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GOVERNING DEVICE FOR INTERNAL COMBUSTION MOTORS.

APPLICATION FILED SEPT. 9, 1912. RENEWED AUG. 13, 1917.

1,283,068. Patented Oct. 29, 1918.

Fig. 1.

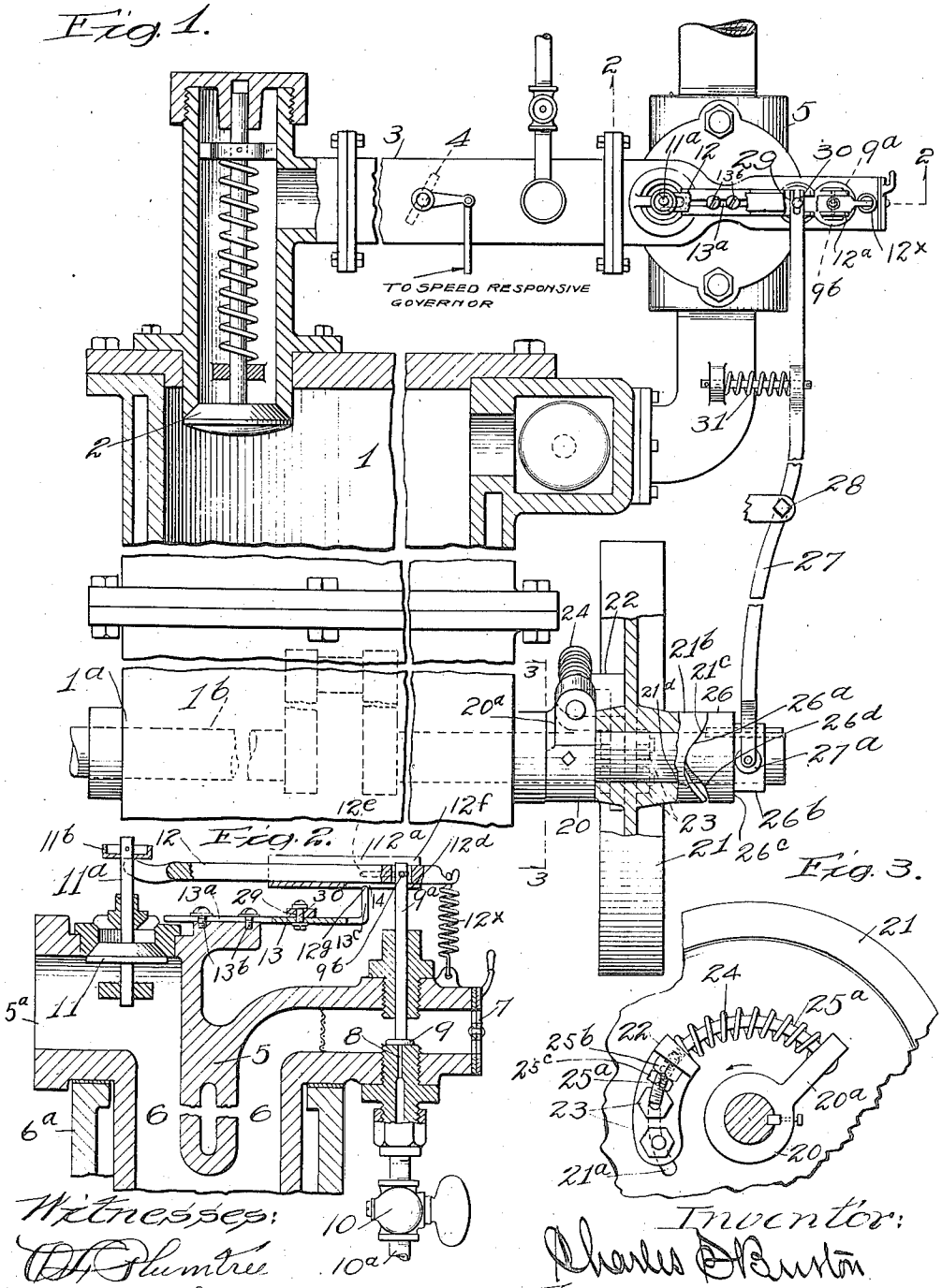

Fig. 2.

Fig. 3.

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UNITED STATES PATENT OFFICE.

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GOVERNING DEVICE FOR INTERNAL-COMBUSTION MOTORS.

