J. B. POLO.

STARTING AND STOPPING MECHANISM FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED JUNE 23, 1909.

957,372. Patented May 10, 1910.

6 SHEETS—SHEET 1.

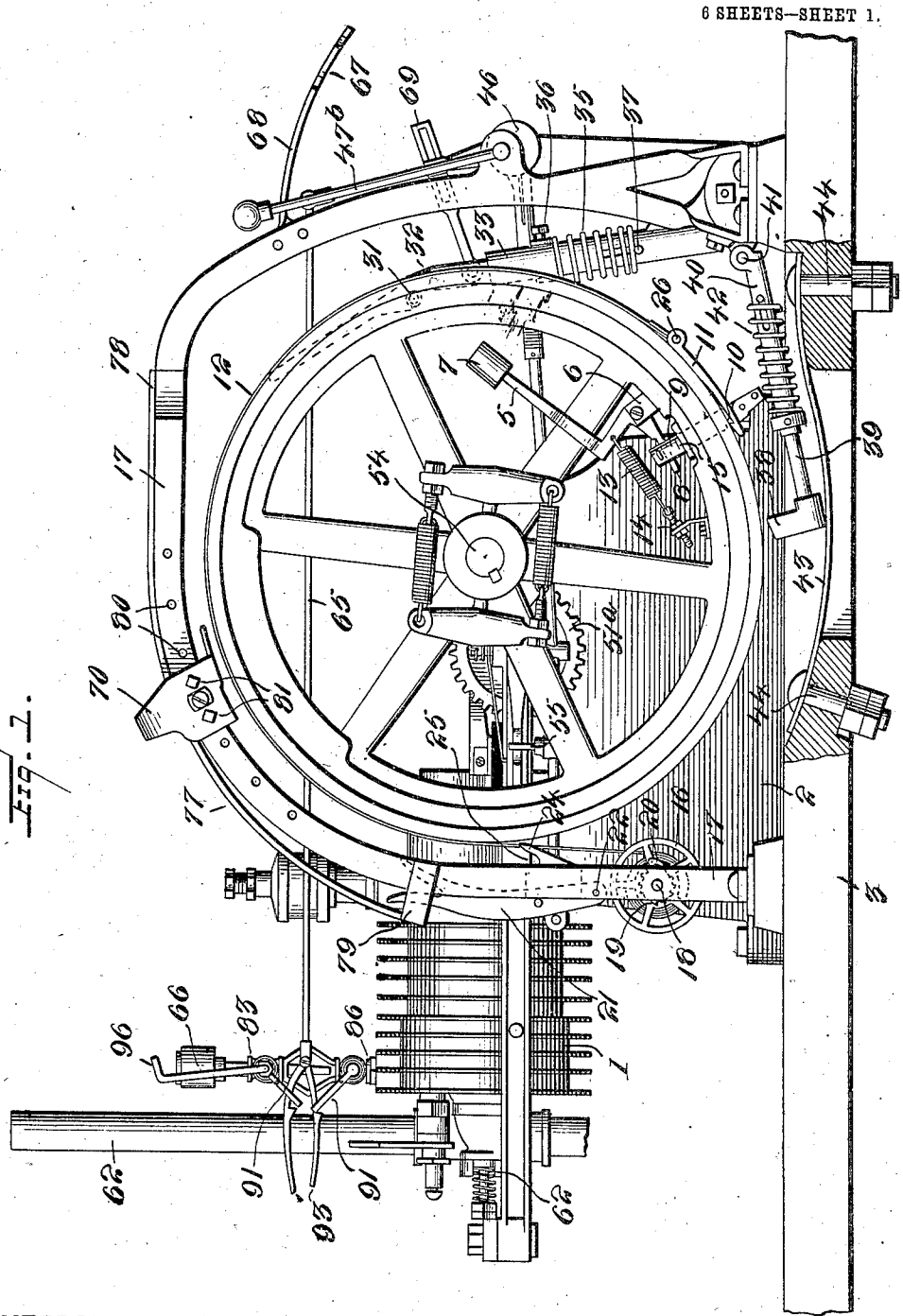

Fig. 1.

