(No Model.)

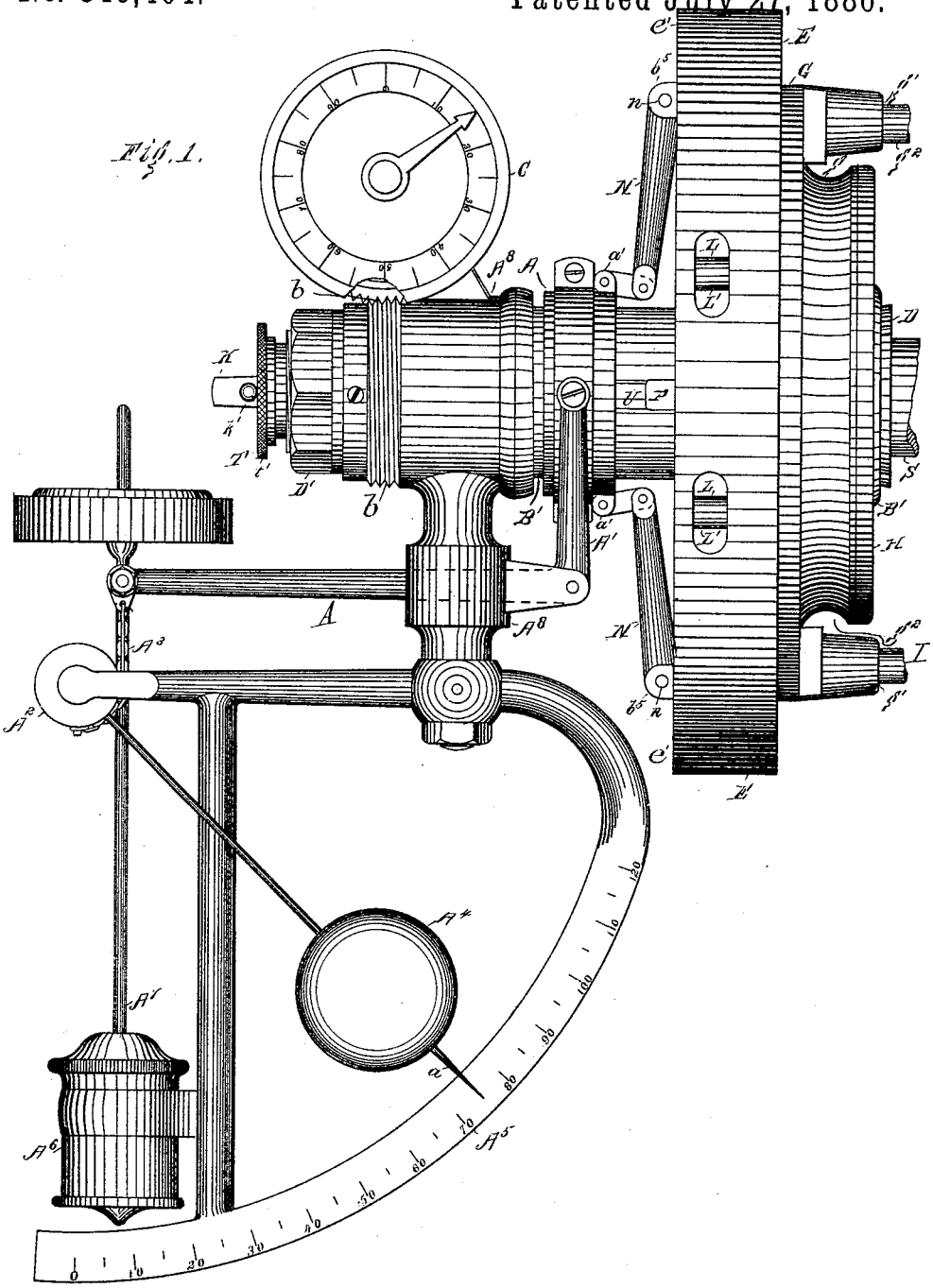
5 Sheets—Sheet 1.

J. EMERSON.

DYNAMOMETER.

No. 346,404. Patented July 27, 1886.

Fig. 1.



Witnesses—

Kirkley Hyde.

Gertrude M. Day.

Inventor—

James Emerson,

By Albert M. Moore

His Attorney.

(No Model.) 5 Sheets—Sheet 2.

J. EMERSON.

DYNAMOMETER.

No. 346,404. Patented July 27, 1886.

