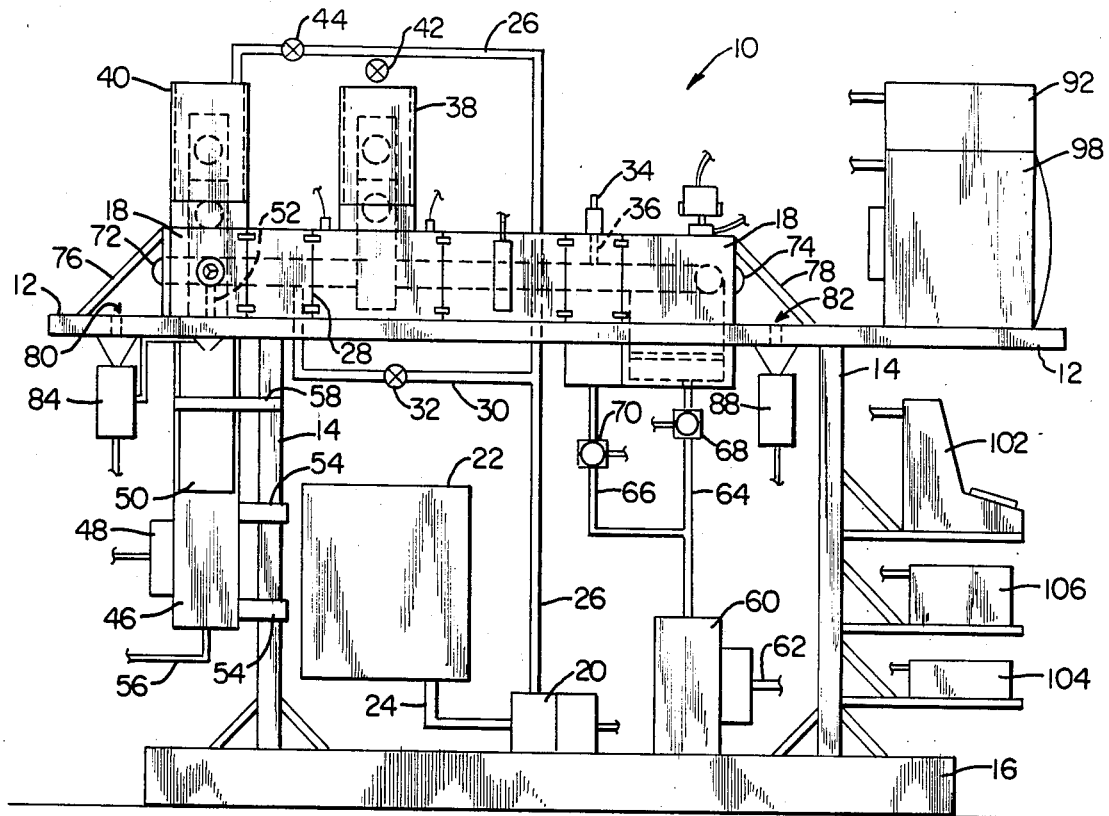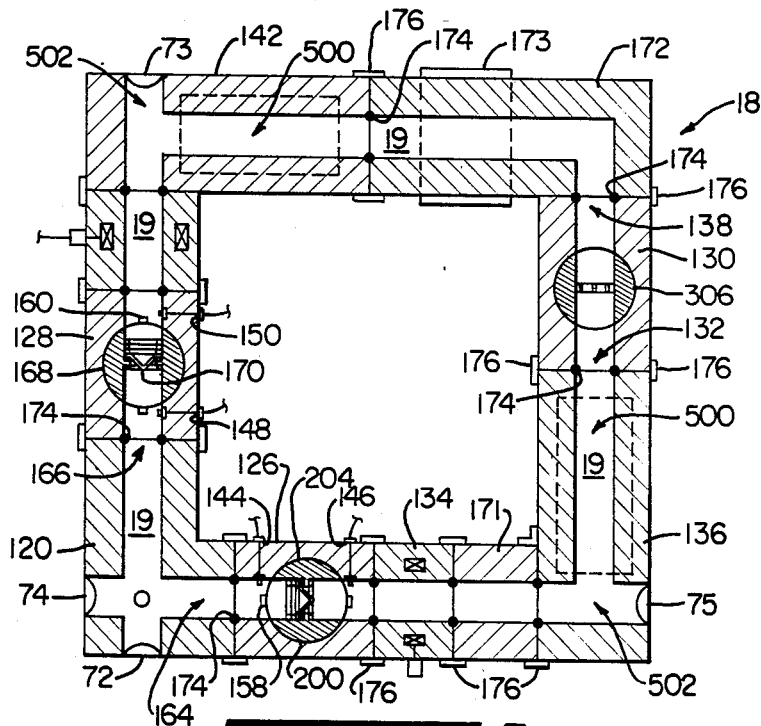