

(No Model.)

2 Sheets—Sheet 1.

A. M. EDWARDS.

SPHYGMOGRAPH.

No. 286,795.

Patented Oct. 16, 1883.

Fig. 1.

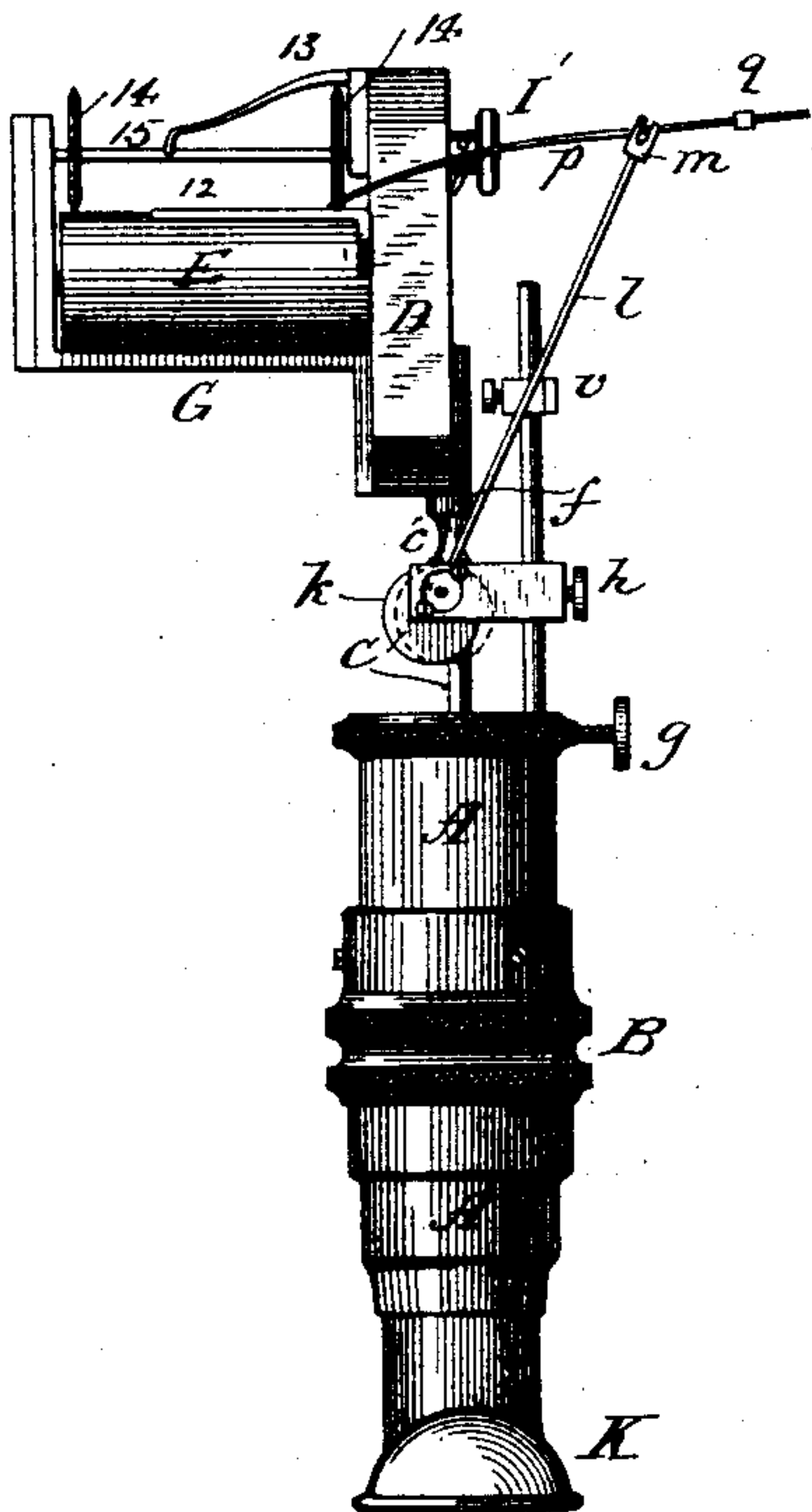


Fig. 2.

