March 2, 1971 H. ERDMANN 3,567,343

HYDRAULIC PUMP ARRANGEMENT FOR INTERNAL-COMBUSTION ENGINE

Filed Feb. 4, 1969 2 Sheets-Sheet 1

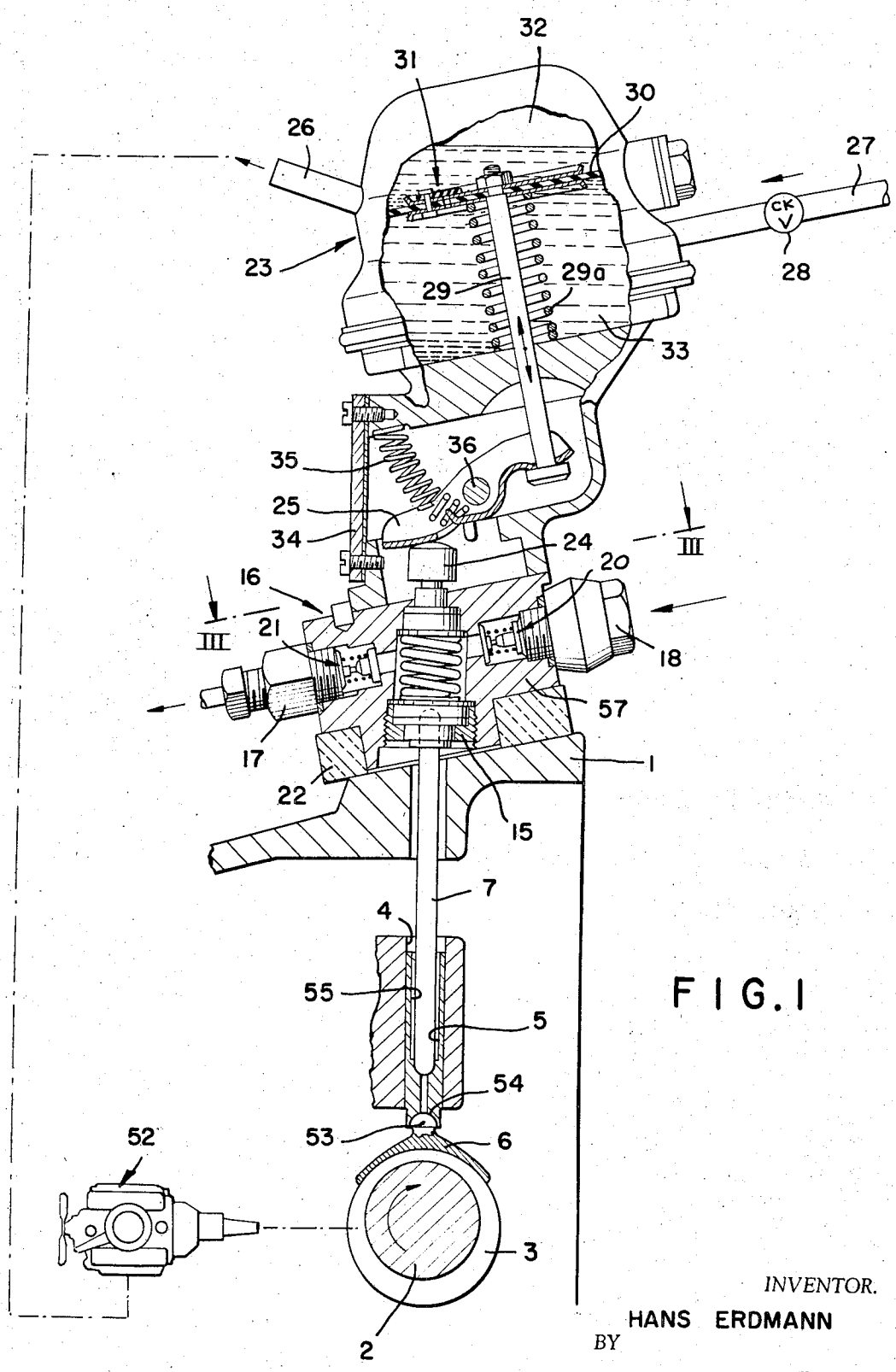

FIG. 1

INVENTOR.
HANS ERDMANN
BY
Karl F. Ross
ATTORNEY

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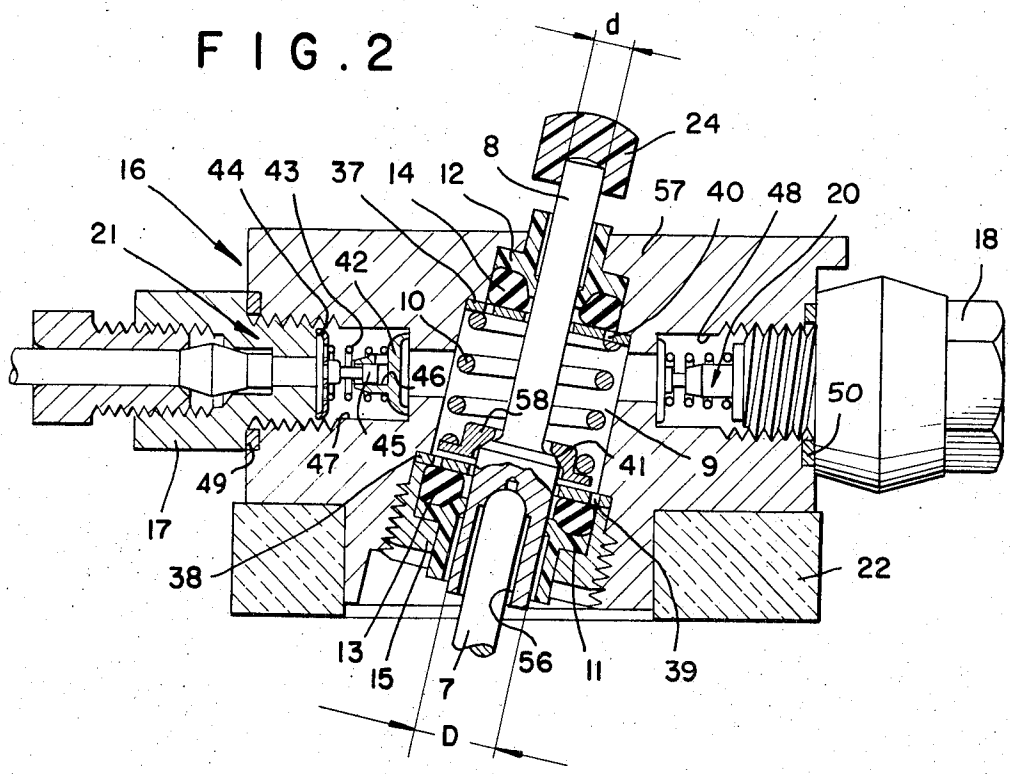