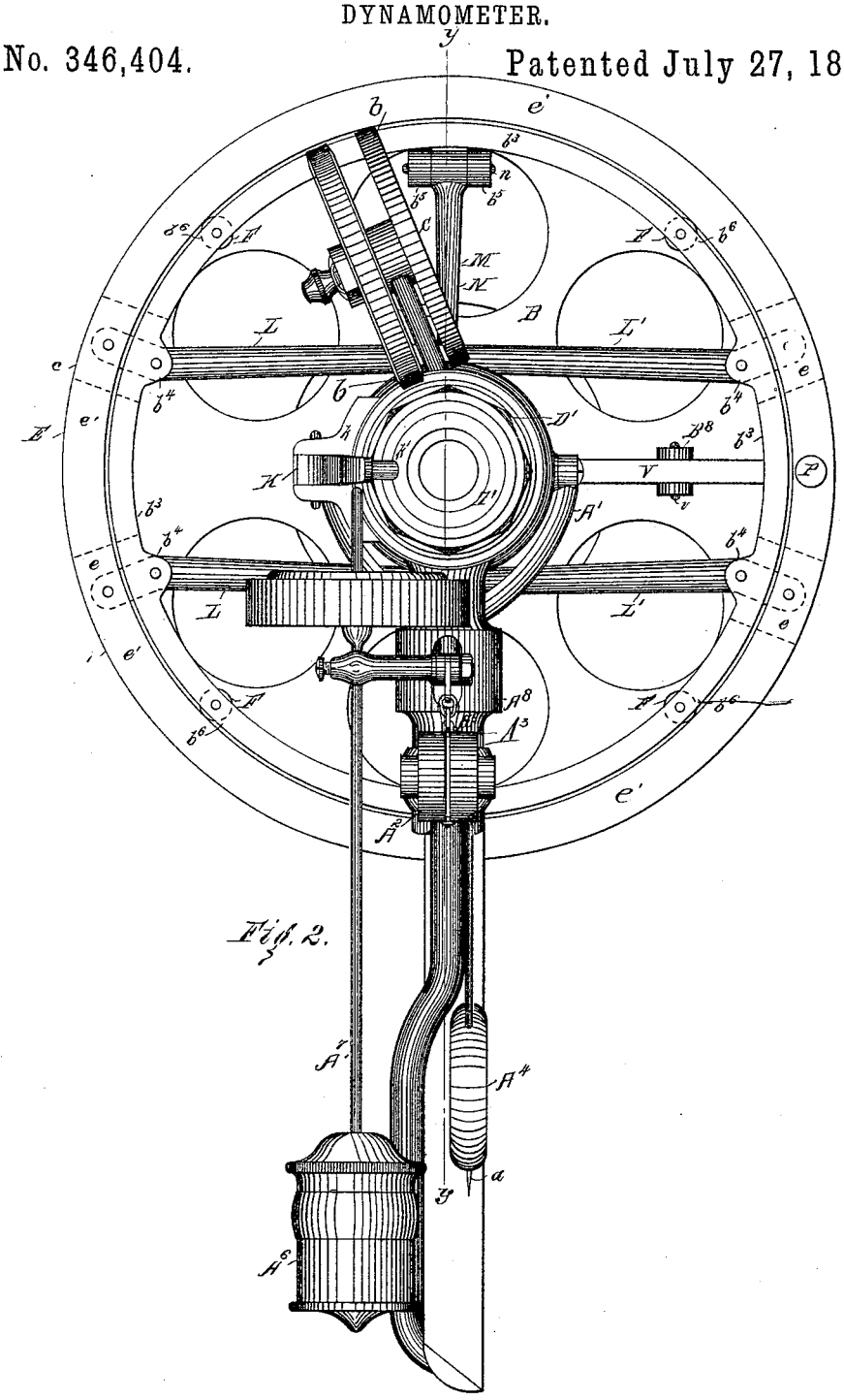


Fig. 2.

Witnesses—
Kirkley Hyde.
Gertrude M. Day.

Inventor—
James Emerson,
By Albert M. Moore,
His Attorney.

(No Model.)

5 Sheets—Sheet 3.

J. EMERSON.

DYNAMOMETER.

No. 346,404.

Patented July 27, 1886.

Fig. 3.

