No. 646,636.

Patented Apr. 3, 1900.

H. F. CRICKLER.

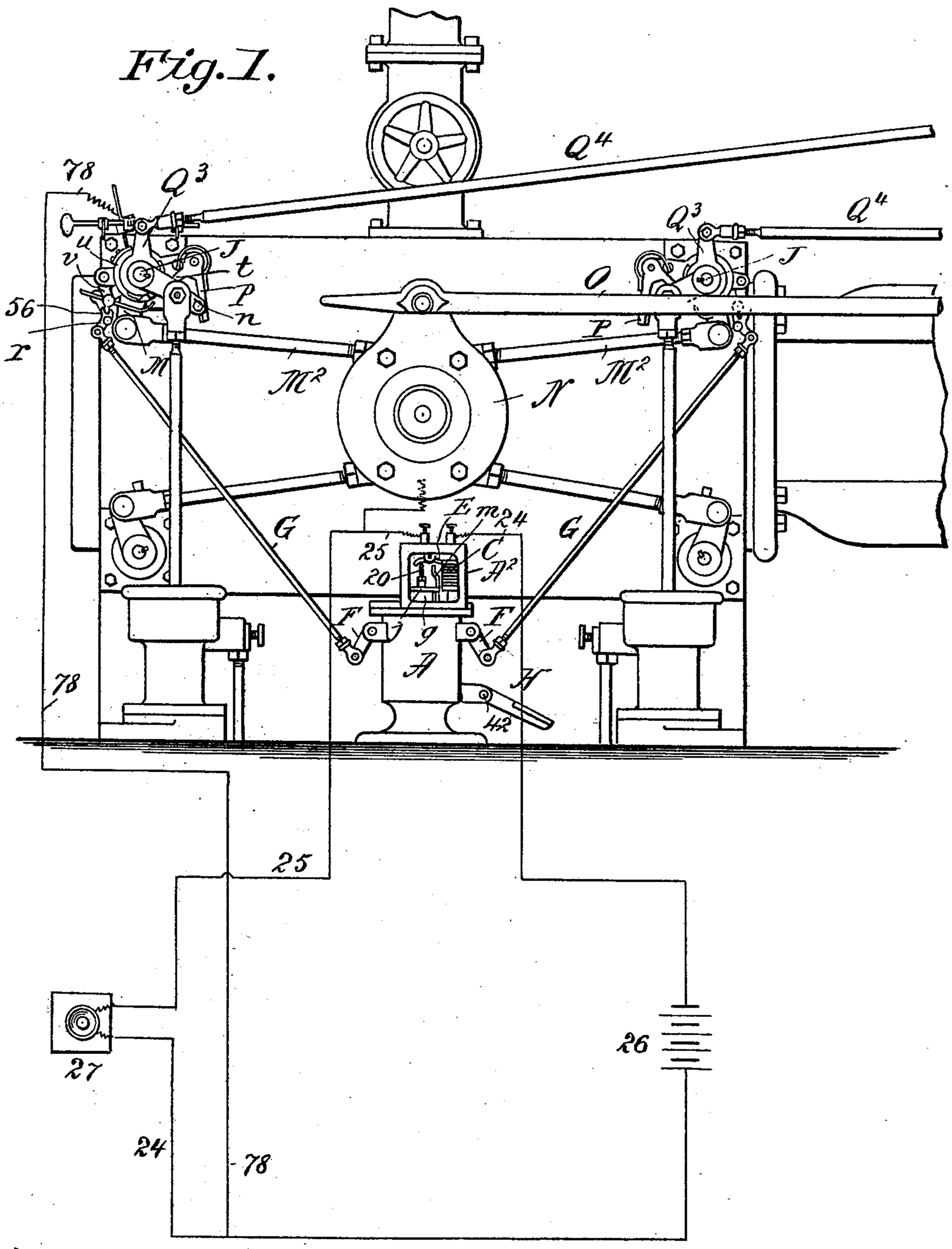
STOP MOTION FOR ENGINES.

(Application filed Aug. 2, 1899.)

(No Model.)

4 Sheets—Sheet 1.

Fig. 1.



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(No Model.) 4 Sheets—Sheet 2.

Fig. 2.