FIG. 2



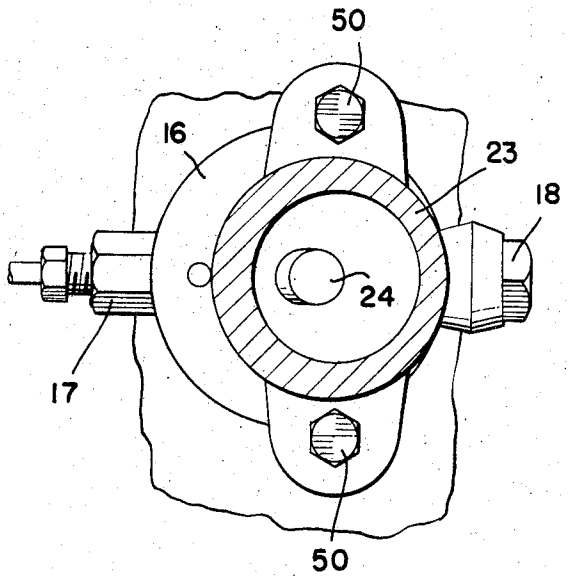


FIG. 3

INVENTOR.
HANS ERDMANN
BY
Karl F. Ross
ATTORNEY

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HYDRAULIC PUMP ARRANGEMENT FOR INTERNAL-COMBUSTION ENGINE

Hans Erdmann, Neu Isenburg, Germany, assignor to Alfred Teves G.m.b.H., Frankfurt am Main, Germany

