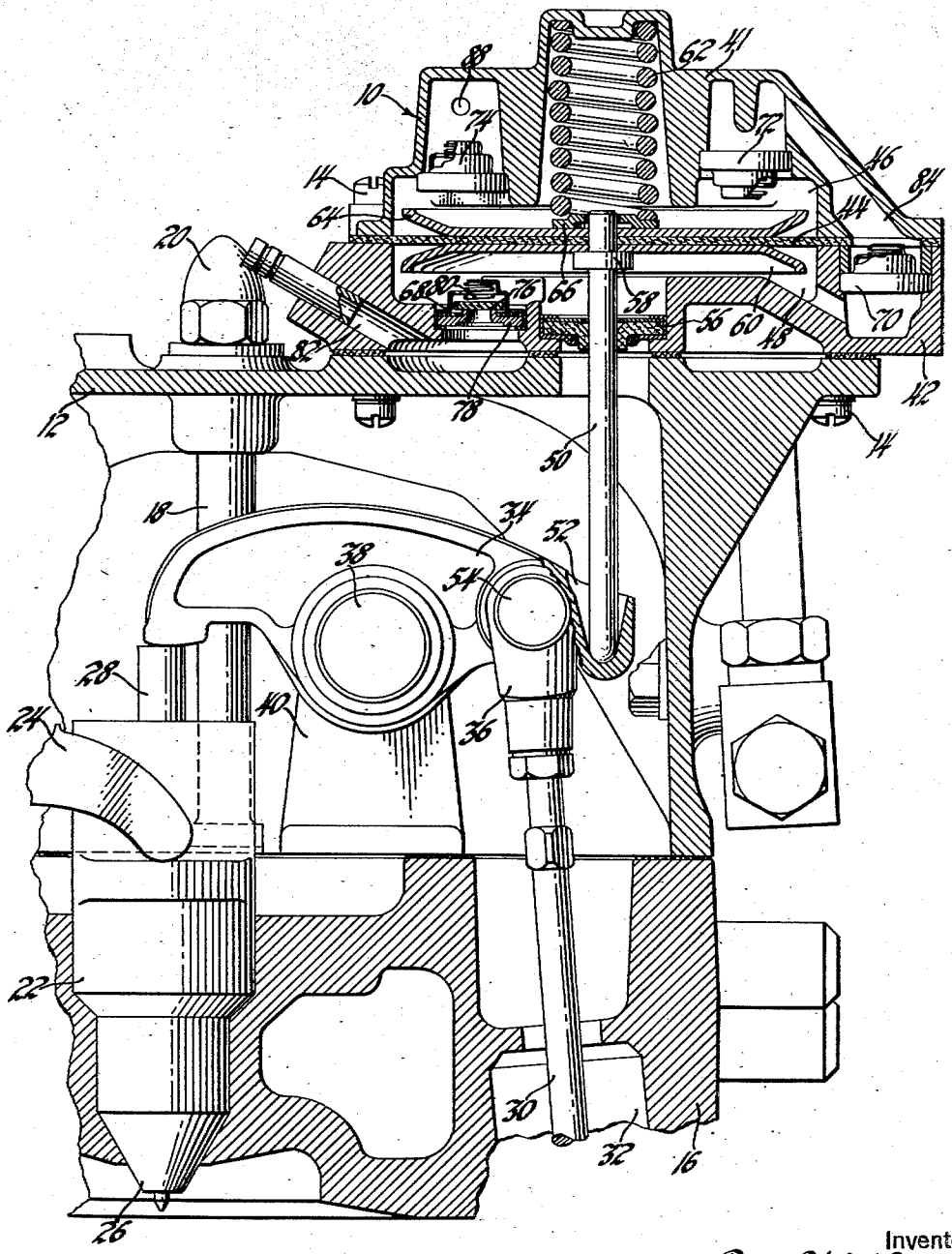
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VACUUM PUMP DRIVE

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VACUUM PUMP DRIVE

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This invention relates to internal combustion engines, and more particularly, to their accessory pump mountings and drive mechanisms.

