

(No Model.)

2 Sheets—Sheet 1.

C. J. HOHENSTEIN.
SOUND RECORDING APPARATUS.

No. 356,877.

Patented Feb. 1, 1887.

Fig. 1.

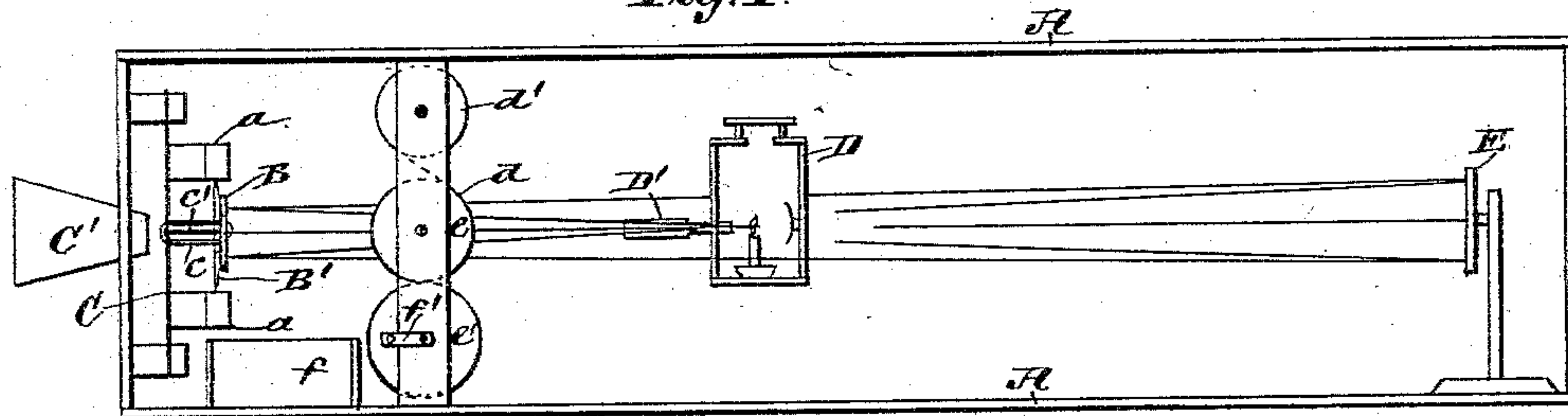


Fig. 2.

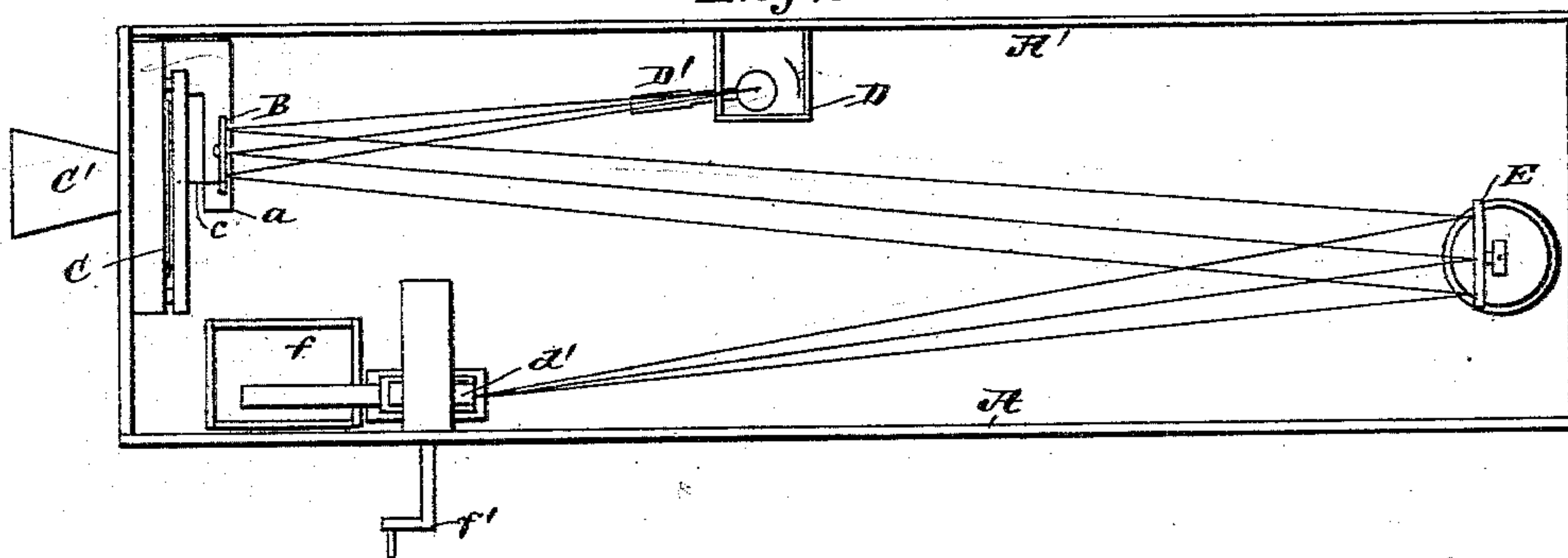


Fig. 3.

