A. J. MILLER & J. T. METCALFE.

SPEED CONTROLLING MECHANISM FOR EXPLOSIVE ENGINES.

APPLICATION FILED JAN. 30, 1906.

936,795.

Patented Oct. 12, 1909.

4 SHEETS—SHEET 1.

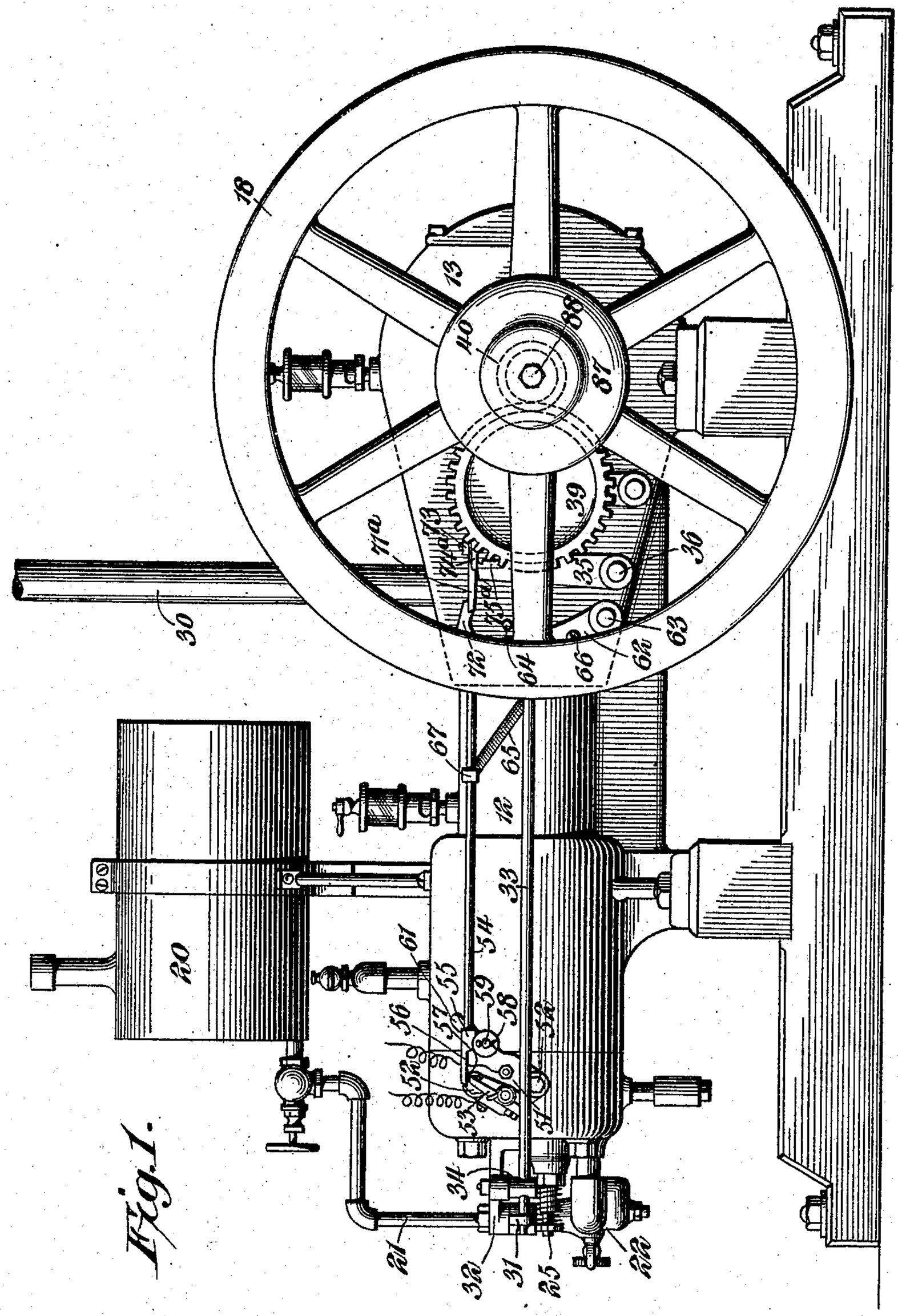


Fig. 1.

Witnesses
Howard D. Orr.
B. H. Foster.

Alfred J. Miller and John T. Metcalfe, Inventors,
By E. G. Siggers.
Attorney

A. J. MILLER & J. T. METCALFE.

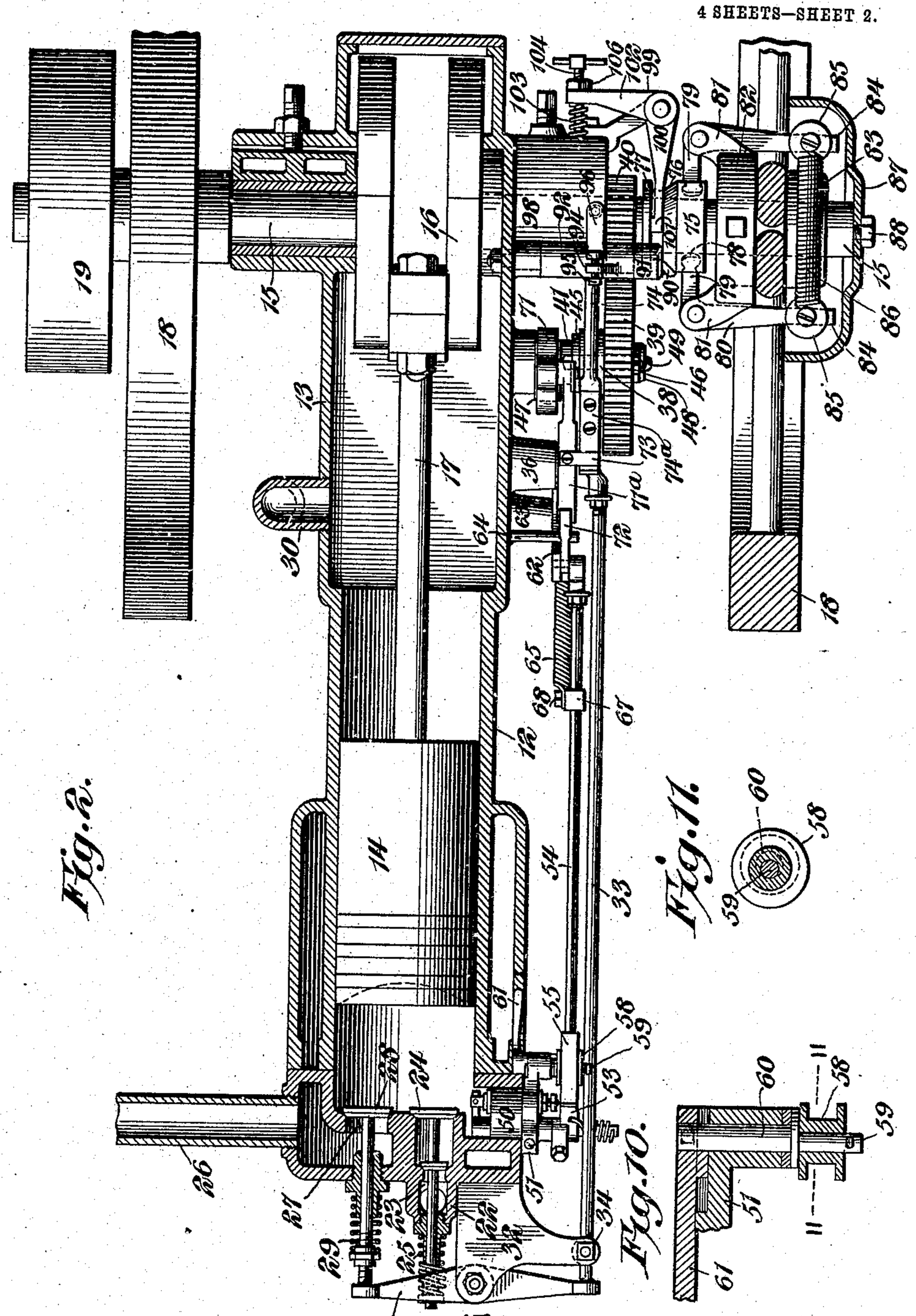
SPEED CONTROLLING MECHANISM FOR EXPLOSIVE ENGINES.

