

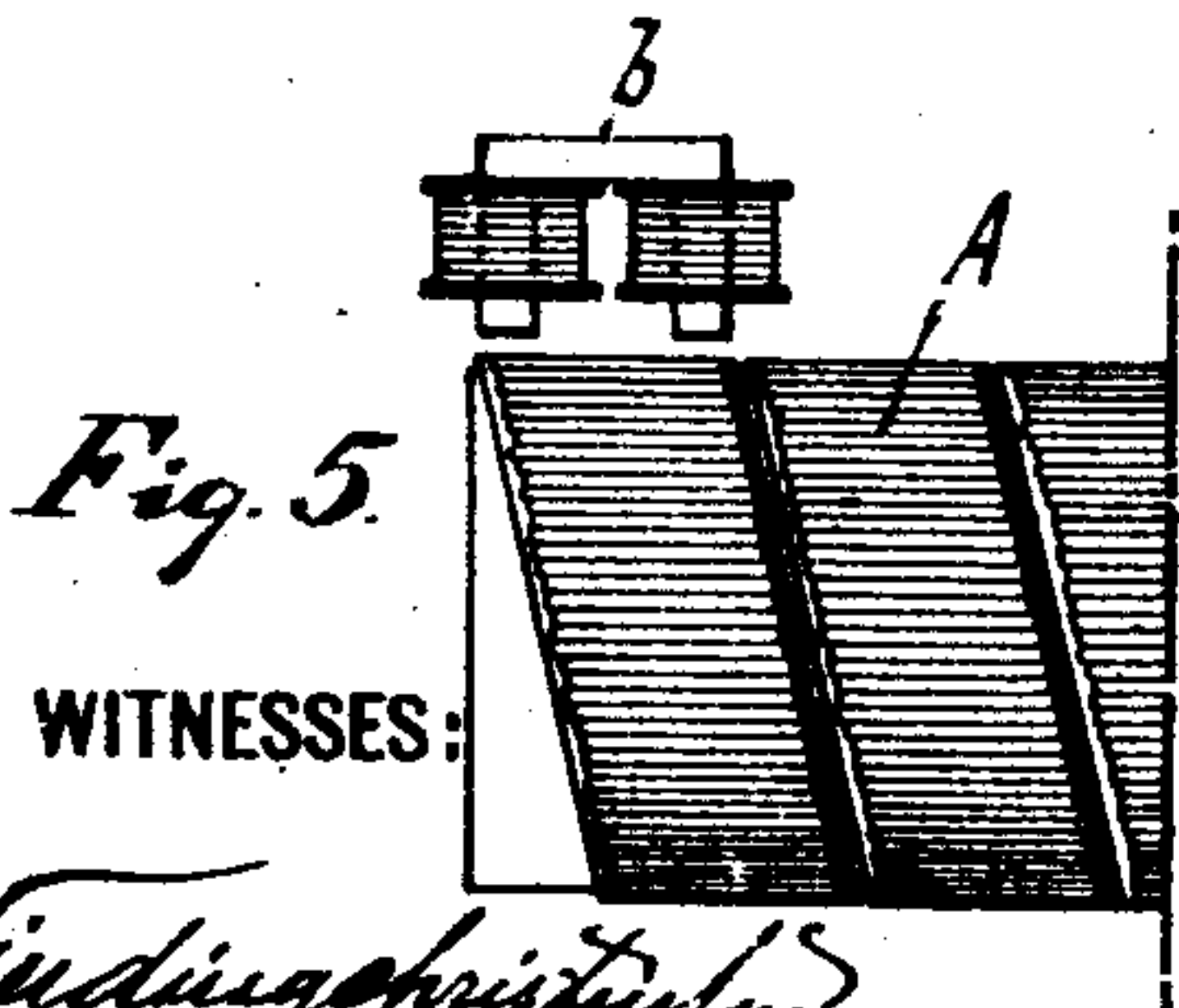
