(No Model.) 2 Sheets—Sheet 1.

C. G. BURKE.

TELEGRAPHIC INSTRUMENT.

No. 405,987. Patented June 25, 1889.

Fig. 1,

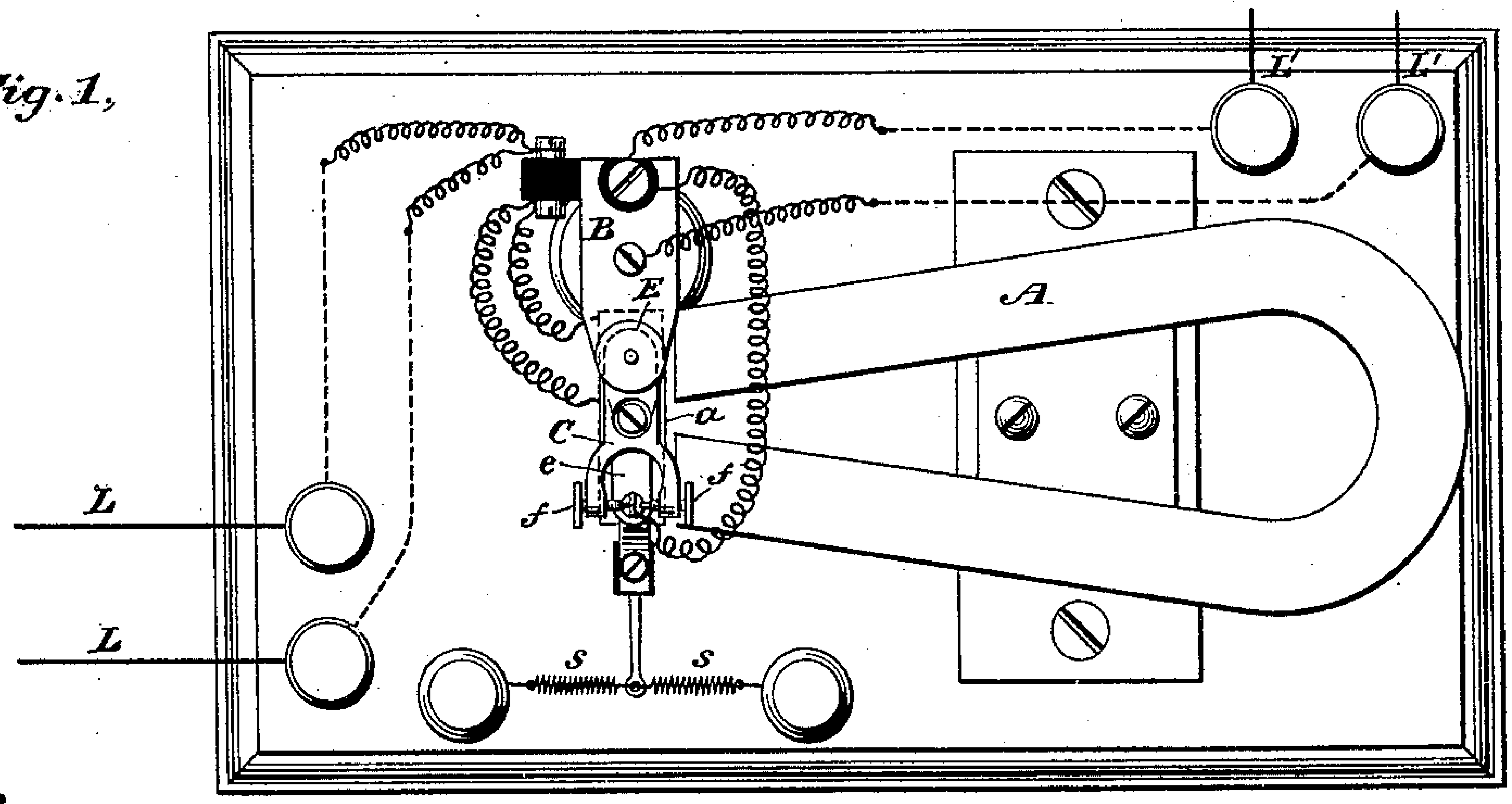


Fig. 2,

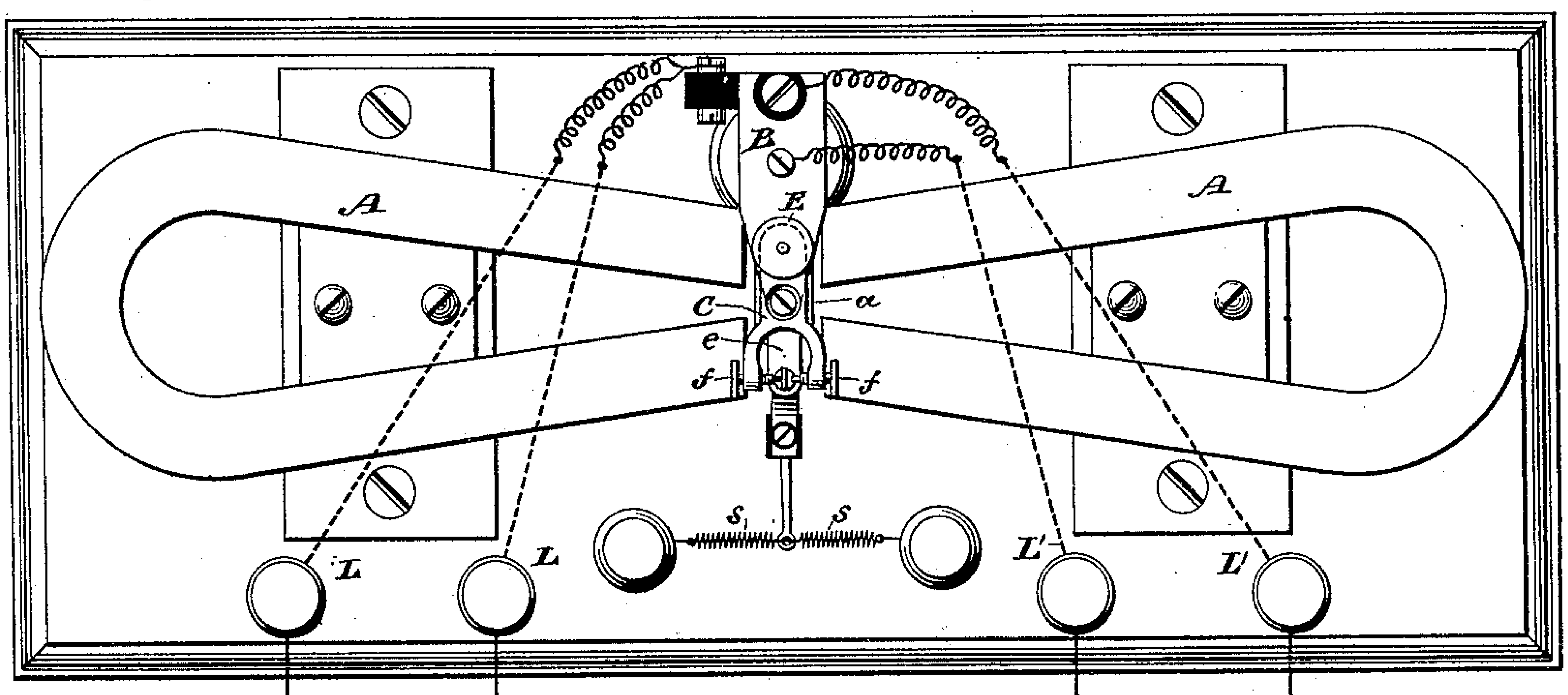


Fig. 4,