APPLICATION FILED JAN. 30, 1906.

936,795.

Patented Oct. 12, 1909.

4 SHEETS—SHEET 2.



A. J. MILLER & J. T. METCALFE.

SPEED CONTROLLING MECHANISM FOR EXPLOSIVE ENGINES.

APPLICATION FILED JAN. 30, 1906.

936,795. Patented Oct. 12, 1909.

4 SHEETS—SHEET 3.

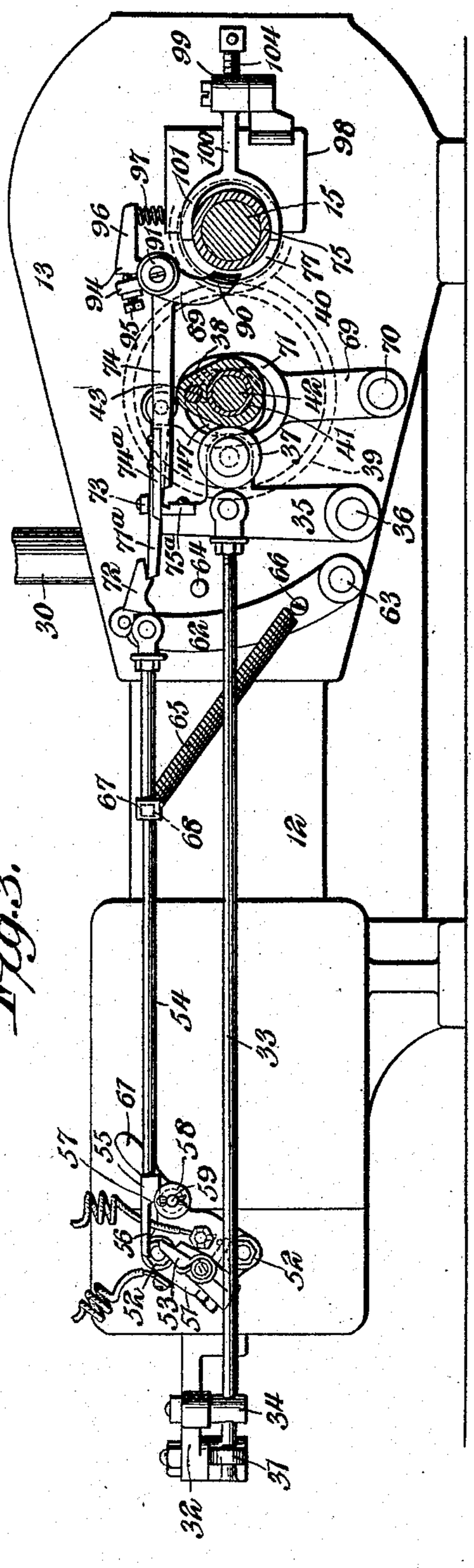


Fig. 3.

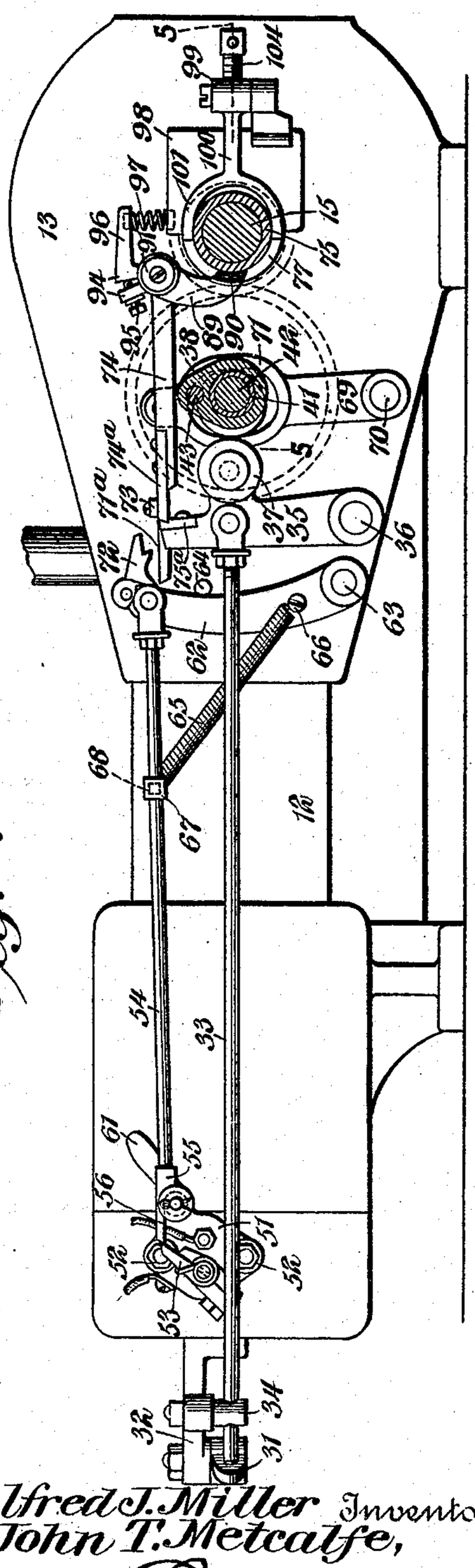


Fig. 4.

