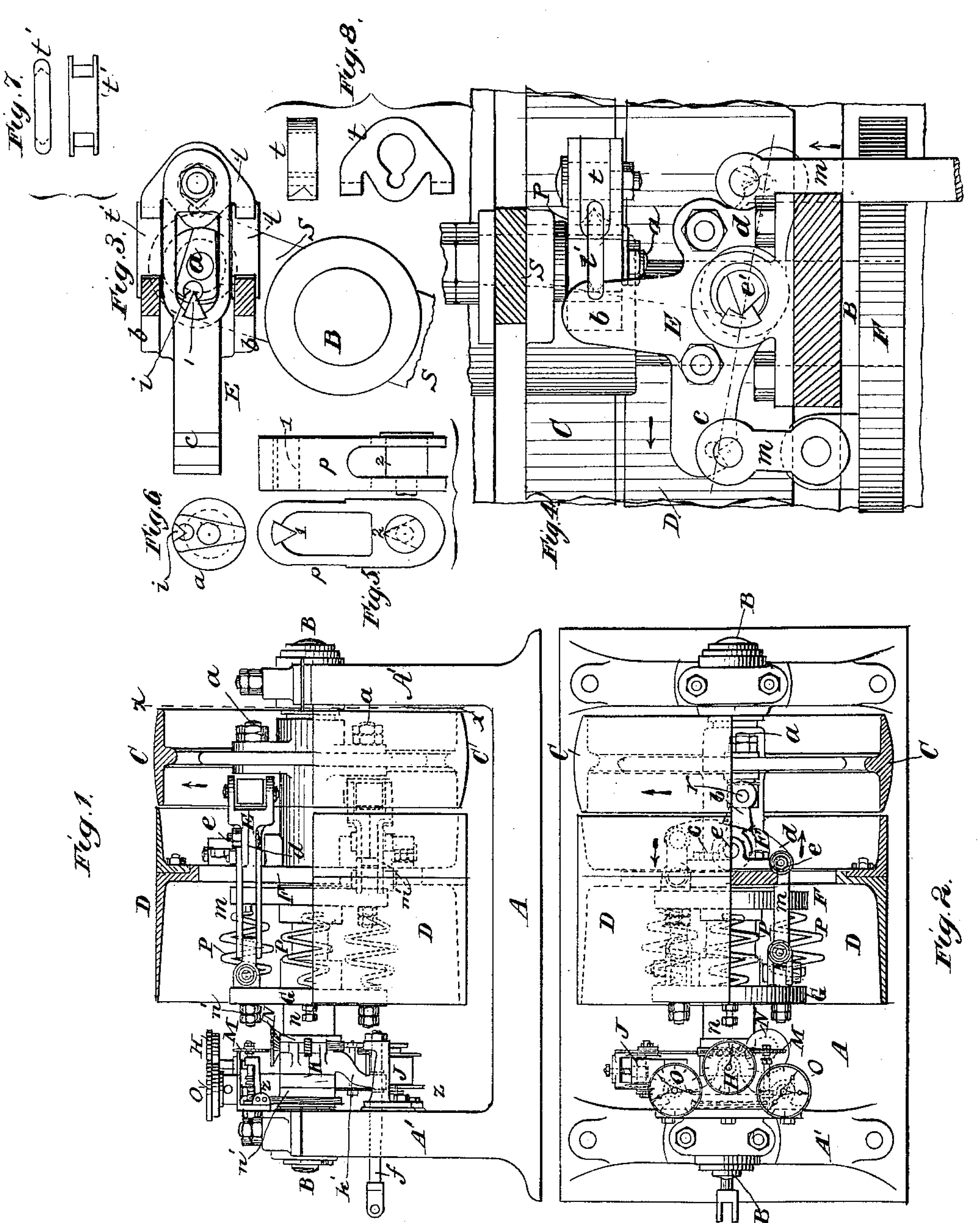
(No Model.) 3 Sheets—Sheet 1.

E. A. BOURRY.

DYNAMOMETER OR MOTIVE POWER BALANCE.

No. 332,697. Patented Dec. 22, 1885.



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(No Model.) 3 Sheets—Sheet 2.

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Fig. 9.