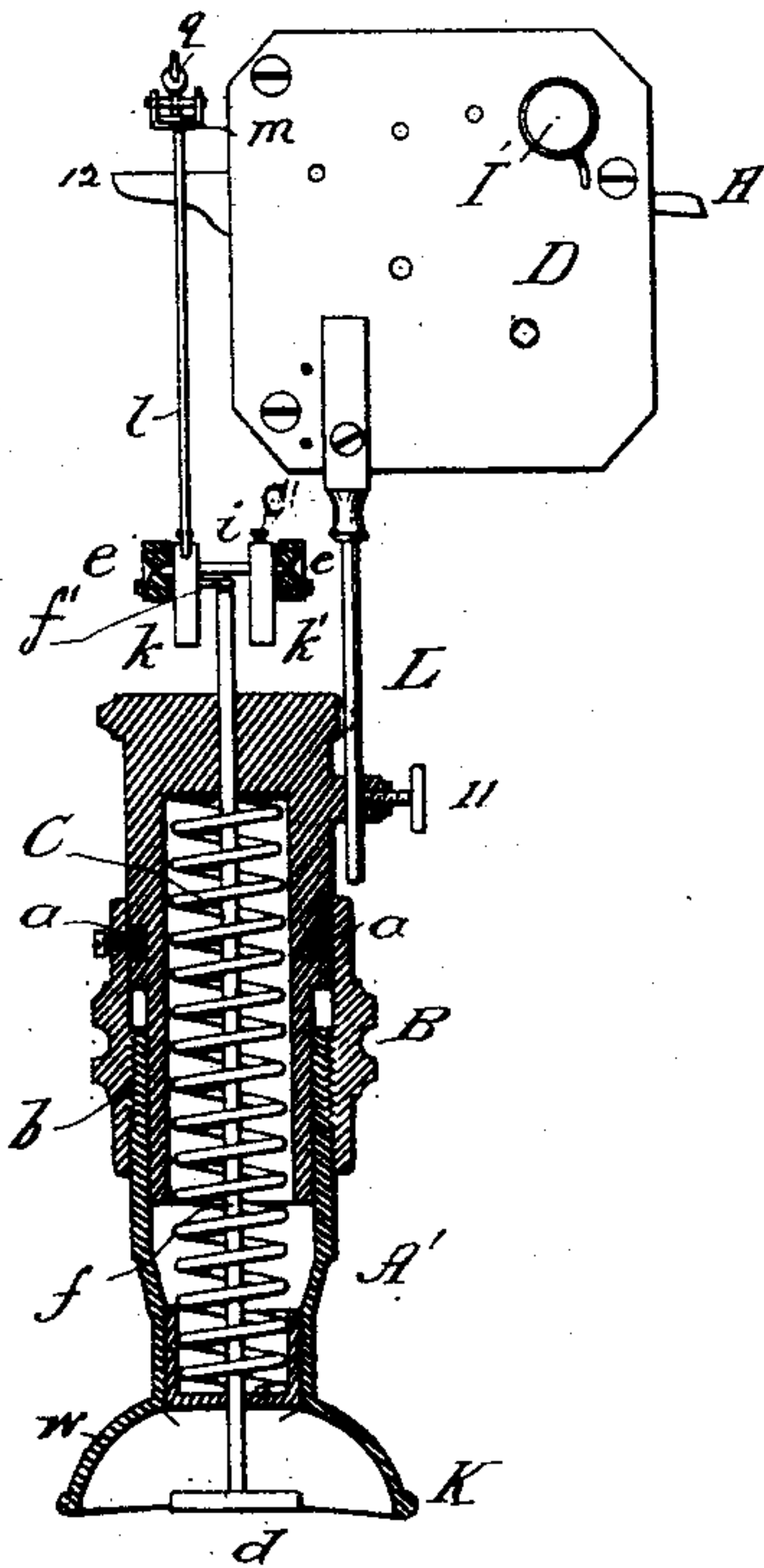
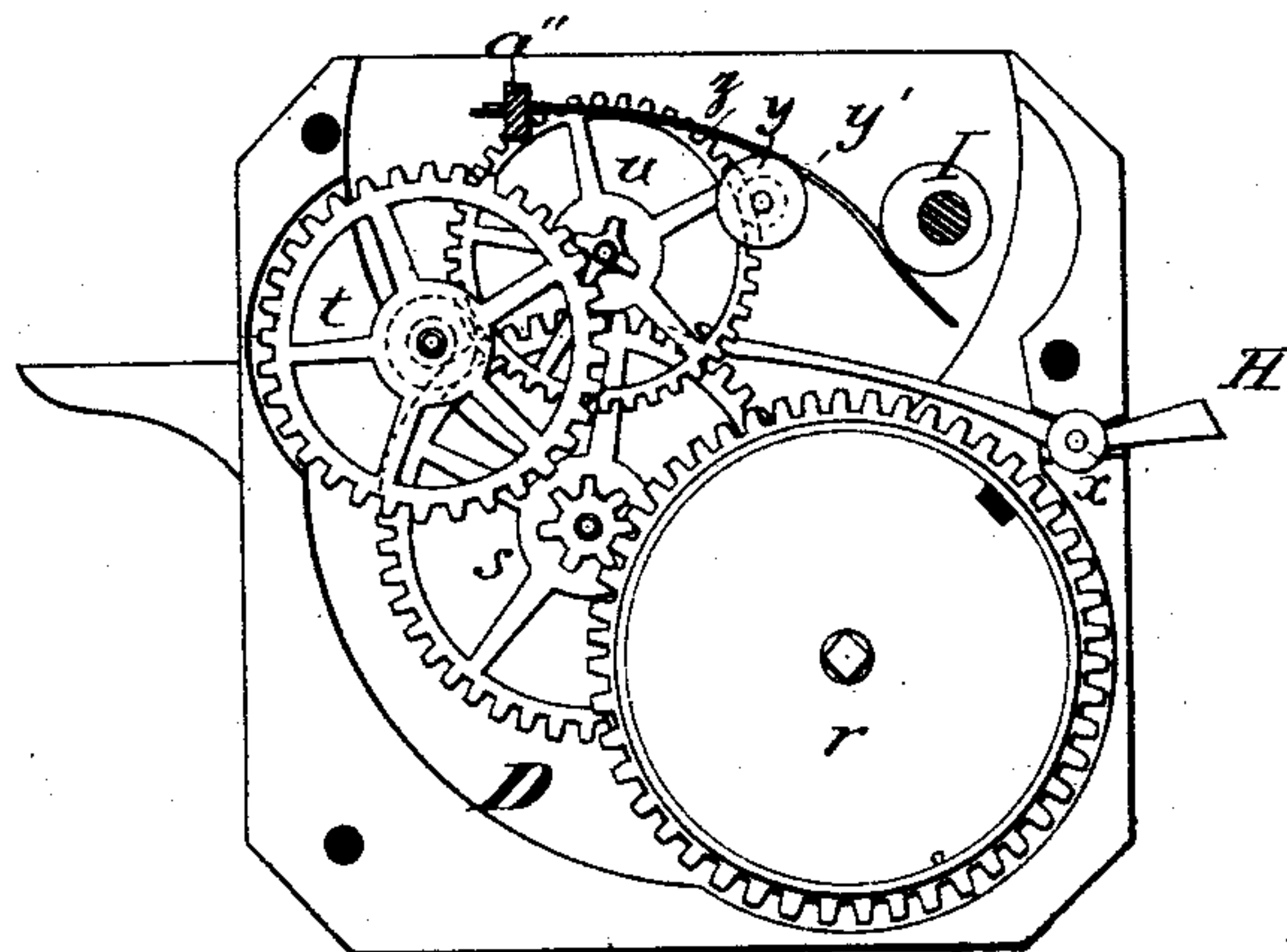