1,283,068. Specification of Letters Patent. Patented Oct. 29, 1918.

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To all whom it may concern:

Be it known that I, CHARLES S. BURTON, a citizen of the United States, residing at Oak Park, in the county of Cook and State of Illinois, have invented new and useful Improvements in Governing Devices for Internal-Combustion Motors, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

The purpose of this invention is to provide an improved means of governing an internal combustion motor so as to obtain uniform speed under changes of load within the limits for which the motor is designed. It consists in the elements and features of construction shown and described as indicated in the claims.

In the drawings:

Figure 1 is a partly sectional elevation of one cylinder of an engine and the carbureter and governing devices embodying this invention, the cylinder and connected parts being broken away in both directions to condense the view, section being made axially with respect to the end portion of the cylinder and intake valve, and the power-communicating wheel being partly broken away and shown in section axial with respect to the main crank shaft.

Fig. 2 is a section at the line, 2—2 on Fig. 1 through the carbureter.

Fig. 3 is a detail section at the line, 3—3 on Fig. 1.

In the drawings this invention is shown applied to an internal combustion motor which has a carbureter and operating connections for the several valves connected for controlling their relative opening, and these parts will be described only so far as will be necessary to make clear the action of features constituting this invention. 1 is a cylinder of the motor terminating at its lower end in the crank casing and main shaft bearing 1^a, in which is journaled the main crank shaft, 1^b. 2 is the inlet valve which controls the admission of the supply of explosive fluid which is conducted through the passages of the pipe connection, 3, in which there is located a throttle valve, 4, connected with the speed-responsive governor of the engine, not shown, for varying by changes of speed the quantity of explosive mixture admitted to the cylinder, with the customary purpose and effect of diminishing the supply upon any increase of speed above that for which the governing device is adjusted, and thereby preventing further increase and restoring the normal speed.

The explosive mixture is supplied through the carbureter, 5, to which the supply of oil, or fuel proper, is admitted from a pipe, 10^a, controlled by a shut-off valve, 10, the oil entering through a passage, 8, under control of an automatically governed valve, 9, from whose face and seat the oil is sucked off when the valve is slightly opened by the air sucked in past through the manually adjustable air valve, 7, and thence around through the passage, 6 (which is jacketed for heating it by the jacket, 6^a, which forms part of the exhaust passage from the engine, not otherwise shown), and thence by way of the carbureter discharge mouth, 5^a, to the pipe, 3, and on to the engine cylinder. In this carbureter, a second supply of air is admitted past the valve, 11, which is sucked off its seat by the suction from the engine, and in being thus withdrawn from its seat operates the valve 9, to open it proportionately to its own opening, by means of the lever, 12, 12^a, whose forked end strides the stem 11^a, of the valve, 11, and engages the collar, 11^b, on said stem. The lever, 12, 12^a, is preferably composed of two relatively slidable members, the member, 12, engaging the valve stem 11^a, and the member 12^a, engaging the stem, 9^a, of the valve, 9, for operating the latter. The member, 12, extends past the valve, 9^a, for connection of its outer end with a spring 12^x, which reacts to yieldingly hold that end of the lever down toward the end of the seat, 9. Said lever member, 12, has an aperture, 12^d into which said stem enters. The member 12^a, is a channel bar fitting under and embracing the member, 12, and having its bottom web cut away for a portion of its length at the end toward the stem, 9^a, so that for that part of its length there is a fork comprising as its fork arms the side flanges of the channel bar, and these fork arms, 12^f, extend past and embrace between them the valve stem, 9^a, which has a cross pin, 9^b, engaged in slots, 12^e, of said fork arms, 12^f. The lever, 12, 12^a, as an entirety is fulcrumed at a line transverse to these slots near their inner end, V-shaped notches, 12^g, being made in the lower edges of the fork arms, 12^f, for engagement with the fulcrum; and said fulcrum is obtained upon up-turned fork-ends,

13c, of a bar, 13, which is mounted for sliding longitudinally with respect to a lever, 12, on the carbureter casing, being slotted at 13a for guide entertaining screws, 13b, which secure it slidably. The engagement of the V-shaped fulcrum fork ends, 13c, in the wider V-shaped notches, 12e, is designed to be sufficient to enable the slidable fulcrum bar, 13, to carry the lever member, 12a, with it in its sliding movement, sliding the slotted fork arms, 12f, of said part, 12a, past the stem, 9a, of the flange, 9.

