(No Model.) 2 Sheets—Sheet 1.

W. E. SLOAN, J. E. HUGHES & O. S. REED.

TELEGRAPHIC APPARATUS.

No. 459,448. Patented Sept. 15, 1891.

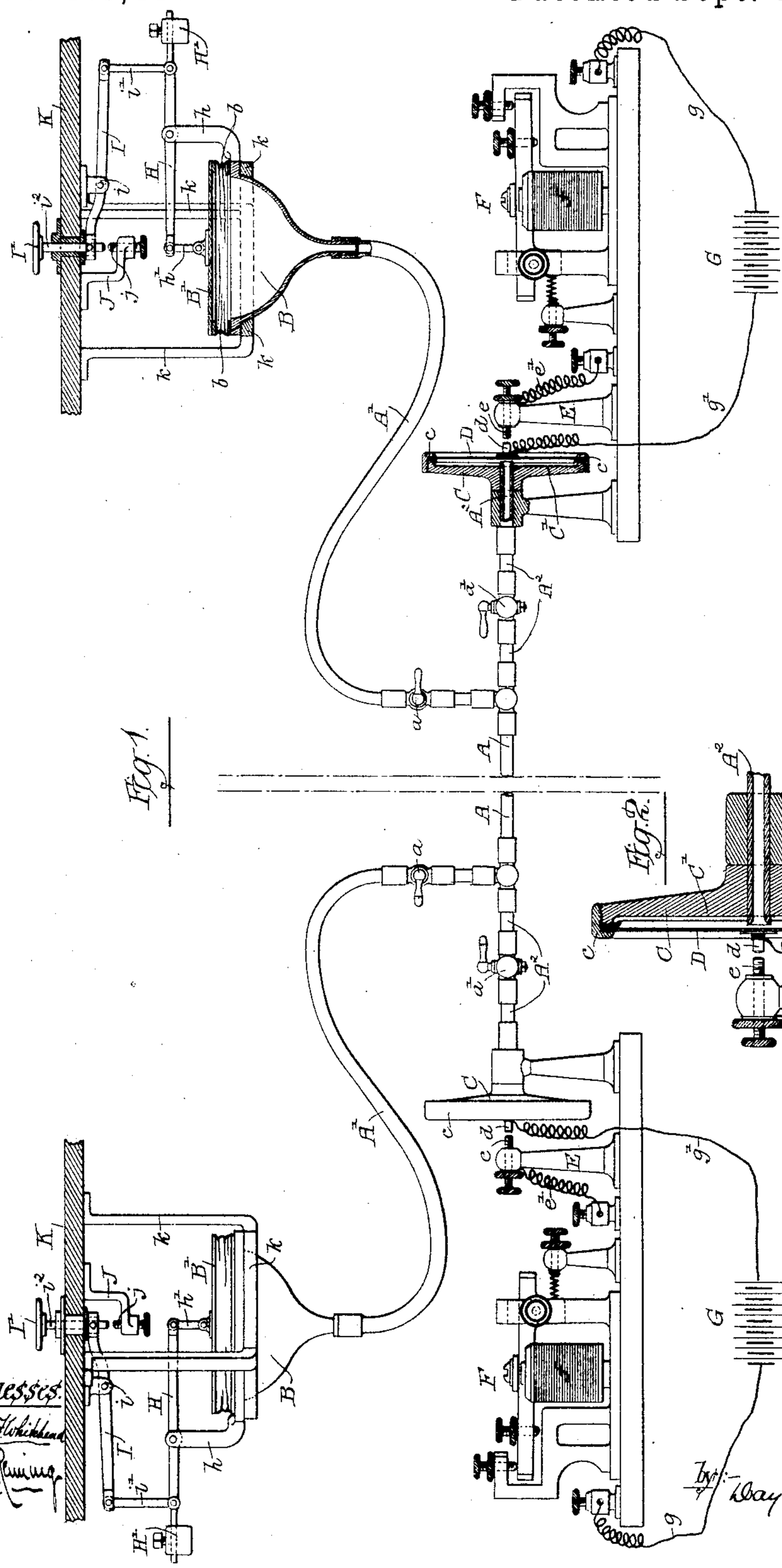

Fig. 1.