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Int. Cl. F04b 23/04
U.S. Cl. 417—364 10 Claims

ABSTRACT OF THE DISCLOSURE

An internal-combustion engine has a rod fitted with a cam follower urged into contact with the engine camshaft. This rod actuates a stepped piston of a small hydraulic pump mounted directly on the engine block at the pedestal on which the fuel pump is normally seated. An end of the piston extends through the housing of the pump and is fitted with a plastic cap engaging the rocker arm of the engine fuel pump mounted in turn on the hydraulic-pump housing. The cam follower is an arcuate shoe engaging around a quarter of the surface of the cam and connected to the rod by a ball-and-socket joint.

My present invention relates to a hydraulic-pump arrangement for an internal-combustion engine and, more particular, for an engine having a rocker-arm actuated fuel pump and some auxiliary liquid-circulation system such as power brakes, a load-leveler suspension, the refrigeration unit of the air conditioner, hydraulic winch or lifts, power steering.

It is the customary practice to mount the hydraulic pump for power brakes or power steering, a load leveler, or a hydraulic clutch or any other liquid-operated load on its own flange on the engine. This pump is also customarily provided with its own pulley which is connected to another engine-driven pulley through a V-belt. In this manner the pump takes up space which is often excessive when considered in the light of the tasks it performs; furthermore its drive adds additional mechanism to the system which is susceptible to wear and increases the repair requirements of the vehicle.

It is, therefore, the principal object of my invention to provide a hydraulic-pump arrangement for an internal-combustion engine which overcomes these disadvantages.

A further object is to provide a pump arrangement which can be accommodated to existing engine constructions with a minimum of difficulty and trouble.

Yet a further object is to provide an improved pump arrangement which takes up a minimal amount of space and adds a minimum of new mechanism to an internal combustion engine.

I attain these objects, in accordance with a main feature of my invention, by providing a hydraulic pump means whose piston forms part of a rigid linkage that drives the fuel pump of an internal-combustion engine of the reciprocating-piston type wherein the camshaft operates the intake and exhaust valves and normally drives the fuel pump, the camshaft being coupled with the crankshaft by timing chains, gears or the like.

More particularly, the piston of my hydraulic pump, which is mounted directly on the engine block and forms a pedestal for the conventional fuel pump, is a stepped piston whose narrow or small diameter end extends through a seal and the wall of the hydraulic pump and engages the rocker arm of the fuel pump while its large diameter end also passes through a seal and a wall of the hydraulic pump and is coupled to a cam follower in the form of an arcuate shoe riding on the circular periphery of a cam of the engine camshaft.

The hydraulic-pump housing defines a cylinder with two lateral (inlet and outlet) openings. Each opening is equipped with a check valve such that fluid may only flow into the pumping chamber through one and out through the other. These openings, constituting the inlet and the outlet of the hydraulic pump, are advantageously of like dimensions (diameters) to make mounting easy and to allow the fittings (e.g., the check valves) to be interchangeable.

According to a further feature of my invention, the cam follower engages a good part of the cam surface via a shoe that is linked to the piston by a ball-and-socket joint.

These and other features, advantages and objects of my invention will be more fully described in the following, with reference to the accompanying drawing, in which:

FIG. 1 is a vertical cross-sectional view through an arrangement embodying my invention;

FIG. 2 is a section through the pump means of FIG. 1, drawn to in enlarged scale; and

FIG. 3 is a section according to line III—III of FIG. 1.

As shown in FIG. 1 an internal-combustion engine **52** of an automotive vehicle, has a block **1** and a conventional camshaft **2** carrying a cam or eccentric **3**. A shoe **6** seats on this cam **3** over one-fourth of its circumference (at least 90°) for best force transmission. The upper part of this shoe **6** is provided with a ball **53** received to more than a hemisphere in a socket **54** of a slider **5** so that it cannot fall out. This slider **5** rides in a bore **4** in part of the engine housing or block **1**. A rod **7** is seated in a bore **55** of the slider **5** and seats in turn in a bore **56** in the bottom of a stepped piston **8**.