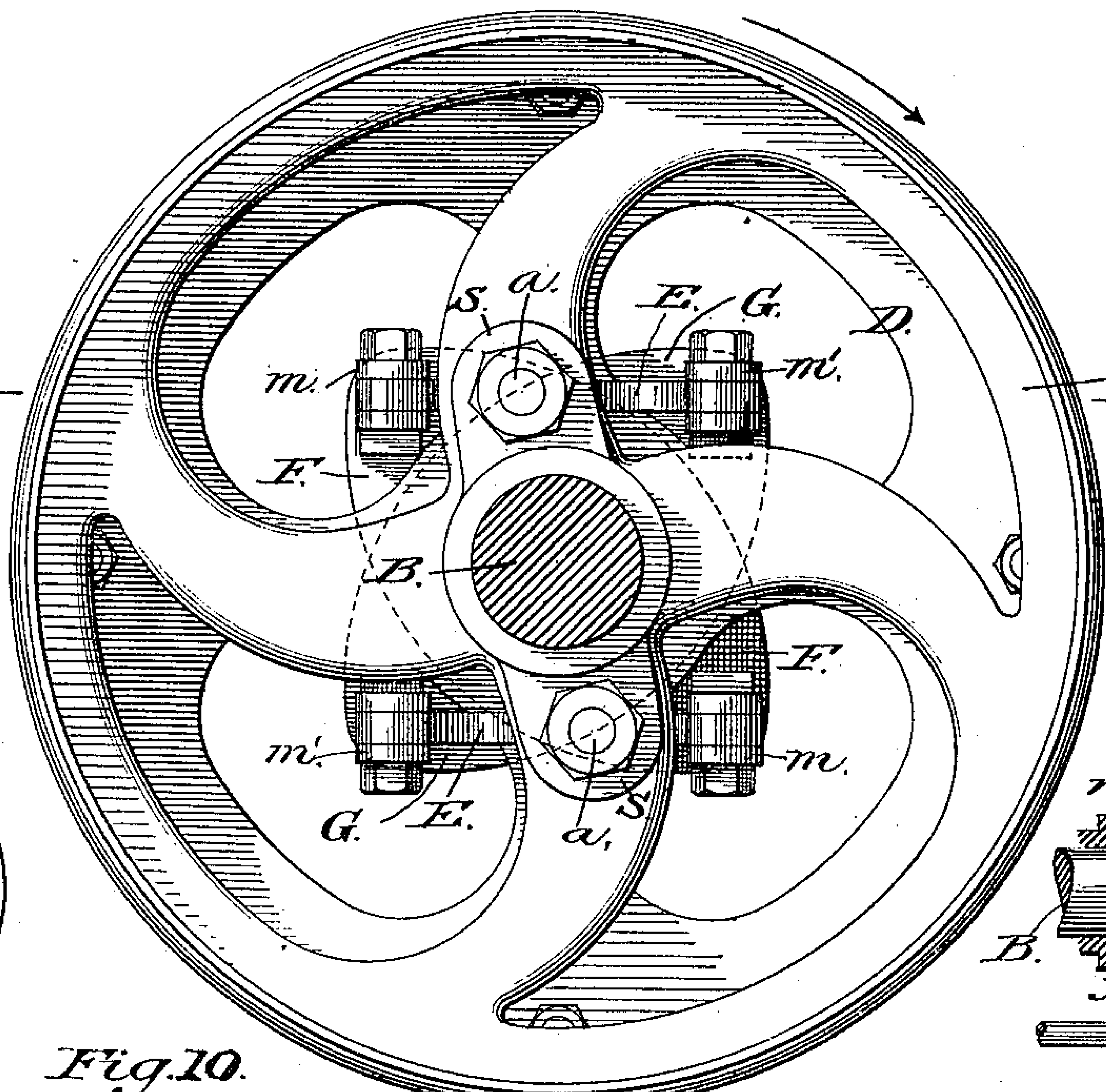


Fig. 11.