Fig. 3.



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Fig. 4.

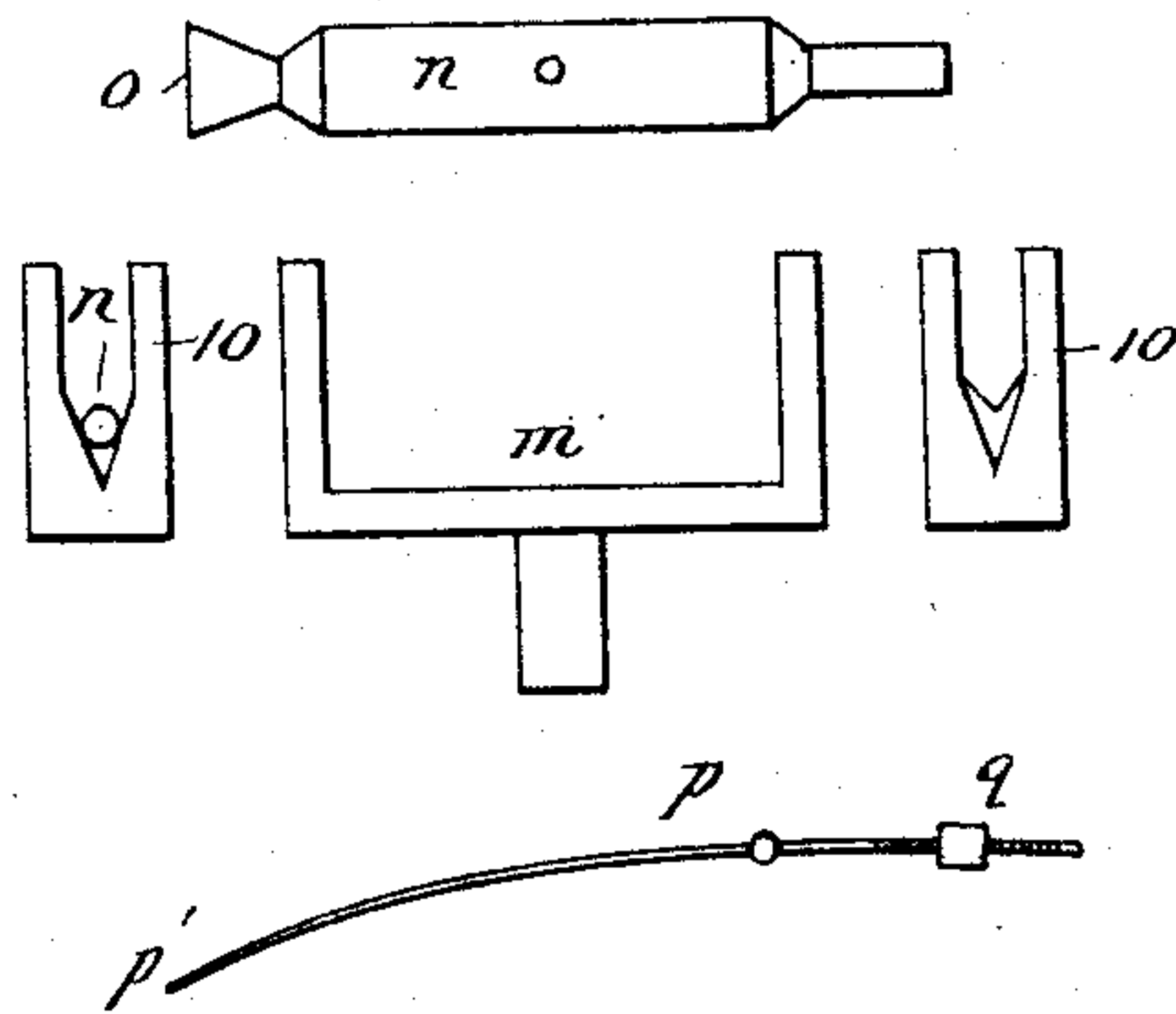


Fig. 5.