Fig. 2.

Witnesses:
Louis W. Whitehead
Wm. F. Fleming

Inventors:
William E. Sloan,
John E. Hughes, &
Orrin S. Reed.
by: Baylis, Poole & Brown
Attorneys.

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Fig. 2.

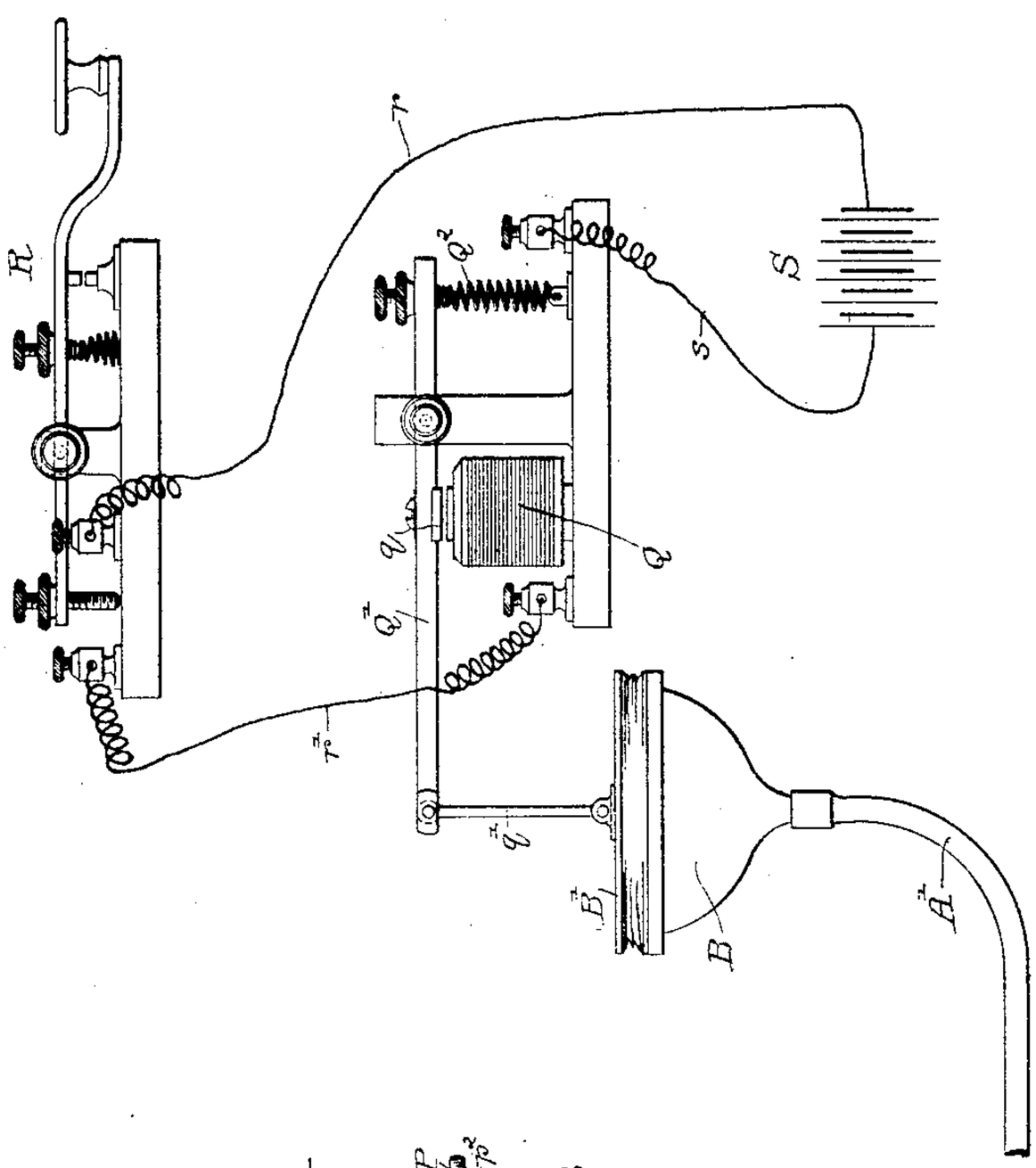


Fig. 4.