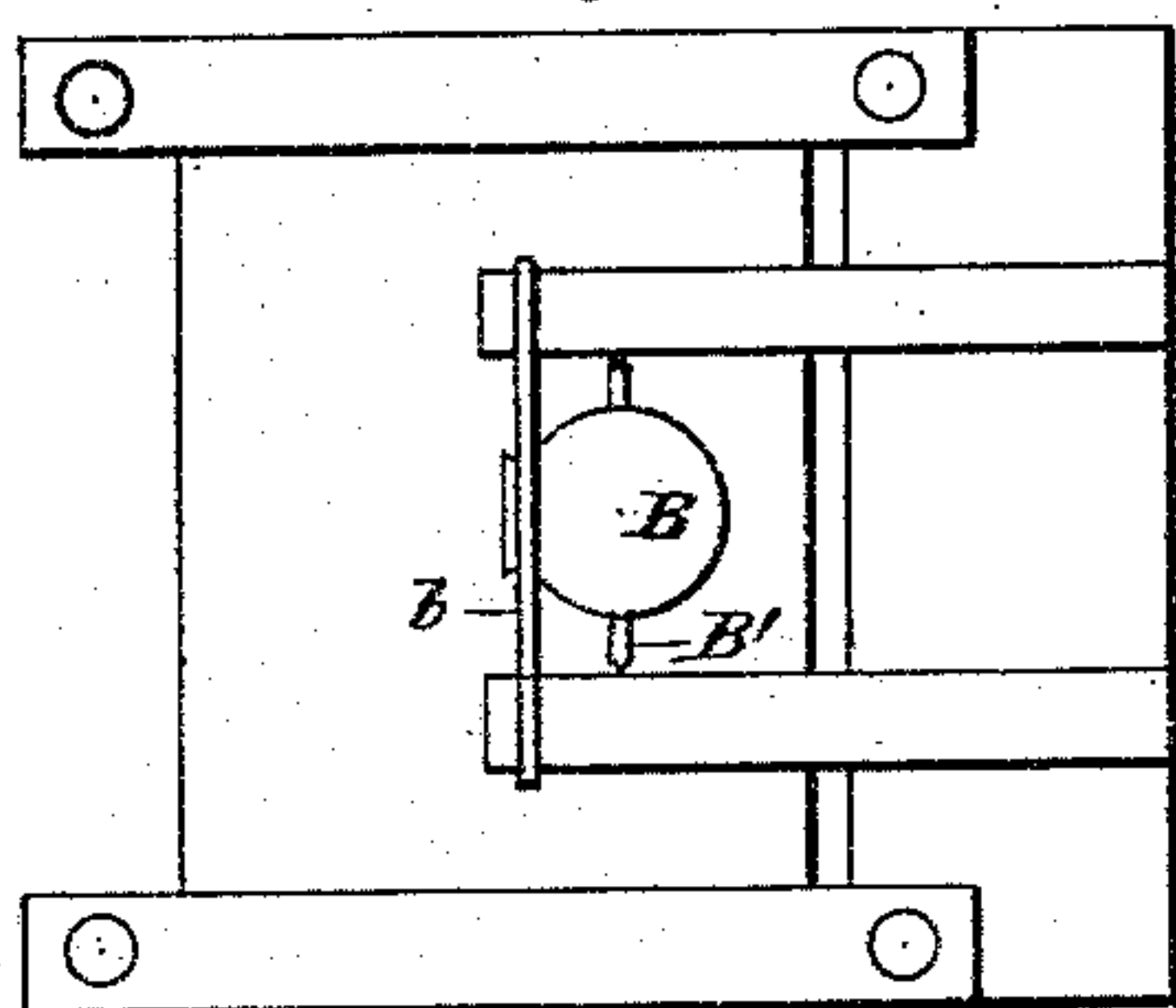


Fig. 4.

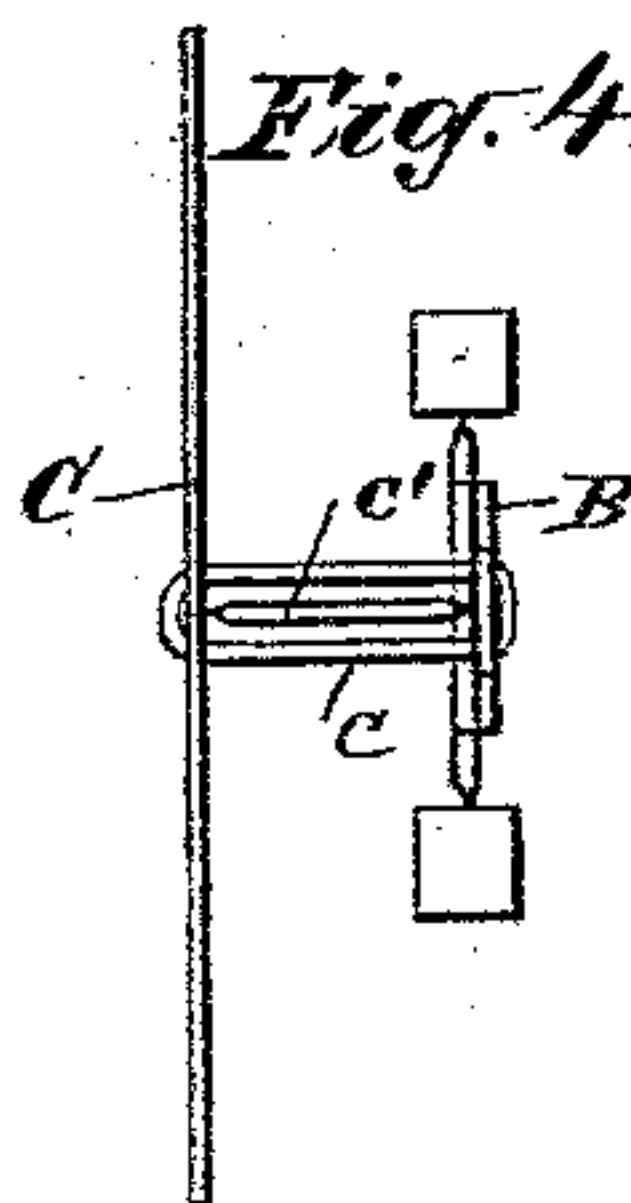


Fig. 5.

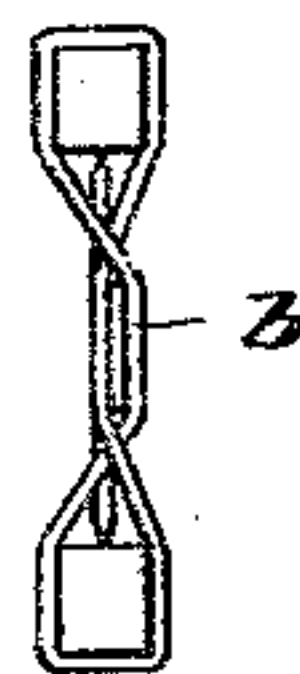


Fig. 6.

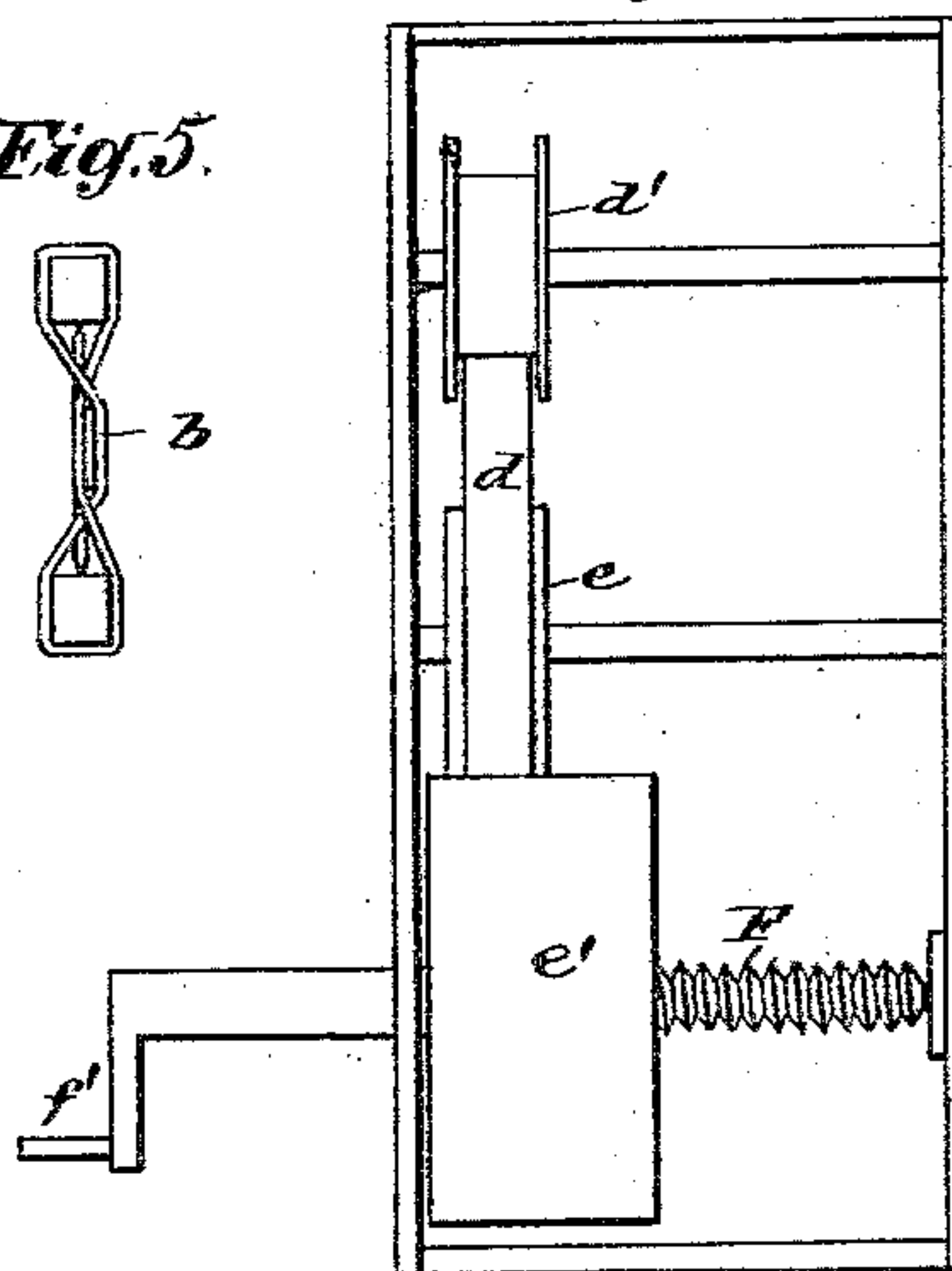


Fig. 7.