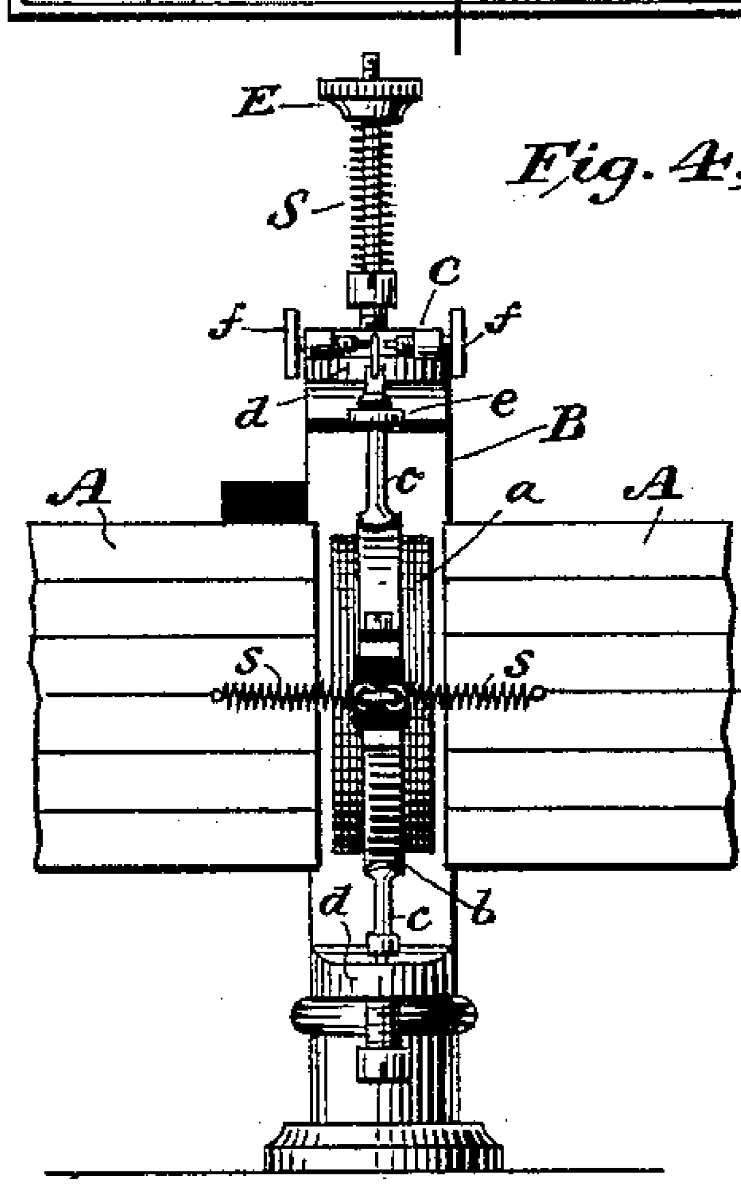


Fig. 3,

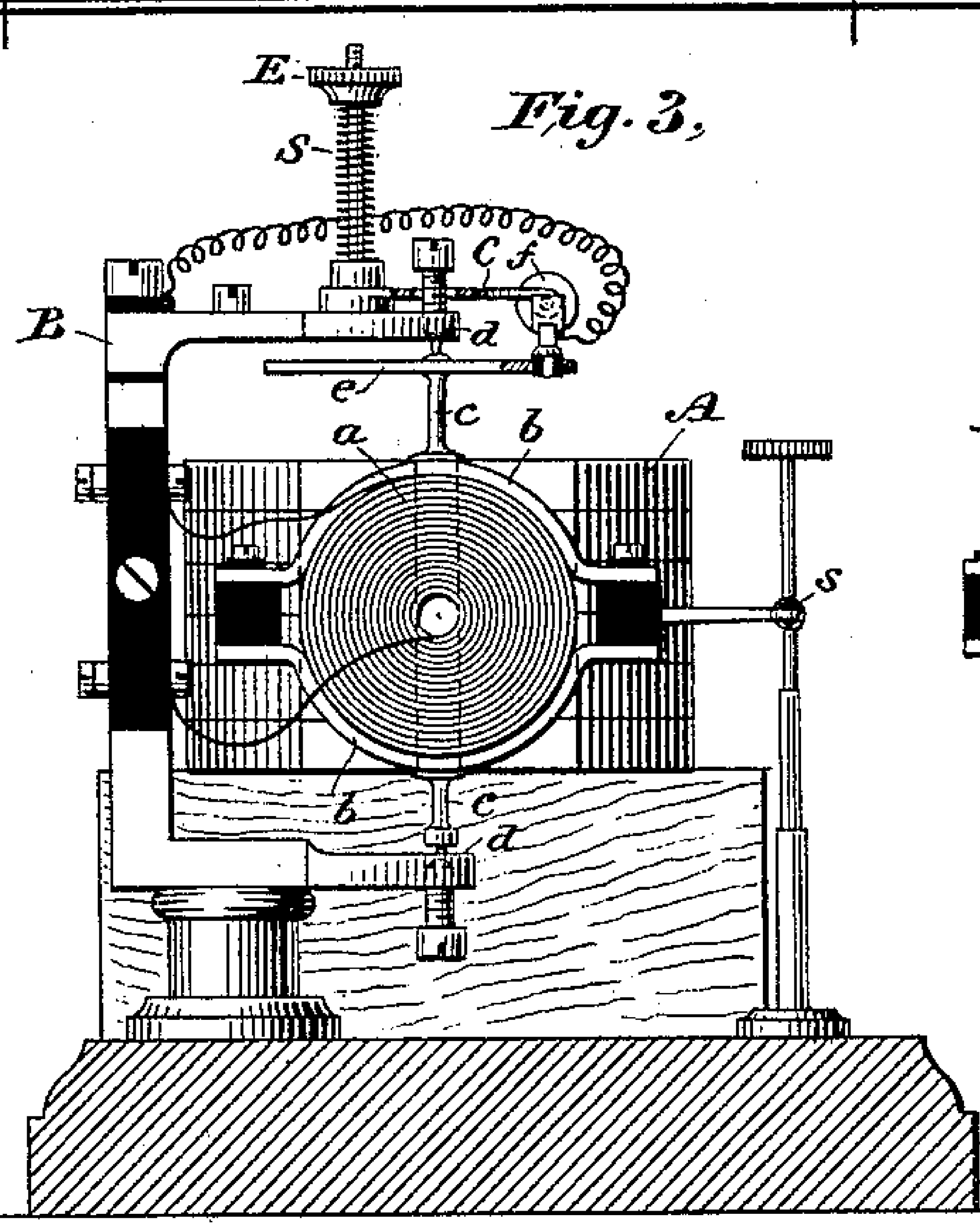
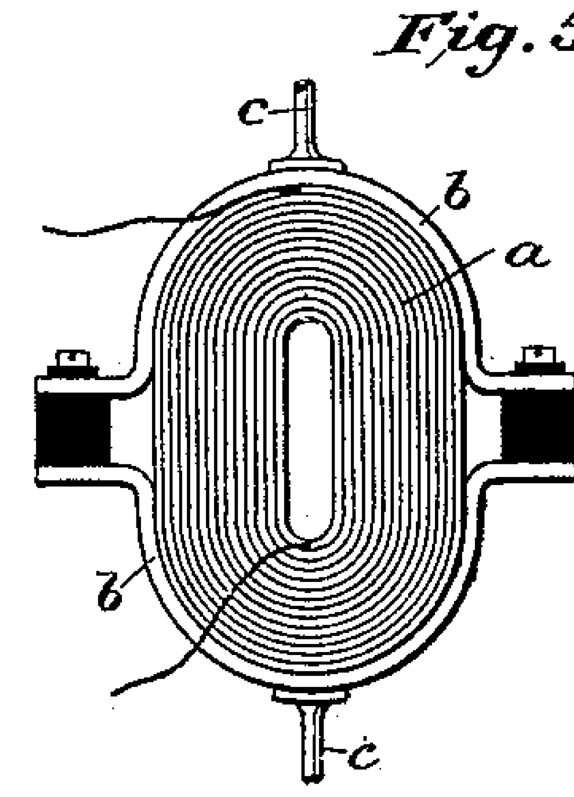


