United States Patent [19]

Shannon

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[54] **TACTILE COMMUNICATION ATTACHMENT**

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[52] **U.S. Cl.**..... **179/2 A,** 179/2 DP, 340/407

[51] **Int. Cl.** **H04m 1/21**

[58] **Field of Search**..... 128/2 S, 2.05 C, 128/2.05 D, 2.05 P; 200/81 H, 83 Q, 83 Z, 200/86 A; 340/407; 179/2 R, 2 A, 103

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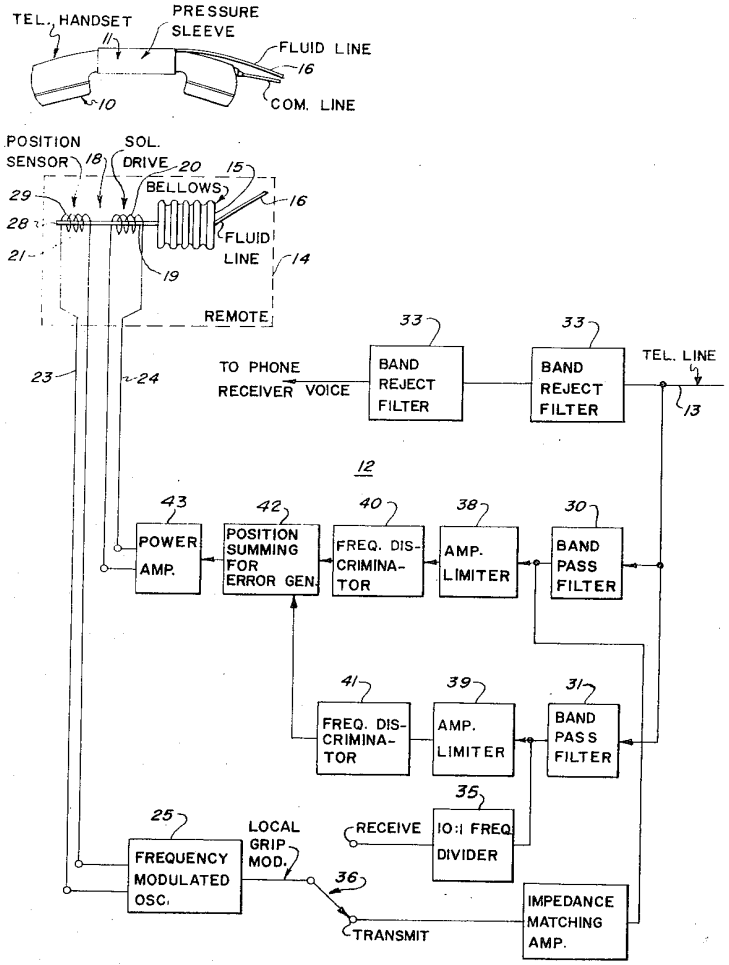
[57] **ABSTRACT**

A tactile communication device including a responsive grip attachment and a control unit which are electromechanical in operation and are intended to be used at least in pairs, to establish or permit tactile communication between two or more parties. The two devices form a closed loop feedback control system whose output to each party is the pressure and volume variations of the responsive grip attachment experienced by both parties.

