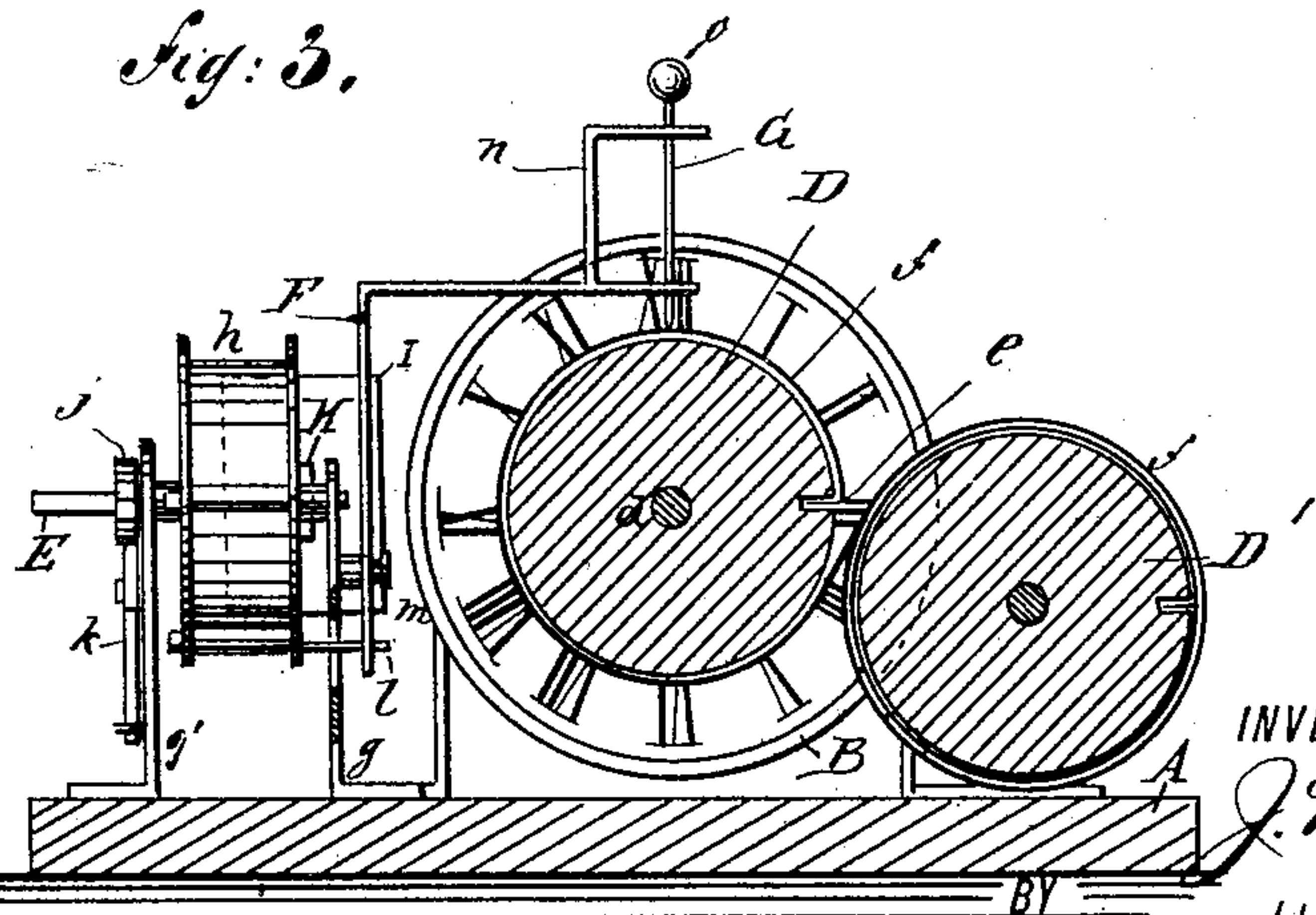