Fig. 5,



Witnesses

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 6,

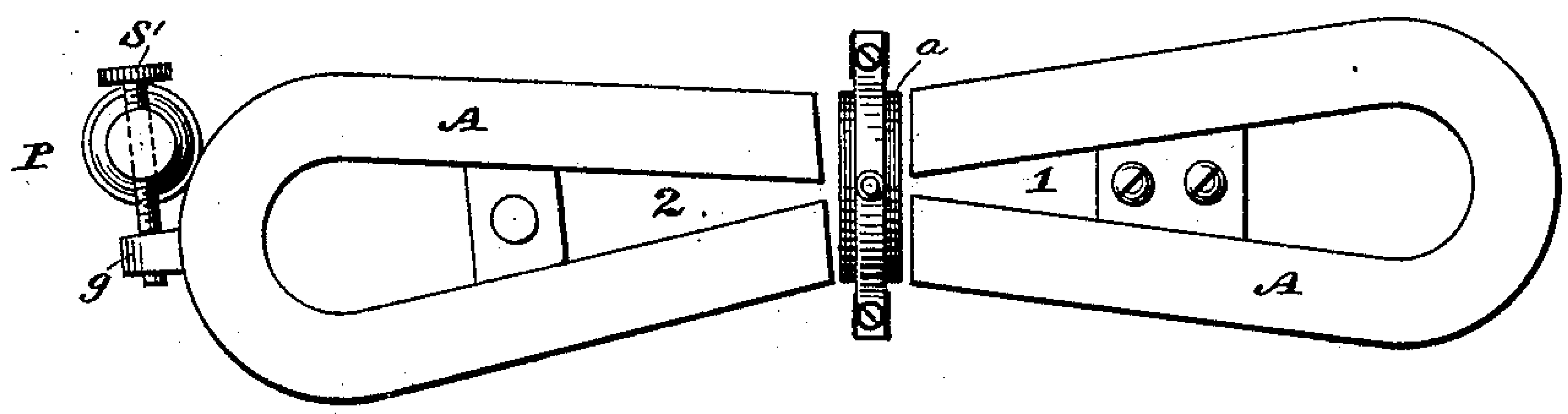


Fig. 8,

Fig. 7,

Fig. 9,

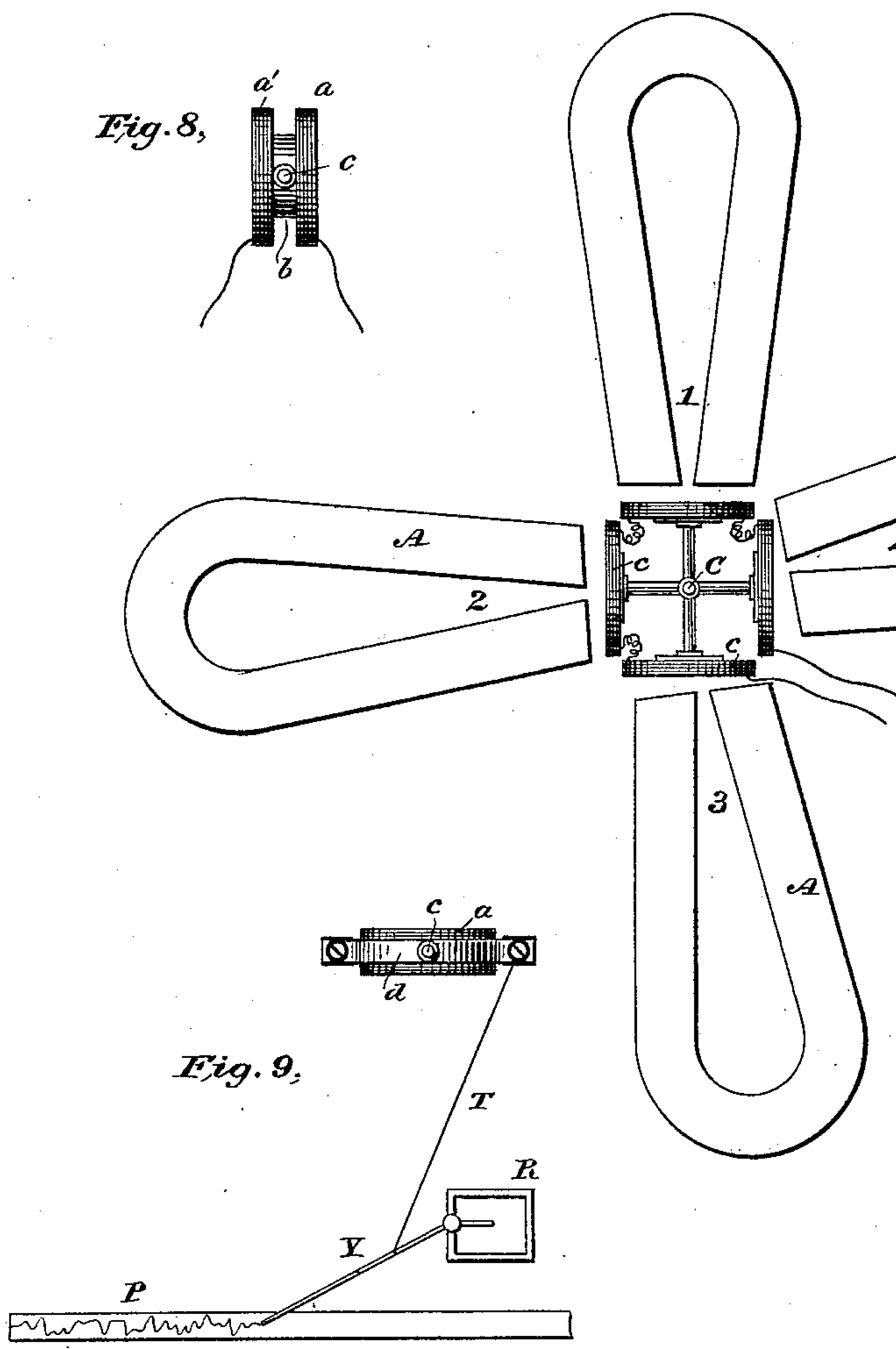


Fig. 10,

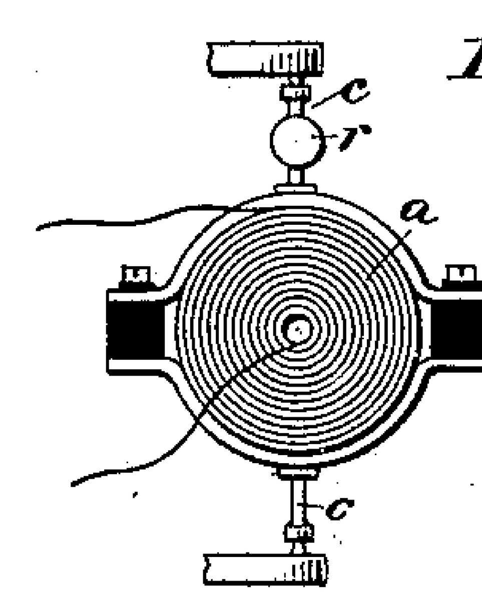
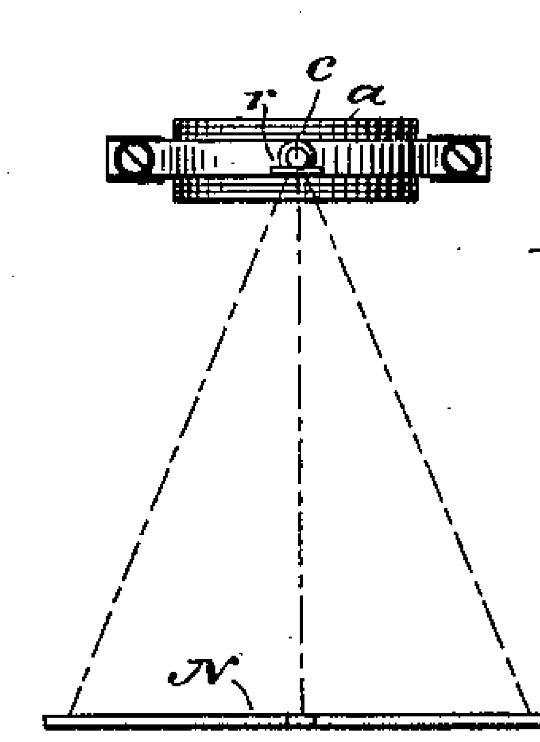


Fig. 11,



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UNITED STATES PATENT OFFICE.

CHARLES G. BURKE, OF RICHMOND HILL, ASSIGNOR TO FREDERICK WOLFFE, TRUSTEE, OF NEW YORK, N. Y.

TELEGRAPHIC INSTRUMENT.

SPECIFICATION forming part of Letters Patent No. 405,987, dated June 25, 1889.

Application filed January 17, 1889. Serial No. 296,630. (No model.)

To all whom it may concern:

Be it known that I, CHARLES G. BURKE, a citizen of the United States, residing at Richmond Hill, in the county of Queens and State of New York, have invented certain new and useful Improvements in Telegraphic Instruments, of which the following is a specification.

The object of the invention is to provide a sensitive receiving telegraphic instrument suitable for cables and other lines where feeble currents are used.

The invention consists, generally, in a solid coil of wire which forms part of the main circuit, wound in the shape of a disk and suspended within a field of force formed by one or more magnets, motion of the coil being caused by the currents passing over the line.

