Oct. 14, 1958 W. H. HIMES 2,855,914

INJECTION PUMP DRIVES

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FIG. 1

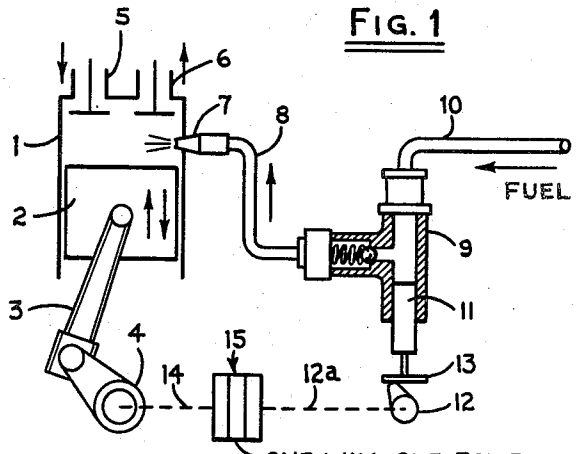


FIG. 2

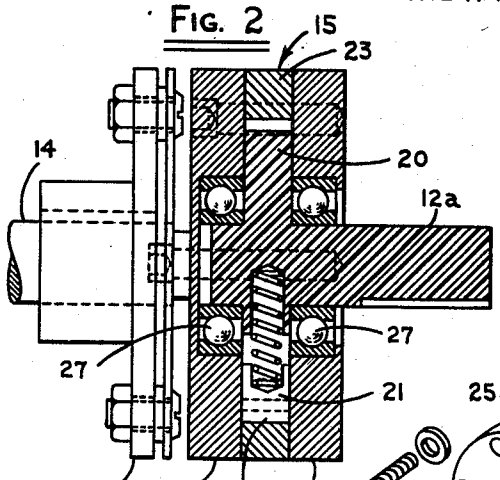


FIG. 3

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INJECTION PUMP DRIVES

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1 Claim. (Cl. 123—139)

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The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to diesel engines and is particularly directed to means to prevent backfiring in such engines. Most internal combustion engines, including diesel type engines, will backfire if either the intake or exhaust ports are open when an explosion takes place, or if either port is open before fuel burning ceases. When such engines are used to drive hoist or lift trucks in handling explosives the danger of sparks or flames about the engine becomes obvious.

An object of this invention is to provide means for preventing backfiring in internal combustion engines.

A more specific object of this invention is to provide improved means for shutting off the fuel supply when the engine operates in reverse.

Other objects will become apparent from the following description of one embodiment of this invention. The invention is defined with particularity in the appended claim and is illustrated in the accompanying drawing in which:

Figure 1 is a sectional diagrammatic view of a diesel engine embodying the invention,

Figure 2 is a sectional assembled view of a one-way, one-point clutch employed in the diesel engine of this invention, and

Figure 3 is an exploded perspective view of the clutch of Figure 2.

The steps involved in each cycle of operation of a diesel engine include (1) intake of fresh air through the intake port; (2) compression of the fresh air; (3) injection of fuel pressure and explosion; and, (4) expulsion of exhaust gases. The intake port is normally opened by a cam driven from the crank shaft and in normal forward operation the intake port is closed at the instant the combustion stroke commences. At the end of the compression stroke and when the pressure is the highest, the fuel is injected and combustion starts. Should the crank at this point be forced to revolve in the reverse direction as by an overload on the engine, the intake port is apt to open and expel ignited fuel into the intake manifold and hence into the air cleaner structure. When the air cleaner is of the oil bath type flames usually result.

In Fig. 1 is shown diagrammatically the cylinder **1** of an internal combustion engine with the piston **2** coupled through the connecting rod **3** to the crank shaft **4**. The intake and exhaust ports **5** and **6**, respectively, are closed by valves which are operated in the usual manner from cam shafts, not shown, driven by the crank shaft. Fuel is injected to the upper end of the cylinder in the 4-cycle engine depicted, from the injection nozzle **7** coupled through the high pressure line **8** to the fuel pump **9**. Ball valves in the ports of the fuel drive fuel from the supply line **10** under pressure into the high pressure line **8**. The piston **11** of the fuel pump is usually coupled

mechanically to reciprocating mechanism such as the cam **12** and its follower **13**, which cam is driven directly by the crank shaft **4**. The speed ratio of the fuel pump cam and the crank shaft is an integral number of one or two, depending upon whether the engine is of the two cycle or four cycle type.