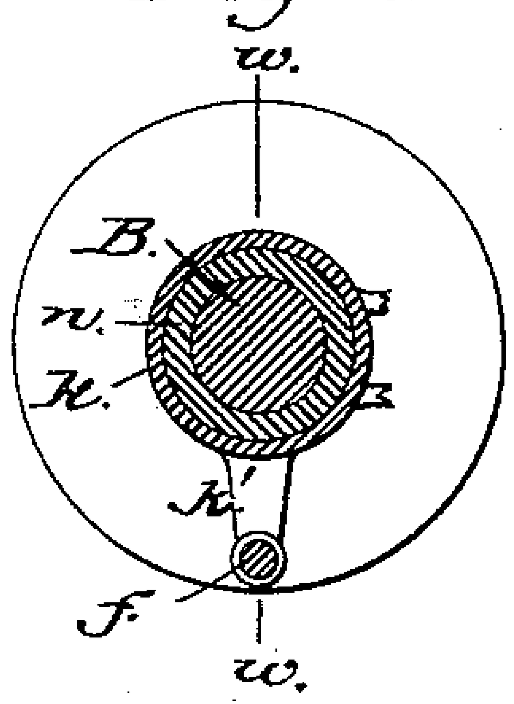


Fig. 12.

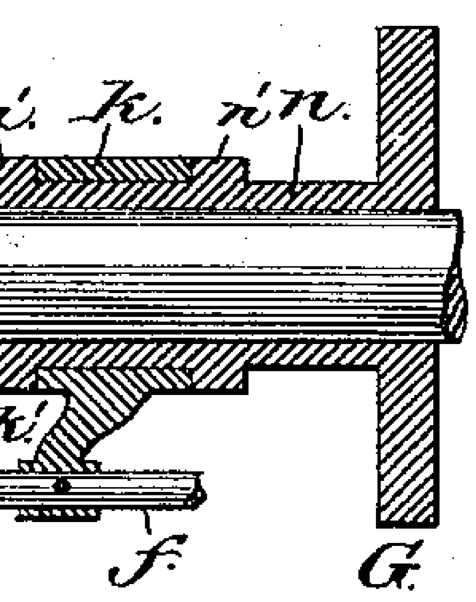
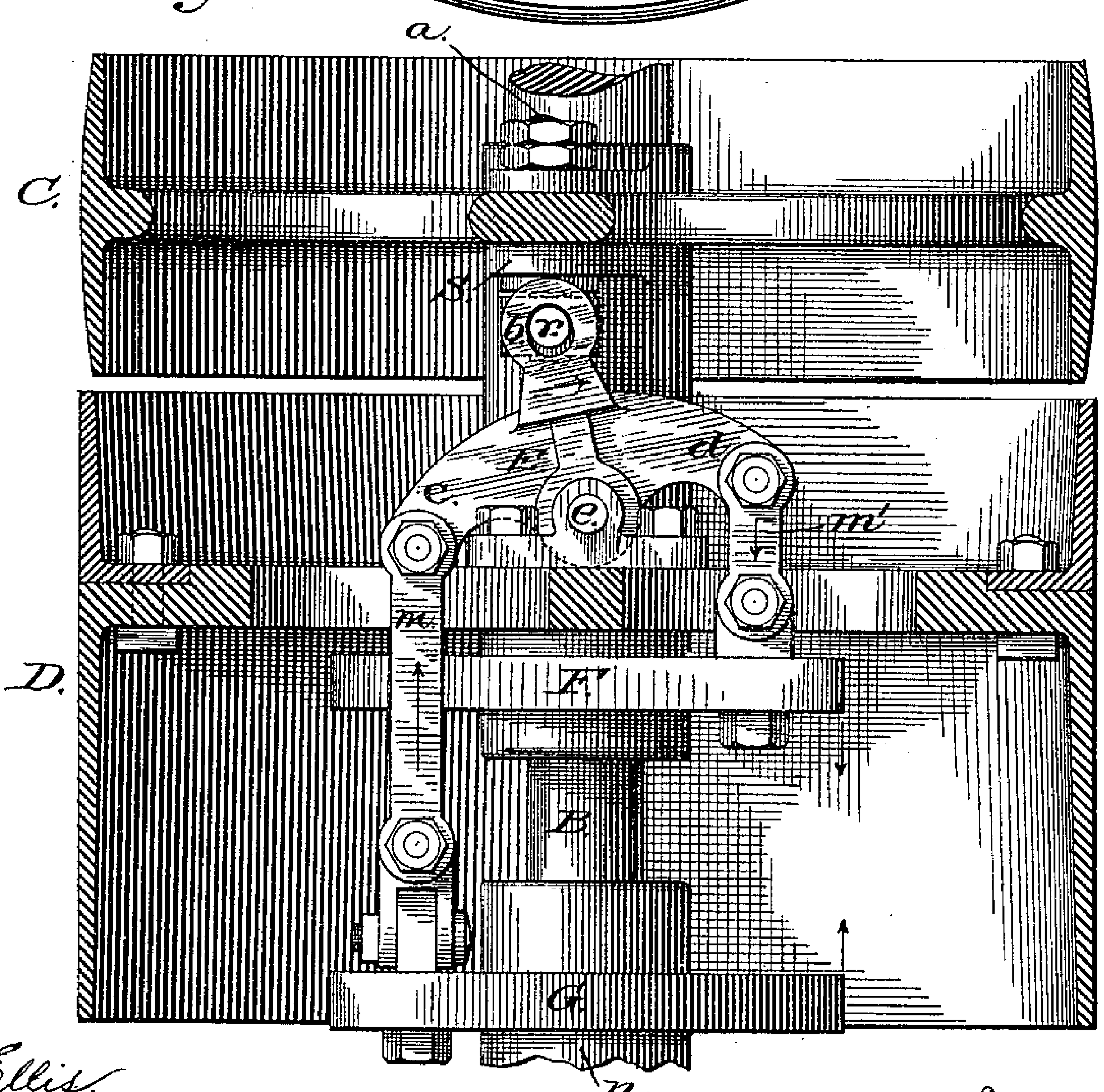