13 Claims, 3 Drawing Figures



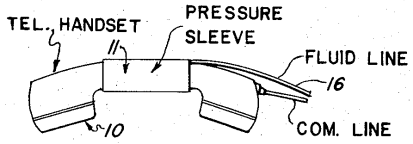


FIG. 1

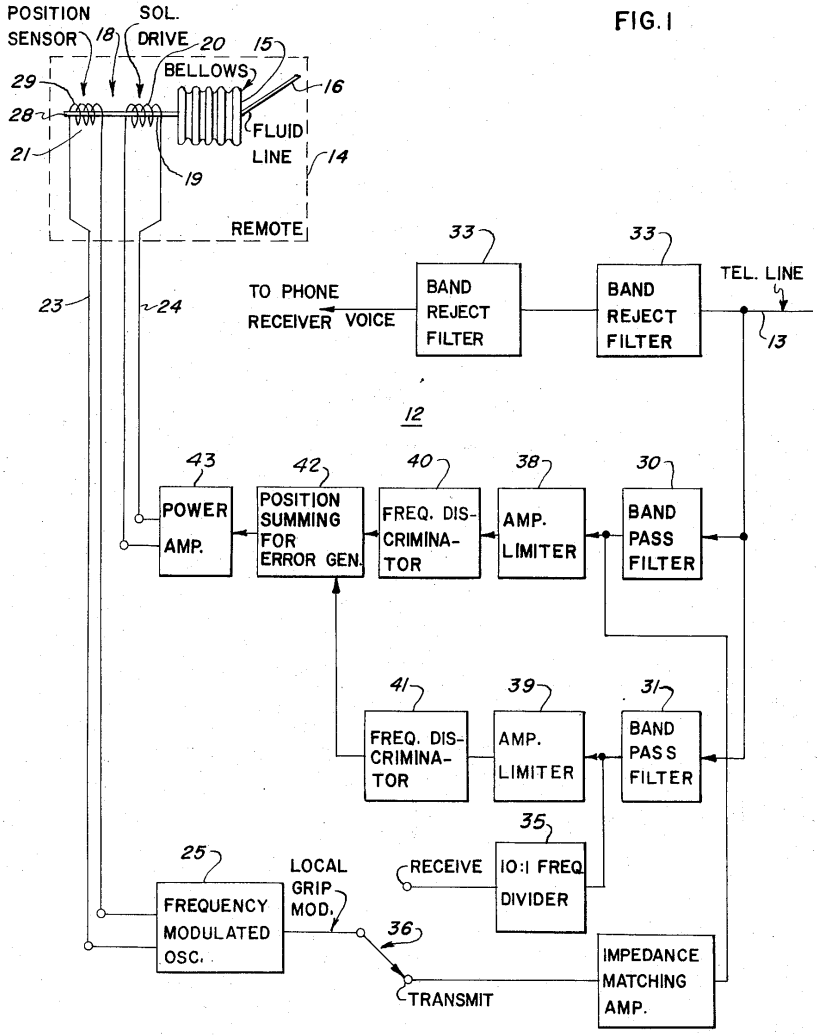
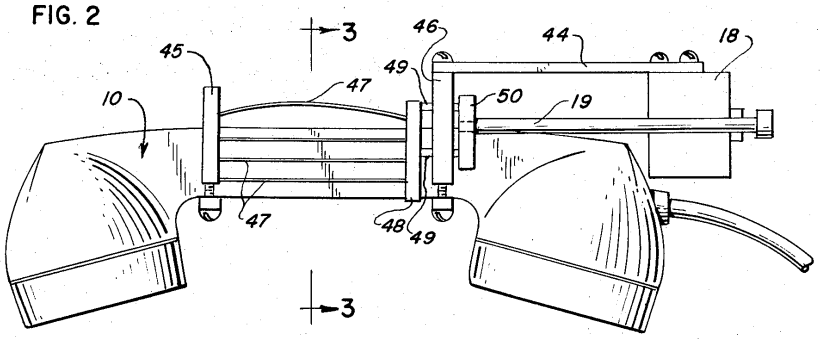