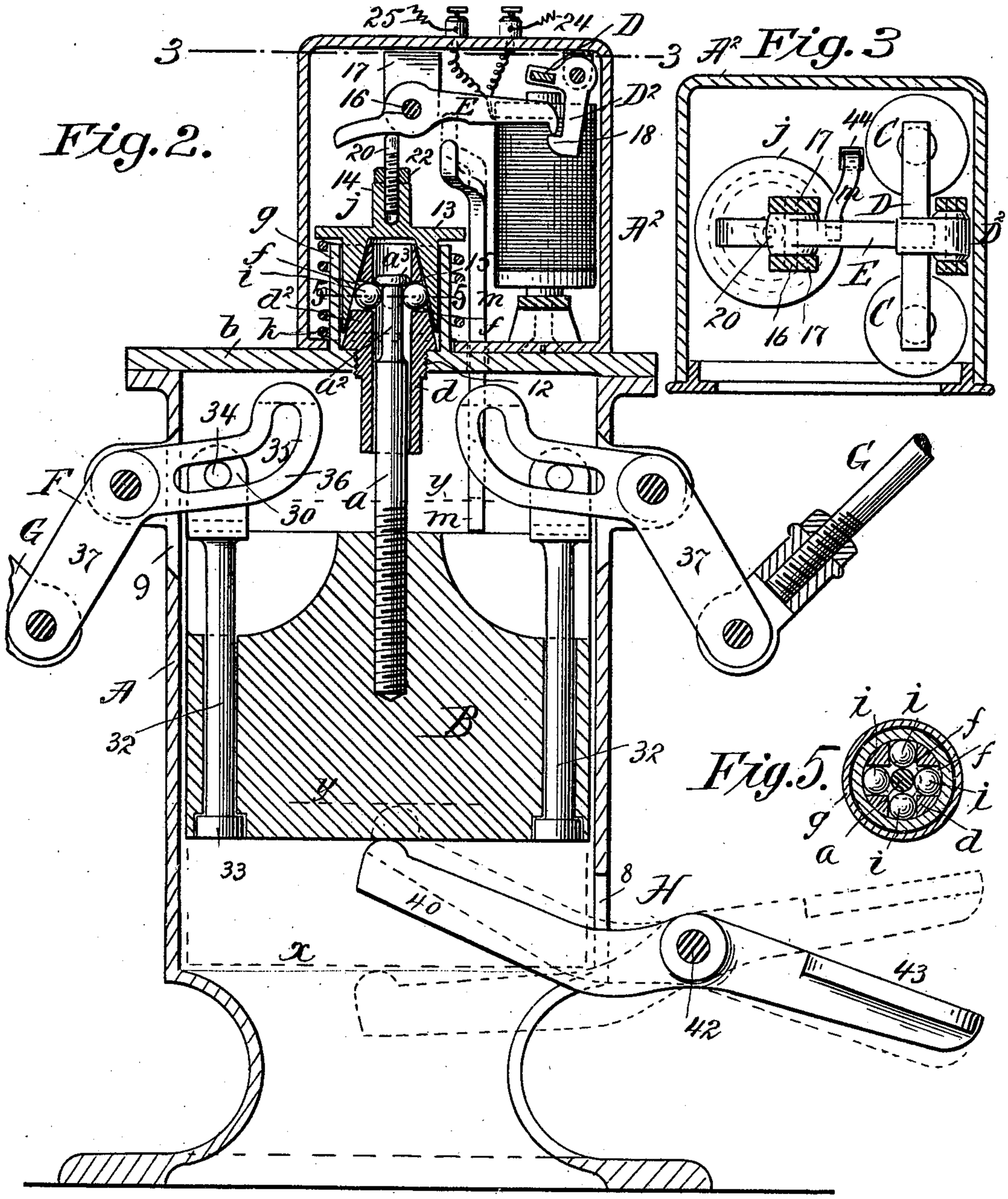
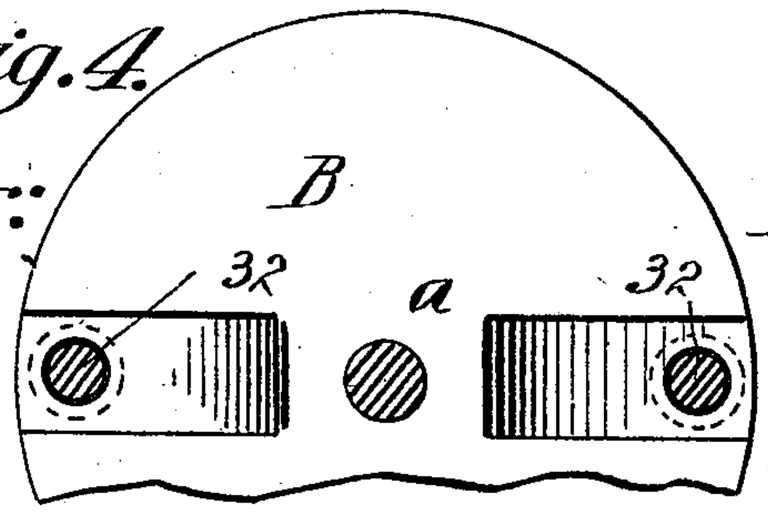


Fig. 3

Fig. 5.

Fig. 4.



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4 Sheets—Sheet 3.

Fig. 6.