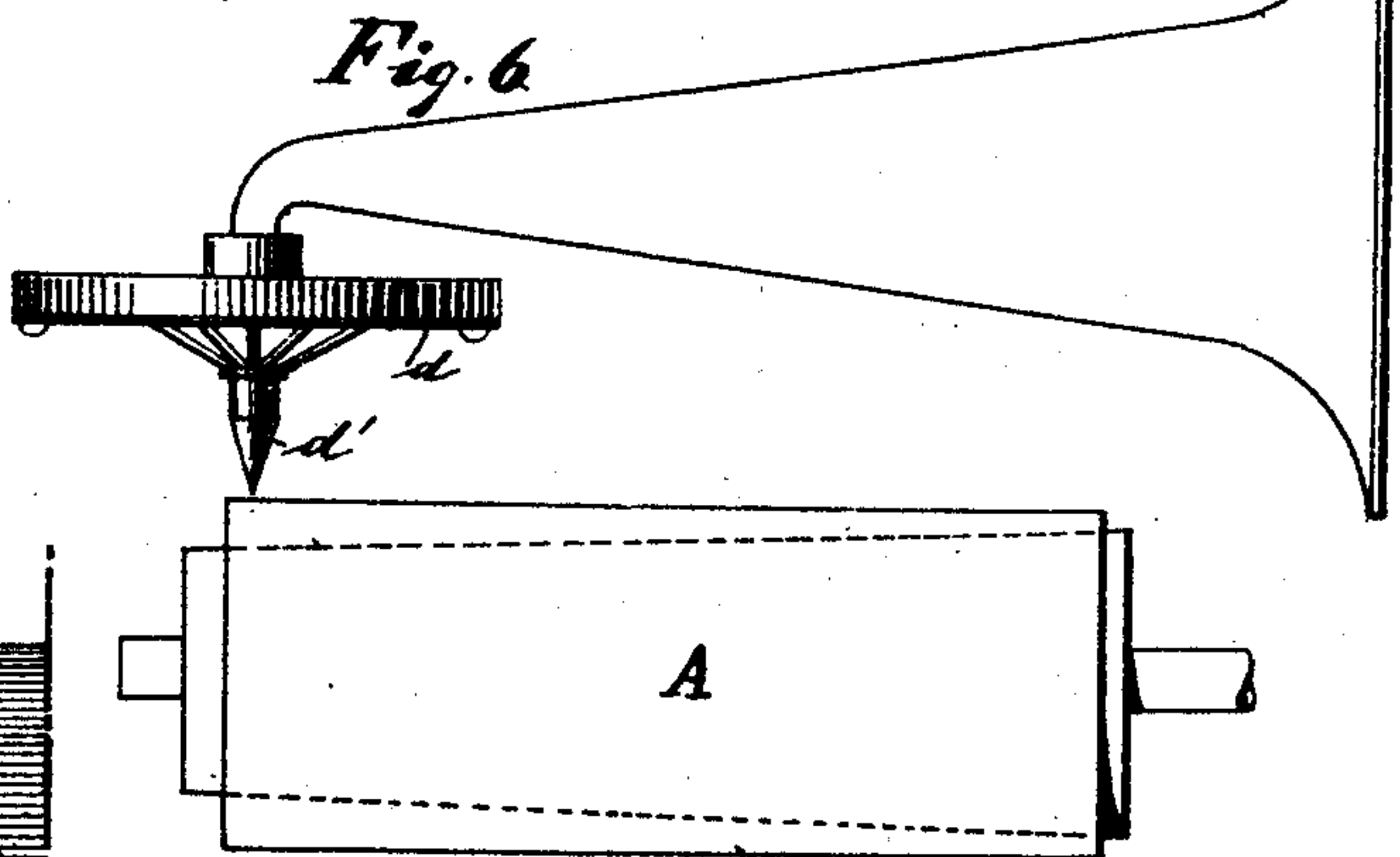
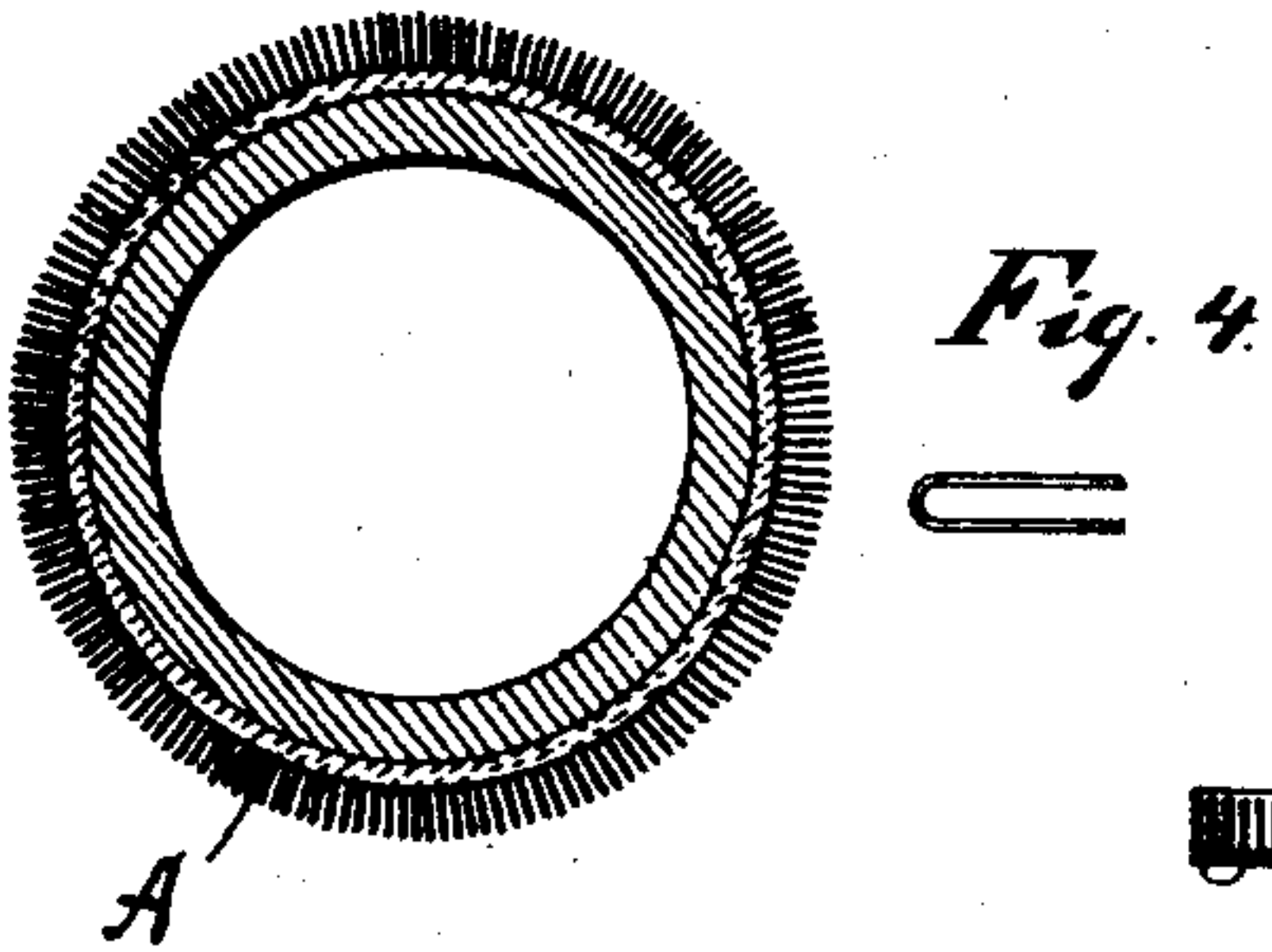
