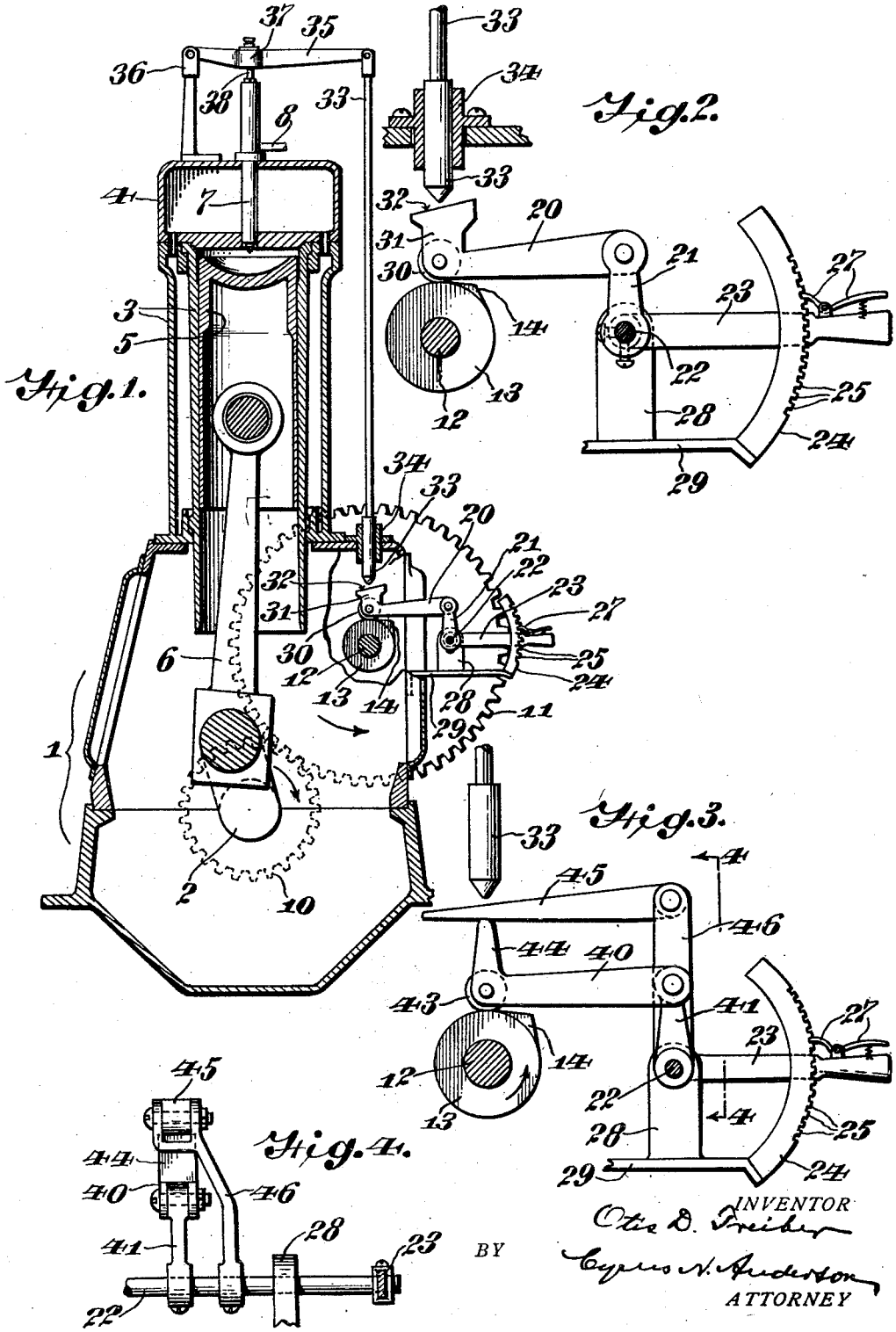
May 5, 1931. O. D. TREIBER 1,803,515

FUEL FEED CONTROL MEANS FOR INTERNAL COMBUSTION ENGINES

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Fig. 5.