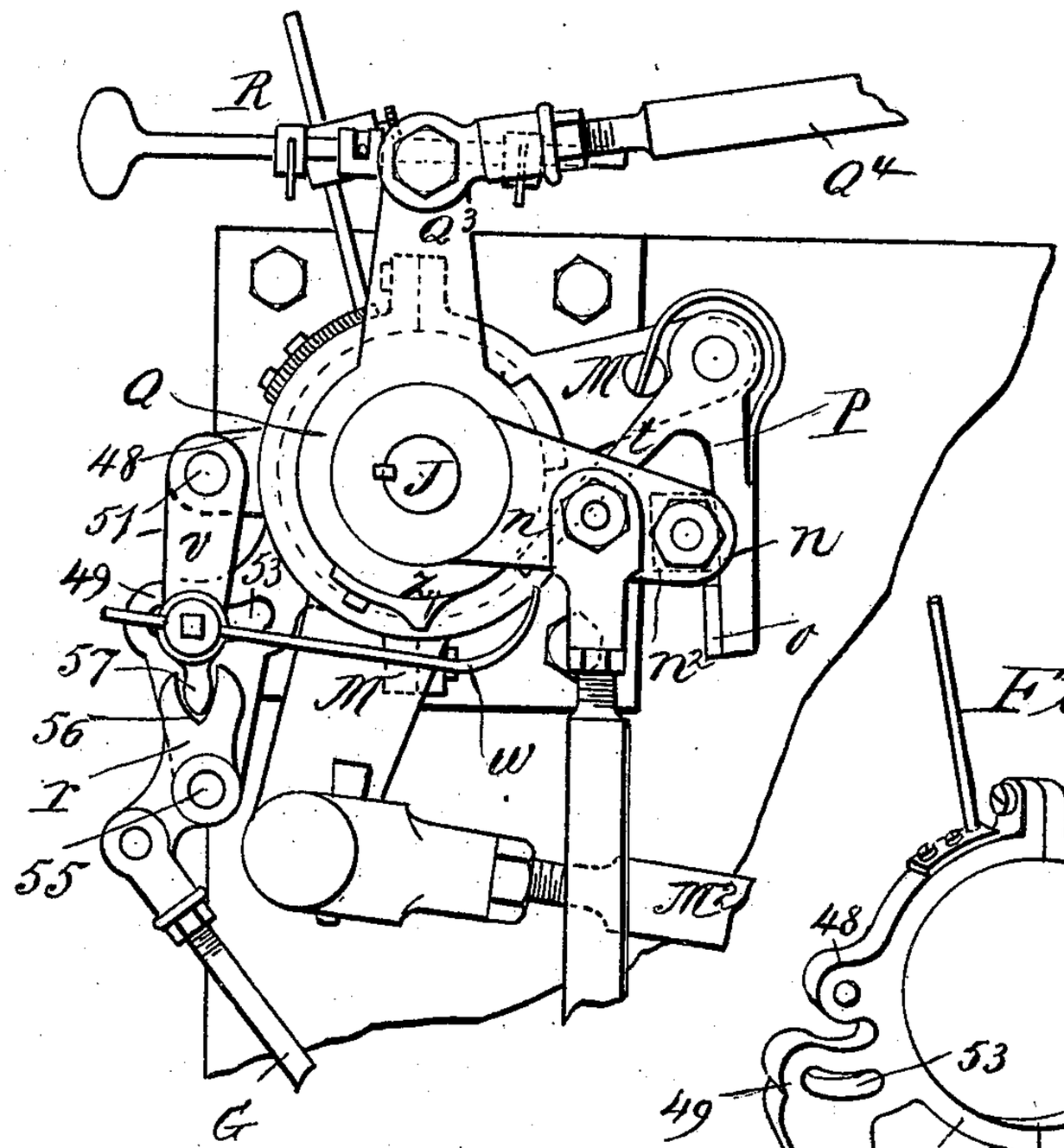
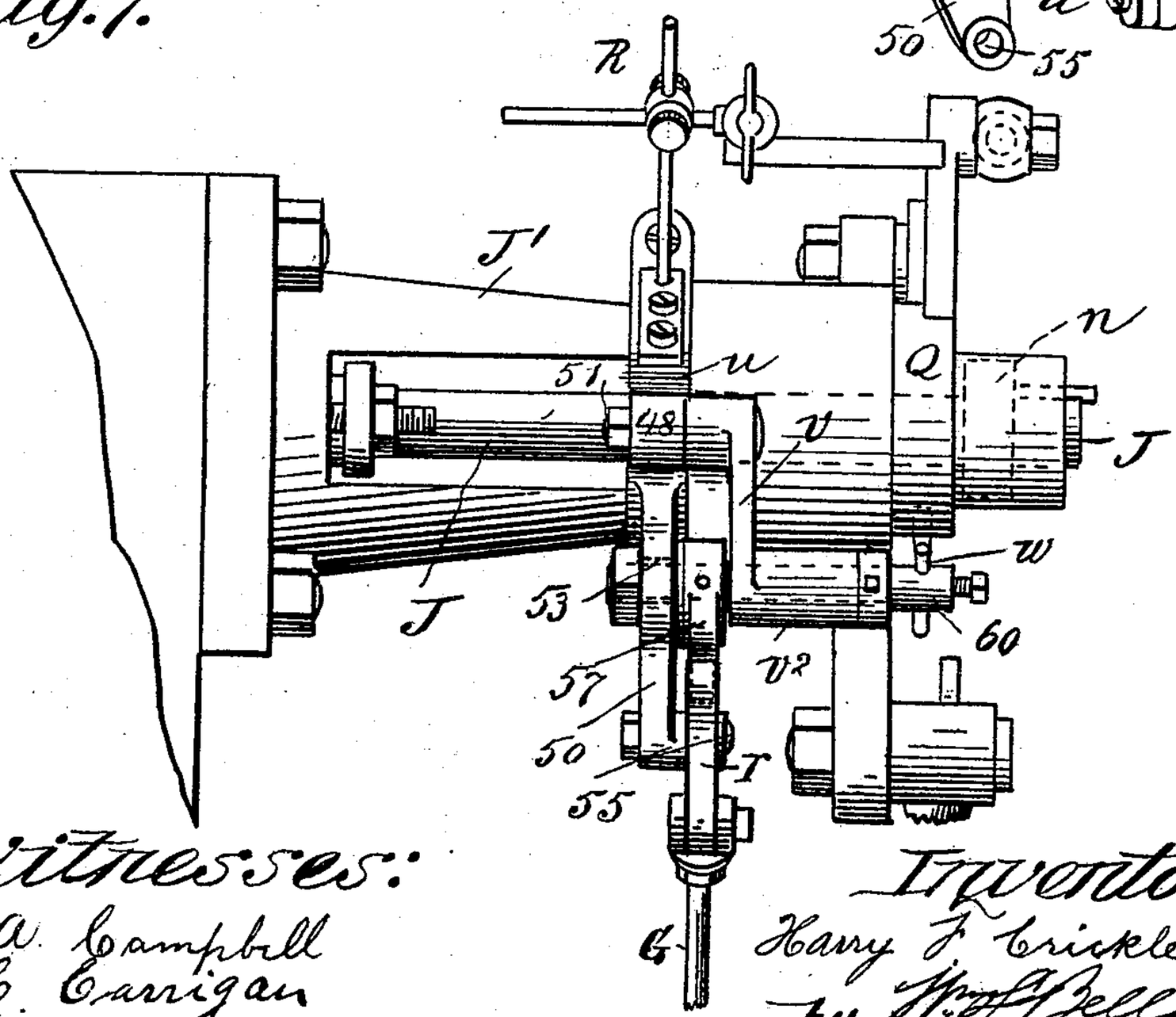


Fig. 8.

Fig. 7.



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(No Model.) 4 Sheets—Sheet 4.