The invention is particularly directed to a motor vehicle diesel engine and to a simplified mounting and drive for the accessory vacuum pump of such an engine. Motor vehicles, especially trucks and buses, may have various vacuum-operated units such as brakes and windshield wipers, and the production of vacuum to operate these units is a simple matter when the vehicles are equipped with Otto engines as the intake manifold of an Otto engine may be used as a vacuum source but an accessory vacuum pump is necessary for vacuum production in diesel engine equipped motor vehicles.

It is an object of the invention to provide an internal combustion engine with an engine driven pump so located as to be readily accessible.

Another object of the invention is to relocate the accessory vacuum pump of a diesel engine from the normal accessory drive portion of the engine to the cylinder head cover of the engine so that more room for the remaining accessories at the normal accessory drive location is had.

Further objects of the invention are to relocate the vacuum pump of a diesel engine to the cylinder head cover of the engine so that the pump is readily accessible and so that the drive and mounting therefor are of great simplicity.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred form of the persent invention is clearly shown.

The drawing is a transverse section through the cylinder head portion of a two-stroke cycle diesel engine illustrating the novel association of the vacuum pump therewith.

The engine is the well known General Motors Series 51 model and therefore only those portions of the engine directly concerned with the present invention are shown. A double-acting vacuum pump **10** is secured to the upper surface of the cylinder head cover **12** by screws **14**, and the cover **12** is secured to the upper surface of the cylinder head **16** by a pair of upwardly projecting cylinder head studs **18** and cylinder head cover cap screws **20** (only one stud and cap screw being visible as the section is perpendicular the axis of the engine). A fuel injector **22** is secured in a vertical bore in the cylinder head **16** by a seat clamp **24**. The fuel injector **22** is of known design and includes a nozzle portion **26** to inject fuel into the combustion chamber and an internal plunger (not shown) actuated by reciprocation of a pump push rod **28**. The upper push rod **30** of the engine projects through a passage **32** in the cylinder head **16** and is pivotably secured to the fuel injector rocker arm **34** by a clevis **36**. The rocker arm **34** is pivotably mounted on a shaft **38** which is supported on the cylinder head **16** by a bracket **40**. The push rod **30** is reciprocated in the usual manner by the cam shaft (not shown) of the engine

to oscillate the rocker arm **34** and thereby actuate the reciprocable rod **28** of the fuel injector **22**. The forenoted description, excluding reference to the vacuum pump **10**, was concerned with known engine construction and therefore is presented only as an aid in understanding the novel vacuum pump arrangement.

The vacuum pump **10** includes an upper casting **41** and a lower casting **42** having a flexible diaphragm **44** secured between them by the screws **14** to form an annular upper pumping chamber **46** and an annular lower pumping chamber **48**. Flexing of the diaphragm **44** for alternate enlargement and contraction of the chambers is accomplished by reciprocation of a push rod **50** pivotably engaged at its ball-shaped lower end by the spherical bottom of a socket **52** formed in the rocker arm **34** near the connection **54** between the rocker arm and push rod **30**. The push rod **50** passes through an air seal **56** and is provided with a shoulder **58** that engages the lower diaphragm protector disk **60**. A compression spring **62** in the upper chamber **46** bears against the upper diaphragm protector disk **64** through a washer **66**. The push rod **50** provides a positive upward pumping stroke while the downward return stroke is provided by the coil spring **62**. The vacuum pump **10** is preferably arranged for double-acting two-stage or series operation as shown, although it may be arranged for double-acting or parallel operation if desired. The lower pumping chamber **48** is provided with an intake check valve **68** and an exhaust check valve **70**, and the upper pumping chamber **46** is provided with intake and exhaust check valves **72** and **74**. The valves are identical and include valve disks **76** lightly biased against the valve seats **78** by springs **80**. The intake passage **82** of the lower pumping chamber **48** is suitably connected to the vacuum reservoir (not shown) of the motor vehicle. The exhaust passage **84** of the lower pumping chamber **48** serves as the intake passage for the upper pumping chamber **46**, thereby placing the pumping chambers in two-stage relation, the upper pumping chamber **46** emptying to atmosphere through an exhaust passage **88**.

