March 24, 1942. W. J. SCOTT ET AL 2,277,153

INJECTOR FOR DIESEL ENGINES

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FIG. 1.

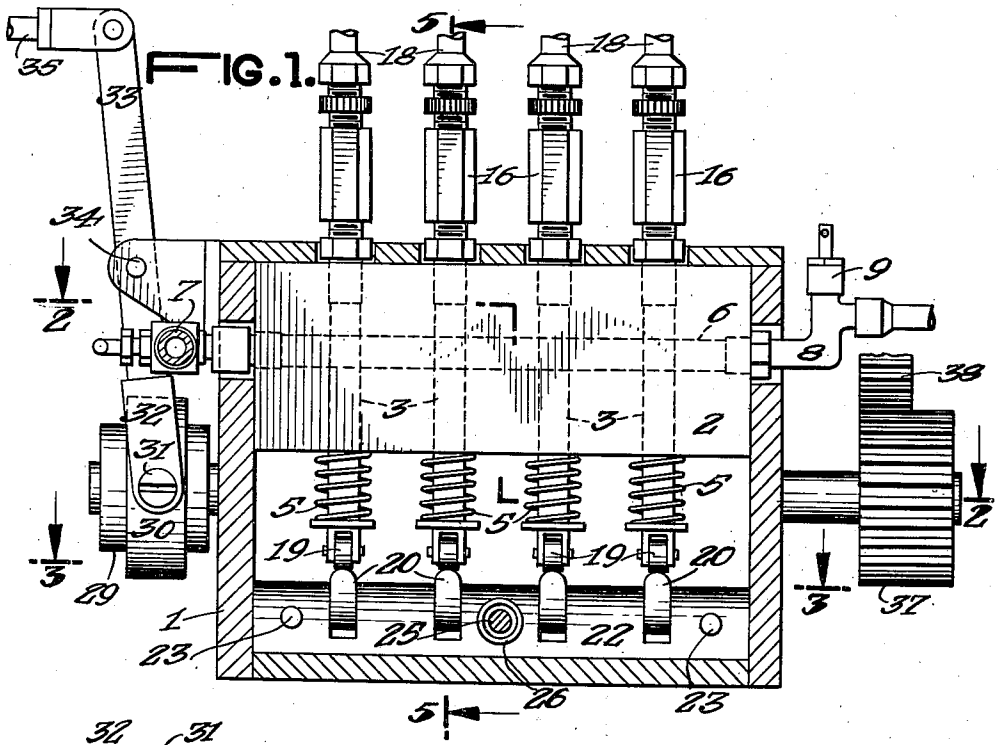


FIG. 2.

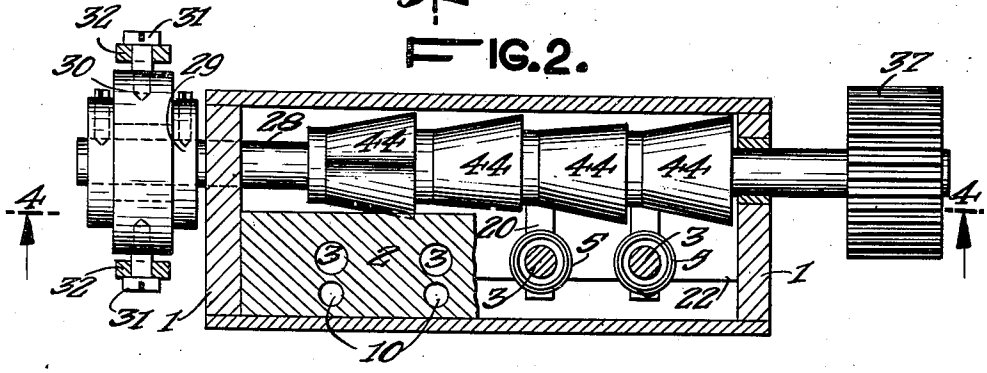
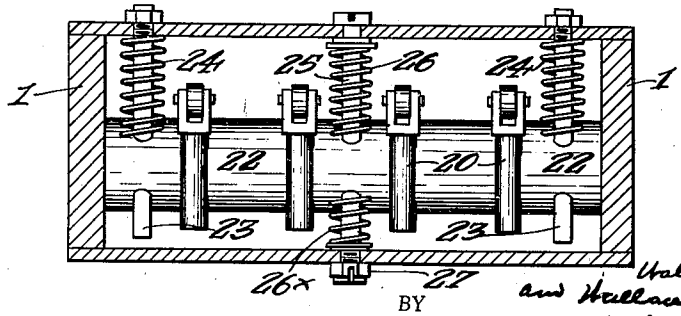


FIG. 3.