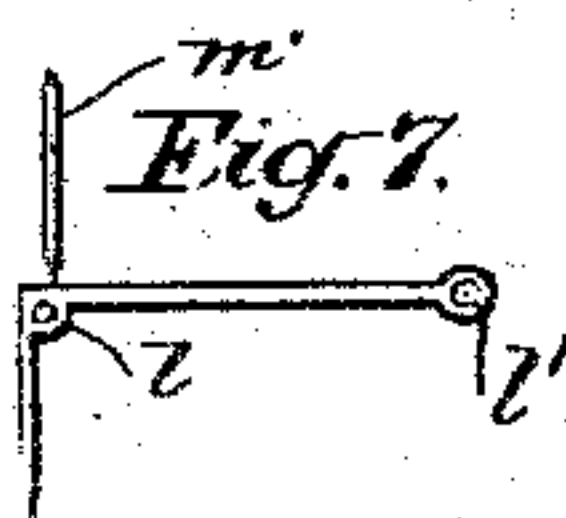


Fig. 8.

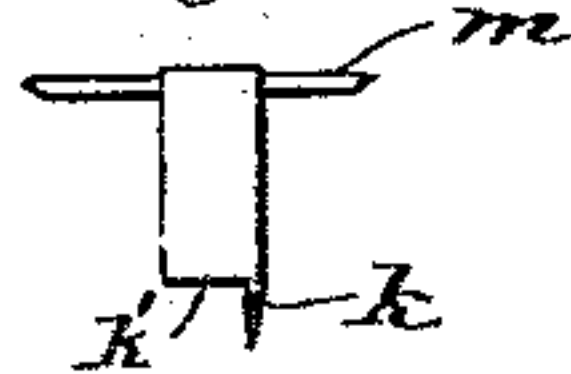


Fig. 9.

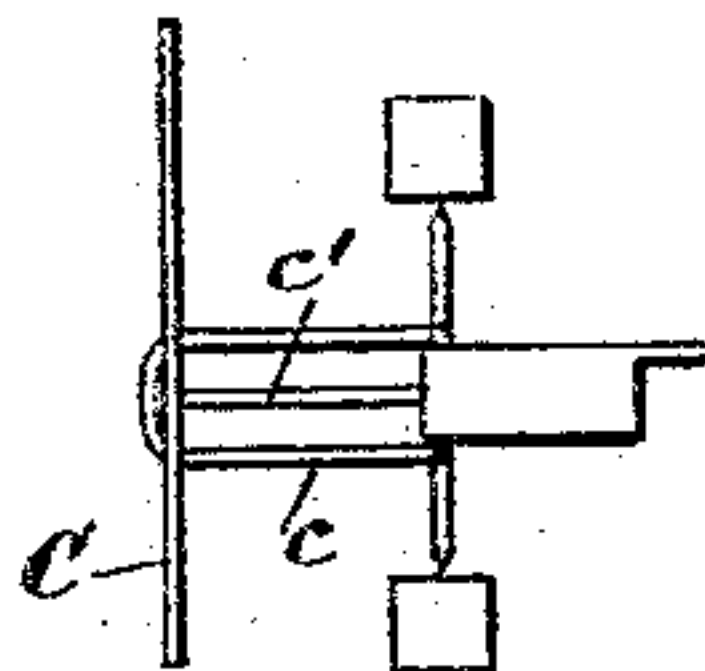


Fig. 10.

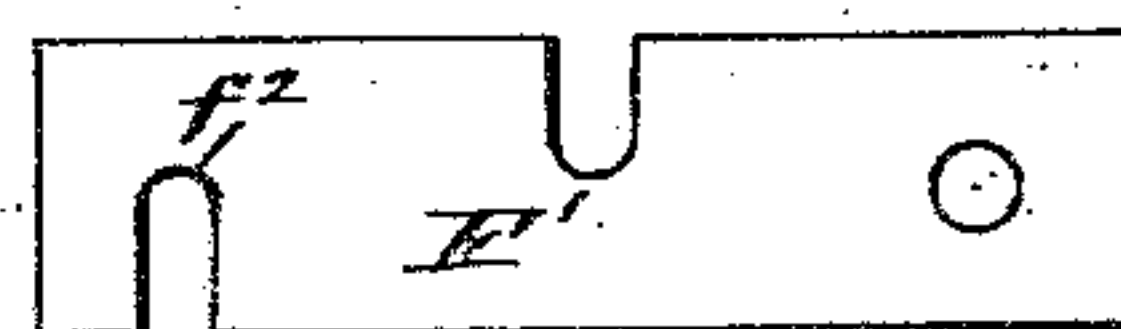


Fig. 11.



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ATTORNEYS.