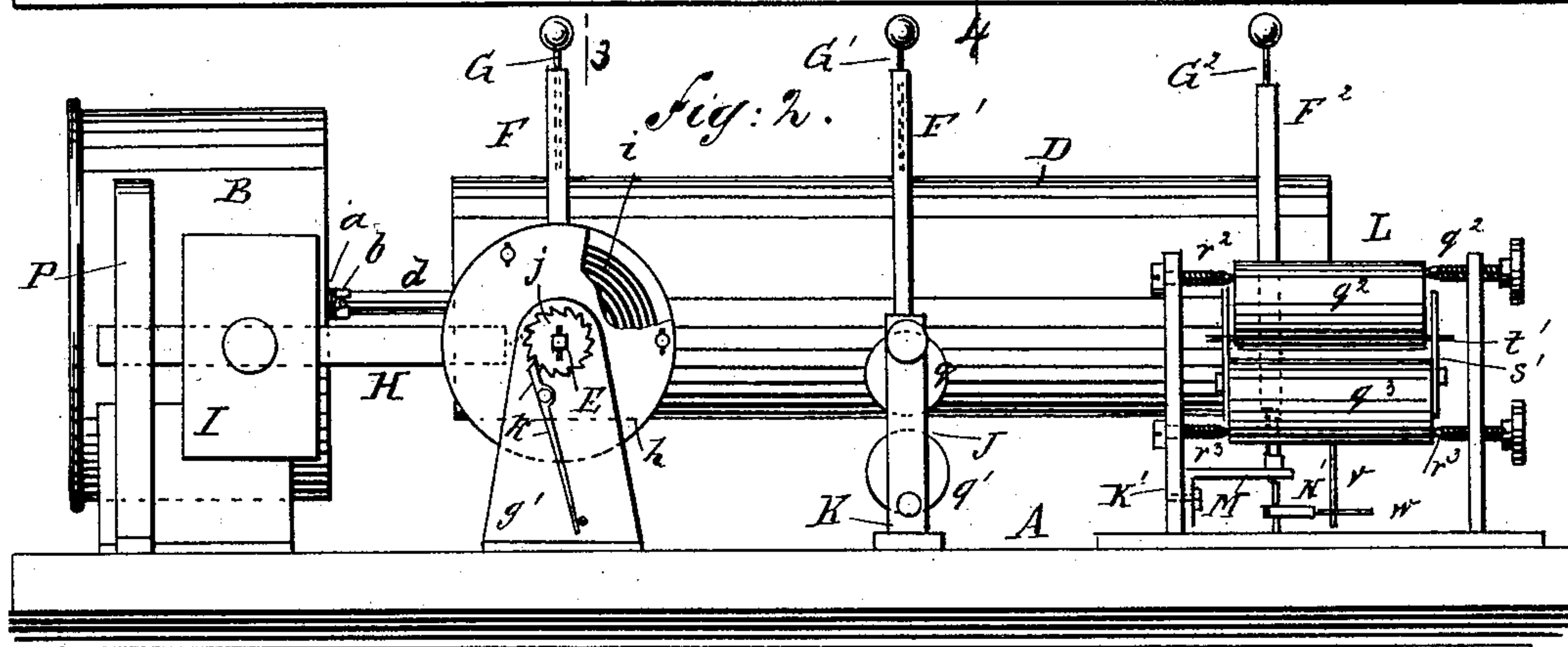