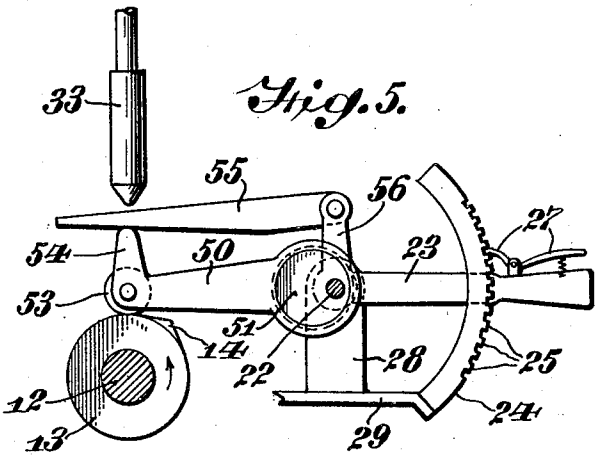


Fig. 6.

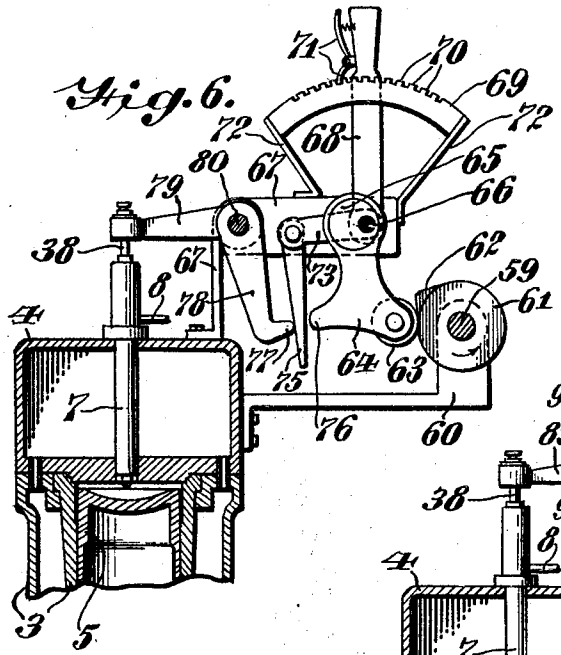
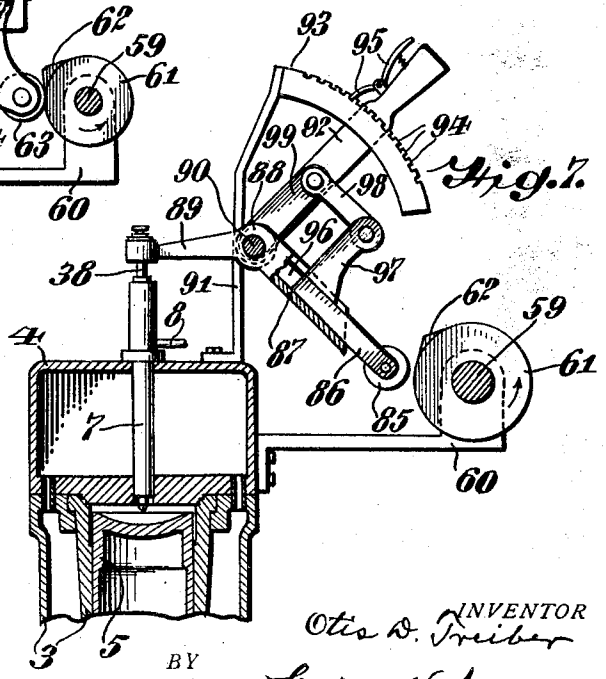


Fig. 7.



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UNITED STATES PATENT OFFICE

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FUEL-FEED-CONTROL MEANS FOR INTERNAL-COMBUSTION ENGINES

Application filed September 13, 1927. Serial No. 219,254.

In the operation of internal combustion engines of the Diesel type in which a liquid fuel, such as oil, is employed it is desirable that the beginning of the discharge of fuel into the engine cylinder shall be begun at a point from 10 to 8 degrees in advance of the top dead center position of the crank shaft. It also happens that it is necessary or desirable at times to vary the amount of fuel fed to the engine cylinders as by decreasing the same when less power is required but even in such case it is still desirable for the sake of economy in the use of fuel, if for no other reason, that the beginning of the discharge of fuel into the cylinders of the engine structure shall take place at the point above stated with respect to the top dead center position of the crank shaft.

