This invention relates generally to internal combustion engines and more particularly to improved means for shutting down a Diesel engine.

It is customary in the operation of engines to employ protective devices responsive to various conditions such, for example, as loss of engine lubricating oil pressure, an abnormal rise in lubricating oil temperature, or excessive overspeed of the engine as well as other possible conditions. In prior arrangements the protective devices have been dependent upon initially establishing a predetermined lubricating oil pressure which moved the fuel injection pumps of a Diesel engine to starting position, but this involved complications in operation and structure such as requiring special pumping mechanism for establishing the lubricating oil pressure before the engine was started, it being understood that the regular lubricating oil pump is driven directly from the engine crankshaft and hence lubricating oil pressure is normally not available for initially setting the injection pumps or speed governor, as the case may be, unless said special pumping mechanism is provided.

It is an object of my invention to provide an improved system and apparatus for initially setting the fuel injection pumps without necessitating special pumping mechanism for establishing lubricating oil pressure prior to starting.

Another object is to provide an improved system and apparatus that is simple, economical, positive and direct in its operation for initially setting the governor or fuel injection pumps prior to starting the engine, and yet is immediately operative to shut down the engine automatically upon occurrence of a predetermined abnormal condition.

Other objects and advantages will be more apparent to those skilled in the art from the following description of the accompanying drawings which is a diagrammatic illustration of my improved system and apparatus applied to government controlled fuel pumps.

In the particular embodiment of the invention as disclosed herein for purposes of illustration I have omitted the engine per se for purposes of simplicity, although there is shown a plurality of fuel injection pumps I, one for each engine cylinder. These fuel pumps may be of any suitable or usual type but are specifically shown herein as being of the well-known Bosch fuel pump type such as disclosed in Patent 1,831,649. This type of pump is diagrammatically shown herein as having a pump plunger 2 reciprocated by a cam 3 while the volumetric displacement of the pump is controlled by angularly adjusting the plungers through a plunger pinion 4 and a governor actuated reciprocable rack shaft 5. Fuel is discharged to the engine cylinder through pipes 6 while fuel is supplied from a low pressure fuel transfer pump 9 to the injector pumps through a pipe 7. The transfer pump is operated from a suitable source of power such as a battery 10 so that a supply of fuel is available to the injector pumps instantly upon starting the engine. The rack shaft 5 is controlled by an engine speed governor diagrammatically indicated at 11. The governor rocker arm 12 is pivotally connected to a shaft 13 which moves into abutting engagement with rack shaft 5 in the direction of movement for shutting down the engine whereas movement from the governor shaft 13 during increase of load is transmitted through a spring 14 and collar 15 to rack shaft 5 to move the latter to the right beyond its initial starting position. After the governor effects the necessary fuel pump adjustment to correspond to a given load demand the governor and pump remain in a constant position until a further load increase momentarily causes the engine speed to drop whereupon the governor causes further right hand movement of shaft 5 to increase the amount of fuel sufficient to carry the increased load.

When the engine shuts down, governor 13 moves rack shaft 5 to its left hand position which adjusts the injector pumps to their shut down position which in the case of Patent 1,831,649 is that angular position of the pump plunger at which all fuel by-passes the plunger during its reciprocatory movements and hence is incapable of producing an injection pressure on the fuel. Hence, to initially set the pump plungers to a starting position it is necessary to move shaft 5 slightly to the right before the engine can be started. The starting position of the pump is that angular position of the pump plunger which will cause at least some portion of the fuel to be compressed for injection purposes. I move shafts by imposing an additional function upon the fuel transfer pump 9 and I coordinate this fuel transfer pressure with the protective control switches. To this end a branch pipe 17 is taken off of pipe 7 and connected to a servo-motor cylinder 18 through a solenoid controlled valve 19. The servo-motor piston 20 is normally biased downwardly by a spring 21 while the piston rod has a lost motion connec-
tion 22 with a bell crank arm 23, this arm being pivotally connected to rack shaft 5. Valve 15 is normally spring biased to its closed position while a solenoid 24 is adapted when energized to open valve 19 thereby to supply transfer pump pressure to raise servo-motor piston 20 and initially take up the lost motion connection 22 and then shift the injection plungers 1 to their starting position. Simultaneously, fuel is supplied through pipe 1 to the fuel pumps so that when the engine is initially turned over the engine is ready to start. Opening of valve 19 simultaneously closes an exhaust valve 26 which is connected to an exhaust pipe 27 returning to tank 8. To initially energize solenoid 24 a manually operated switch 28 is closed until the engine is started whereupon lubricating oil pressure is built up to close a switch 28. Any number of normally closed protective control switches, such as 30, may be placed in the solenoid line 21. These switches may be opened in response to a drop in lubricating oil pressure or to temperature conditions in the lubricating oil, bearings or other points about the engine. Opening of the protective switches will de-energize solenoid 24 thereby closing valve 19 and opening valve 26 whereby lubrication fluid in the servo-motor is exhausted to allow spring 21 to pull on spring 14 and shaft 5 so as to move it and the fuel pumps 1 and fuel pump plungers 2 to their shut down position. When the adverse conditions which caused the shut down have been corrected the solenoid may be re-energized thereupon to re-establish the starting position of the injection pumps.