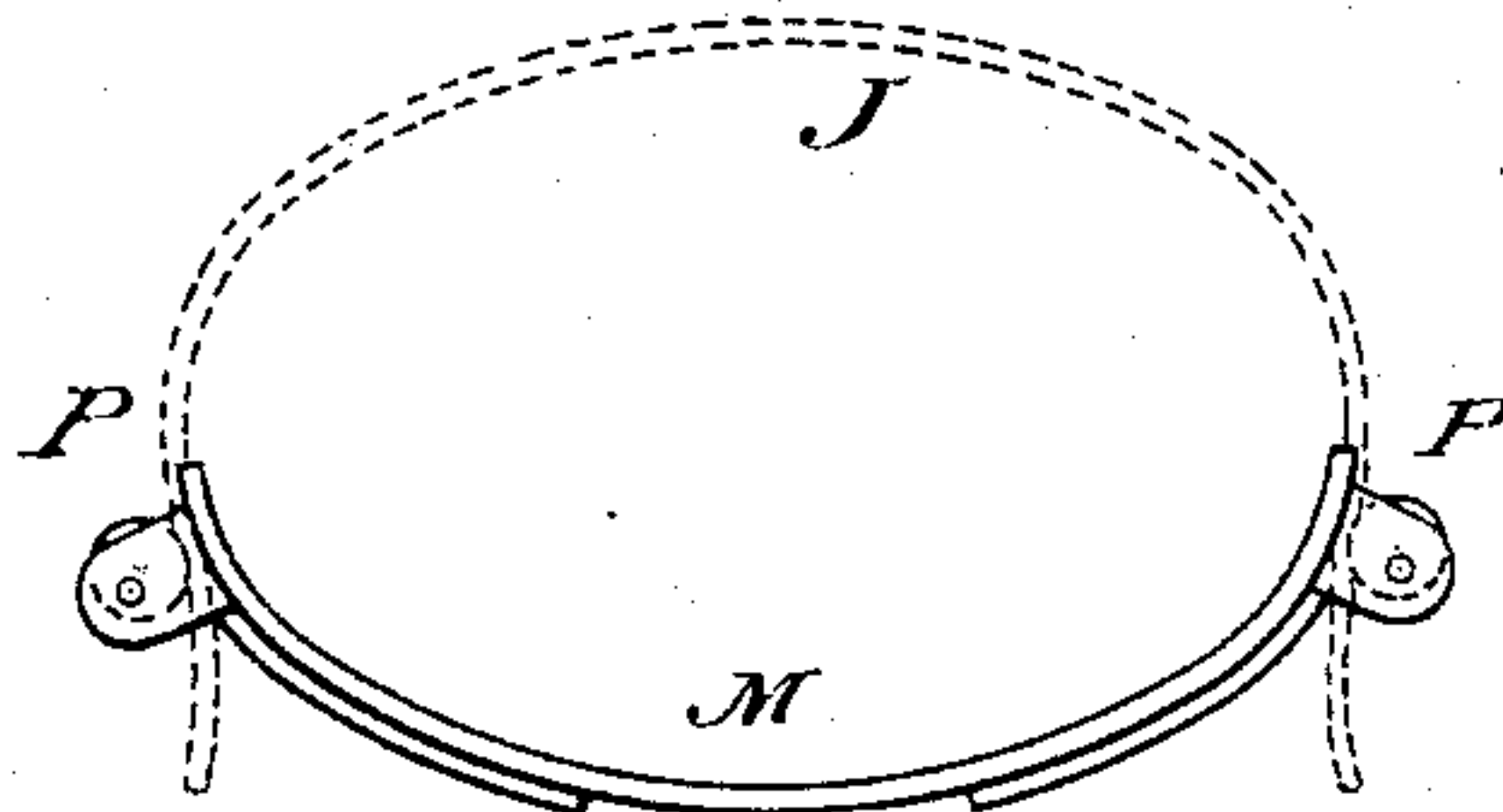
