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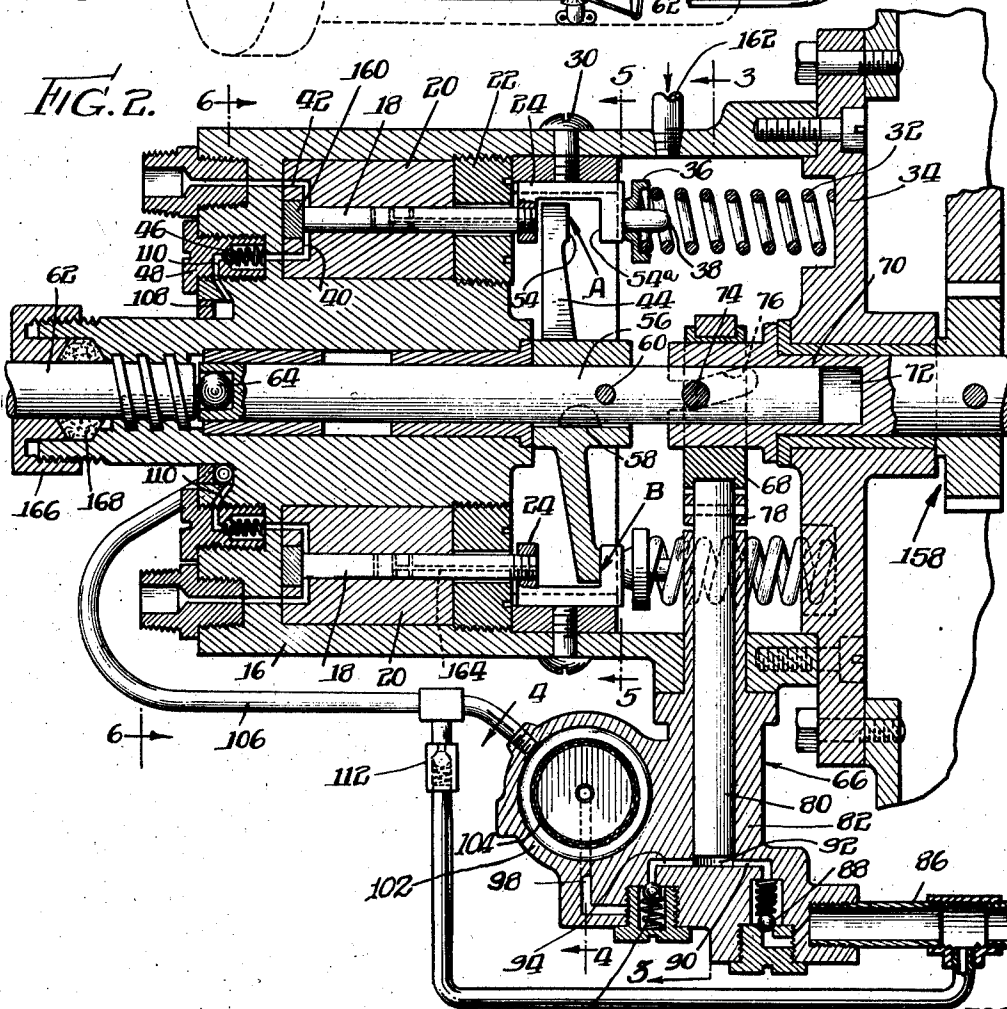
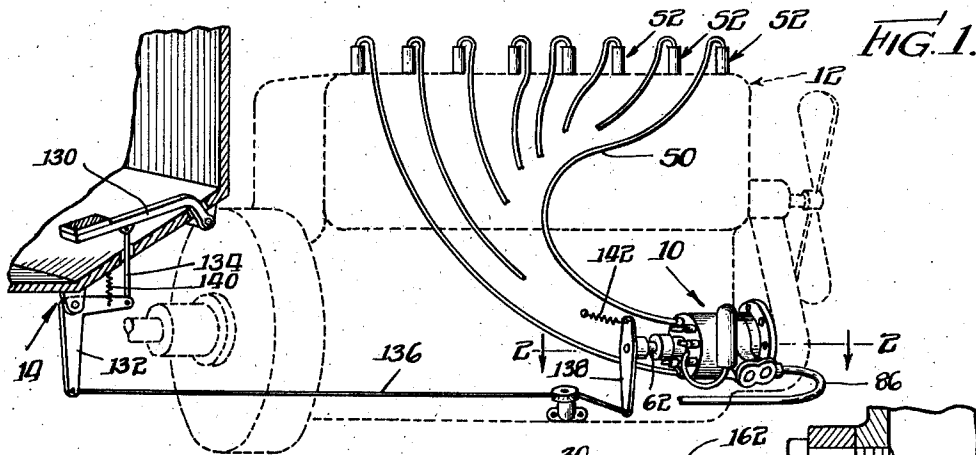
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FLUID CONTROL MECHANISM