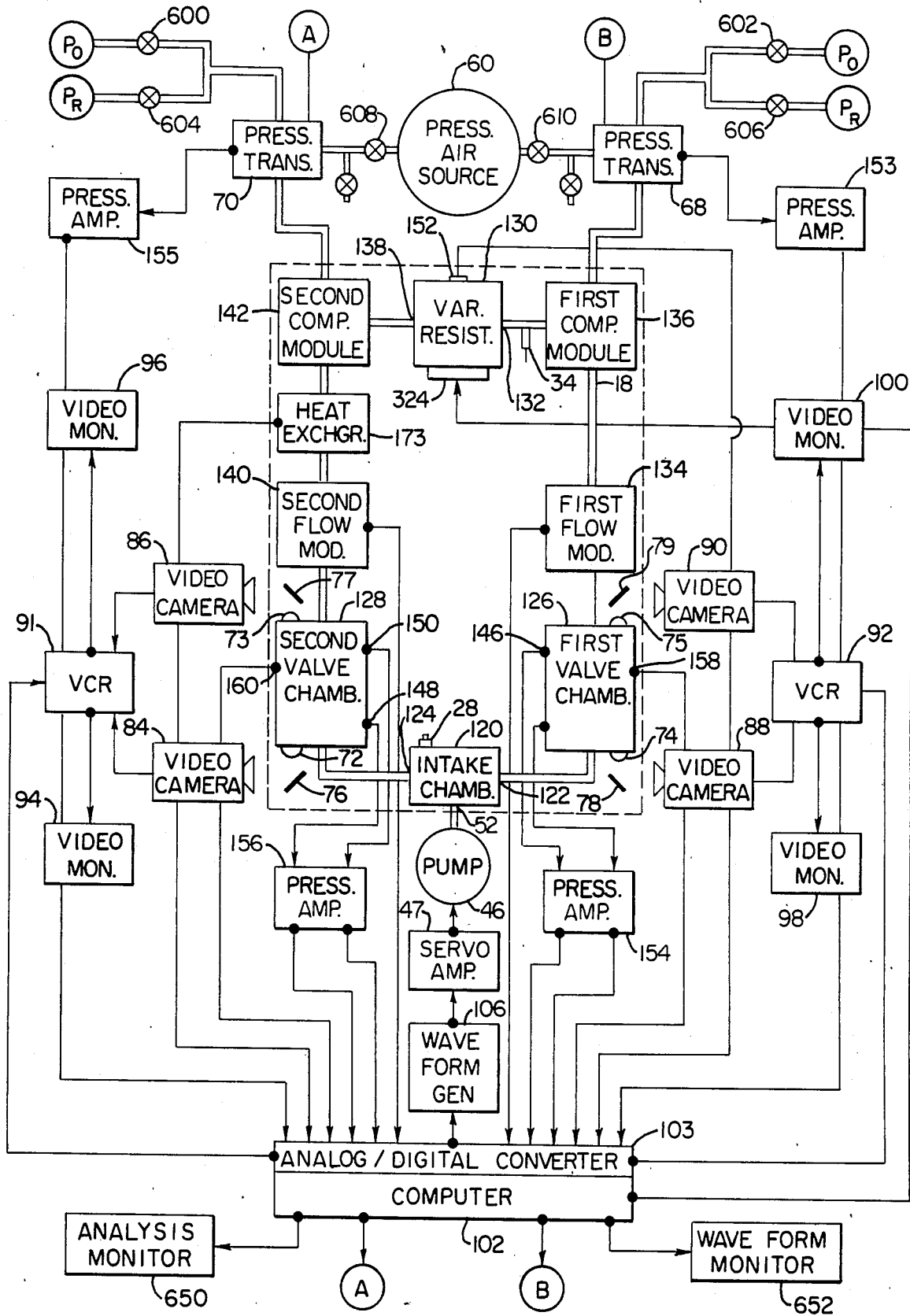
42 Claims, 8 Drawing Figures