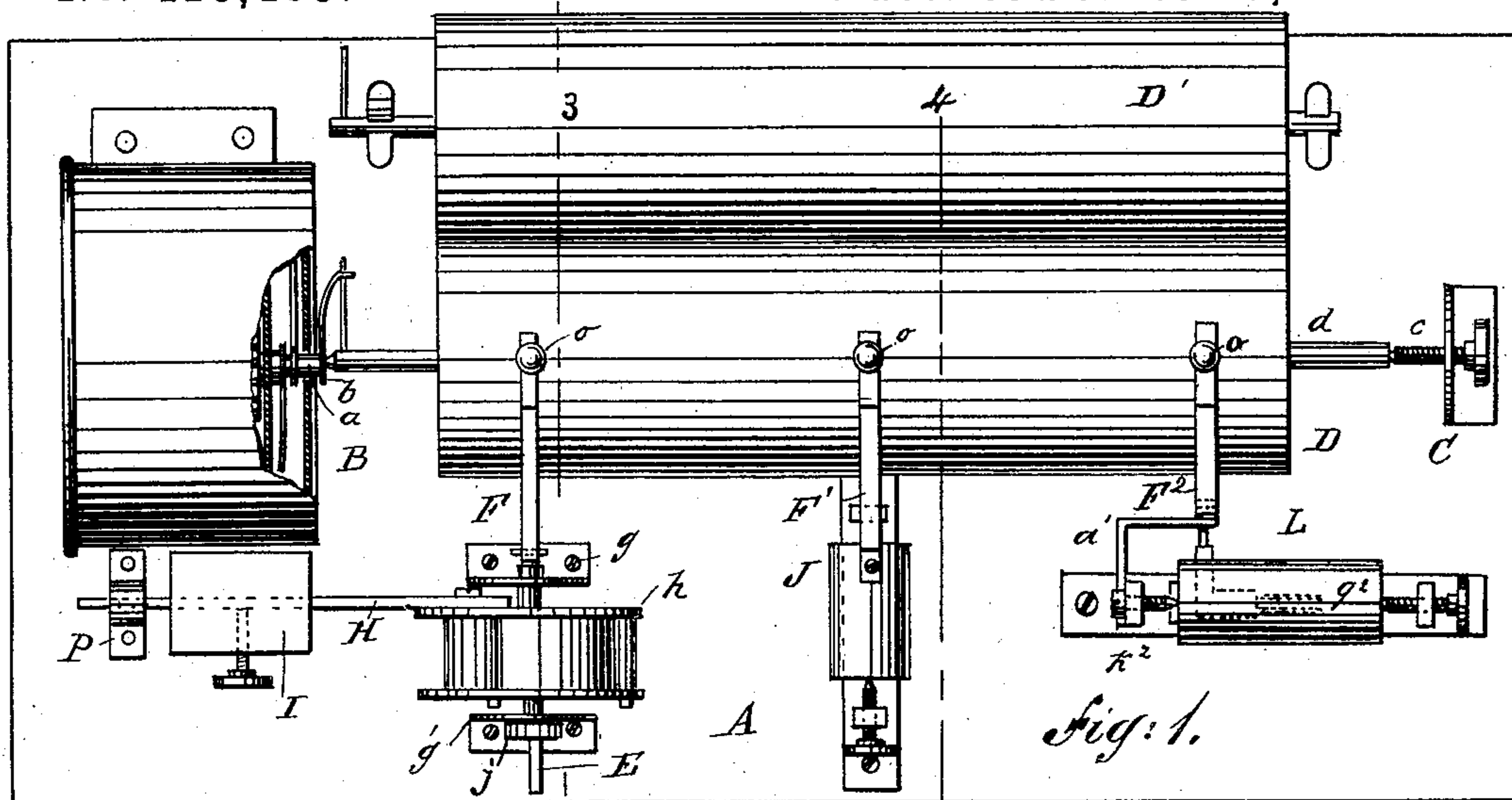