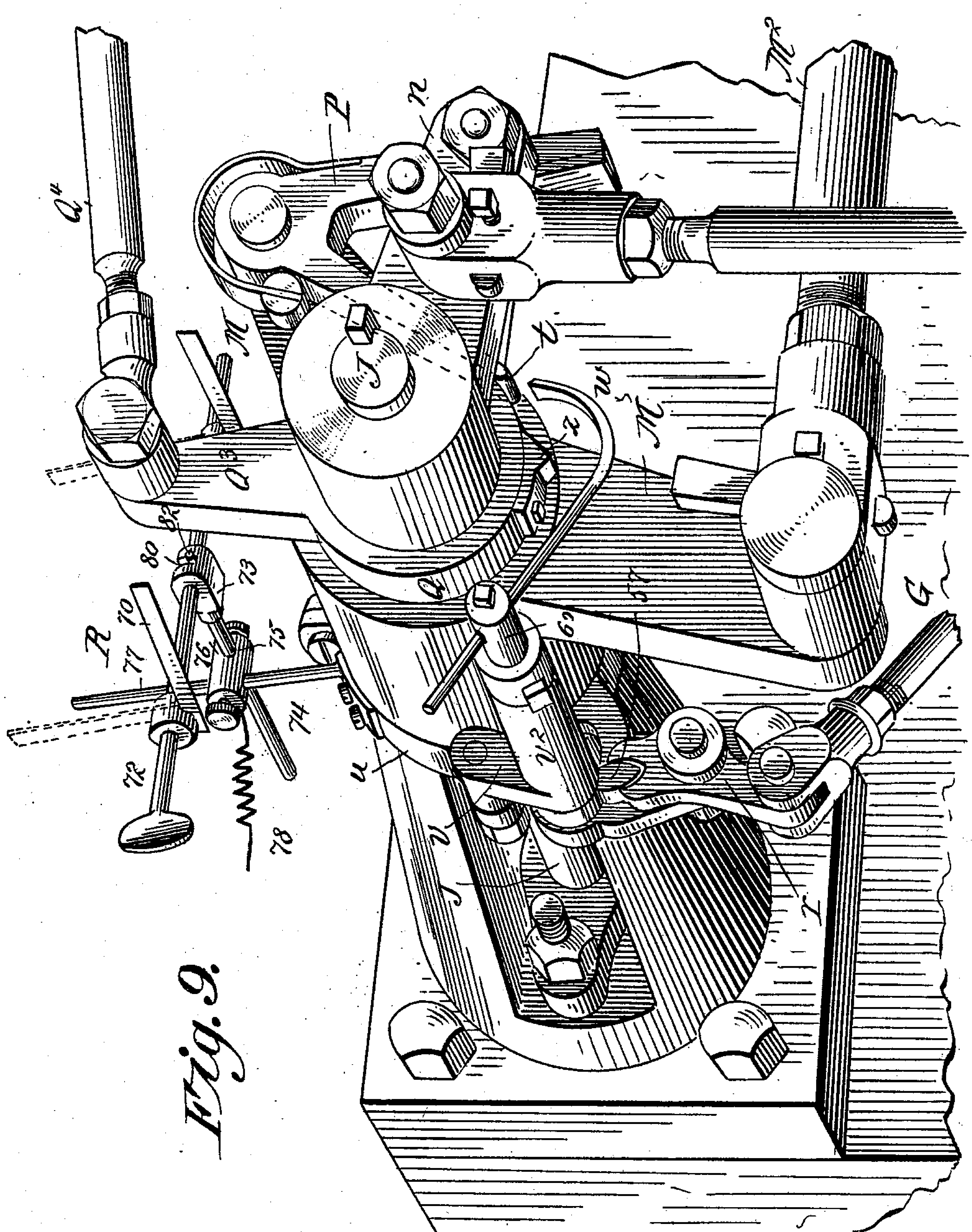

Fig. 9.

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UNITED STATES PATENT OFFICE.

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STOP-MOTION FOR ENGINES.

SPECIFICATION forming part of Letters Patent No. 646,636, dated April 3, 1900.

Application filed August 2, 1899. Serial No. 725,860. (No model.)

To all whom it may concern:

Be it known that I, HARRY F. CRICKLER, a citizen of the United States of America, and a resident of Springfield, in the county of Hampden and State of Massachusetts, have invented certain new and useful Improvements in Stop-Motions and Speed-Limits for Engines and other Machinery, of which the following is a full, clear, and exact description.

This invention relates to a novel device to serve as a stop motion or mechanism for use in a great variety of situations, whether it be operatively combined with a steam-engine or a water-wheel or turbine, electric or other motor or device, or with mechanism which controls the starting and stopping of any machine.

This invention consists in a novel stop motion or mechanism adapted to be operated by the closing of an electric circuit, whereby the comprised armature adjacent an electromagnet which is connected in a circuit and which armature has a detent engagement with a weighted member of the mechanism becomes released, leaving the weighted member free to descend, the force developed by the descending weight being utilized to actuate mechanically devices for stopping the engine or the controller of any motive power or for actuating the stopping or shipping devices of any mechanism or machinery.

The invention furthermore consists in the combination, with the mechanism aforementioned, (comprising, essentially, the weight and the novel devices coöperating therewith, which maintain it in an elevated position, which insure its liberation for descent, and which after an operation of the mechanism and descent of the weight restore it to its elevated position in readiness to be again operated,) of appliances operated thereby and which are especially devised for coöperation with the latch-links or grab-hooks of a steam-engine of the Corliss or other similar type, so that when the mechanism has been freed by the releasing movement of the armature of the electromagnet comprised therein the said appliances will assume such positions as to prevent the valve-operating actions of the grab-hooks.

The invention furthermore consists in the combination, with stop-motion mechanism, of an engine which may be of any suitable description of a novel construction of "speed-limit"—that is to say, a device operatively applied so that the stop-motion may be automatically operated by reason of any abnormal speed conditions developed by the running of the engine.

The invention also consists in constructions, combinations of parts, and appliances, all substantially as hereinafter fully described, and set forth in the claims.

Reference is to be had to the accompanying drawings, in which all the departments of this invention are illustrated, and in which—

Figure 1 is an elevation taken at the front side of the cylinders of an ordinary Corliss or analogous type of steam-engine, showing the usual mechanism which operates the steam-inlet (and also the exhaust) valves and the combination therewith or application for use in relation thereto of the present new stop mechanism and also of the improved speed-limit. Fig. 2 is a central vertical sectional view through the portion of the stop mechanism which comprises the power-weight thereof and the supporting, detaining, and releasing means therefor and the resetting device, together with a portion of the connections through which the developed force of the stop mechanism is transmitted. Fig. 3 is a plan view below the plane indicated by the line 3 3, Fig. 2. Fig. 4 is a plan view of the weight or power member. Fig. 5 is a cross-sectional view of a part of the mechanism as taken on the line 5 5, Fig. 1. Fig. 6 is a side elevation on a larger scale than Fig. 1, showing the usual grab-hook mechanism operatively applied in relation to one of the shafts of the steam-admission valves and showing combined therewith novel devices to be actuated by the power element of this novel stop-motion, shown in Fig. 2, and in turn serving when operated to render the grab-hook inoperative for its opening actions on the steam-admission valve, and this view also shows a

speed-limit. Fig. 7 is a side elevation of the same devices which are shown in front elevation in the preceding view. Fig. 8 is a perspective view in detail of a supporting-bracket to be hereinafter referred to. Fig. 9 is a perspective view of the devices shown in Figs. 6 and 7.