From the foregoing description it will be seen that the ratio of the oil supply admitted past the valve, 9, to the air supply admitted past the valve, 11, is variable by the adjustment of the fulcrum, 14, of the lever, 12, which connects the two valves. The purpose of this invention is to adapt the motive fluid supply to the work being done so that upon increase of work there shall be an increase of motive fluid with the resultant effect of maintaining a substantially uniform speed throughout changes of load on a motor. In adapting this invention to this particular form of carbureter and connections, this result is accomplished by providing automatic means for sliding the fulcrum bar, 13, to move the fulcrum in accordance with the load on the motor.

For this purpose the main power-communicating wheel, 21, in the crank shaft, 1b, is connected thereto for rotation, not by being keyed fast thereon, but by being connected thereto through the medium of a spring whose compression,—or torsion according to the form of the spring,—will correspond to and be an accurate measure and indication of the load or work being done by the motor, the relatively slight movement which takes place between the main crank shaft and the main power-communicating wheel upon change of load being taken advantage of to move the fulcrum, 13c. On the crank shaft there is keyed fast a collar, 20, which is spring-connected with the main power wheel, 21. In the drawings the spring connection is effected by providing the collar with an arm, 20a, projecting alongside the power-communicating wheel, 21, and providing on said wheel a stop, 22, jutting off into the plane of rotation of the arm, 20a, and interposing the spring, 24, between said stop and said arm, causing it to be retained preferably by providing a stud or guide rod, 25a, mounted in the arm, 20a, and curved in the arc of a circle about the axis of the shaft and extending through an aperture in the stop, 22, so as to afford a support for the spring throughout the entire length between the stop and the arm. For adjusting the tension of this spring to cause it to begin to yield at a given minimum load, the stop, 22, is preferably formed as an arm of a bracket mounted adjustably on the web of the wheel, 21, as by providing in said web a slot, 21a, for two bolts, 23, which take through the base of the bracket for securing the latter to the wheel. The rod, 25a, is threaded for a distance back from its end to receive a nut, 25b, at the opposite side of the stop, 22, from that at which the spring rests, and by this means the spring may be put under initial tension corresponding to said minimum load, the bracket being caused to slide around on the wheel-web as the nut is screwed on for compressing the spring and the bolts, 23, being tightened to secure the bracket at the limit of the desired adjustment. Preferably the nut, 25b, will then be run back toward the end of the threaded guide rod, 25a, where a check nut, 25c, is provided as a permanent stop. In this position the nut serves as a stop to prevent the guide rod from being drawn out of the stop, 22, in any accidental reverse action of the motor, and it adapts the device for automatically cutting off the fuel supply in case the motor starts backward accidentally, as will be understood upon considering the means by which this spring connection is made to operate the slidable fulcrum of the lever, 12. The hub, 21b, of the wheel, 21, at the opposite side from that at which the collar, 20, is located, is formed with cam slopes, 21c, at opposite sides of the axis, one of said slopes appearing in the drawing and on the shaft, 1b, adjacent to the hub, and feathered for sliding on the shaft, and rotative therewith there is provided a cam collar, 26, having a cam face, 26a, corresponding with the cam faces, 21c, of the wheel hub so that as the wheel is turned slightly on the shaft by the resistance of the load compressing the spring, 24, the coöperation of the cam faces of the wheel hub and collar, 26, causes the collar to slide longitudinally on the shaft. 27 is a lever fulcrumed at 28, upon any convenient support fixed with respect to the engine having one end forked for striding the reduced end, 26b, of the collar, 26, and its forked arms provided with rollers, 27a, bearing against the endwise-facing shoulder, 26c, of the collar. The other end of the lever is provided with an accommodating pivotal connection with a slidable fulcrum bar, 13, the lever being slotted at the end as seen at 29, and engaged with the stud, 30, on said slidable fulcrum bar. A spring, 31, re-acts between the lever and any fixed stop on the engine for holding the rollers, 27a, against the shoulders, 26c, and thereby causing the forked end of the lever to move outward when the collar, 26c, is forced outward by the cam action described, and to cause the collar to recede toward the wheel hub when the relation of the cam faces permits it to do so. It will be seen that the collar, 20, keyed fast on the shaft, and the cam collar, 26,

feathered on the shaft, both rotating together with the shaft, the cam faces of the cam collar are in fixed relation as to position about the axis of the shaft with the arm, 20^a, of the collar, 20.