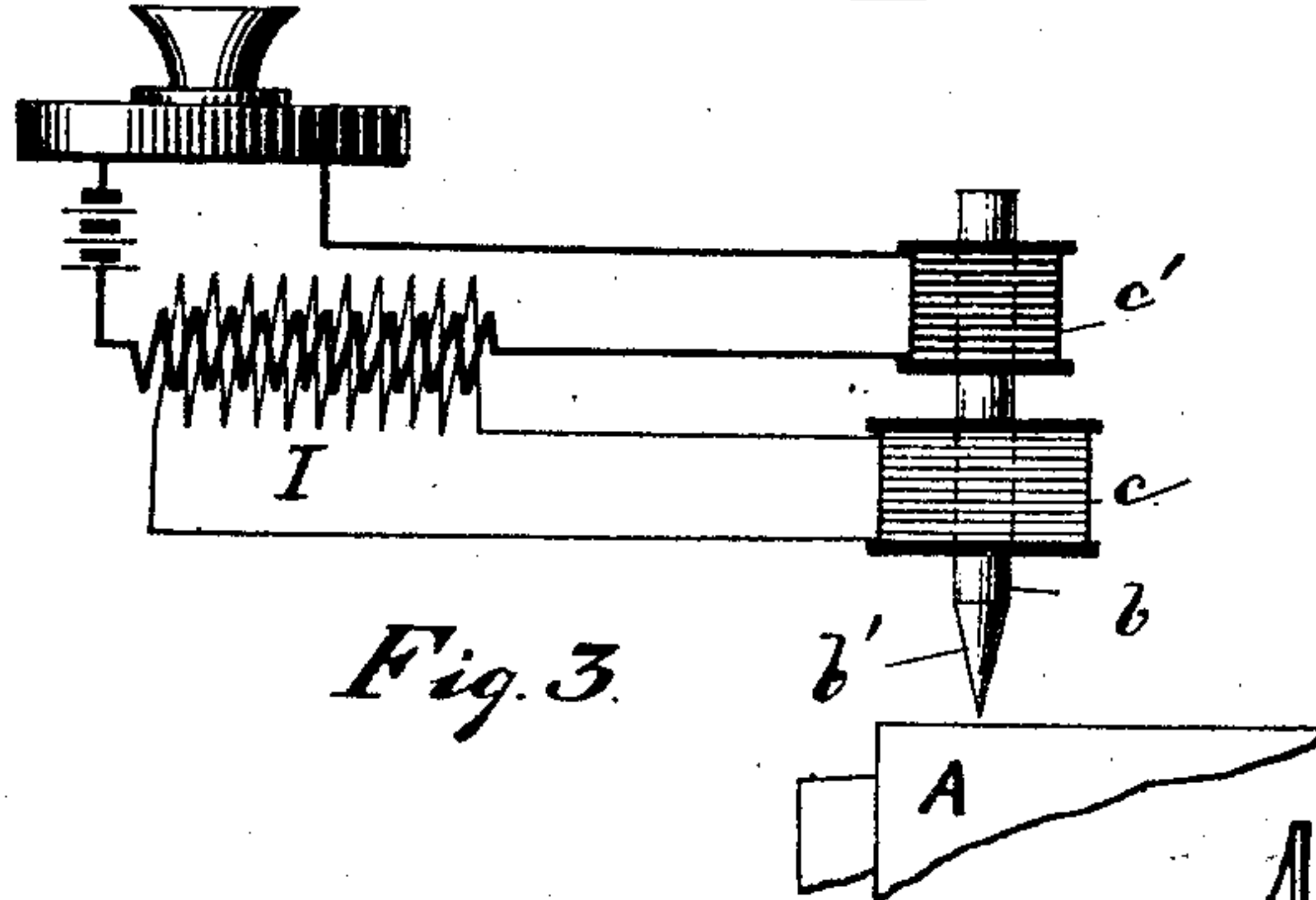