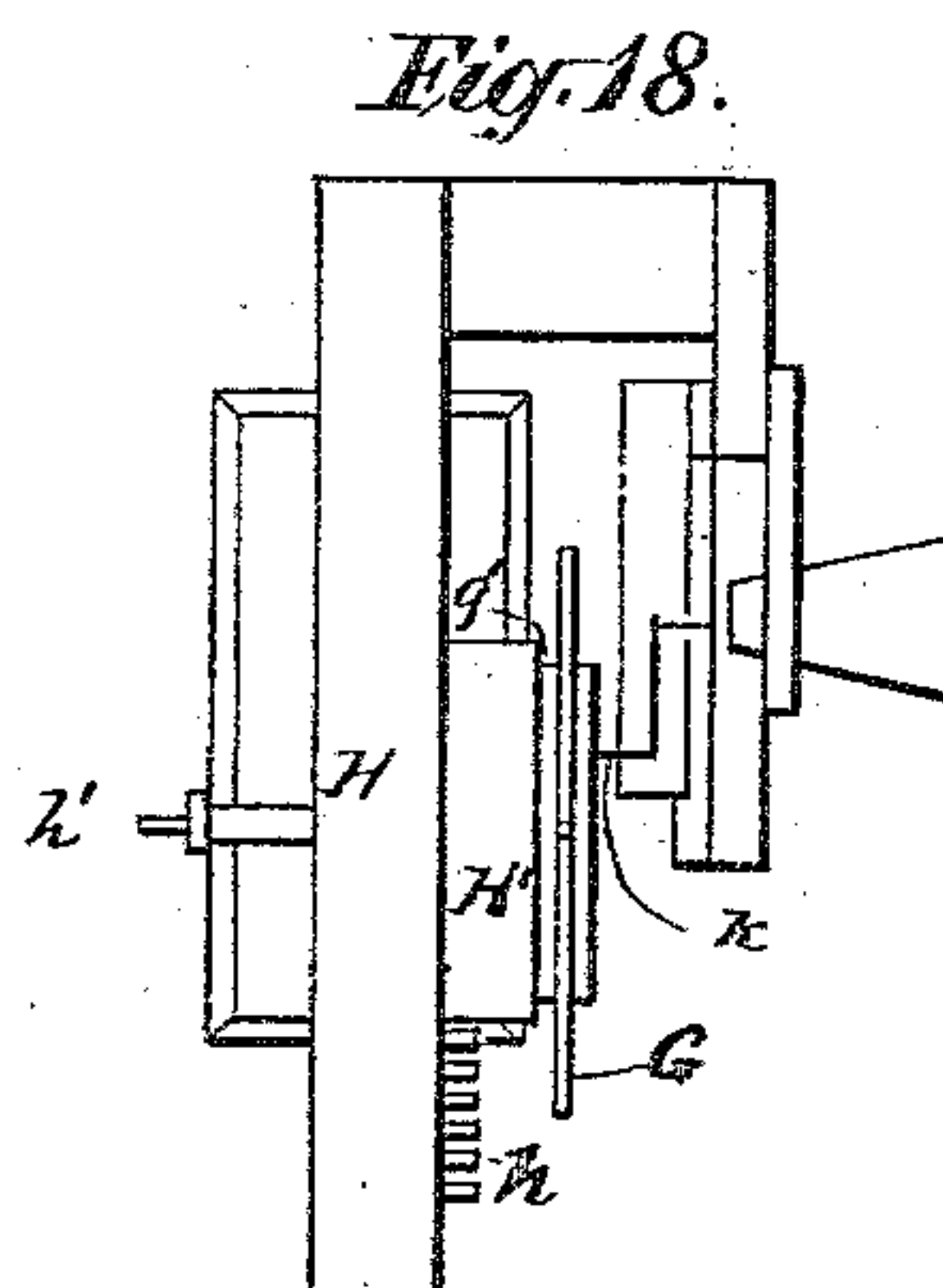
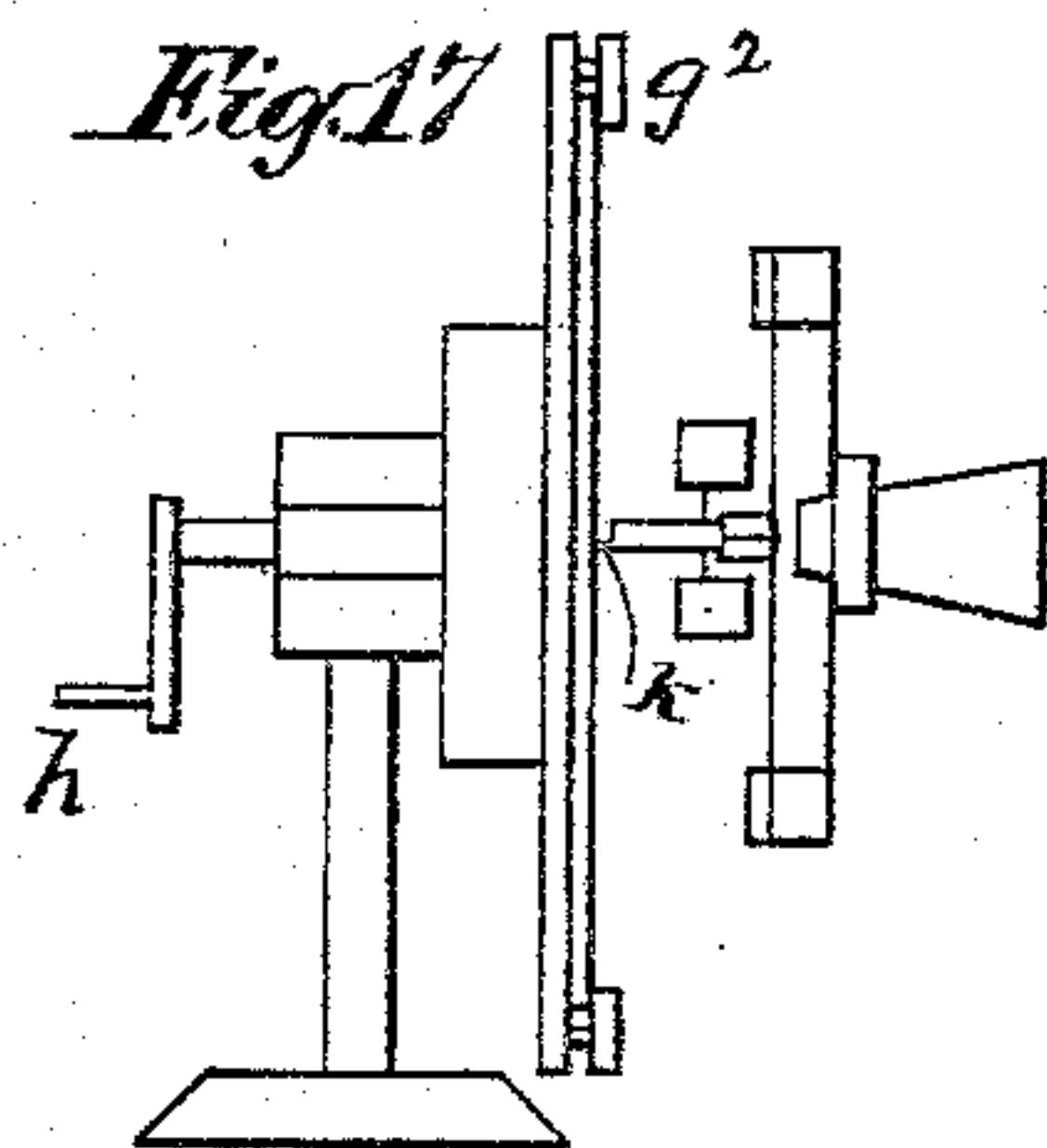
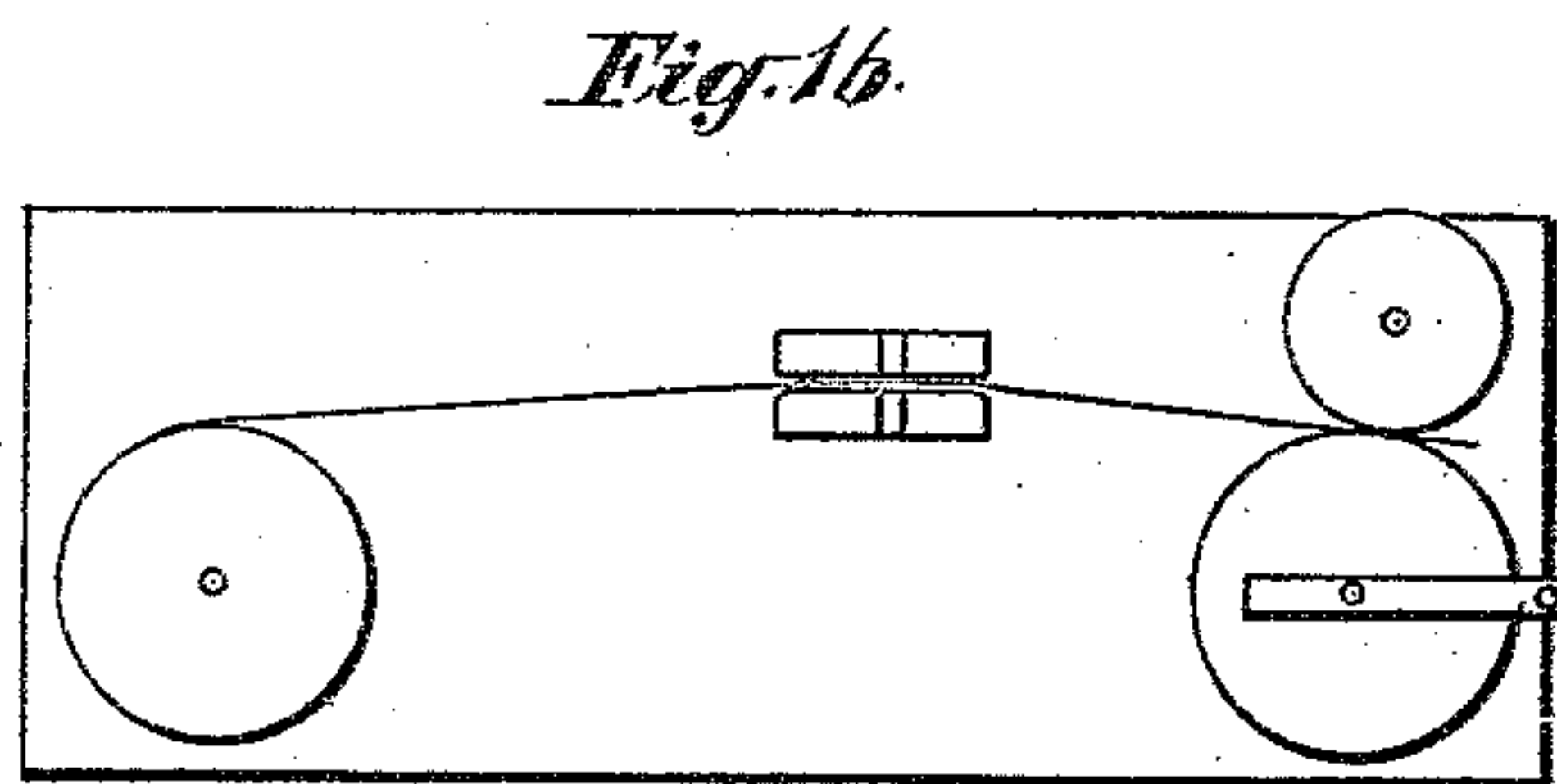