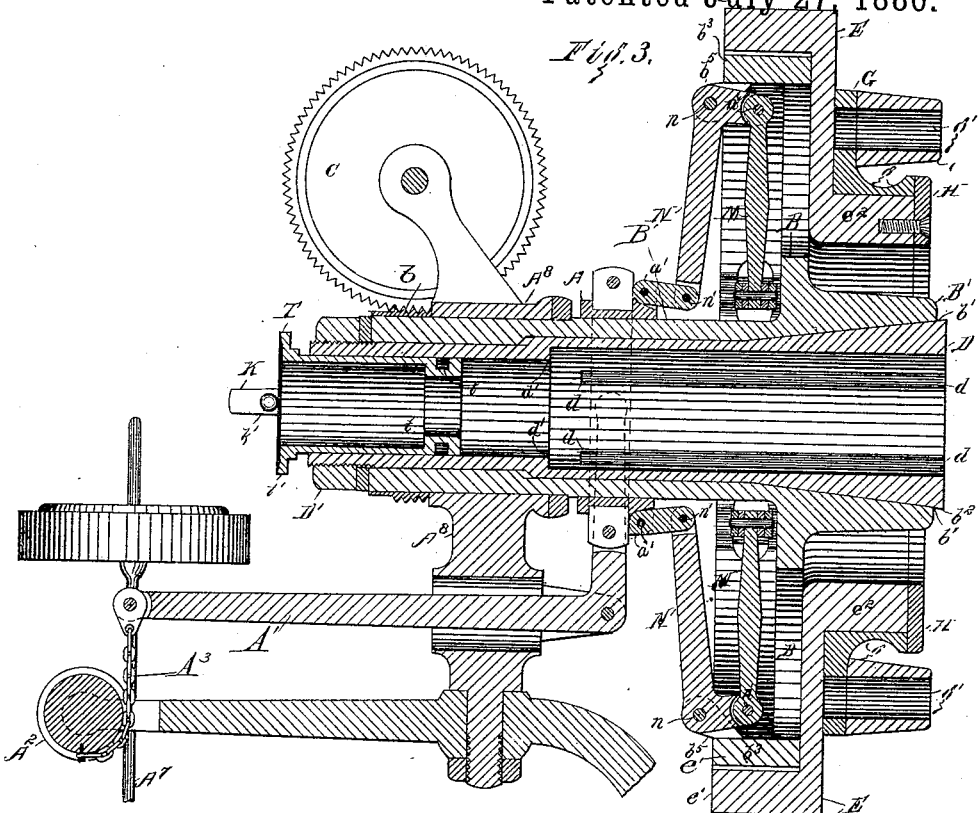
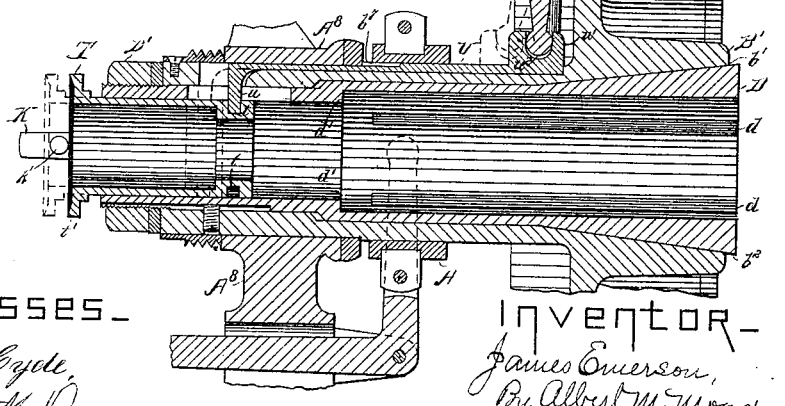


Fig. 4.



Witnesses—
Kirkley Hyde,
Gertrude M. Day

Inventor—
James Emerson,
By Albert M. Moore,
His Attorney—

(No Model.)

5 Sheets—Sheet 4.

J. EMERSON.

DYNAMOMETER.

No. 346,404. Patented July 27, 1886.

Fig. 5.

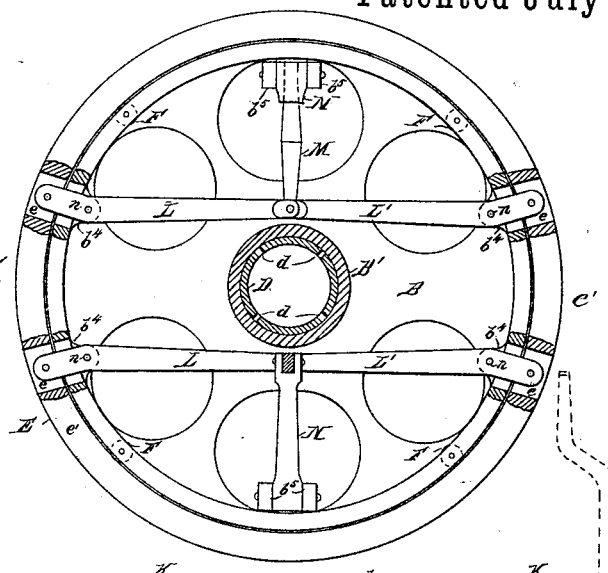


Fig. 8.