Witnesses
Howard D. Orr.
B. G. Foster.

Alfred J. Miller and John T. Metcalfe, Inventors,
By E. G. Siggers.
Attorney

A. J. MILLER & J. T. METCALFE.

SPEED CONTROLLING MECHANISM FOR EXPLOSIVE ENGINES.

APPLICATION FILED JAN. 30, 1906.

936,795. Patented Oct. 12, 1909.

4 SHEETS—SHEET 4.

Fig. 6.

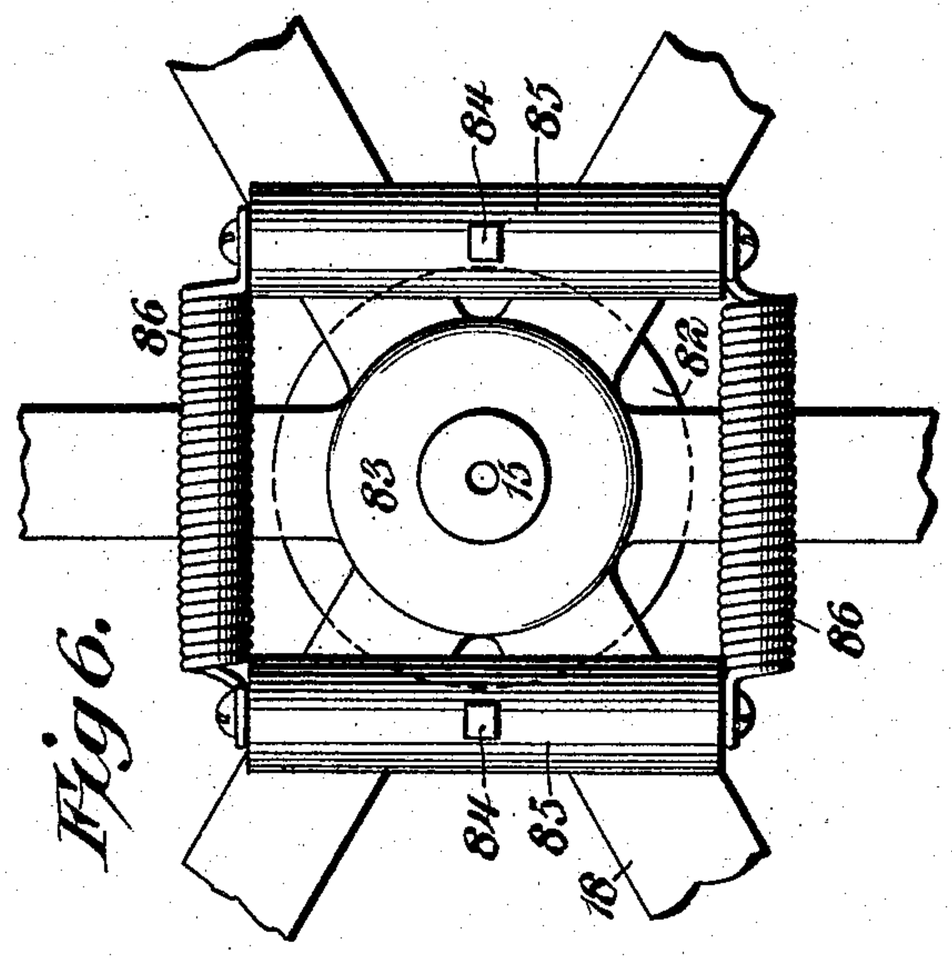


Fig. 9.

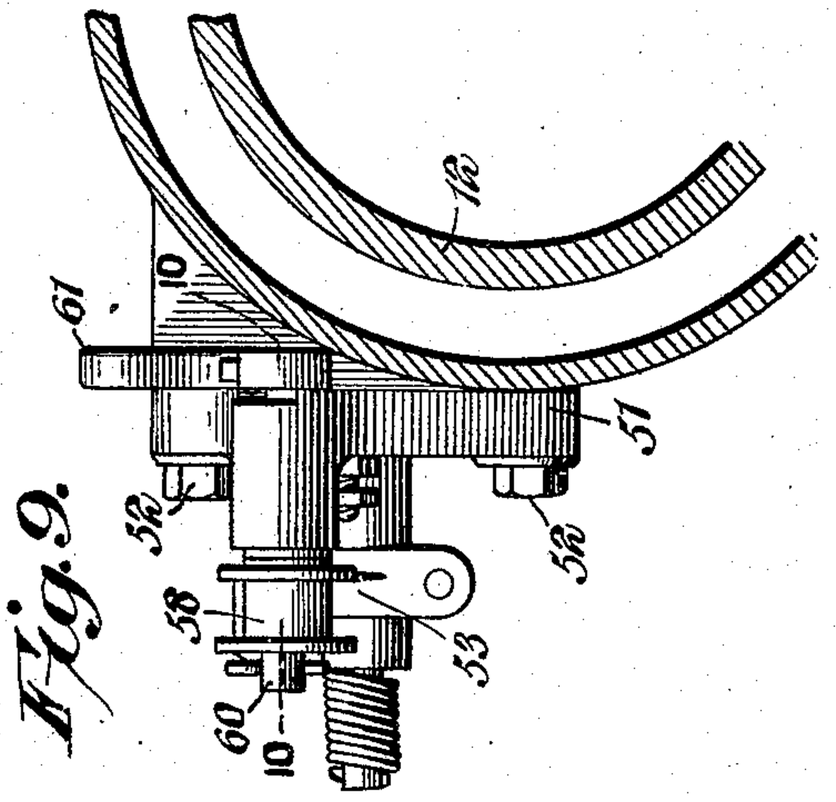


Fig. 5.

Fig. 7.