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FIG.4.

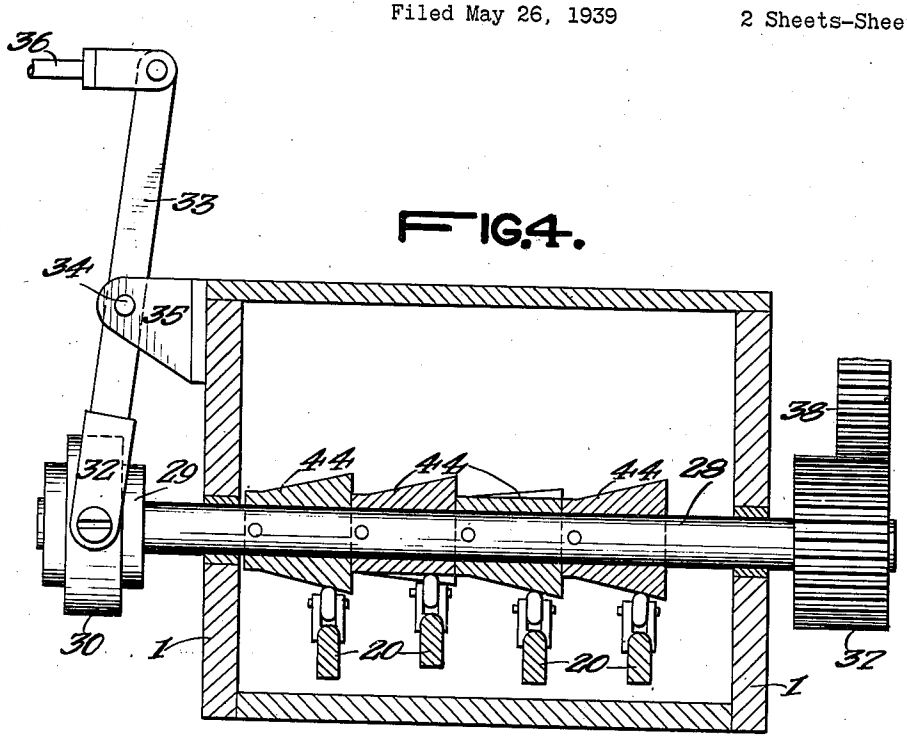


FIG.5.

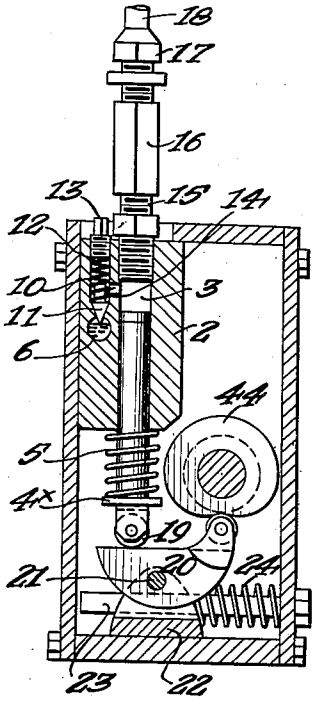


FIG.6.

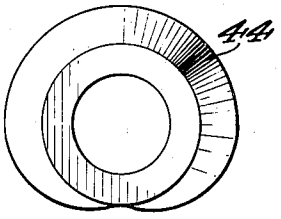
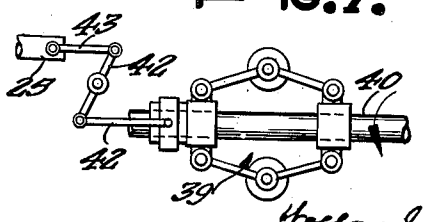


FIG.7.