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FLUID CONTROL MECHANISM

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This invention relates generally to fluid control mechanism, and more particularly to mechanisms for controlling the charging of internal combustion engines with fluid fuel.

The primary object of the invention is to provide improved, efficiently operable, and relatively simple means for timely forcing fluid fuel into charging association with the cylinder or ignition chambers of an internal combustion engine.

Due to the inherent structural features of conventional fuel pumps and the like with which I am familiar, said pumps are not adapted to function satisfactorily when used with internal combustion engines, which operate over a relatively wide range of speeds. Generally speaking, conventional fuel pumps have a constant degree plunger movement when used, for example, with Diesel engines having relatively constant speed operation. Should the engine be subjected to a wide range of operating speeds, these conventional pumps will not function satisfactorily. In other words, at slow or idling speeds, a sluggish discharge of fluid by the pump would be experienced, and hence combustion would be proportionately inefficient.

Due to piping which connects the fuel pump with the engine cylinder, an appreciable lag in fluid delivery from the pump outlet to the cylinder takes place. It is an object of the present invention to compensate for this lag between low and high speeds, and to this end I propose to advance the time of starting of the pump plungers and thereby compensate for high engine speed and for heavy load conditions.

More specifically, I contemplate initiating the delivery stroke of the pump plunger at high engine speed in advance of the initiation of the delivery stroke at low or idling speeds. Thus I propose, at idling or low engine speeds, to cause the fuel to enter the engine cylinder during the interval of engine crank movement which will permit carburetion before the compression stroke is completed, and before ignition takes place. Likewise, for high speeds or when greater power is required, the charging of the cylinder with fuel begins at a somewhat earlier interval so as to afford a longer charging period. Thus the carburetion of the air in the cylinder at low or high speeds will be completed at substantially the same time with respect to the crank movement, that is, in advance of the completion of the compression of the charge in the cylinder and before the ignition spark occurs.

The foregoing and numerous other objects and advantages will be more apparent from the

following detailed description when considered in connection with the accompanying drawings, wherein—

Figure 1 discloses fluid control mechanism of the type contemplated by the present invention 5 shown in operative association with an internal combustion engine;

Figure 2 is an enlarged horizontal sectional view of the fluid controlling mechanism shown in Figure 1, said section being taken substantially 10 along the line 2—2 of Figure 1;

Figure 3 is a vertical transverse sectional view taken substantially along the line 3—3 of Figure 2;

Figure 4 is a detailed view taken substantially 15 along the line 4—4 of Figure 2;

Figure 5 is a vertical sectional view taken substantially along the line 5—5 of Figure 2;

Figure 6 is an end view partially in section of the left end of the mechanism disclosed in Figure 20 2, said view being taken substantially along the line 6—6 of Figure 2;

Figure 7 is a fragmentary detailed disclosure of the valve mechanism which controls the delivery of fluid fuel into the ignition chambers of 25 the engine; and

Figure 8 discloses the manner in which the stroke of the pistons may automatically be controlled in timed relation with the speed of the 30 engine.

Referring now to the drawings more in detail wherein like numerals have been employed to designate similar parts throughout the various figures, it will be seen that my invention contemplates a fluid fuel control mechanism designated generally by the numeral 10 (Figure 1). 35 In Figure 1 this mechanism 10 is shown in operative association with an internal combustion engine 12 designated by dotted lines. Also, a suitable foot operated mechanism 14 is shown 40 in Figure 1, which enables the stroke of the pump pistons to be governed in accordance with the engine speed, as will hereinafter be more clearly described.

