

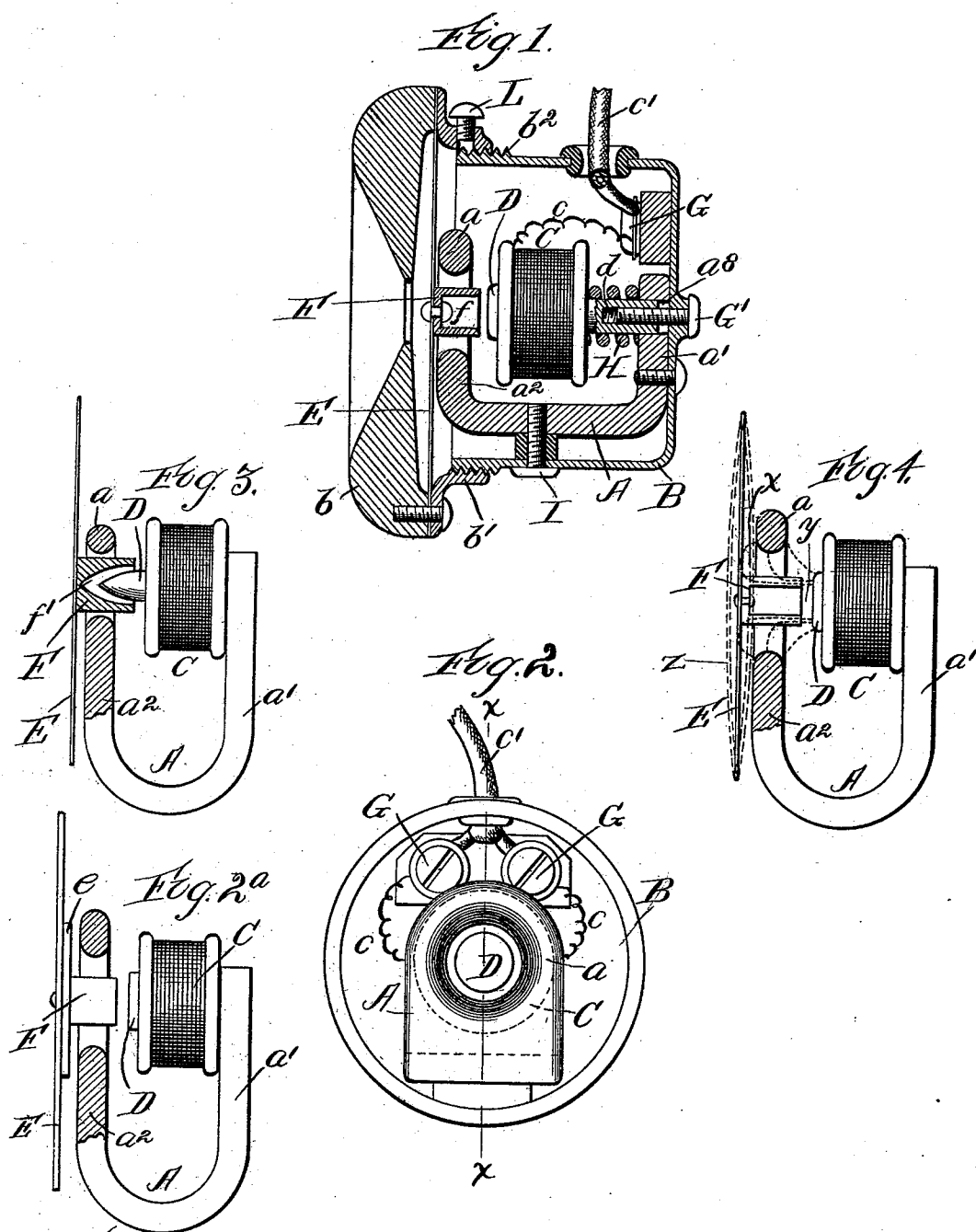
(No Model.)

2 Sheets—Sheet 1.

H. P. PRATT & H. A. ALLEN.
TELEPHONE INSTRUMENT.

No. 555,051.

Patented Feb. 18, 1896.