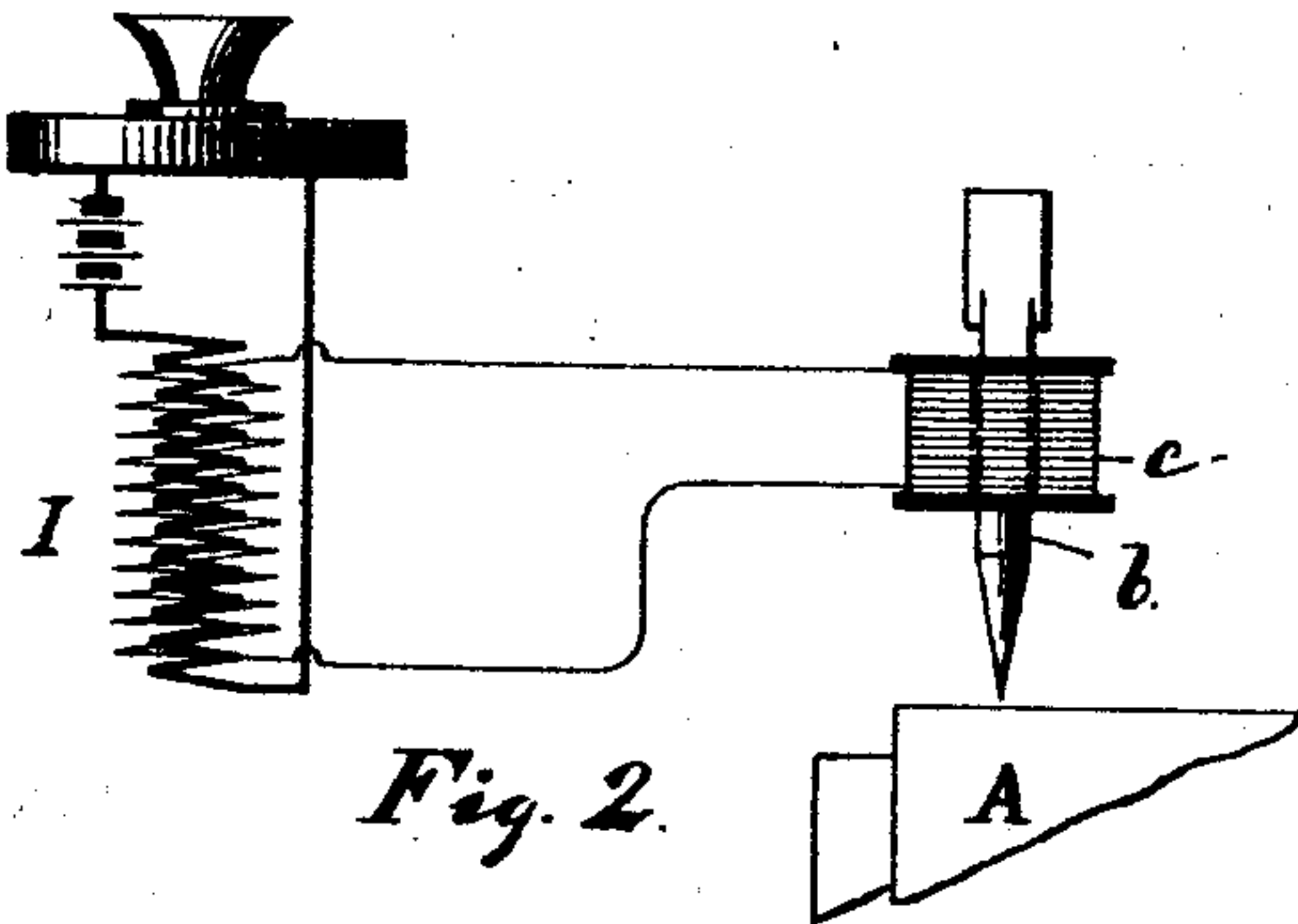