The mechanism 10 includes a suitable pump 45 housing 16. Within the housing 16 are a plurality of reciprocable pump plungers 18, each of said plungers being reciprocable within a suitable sleeve 20. The sleeves 20 are secured in position by means of suitable threaded sleeves 50 22 which make threaded engagement with the pump housing or casing 16, as clearly shown in Figure 2. The right extremity of each plunger 18, as viewed in Figure 2, is connected with an actuating block 24. It will be noted that these 55

blocks 24 are reciprocable within companion recesses 26 (Figure 5) formed along the inner periphery of a ring 28 which is fitted within the casing 16 and secured in place by suitable means such as screws 30. The actuating blocks 24, together with their companion plungers 18, are normally urged to the left (Figure 2) through the agency of coiled springs 32 interposed between an end frame or plate 34 and a washer 36 mounted upon a member 38 projecting from the block 24 in axial alinement with the complementary plunger 18.

Operatively associated with the inner or left extremity of each plunger 18 is a fluid intake channel 40 and a fluid outlet channel 42. Thus as the plungers are moved to the right through the agency of a cam member 44 (later to be described), fluid under pressure is adapted to pass through a check valve 46 provided within a screw member 48, thence through the intake channel 40 into association with the left or inner extremity of the plunger 18. As the plunger 18 is suddenly urged to the left through the agency of the spring 32 (in a manner later to be described), a charge of fluid is suddenly forced through the outlet channel 42 and thence through conduits 50, which connect said channels with control valve mechanism 52. These valve mechanisms 52 shown more in detail in Figure 7, connect with the ignition chamber of the engine 12, and thus serve to control the delivery of fluid to said chamber as the plungers 18 move inwardly or to the left, as viewed in Figure 2.

As previously stated, movement of the plungers 18 to the right against the action of the coiled springs 32 takes place in response to the rotation of the special actuating cam 44. In the present embodiment this cam 44 is in the form of a sector or quadrant, as clearly indicated in Figure 5, and is provided with a cam surface 54 which rises from its lowest point designated by the letter A (Figures 2 and 5) to its highest point designated by the letter B. This cam quadrant or sector 44 is mounted upon a shaft 56 and is rotatable therewith through the agency of a suitable key and keyway structure 58. A pin 60 (Figure 2) also serves to positively secure the cam 44 in proper fixed position upon the shaft 56. This shaft 56 is driven in timed relation with the crank shaft of the engine 12.

The cam surface 54 is designed to coast with companion surfaces 54a on the actuating members of blocks 24. Thus when the cam 54 occupies the position shown in Figure 2, rotation thereof will not cause any movement to be experienced by the plungers 18. An adjusting screw 62 is positioned in end-to-end relation with the left extremity of the shaft 56 and abuts a suitable anti-friction member or ball 64. By turning the screw 62 so as to move the shaft 56 to the right (Figure 2), the cam surfaces 54 are correspondingly shifted so as to cause the high point B of the surface 54 to engage the companion surface 54a of the block 24, and thus move the complementary block and its associated plunger 18 to the right. In other words, the degree to which the shaft 56 is shifted to the right will determine the movement or stroke of the plungers 18. As the cam member 44 rotates in a counter-clockwise direction, as viewed from the right of Figure 2 or as viewed in Figure 5, the plungers 18 will successively experience a degree of retraction which is determined by the degree of adjustment made through the agency of the

adjusting screw 62. As the high point B of the cam surface 54 leaves each actuating block 24, the spring 32 complementary thereto suddenly urges said block and associated plunger 18 to the left, thereby forcing the charge of fluid fuel which had previously been taken in during the retracting stroke of said plunger to be forced into the ignition cylinder of the engine 12 through the control valve 52. Obviously the number of plungers to be used will be determined by the number of cylinders in the engine 12. For the purpose of illustrating one practical embodiment of the invention, it has been disclosed in operative association with an 8-cylinder engine, which necessitates the use of 8 plungers 18 and their associated parts such as the actuating blocks 24, the springs 32, the ports 40 and 42, the conduits 50, and the control valves 52.

The inward or charging stroke of the plungers 18 is obviously timed to take place just prior to the period of ignition. However, the present invention contemplates a novel and extremely practical control arrangement (later to be described) which insures proper carburization regardless of the speeds at which the engine 12 is operating.