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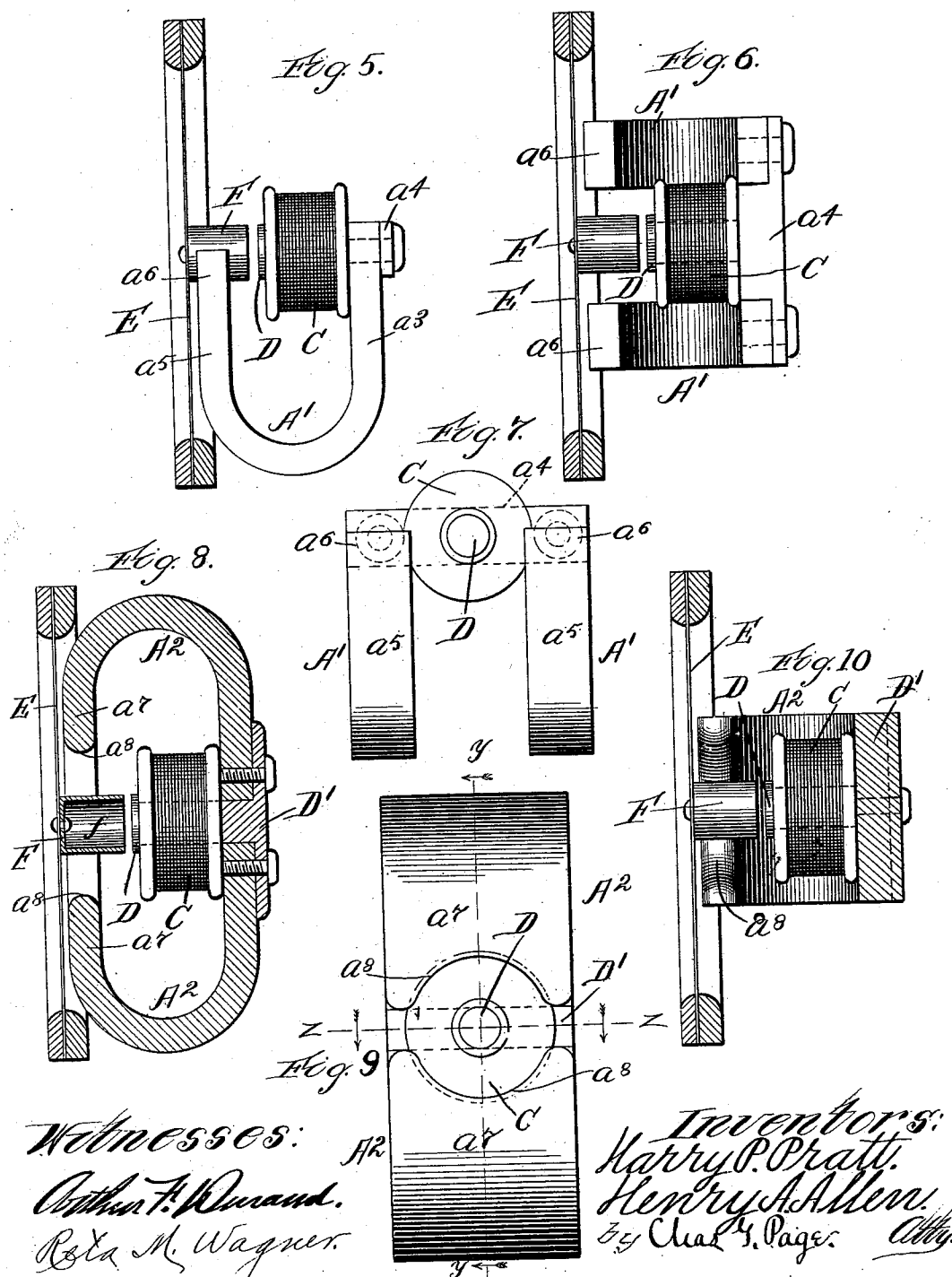
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UNITED STATES PATENT OFFICE.

HARRY P. PRATT AND HENRY A. ALLEN, OF CHICAGO, ILLINOIS.

TELEPHONE-INSTRUMENT.

SPECIFICATION forming part of Letters Patent No. 555,051, dated February 18, 1896.