The general object of the invention is to provide means whereby the amount of fuel fed to the cylinder of an internal combustion engine may be varied without changing to any substantial extent the point at which the initial discharge of fuel into the engine cylinder is effected with respect to the top dead center position of the crank shaft.

It also is an object of the invention to provide means of simple construction for varying the lost motion between the cam shaft of an internal combustion engine structure and the fuel feeding means thereof and for simultaneously varying the relation of the lost motion regulating and controlling means with respect to the cams of the cam shaft and consequently with respect to the top dead center position of the crank shaft.

Other objects and advantages of the invention will appear in the detailed description thereof which follows or will become apparent from such description.

In the drawings I have illustrated various mechanical embodiments of the means embodying the invention and it is to be understood that the invention may be embodied in other means than are shown in the drawings.

The essential purpose of the invention is to provide means whereby the control of the amount of fuel fed into the cylinder of an internal combustion engine may be varied and controlled without varying substantially the initial point of discharge with respect to the top dead center position of the crank shaft.

In the drawings:

Fig. 1 is a view in transverse vertical section of an internal combustion engine provided with means embodying the invention;

Fig. 2 is a similar view of a fragmentary portion of the structure, embodied in Fig. 1, enlarged so as to indicate more clearly the structure thereof;

Fig. 3 is a view similar to that shown in Fig. 2 illustrating a modified construction of means embodying the invention;

Fig. 4 is a view in sectional elevation taken on the line 4—4 of Fig. 3;

Fig. 5 is a view similar to that of Figs. 2 and 3 but showing still another modified construction of means embodying the invention;

Fig. 6 is a vertical sectional view of the upper portion of an internal combustion engine structure showing a modified construtction of fuel feed controlling means; and

Fig. 7 is a view similar to that shown in Fig. 6 but showing a modified construction of feed controlling means embodying the invention.

In the drawings I have shown a crank casing 1, a crank shaft 2, an engine cylinder 3, a cylinder head 4, a piston 5 adapted to reciprocate in the cylinder 3 and a piston rod 6 connecting the piston with the crank arms of the crank shaft 2.

In the construction as illustrated liquid fuel is discharged from spray nozzles 7 (there being one spray nozzle for each engine cylinder), such fuel being supplied to the said spray nozzles through pipes 8 having connection with a supply of liquid fuel (not shown) under constant pressure.

A gear 10 is mounted upon the crank shaft 2 and is in engagement with a gear 11 mounted upon and rigidly connected with a cam shaft 12 upon which cam disks 13 are secured at intervals in proper relation to the respective engine cylinders. Each of these disks is provided with a cam projection 14 which is adapted to contact with and to operate means for actuating and controlling the valves of the spray nozzles to thereby control the feed

of fuel into the engine cylinders. In the several forms of construction the connections between the cam shaft and the feeding means, whether it be a spray nozzle or a pump for forcing fuel into the engine cylinders, comprise or include lost motion means and it is to the latter means that the invention relates. The gears 10 and 11 are employed for operating the cam shafts shown in the several forms of construction illustrated in Figs. 1 to 5 inclusive.

In Figs. 1 and 2 I have provided a link 20 pivotally connected at its outer end to the upper end of an arm 21 secured to a shaft 22 which may be manually rotated by means of a handle 23 which is located in adjoining relation to a quadrant 24 having teeth 25 upon the convex edge with which a spring pressed catch 27 is adapted to engage to hold the handle in any position or to which it may be adjusted, the arm 21 being likewise, in consequence, held in its corresponding adjusted position. The shaft 22 is journaled in bearings provided in the upper ends of brackets 28 supported upon a stationary portion 29 of the frame of the structure upon which also the quadrant 24 is supported. The inner end of the link 20 is provided with a roller 30 which is adapted to contact with the cam disk 13 and the cam projection 14. The said link 20 terminates in an upwardly projecting portion 31, the surface 32 of which is inclined as shown and extends upwardly in a direction away from a vertical line through the axis of the shaft 12 or in an outward direction. The surface 32 usually is spaced from and is adapted to contact with the lower end of an actuating rod 33. The lower end of the said rod is guided by means of a bearing guide 34 supported in any suitable manner upon a stationary part of the frame of the engine structure. The upper end of the rod 33, in the construction shown, is connected with the outer end of a lever 35 pivoted at its opposite end to the upper end of a bracket 36 supported upon the upper side of the cylinder head 4. The said lever 35 is connected intermediate its ends as shown at 37 to the upper end of a rod 38 which is adapted to be lifted upon upward movement of the rod 33 and lever 35 to open a valve (not shown) at the lower end of the spray nozzle 7.