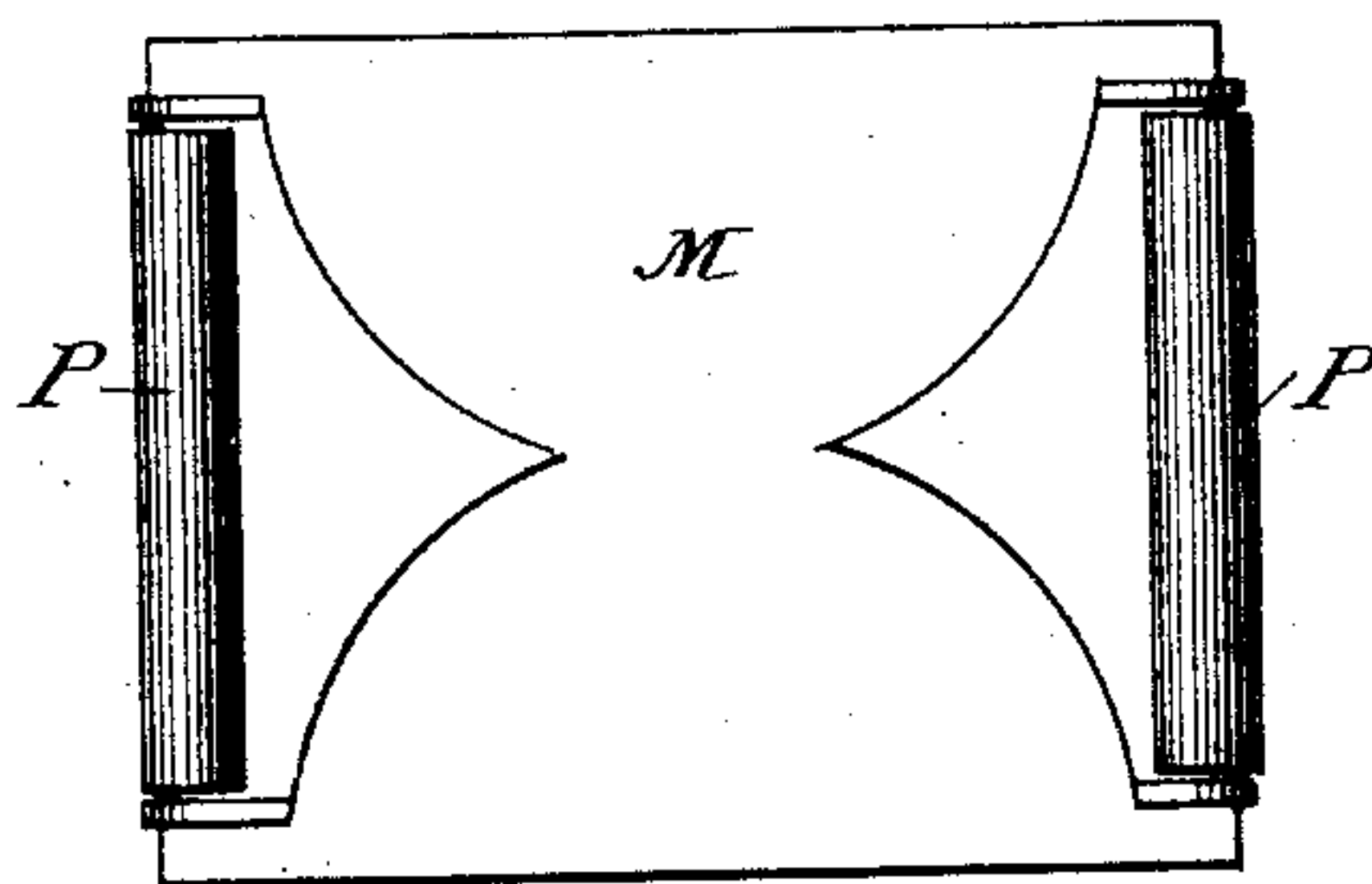


Fig. 6.