Obviously if the nut, 25^b, remained screwed up against the stop, 22, any reverse action of the motor would be without effect upon the sliding cam collar because the wheel, 21, will be positively driven by the pull of the arm, 20^a, on the stop, 22, effected through the guide arm, 25. Hence the nut, 25^b, is withdrawn toward the end of the guide arm, 25, as described, after being employed to tighten the spring and after the stop bracket has been secured in adjustable position on the wheel-web; and the effect of this is that in case of reverse starting of the motor, the arm, 20^a, moving away from the stop, 22,—the reaction of the spring insuring this result,—the wheel, 21, turns on the shaft in the direction for separating the cam slopes, 21^c and 26^a, and bringing into contact the opposite cam slopes, 21^d and 26^e, and said last-mentioned cam slopes then cooperate to cause the sliding cam collar to be moved on the shaft outward from the wheel, 21, to the full extent permitted by the stop collar, 29, which is fixed on the shaft outside said cam collar. This movement of the cam collar shifts the fulcrum, 14, to a line directly under the pivotal engagement of the lever member, 12^a, with the stem, 9^a, of the oil-controlling valve, 9, and prevents any opening of said oil valve, 9, by the opening of the air valve, 2, and thus cuts off all the power.

The regulating device above described may be employed without a speed responsive governor, but the two governing devices may both be present, and when both are present they coöperate in a very useful way as will now be explained.

The method hitherto customary for governing the action of an internal combustion motor is that represented by the speed responsive governor. Such governors, however connected and operating in detail, effect the modification of the motive fluid supply for governing by virtue of an increment of speed above the desired or normal speed. When the purpose is to maintain a substantially uniform speed, it is evident that the extent to which this purpose is accomplished, the governing device will shift the parts by which it operates the valves controlling the motive fluid supply only momentarily or for inappreciably short intervals, because the very purpose of such shifting is to modify the motive fluid supply for the purpose of restoring the original speed. When, therefore, variation of speed results from variation of load, as for example, when the motor is running at a given speed of A, and the load suddenly drops to one-half A, if the governor operates to maintain substantially uniform speed, it will do so by operating the throttle valve,—for example, such a valve as 4, in the drawings, so as to cut down the motive fluid supply to a point where it will furnish only half the power by means of a very slight increment in the speed, and this being done, the speed being checked back to normal, the throttle valve will again be opened to its maximum and again accidentally closed to half-power position, so long as the load remains at one-half while the manually operable valves for controlling the fuel supply remain unchanged by the operator, the speed-responsive governor must constantly oscillate the throttle valve, 4, between the two positions indicated, and it will became steady at any one position only when the fuel supply is cut down by operating the manually-operable valve or the load again increased to that for which the manually-operable valve was originally adjusted. When the engine is governed solely by a speed-responsive governor for maintaining substantially or approximately uniform speed under changing load, the constant change of the governor-operated valve,—whether it be such a valve as shown in the drawings, or a valve of some other sort,—is liable to result in the admission of the oil supply at one stage of the valve while the air supply is admitted at a different stage, and so the richness of the mixture is liable to vary from stroke to stroke with result of following the engine from an over-rich mixture, or defeating the accurate control of speed which is desired, or both. The employment of a governing device responsive to the load instead of responsive to the speed, and causing said governing device to control the oil supply so as to vary the richness of the mixture and its consequent efficiency for generating power upon the explosion or combustion, avoids the difficulty above pointed out which arises when a speed-responsive governor only is employed. On the other hand, a speed-responsive governor is desirable for determining the speed at which the uniformity shall be maintained under changing load so that the speed under a given load may be made as desired by adjusting the speed-responsive governor, and the load can be made to react upon the fuel supply for changing the energy developed in proportion to the work done. If the governor responsive to load is employed alone, that is, without a speed-responsive governor, changes in the quality of the oil from time to time, or even in the condition of the atmosphere effecting the explosive or energy-developing quality of the mixture would be liable to lessen any slight changes of speed, and the speed-responsive governor supplements the load responsive governor in preventing such changes.

It will be observed that without regard to the action of this device for governing the engine speed by the load, it is adapted for cutting off the supply of the fuel element of the motive fluid on a reverse start of the engine, and that this would occur even if the spring, 24, were absent and the forward drive of the power wheel were positive; and I wish to be understood as claiming this feature without regard to the automatic governing of the forward speed.