In the case of a multi-cylinder structure it will be understood that lost motion feed controlling means such as described is associated with each cylinder.

It will be apparent that by adjusting the link 20 and the surface 32 the projecting portion 31 inwardly or outwardly so as to vary the lost motion of the feed operating and controlling means, the period during which the feeding of fuel is effected at each operation may be varied but notwithstanding such variation it is desirable, as has been previously pointed out, that the point with respect to the top dead center position of the crank shaft at which the discharge of fuel begins at each feeding operation shall remain substantially unchanged. If it be desired to decrease the amount of fuel supplied to the engine cylinder or cylinders the link 20 should be adjusted outwardly or toward the right, having reference to Figs. 1 and 2 of the drawings. Such an adjustment increases, as is obvious, the amount of lost motion between the surface 32 and the adjoining end of the actuating rod 33. At the same time the roller 30 is moved in a direction opposite that of the rotation of the cam disk 13 and cam projection 14 thereon so that the latter contacts with the roller 30 at an earlier point or moment in its rotation and at an earlier point in the rotation of the crank shaft with respect to its top dead center position. It follows, therefore, that a certain portion of the surface of the cam projection 14 passes underneath and in contact with the roller 30 before the surface 32 of the projection 31 contacts with the lower adjoining end of the rod 33. The parts are so constructed and related to each other that at the moment of contact and elevation of the rod 33 to actuate the lever 35 to open the valve of the spray nozzle 7 or to actuate any other feeding means the crank shaft has arrived at a position 10 to 8 degrees, as may be elected, in advance of its top dead center position. The initial feeding of the fuel is thus given at the point desired. A portion of the surface of the cam projection 14 having already passed underneath and in contact with the roller 30 and a portion only of the remaining surface thereof being effective to cause elevation of the rod 33, it follows that the latter is held in elevated position for a short period of time, thereby reducing the quantity of fuel fed into the engine cylinder or cylinders. If, however, the link 20 be adjusted in the opposite direction so as to decrease the amount of lost motion between the surface 32 and the adjoining lower end of the actuating rod 33, a reverse result is brought about; that is, the actuating rod 33 is held in elevated position by the cam projection 14 for a long period but the latter contacts with the roller 30 at a later period in its rotation whereby the initial feeding action is effected at substantially the same position with respect to the top dead center position of the crank shaft.

In Figs. 3 to 5 inclusive I have shown modifications of the structure in which the parts 12, 13, 14, 22, 23, 24, 25, 27, 28, 29 and 33 are identical with the parts correspondingly designated in Figs. 1 and 2 of the drawings.

In Figs. 3 and 4 I have provided a link 40 pivoted at its outer end to the upper end of an arm 41 rigidly mounted upon the oscillatable shaft 22, which shaft is adapted to be oscillated or actuated by the handle 23. At its inner end the link 40 is provided with a

roller 43 (corresponding to the roller 30 in Figs. 1 and 2) and is also provided with an upwardly extending projection 44, which may be referred to as an actuator, between the upper end of which and the lower adjoining end of the rod 33 a wedge shaped member 45 is located. The wedge 45 is pivotally connected at its outer end to the upper end of an arm 46 mounted upon the oscillatable or rock shaft 22. Upon oscillating or rocking the shaft 22 the arms 41 and 46 are likewise oscillated or rocked. Upon the rocking of the said arms 41 and 46 outwardly the links 40 and 45 are moved outwardly or if the said arms are oscillated or rocked in the opposite direction the said links 40 and 45 are moved inwardly. The operation of the link 40 and wedge 45 in their control of the feeding of fuel to the engine cylinder or cylinders is identical with the operation as described in connection with the construction disclosed in Figs. 1 and 2 of the drawings.