A suitable fluid pump 66 is employed to enable the delivery of fluid under the required pressure into association with the inner extremities of the plungers 18. This pump 66 includes an eccentric drive 68, which is eccentrically mounted upon the hollow extremity of a shaft 70. The right extremity of the shaft 56 previously described extends within the recess 72 provided in the shaft 70, as clearly shown in Figure 2. Rotation is imparted to the shaft 56 by the shaft 70 through the agency of a cross pin 74, the opposite projecting portions of which extend into complementary slots 76 formed helically within the hollow portion of the shaft 70. The eccentric actuating member 68 operates within a ring 78 (Figure 3) which is connected with an upper end of a pump piston or plunger 80. Thus for each complete rotation of the shaft 70, the pump plunger 80 experiences one complete cycle of reciprocation. The lower extremity of the pump piston or plunger 80 is reciprocable within a suitable pump housing or casing 82, and this casing is secured by means of suitable bolts 84 to the casing 16. During the upward movement of the piston 80 fluid is drawn in from a suitable reservoir or other source of supply (not shown) through a conduit 86, a check valve 88, a channel 90, and thence into the chamber 92. During the downward or compression stroke of said plunger 80 fluid is discharged under pressure through a channel 94, a check valve 96, a channel 98, and then into a pressure or accumulator chamber 100 which is presented within a casing 102. Fluid which enters the casing 102 passes through a filter 104 and is then free to pass outwardly under pressure through a conduit 106. The opposite extremity of this conduit 106 is hydraulically connected with an annular chamber 108 provided within the pump housing 16. The check valves 46 previously described receive fluid from this annular chamber 108 through channels 110. In this manner fluid under pressure is always available for delivery to the fluid dispensing plungers 18. In order to prevent the development of excessive pressures within the conduit 106, a suitable by-passing relief valve 112 is provided, which permits the return of fluid to the source of supply (not shown).

In order to assure the proper delivery of fluid

fuel into the ignition chamber of the engine 12, each of the valve mechanisms 52 is provided with a valve head 114 of special design. This valve head is normally urged toward the upper position shown in Figure 7 through the agency of a coiled spring 116, which acts against a collar 118 secured to the upper end of the valve stem 120. The valve housing 122 is seated within the wall of the engine 12 and a threaded coupling 124 at the opposite extremity serves to connect the valve chamber 126 with its complementary conduit 50. As the charge of fluid fuel under pressure is forced through the conduit 50 and into the valve chamber 126, the valve head 114 is unseated and, as it moves inwardly, any foreign material which may have collected in the vicinity of the head during the previous period of explosion—for example, carbon particles and the like, is scraped away due to the engagement of the periphery of the head 114 with the adjacent cylindrical inner periphery of the valve casing 122. Also, the restricted annular area or orifice 128 presented by the frusto-conical shape of the head 114 causes fluid to be forced into the ignition chamber at a great speed, thereby washing away any possible foreign matter and properly delivering the atomized fluid for carburizing the air within the ignition chamber. Upon the completion of the charging operation, the spring 116 serves to seat the valve head 114.

Conventional fluid control mechanisms or pumps are not adapted to function satisfactorily when used with internal combustion engines which operate over a relatively wide range of speeds. This is due to the fact that during low or idling speeds the delivery of fluid to the ignition chamber is sluggish as compared with the delivery of fuel during high speed operation of the engine. I propose to so control the functioning of the actuating cam 44 (just described) as to insure the delivery of charging fuel at the proper time regardless of the speed at which the engine is operating.

It will be apparent from the foregoing description that the angular setting of the cam 44 with respect to the position of the engine crank shaft will determine the period at which fluid fuel will be suddenly forced into the ignition chamber due to the action of the springs 32 upon the plungers 18. Therefore, it is extremely important that the setting of the cam 44 be synchronized with the engine crank shaft movement at all engine speeds. There is a certain lag of fluid flow resulting from the movement of the plungers 18, due to the frictional resistance set up within the piping or conduits 50, etc. This lag between slow speeds and high speeds can be compensated for by controlling the time at which the plungers 18 move forwardly to cause the discharge of fluid into the cylinders. I accomplish this control of the cam 44 by providing the pin 74 and slot 76 previously described. Thus when the engine is operating at high speeds, the cam 44 is automatically advanced in relation to the crank angle, and this permits the charging of the air within the engine cylinder to be started at a period which is somewhat earlier than the time at which said cylinder begins to be charged under slow speed or idling operation. The helical disposition of the recess 76 causes the cam 44 to experience rotation as it is advanced to the right (Figure 2). In other words, as the stroke of the pump plungers 18 is increased, the cam 44 experiences an

advance setting so as to insure the carburizing of the air within the cylinder in advance of the completion of the compression stroke of the piston within the engine cylinder and always before the ignition spark occurs. With this arrangement, complete carburization at the proper time, regardless of engine speeds, is accomplished.