Application filed February 19, 1895. Serial No. 538,920. (No model.)

To all whom it may concern:

Be it known that we, HARRY P. PRATT and HENRY A. ALLEN, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Telephone-Instruments, of which the following is a specification.

Our invention relates to a telephone-instrument which can be used either as a magneto-transmitter or as a receiver, but preferably as a transmitter.

The primary object of our invention is to augment or approximately double the variation of magnetic disturbance caused by the vibration of the diaphragm, and to such end we cause certain useful lines of force to pass through synchronously varying air-spaces which interrupt metallic circuit portions between the poles of a magnet or magnets. The metallic circuit portions are provided by the diaphragm and an armature thereon, and the air-spaces respectively occur between the diaphragm and one pole and between the armature and the opposite pole. The air-space between the diaphragm and adjacent pole is varied by the vibration of the part of the diaphragm, and synchronously therewith the air-space between the armature and the adjacent pole is varied.

As a simple and effective arrangement the armature is arranged in front of the pole which is provided with a helix, and the opposite pole is arranged between the helix and the diaphragm and positioned in a plane which is intersected by the armature. The vibration of the diaphragm therefore varies the extent of air-space between itself and the pole last mentioned, and synchronously therewith the extent of space between the armature and the pole which carries the helix will be varied.

In the accompanying drawings, Figure 1 is a section taken centrally through a telephone-instrument embodying our invention, the plane on which the section is taken being indicated by dotted line xx in Fig. 2. Fig. 2 shows the instrument in front end elevation, the cap and diaphragm being removed. Fig. 2^a shows another construction of diaphragm. Fig. 3 is a detail illustrating the magnet, dia-

phragm, and an armature having a recess which differs somewhat in shape from the recess of the armature in Fig. 1, the armature and a portion of the magnet being shown in section. Fig. 4 is in the nature of a diagrammatic view, representing the magnet, diaphragm and armature, and indicating the lines of force. Fig. 5 represents in elevation an arrangement including a couple of magnets connected together, as shown in the two succeeding figures, whereof Fig. 6 is a top plan view of Fig. 5, and Fig. 7 is a front elevation of said Fig. 5 with the diaphragm and armature removed. Fig. 8 is a section illustrating another mode of employing a couple of connected magnets in conjunction with the diaphragm and armature. Fig. 9 is a front elevation of the magnet shown in Fig. 8, dotted line yy being drawn to denote the plane on which the section, Fig. 8, is taken. Fig. 10 is a section on line zz in Fig. 9, looking in the direction of the arrows.

A, Figs. 1, 2, 3, and 4, indicates a permanent magnet arranged within the case B. This magnet is formed with an annular portion a , which constitutes one of its poles. The helix C is arranged upon the opposite pole of the magnet, and, as a preferred construction, the pole upon which the helix is thus arranged is formed by a soft-iron core D, attached to arm a' of the magnet and arranged opposite the space which is circumscribed by the annular pole a of said magnet. The arm a' of the magnet could be bent so as to form a core for the helix; but since better results are attained by employing a soft-iron core, we prefer using the latter construction. In order to render the instrument compact, and also conveniently connect the core of the helix with the permanent magnet, the form of the latter can be that of a horseshoe-magnet, having its arm a^2 adapted to provide the annular-shaped pole a , and having its arm a' provided with the core D, which forms the opposite pole of the magnet.

The diaphragm E is separated from the magnet and is arranged in front of the annular pole a of the magnet, and carries upon its rear side a small armature F, which is attached to the center of the diaphragm. This small armature is arranged opposite the pole D and

is preferably recessed or made hollow, so that, while it can be made light, it can comprise sufficient metal to permit it to carry a suitable number of lines of force, and also have
 5 sufficient cross-sectional area to enable the diaphragm to carry an increased number of lines of force, as hereinafter more fully explained.

With further reference to the foregoing-described construction, it will be seen that pole a is arranged in a plane which is parallel to the plane of the normally-quietescent elastic diaphragm and interposed between said diaphragm and the opposite pole of the magnet,
 10 and that the armature which is carried by the diaphragm is arranged to intersect the plane in which the pole a is positioned.