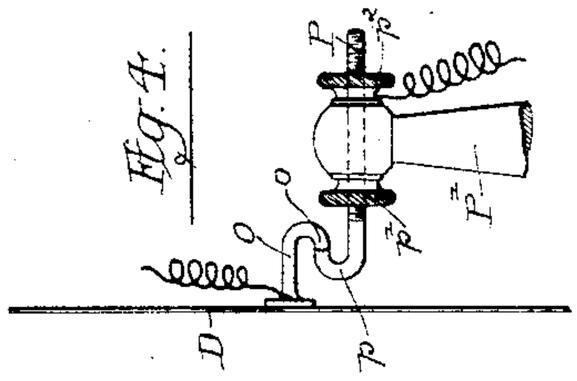
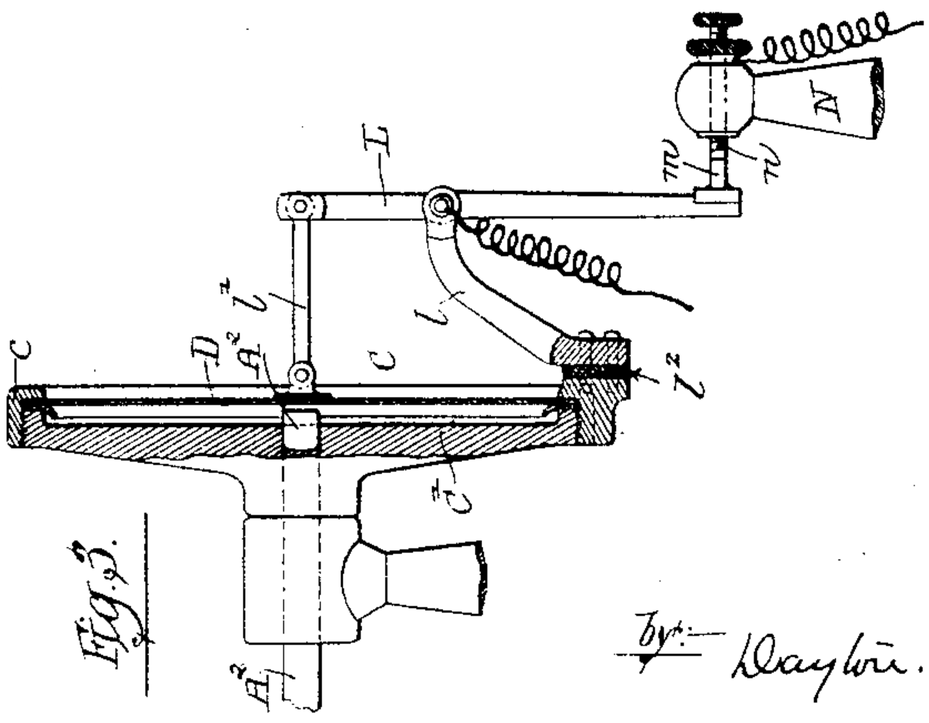


Fig. 3.



Witnesses:-
Louis M. T. Whitehead.
Wm. F. Fleming.

Inventors:-
William E. Sloan.
John E. Hughes. &
Orrin S. Reed.

By:- Dayton. Poole & Brown
Attorneys-

UNITED STATES PATENT OFFICE.

WILLIAM E. SLOAN, JOHN E. HUGHES, AND ORRIN S. REED, OF CHICAGO, ILLINOIS, ASSIGNORS TO THE VIBRO TELEGRAPH COMPANY, OF SAME PLACE.

TELEGRAPHIC APPARATUS.

SPECIFICATION forming part of Letters Patent No. 459,448, dated September 15, 1891.

Application filed July 5, 1890. Serial No. 357,769. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM E. SLOAN, JOHN E. HUGHES, and ORRIN S. REED, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Telegraphic Apparatus; and we do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to an apparatus for the purpose of transmitting intelligence from one point or station to another by means of an elastic medium—such as air—contained in a pipe or tube reaching from the transmitting to the receiving station.