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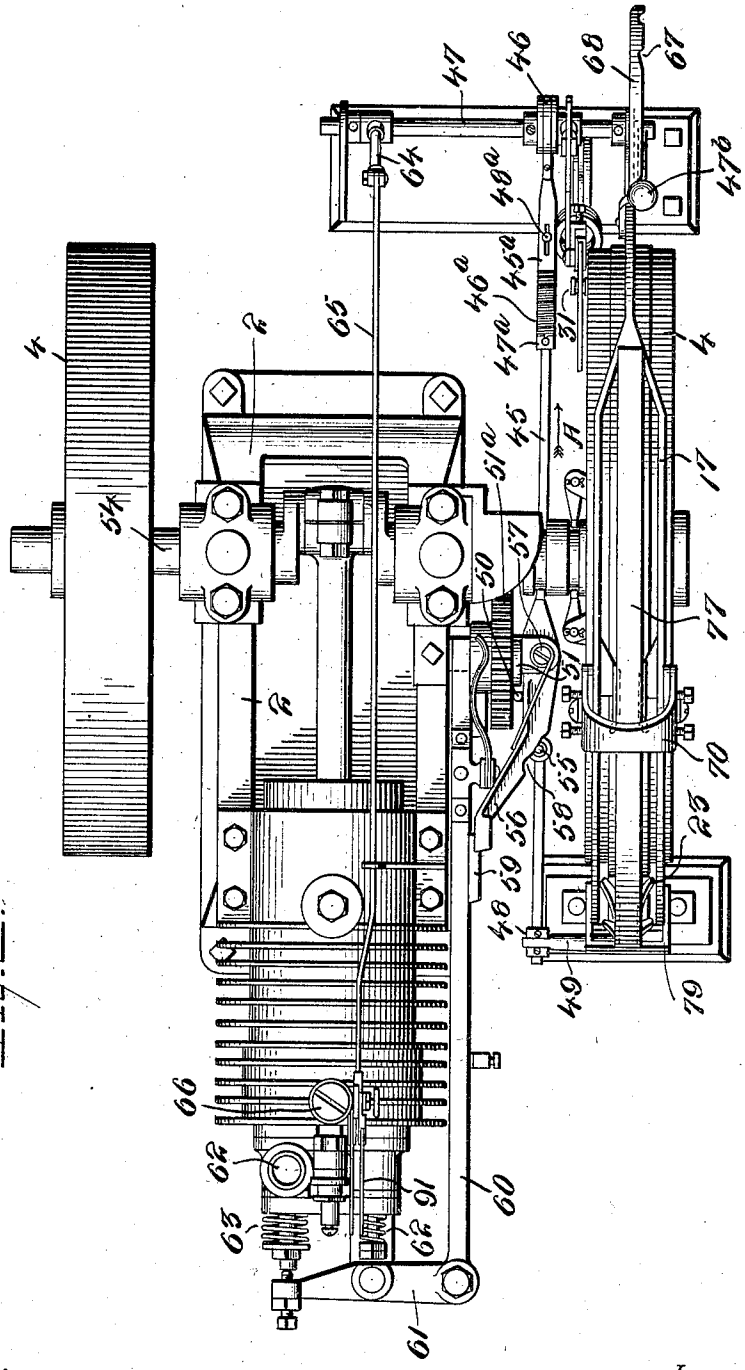

Fig. 2.

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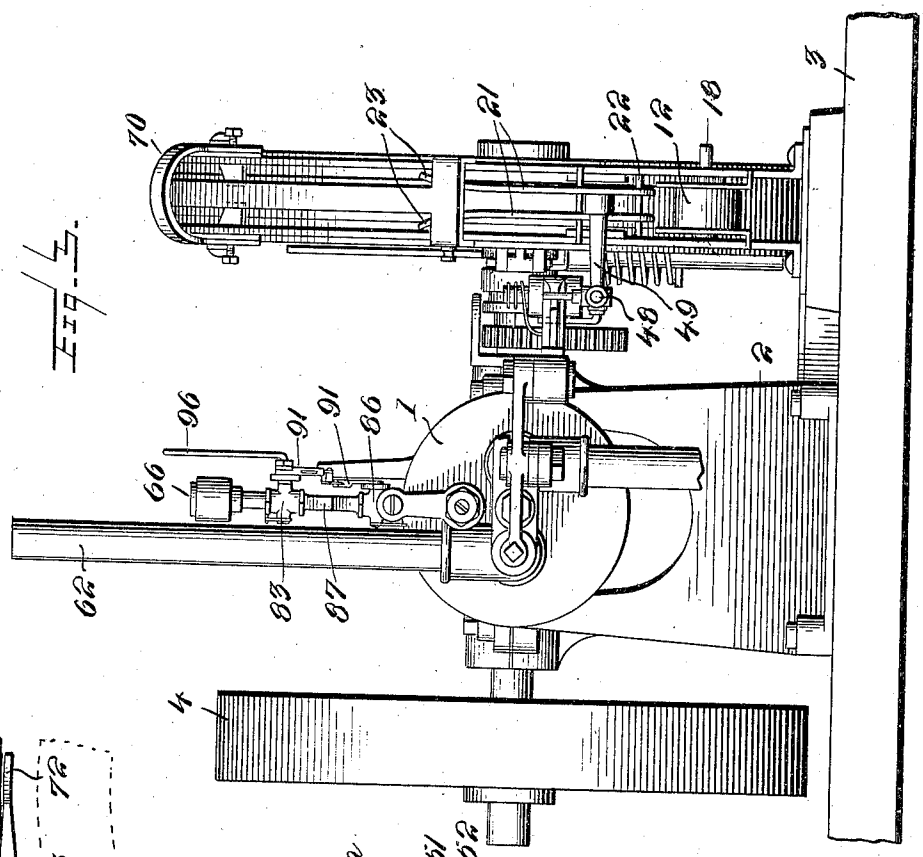

Fig. 4.