An important feature of the invention is a method of adjusting the magnetic field with reference to the position of the coil.

The invention will be readily understood by those skilled in the art by inspecting the accompanying drawings, in which—

Figures 1 and 2 are plans of instruments embodying the invention. Fig. 3 is an end view of the instrument shown in Fig. 1. Fig. 4 is a side view of a portion of the instrument shown in Fig. 2. Fig. 5 shows a coil of oval shape. Figs. 6 and 7 are plans showing a method of arranging the field of force with reference to the coil. Fig. 8 shows a coil divided into two portions and slightly separated. Fig. 9 shows the application of the invention to use with a siphon-recorder. Figs. 10 and 11 show the application of the coil for use with a reflector.

The movable part of the instrument consists of the coil *a* in the figures, suspended within the field of force of the several magnets A.

In Fig. 1 the simplest form of the instrument is shown, and an end view of this instrument is shown in Fig. 3. The coil *a* is wound in the shape of a flat disk, and is solid almost or quite to the center. The disk is mounted within the ring or frame *b*, and is suspended by the pivots *c*, which may turn freely in bearings *d*. Thus the coil has motion about one of its diameters. The wire of the coil is included within the circuit of the main line L. The coil is suspended parallel to the two poles of the magnet A and facing the same. The delicate springs *s* may be used to hold the coil in position. When a current passes over the main line L, the coil will be moved on its axis in a direction determined by the polarity of the current and its relation to the field of force created by the magnet. The upper pivot *c* of the frame which carries the coil has fixed to it the arm *e*, and one end of this plays between the points of the set-screws *f* in the two sides of the yoke at the one end of the arm C. This arm is frictionally attached to the solid portion of the instrument B, the friction being regulated by the spring S and the thumb-screw E; hence while the arm *e* has a very limited motion between the points *f* the arm C has a greater range. The local circuit L′ is connected up in the usual manner, and is made and broken by the movement of the end of the arm *e* between the points of the two screws *f*.

Fig. 2 shows the same instrument furnished with two magnets, whereby a stronger field of force is produced. Similar poles of the magnets are placed opposite each other, and the coil operates between them, as described with reference to Fig. 1.