An apparatus embodying our invention consists in its main or essential features of a tube extending from the transmitting to the receiving station, and containing air or gas under normal pressure, a closed compressible air-chamber connected with the end of the tube at the transmitting-station, a closed chamber in communication with the end of the tube at the receiving-station and provided with an elastic wall or diaphragm, and an electric device which is controlled by the movements of the said elastic wall or diaphragm to make an audible or visible record of the impulses or vibrations sent through the tube by movements of the movable part or wall of the air-chamber.

The invention also embraces features of construction by which the compressible air-chamber may be operated or controlled by an electric device having a key which may be manipulated in the same way as the sending-key of an electric telegraph, together with other features of construction, as hereinafter fully set forth.

The invention may more readily be understood by reference to the accompanying drawings, in which—

Figure 1 illustrates, partially in section and partially in side elevation, the several parts of the apparatus necessary for two stations. Fig. 2 is an enlarged detail section of the air-chamber, provided with a diaphragm for receiving the impulses. Fig. 3 illustrates a modified construction in such a chamber. Fig. 4 shows a modified construction in the contact device. Fig. 5 illustrates an electric device for actuating the compressible air-chamber at the sending-station.

As shown in the said drawings, A indicates a small tube or hollow wire, which extends between the stations or points at which the sending and receiving devices are located. Said tube will commonly be a small one—say between one-sixteenth and one-fourth of an inch in internal diameter—and made of any suitable material.

B indicates a closed compressible chamber provided with a movable wall B′, which is connected with the stationary part of the chamber by a flexible section *b*.

C indicates a closed chamber provided with a flexible and elastic wall or diaphragm D. The tube A is branched at each station, so as to form a tube A′, leading to the air-chamber B and a tube A^2, leading to the air-chamber C, said tubes being desirably provided with valves *a a′*, so that either of the said chambers B or C may be brought into communication with the main tube A, as desired. The flexible diaphragm D is provided at its center with a contact-point *d*, arranged opposite a stationary contact-point *e*, mounted on an insulated post or support E.

F indicates a telegraphic sounder of ordinary construction, the magnet-coils *f* of which are connected in circuit with a battery G, and with the contact-points *d e* by means of conductors *g g′ e′*.

Devices are provided for actuating the movable wall B′ of the chamber B, as follows: H is a horizontal lever pivoted between its ends to a bracket *h* and having one of its ends located over the center of the wall B′ and connected therewith by a connecting bar or link *h′*. The opposite or outer end of the said lever H is provided with a weight H′, which tends to hold the said wall B′ elevated, and to maintain the said chamber normally expanded. I is a second lever mounted horizontally above the lever H and pivoted between its ends to a stationary support *i*. One end of said lever I is connected with the lever H by means of a link *i′*, while the other end of said lever I is attached to a vertically-slid-

ing rod i^2, having attached to its upper end a flat plate or button I', forming a finger-piece. j is an adjustable stop, located in position for contact with the rod i^2 and acting to limit the downward movement of the same, said stop being herein shown as consisting of a set-screw j, mounted in a bracket J. The chamber B is herein shown as supported by means of a bracket k from a table K, to the under surface of which the brackets J and the support i are also secured, and in which the rod i^2 is mounted to slide, the button I' being located above the top of the table in the manner shown. In this construction by pressing upon the button I' the weight H' is raised and the wall B' is depressed, so as to transmit to the air within the chamber an impulse or wave, which is transmitted through the air in the tube A and finally acts upon the elastic diaphragm D at the receiving-station. The pivots of the levers H and I are so arranged that the necessary range of movement in the said wall B' will be given by the depression of the said button through a short distance, said button being preferably so adjusted as to have a movement about equal in extent to that of the sending-key in an electric telegraph, the object of this construction being to enable a telegraph-operator to manipulate the sending devices of the apparatus without trouble.