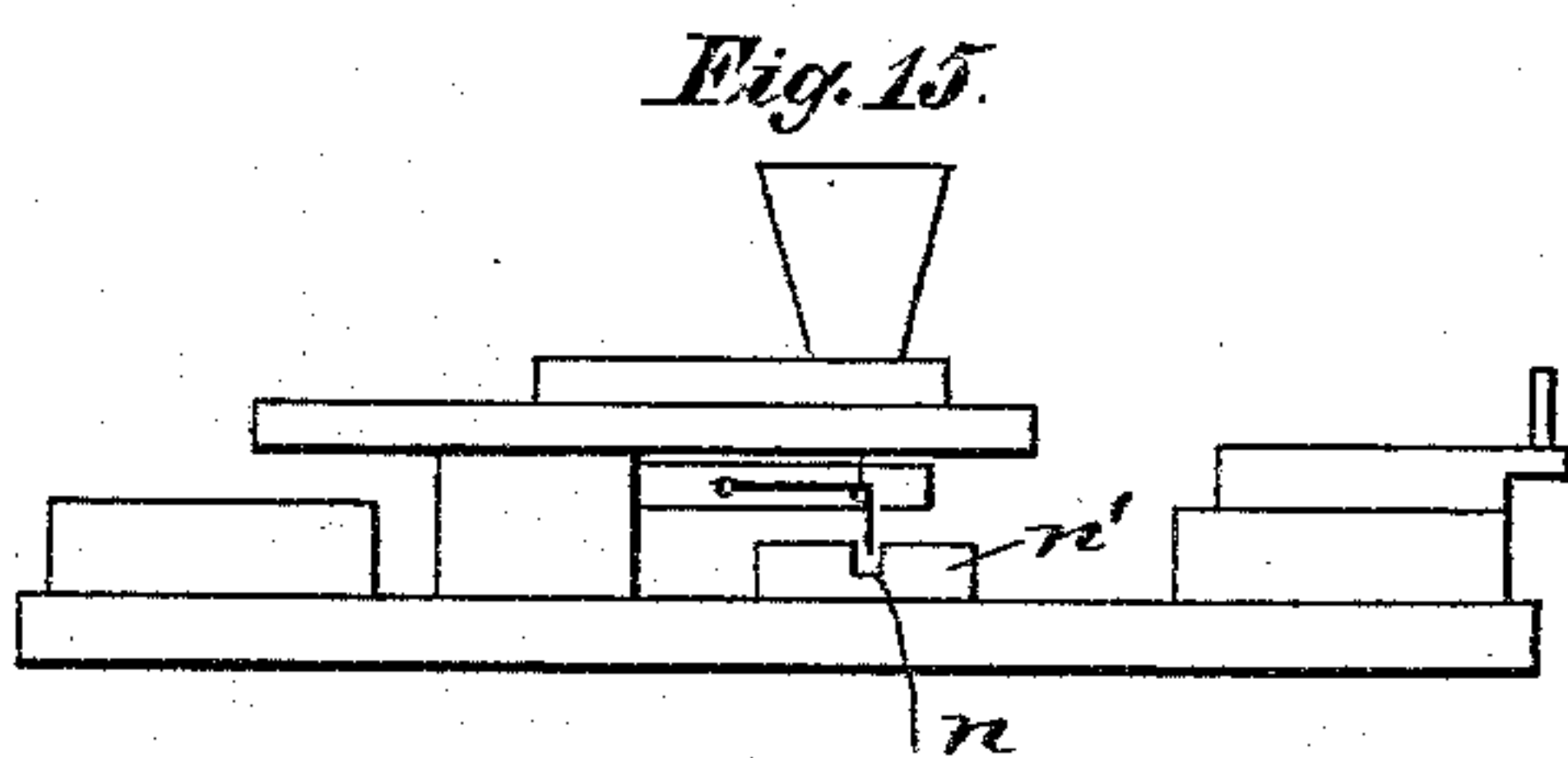
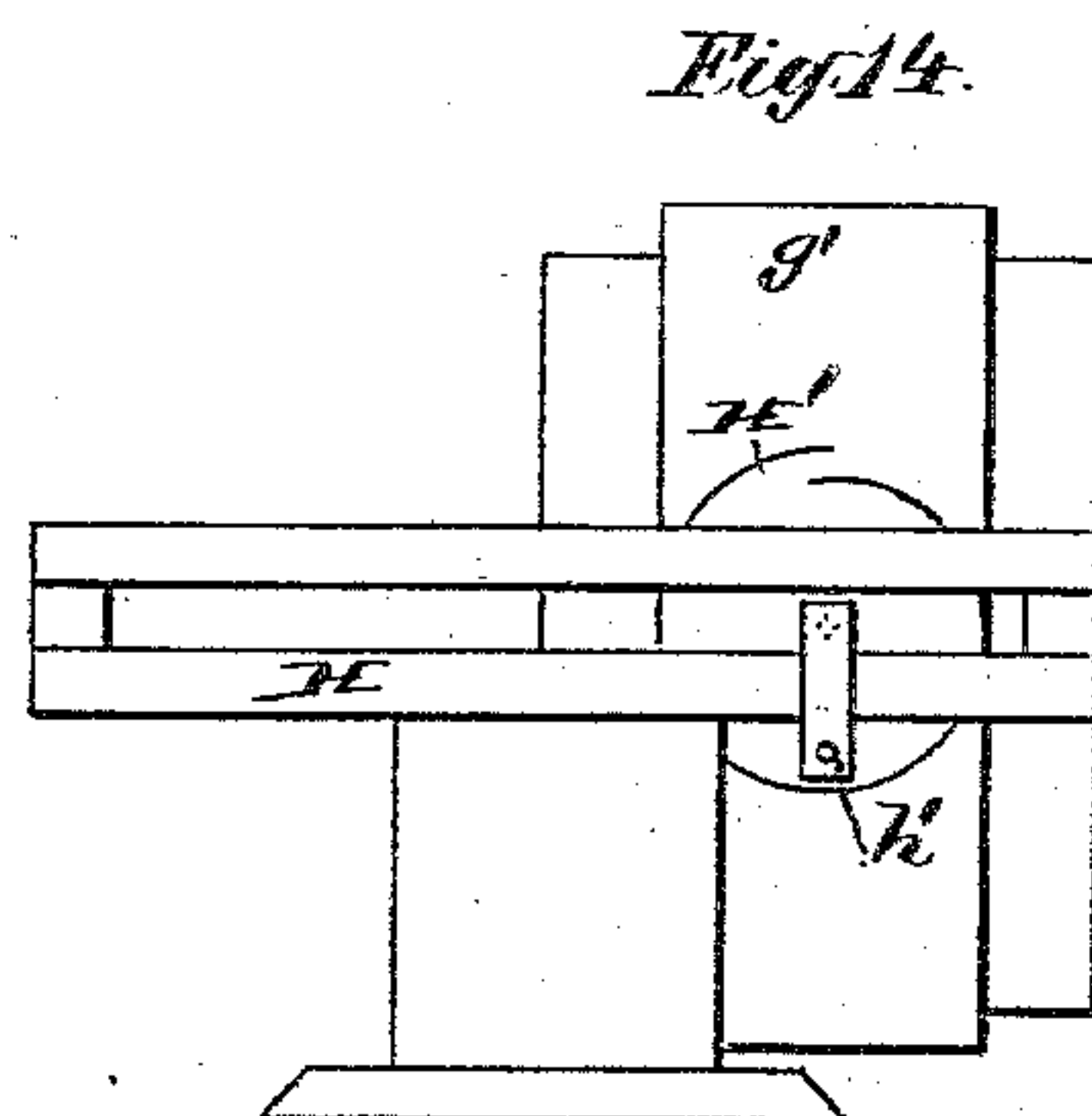
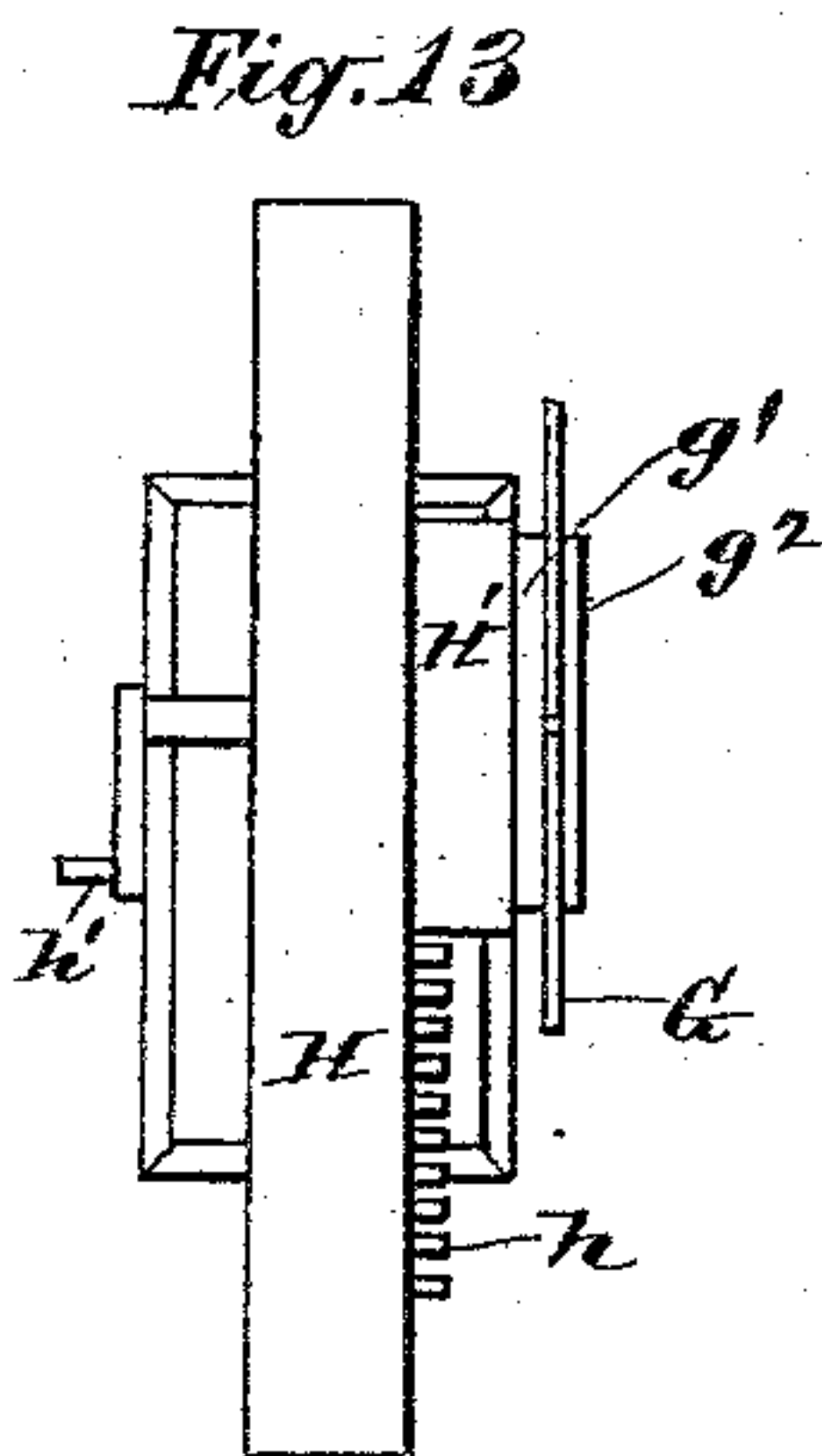