In the construction as illustrated in Fig. 5 I have provided a link 50 mounted upon an eccentric 51 which is secured upon the rock shaft 22. At its inner end the link 50 is provided with a roller 53 which rests upon the cam disk 13 and is actuated by the cam projection 14 which contacts therewith. The link 50 is also provided at its inner end with an upwardly extending projection 54 which may be referred to as an actuator between the upper end of which and the lower end of the actuating rod 33 a wedge 55 is located, which wedge is pivoted at its outer end to an arm 56 secured to the rock shaft 22. The operation of the link 50 and the wedge 55 to control the fuel feeding operation is identical with the similar operations of the corresponding mechanisms illustrated in Figs. 1 and 2 and 3 and 4.

In Fig. 6 I have shown a construction in which the feed control mechanism corresponding to the similar mechanism previously described and illustrated in Figs. 1 to 5 of the drawings is located at the upper part of the engine structure. In said Fig. 6 I have shown a cam shaft 59 journaled in brackets, only one of which is shown at 60, which cam shaft is provided with cam disks, only one of which is shown at 61, having cam projections 62 thereon which co-operate with a roller 63 upon the lower adjoining end portion of a link 64 pivoted upon an eccentric 65 secured to the oscillatable or rock shaft 66 journaled in brackets, only one of which is shown at 67. The link 64 may be referred to as an actuator. The shaft 66 is adapted to be rocked by means of a handle 68 secured to one end thereof and located in co-operative relation to a quadrant 69, the convex edge of which is provided with teeth 70 with which a spring pressed catch 71 co-operates. The engagement of the catch 71 with the teeth 70 holds the handle 68 together with the shaft 66 in any position to which the same may be adjusted. The quadrant 69 is supported upon arms 72 which project from one of the brackets 67. An arm 73 is secured at its outer end to the rock shaft 66 and is adapted to be rocked or oscillated by the rocking movements of said shaft. A depending wedge 75 is pivoted at its upper end to the inner end of the arm 73. The said wedge is located between a projection 76 upon the lower end of the link 64 and an outwardly extending projection 77 upon the lower end of a depending arm 78 of a bell crank lever, the other arm 79 of which extends inwardly and is connected to the rod 38 to actuate the same to effect opening of the valve (not shown) at the lower end of the spray nozzle 7. The bell crank lever comprising the arms 78 and 79 is pivoted upon a rod 80 supported upon the brackets 67.

It will be understood that a lost motion feed control mechanism such as is illustrated by the parts 61, 62, 63, 64, 73, 75, 76, 77, 78, 79 and 80 is associated with each cylinder of a multi-cylinder engine structure.

In Fig. 7 I have shown a construction comprising a cam shaft 59, brackets 60 and cam discs 61 having cam projections 62 similar to the corresponding parts shown in Fig. 6 of the drawings.

In the construction as illustrated in this figure of the drawings I have provided a series of angular levers pivotally mounted upon a rock shaft, one end of each of which levers is connected with a fuel feeding means for actuating the same, while the opposite end thereof is adapted to be acted upon directly by cams mounted upon a revoluble cam shaft and have also provided the last mentioned end of each of said levers with adjustable means so related to the cams with which they are respectively associated that upon adjustment thereof with respect to the said cams variation of the feeding of fuel may be affected.