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Patented Mar. 24, 1942

2,277,153

UNITED STATES PATENT OFFICE

2,277,153

INJECTOR FOR DIESEL ENGINES

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Application May 26, 1939, Serial No. 275,876

1 Claim. (Cl. 74—568)

The object of the present invention is to provide a fuel oil injector particularly adapted for Diesel engines, and in which the injector pump for each cylinder is driven by a cam of special form which may be generally described as a cone penetrated by a body formed of a plurality of cylinders with axes parallel to the axis of the cone, the cam preferably having a cardioid shape and being so formed as to give a progressive lift with the lift greater at the beginning of the lift period, the degree of lift being gradually reduced toward the end thereof.

By reason of the cardioid formation of the cam it is adapted to act quickly upon rotation in either direction when the contact member of the pump piston lies at the low point of the cam. These and other objects of the invention will be described with reference to the accompanying drawings, in which:

Figure 1 is a view in sectional elevation showing an embodiment of the invention.

Figure 2 is a horizontal section on the line 2—2, Figure 1.

Figure 3 is a horizontal section on the line 3—3, Figure 1.

Figure 4 is a vertical section on the line 4—4, Figure 2, omitting the injector pump elements.

Figure 5 is a vertical section on the line 5—5, Figure 1.

Figure 6 is a view in side elevation taken at the end of the cam having its minor lift area.

Figure 7 is a schematic view showing an internal arrangement for automatically shifting the pump lift levers in accordance with varying speeds.

Referring to the drawings, 1 indicates a casing within which is supported a block 2 formed with vertically extending cylinder bores at 3, four in number. Within each cylinder is an injector piston 4, and surrounding the lower end of the piston with its upper end abutting block 2 is a spiral spring 5, the lower end of which engages a shouldered section at 4x carried by piston 4. Extending horizontally through block 2 is an oil feed duct at 6 which receives oil under suitable pressure from a source of supply. The oil may enter duct 6 via pipe 7, Figure 1, and the excess oil may flow out through a pipe 8 in which may be disposed a pressure regulator 9.

Feed duct 6 is in communication with a vertical duct 10 for each injector cylinder. Thus in the embodiment shown there are four of the said vertical ducts. The base of each duct 10 is conical to receive the conical end of a check valve 11 engaged by a spring 12 held in position by an adjustable cap 13 threaded into the top wall of the duct. A small opening or port at 14 affords communication between the duct and its appropriate injector cylinder 3 near the top thereof. The construction is such that when each injector piston 4 rises the oil pressure generated thereby will seat check valve 11 at the proper time.

The injector cylinders are formed by bores which extend completely through block 2 from top to bottom thereof. Thus the connection of each injector cylinder with the engine cylinder may be provided through a sleeve 15 threaded into the cylinder at its upper end and receiving a check valve casing 16, the upper threaded neck of which receives a pipe connector 17 for a pipe 18 leading to the appropriate engine cylinder. Any suitable type of check valve may be carried by the casing 16.

The lower end of each injector piston 4 preferably carries a roller 19 engaged by a rocker arm 20, one rocker arm being provided for each piston. Each rocker arm is pivoted at 21, Figure 5 within a vertical channelway formed in a slide carrier 22. Horizontally projected from one or both walls of the casing 1 near the base thereof, are a plurality of guide rods 23 which pass through horizontal apertures in carrier 22. At one side of the carrier, each guide rod is surrounded by a spiral spring 24. The center threaded bore of the carrier receives an adjusting rod 25 on which is a spiral spring 26 abutting the carrier. This center rod projects through the casing and is threaded at one end to receive a nut 27. At the end of rod 25 and opposite spring 26 may be positioned a balancing spring 26x.

Immediately above the rocker arms 23 are the operating cams for the latter. In the present embodiment these cams are apertured to be received upon an endwise movable cam shaft 28 and are secured thereto in any suitable manner. At one end thereof the cam shaft carries a channeled disk or disks 29 into the channel of which is loosely held a ring 30, the ring being pivotally connected at 31 to yoke 32 carrying a lever 33 pivoted at 34 upon a bracket 35 carried by the casing 1. Lever 33 may be connected to any suitable actuating member, as, for example, a foot pedal, through the instrumentality of link 36. The end of the cam shaft opposite lever 33 has keyed thereon a driven gear 37 in mesh with a driving gear 38.

The moveable rocker arm assembly makes it possible to increase the volume of oil forced from each injector piston at any one of the given vari-

able lifts of the cam appropriate thereto and in the corresponding periods, as well as to decrease it in the same proportion.