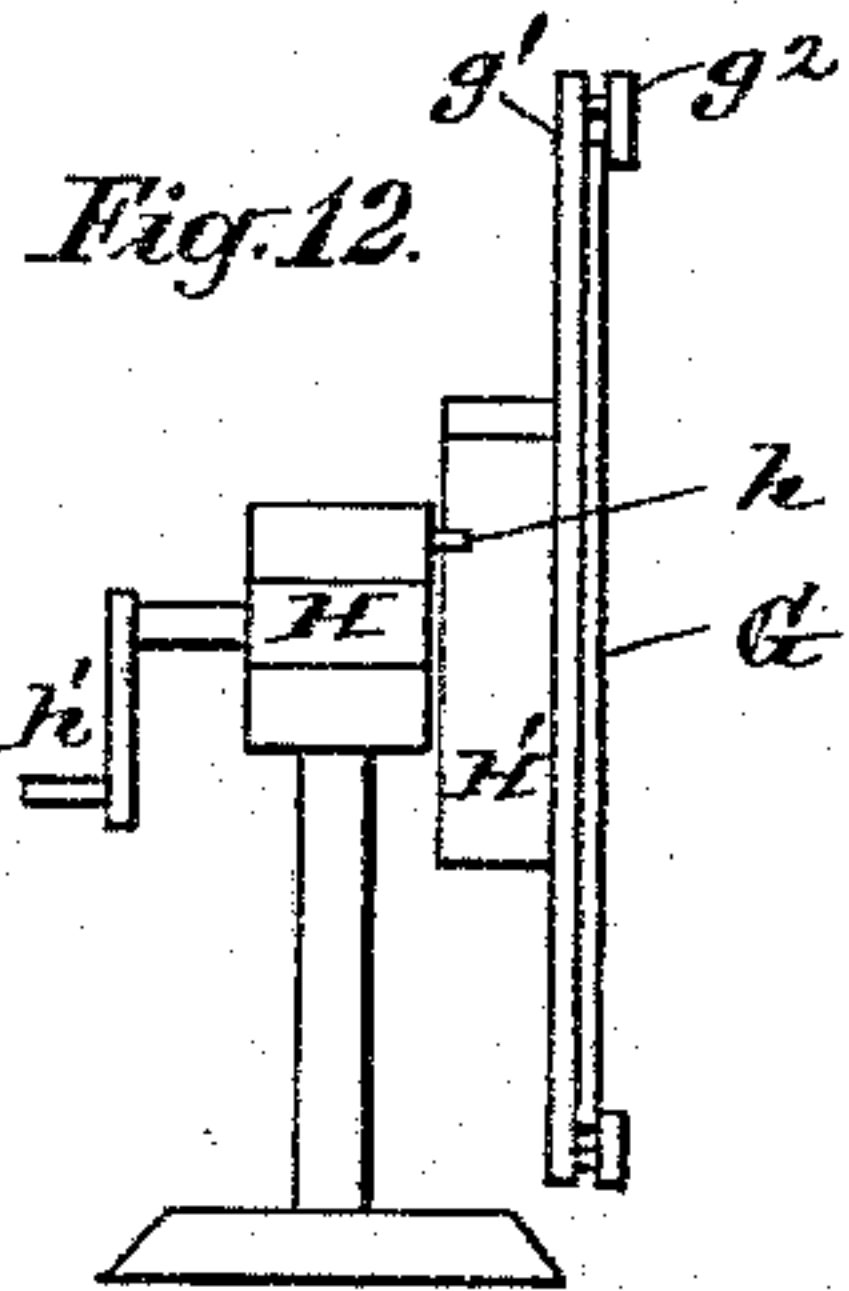
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UNITED STATES PATENT OFFICE.