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UNITED STATES PATENT OFFICE.

AUSTEN M. EDWARDS, OF BUFFALO, NEW YORK.

SPHYGMOGRAPH.

SPECIFICATION forming part of Letters Patent No. 286,795, dated October 16, 1883.

Application filed April 5, 1881. (No model.)

To all whom it may concern:

Be it known that I, AUSTEN M. EDWARDS, of Buffalo, Erie county, State of New York, have invented certain new and useful Improvements in Sphygmographs; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the drawings hereunto attached.

My invention relates to sphygmographs of that class in which the motion of the pulse is recorded on a moving slip of paper.

The object of the invention is, first, to secure great lightness and delicacy of movement in the parts which are operated by the pulsations; and, second, to make provision, not inconsistent with lightness and delicacy of movement, against lost motion in the working parts, so that the feeblest pulsation and every part of any pulsation may be accurately recorded. A third object is to provide adjustability in the operating parts, whereby the throw of the recording pen or tracer may be varied, according to the strength or feebleness of the pulse which is to be recorded; and, fourth, in connection with the vibrating tracer, I have provided a variable feeding device for the paper strip upon which the record is to be made, whereby the feed of the paper may be regulated to correspond to the amount of vibration of the tracer, and a symmetrical and intelligible record be produced. Fifth, my invention is designed to increase the effect or action of feeble pulses by compression of the part to which this instrument is applied, and it includes an adjustable band adapted to encircle the wrist, and to act in connection with the said instrument.

I have described hereinafter the construction in which I have embodied my invention, and have particularly indicated the points which I deem to be new and claim as my invention, all of which are illustrated in the accompanying drawings, in which—

Figure 1 is an elevation of the apparatus, giving an end view of the paper-feed. Fig. 2 represents the same apparatus, one-quarter turn, with the cylinder, hereinafter fully described, in central longitudinal section. Fig. 3 is a detached view of the clock-work; and Figs. 4, 5, and 6 represent details and modifications, all as set forth hereinafter.

The apparatus shown is designed to be seated

upon the wrist or some part of the body of the person of whose pulse a record is to be made, and it is intended that the apparatus shall be held thereon in proper position by the hand of the operator while the record is made.

The base of the apparatus consists of a cylindrical standard, A A', which is formed with a flaring bottom, K, open and in the form shown in Figs. 1 and 2. The bottom and top of this cylinder are provided with holes, preferably central, in which a slender rod of polished steel (marked C) plays freely. Its lower end is provided with a disk, *d*, adapted to bear upon the wrist or other part of the body when ready to be acted upon by the pulse. Through this rod the pulsations are transmitted to the recording apparatus. The rod acts immediately upon balancing-disks *k k'*, which are hung eccentrically upon the shaft *i*, which has its bearings in a frame, *e e*, supported adjustably upon a standard or post, *f*, as shown in Figs. 1 and 2. In the disk *k* is set a slender steel arm, *l*, being fixed, as shown more clearly in Fig. 1, in the upper edge of said disk. The arm *l* carries the tracing-pen *p*, which is pivoted to said arm at the upper end thereof. The small shaft *i* is made to rock by means of the rod C striking against a pin, *f'*, located in the disk *k* a little to the right of the rock-shaft *i*, as shown in Fig. 1. It will be evident from an inspection of said figure that when the slender rod C rises it must strike against the pin *j* and rock the shaft *i*, to which the disk *k* is fixed, thereby throwing the upper end of the rod *l* to the left and causing the pen *p* to move in that direction. The rod *l* is so set in the disk *k* that the weight of the disks *k k'* will return it to the position shown whenever the rod C drops, so that repeated upward movement of the rod C will cause repeated oscillations of the arm and the pen. It is convenient to fix the arm *l* rigidly in the disk *k*, and the backward throw of the arm, by means of the weight of the disks, may be adjusted by the disk *k'*, which is held upon the shaft *i* by means of a set-screw, *c'*, so that the disk *k'* may be thrown farther to the right, as shown in dotted lines in Fig. 1. The backward movement of the arm *l* is limited by the stop *v*, which is set at a proper position by means of a set-screw on the upper end of the post *f*. This post may be conveniently held

in the cylindrical standard A by means of a set-screw, *g*.