The top or narrow diameter end of this piston **8** is fitted with a low-friction, wear-resistant synthetic-resin cap **24** (e.g., of polytetrafluoroethylene) that engages one end of a rocker arm **25** pivoted at **36** and biased downwardly by a spring **35**. The other end of the arm **25** engages the end of a rod **29** which actuates the diaphragm of a nonpositive fuel pump **23** whose spring **29***a* biases the diaphragm upwardly. This fuel pump has an inlet **27** with a check valve **28** and an outlet **26** which leads to the engine **52**. Fuel can enter at **27** into a lower chamber **33**, pass through a check valve **31** into a chamber **32**, and leave via the outlet conduit **26**. Up-and-down motion of the rod **29** transfers fuel from the chamber **33** to the chamber **32** in a manner well known in the art. The rocker arm can be removed and lubricated through a removable plate **34** in the side of the pump **23**.

FIG. 2 shows my hydraulic pump in greater detail. Here the hydraulic pump **16** has a piston **8** whose shoulder **41** defines an upper narrow diameter portion and a lower large diameter portion. The upper portion is sealed by a retaining washer **37** with holes **40** holding an O-ring **14** on a seal **12**. The lower portion is sealed by a similar washer **38** with holes **39** on an O-ring **13** on a seal **11**. The lower ring is held in place by a threaded plug **15** which permits access to the interior or a cylinder **9** while

a spring **10** braced on a stop ring **58** seated on the shoulder **41** holds the washer **37** in place while simultaneously holding the piston **8** in its illustrated starting position.

Hydraulic fluid, for instance for a power brake, enters through a union-coupling **18** screwed into a bore **48** forming an inlet for the cylinder **58** and can leave through an outlet bore **47** and a ring coupling **17**. The coupling **18** has a washer seal **50** and the coupling **17** an identical seal **49**.

The inlet bore **48** is provided with a check valve **20** and the outlet bore **47** with a check valve **21** both of identical design. The valve **21** consists of a valve plate **42**, a spider **44**, a spring **43** and a pin **44** that are press-fitted together and form a captive-spring valve. The bores **47** and **48** are of identical diameter and the check valves **20** and **21** also of identical dimensions so that the connections **17** and **18** can be reversed, with similar reversal of the check valves **20** and **21** with no difficulty.

The piston **8**, due to its different diameters D and *d* pressurizes the cylinder **9** on upward movement thereby forcing fluid out through the check valve **21**, and depressurized it on descending thereby sucking fluid in through the valve **20**.

The housing **57** of the hydraulic pump **16** is insulated from the cylinder head **1** by a gasket **22** that prevents dangerous heat from getting to the hydraulic fluid and fuel.

To add this hydraulic pump **16** to an existing motor one need merely remove the fuel pump **23** and replace the linkage with the rod **7**, slide **5** and shoe **6** and screw the fuel pump **23** back on with the hydraulic pump **16** sandwiched between it and the motor block **1** using 10 cm. mounting screws **50**.

The linkage is changed since the original cam follower is only meant to transmit around 6 Kp to the fuel pump. With the device according to my invention—having a broad engagement between the shoe **6** and the cam **3**—20 to 30 Kp can easily be transmitted. In my invention the hydraulic pump takes up only a few square centimeters of space in a motor, rather than the relatively large space usually occupied by such devices. The hydraulic pump acts as a spacer or pedestal for the fuel pump.

The improvement described and illustrated is believed to admit of many modifications within the ability of persons skilled in the art, all such modifications being considered within the spirit and scope of the invention except as limited by the appended claims.

I claim:

1. A hydraulic-pump arrangement comprising:
an internal-combustion engine having an engine block and a rotatable camshaft;
drive means for transforming rotation of said shaft into reciprocating motion;
pump means for generating hydraulic-fluid pressure and comprising a disk-shaped body provided with a cylinder and a piston axially and reciprocatingly displaceable therein, said piston being actuatable by said drive means; and
a fuel pump for said engine operatively connected to said piston for actuation thereby, said drive means including at least one rigid elongated member linearly reciprocable by said camshaft for actuating said piston and said fuel pump, said pump means and said fuel pump being mounted one above the other on said engine block, said disk-shaped body being directly mounted on said block and forming a flange for securing said fuel pump on said engine block.