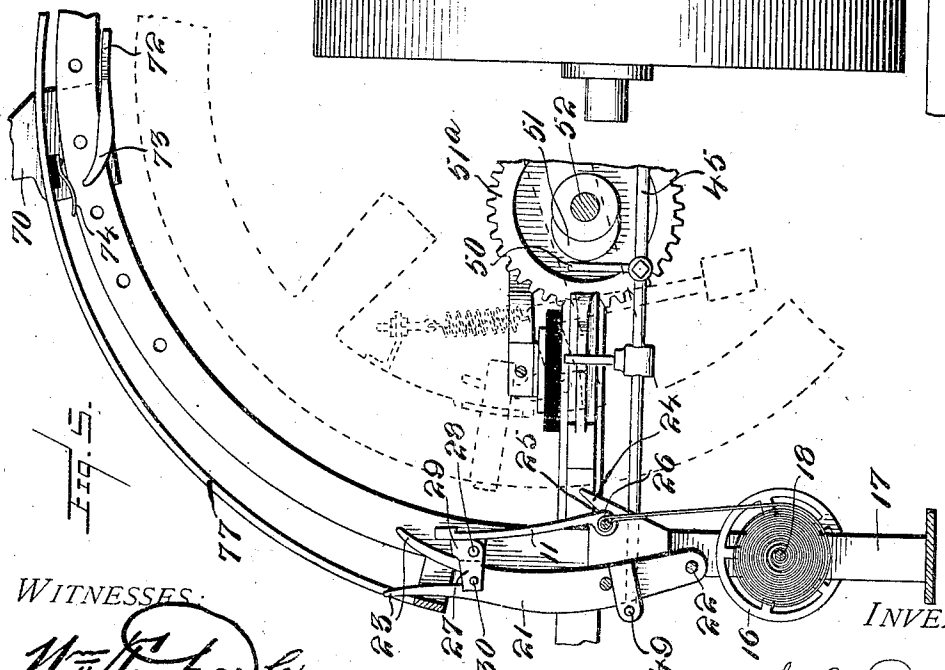

Fig. 5.

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Fig. 4.

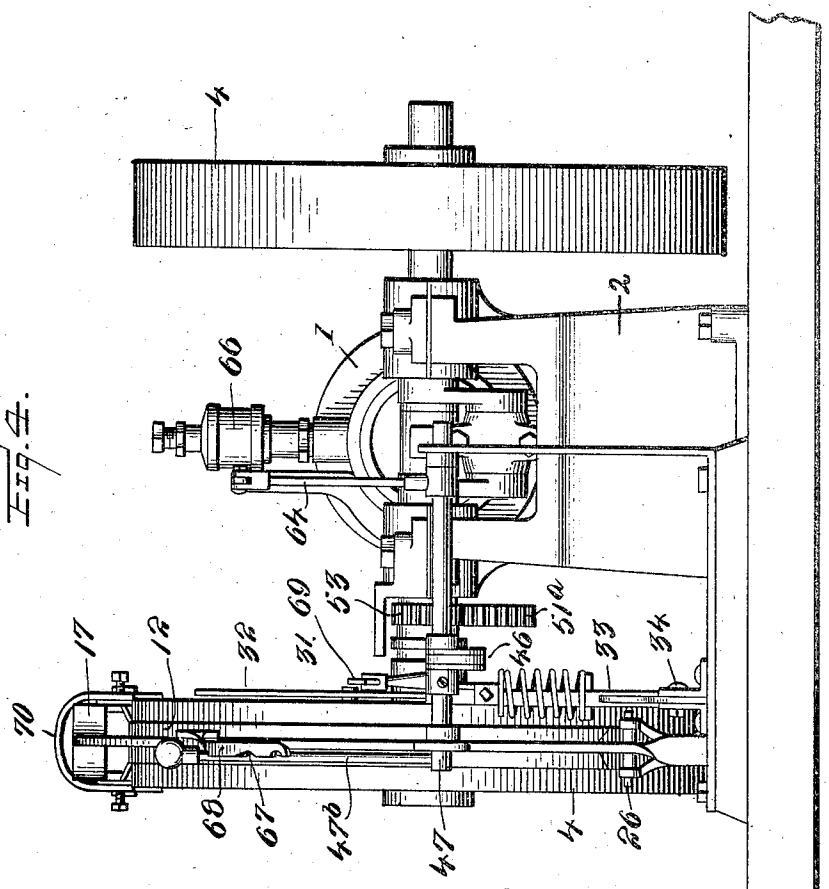
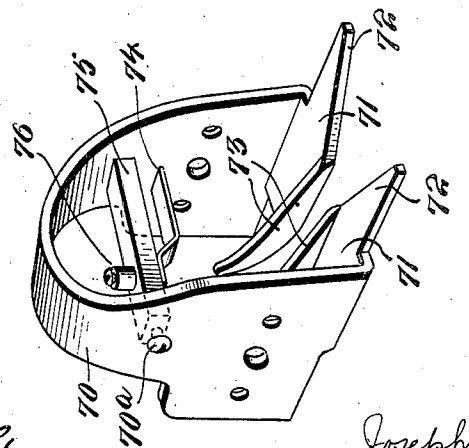


Fig. 5.



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6 SHEETS—SHEET 5.