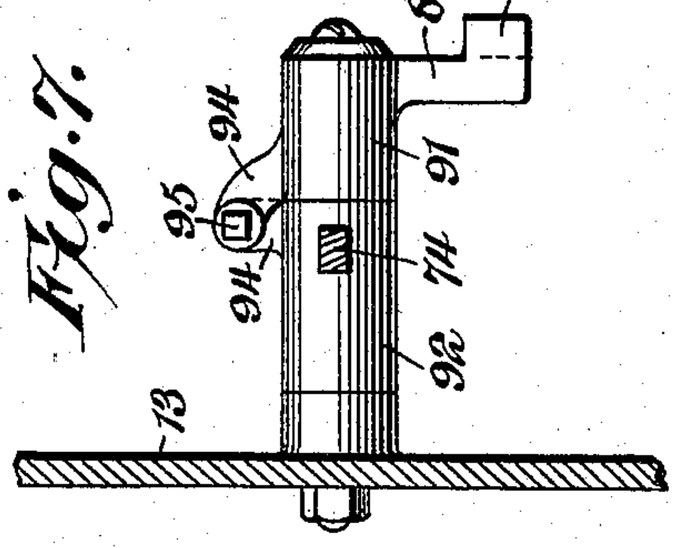
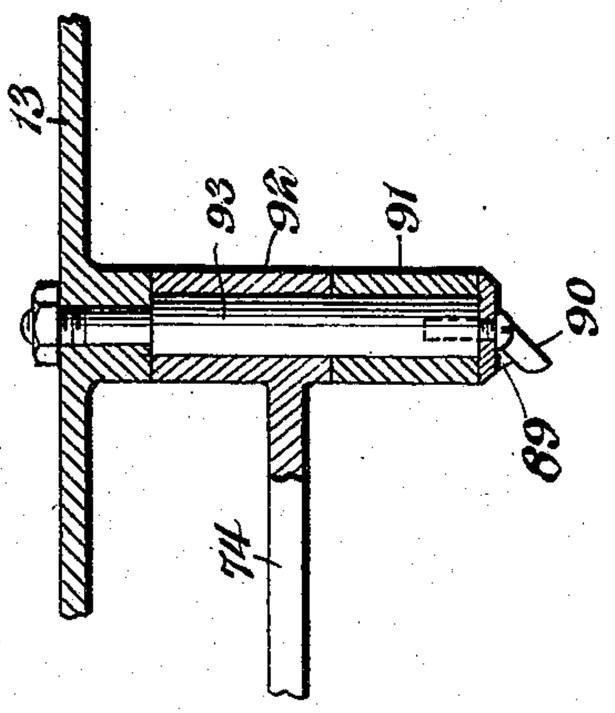


Fig. 8.



Witnesses
Howard D. Orr.
B. G. Foster.

Alfred J. Miller and John T. Metcalfe, Inventors,
By E. G. Siggers.
Attorney.

UNITED STATES PATENT OFFICE.

ALFRED J. MILLER AND JOHN T. METCALFE, OF QUINCY, PENNSYLVANIA.

SPEED-CONTROLLING MECHANISM FOR EXPLOSIVE-ENGINES.

936,795. Specification of Letters Patent. Patented Oct. 12, 1909.

Application filed January 30, 1906. Serial No. 298,644.

To all whom it may concern:

Be it known that we, ALFRED J. MILLER and JOHN T. METCALFE, citizens of the United States, residing at Quincy, in the county of Franklin and State of Pennsylvania, have invented a new and useful Speed-Controlling Mechanism for Explosive-Engines, of which the following is a specification.

This invention relates to means for controlling the speed of explosive engines, and more particularly that type of means in which the exhaust valve is locked in open position, and the ingition mechanism is stopped when the engine reaches a predetermined rate of speed.

One of the principal objects of the present invention is to provide novel means of a simple and effective nature for operating the ignition mechanism and automatically throwing the same out of operation when the speed reaches a predetermined rate, to provide automatically controlled valve operating mechanism, and furthermore to provide controlling means common to both the valve and ignition operating mechanisms, which will not interfere with the adjustment of the latter to vary the timing of the spark.

A further and important object is to provide controlling and operating means of the above character, which may be readily and accurately adjusted to properly perform the various functions desired, said means being so arranged that the parts are not subjected to excessive friction and wear, and not liable to accidental derangement or injury, yet so located and associated that said parts are entirely accessible should repairs or replacements become necessary.

An embodiment of the invention that is at present considered the preferable one, is illustrated in the accompanying drawings, and is described in the following specification. An inspection of the claims will show, however, that the invention is not limited to the embodiment disclosed.

In the drawings:—Figure 1 is a side elevation of the engine. Fig. 2 is a horizontal sectional view therethrough. Fig. 3 is a view partly in section, showing the valve and ignition mechanism operating means in elevation, and in operative condition. Fig. 4 is a similar view, illustrating the relation of the parts when the speed of the engine is excessive. Fig. 5 is a detail horizontal sectional view on the line 5—5 of Fig. 4. Fig. 6 is a detail elevation showing the centrifugal governor and the cap removed therefrom. Fig. 7 is an end elevation of the two-part controlling lever, the supporting arm thereof being shown in section. Fig. 8 is a horizontal sectional view through the same. Fig. 9 is a detail cross sectional view through a portion of the engine cylinder showing the ignition mechanism in elevation. Fig. 10 is a detail sectional view on the line 10—10 of Fig. 9. Fig. 11 is a cross sectional view on the line 11—11 of Fig. 10.

Like numerals of reference designate corresponding parts in all the figures of the drawings.

In the embodiment illustrated, the engine is of the four-cycle type, including a cylinder 12 with a closed crank casing 13 at one end thereof, and a reciprocatory piston 14, which operates in the cylinder 12. An engine shaft 15, journaled in the sides of the crank casing, has a crank 16, located within the casing and connected to the piston by a suitable pitman 17. Fly wheels 18 are mounted on the engine shaft exteriorly of the casing, and a belt pulley 19, or other suitable power-transmitting means may also be carried by the shaft 15. A reservoir 20, suitably supported over the cylinder, has a pipe connection 21 with a carbureter 22, said carbureter communicating with the interior of the cylinder 12, through an inlet 23. An inwardly opening check valve 24 controls the inlet, and is normally held in closed position by a spring 25. An exhaust pipe 26 has communication with the interior of the cylinder through an outlet opening 27, controlled by an inwardly opening exhaust valve 28, normally held in closed position by a spring 29. So far as thus described, the structure is well known to the art, and no particular claims are made therefor.

