2 Sheets—Sheet 1.

E. THOMSON & E. J. HOUSTON.

ELECTRO-TELEGRAPHIC APPARATUS.

No. 183,031. Patented Oct. 10, 1876.

Fig. 1.

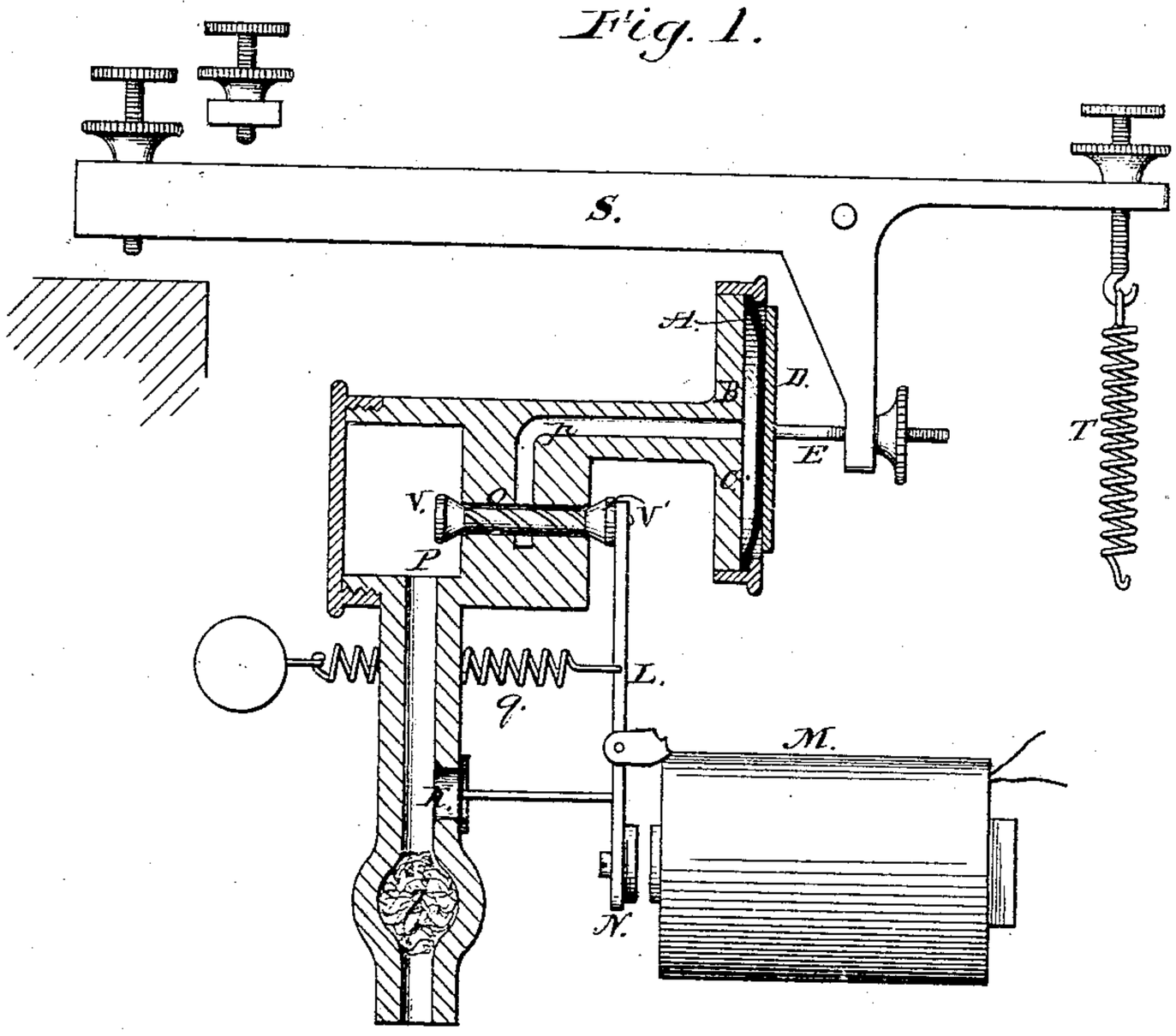


Fig. 2.