FIG. 2



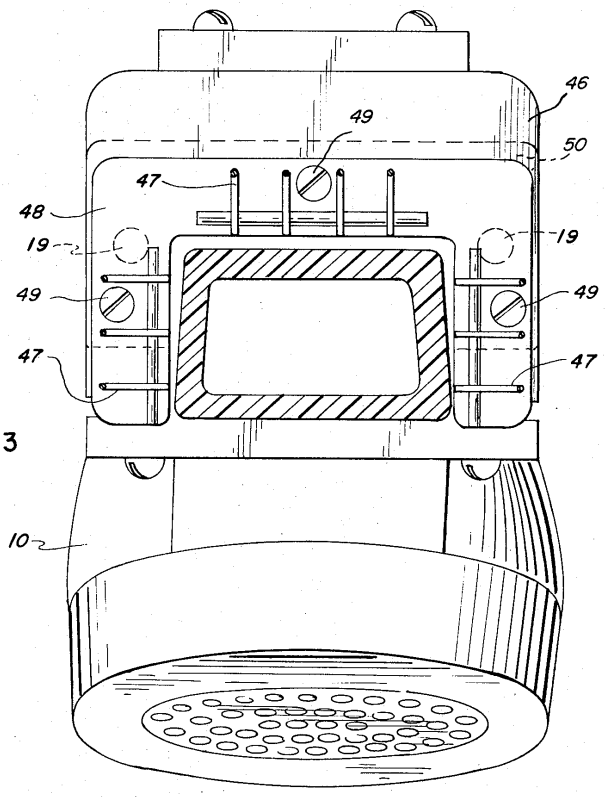


FIG. 3

TACTILE COMMUNICATION ATTACHMENT

This invention relates to a method and apparatus for permitting tactile communications in addition to or instead of audible communication between two or more people via, for example, telephone lines or other communication systems.

The present invention is particularly applicable for use by persons who are deaf, deaf mutes and/or dumb, to carry on communications with another person who may also be deaf, a deaf mute or dumb, by or through an established system of communication using the sense of touch. The invention also permits a person to convey to another person the emotions which are sensed during a conversation, via the same sense of touch. While the above may be the principal application for the invention, it will be apparent from the description below that the apparatus and method of the invention can be used to convey intelligence in the sense of touch over long distances and in various different forms and applications.

In particular, the apparatus of the invention comprises a tactile communication device including a responsive grip attachment and a control unit which are electro-mechanical in operation and are intended to be used at least in pairs, to establish or permit tactile communication between two or more parties. The two devices form a closed loop feedback control system whose output to each party is the pressure and volume variations of the responsive grip attachment experienced by both parties.

In the illustrated embodiment, the pressure and volume variations are provided by means of a fluid-filled device in the form of a sleeve or pad which is wrapped around a telephone hand set. A length of flexible tubing connects the sleeve to a control unit located nearby, and the latter includes a compressible reservoir or fluid, hereinafter referred to as a bellows, coupled to a solenoid. When the sleeve is to be expanded or the pressure is to be increased, an electrical current is applied to the solenoid which attempts to compress the bellows. The magnitude of the solenoid current is proportional to the degree to which the two parties oppose each other's grip on the sleeves.

A compression at one end of the phone line causes an increase in pressure and/or expansion at the other end. Similarly, any opposition to that expansion causes an increase in pressure at both ends. The overall effect is that both parties continually experience each other's grip. A relaxing of one's grip is reflected as a "going limp" at the other end.

This variation in pressure and volume can be used to establish a form of tactile communication, using the sense of touch. While disclosed in a telephone system, it will be appreciated that the device can be connected in any form of two-way communication system using, for example, microwave or shortwave bands and the like. If one or both parties is a deaf mute or either deaf or dumb, communications can be carried on between the parties, by arranging a system or code based on the feel of the responsive grip. Alternatively, these pressure variations can be used for tactile communication in addition to or instead of audible communication, or to operate or activate other apparatus for various different purposes.

It is therefore an object of the present invention to provide a method and apparatus for permitting tactile communications between two or more people.