It is clear from an inspection of Fig. 1 that the amount of throw imparted to the pen *p* will depend upon the vertical movement of the slender rod C, and that the movement will not begin until the said rod strikes the pin *j*. The amount of throw, therefore, whatever the scope of the pulsation, will depend partly upon the normal position of the upper end of the rod C with respect to the pin *j*. If this said upper end is at the beginning of the stroke in contact with the pin *j*, then the pen will receive the greatest amount of throw possible from any given pulsation; but the distance between said pen and the upper end of rod C will be the measure of lost motion of the pulsation. For feeble pulses, therefore, it is desirable that the position of these two parts should be adjustable. This adjustability is accomplished by the special construction of the cylindrical standards A A'. This cylinder is made in two parts, of which the upper, A, is connected to a sleeve, B, by means of a ring, *a*, which is capable only of rotary motion upon the cylinder A. The sleeve B is attached to it, and is provided at its lower end with an internal thread, which fits accurately an external thread on the upper end of the cylinder A'. The sleeve is provided with milled ridges, as shown in Figs. 1 and 2, by means of which it may be conveniently turned, thus extending or shortening the length of the cylinder. Contraction of the cylinder, the upper end of which carries the frame and balancing-disks, will of course bring the pin *j* nearer to the upper end of the rod C. In order to keep the cylindrical standard extended and prevent any inequality of motion resulting from a looseness of the joints, I place within it a coil-spring, *w*, which is constantly under tension. The disk *d* may bear directly upon the person, in which case there should be put upon it, preferably above the lower end, but in any convenient place, a stop to prevent it from dropping out. Instead of this, a delicate rubber diaphragm may be stretched across the mouth of the base K, and the disk *d* may rest upon that.

In order to give steadiness to the parts, the reduced end of the upper cylinder, A, is made to telescope within the lower cylinder, A'.

A very important feature of the invention, and indispensable for the perfect operation of the apparatus, is the device for preventing any lost motion between the rod, which rests directly upon the person, and the point of the pen which effects the record on the paper. This paper slip, it will be understood, travels upon the table Y, moving longitudinally thereon, while the needle moves transversely over the same table. Since it is necessary to have the lightest and freest possible movement with the least amount of friction of the pen upon the paper, it is necessary that the pen should be balanced and hinged upon the upper end of the slender arm *l*. In order to prevent any

looseness and consequent loss of motion in this joint, I have devised a peculiar construction of bearing. (Shown at 10 10, Fig. 4.) These bearings are made in V shape, the left-hand bearing showing the journal of the shaft in position. As the balanced pen is exceedingly light, as well as the shaft *n*, in which it is fixed, the friction of its journals in the wedge-shape bearings is inappreciable, and is not felt in the long leverage of the arm; but these bearings effect a very important result, since they keep the journal always in contact, so that there can be no looseness or loss of motion by reason of such looseness, and the amount of movement imparted to the point of the pen corresponds exactly and in every respect to the amount of movement imparted to the upper end of the arm *l*, to which it is jointed.

It will also be observed that the left-hand end *o* of the small shaft *n*, as shown in Fig. 4, is turned down into the shape of a double reversed cone. This is lodged in the V-shaped bearing adapted to receive it, and serves to prevent endwise movement of the said shaft. This is not of so much importance as the V-shaped bearings before described, but is useful and convenient to secure perfect closeness of fit and accuracy of working.

It will be observed that the upper end of the arm *l* is very nearly upon a level with the surface of the platform over which the paper is fed, and that the recording end of the pen is bent downward slightly, (at about an angle of forty-five degrees,) so as to bear upon the paper. The amount of its pressure upon the paper is regulated by a counterpoise, *q*, which may be adjusted according to the requirements of the case. This arrangement of the parts gives the easiest movement of the point of the pen over the paper, the pen itself moving in nearly horizontal plane. Small pins may be set above the V-shaped bearings to hold the journals of the shaft in place and prevent them from being thrown out in movement of the apparatus.

It will be readily understood that pulsations differing in frequency and force transmitted to the plunger-rod C, and thence through the intermediate mechanism to the tracing-pen, will require a different amount of feed for the paper strip on which the record is made. Unless the paper move faster when the pen is making a series of rapid strokes, (from one hundred and twenty to one hundred and sixty per minute,) the lines will be made so close to each other as to be indistinct, and, on the other hand, the same speed in the paper strip adapted to a rapid stroke of the tracing-pen will, when the pen has only an unfrequent stroke, (from sixty to eighty per minute,) protract the record. In order to give just proportions to the two movements, and to produce a symmetrical and intelligible record, I have made the feed variable at the will of the operator. This is accomplished by means of clock-work. (Shown more clearly in detail in Fig. 3.) It is inclosed in a case, D, which is mounted on