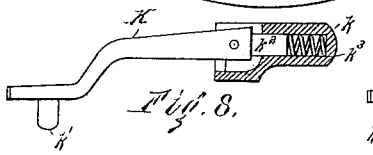


Fig. 7.

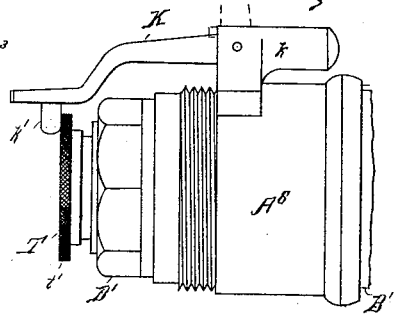
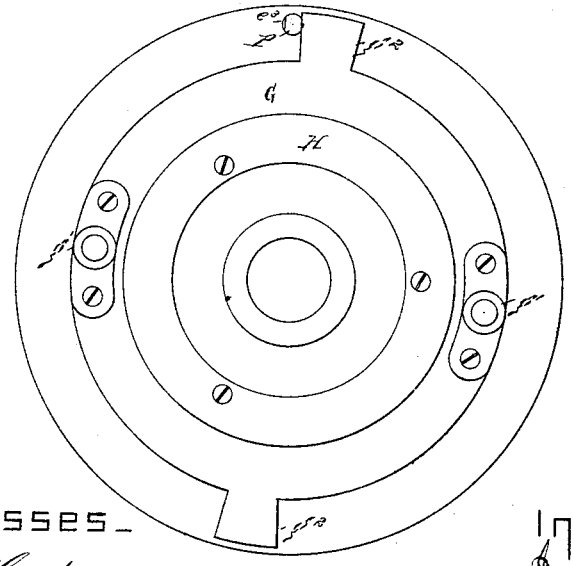


Fig. 6.



Witnesses—
Kirkley Hyde,
Gertrude M. Day.

Inventor—
James Emerson,
By Albert M. Moore,
His Attorney.

(No Model.)

5 Sheets—Sheet 5.

J. EMERSON.

DYNAMOMETER.

No. 346,404. Patented July 27, 1886.

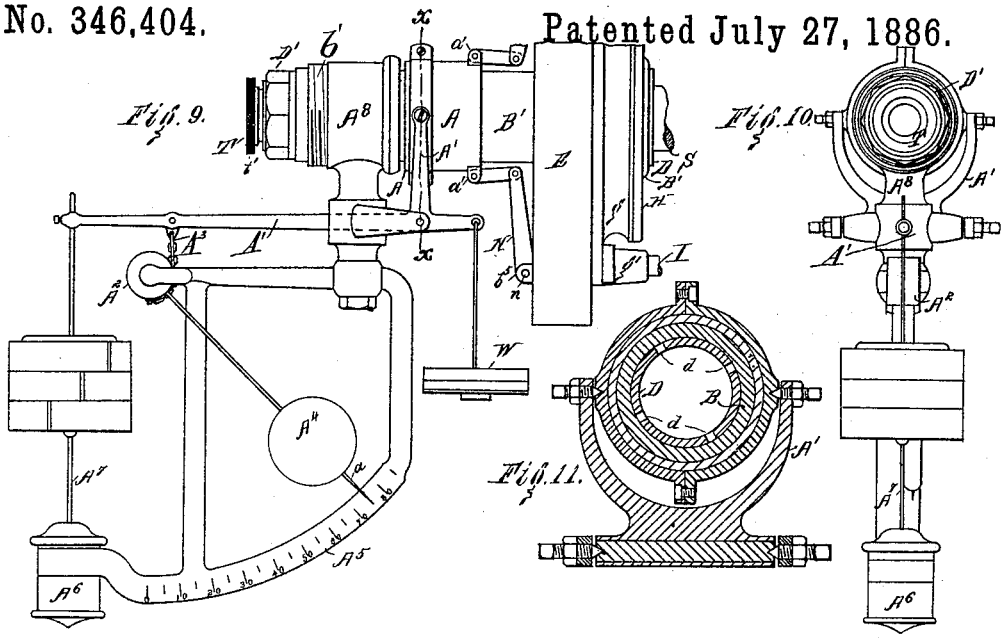


Fig. 9.

Fig. 10.

Fig. 11.