I will first describe that department of the invention comprising the power element held in suspension and its detaining and liberating means, which power element when liberated mechanically and forcibly imparts a movement to a lever, thrust-rod, or other medium of connection, it being understood that such forcibly-imparted movement may be utilized in a great many different ways for useful purposes, and which, as shown in the drawings here provided, operate appliances provided in conjunction with the latch-link or grab-hook devices of the valve mechanism.

In the drawings, A represents a casing comprised in a hollow standard, which advantageously may be of a general cylindrical form and in which is fitted for free vertical movement the weight B, which is of considerable bulk and preponderance. The weight is provided with the upwardly-extended axial stem *a*. The said casing A, at its top, is provided with the disk-like wall *b*, having the central screw-tapped aperture 12, in which is screw-engaged the bushing *d*, the same being enlarged above its screw-threaded portion, which is fitted with a screw engagement in the aforesaid tapped hole of the casing-top, is externally of the form of a frustum of a cone, is formed with a round axial hold or bore leading from end to end, and in its conical portion is provided with the several pockets or transverse perforations *f*. Surrounding and separated from the conical upstanding part d^2 of said bushing is the annular wall *g*, between which and the said upstanding part is the annular space downwardly contracting from the open upper mouth. The upwardly-extending stem *a* of the weight B plays upwardly within said centrally-bored part *d* and has at its upper extremity the neck a^2 and the head a^3.

i i represent hardened-steel balls provided for rotation and free rolling movement, when permitted, in the aforesaid pockets *f* of the upstanding part *d*.

j represents an annular restraining-shell comprising top 13, with central upstanding hub 14 and the depending annular hollow hub-like portion 15, externally cylindrical, but internally formed with the opening therein of frusto-conical form, said opening downwardly flaring and corresponding with the external surface of the aforementioned upstanding part d^2 of the bushing. This restraining-shell *j*, when forced downwardly, exerts an inward-crowding action on the balls *i*, so that they are forced to protrude within the bore of the part *d* and while so restrained serve to support by the head a^3 thereof the weight-stem *a*.

The portion of the upstanding externally-tapered round part d^2 has a thickness of wall through which the pockets *f* are transversely formed less than the diameter of the balls, so that when the outer sides of the balls are flush, or approximately so, with the outer surface of the upstanding conical part comparatively considerable portions of their bulk will protrude inwardly to give sufficient width of bearing engagement for the shouldered head of the weight-stem.

The casing A^2, of rectangular form, is provided upon the top of and supplemental to the casing A, the same inclosing the parts d^2, *g*, and *j* and also inclosing the electromagnets C C, the armature D, and the latch-lever E. The latch-lever is intermediately of its length, at 16, pivotally mounted in the depending ear-pieces 17, provided at the upper part of the supplemental casing A^2, the shorter arm thereof being over the center of the aforementioned restraining-shell *j*, while the longer arm of said lever is adjacent to the latch-like end 18 of the depending arm D^2 of the armature, and when the armature is in its normal position—that is, away from the magnet—the detent member 18 will be in restraining engagement with the long arm of the aforesaid latch-lever.

20 represents a vertically-adjustable screw-rod, screw-engaging into a tapped socket therefor in the upstanding hub portion of the restraining-shell *j*, said screw-rod having combined therewith the lock-nut 22, and this upstanding rod 20, when the mechanism is set in readiness to be operated by the closing of a circuit and the energizing of the electromagnet, is engaged by the short arm of the latch-lever E, so that the restraining-shell *j* is prevented from rising.

The electromagnet C is comprised or connected in a normally-open circuit constituted by the wires 24 and 25, one thereof having connected therein the battery 26, and this circuit is adapted to be closed by the push-button 27, the electromagnetic circuit and its closing devices being the same as commonly employed in electrically-operated stop-motions of the general class to which this invention appertains.

The weight has an upstanding lug or ear 30, the same being firmly united, as by being formed integral with the stem 32, penetrating through to the bottom of the weight, and having its lower end shouldered, as at 30, which lug 30 has the projecting stud 34, engaged through the curved slot 35 of the arm 36 of the two-armed lever F, and to the other arm 37 of this lever F is connected a thrust-rod, which thrust-rod and said lever constitute the medium of transmission sufficiently forcibly of the motion which the weight B has in falling, and this motion may be made available for useful purposes in an infinite number of ways, it being understood that the pressure on the button 27 to close the circuit causes the attraction of the armature C, which

in swinging to the magnet carries the detent member 18, which is constructed as a part thereof, out of the restraining engagement with the latch-lever E, so that the restraining-shell *j* may rise, whereby the balls *i i* will, by the shouldered head of the weight-stem, be crowded out of the way of said headed part of the stem, leaving the weight free to fall.

The provisions for the resetting of the above-described mechanism will be now pointed out and explained.

Beneath the weight is the arm 40 of the foot-lever H, pivoted at 42 in ear members of the upright casing A, the member 43 of this lever being external of the casing.

m represents a thrust-rod, the same being guided and playing through a vertical hole 44 therefor in the top *b* of the casing A, and the lower end of this thrust-rod *m* rests upon the top of the weight B. The upper end of this thrust-rod *m* is normally below the lower edge of the long arm of the latch-lever E, so as to be out of the way of such lever, whereby the latter may swing downwardly when liberated.