Fig. 10.



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3 Sheets—Sheet 3.

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Fig. 13

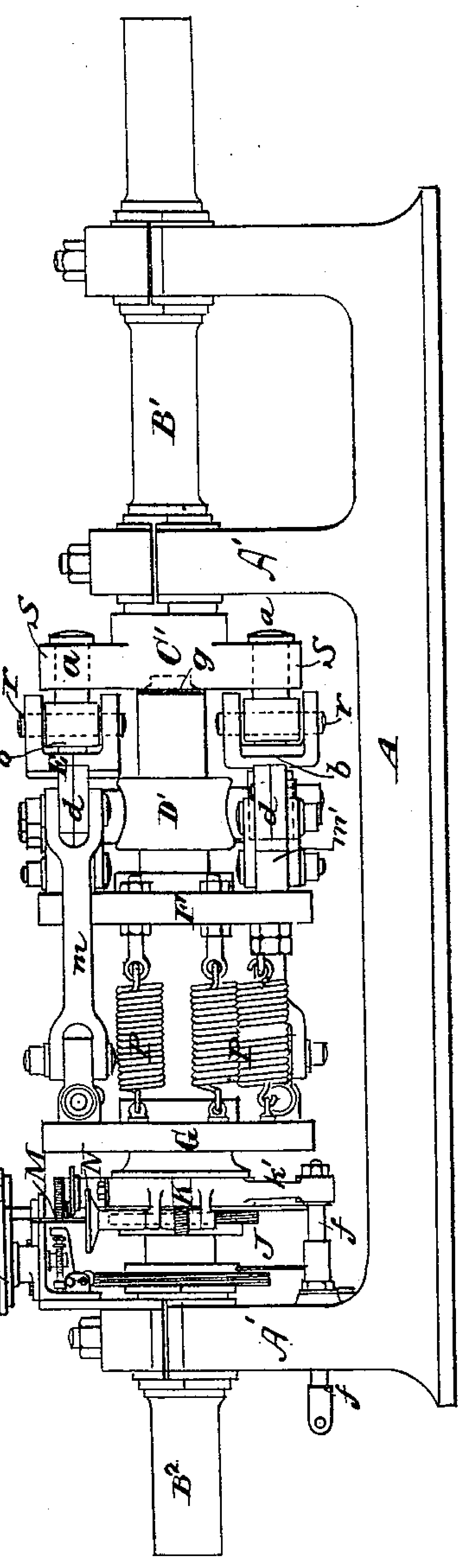
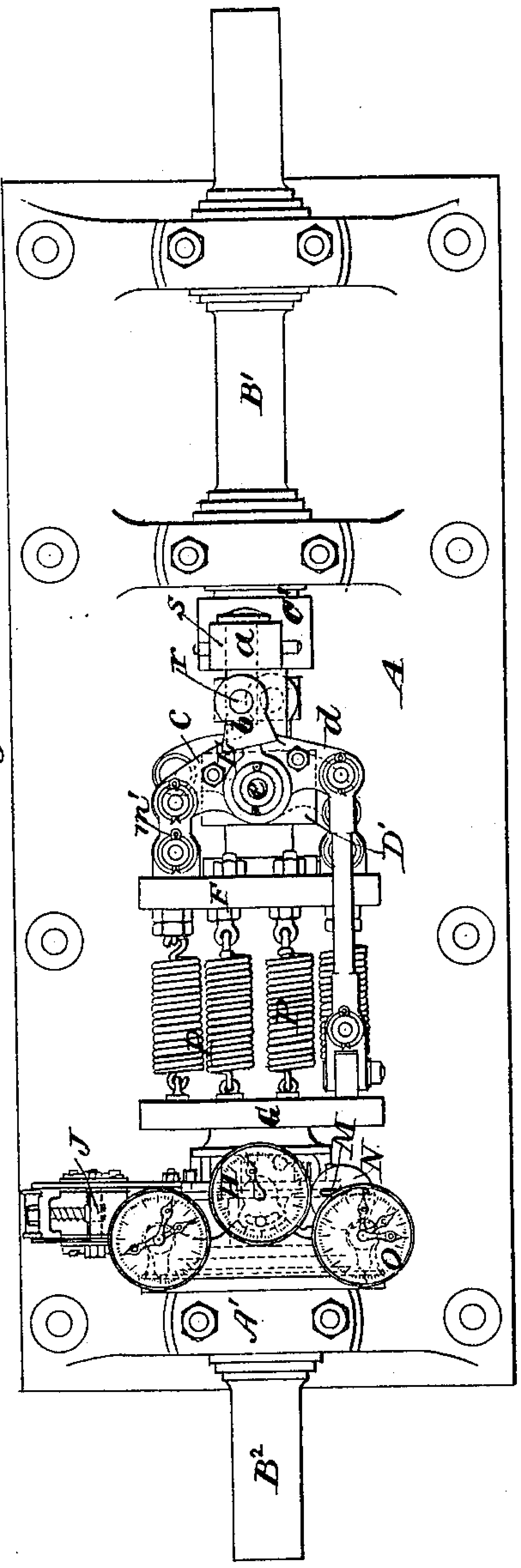


Fig. 14



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UNITED STATES PATENT OFFICE.

ERNEST AUGUST BOURRY, OF HORN, ASSIGNOR TO J. BOURRY-SÉQUIN, OF ZURICH, SWITZERLAND.

DYNAMOMETER OR MOTIVE-POWER BALANCE.

SPECIFICATION forming part of Letters Patent No. 332,697, dated December 22, 1885.

Application filed June 17, 1884. Serial No. 135,193. (No model.)

To all whom it may concern:

Be it known that I, ERNEST AUGUST BOURRY, a resident of Horn, in the Republic of Switzerland, have invented certain new and useful Improvements in Dynamometers or Motive-Power Balances; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, making a part of this specification.

The object of the present invention is to provide a compact, reliable, and as nearly as possible frictionless mechanical device for the permanent and correct measurement and record of rotating dynamical values, whether produced or absorbed, and which is adapted for use with any description of motor or power, from the smallest up to the greatest.

It consists of disks or bearing-plates interposed between a loose pulley or a crank on an independent master-shaft geared to the prime motor, and a second pulley or equivalent device fixed on the shaft to be driven, and which are adapted to slide freely longitudinally upon the subject-shaft to be driven, and yet partake of its rotation, and between which are interposed a series of springs, which are compressed or expanded, as the case may be, by an approach or separation of the disks, produced directly by the driving-pressure of the loose pulley upon the fixed pulley through the medium of the disks and of one or more interposed levers arranged substantially as hereinafter described, the springs and levers being made to serve, in fact, as balances adapted to positively weigh and constantly indicate the power or resistance involved in the transmission of force to the driven mechanism.