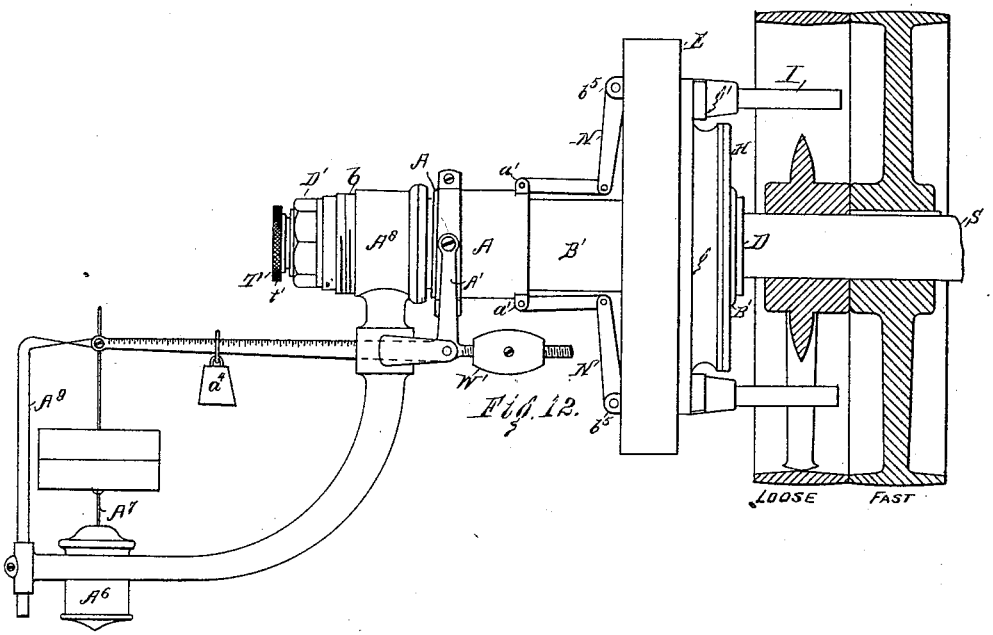


Fig. 12.

Witnesses—
Kirkley Hyde,
Gertrude M. Day

Inventor—
James Emerson,
By Albert M. Moore,
His Attorney

UNITED STATES PATENT OFFICE.

JAMES EMERSON, OF WILLIMANSETT, ASSIGNOR OF TWO-THIRDS TO EARL A. THISSELL, OF LOWELL, MASSACHUSETTS.

DYNAMOMETER.

SPECIFICATION forming part of Letters Patent No. 346,404, dated July 27, 1886.

Application filed June 17, 1885. Serial No. 168,942. (No model.)

To all whom it may concern:

Be it known that I, JAMES EMERSON, a citizen of the United States, residing at Willimansett, in the county of Hampden and Commonwealth of Massachusetts, have made certain new and useful Improvements in Dynamometers, of which the following is a specification.

My invention relates to dynamometers or power-scales for ascertaining the power required to drive a machine or machinery, and has for its object to make the dynamometer more convenient of manipulation and easier to be attached to the shaft of a machine or to a line of shafting.

In the accompanying drawings on five sheets, Figure 1 is a front elevation of a dynamometer provided with my improvement and a speed-indicator, a part of the dial of said indicator being broken away to show how the indicator is driven; Fig. 2, a left-end elevation of the same with the movable parts in the same position as in Fig. 1; Fig. 3, a vertical central section of the same with the scale, pendulum, dash-pot, and part of the dash-pot rod omitted, the movable parts being in the same position as in Fig. 1; Fig. 4, a vertical central section with the parts omitted in Fig. 3, and also the weight and scale omitted, the plane of the section of the movable parts being at right angles to the plane of the section shown in Fig. 3, and on the line *y y* in Fig. 2; Fig. 5, a side elevation of the hub-plate on which the levers are fulcrumed and the carrying-plate, to which the outer ends of the levers are pivoted, parts of said plates being broken away to show the attachment of said levers; Fig. 6, a view of the right side of the carrying-plate and the dog-plate, which forms part of a clutch; Fig. 7, a plan of the left end of the hub and the parts connected thereto, the dotted lines showing the clutch-lock open; Fig. 8, a plan of the clutch-lock detached, its holder being in horizontal longitudinal section; Fig. 9, a front elevation of a modified form of my improvement; Fig. 10, a left-end elevation of the same; Fig. 11, a section on the line *x x* in Fig. 9; Fig. 12, a front elevation of another modified form of my improvement.