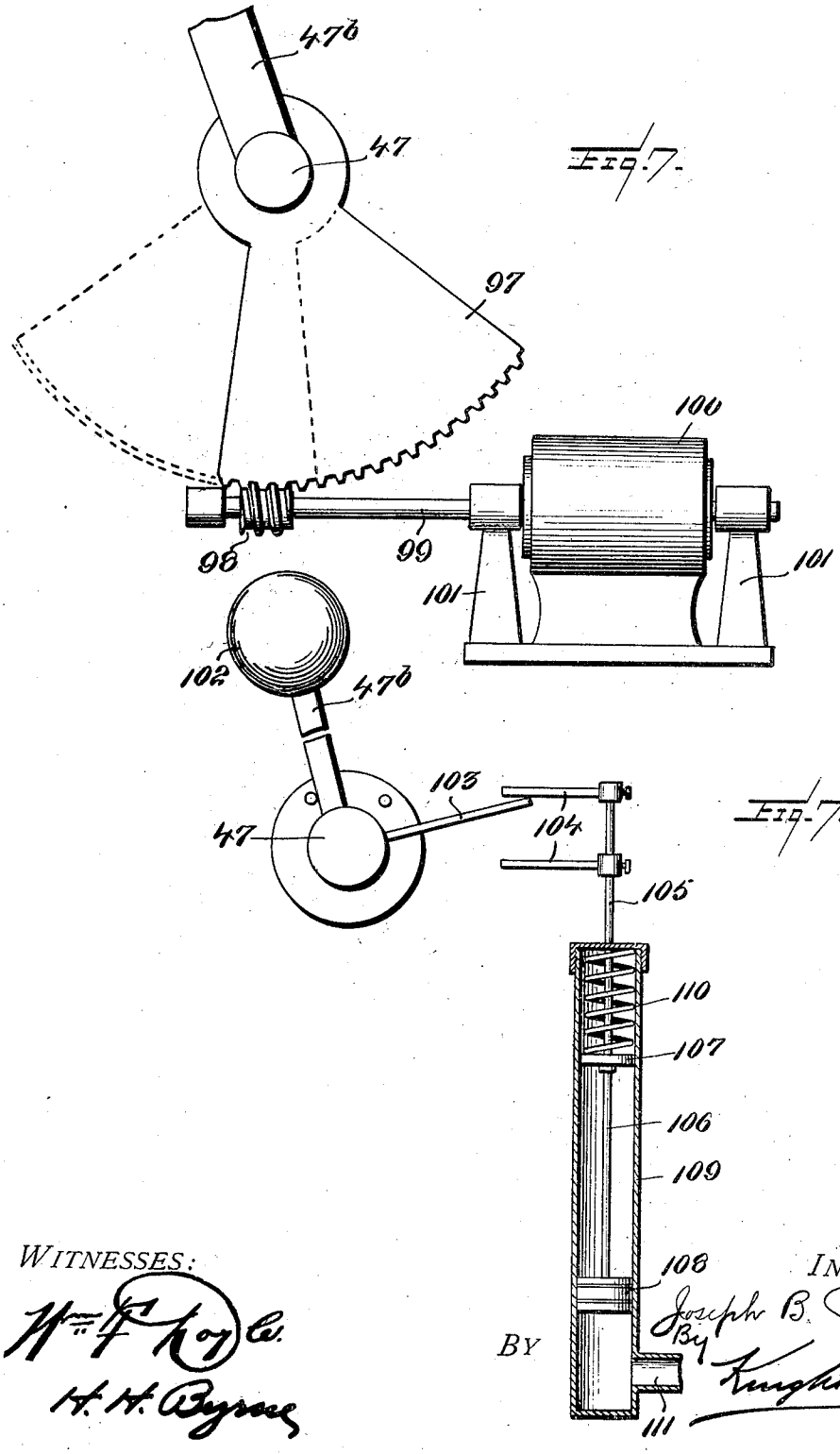

Fig. 7.

Fig. 7a.

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6 SHEETS—SHEET 6.

Fig. 10.

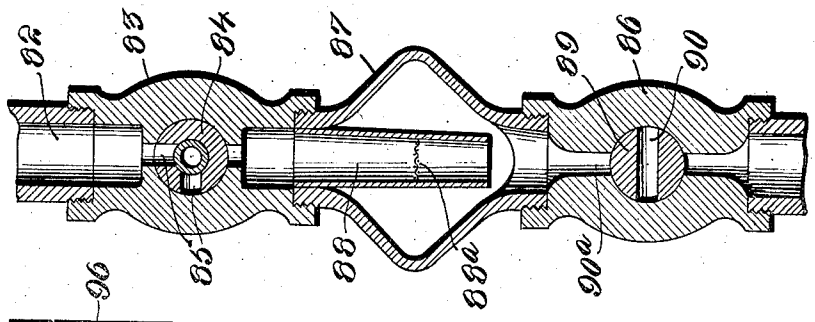


Fig. 9.

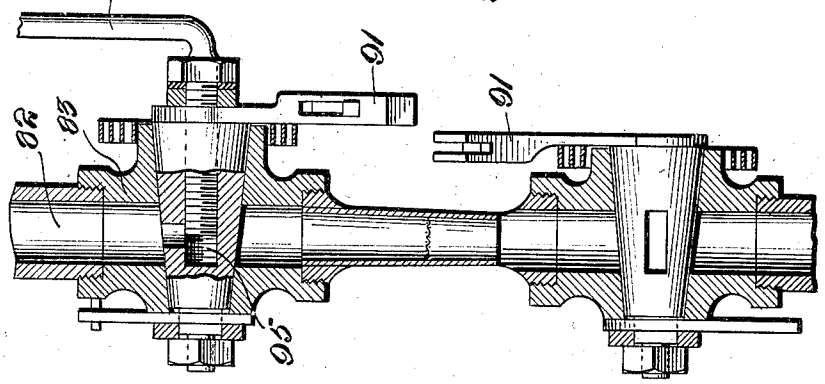
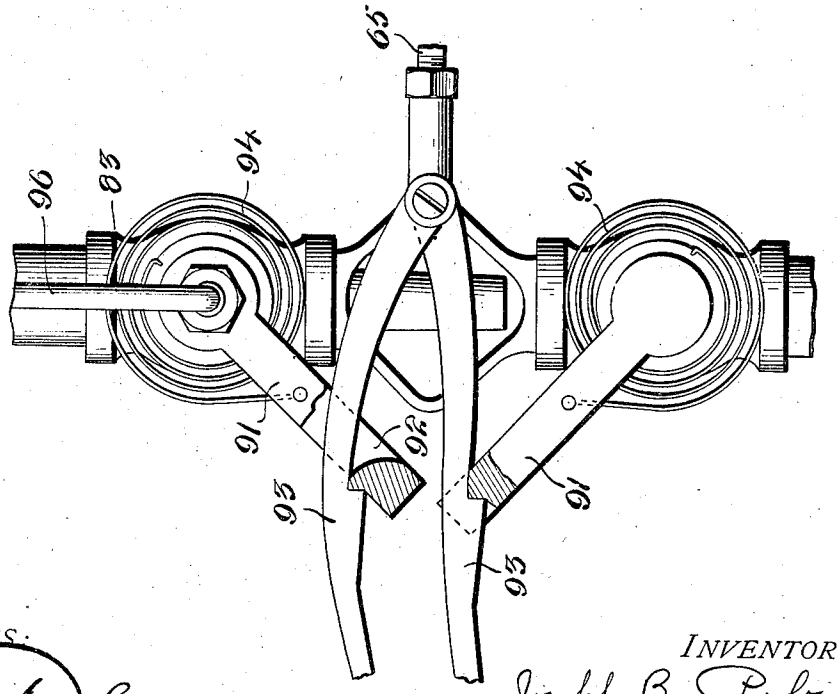


Fig. 8.