CARL J. HOHENSTEIN, OF NEW YORK, N. Y.

SOUND-RECORDING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 356,877, dated February 1, 1887.

Application filed August 10, 1886. Serial No. 210,524. (No model.)

To all whom it may concern:

Be it known that I, CARL J. HOHENSTEIN, a citizen of the United States, residing at New York, in the county and State of New York, have invented certain new and useful Improvements in Sound-Recording Apparatus, of which the following is a specification, reference being had to the drawings accompanying and forming a part of the same.

The object of my invention is to produce an instrument by means of which sounds of any kind, whether simple musical tones or articulate speech, may be permanently recorded and reproduced at will. The special object of the construction which I have devised is to obtain a more sensitive apparatus of the kind than has heretofore been made.

In carrying out my invention I make use of a reflector which is supported in such manner that it is capable of a slight movement or oscillation about an axis. Upon this reflector a beam of light is directed, and it is reflected upon a stationary reflecting-mirror placed at a certain distance in front of the vibrating reflector. The reflecting-mirror is slightly concave and concentrates the reflected rays of light to a focus. To obtain a movement or vibration of the focused rays corresponding to sound-waves, I either connect with the first-named reflector a vibrating diaphragm or use the reflector itself as a diaphragm, so that speaking against it will impart to it a certain movement or vibration. These vibrations are imparted to the beam of light and are greatly amplified in the focused rays, so that if a strip of sensitive photographic paper be drawn through the focused rays the change of position of the latter will be recorded by an undulating line upon the paper. The strip may then be developed in the usual manner and the line reproduced in various ways, as by engraving or photo-engraving or otherwise. When obtained in a permanent form in metal, the strip may be drawn under a stylus or other point connected with a diaphragm and the sounds or words reproduced any number of times.

The main advantage of this instrument over ordinary forms of phonograph or similar instruments resides in the fact that it may easily be made extremely sensitive. The vibrating

reflector may be used with the diaphragm of an ordinary telephone-receiver in circuit with a microphone, and the slightest vibrations so greatly amplified as to reproduce sounds or words uttered a long distance from the microphone.

Many other uses will be suggested by the accompanying description of the nature of the invention, in which reference is made to the drawings.

Figure 1 is a side elevation of the parts comprising the recorder, the side of the box being removed. Fig. 2 is a top plan view of the same parts, the top of the box being removed. Fig. 3 is a front view of the vibrating reflector and its supports. Fig. 4 is a side view of the same without the supports. Fig. 5 is a modified support for the reflector when the latter is used without a diaphragm. Fig. 6 is a plan view of the device for moving a strip of photo-sensitive paper through the focused light-rays. Figs. 7, 8, and 9 are different forms of tracer or stylus used in reproducing sound. Fig. 10 is a supporting-plate used in the device shown in Fig. 6. Fig. 11 is a portion of a screw-threaded shaft used in the same. Fig. 12 is a modification of Fig. 6, shown in side elevation. Fig. 13 is a top view, and Fig. 14 a rear view, of the same. Fig. 15 is a side view of the device for reproducing the sound. Fig. 16 is a top view of the same with the diaphragm and its supports removed. Fig. 17 is a side view illustrating the manner of using a plate made by the instrument in Fig. 12 in reproducing speech. Fig. 18 is a top view of the same.

The recording apparatus is contained in a close box, A. It consists of the following parts: A small circular reflector, B, is soldered or otherwise secured to a metal pin, B', which serves as a supporting axis, being mounted between suitable supports, *a a*. A metal or other diaphragm, C, is mounted in a suitable mouth-piece, C', and the reflector is supported a short distance from it. A resilient connection is made between the diaphragm and the reflector, as by a rubber band, *c*, which is passed through holes in the two. A short pin, *c'*, is then interposed between the central point of the diaphragm and a point on one side of the axis of the reflector, so that any vibration

of the diaphragm is imparted to the reflector, and appears therein as a movement of oscillation or angular displacement about the axial supporting-pin B', and this is true, and in large measure immaterial with reference to ultimate results, whether the line with reference to which the reflector turns pass through the reflector or be situated at a greater or less distance from it.

In the interior of the box A, but out of line with the reflector B, is placed a box or dark-lantern, D, adapted to contain a lamp, candle, electric lamp, or other suitable source of light. In the side of the lantern is an adjustable or telescopic tube, D', which directs the light upon the reflector B. I have a special object in using an adjustable or telescopic tube for this purpose, for the reason that it may be made to increase or diminish the area of the light-surface upon the reflector, and thus provide a means of adjusting the instrument, as will hereinafter more fully appear.