The dynamometer herein described is an improvement on that shown in Letters Patent No. 266,120, granted to me October 17, 1882. The collar A, sliding on the hub B′, the forked bell-crank lever A', the drum A^2, connected by the chain A^3 to said lever A', the pendulum or swinging weight A^4, provided with an index-finger, *a*, the graduated scale A^5, the dash-pot A^6, the dash-pot rod A^7, jointed to said bell-crank lever A', the frame A^8, which hangs from the hub, are all substantially as shown in said patent. The speed-indicator C is of well-known form, and is driven, substantially as shown in said patent, by a worm, *b*, on the hub B′ of the hub-plate B. The hub-plate has a central opening, *b′*, in which is placed a chuck, D, or sleeve of steel, the inner surface of which chuck is cylindrical, the outer surface of which for a distance from its right end, as shown at b^2 in Figs. 3 and 4, is conically enlarged, and the opening of the hub *b′* is correspondingly conically enlarged at its right end. The chuck or sleeve D extends through the hub and projects therefrom at the left end thereof, and is externally screw-threaded to engage a nut, D′, which, being turned thereon against the free end of the hub B′, tends to draw the chuck through the hub, to the left. The chuck is slotted at *d* lengthwise, so that when the conical part of the chuck is drawn into the conical part of the opening *b′* the diameter of that part of the chuck is reduced, which enables the instrument to be secured to a shaft of a machine or to a line of shafting, either of which may be indicated by the part marked S in Fig. 1.

When the chuck is tightened on a shaft, by turning up the nut D′ against the end of the hub, the chuck, hub, and hub-plate will revolve with said shaft if the latter be revolved, the scale, pendulum, dash-pot, and speed-indicator and other parts supported on the bracket not turning with said hub. The internal diameter of the chuck is reduced at a slight distance from the closed end of the slots *d*, to form an annular shoulder *d′*. Into the chuck between its large end and the shoulder *d′* may be inserted a reducing-chuck or steel sleeve slotted nearly from end to end, to enable a smaller shaft to be grasped.

Between ears b^4 on the flange b^3 of the hub-plate are pivoted the prime levers L L′, of which there are four arranged in two pairs, a

pair on each side of the hub, the levers of the same pair being in nearly a straight line with each other and about parallel to the levers of the other pair. The outer ends of the prime levers reach into slots *e* in the flange *e'* of the carrying-plate E, and one lever of each pair is pivoted to said flange, as will be explained below. It is sufficient to say here that a movement of the hub-plate and carrying-plate with reference to each other will turn the prime levers on their fulcrums. The inner ends of the prime levers of the same pair are pivoted to each other and to a connecting-rod, M, which runs about radially, and is pivoted to the short arm of a bell-crank lever, N. The last-named lever, N, is pivoted at *n* between ears b^5, projecting from the flange of the hub-plate, and its long arm runs in radially toward the sliding collar A, and is pivot at *n'* to one end of a link or short connecting-rod, the other end of which is connected to ears *a'*, formed on the side of said collar. It will be seen that an outward movement of the inner ends of the prime levers will cause the collar A to slide toward the hub-plate, raising the lower end of the forked lever A', and unwinding the chain from the drum A^2, to which the pendulum-weight is attached, swinging said pendulum toward the hub-plate, and causing the index-finger to rise over the scale.

The carrying-plate E is provided with a flange, *e'*, which surrounds the hub-plate and has a slight movement around the same, resting on anti-friction rolls F, which are journaled in the flange b^3 of the hub-plate, parallel with the axis of the hub, and turn in slots b^6, formed in the flange of said hub-plate.

The carrying-plate E is provided with a hub, e^2, on which turns the dog-plate G, said dog-plate being provided with a hub, *g*, and being held on the hub of said carrying-plate by an annular plate, H, secured to the end of the hub e^2 of said carrying-plate, and covering the end of the hub *g* of said dog-plate. The dog-plate G is provided with one or more—preferably two—sockets, *g'*, in which are inserted studs I, which are intended to pass between the arms of a pulley, as hereinafter described. The dog-plate is also provided with radial projections or dogs g^2, adapted to strike a sliding pin, P, (placed in a hole, e^3, in the flange of the carrying-plate,) when the said pin projects from the face of the carrying-plate. The pin P is caused to project from said carrying-plate to the right in Figs. 3 and 4, by sliding the tube T by hand to the left, as shown in Figs. 3 and 4, said tube T having an annular groove, *t*, into which reaches a projection, *u*, on a slide, U, which lies in a longitudinal groove, b^7, in the hub. The other end of said slide U is provided with an outward projection, *u'*, which has a notch, u^2, to receive the rounded end of a lever, V, pivoted at *v* to ears b^8, projecting from the left side of the hub-plate. The outer end of the lever V is rounded and enters a notch, *p*, in said pin P; hence pushing the tube T into the hub draws the pin back out of reach of the dogs *g* on the dog-plate, and drawing said tube out or to the left throws the pin P to the right, where it may be struck by said dogs. The tube T is held in either position by a lock consisting of a lever, K, which turns on the bracket *k*, secured to said frame A, and is provided with a stud, *k'*, which, when said lever K is turned into the position shown by full lines in Fig. 7, reaches by the edge of a flange, *t'*, with which said tube T is provided and prevents the tube being drawn out of the hub and the pin P from engaging with the dogs on the dog-plate, and, on the other hand, when the tube is drawn out and the stud *k'* is to the right of said flange (see dotted lines in Fig. 4) the pin P cannot be drawn or accidentally shaken out of engagement with said dogs.