Similar letters represent the same parts in each figure.

Fig. 4, which is a side view of the central part of the instrument shown in Fig. 2, does not require further description.

Fig. 5 illustrates a coil wound oval in shape, and mounted the same as the circular coils in the figures previously described. This form has advantages when the magnets have considerable thickness.

Fig. 6 shows a method of adjusting the position of the magnets to the coil, whereby the relation of the latter to the lines of force change with its movement. In this figure, it will be observed, the magnets are not in line with each other, and therefore the coil, when parallel with the faces of the poles of one magnet, is not parallel to those of the other. One of the magnets has fixed to it a lug *g*. The thumb-screw S′ passes through the post P fixed upon the base of the instrument, and by this means the magnet is adjusted in position, as shown. When a coil is in the position shown in this figure—that is, standing parallel to the poles of magnet 1—and the current passes through it, the strongest effect is produced by magnet 1, for the reason that the lines of force created by this magnet No. 1 are parallel with the convolutions of the coil and the current passing therein; but as soon as the coil has turned so that it is not thus parallel, the effect of this magnet or its power to cause motion in the coil is reduced. Now if magnet 2 is adjusted in the manner described, so that the first movement of the coil carries it in the direction which would place it parallel to the poles of the magnet 2, then it goes into a position whereby the strongest effect is produced by magnet 2, this coil having assumed a position in its relation to magnet 2 similar to that which it originally had to No. 1. In this manner the coil *a* is in position, both at the beginning and end of its movements, to have the best effect exerted upon it by one or the other of the magnets, and the operation of the instrument is improved thereby; and in any position the coil is under an equal influence of the field of the combined magnets.

Bearing this description in mind, the operation of an instrument whose field would be arranged as shown in Fig. 6 will be as follows: Supposing that the operator at the sending-station is employing a double-current key and the continental code, when he closes the switch to send, a current of a given polarity, known as the "clearing-current," will be immediately sent over the line, which will traverse the coil and turn it upon its axis. If, as is the usual practice, the receiving-instrument has been previously arranged in relation to the polarity and potential of this primal or clearing current, so that the motion of the coil will be in a direction away from the face of the poles of the field-magnets, to which it is shown as being parallel and to an extent sufficient to bring it parallel with the polar extremities of the field-magnets at which it originally stood at an angle, then the effect of closing the switch will be to move the coil from its parallel relation to one field to a like parallel relation to the other, and thus preserving it in a position equally favorable for operation as that in which it originally stood. The operator is now ready to transmit; and let us suppose, for instance, he sends a signal representing the letter H, which consists of four equal short key contacts or dots. As he depresses the key, its back contacts are broken and the clearing-current disconnected from line. Through the front contacts of the key a current of opposite polarity is sent to line, which finds the coil in the position to which it had been carried by the closing of the switch. The consequence will be the coil will again be turned on its axis and back to its original position, this movement, when completed, being interpreted as one dot. By the release of the key its front contacts are broken and the marking or operating current disconnected from the line, the back contacts of the key are again restored, which again connects the clearing-current to line, and the coil is again moved as it was when the switch was first closed. This reverse movement of the coil completes the first dot. Again the operator closes and opens his key for the second dot, and a like operation of the coil follows, and so on until the whole signal is completed. It will be observed that in this case the coil at the initial and ending of each impulse occupied a uniform relation to one or the other of the fields, and that therefore the effects upon it of the alternations of the current were equal, and consequently each element of the signal was manifested with equal prominence.

An instrument organized as shown in Fig. 7, should equal reversals be sent over the line, would be operated just as we have described the operation of that shown in Fig. 6; but in mixed signals, where its elements differ in duration, it would afford a wider range of uniformity. The four coils, being part of the main circuit, are rigidly attached to a common movable center, and are so arranged with relation to the field-magnets that the passage of a current through them will have the effect to move their common support by their conjoint action, and whether this motion be to a greater or less degree, as caused by signals of greater or less duration, the coils will present throughout the whole range of motion an almost uniform amount of wire surface and at almost uniform degrees of angularity to the respective fields. By this means, although disproportionally short impulses of clearing-current only can follow the longer contact of marking-current necessary to define the longer elements of signals, they will be sufficient to restore the coils to a favorable position for further operation.