The light-rays reflected from the reflector B fall upon a concave reflector, E, placed at the opposite end of the box. The beam of light does not entirely cover this reflector, but leaves an annular space around the edge. By the reflector E the rays are concentrated and focused at a point near the front of the box, and in the focus is a strip of photo-sensitive paper, *d*. Any suitable provision is made for holding, moving, and receiving this strip. For example, I employ a spool, *d'*, upon which it is wound. It is then carried over a roll, *e*, and passed between the same and a roll, *e'*, provided with a crank. The rolls *e* and *e'* being close together, the strip is unwound by friction and delivered in a receptacle, *f*.

In order to produce a record, the light is adjusted as above described, the voice directed into the mouth-piece, and the handle *f'* turned. The vibration of the diaphragm imparts oscillations to the reflector B, and this produces corresponding vibrations or displacements of the beam of reflected light. These displacements are amplified by the reflector E, owing to its position and distance from the reflector B, and the focus of the reflected rays is shifted by each displacement of the light-surface on reflector E. If while the light-rays are being thus effected the sensitive strip is moved at an even rate, a photographic impression of the focus in all its positions will be taken, forming a wavy or undulating line. The paper is afterward developed and the impression fixed in the ordinary manner.

The construction or the arrangement of the reflector B and diaphragm may be somewhat varied. For example, in lieu of using a diaphragm connected with the reflector, the diaphragm may be dispensed with and the reflector made large enough to serve as a diaphragm itself. In this case it is advisable to pass a rubber cord, *b*, around the projection or ear, as indicated in Fig. 5, in order to hold the reflector better in its position. On the other hand, in lieu of using a strip of photo-

sensitive paper, I may use a cylinder upon a screw-shaft, F, such as is shown in Fig. 6, and cover the surface with a sheet of sensitive paper. The screw-shaft is caused to enter a threaded bearing, so that the cylinder when turned has an endwise movement, which takes the impression in a spiral line. When the cylinder *e'* is used merely to move a paper strip, its surface is covered with rubber to prevent slipping. It is then mounted with one end of the axle in a hole in a supporting-plate, F', which is secured in position by screws that pass through the slots *f''*. The end of the screw-threaded axle is provided with a suitable bearing, as *g*, which will turn freely in the plate F'.

Another way of taking an impression of the path of movement of the focus is to employ a sensitive glass plate. The light is focused upon the surface of this plate and a movement is imparted to the plate that carries it under the focus in a spiral path. An instrument for this purpose is shown in Figs. 12 to 14. G is the sensitive plate secured in a holder, *g'*, by clamps *g''*. The holder is mounted in a bearing that is adapted to slide to and fro in a supporting-guide, H. The back of the holder carries a raised spiral, H', that engages with a set of teeth, *h*, on the support. On turning the handle *h'* the plate is revolved, and at the same time moved horizontally by the spiral H' engaging successively with the teeth *h*.

Having obtained a photographic record of the sound waves or impulses in any of the ways above described, the next step is to engrave or photo-engrave the impression in metal or some other hard substance, to make a permanent record that can be used for reproducing the sounds. In some instances I use a strip of metal and cut it along one edge to correspond to the line traced by the focus. This irregular line, as above described, is obtained when the vibration of the beam of light shifts the position of the illuminated surface on the reflector E. For example, when the illuminated surface is less in area than the reflector and is vibrated from side to side, the focus will change. On the other hand, if the illuminated surface just equal in area that of the reflector, then by the vibration of the beam more or less light will pass beyond the reflector, and the luminosity of the focus will vary, making a line upon the sensitive paper of dark and light portions. In reproducing this line by photo-engraving a line of unequal depressions will be formed. There are other ways of effecting the same result, which will be well understood from the foregoing.

To reproduce sounds from the record made as described, I pass the record under a tracer or stylus attached to a diaphragm. The tracer is attached to the diaphragm in the same manner as the reflector, and I may use either with the same diaphragm by simply substituting one for the other. The tracer shown in Figs. 7 and 8 is a small piece of metal having a point, *k*, and a shoulder, *k'*, and forming part

of a bell-crank lever provided with a hole, *l*, for the spindle in Fig. 9, by which it is supported when a vertical movement is to be imparted to the tracer. At *l'* is another hole, through which the spindle *m* is passed when the tracer is to be used with a record that imparts to it an oscillating movement. In the first supposed case a needle, *m'*, is placed between the tracer and the diaphragm, and a rubber cord is passed through the hole *l'* and one or more holes in the diaphragm. In the second assumed case the cord is passed through the hole *l* and the center of the diaphragm, and the position of the needle may remain as before.

If a strip of metal be cut so that its edge conforms to the photographed line of undulations, it is used with the tracer by drawing it through a slot, *n*, in a guide, *n'*, with its cut edge in contact with the shoulder *k'*. The inequalities in the edge of the strip produce vertical vibrations of the tracer and reproduce the original sounds.

If the record be engraved or photo-engraved on a metal strip, the latter is drawn past the tracer in such manner that the point *k* enters the undulating track or groove. If the record be one produced by variations in the luminosity of the focus, as above described, the movement of the tracer will be vertical; but if the record is a wavy line the point will be oscillated from side to side and the vibrations produced in that way.

The record obtained on a plate may also be engraved or photo-engraved in a metal plate and reproduced by placing a diaphragm provided with a pointer in front of the plate, as in Figs. 17 and 18. The point *k* should extend into the engraved track, so that by turning the handle and revolving the plate it will follow the spiral course of the track. The mechanism in this case is the same, so far as the support for the plate is concerned, as that shown in Figs. 12, 13, and 14, and described above, and is therefore correspondingly lettered. The diaphragm and tracer are of the same construction as in the other devices.

This apparatus or means of recording and reproducing speech is capable of many and useful applications. It is more sensitive than any of which I am aware, and by it a photographed record of ordinary sounds may be obtained in which the length of the vibrations or undulations of light focus is several inches.

This makes it useful in connection with tele-

phones or microphones, for the purpose of recording the words or sounds transmitted by them, and such use would be facilitated by making the reflector B of iron and placing the receiving-magnet immediately behind it.

I have not described all the various ways in which this instrument may be constructed and used; but I do not limit myself to the precise forms shown.

I am aware that sound has been transmitted by means of a reflected beam of light, and I am also aware that a reflector has been used in conjunction with a diaphragm for producing changes in a reflected beam of light corresponding to the vibrations of the diaphragm, and these, therefore, are matters which I do not claim.

What I claim is—

1. In an apparatus for recording sound, the combination, with a source of light and a movable photo-sensitive surface, of a reflector for producing movements or vibrations of or in a beam of light, and mounted upon an axis or pivotal support, whereby the sound-waves produce therein an oscillating movement about said axis or support, as set forth.

2. In an apparatus for recording sound, the combination, with a source of light and a movable photo-sensitive surface, of a reflector for producing movements or vibrations of or in a beam of light, and mounted upon an axis or pivotal support, and a diaphragm connected with said reflector, whereby the vibrations in the diaphragm produce oscillations in the reflector about its axis or pivotal support, as set forth.

3. In a sound-recording apparatus, the combination, with a system of reflectors and a movable photo-sensitive surface, of an inclosed source of light and an adjustable or telescopic tube for directing a beam of light upon the vibrating reflector, as herein set forth.

4. In a sound-recording apparatus, the combination, with a source of light and a movable photo-sensitive surface, of a pivoted reflector, a diaphragm for imparting oscillations or vibrations thereto, a needle or rigid metal piece interposed between the diaphragm and reflector, and one or more elastic bands for holding the reflector in position with reference to the diaphragm.

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Witnesses:

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PARKER W. PAGE.