2 Sheets—Sheet 1.

No. 415,465.

Patented Nov. 19, 1889.



WITNESSES:

Chas. Vida
C. Sedgwick

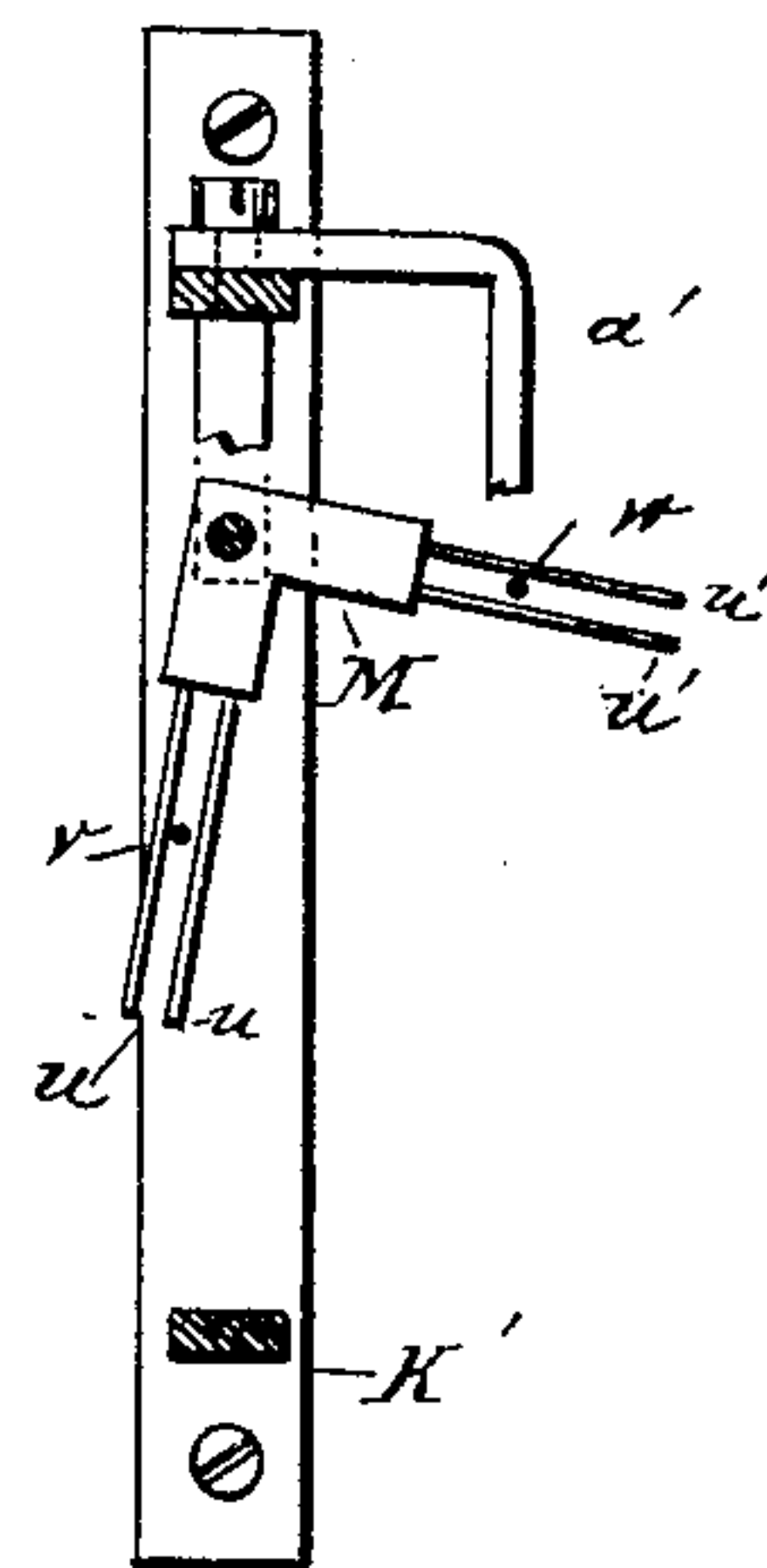