In the accompanying drawings, Figure 1 is an elevation, partly in section, of my improved apparatus when used in connection with a counter-shaft. Fig. 2 is a plan view of the same, also partly in section. Figs. 3 and 4 illustrate a modification in which the bearing-pins and trunnions are replaced by knife-edge pivots. Figs. 5 to 8 illustrate detached details of the same. Fig. 9 is an enlarged sectional view on line *x x* of Fig. 1, illustrating the driving-pulley in side elevation. Fig. 10 is a section on same scale on line *y y* of Fig. 9. Fig. 11 is a cross-section in line *z z* of Fig. 1; Fig. 12, a longitudinal section on line *w w* of Fig. 11. Fig. 13 is an elevation, and Fig. 14 a plan view, of my dynamometer when adapted for use as a coupling for two shafts lying in the same line of axis.

A represents the framing provided for my apparatus, and B a shaft mounted in suitable bearings thereon. Upon this shaft are fitted two pulleys, C and D, one of which, C, is narrow and loose and receives the belt from the engine, while the other, D, is keyed to the shaft, and made of double width, so as to allow the shifting of the belt thereon. The loose pulley or carrier C is provided with two crank-pins, *a a*, (see Fig. 9,) made to project from its spokes or radial arms parallel with the shaft and diametrically opposite each other, and the fixed pulley D is likewise provided with two radial pins or trunnions, *e e*, made to project therefrom within its rim parallel with its arms or spokes. Upon each of these pins or trunnions *e e* a three-armed lever, E, (see Fig. 10,) is pivoted centrally, to oscillate in a plane parallel with the shaft. The lever is formed of the two arms *c* and *d*, of equal length, projecting in a right line on either side of the pivotal center of the lever, and of a third central arm, *b*, projecting at right angles to the other two, the three being united in one piece, which rocks upon the central pivot-pin, *e*. (See Fig. 10.) The outer end of the central arm, *b*, is jointed to the opposite crank-pin *a* on the loose pulley C by a pivot-pin, *r*, (see Fig. 10,) while the ends of the remaining two arms, *c d*, are coupled by suitable links, *m m′*, respectively, (see Fig. 10,) each to one of two separate disks, F and G, which are fitted to slide freely longitudinally upon the shaft B, but are connected thereto by a spline, so as to produce by their rotation a rotation of said shaft.

It is evident that a rotation of the loose pulley C will cause a movement of the arm *b* of the lever in the same direction, and that this movement of said arm, by causing the lever E, of which it is a part, to oscillate upon the pivot-pin *e*, will draw out one of the arms, *c*, and push in the other arm, *d*, and thereby cause the connected disks F and G to approach or recede from each other.

A series of springs, P P, (illustrated in Figs. 1 and 2, but not shown in Fig. 10,) are interposed between the disks and secured thereto, so that their resilient power shall come into play to resist the longitudinal movement of the disks. The collective resistance of these springs is more than equal to that of the load, and when the springs no longer yield to the force exerted thereon by the lever the disks will be made to rotate in unison with the pulley C, the variations in the power required to accomplish this end and overcome the resistance of the pulley D operating to compress or expand more or less the interposed springs P P. The lever, disks, and springs thus operate as a balance, in which the distance between the disks indicates the pressure or power transmitted from the driving shaft or pulley and required to overcome the load or resistance of the shaft to be driven.

The outer disk, G, is fitted with a long sleeve, *n*, (see Figs. 1, 2, 11, and 12,) which is embraced by a loose collar, *k*, secured by an arm, *k′*, to a lateral rod, *f*, extending from the collar in line parallel with the shaft A, through an aperture or bearing for the same in the standard A′ of the frame, upon which the shaft rotates. (See Fig. 1.) While the collar *k* may not rotate with the disk G, it is made to participate in the reciprocating movements of the disk, either by means of bands or offsets *n′*, (see Fig. 12,) formed or fitted upon the sleeve on each side of the collar, or, as an equivalent therefor, by means of a pin projecting from the collar into a peripheral groove in the sleeve. This collar *k*, participating in the reciprocating movements of the disk G, is made to serve, as hereinafter described, to indicate in several ways the effects of the variations in the dynamical power measured or balanced by the springs.