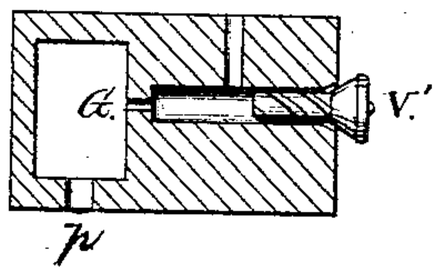


Fig. 3.

Attest:

Theo. L. Popp

Wm. Wagner

Inventors:

Elihu Thomson.

Edwin J. Houston.

2 Sheets—Sheet 2.

E. THOMSON & E. J. HOUSTON.

ELECTRO-TELEGRAPHIC APPARATUS.

No. 183,031. Patented Oct. 10, 1876.

Fig. 4.

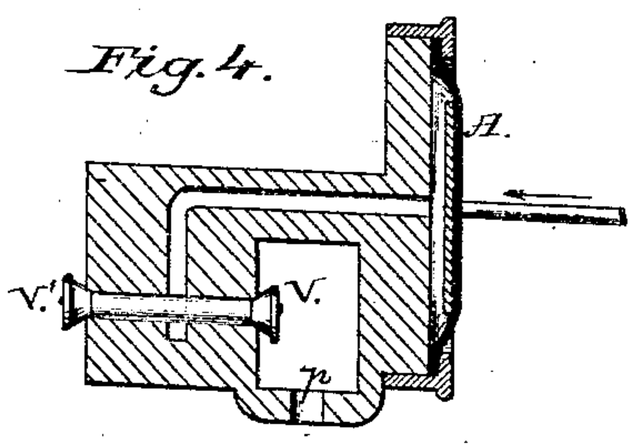


Fig. 5.

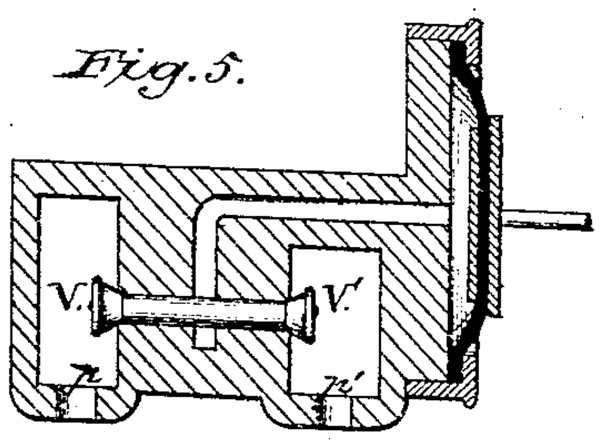
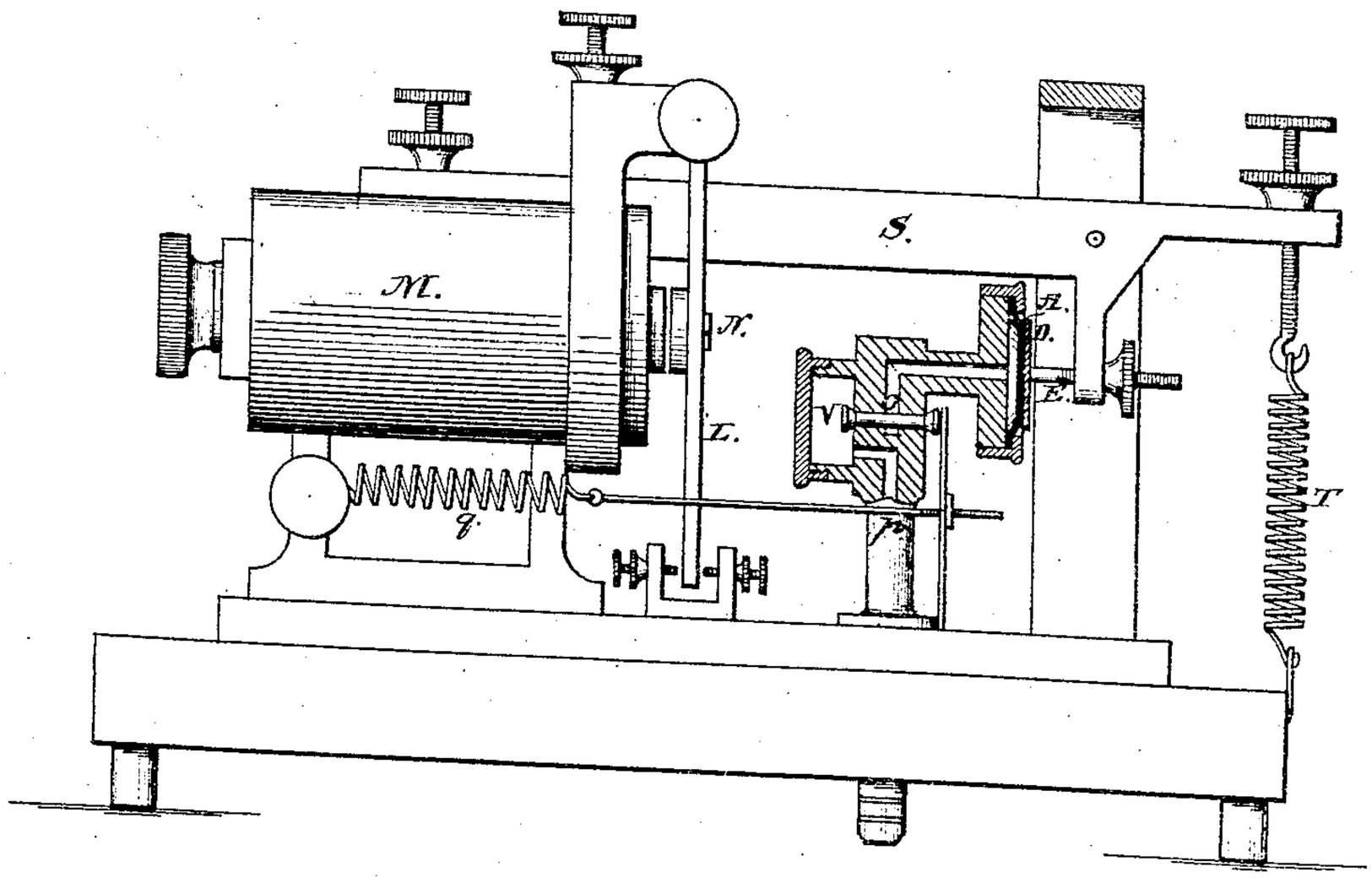