In the operation of this apparatus constructed as described messages will be transmitted by movements of the button I' in the same manner as in sending a telegraphic message by the use of the Morse alphabet, or a similar system of signals, the waves or impulses transmitted through the tube A acting upon the diaphragm D so as to bring together the contact-points d e at each impulse, and thereby establish an electric circuit through the sounder F, so that the sounder will be actuated at each impulse in the same manner as the sounder in an electric telegraph. The contact-points d e will be preferably adjusted very close together, so that a very slight movement of the diaphragm will serve to make and break the contact. Such movement of the diaphragm need not be materially greater than that produced in the diaphragm of a telephone by the sound of the voice. It is not to be understood that the waves or impulses referred to are transmitted by a bodily movement of the air within the tube. On the contrary there is no bodily movement of the air, but the waves or impulses produced by the movements of the movable wall of the chamber at the transmitting-station are transmitted through the air or other elastic medium within the tube by "waves" or vibrations like the so-called "sound-waves," by which, according to now-accepted theories, sounds are transmitted through the medium of the atmosphere. It is to be noted, furthermore, that the diaphragm of the receiving-chamber is necessarily of elastic character, so that it will have a vibratory motion corresponding with the vibrations or impulses transmitted through the elastic medium in the tube.

In the particular construction herein shown the air-chamber B is made of approximately conical shape and tapers toward the tube A', this construction being employed to facilitate the transmission of vibrations from the air within the chamber to that within the tube. The air-chamber C is preferably made with a rear wall C' in the form of a flat disk, having a short marginal flange or rim, against which the diaphragm D is held by a clamping-ring c, the space between the plate C' and the diaphragm D preferably being made small or narrow, so that the chamber will contain a relatively small quantity of air, it obviously being desirable that the bulk of air subject to vibratory movement should be as small as possible. I prefer to extend the end of the tube A^2 through the plate C' and bring said tube as close to the diaphragm D as possible without liability of interfering with the vibrations of the same, it being obvious that in this arrangement the impulses sent through the tube are likely to act with more effect on the diaphragm.

Instead of operating the circuit-closing device directly from the diaphragm by attaching one of the contact-points of the circuit-closing device to the diaphragm itself, intermediate actuating parts may be employed to increase or multiply the movement of the diaphragm. Such a construction is shown in Fig. 3, in which L is a lever pivoted between its ends to an arm l, attached to the side wall of the chamber C. The inner or shorter arm of said lever L is connected with the center of the diaphragm D by means of a link l'. The longer or outer end of the lever L carries a contact-point m, arranged opposite a contact-point n, mounted on an insulating-support N. This construction is useful where the vibratory movement of the diaphragm is very slight, in order to obtain a sufficient movement in the contact-points to properly make and break the electric circuit through the same.

In the construction shown in Figs. 1 and 2 the contact-points d e stand normally separated from each other and are brought together to close the circuit through the sounder by the outward movement of the diaphragm. In the construction shown in Fig. 3, however, the contact-points m and n stand normally in contact, so as to maintain the circuit closed, and the outward movement of the diaphragm serves to separate the contact-points and break the circuit. A construction of this kind will be employed where the electric device for reproducing the impulses transmitted through the tube from the receiving-station is of a character requiring a normally-closed circuit for its operation. It will of course be understood, however, that the lever device shown in Fig. 3 may be used with equal advantage for closing a circuit by a proper ar-

rangment of the contact-points for this purpose.

In Fig. 3 the arm *l* is preferably insulated by a block l^2 of insulating material, and one conductor is connected with the said arm, this construction having the advantage that the connection of the conductor in no way interferes with the movement of the lever.

In Fig. 4 we have shown the arrangement of contact-points when the circuit is normally closed and no lever is employed. In this instance O is an arm attached to the center of the diaphragm D and provided with a bent end, the extremity of which constitutes a contact-point *o*. An adjustable bar P on a standard P′ is provided with a similarly-bent end, forming a contact-point *p*, arranged opposite the contact-point *o*. In this instance the contact-points stand normally together, and are separated by an outward movement of the diaphragm. The rod P is shown as arranged to slide longitudinally, but not to rotate in the support P′, and as adjustably held in the said support by means of thumb-nuts p' p^2, at opposite sides of the support.

In Fig. 5 we have shown an electric device for operating the movable wall B′ of the air-chamber B at the sending or transmitting station. In this instance Q is an electro-magnet, the armature *q* of which is attached to a lever Q′. One end of the said lever is connected by a link *q′* with the movable wall B′ of the chamber B, while to the opposite end of said lever is connected a spring Q^2, which tends to lift the wall B′ and expand the chamber. The electro-magnet Q operates against the action of the said spring Q^2 to depress the said wall B′ and expel the air from the chamber.