The lock or lever K is held in its locking position or at right angles thereto by a block, k^2, which slides in a suitable opening or chamber, k^3, in said bracket, and is pushed by a spiral spring against the flat end of said lever K, when the same is locked, and against the flat back of the same when unlocked. (See Figs. 7 and 8.)

The operation of the above-described dynamometer as applied to the shaft of a machine or to a line of shafting is as follows: The instrument is attached to the shaft by the clutch, as above described, and the studs I are placed between the arms of the loose pulley V, (care being taken that the two studs I bear equally against two opposite arms of such pulley, or equally in two diametrically-opposite holes drilled in the web of a plate-pulley,) said pulley and shaft being at this time at rest and the sliding pin P being out of engagement with the dogs of the dog-plate. The belt is then placed on the loose pulley V, and shifted thence to the fast pulley V', causing the latter to rotate, and with it the shaft, the hub, hub-plate, the levers pivoted thereon, and the carrying-plate and the dog-plate, the latter being rotated by the friction between it and the carrying-plate, and thereupon the connected ends of the prime levers L L' will be thrown outward slightly from the hub by centrifugal force, and will cause the sliding collar A to move on the hub toward the hub-plate, and, through the connecting mechanism above described, will cause the pendulum to move upward over the arc or graduated scale A^5, and the index-finger *a* will indicate on said scale the tare or number of pounds exerted by centrifugal force. The belt is then run very gradually onto the loose pulley, but not entirely off from the fast pulley. When both the fast and loose pulleys have attained an equal speed of rotation, the sliding pin P is pushed to the right, by the means above described, to be ready to engage with the dog of the dog-plate; but inasmuch as the sliding pin P, at the time when it is pushed out to the right, may be at some distance from either of the dogs on the dog-plate, and would be likely to be broken by a violent blow from one of said dogs, the belt is moved very gradu-

ally from the fast to the loose pulley. No weighing of the power takes place when the belt is wholly or partly on the fast pulley, said weighing being accomplished by driving the instrument through the medium of the loose pulley and the dog-plate and its studs. When the belt is entirely shifted from the fast pulley to the loose pulley, the dog-plate, being caused to revolve by the loose pulley, causes the carrying-plate to revolve with it by the dog of the dog-plate pressing against the sliding pin P. The revolution of the carrying-plate and the inertia of the hub-plate causes the prime levers to turn upon their fulcrums and throw their inner ends outward from the hub, and this causes the collar A to slide on the hub toward the hub-plate, and the pendulum-weight to swing to the right, and the index-finger to indicate on the scale the number of pounds of force exerted. The number of revolutions for one minute is ascertained, in the usual manner, by the speed-indicator. The tare is now deducted from the number of pounds indicated while the belt was on the loose pulley and the remainder is multiplied by the number of feet in the circumference of the circle described in a single complete revolution of one of the bearing-pivots which connect the outer end of a prime lever with the carrying-plate. By then multiplying this product by the number of revolutions in a minute, and dividing this last product by thirty-three thousand, (33,000,) the number of horse-power will be shown by the quotient.

In the modifications shown in Sheet 5 of the drawings, the dash-pot rod and the forked bell-crank lever lie in the same vertical plane, instead of being in different planes, as shown in Fig. 2. Arranging the dash-pot rod and said lever last named in the same vertical plane renders said lever less liable to be twisted, and to wear unequally upon its fulcrum, and allows it to move with greater freedom.

In Figs 9 and 12 the forked lever A′ is provided with a counterpoise, W W′, which is supported in each case upon an extension of said lever, the counterpoise in one case, Fig. 9, being suspended in an obvious manner, and in the other case, Fig. 12, consisting of a ball provided with a screw-threaded hole, which engages a thread cut on the extension of said lever A′.

In both of the figures last named the removable weights on the dash-pot rod, instead of being placed over the top of the rod, are slotted to the center, in order that they may be placed on said rod below where it is pivoted to the lever A′. This arrangement tends to make the movement of said lever A′ steadier.