P_O   600   A   B   602   P_O

P_R   604   606   P_R

PRESS. TRANS.   608   70

PRESS. AIR SOURCE   60

610   PRESS. TRANS.   68

PRESS. AMP.   155

PRESS. AMP.   153

152   130   138

142   SECOND COMP. MODULE

VAR. RESIST.

FIRST COMP. MODULE   136

324   132   34   18

VIDEO MON.   96

HEAT EXCHGR.   173

VIDEO MON.   100

140   SECOND FLOW MOD.

FIRST FLOW MOD.   134

VIDEO CAMERA   86

77

79   90   VIDEO CAMERA

91   VCR

73   128   SECOND VALVE CHAMB.   150   160

146   126   FIRST VALVE CHAMB.   158   75

92   VCR

84   VIDEO CAMERA

148   124   28   120

INTAKE CHAMB.

72   76   122   78   74

88   VIDEO CAMERA

94   VIDEO MON.

156   PRESS. AMP.

52   PUMP

PRESS. AMP.   154

VIDEO MON.   98   92

47   46

SERVO AMP.

106

WAVE FORM GEN

103

ANALOG / DIGITAL CONVERTER

COMPUTER

102

ANALYSIS MONITOR   650
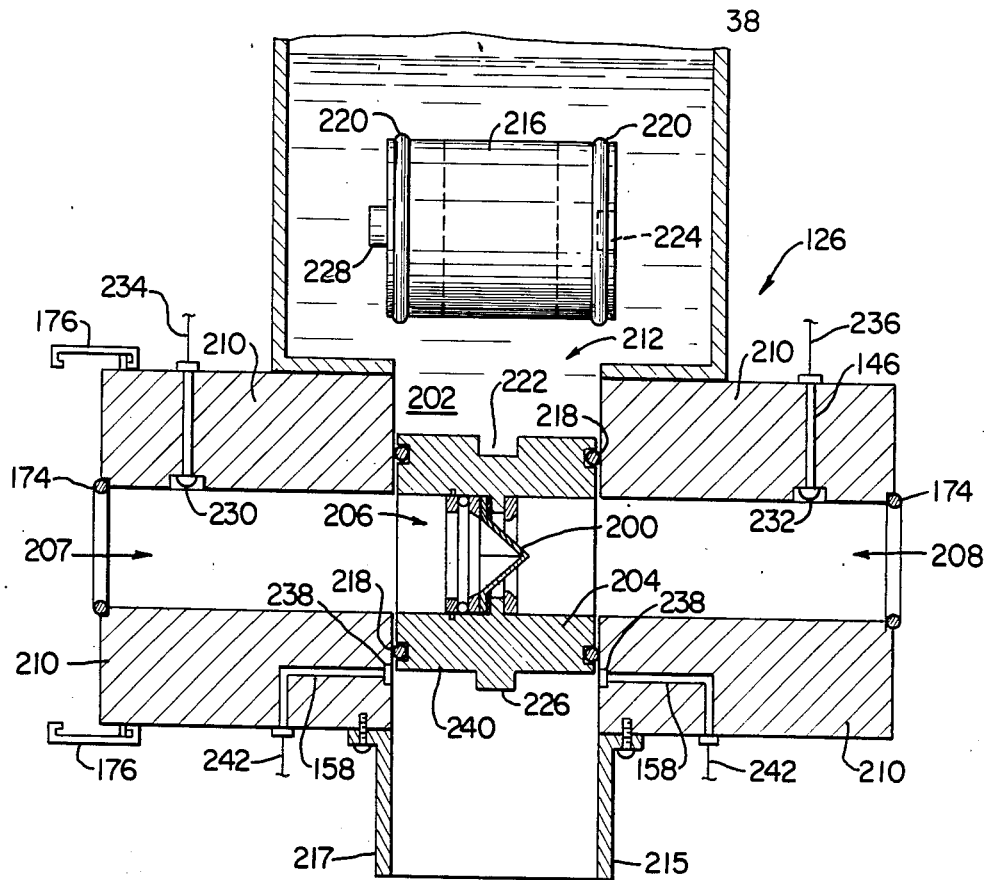
A   B

WAVE FORM MONITOR   652
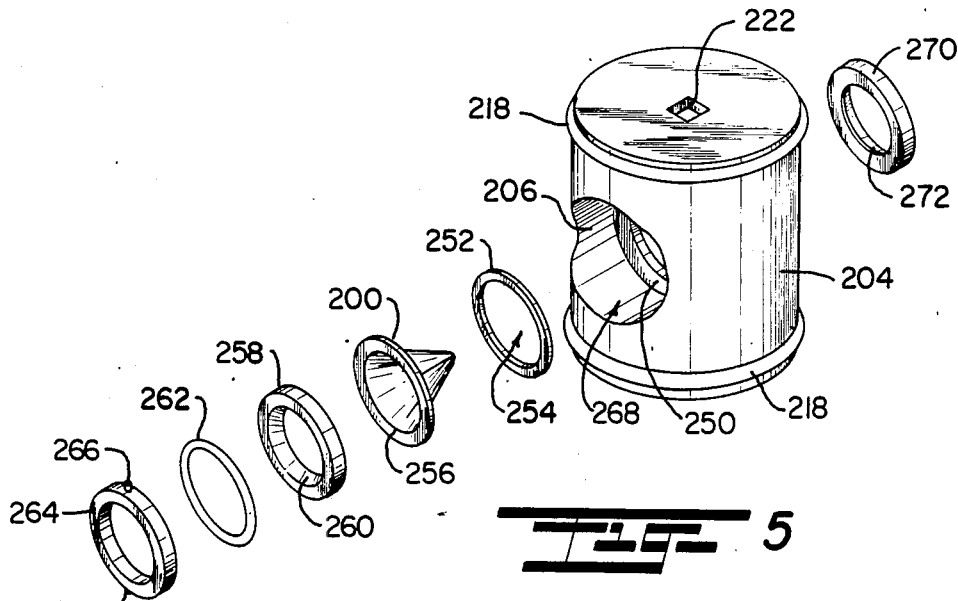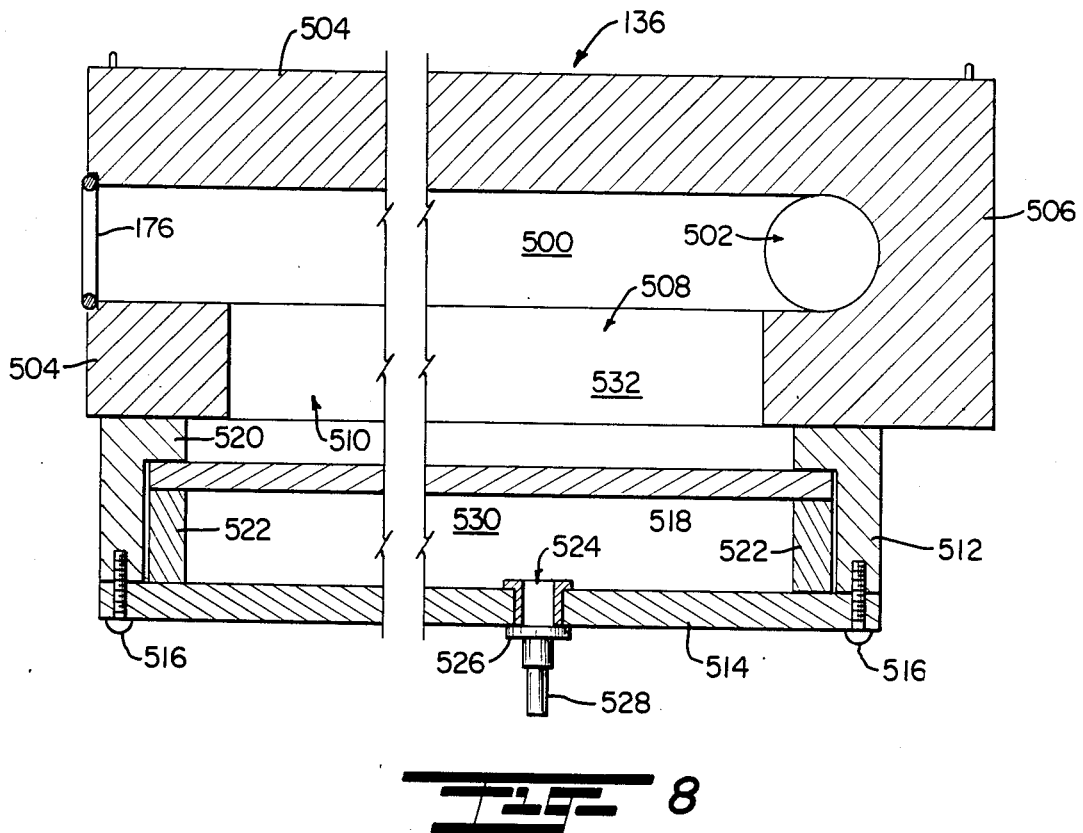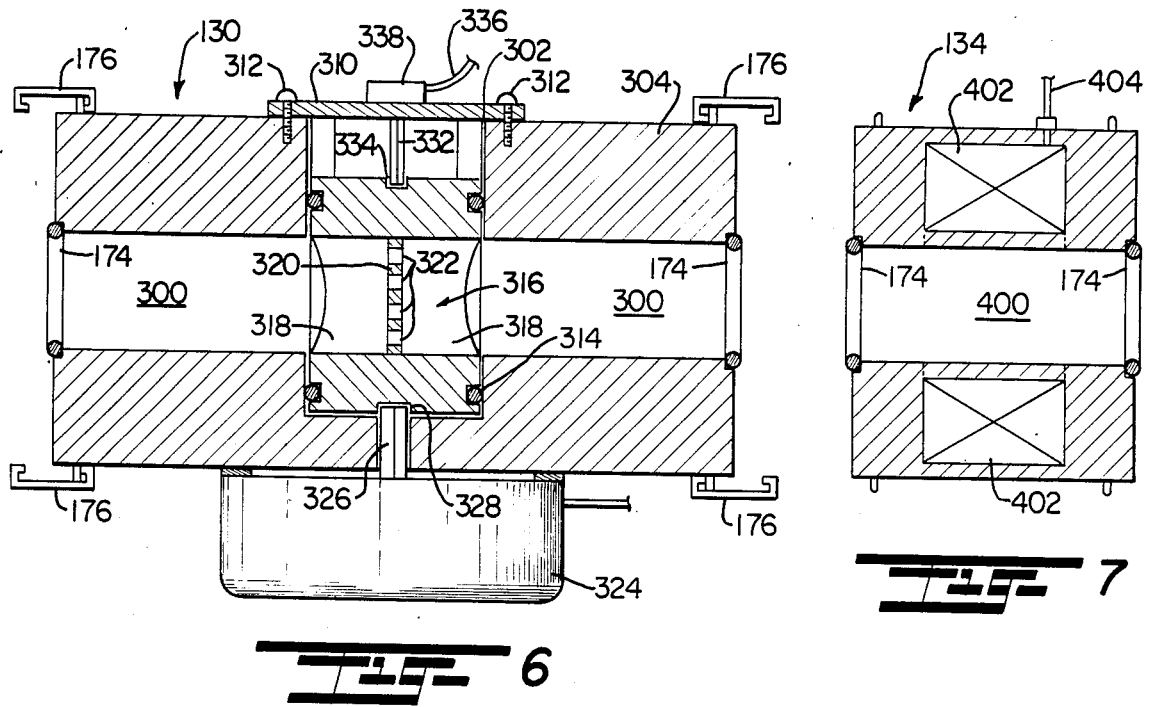
FIG. 2

Fig 4

Fig 5

Fig 6

Fig 7

Fig 8

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.