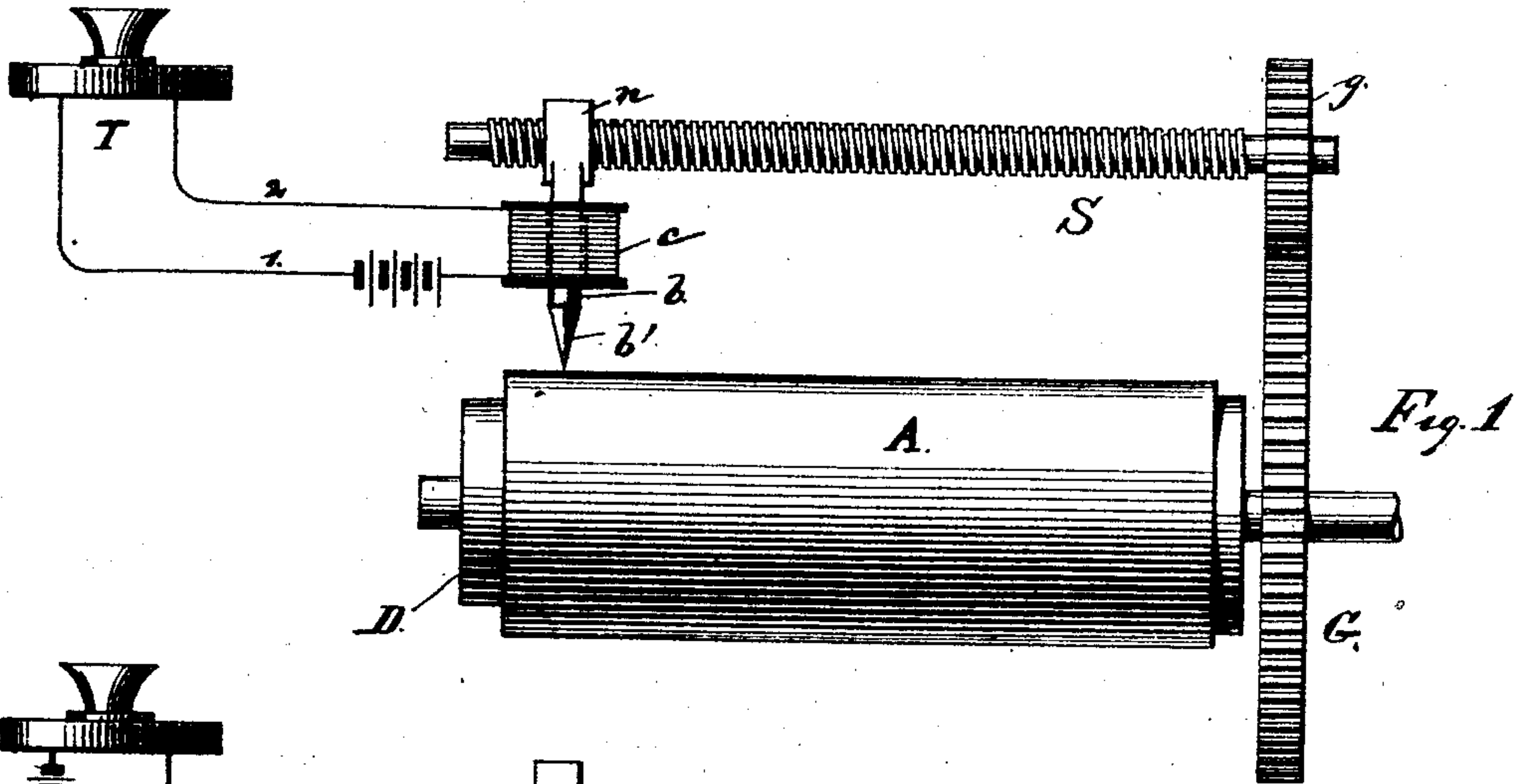
G. KIRKEGAARD.