Fig. 7 illustrates a more extended use of this principle, there being two pairs of magnets and four coils, one facing each magnet. The four coils are attached to the opposite ends of two arms which cross each other, the system having its bearings at C. It will be perceived that the two pairs of magnets are each out of line with each other, as described with reference to Fig. 6, and this may be effected in the same manner. The coil facing magnet 1 is shown parallel to its poles, the coil facing magnet 2 is shown somewhat inclined thereto, and the coils facing magnets 3 and 4 are still more inclined. When a current passes over the line, the best effect, when the parts are in the position shown in Fig. 7, is exerted by the magnet 1, for the reason heretofore given. If we suppose the four coils to turn slightly to the left, then the coil facing magnet 2 comes into the best position to be affected by that magnet, and so a further movement to the left brings the coils facing magnets 3 and 4 into the best position to be affected by the lines of force of those magnets. By arranging the magnets in this way, as shown in Figs. 6 and 7, it will be seen that the tendency of movement is equally great after the first movement of the coil as at that time, instead of the tendency being greatest at the first impulse. Thus it will be perceived that in the case of Fig. 7, if we suppose the limit of motion of the four coils to be that which leaves the coil facing magnet 4 parallel to the poles thereof, then upon the reversing of the current over the line the same effect is produced as has already been described, but in reverse order—that is, the first impulse is most strongly given by magnet 4, then magnet 3 exerts the greatest influence, then magnets 2 and 1, leaving the coil again in the position shown in the figure.

It is well known that in the transmission of signals over long submarine cables, where electrical impulses of the same polarity immediately follow each other—as, for instance, in the letter H—the effect of the first impulse is more emphatic than any of the others, for the reason that the coil of the receiving-instrument, whether it be a mirror-galvanometer or siphon-recorder, at the time of the first impulse normally rests in a field of the highest intensity, and consequently in the best possible position to be operated. Any deviation from this normal position of the coil renders the passing currents less effective. In the arrangement shown in Figs. 6 and 7 deviations of the coils from a normal position do not materially alter the angularity of the respective lines of the coils and field, and consequently the coils throughout the extent of movement preserve a comparatively proportionate relation to field intensity.

Fig. 9 shows in diagram the application of the invention to the use of a siphon-recorder, the thread T being attached to the side of the frame carrying the coil a at one end and to the other end to the stylus Y, which conveys the ink from the reservoir R to the paper strip P.

Figs. 10 and 11 show the application of the invention to a reflector. In this case the reflector r may be placed above the coil upon the pivot, and, as shown in Fig. 11, the rays of light from the source L are received upon the reflector and the movements of the latter throw the beam of light back and forth upon the screen N in the usual manner.

Fig. 8 illustrates a method of dividing the coil into two parts a and a', separated by a central supporting-partition b. It is found in practice that this arrangement performs better than a single or solid coil having the same resistance and having the pivot or axis of support passing through it.

I am aware that it has been proposed to arrange a galvanometer-coil surrounding a soft-iron piece within a magnetic field created by two magnets having consequent poles presented to each other, both poles of each magnet, however, standing in the same relation to the windings of the section of the coil to which they are presented.

I claim as my invention—

1. In a telegraphic instrument, the combination of a coreless coil of insulated wire in the main circuit arranged to turn upon one of its diameters within a field of force created by opposite magnetic poles, both of said poles being presented to one of the faces of said coil, the section of the coil presented to one pole having its windings in a direction opposite to those of the section presented to the other pole.

2. In a telegraphic instrument, the combination of a coreless coil of insulated wire movable within a field of force created by two magnets, one located on each side of said coil, each presenting both its poles to one of the respective faces of said coil, the section of the coil presented to one pole of each magnet having its windings in a direction opposite to those of the section presented to the other pole of the same magnet.

3. In a telegraphic instrument, a coreless compound coil composed of two parts movable in a field of force created by two magnets, opposite poles being presented to the same face of each one of said parts, the section of the coil presented to one pole of each magnet having its windings in a direction opposite to those of the section presented to the other pole of the same magnet.

4. In a telegraphic instrument, a coreless coil of insulated wire arranged to turn upon one of its diameters within a field of force created by two magnets, each presenting opposite poles to the respective faces of said coil, the angular position of the poles of said magnets with reference to the coil being adjustable, the section of the coil presented to one pole of each magnet having its windings in a direction opposite to those of the section presented to the other pole of the same magnet.

5. In a telegraphic instrument, a flat coil of insulated wire wound in two parts separated from each other and fixed on each side of a common center movable in a field of force created by two magnets, each magnet presenting its opposite poles to the outer face of one of the parts of said coil, said magnets being fixed so that the faces of the poles of one magnet are not parallel to the faces of the poles of the other.

In testimony whereof I have hereunto subscribed my name this 16th day of January, A. D. 1889.

CHARLES G. BURKE.

Witnesses:

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CAROLINE E. DAVIDSON.