By the foregoing-described arrangement metallic circuit portions between the pole will
 20 be provided by both the diaphragm and armature, and by the armature alone, as illustrated by Fig. 4, wherein the lines of force are indicated by dotted lines, and, as therein shown, some of the lines of force traverse the
 25 space between the pole a and the diaphragm, and hence pass through both the diaphragm and the armature thereon, while others traverse the space between the pole a and the armature alone. It is also seen that the aforesaid
 30 lines of force traverse the space between the armature and the pole D. Certain useful lines of force, therefore, pass through metallic circuit portions provided by the armature
 35 and diaphragm, and through air-spaces which interrupt the metallic circuit portions and which are synchronously varied by the vibrations or deflections of the diaphragm carrying the armature. In this way the magnetic disturbance is augmented and practically doubled,
 40 thereby greatly increasing the efficiency of the instrument. This may be further explained as follows:

Let x represent the air-space normally between the diaphragm and the pole a of the magnet; y , the air-space normally between the armature and the opposite magnetic pole D, and z a deflection of the diaphragm illustrated by dotted lines in Fig. 4. As the deflection
 50 of the diaphragm at its center is greater than at its marginal portion, the space y is greater than the space x . The deflection z will cause the distance between pole D and the armature to be $y+z$. It will also cause
 55 the distance between the diaphragm and pole a to be increased z' , which is less than z , as the point taken is farther from the center. This deflection z of the diaphragm has therefore increased the path of the lines of force
 60 passing through the diaphragm and armature by the distance $z+z'$, which therefore causes greater variation in the magnetic circuit. It will also be seen that when the diaphragm moves toward the adjacent pole a the aforesaid air-spaces will be reduced in extent or
 65 area so as to shorten the path of the lines of

force, and thereby cause greater variation in the magnetic circuit.

By making the armature hollow it can be made light, so as not to interfere with the free
 70 vibration of the diaphragm, and at the same time the said armature can have a considerable extent of diameter or cross-sectional area, so as to cause the diaphragm to carry a large
 75 number of lines of force, and also provide the armature with ample metal for a like purpose.

The principles involved in the construction and arrangement hereinbefore described and the results and advantages thereby secured are also involved in and secured by the constructions and arrangements of magnets illustrated in the last six figures of the drawings. Thus, in Figs. 5, 6 and 7, we provide in place
 80 of the single-bar magnet shown in preceding figures, a couple of magnets $A^1 A^1$, having their arms a^3 connected together by a metal cross-bar a^4 , to which the soft-iron core or pole-piece D is attached. The arms a^3 of the magnets provide like poles, and hence the core D becomes in effect a pole of a magnet comprising
 90 connected parallel arms or bars. With such arrangement the arms a^5 of the magnets provide like poles a^6 , which are positioned at opposite sides of the armature F. The poles a^6 are arranged in a plane which is intersected
 95 by the armature and parallel with the diaphragm. The difference, therefore, between the construction in Figs. 5, 6 and 7 and the construction in preceding figures is that in said Figs. 5, 6 and 7 the magnet comprising
 100 a couple of connected parallel magnetized bars has one of its poles formed by parallel arms which do not entirely surround the armature, or, in other words, the magnet has one of its poles divided into the pole portions
 105 $a^6 a^6$, arranged at opposite sides of the armature.

In Figs. 8, 9 and 10 the two magnets $A^2 A^2$ are connected by the T-shaped end D' of a soft-iron core D, thereby practically forming
 110 a magnet having the core D for one of its poles. The flattened arms a^7 of the magnets A^2 have their ends cut away to form the part-circular edge portions a^8 arranged so as to provide space between them for the armature.
 115 The magnets A^2 are arranged opposite one another and involve the principle of preceding constructions.

While it is preferable to surround the armature by an annular pole, we do not limit ourselves to such precise construction, since good results can be secured by dividing the pole and only partially surrounding the armature with the same, as in the last six figures.