SOUND RECORDING AND REPRODUCING INSTRUMENT.

APPLICATION FILED NOV. 18, 1899. RENEWED MAR. 5, 1908.

900,392.

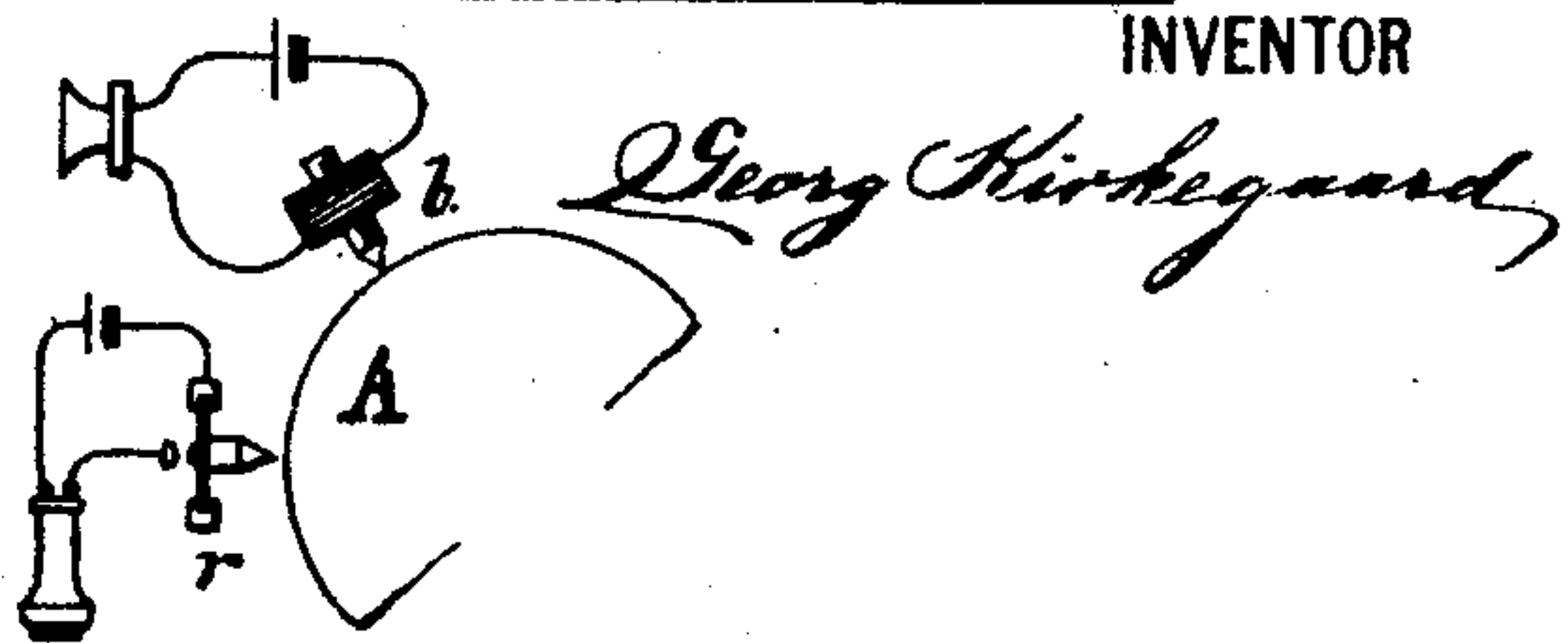
Patented Oct. 6, 1908.



WITNESSES:

Sindigehristen
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Fig. 7.



INVENTOR

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UNITED STATES PATENT OFFICE.

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SOUND RECORDING AND REPRODUCING INSTRUMENT.

No. 900,392.

Specification of Letters Patent.

Patented Oct. 6, 1908.

Application filed November 18, 1899, Serial No. 737,406. Renewed March 5, 1908. Serial No. 419,391.

To all whom it may concern:

Be it known that I, GEORG KIRKEGAARD, a citizen of the United States, and resident of the city of New York, in the borough of Brooklyn and State of New York, have invented a certain new and useful Sound Recording and Reproducing Instrument, of which the following is a specification.

This invention relates to phonographs, the primary object being to provide a method of recording, and reproducing from a record, speech, without the necessity of making mechanical impressions upon a recording surface, as is the common practice.

It is well known that many of the foreign sounds and noises heard in the reproduction of speech from an ordinary wax "record" of a phonograph is due to the fact that the stylus or the diaphragm travels in mechanical contact with the record, and the rubbing of the point upon the record is responsible, in a large measure, for these disturbing sounds.

The ordinary phonograph is a mechanical device in so far as its recording and reproducing elements are concerned. My invention comprehends the recording and reproducing of speech through the agency of electro-magnetism, the record being produced by varying the magnetic condition of a series of magnets capable of retaining such magnetic condition for an indefinite period, then causing such magnets to successively act upon a reproducing diaphragm or device. I produce this varied magnetic condition of the magnets without mechanical contact between relatively moving parts, in consequence of which the reproducer is affected by only such influences as were produced by the recorded speech.

Since my invention is operated electrically, the principle involved may be applied in telephony, telegraphy and electric signaling of any character. For this purpose speech or sounds to be recorded may be delivered into a telephonic transmitter and sent over a line of any length, by any known methods, and at any point or points in the line may pass through the phonographic apparatus constituting my invention and make a record which may be reproduced at any time and in any manner.

To explain my invention in detail I will refer to the accompanying drawings, in which—

Figure 1 shows my invention in conven-

tional form and in accordance with one of the plans by which the principle may be carried out; Fig. 2 shows a slight modification of the electrical apparatus and circuits; Fig. 3 shows a further modification of such apparatus and circuits; Fig. 4 is a trasverse section of a cylindrical "record medium" constructed on a modified plan; Fig. 5 shows in side elevation still another modification of the record; Fig. 6 illustrates the reproducer, and Fig. 7 shows the use of my invention as a telephonic relay.

In accordance with my invention the "record" or record medium, which is the device to be affected by the speech and in turn affects the reproducing mechanism, consists of a surface presenting, or made up of, individual or insulated particles or pieces of material, such as hardened steel, which is capable of being magnetized and retaining its magnetism for an indefinite period. This surface, which may be in the form of a cylinder, disk or other shape, may have its particles of steel disposed thereon in any suitable way. As shown in Fig. 1 for instance, the cylinder A is made of wax, rubber, celluloid, shellac or similar adhesive insulating material acting as a base or binder to contain hardened steel filings, the amount of filings being preferably as much as the base will hold, the exposed outer surface being made as true and smooth as possible. Or, the cement base may hold within or upon it a quantity of small steel pins which may project radially from the base with their ends presented over the entire surface of the record, or such steel pins may be in a horizontal or other position. The record may also be made up of bits of hardened steel wire bent into the shape of the letter U and secured at the bend in a textile or other backing, which is wrapped around the record cylinder or secured to a frame of any character adapted to carry the record. These bent wires all over the surface of the backing will present the appearance of a brush, each wire acting as a magnet in the carrying out of my invention. Likewise, short lengths of ribbon steel or steel plates may be attached to a moving surface and magnetically insulated from each other to receive the magnetic impressions.