Now the weight having been liberated and fallen as low as represented by the dotted line *x* in Fig. 2, the foot-lever is employed to elevate it, not only to its height shown by full lines in Fig. 2, but momentarily up to the height indicated by the dotted lines *y*, so that the thrust-rod will swing the latch-lever E to move its long arm upwardly and to be latched by the armature-detent and to further exert through such swinging motion of the latch-lever the downward crowding by the short arm of the latch-lever of the restraining-shell, which, wedging down between the balls *i* and the surrounding wall *g*, crowds the balls inwardly and insures in such position the retention thereof, so that on then easing up on the foot-lever the weight may come to its position positively shown as supported to the shouldered top end of its stem on the balls.

In this mechanism as I have constructed it and which is illustrated in conjunction with this description the downward-crowding action exerted by the heavy weight B on the balls outwardly exerts when the latch-lever is released against the inclined inner side of the restraining-shell *j* an elevating pressure on the latter, while, on the other hand, as already mentioned, the downward pressure on said shell crowds the balls inwardly. I have, however, shown the spring *k* exerting an elevating pressure on the restraining-shell which may be employed; but I prefer to dispense with it and have dispensed with it, as the mechanism is operative in the absence thereof.

While, as aforementioned, the mechanism which has been described in detail is not limited to its use in conjunction with the valve operating and controlling devices of a steam-engine, I have used it in conjunction therewith and, as shown in Figs. 1, 6, and 9, have devised especial appliances to coöperate with the latch-link or grab-hook mechanism, and the last-mentioned appliances will be now described, after pointing out briefly the well-known parts of the Corliss-engine valve-gearing with which these appliances coact.

J represents the valve-shaft, having fast thereon the crank-arm *n*, which is provided with the engagement-block n^2. Loose about the valve-shaft J is the two-armed or bell-crank lever M, having rocking reciprocatory motion imparted thereto by means of the connection therewith of the "valve-stem" or connecting-rod M^2, which is also hung in the usual way to the wrist-plate or rocker N, to which the rocking reciprocatory motion is imparted by the eccentricr-od O, which is operated by the eccentric, as well known, on the crank-shaft of the engine.

P represents the latch-link or grab-hook, which is hung on one of the arms of the bell-crank M, the same having the hook or shoulder *o* to engage the aforementioned block n^2 of the crank-shaft lever, and this appliance also has the arm *t*, which lies as held by the spring t^2 in bearing against the periphery of the trip-collar Q, which collar is loose about the valve-shaft and is formed with the radial arm Q^3, with which is connected the reach-rod Q^4, extending thereto from the governor. Now I provide as a new device, in conjunction with this grab-hook mechanism last referred to and which is well known, a device operated by the thrust from any power element to cast off the grab-hook and render it inoperative to rotate the steam-admission valve, as follows:

u represents a clamp-ring to encircle the journal-hub J′ of the engine through which the valve-shaft extends, the same comprising the ear member 48 and the second ear member 49, with the depending lug 50. Pivoted at 51 to the ear 48 is the link *v*, having at its lower end the forwardly-standing hollow hub v^2.

57 is a tongue having its circular or hub-like upper end portion provided with a comparatively-long, rigidly-affixed, right-angularly-extending, stud 60, which is journaled through the hub v^2 and has on its projecting forward end the guard or cast-off rod *w* which is extended into proximity to, but normally separated from, the edge of the trip-ring Q or other circular portion on which the grab-hook member *t* rides. Said part 57, engaged with the hub end of the lever *v*, as mentioned, also has a projection coincident with the stud 60, (and which may be a part of said stud,) engaged loosely through the slot 53 in the aforesaid bracket *u*.

The bell-crank *r* is at its elbow pivoted, as seen at 55, to the lever-lug 50 of the bracket-ring *u*, its upper end being forked, as seen at 56, and receiving engagement therein of the depending tongue 57. Now when the stop-motion is operated, imparting a given length of thrust to the lever G, which is pivoted to said bell-crank *r*, the swinging motion of the latter imparts, first, a swinging motion of the tongue 57 and rocking motion of the stud

60, which causes the rod *w* to be swung with its extremity in contact on the trip ring or part Q of the valve mechanism over which the heel or arm *t* of the grab-hook rides, and then, secondly, a bodily movement of the said tongue 57, its stud, and the guard-rod *w*, as constrained by the depending member *v* and the projection coincident with the stud which is engaged through said slot 53, so that such arm *t* will, as it rides in its back-and-forth motion, be crowded outwardly by the curved extremity of the rod *w*, which constitutes a cam-like guard for this purpose. The reason of the means which imparts initially the swinging motion through the tongue, the rocking of the stud and corresponding swinging of the cast-off rod *w*, and thereafter the bodily motion of these parts whereby the rod *w* moves around to lie well within the path of movement of the grab-hook member *t*, is so that the device will have its proper capability for the throw-off action of the grab-hook for which it is primarily designed and yet normally have such position (shown in Fig. 6) as to constitute no obstruction to the trip projection *z* of the trip-ring Q, whereby on occasion this projection may itself (instead of member *w*) assume the casting-off position in relation to the grab-hook—that is to say, when the speed of the engine becomes so excessive that the reach-rod Q^4 is by the governor so far forwardly forced that it, through the lever-arm Q^3, places the trip-ring in the position to cast off the grab-hook.

R represents the speed-limit applied in relation to the valve mechanism to close the circuit should the engine start to race or "run away with itself" or develop an abnormal speed, whereby the stop-motion will be operated the same as if the push-button were pressed and with the same effect. The speed-limit comprises the bar or member 70, having its hub fixed on the small shaft or rod 72, which is rotationally adjustably mounted in the hub or enlarged end 73 of the rod 74, which in turn is adjustable as to its length through the transverse socket 75 of the hub 76 on the rod 77, supported upstanding above, but insulated from, the clamp-ring *u*. The bar 70 is in proximity to the trip-ring crank Q^3, not, however, to be contacted thereon, except the governor of the engine is excessively moved, whereby through the reach-rod the crank Q^3 would be thrown over into its unusual position, so as to contact on the bar 70. This speed-limit comprising the said bar 70 is in electrical connection by the wire 78, Fig. 1, with the stop-motion circuit, and the trip-ring crank Q^3 is also, through the metallic parts of the engine and as further continued by the wire 79, in connection with the stop-motion circuit. When the engine starts to race, the trip-ring crank Q^3 then being swung so far as to contact with the blade or member 70 of the speed-limit causes the establishment of the stop-motion circuit, whereby the electromagnet becoming live causes the operation of the stop-motion and the interposition of the cast-off guard *w* to prevent the grab-hooks from performing their ordinary valve-shaft-rocking actions.