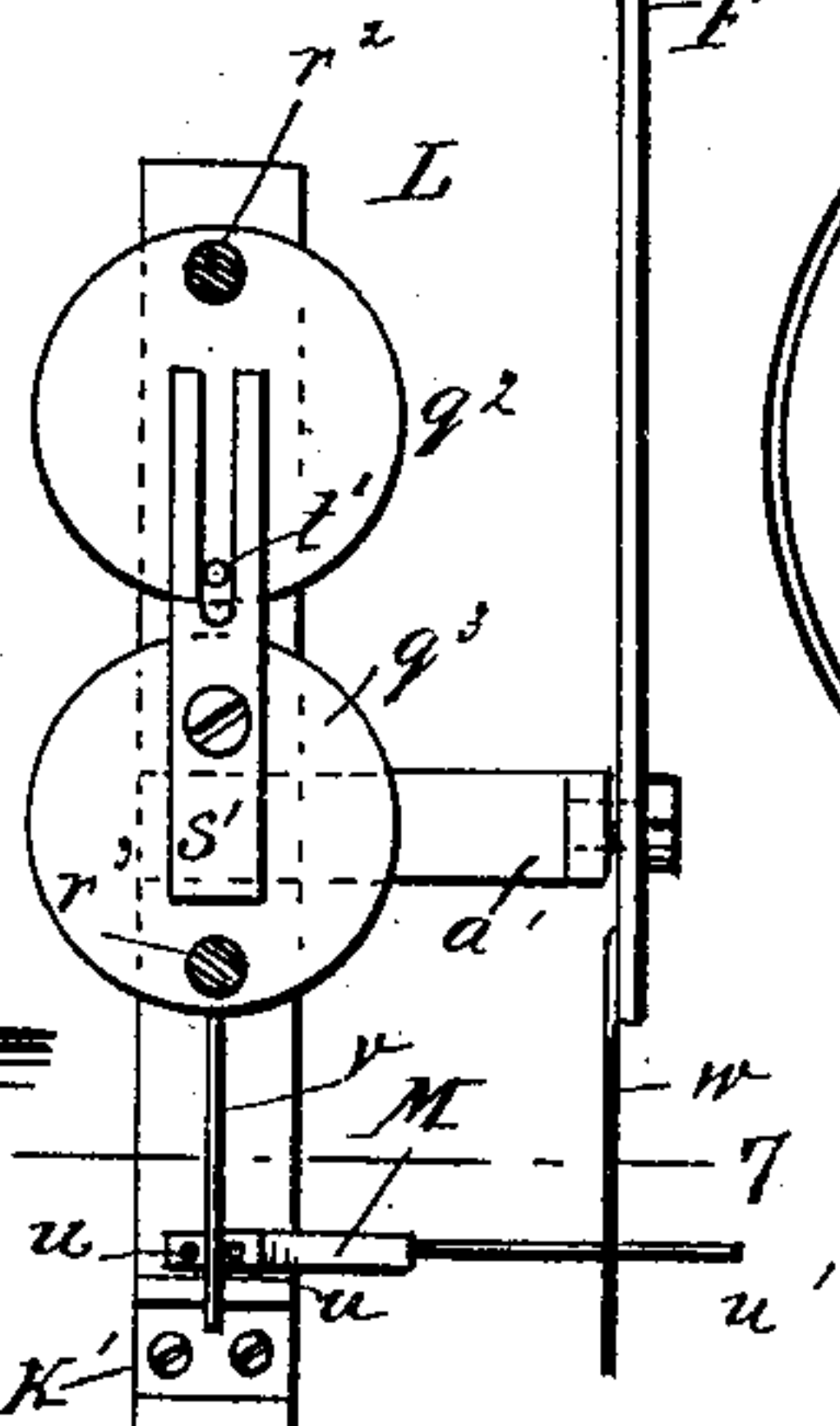
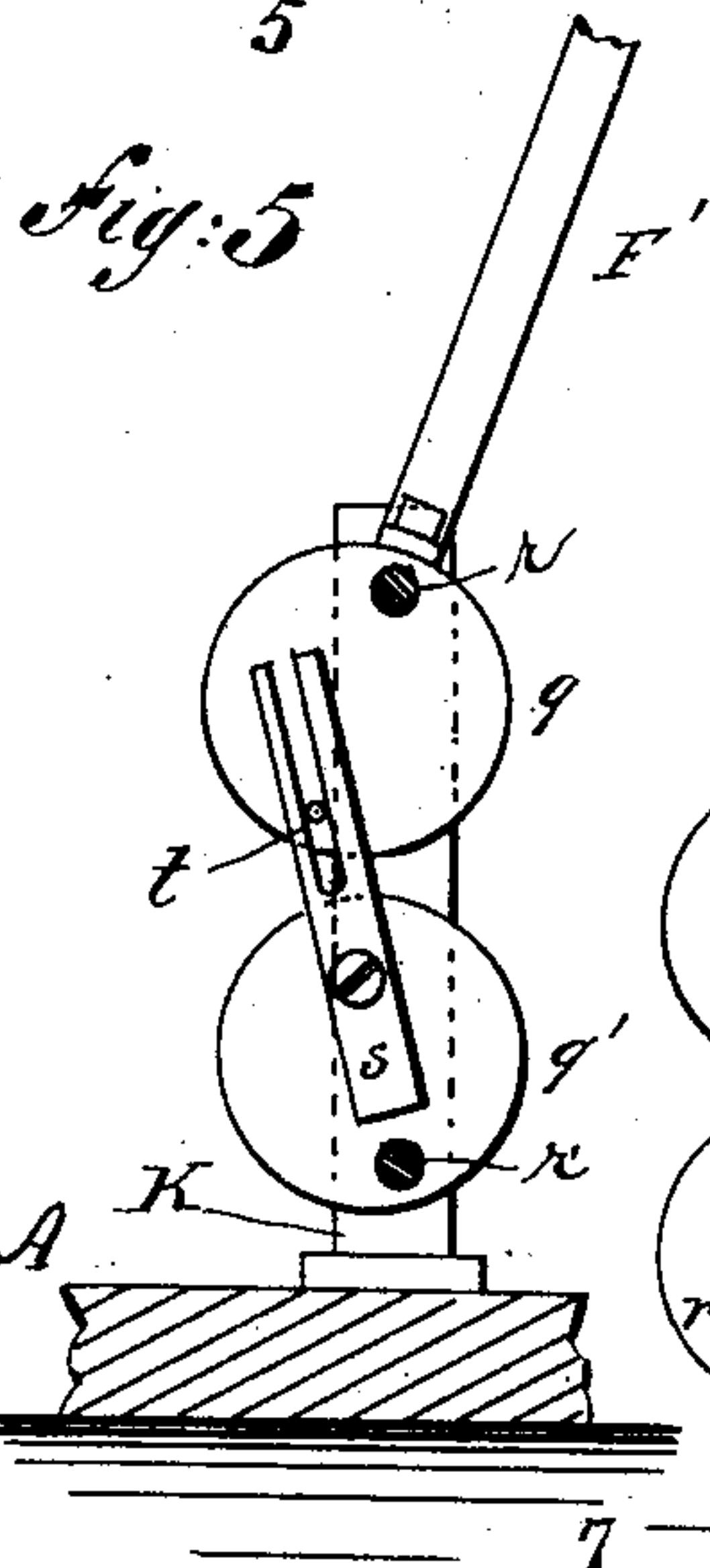
INVENTOR:

J. Milne
Munn & Co.
ATTORNEYS.

2 Sheets—Sheet 2.

No. 415,465.

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WITNESSES:

Chas. Nida
C. Sedgwick

INVENTOR:

J. Milne
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ATTORNEYS.

UNITED STATES PATENT OFFICE.

JOHN MILNE, OF CROYDON, ENGLAND.

VIBRATION-RECORDER.

SPECIFICATION forming part of Letters Patent No. 415,465, dated November 19, 1889.

Application filed May 28, 1889. Serial No. 312,387. (No model.)

To all whom it may concern:

Be it known that I, JOHN MILNE, of Croydon, England, have invented a new and Improved Vibration-Recorder, of which the following is a specification, reference being had to the annexed drawings, forming a part thereof, in which—

Figure 1 is a plan view, partly in section, of my improved vibration-recorder. Fig. 2 is a front elevation, partly in section, of the same. Fig. 3 is a transverse section taken on line 3 3 in Fig. 1. Fig. 4 is a transverse section taken on line 4 4 in Fig. 1. Fig. 5 is a transverse section taken on line 5 5 in Fig. 4. Fig. 6 is an end elevation, and Fig. 7 is a horizontal section taken on line 7 7 in Fig. 6.

Similar letters of reference indicate corresponding parts in all the views.

The object of my invention is to construct an instrument by which vibrations in two directions at right angles to each other in a horizontal plane may be detected and recorded, and by which vibrations in a vertical plane may also be detected and recorded, the instrument to be applicable for engineering-work, for the investigation of the vibration of bridges and other structures, for the examination of the actions of locomotives and cars, and through such actions for the detection of imperfections in the railroad-track, and for the examination of the vibrations of buildings or vessels and vibrating bodies.

My invention consists in a series of pendulums, the first arranged to be operated by vertical vibrations, the second by vibrations in a horizontal plane, and the third by vibrations in a horizontal plane at right angles to those which actuate the second pendulum; also, in the combination, with the series of pendulums, of a record-cylinder carried by a clock-movement and adapted to carry a record-sheet to be marked upon by tracing-points connected with the several pendulums, all as will be hereinafter described.

To the base A, near one end, is attached the clock-movement B, of ordinary construction, having upon an extension of its hour-hand sleeve *a* a forked arm *b*. To the opposite end of the base A is secured a standard C, provided with a pivotal screw *c*, axially in line with the hour-hand sleeve *a*.

The record-cylinder D is provided with a shaft *d*, which is pointed at one end to enter a conical recess in the closed end of the hour-hand sleeve *a*, and is recessed at the opposite end to receive the pivotal screw *c*. The record-cylinder D is provided with a longitudinal slot *e*, for receiving the edges of the record-sheet *f*, which is wrapped around said cylinder.

Upon a shaft E, journaled in standards *g g'*, is loosely mounted a drum *h*, which contains a volute spring *i*, the inner end of which is attached to the shaft E, the outer end being connected with the drum. The outer end of the shaft E is squared to receive a key for giving the spring *i* the proper tension, and provided with a ratchet-wheel *j*, which is engaged by a spring-pawl *k*, pivoted to the standard *g'*. In the side of the drum *h* facing the record-cylinder D is inserted a pin *l*, which extends through a slot in the standard *g*, and engages the shorter arm of the angled lever F, which is pivoted on a stud *m*, projecting from the standard *g*, the said shorter arm of the lever F being slotted to receive the pin *l*. The upper and longer arm of the angled lever F extends over the top of the record-cylinder D, and is perforated to receive the tracing-point G. The said tracing-point G is guided by a perforated angled arm *n*, secured to the lever F, and extending over the said lever parallel with it. The tracing-point G is provided at its upper extremity with a weight *o*, which causes it to press upon the record-sheet *f* with sufficient force to produce a mark. To the drum *h* is attached an arm H, which extends horizontally and supports a weight I. The end of the arm H projects through a guide P, secured to the base A. The weight I and the spring *i* are proportioned relatively, so as to counterbalance each other. Arranged in this manner, when the base A is moved in a vertical direction, the inertia of the weight I causes it to resist such a movement, and in consequence some point in the weight I will be stationary, while the drum *h* moves up or down with the base. By this construction the said drum is made to turn through a small arc and imparts motion to the lever F, which, by moving the tracing-point G over the face of the record-sheet *f*,

causes a mark to be made upon the record-sheet representing the vertical movement of the apparatus.