The lower pumping chamber **48** is preferably provided with less clearance volume than the upper pumping chamber **46** so that the volumetric efficiency of the initial stage of the pump is greater than the volumetric efficiency of the final pumping stage. Providing the initial pumping stage with a higher volumetric efficiency than the final pumping stage results in higher vacuum production in the initial or lower pumping chamber **48** than in the final or upper pumping chamber **46** without the use of a differential area piston. The high vacuum or initial pumping stage is preferably arranged as shown so that differential pressure on the flexible diaphragm will augment the force of the return spring **62** thereby enabling the use of a relatively light return spring.

The pump may be adapted for parallel operation if desired by inverting the valves **72** and **74**, by utilizing the passage **88** as an intake passage in parallel with intake passage **82**, and by venting passage **84** to atmosphere so that it will exhaust both pumping chambers.

While the preferred embodiment of the invention has been described fully in order to explain the principles of the invention, it is to be understood that modifications in structure may be made by the exercise of skill in the art within the scope of the invention, which is not to be regarded as limited by the detailed description of the preferred embodiment.

I claim:

1. A pumping system adapted for operation from the cylinder head rocker arm of an internal combustion engine of the type having a cam shaft comprising, in combination, a cylinder head, a rocker arm pivotally secured

to said cylinder head, a push rod adapted for reciprocation by the cam shaft of said engine, said push rod being operatively engaged with said arm to oscillate the same, a device for introducing fluid to said engine including a rod reciprocable in said head operatively engaged with said arm for actuation thereby, a cover secured to said head to enclose said arm, a reciprocating accessory pump secured to said cover, and a pump actuating push rod operatively engaged with said pump and extending through said cover and operatively engaging said arm for reciprocation thereby.

2. A pumping system adapted for operation from the cylinder head rocker arm of a diesel engine of the type having a cam shaft comprising, in combination, a cylinder head, a rocker arm pivotably secured to said cylinder head, a push rod adapted for reciprocation by the cam shaft of said engine, said push rod being pivotably engaged with said arm to oscillate the same, a device for introducing fluid to said engine including a rod reciprocable in said head operatively engaged with said arm for actuation thereby, a cover secured to said head to enclose said arm, a reciprocating accessory pump secured to said cover, and a pump actuating push rod operatively engaged with said pump and extending through said cover and operatively engaging said arm for reciprocation thereby.

3. A pumping system adapted for operation from the cylinder head rocker arm of a diesel engine of the type having a cam shaft comprising, in combination, a cylinder head, a rocker arm pivotably secured to said cylinder head, a push rod adapted for reciprocation by the cam shaft of said engine, said push rod being pivotably engaged with said arm to oscillate the same, a fuel injector secured to said head operatively engaged with said arm for actuation thereby, and a reciprocating accessory pump secured to said head operatively engaged with said arm separately of said fuel injector for actuation by said arm.

4. A vacuum pumping system adapted for operation from the cylinder head rocker arm of a diesel engine of the type having a cam shaft comprising, in combination, a cylinder head, a rocker arm pivotably secured to said cylinder head, a push rod extending through said head adapted for reciprocation by the cam shaft of said engine, said push rod being pivotably engaged with said arm to oscillate the same, a fuel injector secured to said head operatively engaged with said arm for actuation thereby, a cover secured to said head to enclose said arm, a vacuum pump mounted on said cover including a movable wall and a spring urging said wall in one direction, a passage through said cover, and a pump push rod extending through said passage operatively engaging said wall and said arm for reciprocation by said arm, said arm serving to move said wall against said spring.

5. A vacuum pumping system adapted for operation from the cylinder head rocker arm of a diesel engine of the type having a cam shaft comprising, in combination, a cylinder head, a rocker arm pivotably secured to said cylinder head, a push rod extending through said head adapted for reciprocation by the cam shaft of said engine, said push rod being pivotably secured to said arm to oscillate the same, a fuel injector secured to said head operatively engaged with said arm for actuation thereby, a cover secured to said head to enclose said arm, a double-acting vacuum pump mounted on said cover including a movable wall and a spring urging said wall in one direction, said pump having one pumping chamber on one side of said wall and another pumping chamber on the other side of said wall, and a pump push rod extending through said cover and operatively engaging said wall and said arm for reciprocation by said arm, said arm serving to move said wall for one stroke and said spring serving to move said wall for the other stroke.