The speed-limit is vertically adjustable and the contact-blade 70 is bodily adjustable along the rod 72, which, it will be seen, is adjustable in a line parallel with the crank-shaft, all whereby the speed-limit may very readily, be properly mounted to be coöperated with by the trip-ring crank and whereby, especially, the member 70 may be near or closer said crank, so that contact may be earlier or later, as predetermined.

It will be noted that the hub 73, in which the rod 72 may partially rotate, has the slot 80, in which is the pin 82, radially extended from the rod 72, which serves to limit the quadrantal swinging motion of the speed-limit blade or contact member.

When the engineer leaves the engine, he swings the speed-limit down to the position shown in Fig. 9; but when he remains about the engine he swings the speed-limit out of its coöperative relation to the crank Q^3, because when present he can detect the tendency of the engine to race and personally regulate the engine without the stoppage thereof, which latter is provided to be done automatically in exigency during his absence.

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

1. In a stop-motion, a power element, as a weight, having a headed or shouldered sustaining member, a centrally-apertured part within which the said headed sustaining member is movable constructed with one or more pockets opening inwardly, balls in said pockets, a restraining device for normally holding the balls in their positions of supporting engagement for and relatively to the shouldered weight-sustaining member, an electromagnet connected in a suitable circuit and having an armature in detent engagement with the restraining device, and a medium of transmission adapted to be operated by the released weight, for the purpose set forth.

2. In a stop-motion, the weight having an upwardly-extended stem with a shoulder, the centrally-apertured part within which said shouldered stem is movable, and constructed with radial pockets or apertures *f f* opening inwardly and also to the exterior of said part, balls in said pockets, a restraining device arranged externally of said centrally and radially apertured part for normally holding the balls in positions of supporting engagement relatively to the shouldered stem, and electromagnetically-actuated detent devices for preventing and insuring as required, the liberation of said ball-restraining device, for the purpose set forth.

3. In a stop-motion, in combination, the centrally-bored part *d* having the radial pockets opening inwardly to the central bore and balls in said pockets, the weight having the

stem provided with a shoulder adapted to play through the central bore of said part and to be sustained by the inwardly-restrained balls which protrude into the bore and engage under the shoulder, means for restraining the balls in their inward disposition, and means operative to release the restraining device to permit the balls to be disengaged from the shouldered stem.

4. In a stop-motion, in combination, the centrally-bored part *d* having the radial pockets opening inwardly to the central bore and balls in said pockets, the weight having the stem provided with a shoulder adapted to play through the central bore of said part and to be sustained by the inwardly-restrained balls which protrude into the bore and engage under the shoulder, means for restraining the balls in their inward disposition, means operative to release the restraining device to permit the balls to be disengaged from the shouldered stem, and a device elevating the weight after an operation of the mechanism, whereby the shoulder of its stem resumes its position to be engaged for support by the balls.

5. In a stop-motion, in combination, the centrally-bored part *d* having the radial pockets opening inwardly to the central bore and balls in said pockets, the weight having the stem provided with a shoulder adapted to play through the central bore of said part and to be sustained by the inwardly-restrained balls which protrude into the bore and engage under the shoulder, means for restraining the balls in their inward disposition, means operative to release the restraining device to permit the balls to be disengaged from the shouldered stem, a device for elevating the weight after an operation of the mechanism, whereby the shoulder of its stem resumes its position to be engaged for support by the balls, and mechanism operated by the weight-elevating device for insuring the resumption of the restraining device in its position for maintaining the balls inwardly crowded, and retained in their engagement with the shoulder of the weight-stem.

6. In a stop-motion, a weight, balls and ways or guides in which the same are inwardly and outwardly movable whereby they may have weight-supporting positions and engagements relatively to the weight and positions of release therefrom, a movable part adapted to impinge against the balls and to crowd and restrain them into the weight-engaging position, a detent device for said movable part for holding it in the ball-restraining position, means for liberating the detent device, and a medium of transmission adapted to be operated by the forcible movement of the weight.

7. In a stop-motion, a weight, constituting a power element; movable supports therefor; restraining means movable to force, and hold, the supports in the weight-engaging position, and comprising a detent; a medium of transmission deriving forcible motion from the descent of the weight; a weight-elevating device; and a device arranged to be operated by the elevation of the weight to operate and hold engaged, the aforesaid restraining mechanism, substantially as described.

8. In a stop-motion, a weight, movable supports therefor adapted to engage and disengage same, a restraining member to force, and adapted to hold, the supports in the weight-engaging position, and having combined therewith a latch-lever, an electromagnet having its armature serving as a detent with which said lever has a latching engagement, means for insuring the elevation of the weight, a device operating in unison with the elevation of the weight for swinging the latch-lever, whereby it both actuates the said restrainer, and assures engagement with the armature-detent, and circuit connections for said electromagnet comprising a generator.

9. In a stop-motion, a weight, movable supports therefor, restraining means coöperating as described with the said supports, the latch-lever combined in the restrainer, a detent adapted to engage the latch-lever, a weight-elevating device, a rod applied between the weight and the latch-lever serving on the raising of the weight to swing the latch-lever for insuring by such lever the resetting operation of restrainer and the reëngagement of the detent with such latch-lever, means for releasing the detent, and a medium of transmission actuated by the released weight.