The vibrations in a horizontal plane are recorded by the second pendulum J, which is constructed as follows: In a frame K, secured to the base A in front of the record-cylinder D, are pivoted two cylindrical weights q q' , the upper weight q being suspended from pivotal screws r , inserted in the frame, the axis of motion of the said weight q being eccentric to the axis of the weight. The lower cylindrical weight q' is pivoted eccentrically upon the screws r' , and to the ends of the said cylindrical weight q' are attached slotted bars s , which extend upward and engage pins t , projecting from the ends of the weight q . Arranged in this way the weight q is suspended in stable equilibrium and the weight q' is in unstable equilibrium. The effect of this construction is to produce a practically "dead-beat" action of the pendulum. To the pendulum J is attached an angled lever F' , which is arranged in all respects like the angled lever F , and carries a tracing-point G' , which is adapted to trace upon the sheet f , carried by the record-cylinder D. The pendulum J thus arranged is adapted to record vibrations made in a horizontal plane in the direction of the length of the record-cylinder D.

The record of vibrations in a horizontal plane proceeding in a direction at right angles to the record-cylinder D are recorded by the third pendulum L, the construction of which is similar to that of the pendulum J—that is to say, in a frame K' , arranged parallel with the record-cylinder D, are eccentrically supported the weights q^2 q^3 upon pivotal screws r^2 r^3 , as in the other case, and to the weight q^3 are secured slotted bars s' , which engage pins t' , projecting from the ends of the weight q^2 . In the lower part of the frame K' is pivoted a right-angled lever M, having two forked arms u u' , the forked arm u being engaged by a rod v , projecting downward from the weight q^3 , while the forked arm u' engages a rod w , projecting downward from the shorter arm of the angled lever F^2 , the said lever being pivoted to a bracket a' , attached to one of the standards of the frame K' . The upper end of the angled lever F^2 is formed like the corresponding part of the levers F F' , and is arranged to carry a tracing-point G^2 , in position to trace upon the record-sheet f , carried by the record-cylinder D, as in the other cases. The pendulum thus constructed is oscillated by the movement of the apparatus in a horizontal plane in a direction at right angles to the record-cylinder D, the motion of the tracing-point G^2 being produced through the medium of the right-angled lever M, so that the tracing will be in the direction of the length of the tracing-cylinder, as in the case of the other pendu-

lums. It will thus be seen that as the record-cylinder D is rotated by the clock-movement, any vibrations in a horizontal or a vertical plane will be recorded upon the cylinder, and the time of such record will be known by the position of the marks relative to the starting-point. The amplitude of the vibrations will be indicated by the lengths of the tracing upon the sheet.

It is obvious that I may arrange a cylinder to rotate once during twenty-four hours, thereby forming a complete record for one day upon a sheet carried by the cylinder; or I may arrange behind the record-cylinder D another cylinder D' , parallel with the said cylinder D, and wind thereon a record-sheet which will be drawn off and wound upon the record-cylinder D, as indicated in Figs. 1 and 3, thereby permitting the making of a longer record.

In addition to the advantages already mentioned, my improvement gives an automatic record of the run of a train, indicating the number and duration of stoppages and variations in speed. It gives information respecting the nature of the track over which the train runs—for example, pointing out where there are faults in construction. It gives information respecting the balancing and nature of the locomotive on which it may be placed.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In a vibration-recorder, the combination of a weighted lever, an adjustable opposing spring, a recording-arm connected with the lever, recording-points carried by the arm, and a surface for receiving the record, the weighted lever and the spring being adjusted relative to each other so that some point in the weight will be made to remain stationary while the pivoted end of the weighted lever is oscillated in a vertical plane, substantially as specified.

2. The combination, with the recording-cylinder, of two vertically-extending pivoted parallel recording-arms having recording-points at their upper ends extending toward the cylinder, and vertically-vibrating pendulums to one side of the cylinder at right angles to each other and connected with said recording-arms, substantially as set forth.

3. In a vibration-recorder, the combination of the weighted lever H, an opposing spring i , the recording-arm F, the two pendulums J L, arranged to vibrate in two planes at right angles to each other and provided with recording-arms F' F^2 , the recording-cylinder D, and mechanism for rotating the same, substantially as specified.

JOHN MILNE.

Witnesses:

GEO. M. HOPKINS,
C. SEDGWICK.