Fig. 6.



Attest:

Theo L. Popel

Wm Maguer

Inventors:

Elihu Thomson.

Edwin J. Houston

JAMES R. OSGOOD & CO. BOSTON.

UNITED STATES PATENT OFFICE.

ELIHU THOMSON AND EDWIN J. HOUSTON, OF PHILADELPHIA, PA.

IMPROVEMENT IN ELECTRO-TELEGRAPHIC APPARATUS.

Specification forming part of Letters Patent No. **183,031**, dated October 10, 1876; application filed November 8, 1875.

To all whom it may concern:

Be it known that we, ELIHU THOMSON and EDWIN J. HOUSTON, both of the city and county of Philadelphia, Pennsylvania, have invented an Improved Method of Imparting Motion to Electro-Telegraphic Apparatus, whereby the use of relays and local batteries may be completely dispensed with, and at the same time a lessening of expense be secured, both in the first cost of instruments and in their maintenance in operation.

In our invention the line-current, or that ordinarily employed to operate a system of relay-magnets, is used through the medium of an electro-magnet, to operate the hereinafter-described valve mechanism, which controls the ingress and egress of air, gas, or other fluid, to and from a movable diaphragm or piston, the movement of which is communicated to the striking-lever of an electro-signal or telegraphic apparatus.

In the application of our invention to the movement of the parts of telegraphic instruments, the movements of which are ordinarily obtained from the electrical currents generated by the use of secondary or local batteries, we employ a diaphragm or piston, A, Figure 1, so placed with respect to the plate B, of any convenient outline, as to leave a space, C, for the entrance of compressed air or gas, the pressure of which is employed in the movement of the diaphragm or piston A to give motion to the striking mechanism, bell, sounder, &c., either directly or through the intervention of the plate D and the rod E, as shown.