WITNESSES:

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UNITED STATES PATENT OFFICE.

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STARTING AND STOPPING MECHANISM FOR INTERNAL-COMBUSTION ENGINES.

957,372. Specification of Letters Patent. Patented May 10, 1910.

Application filed June 23, 1909. Serial No. 503,949.

To all whom it may concern:

Be it known that I, JOSEPH B. POLO, a subject of the Emperor of Austria-Hungary, residing at Clear Lake, in the county of Deuel, State of South Dakota, have invented certain new and useful Improvements in Starting and Stopping Mechanism for Internal-Combustion Engines, of which the following is a specification.

The present invention pertains to internal combustion engines and has for its purpose to provide a means for automatically imparting to the same its initial or preliminary cycles of movement, sequentially to which the regular explosive operations will occur; and wherein the starting mechanism employed serves also as a means for positively arresting the engine on its stopping movement.

The invention is designed with especial reference to explosive engines of that type employed for pumping water wherein the running of the engine is required only periodically, and which can therefore appropriately use a means for starting and stopping the same such as the aforesaid. The mechanism is, however, equally as applicable to combustible engines used on automobiles to which end the structure is subject to the necessary changes.

Summarily stated, the invention comprises a centrifugally actuated means carried by the fly wheel and adapted to engage and distend a coil spring on the "slow-down" or stopping movement of the engine and positively arrest such movement; and which coil by this distention provides the power necessary for imparting to the fly wheel its initial turn. Just preceding the arresting of the fly wheel the exhaust valve is opened and kept temporarily so whereby to overcome suction. And for effecting the starting of the engine there is a manually operated lever which on its starting movement effects the priming of the cylinder from an auxilliary source, and which on its final movement causes the releasing of the fly wheel whence the fly wheel turns under the impulse of the tensioned spring a distance sufficient to compress the admitted charge, which charge is ignited through the closing of an auxiliary circuit that is effected instantly the spring is disconnected from engagement with the fly wheel.

In this order of construction and operation, the invention will be hereinafter described, reference being had to the accompanying drawings wherein is shown the invention in its preferred structure.

In the drawings, Figure 1 is a side elevation of an engine showing the application of my invention thereto, Fig. 2 is a top plan view thereof, Fig. 3 is a front elevation of the same, Fig. 4 is a rear end elevation, Fig. 5 is a detail view of the starting and stopping mechanism, Fig. 6 is a detail perspective view of the starting mechanism release and auxiliary circuit closing means, Figs. 7 and 7ª illustrate means for operating the device, Fig. 8 is a side elevation of the primer, Fig. 9 is a longitudinal sectional view thereof, and Fig. 10 is a similar view taken at right angles to Fig. 9.

Referring in detail to the several figures and wherein like characters of reference indicate corresponding parts in the different figures shown, 1 designates the engine cylinder, 2 the frame and 3 the base, all of which parts are of the usual gas engine construction to which the present invention is applicable. To one of the usual fly-wheels 4, preferably that one selected for the present illustration, a centrifugal actuated device 5 is fitted by being journaled to a stud 6 which projects from the inner periphery thereof. The centrifugal device comprises an angle bar to one end of which is fitted a controlling weight 7 and at its opposite end 8, the bar is reduced whereby to move within a slot formed on the inner end of a radially disposed pin 9 that projects through the rim of the fly-wheel. The pin 9 is adapted to have lateral movement in its mounting, whereby the outer end thereof projects beyond the fly-wheel at times controlled by the centrifugal action of the weight 7 and when thus projecting, its hooked end 10 is adapted to engage the correspondingly shaped end of a link 11 that is carried by the tensioning means 12 in such manner as that shown in Fig. 1. This engagement is timed to occur on the "slow-down" or stopping movement of the fly-wheel and to render its operation more positive, the arm 5 has connection with a tensioning spring 13 whose other end is anchored at 14; through this medium it will be obvious that the pin 9 will be projected

into operative position when centrifugal force practically ceases to act upon the weight 7. To limit the outward movement of the engaging pin 9, a stopping member 15 is provided.