According to an important and characteristic feature of this invention the power take-off shaft **14** of the engine is coupled to the fuel pump shaft **12***a* through the one-way, one-point clutch **15**. Because of this clutch, power can be transmitted from the crank shaft to the fuel injection pump only while the crank shaft is rotating in its normal forward direction. If the crank shaft and the power take-off shaft should reverse direction because of improper timing or because of a stalling load on the engine, the fuel injection pump will not follow. Accordingly, power for the injection of fuel stops the instant reverse rotation commences.

Because the rotational position relationship of the injection pump shaft and the engine crank shaft must be fixed for proper synchronization of fuel injections with piston travel, the clutch **15** must permit the driving and driven shafts of the clutch to return to their original positions each time the clutch is operated. Means, not shown, is provided for effecting the necessary fine timing adjustments of the injection pump. Because the clutch must be of the one-point type a single pawl and detent must be used in the clutch.

One clutch which has been found to be well balanced dynamically in spite of the asymmetry of the one-point structure is shown in Figs. 2 and 3. The principal elements of the particular clutch shown comprise the disk **20** keyed on or machined integrally with the driven shaft **12***a*. In the periphery of the disk is fitted a radially retractable pawl **21**, the pawl being biased axially by the coil spring **22**. The disk **20** runs inside the ring **23**, the ring having an axial thickness slightly greater than the disk **20** and an inside diameter sufficient to clear the outer edge of the disk **20**. On the inner periphery of the ring is formed a single detent **24** to receive the toe of the pawl **21**. Secured to opposite faces of the ring are plates **25** and **26**, the inner surfaces of the plates being machined and ground to accurately fit the ring and its enclosed disk **20**. Ball bearings **27** are preferably installed between the shaft **12***a* and the plates **25** and **26** for low friction operation.

A universal joint is preferably employed to couple the driver shaft **14** to the clutch housing. Conveniently, the joint comprises a fiber washer **28** bolted at alternate points along its periphery to the collar **29** on the driven shaft and through bolts **30** to the clutch housing.

The weight and moment of inertia of the pawl may be made, by proper design, approximately equal to the moment of inertia of the diametrically opposite segment of the disk for proper dynamic balance to the normal operating speed of the clutch.

In operation, power from the driving shaft **14** is transmited through the universal coupling **28** and **29** to the clutch housing. Rotation of the housing is imparted to the disk **20** and its keyed shaft **12***a* through the engaged pawl **21** and detent **24**. Should the direction of rotation of the driving shaft reverse, the pawl leaves its detent with negligible torque and rotate freely without disturbing the driven shaft **12***a*. The internal combustion engine of this invention will not inject fuel into the cylinders during reverse rotation and will prevent backfiring. The one-way, one-point clutch is easy to make and to install in conventional diesel engines between the power take-off shafts and injection pump shafts, and is reliable in operation.

Many modifications may be made in the details of con-

struction without departing from the spirit of the invention, as particularly defined in the appended claim. One-way, one-point clutches, for example, of different design may serve to prevent reverse rotation of the fuel injection pump.

What is claimed is:

In combination with an internal combustion engine with cooperating piston and valves, a fuel injection pump, a crankshaft driven by said engine and rotatable in either direction, a cam shaft operatively connected to said crankshaft and having a cam secured thereto and rotatable therewith for operating said pump to inject fuel under pressure into the cylinder of the engine in timed relation with respect to the operation of the piston and valves, the improvement comprising a one-way, one-point clutch member disposed between said shafts for rigidly connecting said shafts in a single predetermined angular relationship to cause fuel to be pumped only when said crankshaft is rotated in one direction and comprising a pair of mutually spaced plates, a ring disposed between said plates, securing means for said plates and ring, means connecting said crankshaft to said plates and ring for imparting rotative movement thereto, a disk carried by said cam shaft and disposed between said plates and within said ring, a single notch formed in the inner periphery of said ring, a radially movable pawl carried by said disk and normally in engagement with said notch for releasably locking said disk to the ring and causing said

cam shaft to be rotated in said one direction in response to rotation of the crankshaft in that direction, said ring being adapted to actuate said pawl to release said disk as the ring is rotated in reverse direction by the crankshaft thereby to prevent further rotation of said cam shaft and operation of the pump by the cam, and yieldable means disposed within said disk and having one end thereof in abutting engagement with said pawl and the other end in abutting engagement with the disk for yieldably urging and maintaining the pawl in locking engagement with said notch until the ring is rotated in said reverse direction by the crankshaft.

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