The angular setting of the cam 44 may be controlled in synchronism with the speed of operation of the engine 12 by means of the mechanism disclosed in Figure 1. The foot operated mechanism 14 includes a conventional foot operated accelerator member or pedal 130, which is connected to a bell crank 132 by means of a link 134. The bell crank 132 is connected through a flexible member 136 with a lever 138, which is mounted upon the screw shaft 62. Thus, when the engine is speeded up by depressing the accelerator pedal 130, the screw shaft 62 is rotated so as to shift the cam 44 longitudinally. The axial or longitudinal shifting of the cam 44 causes said cam to be rotatably adjusted due to the cooperation of the pins 74 and helical slots 76, as previously described. In this manner the setting of the cam 44 is synchronized with crank shaft movement at all engine speeds. Suitable means such as springs 140 and 142 serve to rotate the screw shaft 62 in an opposite direction when the accelerator pedal is released. Obviously the specific foot-operated mechanism for controlling the rotation of the screw shaft 62 may be changed without departing from the spirit and scope of the present invention.

In Figure 8 I have disclosed a mechanism whereby the setting of the cam 44 may be automatically controlled in response to variations in engine speeds. To accomplish this, I propose to employ a governor mechanism 144. As the centrifugal members 146 of the governor mechanism 144 move outwardly, a shaft 56a, corresponding with the previously described shaft 55, is moved to the right, thereby carrying the pins 74 into operative relation with the helical slots 76 provided in a hollow shaft 70a, which corresponds with the shaft 70 previously described. This shaft 70a is driven in timed relation with the crank shaft of the engine. In this manner the setting of the cam 44 is automatically controlled in response to variation in engine speeds. A suitable lever 148 which connects with a second lever 150 through a spring 152 operates to continuously urge a collar 154 connected with the governor mechanism 144 to the left. In other words, the spring 152 constantly urges the shaft 56a to the left. Cooperating with the spring 152 is a coiled spring 156 interposed between the extremities of the governor arms, as shown in Figure 8.

It will be apparent from the foregoing description that the shafts 70 and 70a are driven from and in synchronism with the engine crank shaft through suitable gearing 158. The gearing 158 disclosed in the drawings is used for four-cycle engines, whereas when the fluid control mechanism above described is used with two-cycle engines, the shafts 70 and 70a may be driven at the same speed as the crank shaft. In other words, no reduction gearing is necessary for two-cycle engines. Attention is also directed to a hardened ground plug 160 fitted within the sleeves 20 at the inner extremities of the plungers 18. By employing these plugs, it is possible to lap the cylinders or bores within the sleeves 20 and thereby enable a perfect fit of the plungers 18 within said bores. In order to facilitate lubrication, a suitable lubricant can be introduced

through a conduit 162 (Figure 2). Thus the chamber which houses the eccentric drive mechanism, the actuating cam, etc., may be supplied with the required amount of lubricant. Each plunger 18 is provided with passageways 164 to enable a supply of lubricant to be directed to the peripheral surfaces of the plungers. Each time the plunger is suddenly urged to the left (Figure 2) through the action of the springs 32 and into engagement with the hardened plugs 160, the lubricant within the passageways 164 is urged by impact into association with the contacting peripheral surfaces of the plungers 18 and the complementary bore in the sleeve 20. It will also be seen that a suitable cap 166 and packing 168 encircle the adjusting screw 62.

From the foregoing description it will be apparent that my invention contemplates the provision of a fluid control mechanism for internal combustion engines, which is extremely simple in construction and requires a minimum number of constituent elements. The device may be manufactured by practicing conventional machine shop methods. It will also be apparent that by the use of my improved fluid control mechanism the operating efficiency of an internal combustion engine will be materially increased above that obtained when conventional fluid control or injector mechanisms are employed. While I have shown certain specific structural features of construction, it will be apparent that my invention contemplates other changes and modifications without departing from the spirit and scope of the appended claims.

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

1. In fluid control mechanism for an internal combustion engine, a housing, a plurality of fluid pressure generating plungers therein, springs for causing said plungers to experience a fluid discharge movement to inject fluid into the engine, cam means for successively tensioning and then releasing said springs to control the injection strokes of said plungers in predetermined relation, and means including an adjustable element and operative connections between said springs and said cam means for adjusting said cam means to govern the time of beginning and the length of said injection strokes whereby to maintain substantially constant, for a given speed, the time of ending said injection strokes.