Recapitulating the functions of the apparatus constructed as above described, it will be understood that if the crank-pins *a a* on the loose pulley C are pressing upon the arms *b b* of the balance-levers E the arms *c c* push the disk F, and the arms *d d* pull the disk G, one toward the other, with exactly the same force, the interposed springs reacting upon both disks alike, and the pivots *e e* of the balance-levers E are thus relieved from all strain, except in the direction of their rotation around the axis, whereby the measurement of the rotating energy is effected without any absorption or loss from friction in the apparatus, securing, consequently, a fair correctness in the desired indications for all practical purposes.

Where, however, for academical or other scientific purposes, dynamometers are required of exceptional sensitiveness, the round pins and trunnions *e*, as shown in the drawings, Figs. 2 and 10, are replaced by knife-edge pivots *e′*, (see Fig. 4,) such as are found in scales and balances, the points of contact being made to correspond to the centers of the pins and trunnions. Figs. 3 and 4 illustrate, on an enlarged scale, this modification of the device, Fig. 3 being a side sectional view of one of the cranks S in connection with the central arm, *b*, of the balance-lever E; Fig. 4, a plan view of the balance-lever E in connection with said crank S, and Figs. 5, 6, 7, and 8 detached details of the several parts of the crank S and its connections, and illustrating more fully the knife-edges of the pivotal points interposed between the cranks and the lever E. In said details, Fig. 6 shows the configuration of the crank-pin *a*, provided with a hard steel socket, *i*, which is made to receive the knife-edge 1 of the link *p*. (See Fig. 5.) The other knife edge, 2, of the same link *p* acts upon the socket of a little balance-beam, *t*, (shown in Fig. 8,) the extremities of which are again provided with sockets, upon which articulate the little stays *t′*, (shown in Fig. 7,) bearing with their other ends upon sockets upon the arm *b* of the lever E. This application of knife-edges as a pivotal connection between the balance-beam and disks is so simple as to require no further explanation.

Figs. 13 and 14 represent the motive-power balance when adapted to serve as a coupling between two shafts lying in the same line of axis. The pulleys C and D, Figs. 1, 2, 9, and 10, are here replaced by a double crank, C′, and a kind of cross-head, D′, these devices being fitted, respectively, upon the ends of the two shafts B′ and B^2, a central axial guide-pin or stud, *g*, being made to project from the one into a recess in the other. The springs here act expansively, while in the former case they act by compression.

The dynamical measurations obtained by the to-and-fro movements of the disks F and G, and indicated by the movement of the loose collar *k*, may be registered and recorded by various devices—as, for example, by the form of dynamical index (see at H) called a "dynameter," and which is adapted to show constantly the load to be overcome; or by a "dynamograph," (see at J,) wherein the dynamical work realized defines itself in uninterrupted abscisses and ordinates upon an endless paper ribbon; or by a "dynamognom," which is adapted to sum up any given force-units expended, and which consists simply of a rotating counter, O, driven by a roller, M, itself driven by frictional contact with the face of a rotating disk, N, carried by the collar *k*, so that the load imposed upon the dynamometer determines the speed of rotation of the counter O; but as these devices do not constitute any part of my invention it is unnecessary to describe them here in detail.

The apparatus admits of being driven in either direction with equal effect.

Instead of two balances, as described, three or more may be used conjointly without altering the functions of the apparatus.

I claim as my invention—

In dynamometer, or motive-power balances, the combination, with the driving and driven mechanism, of a plurality of interposed balances so distributed as to counterbalance each other reciprocally, and transfer the dynamical energy from the driving to the driven mechanism while weighing conjointly the drag, said balances consisting each of a T-shaped beam, E, formed by the arms *b*, *c*, and *d*, which oscillate at their point of intersection upon the radial trunnion of a fixed pulley or cross-head, D, upon the driven shaft B, the extremity of the arm *b* receiving the driving-pressure from a pin, *a*, on the driving pulley or shaft C, and transmitting the same through the arms *c* and *d* and suitable connecting-links to the disks F and G, reciprocating longitudinally upon the shaft B, and between which a number of springs are interposed, all substantially in the manner and for the purpose herein set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ERNEST AUGUST BOURRY.

Witnesses:
EDUARD A. CEGG,
RICHARD HOFER.