R is a key or circuit-closer of ordinary construction arranged in circuit with the electro-magnet Q and the battery S by means of conductors *r r′ s*. Whenever the key is depressed a circuit is completed through the electro-magnets Q and the movable wall B′ actuated, and thereby send an impulse through the tube to the opposite or receiving station.

In the employment of a transmitting or sending device consisting of an eletro-magnet and a circuit-closer or key, as shown in Fig. 5, the apparatus is operated in the same manner as an ordinary electric telegraph, by manipulation of the key R.

It may sometimes be desired in connection with an electric device for actuating the movable wall B′, such as is shown in said Fig. 5, to provide means for giving a greater amplitude of movement to the said movable wall B′ than can be readily afforded by the movement of the armature *q* with a lever of convenient length. In such case a compound lever may be employed of the same character as that shown in connection with the transmitting devices illustrated in Fig. 1, to give such increased movement to the said movable wall. It will of course be understood that a weight may be substituted for the spring Q^2 as a means of actuating the said lever Q′, if found desirable.

While the apparatus illustrated is adapted for transmitting and receiving messages by the employment of a movable button or key at the sending-station and a sounder at the receiving-station, so as to provide for the transmission by the Morse alphabet or a similar system of signals, yet it is to be understood that the main features of our invention may be employed in connection with any other kind of sending and receiving devices. For instance, an automatically-operating sending device may be employed to transmit impulses through the tube A by suitably compressing and expanding the chamber B, and any suitable telegraphic receiving or recording device may be actuated by the electric circuit, which is controlled by the movements of the diaphragm at the receiving end of the tube. It is not essential, however, that any particular device or apparatus should be employed at the sending-station for the purpose of giving movement to the movable wall of the compressible chamber there located, inasmuch as such movable wall may be actuated by the direct application of the hand or finger thereto, the said wall in such case being moved or carried by the hand both in and out, so as to give a proper initial impulse to the air within the chamber. When the compressible chamber is especially adapted for actuation by immediate contact of the hand or finger, however, its movable wall will preferably be held normally in position to maintain the chamber expanded by means of a spring or counterbalance-weight, so that impulses may be sent through the tube by a simple pressure against said movable wall in the same manner as in operating the key or circuit-closer of the electric telegraph, the pressure of the hand in such case acting against the spring or weight to move the wall inwardly, while the movable wall is retracted or drawn outwardly by the spring or weight preparatory to giving another or succeeding impulse to the air.

The apparatus herein described is adapted for use in transmitting messages both for long and short distances—that is to say, between distant cities or between points within the same city. In either case it has the important advantage of requiring no insulation of the conductor through which the impulses are transmitted, it being obvious that the tube illustrated may be buried in the ground or placed in other positions most convenient for its protection. The employment of such tube will be of great benefit in cities where the employment of overhead electric wires is not permitted, it being obvious that such tube may be easily placed under ground, and that when so placed it will not be subject to any of the disadvantages arising from the similar location of electric wires—that is to say, it will not be injuriously affected by moisture and the transmission of messages

will not be affected by the proximity of electric conductors.

As hereinbefore stated, it is designed that the tube should be a very small one, so that it will have the general characteristics of a hollow wire—that is to say, it will preferably be so small as to be easily handled and so that it may be laid through buildings and sustained upon poles or supports where desirable in the same manner as wires are now placed or supported. We have not yet determined how small the tube or hollow wire may be made for successfully carrying out our invention; but we now contemplate the use of a tube of one-eighth inch internal diameter for ordinary distances within cities or towns.

A single tube extending between terminal stations may be connected at intermediate points with transmitting and receiving devices constructed in the same manner as those herein shown, and in such case a message sent from either terminal or either intermediate station may be received at all or part of the other stations, and by the employment of suitable valves in the branch tubes leading from the main tube to the receiving and transmitting devices messages may be transmitted from either of the terminal stations to either intermediate station, or between the intermediate stations exclusive of the other stations, it of course being necessary to provide valves in the main tube in case it is desired to prevent the transmission of impulses past the intermediate stations.