In Fig. 12 the pendulum-weight is dispensed with and the long arm of the lever A′ is notched and graduated like the long arm of an ordinary steelyard, and a weight, a^4, provided with a hook, is moved along said long arm by hand, just as the weight of a steelyard is, and the part of the frame A^3, which in the other figures is shown to be provided with a scale, serves merely to support a rod, A^9, the upper end of which is bent horizontally and pointed in the line of the axis of the lever A′, when the same is in a horizontal position.

In Fig. 12 the free end of the long arm of the lever A′ is pointed, and when this pointed end is in the same straight horizontal line with the point on the rod A^9 the power and the weight balance each other.

I claim as my invention—

1. The combination, in a dynamometer or power-scale, of a hub plate or frame adapted to be secured to a shaft and to rotate therewith, prime levers having their fulcrums on said hub-plate, a carrying-plate having a hub, and having a flange or ring supported and bearing upon rolls turning in said hub-plate, a dog-plate turning upon the hub of said carrying-plate, and adapted to be engaged with the loose pulley on said shaft, and having one or more dogs, and a pin sliding in said carrying-plate and adapted at will to be thrown into or out of engagement with a dog of said dog-plate, to enable the rotation of the hub-plate and carrying-plate to be started and stopped without stopping said loose pulley, substantially as described.

2. The combination of the hub plate or frame adapted to be secured to the shaft and to be revolved therewith, said hub-plate being provided with a hub having a longitudinal groove and a slot leading from the end of said groove into said hub, prime levers having their fulcrums on said hub plate, and having their outer ends pivoted to the carrying-plate, said carrying-plate provided with a flange, and with a hub, and concentric with said hub-plate, a dog-plate provided with one or more dogs, and turning upon the hub of said carrying-plate, and adapted to be connected with a loose pulley on said shaft, and to be rotated by said loose pulley, a pin sliding in the flange of said carrying-plate, a tube adapted to slide in said hub and provided with an annular groove, a slide arranged within said longitudinal groove, and having a projection adapted to reach through said slot and into said annular groove, a lever having its fulcrum on said hub-plate and engaging at one end with said slide and at the other with said sliding pin, to throw said pin into or out of engagement with said dog-plate, substantially as described.

3. The combination, in a dynamometer or power-scale, of a hub plate or frame adapted to be secured to a shaft and to revolve therewith, two pairs of prime levers having their fulcrum upon the said hub-plate or frame, a carrying-plate provided with a flange, one lever of each pair of prime levers being pivoted at its outer end to said flange by a removable pivot adapted to connect the other lever of the same pair to said flange when the direction of motion is reversed, as and for the purpose specified.

4. The combination, in a dynamometer or power-scale, of a hub plate or frame adapted to be secured to a shaft and to revolve there-

with, two pairs of prime levers having their fulcrums upon said hub plate or frame, the inner end of each pair of prime levers being connected to each other and to the inner end of a connecting-rod, said connecting-rod connected at its outer end to the short end of the bell-crank lever, the other or inner end of said bell-crank lever being connected by a link, a collar connected to said link and sliding on said hub, a forked lever pivoted to said sliding collar, a stationary frame or bracket depending from said hub, pendulum-weight provided with an index-finger and with a drum, a chain connecting said drum and the outer end of said last-named lever, a graduated scale supported by said stationary frame, one lever of each pair of prime levers being pivoted by a removable pivot to the flange of said carrying-plate, said pivot being adapted to connect the other lever of the same pair to said flange when the direction of motion is reversed, as and for the purpose specified.

5. The combination of the hub plate or frame adapted to be secured to a shaft and to be revolved therewith, said hub-plate being provided with a hub having a longitudinal groove, and a slot leading from the end of said groove into said hub, prime levers having their fulcrums on said hub-plate and having their outer ends pivoted to the carrying-plate, said carrying-plate provided with a flange, and with a hub, and concentric with said hub-plate, a dog-plate provided with one or more dogs, and turning upon the hub of said carrying-plate, and adapted to be connected with a loose pulley on said shaft, and to be rotated by said loose pulley, a pin sliding in the flange of said carrying-plate, a tube adapted to slide in said hub and projecting therefrom and provided with an annular flange outside of said hub, and with an annular groove within said hub, a slide arranged within said longitudinal groove, and having a projection adapted to reach through said slot and into said annular groove, a lever having its fulcrum on said hub-plate, and engaging at one end with said slide and at the other with said sliding pin, a stationary frame or bracket depending from the hub of said hub-plate, a lever or lock provided with a pin, and pivoted to said stationary frame, and adapted to hold said last-named pin in engagement with and on either side of the flange of said sliding tube, and to hold said sliding pin either in or out of engagement with said dog-plate, as and for the purpose specified.

JAMES EMERSON.

Witnesses:
ALBERT M. MOORE,
GERTRUDE M. DAY.