Connected to the crank casing and communicating with the interior thereof, outside the cylinder and outside the piston, is a vent conduit 30, which conduit is for the purpose of conducting off the odors and burned gases that collect in the crank casing due to leakage past the cylinder and the

carrying action of said cylinder. The employment of this vent is particularly advantageous in closed rooms, where heretofore it has been practically impossible to prevent the odors escaping from the crank casing or piston.

The exhaust valve 28 is actuated through the medium of a lever 31, fulcrumed between its ends on a bracket 32, carried by the cylinder head. One end of the lever bears against the valve stem, the other end is borne against by a reciprocatory driven element in the form of a rod 33, the rear end of which slides in a bearing 34, carried by the bracket 32, the front end being pivotally supported on an upright swinging arm 35, having its lower end pivoted, as shown at 36 to the crank casing. A roller 37, journaled on the arm 35 in line with the rod 33, is operated against by a cam 38, forming an integral part of the hub of a gear wheel 39 that is in mesh with a pinion 40, secured to the engine shaft 15. The roller 37 is normally held against the cam by the spring 29 that normally maintains the valve 28 in closed position, and thereby, through the lever 31, urges the rod toward said cam. The gear wheel 39 is mounted on a countershaft in the form of a bushing 41, which, as clearly shown in Fig. 5, is journaled on a stud or stem 42 fixed to the casing 13. The gear wheel 39 is rotatable upon the bushing 41, but is normally clamped thereto by a bolt 43, passing through the hub of the wheel, and through the cam 38, the inner end of said bolt having an inturned head 44 that engages over an annular flange 45 carried by the bushing, the outer end having a nut 46 threaded thereon. Forming an integral part of the bushing 41 is an eccentric 47, the purpose of which is hereinafter described. The wheel and bushing are detachably held on the spindle by a cap disk 48 secured to the end of the spindle by a screw as 49, and engaging over the outer end of the bushing.

Ignition mechanism of any desired character is employed. In the embodiment shown, this ignition mechanism is mounted on a block 50 seated in the rear portion of the cylinder and having a head 51 arranged exteriorly of the cylinder and bolted thereto, as shown at 52. The mechanism includes an oscillatory hammer trip 53, that is periodically actuated by a reciprocatory driven element in the form of a rod 54. The rear end of the rod 54 has a head 55, provided with a flat bearing surface 56 terminating at its front end in an inclined portion 57, the surface 56 and inclined portion 57 operating upon a flanged roller 58, and the rear end of said head engaging and tripping the hammer 53 upon the reciprocation of the rod. The roller 58, as shown in Figs. 10 and 11 is mounted on a spindle 59, having an eccentric bearing 60 in the head 51. The rear end of the spindle eccentric 60 is extended inside the head, and has attached thereto a handle crank 61, which, as shown in Fig. 9 is located between the inner side of the head and the cylinder. By turning this handle crank 61 to different positions, the eccentric bearing will be revolved, and consequently the roller 58 will be raised or lowered, thereby bringing the rear end of the head 55 into position to engage different parts of the trip hammer 53 to vary the time of ignition. The front end of the reciprocatory element 56 is pivoted to the upper end of a swinging arm 62, the lower end of which is pivotally mounted upon the casing 13, as shown at 63. The swinging movement of the arm in one direction is stopped by a lug 64, and the movement of such arm and of the rod 54 toward and against the stop 64 is accomplished by means of a coiled spring 65, one end of which is secured, as shown at 66 to the lower portion of the swinging arm 62, the other end being connected to a collar 67 that is slidable along the rod 54, and is held at any desired position thereon by a set screw 68. Another arm 69 is pivoted at its lower end, as shown at 70 to the casing 13, said arm being provided with a yoke 71 that surrounds and is operated upon by the eccentric 47. To the upper end of the arm 69 is pivoted a driving element in the form of a latch 71^a that extends rearwardly in substantial alinement with the rod 54 and detachably engages a dog 72 pivoted to the upper end of the arm 62. This driving element 71^a is reciprocated by the arm 69, and is capable of swinging movement laterally. It is supported by a lug 73 that slides upon a rearwardly extending arm 74, hereinafter more fully described. It will be noted, however, that when the eccentric 47 is rotating, the arm 69 will be oscillated, and as long as the latch or driving element 71^a is moving rearwardly and is engaged with the dog 72, it will move the rod 54 rearwardly, the spring 65 returning said rod. Upon this movement, the head 55 will engage the hammer trip 53, and effect the oscillation thereof.

Slidably mounted on the engine shaft 15 between the pinion 40 and the adjacent fly wheel 18 is a collar 75, said collar being rotatable with the shaft. The collar has an annular beveled portion 76, and an annular flange 77 located inside the beveled portion. It is also provided with recessed seats 78 that receive the inwardly extending arms 79 of bell crank levers 80, said levers being pivoted on ears 81 carried by a collar 82 that is fastened on the inner side of the hub 83 of the adjacent fly wheel 18. The other arms 84 of the levers extend between the spokes of the wheel, and have secured thereto cylindrical, transversely disposed weights 85. Connecting the corresponding ends of these

weights are helical springs 86, that extend on opposite sides of the wheel hub 83. A cap 87, detachably secured to the end of the shaft 15 by a set screw 88, covers the outer ends of the levers, the weights and the springs and constitutes a guard that prevents clothing or the like being caught by these rapidly revolving projecting portions. The arm 74 above described constitutes in effect a section of a two-part lever, the other arm 89 of which extends downwardly, and has an inclined shoe 90 that bears upon the inclined or beveled portion 76 of the collar 75. The two arms 74 and 89 are carried by independent hub portions 91 and 92, mounted on a spindle 93, fixed to the casing 13. The hub portions 91 and 92 have ears 94 disposed in opposing relation, and threaded through one of these ears is a set screw 95 that bears against the other. The hub 92 carrying the arm 74, is furthermore provided with a rearwardly extending portion 96 against which bears a spring 97 interposed between said portion 96 and a projecting part 98 of the casing. The arm 74 terminates at its free end in a hard metal shoe 74ª that is capable of swinging into and out of the path of movement of the upper end of the arm 35, when said arm 35 has been moved to its rearmost position by the cam 38. Said upper end of the arm 35 is preferably provided with an abutment plate 75ª that is notched to receive the shoe 74ª. A speeding device in the form of means for opposing a variable resistance to the action of the centrifugal governor is also provided. In the embodiment shown, this means consists of an angle lever 99, one arm 100 of which terminates in a yoke 101, that bears against the outer face of the annular flange 77 on the opposite side of the shaft 15. The other arm 102 of said lever is operated against by a spring 103 interposed between said arm and the projecting portion 98 of the casing. The spring bears against the inner end of an adjusting stem 104 that is threaded through the arm 102, and has a reduced portion 105 extending into the spring. A jam nut 106 serves to normally hold the adjusting stem against rotation.