It has been found that a motor running at high speeds operates considerably better on a somewhat leaner mixture than it will at lower speeds.

This necessary variation of mixtures is accomplished by setting the rocker arms to the proper mixture setting for normal running conditions of the motor, and this setting is maintained by the springs **24**, **26**, **26***x*, which provide a small movable range in either direction as pressure is exerted on the rocker carrier or released therefrom through suitable mechanism. This mechanism may be linked to a governor driven by some part of an engine to which our apparatus is applied. The action of this governor will be to move the rocker arm carrier to a position which will lessen the amount of oil delivered for each power impulse or stroke of the engine at increasing speeds, and relatively lighter loads. In the event that the load was increasing and the motor speed was also falling off, the action of this mechanism would be to return this rocker arm assembly to a position more suitable for heavier loads and slower speeds. This assembly tends to regulate the quantity of oil injected proportionate to the changes in the characteristics and quality of combustion, at and within different time limits, thereby tending to having the mixtures of fuel as near a perfect mixture as possible at all speeds and loads of the motor, which may be encountered in normal use of the motor.

The action of the governor, generally indicated at **39**, Figure 7, as carried on a shaft **40** given rotation through suitable means, is, through link **41**, to actuate a lever **42** connected by link **43** with the rocker arm carrier **22** as, for example, through the instrumentality of rod **25** which in such case will be freely slidable relatively to casing **1** but fixed to carrier **22**.

The cams **44** are alike in formation but not in position with respect to the cam shaft. There being four cylinders and four different periods, the cams from left to right are successively turned with respect to the cam shaft and to the preceding cam in each case a distance of 45 degrees.

Unlike other cams which have been proposed for the general purpose, each cam **44** has such characteristic that it gives a progressive lift, as, for example, through a lift surface of, say, 90°, with the proportion of the lift greater at the beginning of the lift action, the degree of lift being gradually reduced toward the end of the 90° lift. For example, but not exclusive of other examples, 50% of the lift may be reached upon a movement of the cam slightly more than 15°. Between the end of the somewhat more than 15° lift and the end of 45° of the cam lift surface the injector piston will have reached two thirds of its active stroke. In the final 40° of lift the remaining third of the lift is effected.

It will thus be seen that there is a quick lift at the beginning of the cam operation and a slower and progressive lift from that point on to the end of the cam lift surface, the whole covering, in the example given, a movement of the cam somewhat less than 90° because at the initial movement the roller or other contact end of the injector piston lies in the recessed area of the cam and the center of this recessed area is a neutral point.

The cam is formed so as to act quickly upon rotation in either direction when the contact end of the pump piston lies at the neutral point of the cam within the depression. The cam therefore is cardioid in cross section.

The reason for securing a higher degree of lift at the beginning of action of the cam and then slowing up the degree of lift until the complete 90° active movement of the cam has been effected, is as follows:

The cam is so formed as to taper off the quantities of oil to correspond with the diminishing quantities of oxygen in the cylinder appropriate thereto. It is desired to institute the injection of oil when the piston has reached 10–15° before the end of its compression stroke or before top dead center. Oil is injected throughout the movement of the piston from that point to dead center position. At this instant firing takes place. If the injection of the oil continued at the same ratio throughout the movement of the piston to dead center position, the final injection of oil would be in a dense mixture of oil and reduced air and the mixture would not be uniform but would be heavily laden with globules of oil at the top of the combustion area of the cylinder. The result would be that incomplete combustion would take place. If, however, the amount of oil being injected within the combustion area is gradually reduced as the piston rises a uniform and homogeneous mixture of air and oil is secured. The reason for the sudden and greater injection of oil at the beginning of the injection is that the combustion area contains only air.

The cam in its present form is adapted, without change, for two or four cycle operation, either uni-directional or reverse directional without change in form.

Having described our invention, what we claim and desire to secure by Letters Patent, is as follows:

A rotatable cam element adapted for actuating fuel injectors for Diesel engines and the like, said cam element having a cam device adapted to simultaneously change the degree of actuation and period of actuation of the injector by the longitudinal movement of said cam, and having an arcuate lift surface adapted to effect a maximum active movement of the injector at the beginning of the cam action and progressively lesser active movement thereafter, the two sections of the cam, at opposite sides of a line drawn transversely therethrough at its axis, being symmetrical.

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