From the foregoing disclosure, it is seen that I have provided an improved system whereby the fuel transfer pump is operative to perform dual functions without in any way requiring a special pump for building up a preliminary lubricating oil pressure pump or of otherwise requiring any special preliminary attention on the part of the operator preparatory to starting the engine. My improved system not only has the virtue of using a single device for a multiplicity of functions, but also of providing a simple, direct and relatively inexpensive arrangement requiring a minimum of effort, attention and thought by the operating personnel.

It will of course be understood that various changes in details of construction and arrangement of parts may be made by those skilled in the art without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. A control system for a fuel injection pump having a plunger adjustable to starting and shut down positions whereby in the starting position fuel is discharged under pressure and in the shut down position the discharge of fuel under pressure is discontinued, a fuel transfer pump for supplying fuel to said injection pump, a servo-motor, means operated by said servo-motor for adjusting said injection pump plunger and normally biasing the same to its shut down position, means for supplying operating fluid from said transfer pump to said injection pump plunger to its starting position, and means for controlling the operating fluid for said servo-motor so as to control said adjustment of said injection pump plunger to its starting position.

2. A control system for a fuel injection pump having a plunger adjustable to starting and shut down positions whereby in the starting position fuel is discharged under pressure and in the shut down position the discharge of fuel under pressure is discontinued, a fuel transfer pump for supplying fuel to said injection pump, a servo-motor, means operated by said servo-motor for adjusting said injection pump plunger and normally biasing the same to its shut down position, means for supplying operating fluid from said transfer pump to said servo-motor so as to control said adjustment of said injection pump plunger to its starting position, and means for controlling said operating fluid for said servo-motor so as to control said adjustment of said injection pump plunger to its starting position, and means for controlling said operating fluid so as to adjust said injection pump plunger to its shut down position.

3. A control system for a fuel injection pump having a plunger adjustable to starting and shut down positions whereby in the starting position fuel is discharged under pressure and in the shut down position the discharge of fuel under pressure is discontinued, a fuel transfer pump for supplying fuel to said injection pump, a servo-motor, means operated by said servo-motor for adjusting said injection pump plunger and normally biasing the same to its shut down position, means for supplying operating fluid from said transfer pump to said servo-motor for adjusting said injection pump plunger to its starting position, a valve mechanism normally biased to its closed position in which the operating fluid is controlled so as to allow the biasing action of said servo-motor thereby to adjust the fuel injection pump plunger to its starting position, and a protective switch in said circuit whereby upon opening of said switch said valve mechanism is actuated to cause said servo-motor to adjust the fuel injection pump plunger to its shut down position.

4. A control system for a fuel injection pump having a plunger adjustable to starting and shut down positions whereby in the starting position fuel is discharged under pressure and in the shut down position the discharge of fuel under pressure is discontinued, a fuel transfer pump for supplying fuel to said injection pump, a servo-motor, means operated by said servo-motor for adjusting said injection pump plunger and normally biasing the same to its shut down position, means for supplying operating fluid from said transfer pump to said servo-motor for adjusting said injection pump plunger to its starting position, a solenoid controlled valve for controlling supply of fluid pressure from said transfer pump to said servo-motor, and a circuit having a protective switch for controlling said solenoid controlled valve and also for energizing fluid from said transfer pump moves said servo-motor and the fuel injection pump plunger to its starting position and when said switch is opened the solenoid is de-energized and fluid pressure for said servo-motor is exhausted so as to shift said injection pump plunger to its shut down position.

5. A control system for a fuel injection pump...
having a supply inlet and a discharge outlet and a plunger for forcing fuel under pressure through said outlet, said plunger being adjustable to a shut down position for discontinuing discharge of fuel under pressure through said outlet and adjustable to another position whereby said plunger is subjected to said pressure, a fuel transfer pump for supplying fuel to said injection pump, a servo-motor, means operated by said servo-motor for adjusting said injection pump plunger and normally biasing the same to its shut down position, means for supplying operating fluid from said transfer pump to said servo-motor for adjusting said injection pump plunger to its starting position, and means for controlling the operating fluid for said servo-motor so as to control said adjustment of said injection pump plunger to its starting position.

7. A control system for a fuel injection pump having a supply inlet and discharge outlet and a reciprocating plunger angularly adjustable to starting and shut down positions, means whereby said plunger when angularly adjusted to its starting position is adapted to receive fuel from said supply inlet and discharge the fuel under pressure through the outlet and when angularly adjusted to its shut down position is adapted to have the fuel by-pass the pump plunger thereby to prevent the fuel from being discharged through said outlet under said pressure, a fuel transfer pump for supplying fuel to said injection pump, a servomotor, means operated by said servomotor for adjusting said injection pump plunger and normally biasing the same to its shut down position, means for supplying operating fluid from said transfer pump to said servomotor for adjusting said injection pump plunger to its starting position, and means for controlling the operating fluid for said servomotor so as to control said adjustment of said injection pump plunger to its starting position.

DANA R. STAPLES.
CERTIFICATE OF CORRECTION.


DANA R. STAPLES.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, line 47, for the word "shafts" read --shaft 5--; page 3, first column, line 7, claim 5, after "fuel" insert --in--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 13th day of February, A. D. 1945.

Leslie Frazer

(Seal) Acting Commissioner of Patents.