The operation of the apparatus may be briefly outlined as follows: Under normal conditions, the centrifugal speed governor will have its outwardly extending weighted arms located in their inner positions. Consequently the shoe 90 bearing against the inclined portion 76 of the collar 75 will maintain the two-part lever with the rearwardly extending arm portion 74 in substantial horizontal position, or in the relation illustrated in Fig. 3. When so disposed, the shoe 74ª will be above the upper end of the swinging arm 35, and the reciprocating driving element or latch 71ª will be supported by the arm 74 with its rear end in line and in engagement with the latch 72. Consequently it will be apparent that if the engine is in operation, the countershaft bushing will be rotated, so that the cam 38 will periodically effect the reciprocation of the rod 33, and thereby open the exhaust valve at proper intervals. In like manner, the arm 69 will be swung by the eccentric 47 and the driven element or rod 54 actuated by the driving element or latch 71ª will be reciprocated, so that the operative movement of the hammer trip of the ignition mechanism will be periodically effected. The timing of this movement, as already explained can be readily altered by swinging the handle crank 61 to thereby raise or lower the guide roller 58, and vary the points of engagement between the head 55 and the trip 53. The return movement of the rod 54 is effected by the spring 65, which spring also serves to hold the head 55 in the guideway of the roller formed by and between the flanges thereof. If, however, the speed of the engine becomes excessive, the weighted arms under centrifugal force will move outwardly, thereby sliding the collar 75 outwardly upon the shaft 15. As a result, the shoe 90 of the depending arm 89 will ride inwardly on the beveled portion, and the arm 74 under its own weight and under the action of the spring 97 will swing downwardly. Therefore when the swinging arm 35 of the exhaust valve operated mechanism is moved to its rearmost position by the cam 38, the shoe 74ª will drop behind the upper end of the arm 35, and prevent its return, when the cam leaves it. Moreover, as the arm 74 constitutes a support for the driving element or latch 71ª, when said arm 74 moves downwardly, the driving element or latch 71ª will move into corresponding direction, and disengage from the dog 72, whereupon the spring 65 will return the arm 62 and driven element 64 of the ignition mechanism operated means to its foremost position, as shown in Fig. 4. The driving and driven elements therefore of the ignition operated means, which before had a common path of movement, now have different and overlapping paths of movement, the latch or driving element 71ª being still operated by the eccentric 47, but being disengaged from the dog 72, and operating beneath the same, as shown in Fig. 4. The exhaust valve being now held open, there will be no charges fed to the cylinder, and the ignition mechanism will also be inoperative. Consequently the engine will merely be running under the momentum of the fly wheels, and there will be no waste of motive fluid or of electric current. As soon, however, as the speed diminishes to its normal or predetermined rate, the arms 84 will swing inwardly, thereby moving the collar 75 inwardly on the shaft 15, and causing the

shoe 90 to ride outwardly on the beveled portion 76. As a result, the arm 74 will be moved above the swinging arm 35, and the driving element or latch 71ª will be again engaged with the dog 72, thereby throwing the exhaust valve and the ignition mechanism again into operation.

To vary the speed of the engine, it is only necessary to oppose more or less resistance to the outward swinging movements of the weighted arms 84. This is accomplished by the parts 99—106. It will be apparent that when said arms 84 swing outwardly and the collar 75 slides outwardly on the shaft 15, the angle lever 99 is operated, and the spring 103 compressed. By threading the adjusting stem 104 into and out of the arm 102, the spring 103 will be more or less compressed, thereby providing a variable resistance against the action of the centrifugal governor.

There are several decided advantages for the structure disclosed. In the first place, the means for throwing the exhaust valve and ignition mechanism into and out of operation, is very effective, and does not interfere with the adjustment or timing of the spark. The means employed for varying such timing is exceedingly simple, requiring but the movement of a handle crank. The particular mounting of the cam and eccentric is an important feature. As already described the cam 38 being in effect a part of the gear wheel 39, is rotatable on the bushing 41 that carries the eccentric 47. Consequently said eccentric and cam are relatively rotatable but can be quickly and effectively secured against relative rotation, and in different relations by the bolt 43. Thus the operation of the exhaust valve and ignition mechanism can be properly and relatively adjusted.

The means for actuating the controlling device or arm 74 has features of advantage. It will be observed that the two-part lever comprising the arms 74 and 89 have comparatively little strain brought against them, and therefore there is little wear between the shoe 90 and the beveled portion 76 of the collar. The adjustment between the two arms is readily effected, however by means of the set screw 95, interposed between them, not only to take up all wear that may occur, but also to secure the proper operation of the arm 74. The speeding device, being entirely independent of this controlling means, produces no additional strain thereon, said speeding device having its yoke 101 operating on a portion of the collar 75 that is entirely independent of the bearing between the controlling device and sleeve and being also independent of the centrifugal governing mechanism.

From the foregoing, it is thought that the construction, operation, and many advantages of the herein described invention will be apparent to those skilled in the art, without further description, and it will be understood that various changes in the size, shape, proportion, and minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

Having thus fully described our invention, what we claim as new, and desire to secure by Letters Patent, is:—

1. In speed controlling mechanism of the character described, the combination with ignition mechanism, of a driven element for moving the same, a driving element detachably engaging the driven element to move the same, a support for the driving element on which it moves, a centrifugal governor, and means operated by the centrifugal governor for raising and lowering the support to carry the driving element into and out of coaction with the driven element.

2. In speed controlling mechanism of the character described, the combination with ignition mechanism, of a driven element for moving the same, a reciprocatory driving element for moving the driven element, said driving element having a swinging movement into and out of coaction with the driven element, a swinging support for the driving element on which said driving element slides, a centrifugal governor, and means operated by the centrifugal governor for swinging the support to move the driving element into and out of coaction with the driven element.