2. The arrangement defined in claim **1** wherein said engine is an internal-combustion engine and has an engine block, said shaft is the camshaft of said engine, said drive means including at least one rigid elongated member linearly reciprocable by said camshaft for actuating said piston and said fuel pump, said pump means and said fuel pump being mounted one above the other on said engine block.

3. The arrangement defined in claim **8** wherein said cylinder further is formed with an inlet and an outlet, said pump means further comprising a respective check valve at said inlet and at said outlet, said piston being a stepped piston.

4. The arrangement defined in claim **3** wherein said stepped piston forms part of said rigid member and is provided with a shoulder defining a relatively small diameter portion and a relatively large diameter portion along said piston, said fuel pump being connected to said small diameter portion and said drive means being connected to said large diameter portion.

5. The arrangement defined in claim **4** wherein the relatively small diameter portion of said piston is provided with a cap of synthetic-resin material for actuating said fuel pump.

6. The arrangement defined in claim **1** wherein said fuel pump is mounted directly on said pump means.

7. The arrangement defined in claim **6** wherein said drive means includes a rotating eccentric cam mounted on said camshaft, and a cam follower engaging said cam, said member being operatively connected to said follower.

8. A hydraulic-pump arrangement comprising:
an internal-combustion engine having an engine block and a rotatable camshaft;
drive means for transforming rotation of said shaft into reciprocating motion;
pump means for generating hydraulic-fluid pressure and comprising a cylinder and a piston axially and reciprocatingly displaceable therein, said piston being actuatable by said drive means; and
a fuel pump for said engine operatively connected to said piston for actuation thereby, said drive means including at least one rigid elongated member linearly reciprocable by said camshaft for actuating said piston and said fuel pump, said pump means and said fuel pump being mounted one above the other on said engine block, said fuel pump being mounted on said pump means, said drive means including a rotating eccentric cam mounted on said camshaft, and a cam follower engaging said cam, said member being operatively connected to said follower, said cam having a circular periphery, said cam follower is an arcuate shoe engaging said periphery over an arc of at least 90°, said member includes a rigid rod connected to said piston and said drive means further includes a ball joint connecting said shoe to said rod.

9. The arrangement defined in claim **3** wherein said inlet and said outlet are of like dimensions, said pump means further comprising connecting means connectable to said inlet and outlet and each receiving a respective one of said check valves.

10. A hydraulic-pump arrangement comprising:
an internal-combustion engine having an engine block and a rotatable camshaft;
drive means for transforming rotation of said shaft into reciprocating motion;
pump means for generating hydraulic-fluid pressure and comprising a cylinder and a piston axially and reciprocatingly displaceable therein, said piston being actuatable by said drive means; and
a fuel pump for said engine operatively connected to said piston for actuating thereby, said drive means including at least one rigid elongated member linearly reciprocable by said camshaft for actuating said piston and said fuel pump, said pump means and said fuel pump being mounted one above the other on said engine block, said drive means further comprising a circular cam eccentrically mounted on said camshaft and a cam follower engaging said cam over an arc of at least 90° on said cam, said cam follower being formed with a ball head, said mem-

ber including a sleeve, said sleeve being formed with a socket on one end receiving more than a hemisphere of said ball head, a longitudinal bore opening at its other end, a rod received in said sleeve and seated in said piston, said piston being a stepped piston having a shoulder defining a relatively large diameter portion and a relatively small diameter portion, said relatively large diameter portion being engaged by said rod, said pump means further comprising spring means biasing said piston toward a starting position with said large diameter portion substantially out of said cylinder, said cylinder having an inlet provided with a check valve permitting fluid flow into said cylinder and an outlet provided with a check valve permitting fluid flow therefrom, said relatively small diameter portion having an end provided with a synthetic-resin cap, said fuel pump

comprising a rocker arm engaged by said cap, said arrangement further comprising a thermally insulating gasket between said pump means and said block.

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ROBERT M. WALKER, Primary Examiner