A further object is to provide an apparatus which can be easily coupled to a communication system such as a telephone, for permitting tactile communications in addition to or instead of audible communication.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the several steps and the relation of one or more of such steps with respect to each of the others and the apparatus embodying features of construction, combination of elements and arrangement of parts which are adapted to effect such steps, all as exemplified in the following detailed disclosure, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings in which:

FIG. **1** is a diagrammatic illustration of the tactile communication device;

FIG. **2** is a side plan view of a responsive grip telephone attachment exemplary of a second embodiment of the invention, shown affixed to a telephone hand set; and

FIG. **3** is a sectional view taken along lines **3**—**3** of FIG. **2.**

Similar reference characters refer to similar parts throughout the several views of the drawings.

Referring now to the drawings, in FIG. **1** there is illustrated a tactile communication device exemplary of the invention including a responsive grip telephone attachment in the form of a fluid-filled sleeve **11** affixed to a telephone hand set **10** and a control unit **12** which when coupled to a telephone line **13** and another such device coupled to the telephone line **13,** permits tactile communications in addition to or instead of audible communications between two parties via the telephone line **13.** The telephone, including the telephone hand set **10,** can be of standard construction, with the sleeve **11** affixed thereto. The latter is a fluid-filled, sealed, compressible sleeve affixed about the grip portion of the telephone hand set **11** in appropriate fashion, and coupled to a bellows **15** by means of a fluid line **16.** The bellows **15** comprises part of an actuator unit **14** of the control unit **12** and is remotely located with respect to the telephone hand set **10.** In addition, the actuator unit **14** can be remotely located with respect to the other electrical apparatus forming the control unit **12,** and can be electrically coupled to the latter by means of the electrical conductor wires **23** and **24.** This actuator unit **14,** as explained more fully below, can be affixed to the telephone hand set **11,** if desired. The electrical apparatus forming the control unit **12** therefore can be placed in any convenient location hidden from sight, and the actuator unit **14** can be located nearer to the telephone hand set **10,** thus permitting a shorter length of fluid line **13** to be used to couple the sleeve **11** to the bellows **15.** It is preferred that a fluid line **16** as short as possible be used, since the shorter fluid line requires less fluid to be moved to actuate the bellows **15** and/or the sleeve **11.** The system sensitivity therefore is enhanced.

The sleeve **11** and its associated bellows **15** are used to control a frequency modulated oscillator **25,** to gen-

erate positional information signals which are transmitted over the telephone line **13,** together with the voice frequency signals, and used to actuate the bellows **15** and sleeve **11** of another tactile communication device coupled to the telephone line, through the medium of the telephone central office equipment. These positional information signals are converted in the control unit **12** and used to generate solenoid currents for operating a solenoid **18** (shown schematically) coupled to the bellows **15** to vary the pressure and volume of the sleeve **11,** to produce a signal detectable by the party holding the telephone hand set **10,** through the sense of touch.

To generate the proper and identical solenoid currents in each control unit **12,** two frequency modulated signals are used. The two center frequencies for the signals are 290 HZ and 2,900 HZ. The intended frequency range of each signal is from 10 percent below to 10 percent above the center frequency. The actual frequency transmitted at any instant is determined strictly by the position of the solenoid plunger **19** which is mechanically linked to a movable slug **28** in a frequency determining inductor **29** of the frequency modulated oscillator **25.** Different positions of the slug **28** produce different values of inductance and hence different frequencies. Compressing the sleeve **11** will force fluid into the bellows **15** which will pull the plunger **19** outward from the solenoid **18.** The plunger **19** will move the slug in such a direction that the oscillator frequency decreases.

The positional information signals generated by the oscillator **25** pass through an appropriate band pass filter which, in the case of the upper frequency band, is the band pass filter **30** and, in the case of the lower frequency band is the band pass filter **31,** before being coupled to and sent over the telephone line **13.** The voice signals are passed through two band reject filters **32** and **33** to prevent voice frequency components from interfering with the positional information signals.