10. In a stop-motion, a weight provided with the upstanding stem, having the head or shoulder a^3, the centrally-apertured part *d* within which said stem plays being externally of conical form and provided with the transverse apertures, the balls, the surrounding annular wall *g* and the restraining-shell *j*, having its internal wall flaring downwardly, the latch-lever E, electromagnet having an armature coöperating as a detent with the latch-lever, a circuit in which the electromagnet is connected, and a connection for the transmission of the force developed by the descent of the weight.

11. In a stop-motion, the combination with the weight, means for the suspension and means for effecting the liberation thereof, the lever F pivotally mounted adjacent the weight and having the curved slot 35, and a member provided on the weight engaged in said slot.

12. In a stop-motion, the hollow standard or upright casing A having an aperture 9 through its side, and having a cylindrical weight vertically movable within said casing, movable means adapted to have imparted thereto positions whereby they engage said weight for supporting the same elevated, and means coöperating therewith for the disengagement thereof, the lever F intermediately pivoted on said casing adjacent said aperture, and having the slotted arm 36 inwardly extended and the outwardly-extended arm 37, and the upstanding ear or lug provided at the top of the weight and having the stud 34

engaged in said slot of the lever-arm, substantially as described.

13. In a stop-motion, in combination, the casing A having the apertures 8 and 9 through its side, the weight B, weight sustaining and liberating mechanism, the lever F pivoted at the side of the casing and having the slotted arm 36 extended through said aperture within the casing above the weight, and having also the outwardly-extended arm 37 and an operating-arm G connected therewith, the upstanding projection 30 above the weight and the stud engaged through the slot of the arm, the lever H pivoted on the casing adjacent the aperture 8 having the inwardly-extended arm 40 beneath the weight and having the outwardly-extended pedal member 43, substantially as described.

14. In a stop-motion, the combination with the casing A having therein the weight B, provided with the upwardly-extended shouldered stem, the part *d* having a central bore having its exterior conical and provided with the transverse apertures, the balls therein, the surrounding annular wall *g* and the restraining-shell *j* having the conical-formed opening therein, of the latch-lever E, electromagnet and armature-detent, and a transmission medium operated by the descent of the liberated weight, for the purpose set forth.

15. In a stop-motion, the combination with the casing having therein the weight B, having the shouldered stem *a*, the part *d* having a central bore, having its exterior conical and provided with the transverse apertures, the balls therein, the surrounding annular wall *g*, and the restraining-shell having the conical formed opening therein, of the latch-lever E, electromagnet and armature-detent, the thrust-rod *m* interposed between the top of the weight and the under side of the latch-lever, and a transmission medium subject for its movement to the action of the descending weight, substantially as described.

16. In a stop-motion, the combination with the grab-hook mechanism for the steam-admission valve thereof, of the character described, of a guard or cast-off member adjacent the normal path of oscillation of the grab-hook which is movably mounted, the weight, means for the suspension and means for effecting the liberation thereof, the lever F pivotally mounted adjacent the weight and having the arm 36 engaged by the weight, and the arm 37, and the rod G connecting said arm 37 with the movable support for said cast-off member, substantially as described.

17. The combination with the valve mechanism of an engine, of the character substantially as described, comprising the grab-hook, and the trip-ring, of a guard or cast-off member normally located adjacent the path of oscillation of the grab-hook, and slightly distant from the edge of the trip-ring, a support on which it is mounted having compound movements whereby the guard is first moved toward the ring, and thereafter along the ring, a mechanism comprising a power element, electromagnetic devices controlling the same, and a medium of transmission connected between said power element and said movable support for the cast-off device, for the purposes set forth.

18. The combination with the valve mechanism of an engine, substantially as described, of the fixed part having a curved slot 53, the bell-crank *r* pivotally mounted, the lever *p* also pivotally mounted above the said bell-crank, and having the lower extremity thereof formed with a journal-opening therethrough, the tongue 57 having the stud 60 in bearing through said journal-opening, and having at its outer end the guard-rod *w* adapted for coöperation as described, with the grab-hook, and said tongue being engaged with the bell-crank, a projection extended backwardly from said tongue in engagement through said slot 53, and mechanism for imparting a rocking motion to said bell-crank, for the purposes set forth.

19. The combination with the valve mechanism of an engine, substantially as described, of the pivotally-mounted lever *v* having in its extremity the journal-opening, the tongue 57 having the stud 60 journaled through said opening in said part *v*, and having the cast-off or guard-rod *w*, means for imparting primarily an independent swinging motion of the tongue 57 whereby the guard-rod is presented in contact on the part of the valve-gearing on which the grab-hook rides, and secondarily, a bodily movement of the tongue and guard-rod as constrained by the connected part *v*, substantially as described.

20. The combination with the valve mechanism of an engine, of the character described, comprising the governor-operated trip-ring crank Q^3, and a stop-motion for the engine which is electromagnetically controlled comprising a contact member mounted adjacent the said crank and adapted to be contacted on thereby when such crank is excessively moved under an abnormal running of the engine, said crank and contact being connected in the stop-motion circuit, for the purpose set forth.

21. A speed-limit comprising the contact bar or blade 70, and a support therefor whereby the same is mounted adjacent the trip-ring crank of the valve mechanism, said blade being adjustable forward and back in the direction of throw of said crank, and also adapted to be moved out of the path of its movement, said blade and crank being connected in a stop-motion circuit, for the purpose set forth.

22. The combination with the valve mechanism of an engine, of the kind shown, comprising the trip-ring crank, and with a stop-motion for the engine having electromagnetic controlling apparatus therefor, the speed-limit substantially as shown, comprising the upstanding rod 77 having member 76 vertically adjustable thereon, the rod 74 transversely

adjustably supported by the part 76, and having in the enlarged end thereof the slot 80, the rod 72 playing through the enlarged end of said rod 74 having the limiting-pin 82 the contact-blade 70 movable along the rod 72, and also adapted for a swinging movement thereon, said contact-blade and the trip-ring crank being both electrically connected with the electric-circuit connection of said stop-motion for the engine.

Signed by me at Springfield, Massachusetts, this 28th day of July, 1899.

HARRY F. CRICKLER.

Witnesses:
WM. S. BELLOWS,
M. A. CAMPBELL.