In Fig. 1, S is the lever of a telegraphic sounder, as modified by our invention, the stroke in one direction being produced by the motion of the diaphragm, communicated by the rod E. The return stroke is secured by the operation of a spring, as shown at T. The ingress and egress of compressed fluids to the aforesaid space C, between the diaphragm A and the plate B, is controlled by a suitable valve mechanism, V V′, consisting essentially of the plug or valve V, regulating the flow of the compressed air, gas, or other fluid from the conduit P, attached to a suitable reservoir containing such compressed fluid, to the chamber C, through the passage *p*. The valve or plug V′ regulates the escape of air from the chamber C. The valves V and V′ are connected each to each by a valve-stem passing through an opening, *o*, by means of which a guidance for the proper seating of the valves is secured. The valve-stem is preferably furnished with a straight or spiral grooving, extending in the direction of the length, so as to admit of the passage of the proper amount of air to and from the valves V and V′, and the passage *p*, leading to the chamber C, as aforesaid. It is evident that, with the construction of the valve mechanism as heretofore described, the space provided for the passage of air to and from the chamber C may be reduced to any desirable extent, still preserving a workable size of valve. The valves V and V′ are moved by a suitable attachment, as a lever, L, to the armature N, of an electro-magnet, M. In order to balance the valves, or to render their motion independent of the pressure in the conduit P, as far as desirable, we use for simplicity a regulable spring, *q*, exerting a pressure in the opposite direction to that exerted by the compressed fluid. When it is desirable to balance the valves under variations in the fluid-pressure, we employ a flexible surface, K, inclosing an opening in the conduit P, so arranged as to size and position that it shall exert, as nearly as practicable, a pressure on the lever L equal and opposite to that exerted on the back of the valve V by the compressed fluid. In order to avoid frequent regulation of the spring *q*, under variations of pressure in the fluid-supply, a constant pressure is maintained in the conduit P by the introduction, between it and the supply-reservoir, of any form of governor suitable for the purpose.

It is evident that, under the conditions of balancing of the valves V V′ already described, a very slight force, exerted by the magnet M upon the armature N, will be sufficient for opening the valve V and closing V′, so as to permit the compressed fluid, supplied from the conduit P, to exert its pressure on the diaphragm A, by which motion is communicated to the striking-lever of the electro-signal or telegraphic instrument.

When an abundant supply of fluid under pressure exists, we dispense with the use of

the valve V or the valve V′, Fig. 1, and replace either by a small opening, as at G, Fig. 2, (where the valve V is removed,) forming a permanent passage to the diaphragm. If, now, the valve V′ is open, the fluid passing through G, instead of exerting its pressure on the diaphragm, passes directly into the outer air. When, however, V′ is closed by the action of the magnet, and the escape of fluid prevented, it passes through the opening G, thence through *p*, and is utilized for the movement of the diaphragm. The removal of the valve V′, and its replacement in a similar manner by a permanent opening, (the valve V, Fig. 1, being retained,) serves also for the movement of the diaphragm.

In the foregoing description we have shown the application of our invention to the movement of levers, &c., in one direction only, the return stroke being accomplished by the action of a spring.

When it is desirable to dispense with the action of a spring we employ additional diaphragms or pistons, the pressure of which is exerted in a direction opposite to or at any angle with that exerted by the mechanism hereinbefore described.

In the application of our invention to conditions in which either a very feeble current is available for operating an electro-magnet, or where it is necessary that considerable force shall be exerted by the compressed fluid, we use a series of diaphragms or pistons so arranged that the valves operated by the magnet control the motion of a diaphragm, which, in its turn, controls the valve mechanism of the second diaphragm, and it, when so desired, the valve mechanism of the third, similarly to the end of the series. Such an arrangement is shown in Fig. 3, where the motion of the valve mechanism V, controlled by the electro-magnet, operates the diaphragm A, which, in its turn, controls the valve mechanism V′, giving movement to the diaphragm F. By so regulating the size of the diaphragms, and the fluid-pressures supplied to each, any desirable force may be exerted by the last in the series.

In the application of our invention we do not restrict ourselves to the use of air-pressure; but may, as already indicated, employ the pressure exerted by any vapor, gas, liquid, or other fluid substance.

In like manner where it is desirable to use a pressure less than that exerted by the atmosphere, as in the case of rarefied air or a vacuum, we employ a device similar to that already described in connection with Fig. 1.

In our modified device, Fig. 4, the valve mechanism V V′ serves to regulate the escape of air into a rarefied air space or conduit, *p*, in such a manner that, when the valve V is open and V′ (communicating with the external air) closed, the pressure of the atmosphere may be exerted on the surface of the diaphragm in the direction shown by the arrow. When V is closed and V′ opened the communication between the external air and the inner surface of the diaphragm being re-established the diaphragm may be brought back to its former position by means of a spring or other self-acting device.