A roller 85 mounted upon the lower end of an adjustable arm or support 86 is held in co-operative relation with respect to the rotating cam disk 61 and is adapted to contact with and to be actuated by the cam projection 62 thereon. The support 86 for the roller 85 is slidably mounted upon the outwardly and downwardly extending arm 87 of an angular lever 88, the other or opposite arm 89 of which is connected with the rod 38 to actuate the same to control the valve of the spray nozzle 7. The angular arm 88 is pivoted upon a rock shaft 90 journaled in brackets, only one of which is indicated at 91. The shaft 90 is adapted to be rocked by means of a handle 92 secured to one end thereof, which handle projects in co-operative relation to a quadrant 93 (supported in any suitable manner upon a stationary part of the engine structure) the convex edge of which is provided with teeth

94 which are adapted to be engaged by means of a spring pressed catch 95. The arm 86 is mounted within a suitable slot 96 provided in the upper outer side of the arm 87 and is provided with a projection 97 to the upper end of which the outer end of a link 98 is pivotally connected, the opposite end of which is pivotally connected to the upper end of an arm 99 secured to the rock shaft 90 previously referred to. It will be apparent that upon rocking of the rock shaft 90 the arm 99 is likewise rocked, as a result of which the supporting arm 86 is adjusted in one direction or the other (depending upon the direction of the rocking movement) so as to vary the position of the roller 85 with respect to the cam disk 61. It will be understood that the cam shaft 59 and the cam disk or cam disks thereon rotate in an anti-clockwise direction. If the arm 86 be adjusted outwardly the result is that the cam projection 62 contacts with the roller 85 at a slightly later point in its revolution and in consequence of which the roller 85 is held depressed for a shorter period resulting in shorter periods of fuel feed at each revolution of the cam shaft. If, on the other hand, the supporting arm 86 should be adjusted in the opposite direction or toward the axis of the rock shaft 90, the roller 85 is adjusted into a position such that the cam projection 62 contacts therewith at an earlier point or movement in its revolution, in consequence of which the periods during which the roller 85 is held depressed are increased resulting in increased fuel feed at each fuel discharging operation. Upon reference to Fig. 7 it will be apparent that when the supporting arm is adjusted inwardly the distance between the axes of the roller 85 and cam 61 is increased whereas if adjustment is outward the distance is decreased.

It will be understood that the feeding controlling mechanism illustrated in Fig. 7 is duplicated for each cylinder of a multi-cylinder engine structure.

It will be understood that the cam shafts 59 of the constructions illustrated in Figs. 6 and 7 are operated by means of gear trains between the crank shaft and the said cam shaft.

It will be seen that by my invention I have provided simple means easily controlled and regulated for controlling and regulating the feeding of fuel into the cylinders of internal combustion engines, whether the said control be employed for opening the valve of spray nozzles as illustrated or for controlling the operation of pumps by means of which fuel is forced into the engine cylinders.

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

1. In mechanism for controlling the means for feeding fuel into the cylinder of an internal combustion engine, the combination of a cam shaft having a cam thereon, rotation of the said cam shaft being effected by the crank shaft of the engine, an actuating rod interposed between the fuel feeding means and the said cam shaft, means adapted to be actuated by the cam upon said cam shaft for actuating the said rod, the said last mentioned means being spaced from the said rod, adjustable means interposed between the said means and the said rod whereby the lost motion space between the said means and the said rod may be varied, and means for adjusting the said cam actuated means tangentially of the said cam simultaneously with the adjustment of the said adjustable lost motion controlling means.

2. In mechanism for controlling the operation of the fuel feeding device of an internal combustion engine, the combination of a cam shaft adapted to be rotated from the crank shaft of the engine, which cam shaft is provided with a cam disk having a cam projection thereon, an actuating rod having connection with the fuel feeding means, an actuator for the said actuating rod, which actuator is adapted to be actuated by the said cam projection and the said actuator being spaced from the adjoining end of said rod, adjustable means interposed between the said actuator and the said actuating rod for varying the lost motion space therebetween, and means for adjusting the said actuator in the plane of said disk and transversely of the axis of rotation thereof, simultaneously with the adjusting of the said interposed lost motion controlling means for varying the position of the said actuator with respect to the circumference of the said cam disk.

3. In mechanism for controlling the operation of the fuel feeding means of an internal combustion engine, the combination of a cam shaft adapted to be rotated by means interposed between it and the crank shaft of the engine, which cam shaft is provided with a disk having a cam projection thereon, a device having connection with the said fuel feeding means, a portion of which device is located in cooperative spaced relation to the said cam disk and the said cam projection thereon, a pivotally supported actuator interposed between the said cam disk and the cam projection thereon and the said device, said actuator being spaced from the said device to provide lost motion, adjustable means interposed between the said actuator and the said device for controlling the amount of lost motion, and means for adjusting the said actuator transversely of the axis of the said cam disk and in the plane thereof to vary its position with respect to the periphery of said disk.