The tensioning means 12 comprises a coil spring carried by a reel 16 that is fixed within the frame 17 in such manner that the distention of the spring *i. e.* when it is engaged by the pin 9 of the fly-wheel, effects to provide power, which in the present instance is utilized for a twofold purpose viz. to arrest the rotation of the fly-wheel; and to impart the initial turn thereto on the starting of the engine. For regulating its tensile strength, the arbor 18 upon which the spring is coiled may be turned by a key or other means and for holding this adjustment, a pawl and ratchet 19 and 20 respectively is provided. When the spring 12 is in position to be engaged by the pin 9 of the fly-wheel it is in substantially that position shown in Fig. 5 and when so positioned the link 11, which it carries pivoted to its end, is held under tension within a pair of receiving bars 21 which are fulcrumed to oscillate at their lower ends 22. Each of the oscillating arms 21 is bifurcated at its upper end to form a pair of receiving prongs 23 and on its lower edge adjacent the fly-wheel, is formed with a projecting piece 24, the purpose whereof being to provide a crotch 25 in which is adapted to lie the projecting ends of the pivot pin 26 of the link 11 in precisely that manner shown in Fig. 5. On its upper and outer end, the link 11 is fitted with a toggle 27 pivoted thereto at the point 28. The toggle 27 has an extended portion 29 which permits the toggle to turn in the direction of the pivot pin 26 but prevents its movement in the opposite direction, the purpose of which movements will be presently made clear. On the outer end of the toggle there is a pin 30 which projects beyond either side thereof, whereby to engage within the crotch formed by the portions 23 when the link 11 is in position to be engaged by the pin 9 (see Fig. 5).

From the foregoing, it will be clear that when the pin 9 projects beyond the fly-wheel, which as stated occurs on the "slow-down" movement of the latter, the hooked end 10 of said pin engages the link 11 and carries the same from the position shown in Fig. 5 to that position shown in Fig. 1 thus distending the spring 12 the circumferential distance of the fly-wheel between those points, and in this position the fly-wheel is held by reason of a stud 31 which it carries coming into engagement with the detent 32 as shown in Figs. 1 and 2.

The detent 32 comprises a bar telescoped within a post 33 which is fulcrumed at its lower end 34 to the machine base as shown in Fig. 4; and for permitting relative movement between the detent and the post 33 whereby to permit a cushioning effect of the lock connection 31, the post 33 has a spring 35 which engages a collar 36 carried by the post and a pin 37 carried by the detent. The engagement between the fly-wheel and the spring 12 is timed in such manner that such engagement will usually effect the arresting of the latter's movement at approximately the time when the stud 31 passes the engaging point of the detent 32 whence the locking of the fly-wheel occurs. However, a safety device is provided in the event of this securement not being effected, *i. e.* should the link 11 be carried any substantial distance beyond that point where it is shown in Fig. 1. In this event the link 11 would abut against the buffer block 39 which by reason of its peculiar mounting would take up or cushion such movement and thereby prevent the distortion of the spring 12 or disarrangement of its associated parts. The buffer block 38 is fixed to one end of a plunger 39 that telescopes within a bar 40 which is fulcrumed at 41 to the machine frame. A buffer spring 42 is interposed between fixed members on the plunger 39 and the bar 40 in the same manner as that connection on the detent 32 and the bar 33 above described. In its position for action the buffer block 38 lies upon an arcuate bedplate 43 which is secured to the base of the machine by bolts 44.

In order that the arresting of the fly-wheel may not occur when the shaft is on the wrong dead center, *i. e.* with respect to the pitman, a means is provided which effects this result by preventing the engagement of the fly-wheel with the spring 12 except at the proper period. This means comprises a horizontally disposed rod 45 which is supported by an eccentric connection 46 to the operating or starting shaft 47, which shaft is journaled in a convenient position at one end of the machine. An operating lever 47^b is the means whereby the shaft 47 is turned for actuating the rod 45. At its opposite end the rod 45 has a turning connection 48 with a stud 49 which stud is mounted upon and moved with the oscillating bars 21. Toward the end of its eccentric connection, the bar 45 is provided with means for having relative movement between the points 46 and 48. This means comprises a sleeve 45^a within which telescopes the end of the bar 45. and at this point a spring 46^a is interposed, said spring abutting against the sleeve 45^a, and a collar 47^a fixed to the rod 45. A pin 48^a upon the rod 45 projects through a slot in the sleeve 45^a and serves to prevent relative rotation between the rod 45 and said sleeve. At another point intermediate its ends, the rod 45 has fixed thereon an upwardly disposed finger 50 which is adapted to be acted upon by a cam 51 which cam is

carried by a pinion 51ª that is mounted upon a counter-shaft 52 supported by the framework 2. The pinion 51ª meshes with a pinion 53 on the main or fly-wheel shaft 54 and the relative gearing between these pinions is such that it takes two complete revolutions of the pinion 53 to effect one revolution of the pinion 51ª. The position of the cam 51 with respect to the crank shaft 54 is such that said cam will engage the finger 50 and move the rod 45, stud 49 and consequently the arms 21, when the crank shaft 54 is on its wrong dead center; that is, through the means just described, the arms 21 holding the link 11 are moved away from the fly-wheel when the crank shaft 54 is in the position opposite to that it would have when compressing a charge. It is understood of course that these operations are occurring only when the lever 47ᵇ has been thrown to such position as to effect the stopping of the engine, since at all other times the finger 50 is moved clear of the cam 51 by reason of the eccentric 46.