a standard, L. The standard L is adjustable vertically on the cylindrical standard A by means of a set-screw. (Shown at 11 in Fig. 2.) Within this case is a barrel containing a spring, as shown at *r*, connected by an ordinary train of gearing to a wheel, *y*, on the same shaft with the last pinion *y'*. This shaft projects through the case, and outside of the case bears a drum, E, located within the two-part table 12 12, as shown more clearly in Fig. 1. Two light wheels, 14 14, on a shaft, 15, bear upon the upper surface of the drum E and hold the paper strip thereto. They are pressed down slightly by a spring, 13, bearing upon the shaft. A spring, *z*, attached within the case, is prolonged over the periphery of the pulley *y*, and is pressed at its free end by an eccentric, I, which may be turned by a thumb-piece, I'. Amount of pressure can be applied at will, and regulates the speed of the pulley *y*, and consequently the drum E, over which the paper is fed, it being understood that the paper passes over the table 12 12 between and over the feed-roll E. The operator can determine the amount of pressure to be applied for any desired rate of speed, or some mark may be used to indicate the point to which the thumb-piece thereon should be turned for any given rate of speed required. A stop-pawl, H, Fig. 3, bears against the last pinion *y'*, and stops the clock-work whenever it is desired so to do.

In Figs. 5 and 6 is shown a device for increasing the effect of a feeble pulse upon the instrument. I have discovered that by tightly compressing the wrist by means of a suitable band placed over the pulsating part nearly double the usual motion may be imparted to the working parts of the instrument when properly set thereon. The device consists of a thin plate, M, of sheet metal, hard rubber, or any suitable material capable of approximately encircling half the wrist, and provided at each end with clamping-rolls P, eccentrically hung in ears. A rubber band, J, is held to the plate *m* by means of the clamping-rolls, and the band may be stretched tightly around the wrist and held securely in place. When thus stretched over the proper part, the rubber diaphragm is taken off from the foot of the instrument, which is then set on the said band, the disk on the lower end of the plunger-rod resting directly on the band. The band may be composed wholly of rubber, if preferred, with any suitable fastening devices.

Having thus described my invention, what I claim is—

1. In a sphygmograph, the combination of a standard adapted to be placed upon the pulsating surface, a reciprocating plunger-rod, also adapted to bear on such surface, a horizontally-balanced tracer or pen adapted to bear upon moving paper, and intermediate mechanism, whereby motion of the plunger imparts horizontal motion to said pen or tracer, substantially as described.

2. The combination of the standard and its plunger-rod, adapted to bear upon the pulsating surface, the arm *l*, and devices, substantially as described, whereby the arm *l* is caused to oscillate by the direct reciprocation of the plunger-rod, and a balanced pen or tracer pivoted to the upper end of the oscillating rod or arm *l*, substantially as described.

3. The combination, with the standard and plunger-rod, of the oscillating shaft *i*, carrying counterpoise-pin *j*, and the arm *l*, with the balanced pen, as set forth.

4. The combination, in a sphygmograph, of the standard, the adjustable frame *e*, the post *f*, the shaft *i*, the counterpoises, and arm *l*, the whole being adapted to operate as and for the purposes set forth.

5. The combination, in a sphygmograph, of the sections A A', sleeve B, and inclosed spring, substantially as described.

6. The combination, in a sphygmograph, of the standard provided with a reciprocating plunger-rod, both adapted to bear upon the pulsating surface, the plunger-rod receiving movement therefrom, intermediate mechanism, substantially as described, for communicating the motion of the rod to the pen or tracer, and means, substantially as described, for adjusting the length of the standard, whereby the greater or less movement is imparted to the pen or tracer, as set forth.

7. The combination, in a sphygmograph, of the reciprocating pen or tracer adapted to move over the surface of the strip of paper, and a variable feed mechanism for said paper, whereby different rates of speed may be given to the said strip at the will of the operator, as set forth.

8. The combination of the oscillating arm *l*, the V-shaped bearings carried at its upper end, and the shaft *n*, resting thereon and carrying the pen or tracer, substantially as described.

9. The combination, with the oscillating arm *l*, of a balanced pen or tracer adapted to move in an approximately-horizontal plane, and having its tracing end bent downward to bear upon the paper, as set forth.

10. The combination of the instrument and a band adapted to encircle the wrist and to transmit pulsations to the plunger-rod, substantially as described.

11. The described method of indicating movements of the pulse, consisting in first tightly stretching an elastic band upon the pulsating part and then placing the instrument upon said band, whereby increased motion is obtained, as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

A. M. EDWARDS.

Witnesses:

J. R. DRAKE,

H. R. HOPKINS.