I claim:—

1. In an internal combustion motor in combination with the main power shaft and main power-communicating wheel, the wheel being loose on the shaft; a valve for limiting the admission of the fluid element of the motive fluid; an adjustable device for effecting the extent to which said valve opens; a driving member fast on the shaft; spring connections by which the driving member rotates the power wheel with the shaft; a cam collar mounted for sliding and rotating on the shaft adjacent to the power wheel, the power wheel having an abutment coöperating with said cam collar for crowding the latter along the shaft when the wheel yields back around the shaft under the load, and operating connections from said sliding collar to said adjustable device for moving the latter by said sliding movement of the former.

2. In an internal combustion motor in combination with the main power shaft and the main power-communicating wheel loose on the shaft; a member fast on the shaft and spring connections by which it rotates the power wheel with the shaft; a valve for limiting the admission of fuel element of the motive fluid, and a valve for limiting the amount of air for mixture with said fluid element; a lever connecting said valves for causing them to open proportionately; a movable fulcrum for said lever, and means for moving said fulcrum automatically, comprising a member mounted for sliding on and rotating with the power shaft; a lever operated by the sliding of said lever to move said fulcrum, and coöperating cam devices on said member and the power wheel for converting the rotary movement of the wheel about the shaft into the sliding movement of said member.

3. In an internal combustion motor, in combination with the main power shaft; a main power communicating wheel loose on the shaft; a member fast on the shaft, a spring connecting said member with the power wheel for rotating the latter with the shaft; a collar mounted for sliding on and revolving with said shaft; said collar and main wheel having coöperating cam abutments by which the rotation of the wheel on the shaft crowds the collar longitudinally thereon; said spring connections between the wheel and driving member comprising a stop on the wheel mounted for adjustment about the axis to vary the tension of the spring at a given relative position of the wheel and driving member; a valve which controls the admission of motive fluid; an adjustable device for effecting the extent to which said valve opens, and means actuated by the sliding of the collar for operating said adjustable device.

4. In an internal combustion engine, in combination with the main power shaft and the main power wheels thereon, a cam collar feathered on said shaft for sliding thereon toward and from the power wheel, said wheel and collar having coöperating cam faces by which relative rotation in one direction of the wheel and shaft slides the collar; a valve which controls the admission of motive fluid, and means actuated by the sliding of the collar to hold said valve closed.

5. In an internal combustion engine, in combination with the main power shaft and the main power wheel loose thereon, a cam collar feathered on said shaft for sliding thereon toward and from the power wheel, said wheel and collar having coöperating faces by which relative rotation in one direction of the wheel and shaft slides the collar; a valve for limiting the admission of fuel element of the motive fluid; a lever for operating said valve, a movable fulcrum bearing for said lever, and means actuated by the sliding of said collar for moving said fulcrum bearing to carry the fulcrum substantially to the line of the operating connection of said lever with said valve for reducing the valve - actuating movement to zero.

6. In an internal combustion motor, the method of maintaining uniformity of speed which includes automatically governing the relative proportions of the fuel elements and the air of the motive fluid by the load on the motor independently of its speed.

7. In an internal combustion motor, the method of maintaining uniformity of speed which consists in automatically governing the amount of motive fluid admitted by the speed of the motor, and governing the relative proportions of fuel element and air by the load on the motor independently of its speed.

8. In an internal combustion motor, the method of maintaining uniformity of speed which includes automatically governing the relative proportions of the fuel element and the air of the motive fluid by the torque between the main power shaft and the main power-transmitting wheel.

9. In an internal combustion motor, in combination with the main power shaft and main power-communicating wheel loose on the shaft, a member fast on the shaft, and

spring connections by which it rotates the power wheel with the shaft; a lever associated with the motive fluid controlling means; a movable fulcrum for said lever and means for moving said fulcrum automatically, comprising a member for sliding on and rotating with the power shaft; a lever operated by the sliding of said last-mentioned lever to move said fulcrum, and co-operating cam devices on said member and the power wheel for converting the rotary movement of the wheel about the shaft into a sliding movement of said member.

In testimony whereof, I have hereunto set my hand at Chicago, Illinois, this 6th day of September, 1912.

CHARLES S. BURTON.

Witnesses:

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