The means for producing the recording medium or magnetic impressions upon the record medium by speech consists of a magnetic core *b*, a pole *b*¹ of which is presented

to the surface containing the steel particles or pieces described, there being sufficient clearance left between the face or end of the pole and the surface of the record, to permit of relative motion of these two parts without mechanical contact. This magnetic core is surrounded by a coil of wire *c* through which variable or undulating currents are caused to flow, which currents are created or induced by and in accordance with the sound waves which are to be recorded and reproduced. As shown in Fig. 1, the coil *c* is in a circuit 1—2 containing a battery *B* and a telephonic transmitter *T* of any approved type. The sound waves which enter the transmitter create corresponding changes in the resistance of the circuit and so produce corresponding changes of magnetism in the core *b*.

In Fig. 2 the transmitter is in circuit with the primary of induction coil *I*, the secondary of which extends to, and includes, the coil *c* on the magnetic core. For long distance transmission this will be preferable to the form shown in Fig. 1. If desired the circuit containing the primary of the induction coil and transmitter may also include a second coil *c'* on the core *b* which, if properly wound, will augment the influence of the coil *c*, (see Fig. 3.)

The mechanical appliances necessary for this apparatus may consist of a suitable motor which for brevity I have indicated by the gear wheel *G*, for revolving the record surface in front of the pole *b'* of the magnet, and suitable means for moving the magnet across the face of the record so that new portions of it may be constantly presented to the pole while the machine is in operation. For this purpose a worm shaft *S* passing through a nut *n* attached to the core *b* or its frame, is rotated by the gear *g*, but any suitable mechanism may be substituted for these devices.

The operation of producing the magnetic record is as follows: Sounds which enter the telephonic transmitter *T* will create corresponding variations of current in the circuit which it controls, which variations will either be delivered direct to the coil *c* or first through the induction coil *I* and then to the coil *c*. These variations will create corresponding variations in the magnetic strength of the core *b*, and the lines of force passing through its pole piece *b'* and through the steel particles or pieces in the recording surface will transform such particles or pieces into magnets the magnetism of which will be retained for an indefinite period on account of the fact that the particles are made of hardened steel. Assuming the recording surface and the magnet to have the relative motions above described, it is evident that the magnetism of the successive individual magnets in the recording surface which pass in front of the pole of the magnet will be of greater or less strength in exact proportion to

the strength of the magnet core *b* when the particles pass under its influence. The result of this upon the record will be the production of a spiral line or row of little magnets extending from one end of the cylinder towards the other. I prefer to make the pole *b'* of the magnet pointed, as shown, so that the row of magnets *g* produced by it will be narrow and therefore enable me to put a large number of the spiral rows upon the cylinder.

In order to increase the magnetic effect of the magnet *b* I may mount the record cylinder *A* upon a soft iron drum or cylinder *D*. This will decrease the resistance of the magnetic circuit and enable me to move the individual magnets in the record surface through a very narrow "air gap" or field of force between two magnetic bodies. If the record is in the form of a disk, an iron backing may also be used.

A record thus produced may be used at any time thereafter in the following manner: The core *b* with its coil is removed from the machine and the reproducer shown in Fig. 6 substituted. This reproducer consists of a diaphragm *d* to the center of which is fixed an armature *d'* of soft iron having a pointed end similar to the point *b'* of the magnet. When the reproducer is adjusted in place of the magnet, the point of the armature occupies the same relative position with respect to the surface of the record as did the point *b'*. Opposite the other side of the diaphragm of the reproducer may be attached a megaphone or other device for increasing the sound waves created by the diaphragm. When the same motions are imparted to the record cylinder and reproducer, given to the cylinder and magnet, as were before, the little magnets in the surface of the record, as they successively pass the armature *d'*, will attract it more or less, depending upon the strength of magnetism in each instance, and the diaphragm will therefore vibrate and reproduce upon the air the sound waves that were originally delivered to the transmitter.

I do not limit myself in any manner to the size or shape of the individual metallic particles in the surface of the record. As one of the objects of my invention is to avoid mechanical contact between the moving parts it will be understood that in this respect my invention is not limited to the nature of the magnetic surface of the cylinder. It may also be remarked that in the production of the record mechanical contact between the magnet core *b* and the recording surface would not tend to make a poor record, but quite the reverse. But in reproducing, the contact is not desirable. Hence I may arrange to let the end or pole of the magnet *b* slide upon the record surface in making the record and the armature of the reproducer run clear in reproducing the sounds. It will

also be understood that the diaphragm of the reproducer may be used as the diaphragm of a microphone transmitter wherein its vibrations will vary the resistance of a circuit containing any preferred form of receiving apparatus.