3. In speed controlling mechanism of the character described, the combination with ignition mechanism, of a swinging support, a driven element for the ignition mechanism and a dog, both pivotally mounted on and supported by the swinging support, and a reciprocatory driving element having a swinging movement into and out of engagement with the dog.

4. In speed controlling mechanism of the character described, the combination with ignition mechanism, of two swinging supports having angularly disposed paths of movement, a driven element mounted on one support, a driving element mounted on the other support, and a centrifugal governor having connections with one of the supports for effecting its swinging movement.

5. In speed controlling mechanism of the character described, the combination with ignition mechanism, of a driven element for moving the same, a swinging support for the element, a reciprocatory driving element coacting with the swinging support for moving the same and having a swinging movement to carry it into and out of coaction with said support, a centrifugal speed governor, and means operated by the centrifugal

speed governor for effecting the swinging movement of the driving element to stop the movement of the support and of the driven element.

6. In speed controlling mechanism of the character described, the combination with ignition mechanism, of a pivotal support, a driven element for the ignition mechanism associated with the pivotal support, a spring connecting the support and driven element, and means for moving the support and driven element against the action of the spring.

7. In speed controlling mechanism of the character described, the combination with ignition mechanism, of a reciprocatory driven element coacting therewith, a swinging supporting arm connected to the rear end of the driven element, a dog pivoted on the arm, another swinging arm, a driving element pivoted on the swinging arm and having a detachable engagement with the dog, and means for effecting a relative lateral swinging movement between the dog and driving element to effect their disengagement.

8. In speed controlling mechanism of the character described, the combination with ignition mechanism, of a reciprocatory driven element for moving the same, a swinging support for the element, a spring connecting the element and support for moving the same in one direction, and means for moving said element and support in the opposite direction.

9. In speed controlling mechanism of the character described, the combination with ignition mechanism, of a reciprocatory driven element for moving the same, a swinging support for the element, a spring connecting the element and support for moving the same in one direction, means detachably engaging the support for moving said element and support in an opposite direction, and mechanism for automatically effecting the engagement and disengagement of said moving means.

10. In speed controlling mechanism, the combination with an explosive engine including a shaft, of ignition mechanism, a reciprocatory driven element coacting with the ignition mechanism, a swinging arm connected to one end of the driven element, a spring connecting the arm and element, a dog pivoted on the arm, a countershaft having a cam and a gear connection with the engine shaft, a swinging arm operated on by the cam, a driving element pivoted on the arm and having a detachable engagement with the dog, and a governor operated by the engine and having connections with the driving element for effecting the swinging movement of the same into and out of coaction with the dog.

11. In speed controlling mechanism of the character described, the combination with ignition mechanism including a trip, of a reciprocatory driven element coacting with the trip, means for reciprocating the element, a support, a guide for the driven element comprising an eccentric having a rotatable bearing on the support, and a roller journaled on the eccentric said element reciprocating upon the upper side of the roller.

12. In speed controlling mechanism of the character described, the combination with ignition mechanism including a support, and an oscillatory trip mounted thereon, of an eccentric journaled on the support, a roller journaled on the eccentric, a reciprocatory driven element coacting with the oscillatory trip and operating on the roller, and means for reciprocating said element.

13. In speed controlling mechanism of the character described, the combination with an explosive engine having an exhaust, of a valve controlling the same, a driven element for moving the valve, ignition mechanism, a driven element for moving the ignition mechanism, actuating means including a driving element movable into and out of engagement with one of the driven elements, the other driven element being movable into and out of engagement with the actuating means, a speed governor, and a controlling device operated by the speed governor and movable into and out of engagement with the first-mentioned driven element, said device constituting a support for the driving element and effecting the movement thereof into and out of engagement with its coacting driven element.

14. In speed controlling mechanism of the character described, the combination with an explosive engine having an exhaust, of a valve controlling the exhaust, ignition mechanism, separate sets of coacting and detachably associated driving and driven elements for the valve and ignition mechanism respectively, a speed governor, and a device actuated by the speed governor, said device being movable into and out of engagement with the driven element of one set to hold the same out of coaction with the driving element of said set and effecting the movement of the driving element of the other set into and out of coaction with the other element of said driven set.

15. In speed controlling mechanism of the character described, the combination with an explosive engine having an exhaust, of a valve controlling the same, a driven element for moving the valve, ignition mechanism, a driven element for moving the ignition mechanism, actuating means including a driving element movable into and out of engagement with the driven element of the ignition mechanism, the driven element of the valve being movable into and out of engagement with the actuating

means, a speed governor, and a controlling device operated by the speed governor and movable into and out of engagement with the driven element of the valve, said device constituting a support for the driving element and effecting the movement thereof into and out of engagement with the driven element of the ignition mechanism.

16. In speed controlling mechanism of the character described, the combination with an explosive engine having an exhaust, of a valve controlling the same, a driven element for moving the valve, actuating mechanism engaging the driven element for moving the same, a speed governor, a device actuated by the speed governor for holding the driven element out of engagement with the actuating mechanism, ignition mechanism, a driven element therefor, and a movable driving element detachably engaging the latter driven element, said holding device constituting means for effecting the movement of the igniter driving element into and out of engagement with said igniter driven element.

17. In speed controlling mechanism of the character described, the combination with an explosive engine having an exhaust, of a valve controlling the exhaust, ignition mechanism, separate sets of coacting and detachably associated driving and driven elements for the valve and ignition mechanism, a speed governor, and a movable arm actuated by the speed governor, said arm in one position directly engaging with and supporting the igniter driving element in alinement with its driven element and in its movement to its other position permitting the movement of the said ignition driving element out of engagement with its driven element, said arm in this last position directly engaging with the exhaust-driven element to hold the same out of engagement with its driving element.

18. In speed controlling mechanism of the character described, the combination with an explosive engine having an exhaust, of a valve controlling the exhaust, ignition mechanism, coacting and detachably associated driving and driven elements for the valve, coacting and detachably associated driven and driving elements for the ignition mechanism, a speed governor, and an arm actuated by the governor, said arm in one position directly engaging the driving element of the ignition mechanism to support it in alinement with its driven element but movable by said governor to permit the said driving element to drop out of alinement with the driven element, said arm in this position directly engaging with the driven element of the exhaust mechanism to hold the same out of engagement with its driving element.