In the use of the apparatus herein shown for communicating between places at a very great distance apart, or where a great number of receiving devices are connected with the same tube, it may be necessary to employ repeating devices consisting of an electric circuit which is controlled by the movements of a diaphragm at the terminal of a transmitting-tube, and which serves to operate a transmitting device acting on another tube in the same general manner as in the so-called "relay-transmitter" of an electric telegraph. As, for instance, assuming that the receiving device shown in Fig. 2 is substituted for the circuit closer or key R of Fig. 5, and that the conductors e' g' of said Fig. 2 are connected with the wires r' r of said Fig. 5, then a device will be obtained by which the impulses communicated to the diaphragm shown in Fig. 2 will be transmitted to the movable wall B′ of the chamber B of Fig. 5—that is to say, when the diaphragm D is moved so as to close the circuit through the conductors by an impulse of the air through the tube, the electro-magnet Q will be excited to draw downwardly the lever Q′, Fig. 5, and thereby move the wall B′ and give an impulse through the tube connected with the chamber B.

It is obvious that the relay or repeating device above described may be employed to repeat the signals transmitted through separate tubes, so as to enable messages to be transmitted any number of times and to any distance desired. It will of course be understood where a number of receiving devices are in communication with the same tube, so that all such devices receive the same impulse, that the force of the impulse at the terminal of the tube will be diminished, and such impulse can be transmitted to a less distance than when the impulses are received at a terminal station only, and it follows that when the line is constructed with a number of intermediate stations it may be necessary to employ relay devices at more frequent intervals than when the intermediate stations are less in number or are entirely absent.

We claim as our invention—

1. A telegraphic system comprising a tube extending between two or more stations and sending and receiving apparatus at each station, severally consisting of a closed compressible chamber, means for maintaining said chamber normally expanded, and a closed chamber provided with an elastic vibrating wall or diaphragm, branch tubes connecting both of said chambers with the said tube, and a receiving device embracing an electric circuit which is controlled by the movements of the said elastic wall or diaphragm, and a telegraphic sounder or recording mechanism operated by said circuit, substantially as described.

2. A telegraphic apparatus comprising a tube which extends from the transmitting to the receiving station, a closed compressible chamber connected with the tube at the transmitting-station, a closed chamber in communication with the tube at the receiving-station and provided with a flexible wall or diaphragm, means for actuating the movable wall of the said compressible chamber embracing an electro-magnet, an electric circuit, a key or circuit-closer, and a receiving device embracing an electric circuit which is controlled by the movements of said flexible wall or diaphragm, substantially as described.

3. A telegraphic system comprising a tube extending between two or more stations and sending and receiving apparatus at each station, consisting of a closed compressible chamber and a chamber provided with a flexible wall or diaphragm, both of said chambers being connected with the said tube by means of valved branch tubes, and a receiving device embracing an electric circuit which is controlled by the movements of the said flexible wall or diaphragm, substantially as described.

4. A telegraphic apparatus comprising a tube which extends from a transmitting to a receiving station, a closed compressible chamber connected with the tube at the transmitting-station, a closed chamber in communication with the tube at the receiving-station, such chamber being provided with a flexible wall or diaphragm, a lever pivoted upon a stationary support and connected with the said diaphragm, receiving devices embracing an electric circuit, and contact-points in the cir-

cuit, one of which contact-points is carried by the said lever, substantially as described.

5. A telegraphic apparatus comprising a tube extending from a transmitting to a receiving station, a compressible chamber connected with the tube at the transmitting-station, a closed chamber in communication with the tube at the receiving-station, said chamber being provided with a flexible wall or diaphragm, a lever mounted upon an insulated support connected with the said diaphragm, and an electric circuit embracing contact-points, one of which is carried by the said lever, and embracing also a conductor connected with the support to which the lever is pivoted, substantially as described.

In testimony that we claim the foregoing as our invention we affix our signatures in presence of two witnesses.

WILLIAM E. SLOAN.
JOHN E. HUGHES.
ORRIN S. REED.

Witnesses:
C. CLARENCE POOLE,
GEORGE W. HIGGINS, Jr.