2. In fluid control mechanism for an internal combustion engine, a housing, a plurality of fluid generating plungers therein, spring mechanism for causing said plungers to experience a fluid discharge movement to inject fluid into the engine, rotary cam means for successively tensioning and then releasing said springs to control the injection strokes of said plungers in predetermined timed relation said springs urging the cam means axially in one direction and means including a mechanism responsive to the speed of the engine urging said cam means in opposition to said springs for axially and rotatively shifting said rotary cam means relative to said plungers whereby simultaneously to vary the time of beginning and the length of said injection strokes as the speed of the engine varies.

3. In a fluid control mechanism for an internal combustion engine, a body casting having a plurality of annularly arranged openings, each of said openings having a pump cylinder therein, means threadedly engaging said body

casting and retaining said cylinders in said openings, pump plungers slidably mounted in said cylinders and passing through said retaining means, said cylinders having inlet and outlet ports communicating with inlet and outlet passages formed in said body casting, a driving shaft journaled in said body casting concentrically with said cylinders and pump plungers, cam means carried by said shaft for controlling the suction movements of said plungers, spring means controlling the pressure discharge movements of said plungers, means including an adjustable element and operative connections between said cam means and said spring means for axially and rotatably adjusting the shaft and the length of the injection stroke of said pump plungers.

4. In a fluid control mechanism for an internal combustion engine, a body casting having a plurality of annularly arranged pump cylinders therein, pump plungers slidably mounted in said cylinders, said cylinders having inlet and outlet ports communicating with inlet and outlet passages formed in said body casting, a ring secured to said casting and having a plurality of spaced apart axially directed grooves in radial alinement with said plungers, tappet means secured to the inner ends of said plungers and engaging in said grooves, springs engaging said tappets for controlling the pressure discharge movements of said plungers, a driving shaft journaled in said body casting concentrically with said cylinders and pump plungers, cam means carried by said shaft for engaging said tappets for controlling the suction movements of said plungers means adjustable in one direction for axially and rotatably moving said shaft with said cam means to increase the length of the stroke of each plunger and to advance the time at which the stroke shall begin, said springs acting on said cam means in an opposite direction so as to decrease the length of the stroke and retard its time of beginning upon adjustment of said adjustable means in the opposite direction.

5. In a fluid control mechanism for an internal combustion engine having a crankshaft, a body casting having a plurality of annularly arranged pump cylinders therein, pump plungers slidably mounted in said cylinders, said cylinders having inlet and outlet ports communicating with inlet and outlet passages formed in said body casting, tappet means secured to the inner ends of said plungers, springs engaging said tappets for controlling the pressure movements of said plungers, a driving shaft journaled in said body casting concentrically with said cylinders and pump plungers, cam means carried by said shaft for successively engaging said tappets to control the suction strokes of said plungers, to tension said springs and to release said tappets thereby to control the initiation of the pressure strokes of said plungers, means including an adjustable element and operative connections between said springs and said cam means for adjusting said driving shaft axially, with said cam means, to vary the length of the strokes of said plungers, and an adjustable driving connection between the crankshaft and said driving shaft for rotating said driving shaft relative to said crankshaft upon axial adjustment of said driving shaft whereby to vary the time of initiation of the strokes of the plungers.

6. In fluid control mechanism for an internal combustion engine having a crank shaft, a hous-

ing, a plurality of fluid pressure generating plungers in said housing, spring mechanism for causing said plungers to experience a fluid discharge movement to inject fluid into the engine, rotary cam means driven from said crank shaft for urging said plungers against the action of said spring mechanism to condition said plungers for making said discharge movement in predetermined timed relation, means adjustable in one direction for shifting said rotary cam means axially relative to said plungers to increase the stroke of said plungers and for simultaneously

rotating said cam means relative to said crank shaft to advance the time at which the discharge movement of each plunger shall begin, said spring mechanism being operatively connected to the rotary cam means and operable when the adjustable means is adjusted in the opposite direction to shift said cam means axially relative to the plungers to decrease the stroke of said plungers and to simultaneously rotate the cam means to retard the time at which the discharge movement of each plunger shall begin.

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