With reference to further details, the hollow armature F, in Fig. 1, is externally and internally cylindric and the adjacent flat end of the core D is larger in area than the transverse area of the space f within the armature. In Fig. 3 the recess f' in the armature is made
 130 substantially conical, and the adjacent end of the core is of like form and made suffi-

ciently small to admit of its reception within such recess. By this arrangement the armature presents a larger area of surface to the pole D, and by a slight movement of the diaphragm the space between the armature and pole D can be reduced to the ultimate minimum. This form or arrangement, while desirable in using the instrument as either a transmitter or a receiver, is particularly serviceable when it is employed as a receiver.

Wires *c* from the helix are carried to binding-posts G arranged within the case, and from thence the wires can be carried out in an insulating cord or cable *c'*.

The core which extends through the helix is adjustably connected with the magnet, and to such end it is engaged by an adjusting-screw G', arranged to extend through the back of the casing and engage in a threaded socket *d* in the core. With such arrangement, the rear end of the core fits within a socket-bearing *a*⁸ in the magnet, and a spring H is arranged between the magnet and the helix. By forming the magnet of a substantially horseshoe shape, one of its arms can be conveniently bolted to the back portion of the case, and to further steady the magnet it can also be secured to the side of the case by a bolt or screw I. The cap *b* is secured to a screw-ring *b'*, which is in turn screwed upon an externally-threaded portion *b*² of the case, and the diaphragm is clamped along its edge portion between said ring and cap. By this arrangement the cap and ring can be adjusted as a whole upon the case for the purpose of varying the distance between the diaphragm and the annular pole *a*, which lies in a plane parallel with the normal plane of the diaphragm and situated between the diaphragm and core of the helix. The helix and its core can be adjusted with reference to this adjustment of the diaphragm, and hence proper relationship between the armature F and the adjacent end of the core can be maintained. The cap can also be temporarily locked in its adjustment upon the case, and to such end the ring *b'* can carry a set-screw L arranged for engagement with the case.

The telephone-instrument which we have herein described can be used either as a magneto-transmitter or as a receiver. Its preferred use, however, is that of a receiver, and when so used, any suitable type or construction of transmitter can be employed.

As a matter of preferred construction, the diaphragm consists of an elastic metal plate. It could, however, consist of a flexible or elastic plate of other material—wood, for example—provided with a centrally-arranged metal plate *e*, as in Fig. 2^a, and if the diaphragm should be simply of flexible material, lacking a suitable degree of flexibility, one or more springs could be connected with it. All of such matters are, however, common in the construction of diaphragms for telephone-in-

struments, and are therefore understood to be included in the term "diaphragm" as employed in the following claims.

What we claim as our invention is—

1. A telephone-instrument comprising a magnet having one of its poles provided with a helix, and a combined diaphragm and armature both separated from the magnet and arranged to provide metallic circuit portions located between the poles thereof and interrupted by air-spaces between the combined diaphragm and armature and both poles of the magnet, substantially as set forth.

2. A telephone-instrument comprising a diaphragm provided with an armature, and a magnet having one pole provided with a helix and arranged opposite the armature, and having its other pole arranged between the helix and diaphragm in a plane which is intersected by the armature, the combined diaphragm and armature being separated from the magnet by air-spaces and forming metallic circuit portions interrupted by the air-spaces between the armature and both poles of the magnet, and between the diaphragm and the magnet, substantially as described.

3. A telephone-instrument comprising the bent magnet having an annular pole-piece on one end, and a pole-piece provided with a helix and arranged at its opposite end, and the diaphragm provided with an armature arranged to extend through the space within the annular pole-piece, substantially as described.

4. A telephone-instrument comprising a magnet having one of its poles provided with a helix, and the diaphragm with a hollow armature arranged opposite said pole which is provided with the helix being projected within the hollow armature, and the other pole of the magnet being arranged in a plane which is intersected by the hollow armature and located to provide an air-space between such pole and the diaphragm, substantially as described.

5. A telephone-instrument comprising a diaphragm provided with an armature, a magnet having one of its arms connected with an adjustable pole-piece arranged opposite the armature and forming a core for the helix, and having its other arm arranged between the diaphragm and helix in a plane intersected by the armature, and a cap adjustably held upon the case of the instrument and supporting the diaphragm, the said core for the helix being adjustable toward and away from the armature, and said cap being adjustable to determine the normal space between the diaphragm and adjacent pole of the magnet, substantially as set forth.

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