It is evident that with the same arrangement of parts, as anywhere hereinbefore described, a negative pressure or partial vacuum will produce a movement of the diaphragm in the opposite direction to that produced by positive pressure, as compressed air, which movement is similarly utilized to impart motion to telegraphic instruments, as described.

We also combine the action of compressed and rarefied air by means of the modification obtained by combining Figs. 1 and 4, as shown in Fig. 5, where *p* is the conduit connected with the supply of compressed air, and *p′* that connected with the rarefied air or vacuum. By this arrangement a motion of the diaphragm in both directions is attainable by the movement of the valve mechanism V V′.

The valve-motion requisite to operate our invention may be obtained, as already described, from the lever of an ordinary relay-magnet, which, by the usual contact mechanism, is at the same time acting to open or close a second electrical circuit, thereby serving the purpose of a combined sounding-instrument and relay or repeater.

In order to prevent the possibility of the clogging of the valve mechanism hereinbefore described by the infiltration of dust-particles, we insert in the conduit P a dust-arrester, consisting essentially of a plug of cotton, Z, Fig. 1, or other porous material, suitably incased.

We do not broadly claim the application of the movement of compressed or rarefied air or gas for signal-transmission between different stations, as in the various systems of pneumatic telegraphy, our invention consisting solely of an improved method of intensifying the movements produced by the passage of weak electrical currents, so as to impart motion to the striking-lever of an electro-signal or telegraphic apparatus.

In order to show the application of our invention to any form of signal or telegraphic apparatus, we select the ordinary telegraphic sounding-instrument, which is modified by our invention as follows, viz: Local batteries and relays are dispensed with, and the available electrical current is caused to pass through the coils of an electro-magnet, M, Fig. 6, whereby the armature N is set in motion, which motion, being communicated by a lever, operates the valve mechanism V, controlling the action of the diaphragm A. The conduit or tube *p* connects with the compressed-air reservoir. The motion of the diaphragm is communicated to the sounding-lever S by means of the rod and plate E D, the spring T securing the return of the lever on the relief of pressure from the diaphragm A. The spring *q* serves to balance the valves V. In this manner we secure, by the passage of extremely feeble electrical

currents through the magnet-coils, a pure, loud-toned sound from the instrument. This instrument we call the "pneumo-dynamic relay-sounder."

We claim—

1. In a telegraphic sounder, the combination of a movable diaphragm or piston, A, with the sounding-lever S, to produce the stroke in one direction, and with a spring, T, to produce the return-stroke of said lever, as described in the foregoing specification.

2. In an electric signal or telegraphic apparatus, as a means of controlling the fluid-supply, the valve mechanism V V′, consisting essentially of a longitudinally or spirally grooved stem or rod, bearing and serving as a guide for the valves V and V′, to operate in the manner and for the purpose hereinbefore described.

3. The combination of the valve mechanism V V′, consisting of the longitudinally or spirally grooved rod or stem and the valves V and V′, as described, with a movable diaphragm or piston, for the purpose set forth.

4. The combination of the armature-lever L of an electro-magnet with the valve mechanism V V′, constructed as hereinbefore described, for the purpose set forth in the foregoing specification.

5. As a means of regulating the force required for the movement of the valve mechanism V V′, the adjustable spring *q*, the elasticity of which is employed for balancing the fluid-pressure on the valves, as described in the foregoing specification.

6. As a means of rendering the motion of the valve mechanism V V′ independent of variations in the fluid-pressure, the flexible surface K, closing and opening into the conduit P, arranged in the manner hereinbefore described, so as to exert a pressure on the valve mechanism V V′ equal and opposite to that exerted by the fluid-supply.

7. The combination of the diaphragm and valve mechanism V V′ with the conduits P P′, connected, respectively, with two reservoirs containing fluid at different pressures, as shown and described in the foregoing specification.

8. The combination of two or more movable diaphragms or pistons, provided with a valve mechanism, as described, so as to exert pressures in the same direction, in opposite directions, or in directions at any angle with each other.

9. The combination of two or more movable diaphragms or pistons in such manner that the movement of the first, controlled by the electro-magnet, as described, may control the valve mechanism of the second, and the second of the third, if so desired, and similarly to the end of the series, in the manner and for the purpose set forth in the foregoing specification.

10. The combination, with the conduit P, of an air-filter, Z, for the purpose set forth.

ELIHU THOMSON.
EDWIN J. HOUSTON.

Witnesses:
GEO. I. RICHÉ,
M. B. SNYDER.