The oscillator **25** for both parties generate positional information signals in the upper frequency band, however, in one of the control units **12** this signal is converted to the lower frequency band by pulsing a frequency divider in the form of a decade counter **35** whose output is a square wave of exactly one-tenth the frequency of its input. Since this square wave output passes through the band pass filter **31,** only the sinusoidal frequency component is coupled to the telephone line **13.** Other methods could be used to generate the low frequency signal, but this method yields an exact frequency division factor rather than one subject to variations due to component tolerances. The decision of which party sends at the higher frequency and which at the lower frequency is determined automatically by means of an electronic switch **36,** which, for simplicity, is shown as a manually operated switch, when one person initiates a call and the other answers. In the illustrated example, the party who initiates or transmits a call will send at the higher frequency and the party who receives the call will send at a lower frequency.

In each control unit **12,** both the upper and lower frequency band positional information signals are processed in the same way. These signals enter an amplitude limiter **38** or **39,** depending on the signal band, wherein they are first amplified and then clipped to generate or produce a fixed amplitude square wave of exactly the same frequency for a wide range of signal strengths at the input. This square wave is coupled to a frequency discriminator **40** or **41** which generates an output signal whose magnitude varies directly with frequency. Specifically, in the illustrated example, the frequency discriminator **40** or **41** generates one fixed amplitude and duration pulse for each cycle of the input signal. Thus, as frequency increases, the average DC voltage of the train of output pulses increases. The pulses for the upper frequency signal are one-tenth as wide as the lower frequency pulses but, of course, are ten times as many in number. Accordingly, if the upper and lower band signals are both at their center frequencies, the DC component of both pulse trains are equal.

The pulse train outputs from both of the frequency discriminators **40** and **41** (representing the pulse train outputs from the calling and called stations) are coupled to an error generating circuit **42** which filters out a voltage that is proportional to the DC value of the sum of these two inputs. A fixed DC voltage equal to the sum when both signals are at their center frequencies is substracted from the actual sum to generate the error signal. Accordingly, when both position signals actually are at their center frequencies, the error is 0. The current to drive the solenoid coil **20** is derived by simply amplifying, by means of a power amplifier **43,** this error signal so, in this case, the solenoid current is also 0. If one signal decreases in frequency by some percentage, the same percentage increase signal will cause the error to again be 0. But, if the second party prevents its frequency from increasing by The same percentage (by resisting the motion of his sleeve **11**), then an error signal will occur whose magnitude is proportional to the difference between the percentage change that should occur and the percentage change allowed to occur. The error can be brought to 0 either by the first party relaxing his grip on the sleeve **11** to reduce the required percentage change, or by the second party relaxing his grip on the sleeve **11** and so allowing the required percentage change to occur.

Referring now to FIG. **2** and FIG. **3,** an alternate construction for the responsive grip telephone attachment is illustrated, and it can be seen that the same includes a pair of mounting brackets **45** and **46** for removably affixing it to the telephone hand set **10.** The solenoid **18,** in this case, is affixed to the telephone hand set **10,** and is supported thereon by means of a support bracket **44** affixed to the mounting bracket **46.** The sleeve **11** is replaced by means of spring wires **47** which are affixed at their one end to the mounting bracket **45** and at their other end to a slide **48.** The slide **48** is slidably supported by means of shafts **49** extending through the mounting bracket **46** and affixed to an actuating plate **50.** The plunger **19** of the solenoid **18** is affixed to the actuating plate **50.** The power amplifier **43** is coupled to the solenoid **18,** via the electrical conductor wires **24.** The plunger **19** of the solenoid **18** again is mechananically linked to the movable slug **28** (not shown) in the frequency determining inductor **29** (not shown) of the frequency modulated oscillator **25.**

The operation of this pressure grip telephone attachment is the same as that described above, however, in this case, the spring wires **47** when squeezed exert a force on the slide **48** to move the latter, which force is coupled to the actuator plate **50** and hence the plunger **19** of the solenoid **18.** Conversely, upon energizing the solenoid **18,** its plunger **19** transmits the pressure to the actuator plate **50,** the slide **48** and the wires **47,** to pro-

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