19. In speed controlling mechanism of the character described, the combination with an explosive engine having an exhaust, of a valve controlling the exhaust, a driven element for actuating the valve, a driving element for effecting the movement of the driven element, a speed governor, a bell crank lever having one arm thereof actuated by the speed governor and movable thereby into position to bring its other arm into direct supporting engagement with the driving element of the ignition mechanism to hold it in engagement with the driven element, but when moved to the other position by said governor allowing the ignition driving element to descend, said arm in this position engaging with the driven element of the exhaust to hold the same out of engagement with its driving element.

20. In speed controlling mechanism of the character described, the combination with an explosive engine having an exhaust, of a valve controlling the exhaust, a driven element associated with the valve, a swinging arm connected with the driven element, ignition mechanism, a driven element coacting with the ignition mechanism, a swinging arm connected to said driven element, a swinging driving element movable into and out of engagement with one of the arms, a swinging holding device movable into and out of engagement with the other arm, and means for effecting the movement of one out of engagement with its arm when the other moves into engagement with its arm and vice versa.

21. In speed controlling mechanism of the character described, the combination with an explosive engine having an exhaust, of a valve controlling the exhaust, a reciprocating rod coöperating with the valve, a swinging arm connected to the rod, a countershaft having a cam for swinging the arm, ignition mechanism, a driven rod coacting therewith, a swinging arm connected to said rod, an eccentric mounted on the countershaft, an arm operated by the eccentric, a swinging driving element movable into and out of engagement with the arm of the ignition mechanism rod, a speed governor, and a swinging arm operated by the speed governor, said arm effecting the swinging movement of the driving element and being movable into and out of engagement with the swinging arm of the valve rod.

22. In speed controlling mechanism of the character described, the combination with an explosive engine, of movable speed varying means therefor, mechanism for controlling the movement of said means including a speed governor operated by the engine, a lever comprising relatively adjustable arms separately journaled on the fulcrum for said lever, one of the arms coacting with the governor, the other coacting with the speed varying means, an adjusting screw threaded

on one arm and having a bearing against the other to relatively move the arms, and a spring for maintaining the screw and coacting arm in engagement.

23. In speed controlling mechanism of the character described, the combination with an explosive engine, of movable speed varying means therefor, mechanism for controlling the movement of said means including a speed governor operated by the engine, a spindle, a lever comprising relatively adjustable arms journaled on the spindle, one of the arms coacting with the governor, the other coacting with the speed varying means, said arms having ears, an adjusting screw threaded through one ear and bearing against the other, and a spring bearing against one of the ears to maintain the screw and ear in engagement.

24. In speed controlling mechanism of the character described, the combination with an engine, of movable speed controlling means therefor including detachably engaged driving and driven elements, a lever movable into engagement with the driven element to maintain the same in inoperative position with respect to the driving element, a spring bearing against the lever to urge it into such engagement, a centrifugal speed governor, and a shiftable collar shifted by the speed governor longitudinally of the axis of rotation of the speed governor, said collar having a continuous bearing against the lever moving the latter against the action of the spring to carry it to a position to permit the operation of the driven element by the driving element.

25. In speed controlling mechanism of the character described, the combination with an explosive engine having a shaft, of a collar rotatable with the shaft and slidable thereupon, said collar having a beveled portion and an annular flange, the inner face of which is opposed to the beveled portion, centrifugal operating means connected to the collar and sliding the same, speed varying mechanism for the engine, a controlling device coacting with the speed varying mechanism and having an inclined shoe that operates on the beveled portion of the collar, an angle lever having an arm bearing against the inner face of the flange, a spring operating against the other arm of the angle lever to move the collar in opposing relation to the centrifugal operating means, and means mounted on the latter arm of the lever and engaging the spring for varying the tension of the spring upon the angle lever.

26. In speed controlling mechanism of the character described, the combination with an explosive engine, of an engine shaft, a countershaft geared to the engine shaft, an exhaust valve, operating means for the exhaust valve including a swinging arm, a cam carried by the countershaft and operating on the arm, ignition mechanism, operating means therefor including a swinging arm, another swinging arm, an eccentric carried by the countershaft and operating the latter swinging arm, a driving element pivoted to said arm and detachably engaging the swinging arm of the ignition mechanism operating means, a collar slidably mounted on the engine shaft and having a beveled portion and an annular flange, a pivoted controlling lever having a shoe bearing on the beveled portion of the collar, said lever having an arm movable into and out of the path of movement of the swinging arm of the valve actuating mechanism, said lever arm also constituting a swinging support for the said driving element, centrifugal operating means rotatable with the engine shaft and connected to the collar for sliding the same, an angle lever having a yoke bearing against the annular flange of the collar on opposite sides of the engine shaft, a spring operating against the angle lever, and means for varying the tension of the spring.

27. In speed controlling mechanism of the character described, the combination with an engine having an exhaust, of an engine shaft, a valve controlling the exhaust, ignition mechanism, and means for operating the exhaust valve and ignition mechanism, said means including a countershaft geared to the engine shaft, relatively adjustable cam and eccentric devices mounted on the countershaft, and means for securing the devices together against relative movement and in different positions.

28. In speed controlling mechanism of the character described, the combination with an explosive engine, having an exhaust, of a valve controlling the exhaust, an engine shaft operated by the engine, ignition mechanism, and means for operating the exhaust valve and ignition mechanism, said means including a spindle, a countershaft bushing journaled on the spindle and geared to the engine shaft, and relatively adjustable cam and eccentric devices mounted on the countershaft bushing.

29. In speed controlling mechanism of the character described, the combination with an explosive engine having an exhaust, of a valve controlling the exhaust, a shaft driven by the engine, ignition mechanism, and means for operating the exhaust valve and ignition mechanism, said means including a rotatable bushing geared to the shaft, an eccentric carried by the bushing, a cam rotatable on the bushing, and means for clamping the eccentric to the bushing in different relations to the cam.

30. In speed controlling mechanism of the character described, the combination with an engine having an exhaust, of an engine shaft, a valve controlling the exhaust, ignition mechanism, and means for operating the exhaust valve and ignition mechanism,

said means including a countershaft having a cam, a gear wheel rotatably mounted on the countershaft and geared to the engine shaft, a flange carried by the countershaft, a clamping bolt mounted on the gear wheel and engaging the flange, and a cam carried by the gear wheel.

In testimony, that we claim the foregoing as our own, we have hereto affixed our signatures in the presence of two witnesses.

ALFRED J. MILLER.
JOHN T. METCALFE.

Witnesses:
ALF. N. RUSSELL,
GEO. H. RUSSELL.