With the throwing of the lever 47ᵇ to its position for stopping the engine a means is operated which effects to open the exhaust and keep the same in that position during the few remaining cycles of movement of the piston. Said means comprises a second finger 55 carried by the rod 45 adapted to impinge the arm 56 pivoted at 57 and which comprises a part of the usual explosive engine. When the rod 45 is moved in the direction of the arrow A, the pin 55 riding within the notches 58 moves the bar 56 into that position where it would engage the block 59 on the reciprocating shaft 60 and thus cause said shaft through the medium of the crank 61 to open the exhaust 62 and hold the same in that position until the lever 47ᵇ is removed in reverse direction, whence the exhaust valve 62 is closed by the spring 63 after the usual manner. Assuming that the engine has been stopped through the utilization of the present device and that the fly-wheel is under the tension of the spring 12 in that manner shown in Fig. 1, it may be now further assumed that the engine is to be started. Immediately the lever 47ᵇ is moved to the rearward, the eccentric 46 acting through the bar 45 moves the pins 50 and 55 from functional position and permits the arm 56 to disengage the shaft 60 whence the exhaust is closed. Further movement of the starting lever causes the shaft 47 to turn the arm 64 keyed thereon to pull a rod 65 and actuate mechanism on a primer 66 and cause the same to deliver a charge into the cylinder, the structure of which primer and its manner of operation will be described later in further detail. When the cylinder has been primed the starting lever has reached substantially that position indicated by the notch 67 in the quadrant arm 68. The final movement of the starting lever withdraws a link 69 carried by the detent 32 and causes said detent to disengage from the stud 31. Thus free the fly-wheel is rotated through the medium of the spring 12 a distance sufficient to compress the primary charge in time for its ignition, which ignition is likewise timed to occur at the instant the link 11 is disconnected from the fly-wheel. This latter is effected in the following manner.

A releasing device 70 is mounted upon the arms 17 which arms span the fly wheel and are anchored to the machine frame base. The releasing device has its lower edges turned inwardly as at 71 whose forward portions are partly cut away to readily permit the entrance of the toggle 27 carried by the link 11. The inner adjacent edges of the members 71 are disposed to incline upwardly as shown in Fig. 6 and have for their function to engage the projecting ends of the pin 30 and cause the same to be lifted whereby to release the link 11 from engagement with the pin 9, whence the said link and toggle are returned to their normal or resting position which is precisely that shown in Fig. 5. In riding up the inclined members 73, the toggle 27 is brought into such relation to the terminal plate 74 as to cause the same to contact and make the necessary circuit for creating the spark to ignite the primary charge. The plate 74 is mounted to the under side of an insulating block 75 by the terminal plug or screw 76 to which connects also the wire of the circuit. The block 75 is held within the side plates of the releasing member by screws 70ª or otherwise. On that movement of the spring which effects the initial turning of the fly wheel the link 11 and toggle 27 would ordinarily be thrown out of a true returning position and to insure such proper return a guiding strip 77 is provided which strip extends from the top of the arch frame 17 where it is secured at 78 to a point where it is secured adjacent the prongs of the oscillating arms 21 by the yoke 79. The arch frame 17 is provided with a plurality of holes 80 within which may be secured bolts 81 carried by the member 70 for adjusting the same whereby the compression of the primary charge and the firing point thereof may be regulated.

The priming device 66 is disposed on the engine cylinder precisely over that point where the sparking occurs in order that when the priming charge is admitted to the cylinder it will strike or shower upon the spark plug to facilitate igniting the charge. The purpose for effecting this is to eliminate the need of a carbureter for conditioning this primary charge. The primer comprises in its structure the reservoir 82 communicating with a casing 83 within which turns a two-way stop cock 84. The two-ways 85

of the stop cock are disposed at right angles whereby one of the ways is closed when the other communicates with the reservoir. The casing 83 is connected with a casing 86 of similar design by a split pipe coupling 87, and for communicating the two a pipe 88 is disposed within the split pipe 87. The valve 89 within the casing 86 is of turn plug construction and has the single straight opening 90 therein. Each of the valves 84 and 89 is fitted with an operating arm 91 which are recessed at 92 to receive a pair of lazy tongs 93 carried by the rod 65. The structure of the arms 91 and the tongs 93 is such that said arms are actuated by the movements of said tongs in one direction but have independent movement in the opposite direction. For effecting this independent movement each of the arms is fitted with a coil spring 94. The turning plug 84 has a center bore 95 which is screw threaded to receive a pipe 96 which pipe is adapted to be adjusted within the bore 95 whereby to open or close communication between the two ways 85 in order to adjust the primer commensurate with the altitude and temperature in which the engine is being operated. By reason of actuating the valves 84 and 89 simultaneously and because of the difference in structure between the two, it will be readily seen that on the operation of the rod 65 the upper valve 84 will take from the reservoir a determined quantity of fuel and cause the same to be transferred through the pipe 88, the strainer 88^a, and through the lower valve 89 at the moment the passage 90 registers with the passage 90^a therein; and that in passing from the pipe 88 in its partially diffused state it is partly vaporized by reason of the split coupling 87 communicating with the atmosphere.

Referring now to Figs. 7 and 7^a wherein is shown other means for starting and stopping the engine, the numeral 97 indicates a toothed quadrant fixed to the shaft 47 and in gearing connection with a worm gear 98 carried by the shaft 99, which shaft connects directly with the armature of the motor 100 which is mounted on the standards 101 and which is adapted to be controlled from a source remote from the engine. That form of starting device shown in Fig. 7^a comprises an arm 103 fixed to the shaft 47 and to which shaft is also fixed a controlling weight 102 mounted preferably on the hand operating lever 47^b. This arm 103 is adapted to be engaged and moved by either of the arms 104 carried by a piston rod 105 whose end has the piston 108 reciprocating within the cylinder 109. The shaft 106 is fitted with a disk head 107 adapted to compress a spring 110 within the cylinder, the purpose whereof being to resist any sudden action on the part of the piston when fluid is admitted to the cylinder from the source 111.

The present structure of my invention is that particularly serviceable on engines wherein the same are used for pumping water and which therefore usually requires the service of an attendant and to this end the present device is adapted to be rendered entirely automatic in its operations, thus a float having suitable connections may be caused to actuate the lever 47^b on the rising and falling of the water in the reservoir to be supplied; and with further modifications the present invention is equally applicable to explosive engines of the automobile type, the changes to effect which may be made without in any manner departing from the spirit of the present idea or limiting its scope.