The magnetic condition of the record may be nullified at any time and the surface used for a new record, by using any known means of "demagnetizing."

This invention will serve admirably as a telephonic relay or repeater and as such the reproducing or repeating may be done after the message has been recorded as before described, or, simultaneously with the production of the record. According to the latter plan a microphone *r* may be placed immediately behind the recording magnet *b* and move with it, and thus receive and transmit the impulses of the magnetized bodies immediately after they have been magnetized by the magnet *b*, as illustrated in Fig. 7.

Having described my invention, I claim—

1. A sound recording and reproducing instrument consisting of a number of magnetizable bodies arranged in a series, means for successively magnetizing said bodies in accordance with sound waves and a diaphragm subjected to the successive action of said bodies.

2. A sound recording instrument consisting of an electro-magnet and means for varying its magnetism in accordance with sound waves, in combination with a relatively moving surface containing a multiplicity of pieces of magnetic material adapted to be successively brought under the influence of the magnet.

3. A sound recording and reproducing instrument consisting of a series of independent bodies of magnetizable material, means for successively magnetizing them in accordance with successive changes in sound waves and an armature adapted to be brought successively under the influence of said bodies after they have been magnetized.

4. The combination of an electric circuit, a magnet in said circuit, a series of magnetizable bodies adapted to be magnetized successively under the influence of said magnet, and a record electric circuit adapted to be affected successively by the said magnetized bodies.

5. A sound recording and reproducing instrument consisting of an electro-magnet and means for changing its strength in accordance with sound waves, and a relatively moving surface of magnetic material exposed to the influence of said magnet for the purpose of making a record of said sound waves, in combination with a reproducing device consisting of a vibratory body carrying an armature adapted to be exposed to the magnetic record contained in said moving surface, substantially as described.

6. In a telephonograph, the combination with a magnetic record medium having a multiplicity of record portions partially insulated from one another, of a recording medium cooperative therewith.

7. In a telephonograph, the combination with a magnetic record medium having a multiplicity of record portions partially insulated from one another lengthwise and crosswise of the line of record, of a recording medium cooperative therewith.

8. In a telephonograph, the combination with a magnetic record medium having a multiplicity of record portions partially insulated from one another lengthwise, crosswise and depthwise of the line of record, of a recording medium cooperative therewith.

9. In a telephonograph, the combination with a magnetic record medium having a plurality of record portions disposed depthwise of the medium and partially insulated from one another, of a recording medium cooperative therewith.

10. In a telephonograph, the combination with a relatively thick magnetic record medium having a multiplicity of record portions partially insulated from one another, of a recording medium for impressing into said record medium magnetic records of great depth.

11. In a telephonograph, the combination with a relatively thick magnetic record medium having a multiplicity of record portions partially insulated from one another, of means for impressing into said record medium a line of partially insulated magnetic records each extending entirely through said medium.

12. In a telephonograph, the combination with a relatively thick magnetic record medium having a multiplicity of record portions partially insulated from one another, of means for impressing into said record medium a line of partially insulated needle-like magnetic records each extending entirely through said medium.

13. In a telephonograph, the combination with a magnetic record disk having a multiplicity of record portions partially insulated from one another, of a recording medium for impressing into said record disk a line of partially insulated magnetic records.

14. In a device of the character described, the combination of a magnet and a magnetic record medium adapted to be influenced by and to influence said magnet, means for supporting said record medium and said magnet in such positions that the pole of said magnet is adjacent to but out of contact with said record medium, and means for producing relative movement of said magnet and record medium.

15. In a device of the character described, the combination of a record medium of substantial width, a magnet adapted to influence

and be influenced by said record medium and means for imparting relative movement to said record medium and magnet to cause the magnet to trace a diagonal or spiral line
5 with respect to the surface of the medium.

16. In a device of the character described, the combination of a record medium, a magnet adapted to influence or be influenced by said medium, a telephonic transmitter comprising an induction coil having primary and secondary windings, and two coils applied to said magnet, one of said coils being in circuit with the primary of the induction coil, and the other coil being in circuit with the sec-
15 ondary of the said induction coil.

17. In a device of the character described, the combination of a magnet and a record medium adapted to influence and be influenced by said magnet, said record medium
20 being magnetically discontinuous.

18. In a device of the character described, the combination of a magnet and a record medium adapted to influence and be influ-

enced by said magnet, said record medium being physically continuous and magnetic- 25 ally discontinuous.

19. In a device of the character described, the combination of a magnet and a record medium adapted to influence and be influenced by said magnet, said record medium 30 being composed of a suitable base or binder and magnetic particles held thereby.

20. In a device of the character described, the combination of a magnet and a record medium adapted to influence and be influ- 35 enced by said magnet, said record medium being composed of a suitable base or binder and steel filings held thereby.

Signed at the city of New York in the county of New York and State of New York 40 this 16th day of November A. D. 1899.

GEORG KIRKEGAARD.

Witnesses:

WM. BAHT,

LUDWIG CHRISTEN, Jr.