6. A vacuum pumping system adapted for operation

from the cylinder head rocker arm of a diesel engine of the type having a cam shaft comprising, in combination, a cylinder head, a rocker arm pivotably secured to said cylinder head, a push rod extending through said head adapted for reciprocation by the cam shaft of said engine, said push rod being pivotably secured to said arm to oscillate the same, a fuel injector secured to said head operatively engaged with said arm for actuation thereby, a cover secured to said head to enclose said arm, a double-acting vacuum pump outside said cover and secured thereto including a flexible diaphragm and a spring urging said diaphragm in one direction, said pump having a first stage pumping chamber on one side of said diaphragm and a second stage pumping chamber on the other side of said diaphragm, a passage through said cover, and a pump push rod extending through said passage operatively engaging said diaphragm and said arm for reciprocation by said arm, said arm serving to flex said diaphragm for the intake stroke of the first stage pumping chamber and said spring serving to flex said diaphragm for the intake stroke of the second stage pumping chamber.

7. A vacuum pumping system adapted for operation from the cylinder head rocker arm of a diesel engine of the type having a cam shaft comprising, in combination a cylinder head, a rocker arm pivotably secured to said cylinder head, a push rod extending through said head adapted for reciprocation by the cam shaft of said engine, said push rod being pivotably engaged with said arm to oscillate the same, a fuel injector secured to said head operatively engaged with said arm for actuation thereby, a cover secured to said head to enclose said arm, a vacuum pump outside said cover and secured thereto including a movable wall and a spring urging said wall in one direction, a passage through said cover, and a pump push rod extending through said passage operatively engaging said wall and said arm for reciprocation by said arm, said arm serving to move said wall against said spring, a socket formed in said arm proximate said first mentioned push rod connection with said arm and being in substantial alignment with said first mentioned push rod, said pump push rod being pivotably received in said socket.

8. A pumping system adapted for operation from the cylinder head rocker arm of an internal combustion engine of the type having a cam shaft comprising, in combination, a cylinder head, a rocker arm pivotably secured to said cylinder head, a push rod adapted for reciprocation by the cam shaft of said engine, said push rod being pivotably engaged with said arm to oscillate the same, a fuel injector rod reciprocable in said head operatively engaged with said arm for actuation thereby, a cover secured to said head to enclose said arm, a pump secured to said cover including a movable wall and a spring urging said wall in one direction, and a pump push rod extending through said cover and operatively engaging said wall and said arm for reciprocation by said arm, said arm serving to move said wall against said spring, a socket formed in said arm proximate said first mentioned push rod connection with said arm and being in substantial alignment with said first mentioned push rod, said pump push rod being pivotably received in said socket.

9. A vacuum pumping system adapted for operation from the cylinder head rocker arm of a diesel engine of the type having a cam shaft comprising, in combination, a cylinder head, a rocker arm pivotably secured to said cylinder head, a push rod extending through said head adapted for reciprocation by the cam shaft of said engine, said push rod being pivotably secured to said arm to oscillate the same, a fuel injector secured to said head operatively engaged with said arm for actuation thereby, a cover secured to said head to enclose said arm, a double-acting vacuum pump outside said cover and secured thereto including a flexible diaphragm and a spring urging said diaphragm in one direction, said pump having a first stage pumping chamber on one side of said diaphragm and a

second stage pumping chamber on the other side of said diaphragm, a passage through said cover, and a pump push rod extending through said passage operatively engaging said diaphragm and said arm for reciprocation by said arm, said arm serving to flex said diaphragm for the intake stroke of the first stage pumping chamber and said spring serving to flex said diaphragm for the intake stroke of the second stage pumping chamber, a socket formed in said arm proximate to said first mentioned push rod connection with said arm and being in substantial alignment with said first said mentioned push rod, said pump push rod being pivotably received in said socket.

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