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

1. The combination with an explosive engine, of means automatically operated through centrifugal force for arresting the same on its stopping movement, said means operable to impart to the engine its starting movement.

2. The combination with an explosive engine, of automatic means for arresting the same on its stopping movement, said means operable to impart to the engine its starting movement, and means for priming the cylinder, said starting means adapted to effect the ignition of the primary charge.

3. The combination with an explosive engine, of means automatically operated through centrifugal force for arresting the same on its stopping movement, said means operable to impart to the engine its starting movement, means for priming the cylinder, means for igniting said charge, and means whereby the compression of the primary charge and the firing point thereof may be regulated.

4. The combination with an explosive engine, of means automatically operated through centrifugal force for arresting a rotating part thereof and holding the same under tension, means for effecting the release of said part whereby said tensioning means may impart movement thereto, and means coöperating therewith for priming the cylinder and igniting the charge.

5. The combination with an explosive engine, of means automatically operated through centrifugal force for arresting the same on its stopping movement, said means operable to impart to the engine its starting movement, auxiliary means for priming the cylinder prior to said starting movement, and auxiliary means for effecting the ignition of the primary charge.

6. The combination with an explosive engine, of means automatically operated through centrifugal force for arresting the fly-wheel on its stopping movement, said

means operable to impart to the fly-wheel its starting movement, and auxiliary priming and ignition effecting means.

7. The combination with an explosive engine, of means automatically operated through centrifugal force for arresting the fly-wheel on its stopping movement, said means operable to impart to the fly-wheel its starting movement, means for priming the cylinder, and means for igniting the charge by the starting means.

8. The combination with an explosive engine, of automatic means for arresting the fly-wheel on its stopping movement, said means operable to impart to the fly-wheel its starting movement, and a starting lever for effecting the release of the fly-wheel and the priming of the cylinder, said starting means adapted to effect the ignition of the primary charge.

9. The combination with an explosive engine, of means for arresting a rotating part thereof on its stopping movement and holding the same under tension, a resilient stop for limiting the movement of said stopping means, means for effecting the release of the stopping means whereby to start the engine, and means operable through said releasing means for priming the cylinder, said starting means adapted to effect the ignition of the primary charge.

10. The combination with an explosive engine, of means for arresting a rotating part thereof on its stopping movement, and holding the same under tension, means for effecting the release thereof whereby to start the engine, means operable through said releasing means for priming the cylinder, said starting means adapted to effect the ignition of the primary charge, and means for regulating said stopping and starting means whereby the compression of the primary charge and the firing point thereof may be regulated.

11. The combination with an explosive engine, of a tensioning means, a centrifugally actuated means carried by a rotating part of the engine, said means adapted to engage the tensioning means on the stopping movement of the engine whereby to arrest said rotating part and hold the same under tension, means for releasing the rotating part and permitting the same to be rotated by the tensioning means, means for priming the cylinder prior to the release of the rotating part, and means for effecting the ignition of the admitted charge on the release of the tensioning means from the rotating part.

12. The combination with an explosive engine, of a tensioning means, a centrifugally actuated means carried by a rotating part of the engine and adapted to engage the tensioning means on the stopping movement of the engine whereby to arrest the same, means for holding said rotating part under the tension of said tensioning means, a starting lever for releasing said rotating part and permitting the same to be moved by said tensioning means, means for priming the cylinder through the medium of said starting lever, and means for effecting the ignition of said charge upon the release of the tensioning means from said rotating part.

13. The combination with an explosive engine, of a tensioning means, centrifugally actuated means carried by a rotating part of the engine and adapted to engage the tensioning means on the stopping movement of the engine, means for engaging said rotating part and holding the same under tension of the tensioning means, means for preventing said engagement when the engine is on the wrong dead center, a starting lever adapted to effect the priming of the cylinder and to release the rotating part, and means for effecting the ignition of the primary charge simultaneously with the disconnection between the centrifugal member and the tensioning means.

14. The combination with an explosive engine, of a tensioning means comprising a coiled spring, a centrifugally actuated means carried by a rotating part of the engine and adapted to engage and distend said spring on the stop movement of the engine, automatic means for holding open the cylinder exhaust during said stopping movement, means for holding said rotating part under the tension of said spring, means for effecting the release of said rotating part, a primer actuated by the starting movement of said releasing means, means for disconnecting the spring from the rotating member, and means for effecting the ignition of the primary charge simultaneously with said disconnection.

15. The combination with an explosive engine, of a tensioning means comprising a coiled spring, a centrifugally actuated means carried by a rotating part of the engine and adapted to engage said spring on the stopping movement of the engine, automatic means for keeping the cylinder exhaust open during said stopping movement, means for engaging said rotating part and holding the same under the tension of said spring, means for preventing said engagement while the shaft of the rotating part is on the wrong dead center, a starting lever adapted to effect the release of said engagement, a primer actuated by said starting lever, automatic means for closing said exhaust, means for disconnecting the centrifugal member from the coiled spring, and an auxiliary circuit adapted to effect the ignition of the charge admitted simultaneously with said disconnection.

16. The combination with an explosive

engine, of means automatically operated through centrifugal force for arresting a rotating part thereof and holding the same under tension, means for effecting the release thereof whereby to start the engine, and an auxiliary means for priming the cylinder, said auxiliary priming means designed to be adjusted for regulating the amount of the primary charge, and for adapting the same to engines of various powers.

The foregoing specification signed at Washington, D. C., this 13 day of May, 1909.

JOSEPH B. POLO.

In presence of—
HERVEY S. KNIGHT,
EDWIN S. CLARKSON.