4. In mechanism for controlling the operation of the liquid fuel feeding means of an internal combustion engine, the combination

of a cam shaft having a cam disk thereon provided with a cam projection upon its periphery, which cam shaft is rotated by means interposed between it and the crank shaft of the engine, a device interposed between the said cam disk and cam and the said fuel feeding means, one portion of which device is located in operative spaced relation to the said cam disk and cam, a pivotally supported actuator resting upon the said cam disk and adapted to be actuated by the said cam projection, said actuator being located between the said cam disk and the adjoining portion of the said device and spaced from the latter, the surface of the said actuator adjoining the said device being beveled outwardly, and means for adjusting the said actuator transversely of the axis of the said cam disk to vary its position with respect to the latter and with respect to the adjoining portion of said device.

5. In mechanism for controlling the feeding operation of means for feeding liquid fuel to the cylinder of an internal combustion engine, the combination of a cam shaft having a cam disk thereon provided with a cam projection, rotation of which shaft is effected by means interposed between it and the engine crank shaft, a device interposed between the liquid fuel feeding means and the said cam disk and being spaced from the latter, a rock shaft, an arm mounted thereon, a link having pivotal connection at its outer end to the said arm, the inner end of said link being interposed between the said cam disk and the said device and spaced from the latter, the said inner end of the said link having an inclined surface whereby upon the rocking of the said arm to effect movement of the said link relatively to the said cam disk and the said device the width of the space between the one end of said link and the adjoining portion of said device is varied, the position of the inner end of said link with respect to the periphery of the said cam disk being simultaneously varied.

6. In mechanism for controlling the operation of the liquid fuel feeding means of an internal combustion engine, the combination of a cam shaft having a cam disk provided with a cam projection, rotation of the said cam shaft being effected by means interposed between it and the crank shaft of the engine, a device interposed between the said fuel feeding means and the said cam disk, the said device being operatively related at one end to the said fuel feeding means and at its opposite end being spaced from the said cam disk and the cam projection thereon, a rock shaft having a laterally projecting arm rigidly connected therewith, means for effecting rocking movement of said shaft and of the said arm, and a link having pivotal connection at its outer end with the said arm, the inner end of said link resting upon the said cam disk and being provided with a projection extending transversely of the axis of the said disk, which projection is provided upon its outer end with a surface which is inclined upwardly from its inner end, which surface is normally in spaced relation to the adjoining portion of the said device.

7. In mechanism for controlling the operation of the liquid fuel feeding means of an internal combustion engine, the combination of a rotating cam shaft having a cam located thereon, operative connections between said cam shaft and the fuel feeding means for actuating the latter, said connections including a lost motion varying device located intermediate of and in spaced relation to other portions thereof, and means for simultaneously adjusting said device and a co-operating portion of said connections.

8. In mechanism for controlling the operation of the fuel feeding means for an internal combustion engine, the combination of a cam shaft having a cam disk mounted thereon, an actuating rod connected to the said fuel feeding means, an actuator interposed between the cam disk and one end of said rod, said actuator having means thereon located in spaced relation to the said actuating rod to provided a lost motion connection therewith, a cam roller connected to said actuator and movable therewith, and means common to the said means and said actuator for adjusting both simultaneously, the said actuator being adjusted tangentially of the said cam disk.

9. In mechanism for controlling the operation of the fuel feeding means of an internal combustion engine, the combination of a cam shaft having a cam thereon, which shaft is adapted to be rotated by the crank shaft of the engine, a member having connection with the fuel feeding means, a member with which the said cam is adapted to contact, a lost motion regulating means interposed between the said members, and means for simultaneously adjusting the said second named member and the said lost motion regulating means, the adjustment of the latter being in the plane of the said cam and transversely of the first named member.

In testimony that I claim the foregoing as my invention I have hereunto signed my name this 31st day of August, A. D. 1927.

OTIS D. TREIBER.