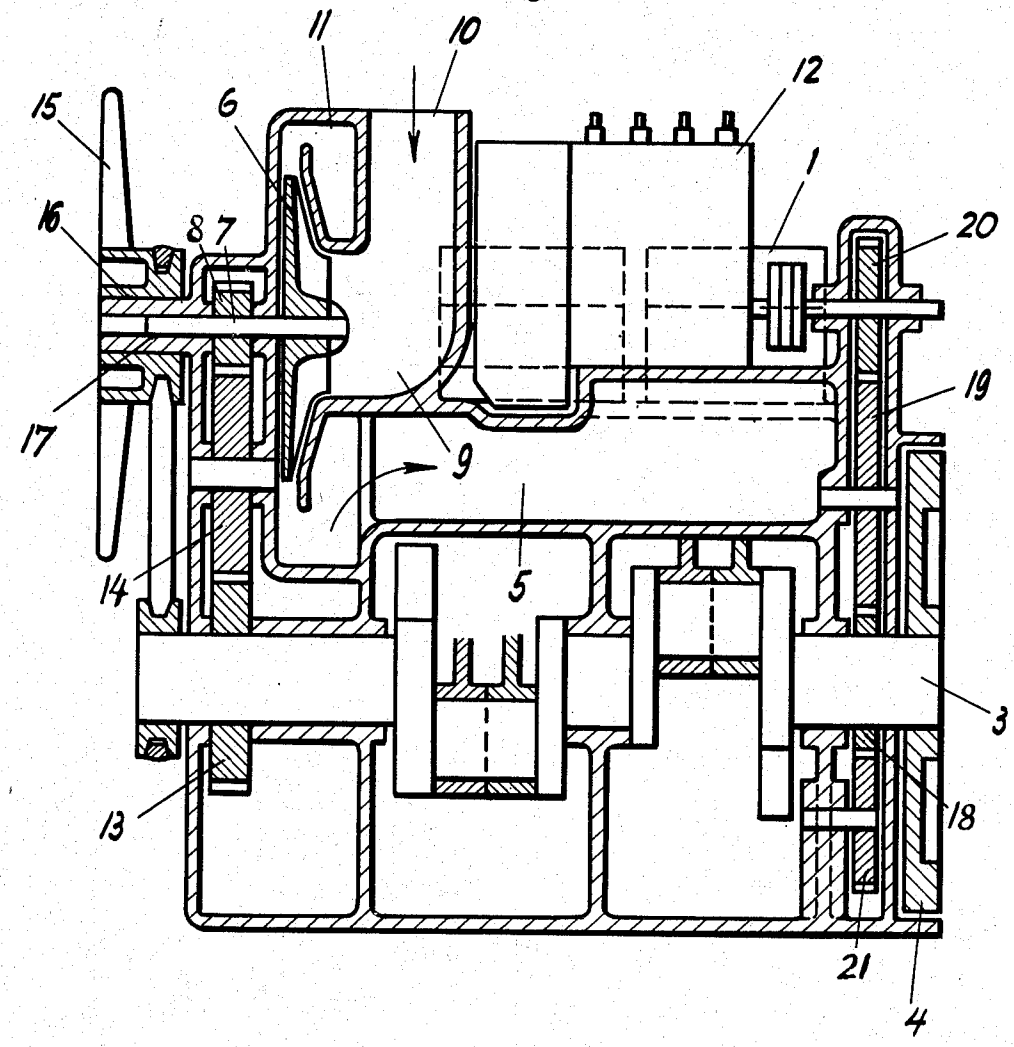
Nov. 24, 1953 J. KOPF ET AL 2,660,156

INTERNAL-COMBUSTION ENGINE WITH SCAVENGING AIR BLOWER

Filed April 5, 1949 5 Sheets-Sheet 1

Fig. 1



Witnesses:
Heinz Remmink
Fritz Posenke

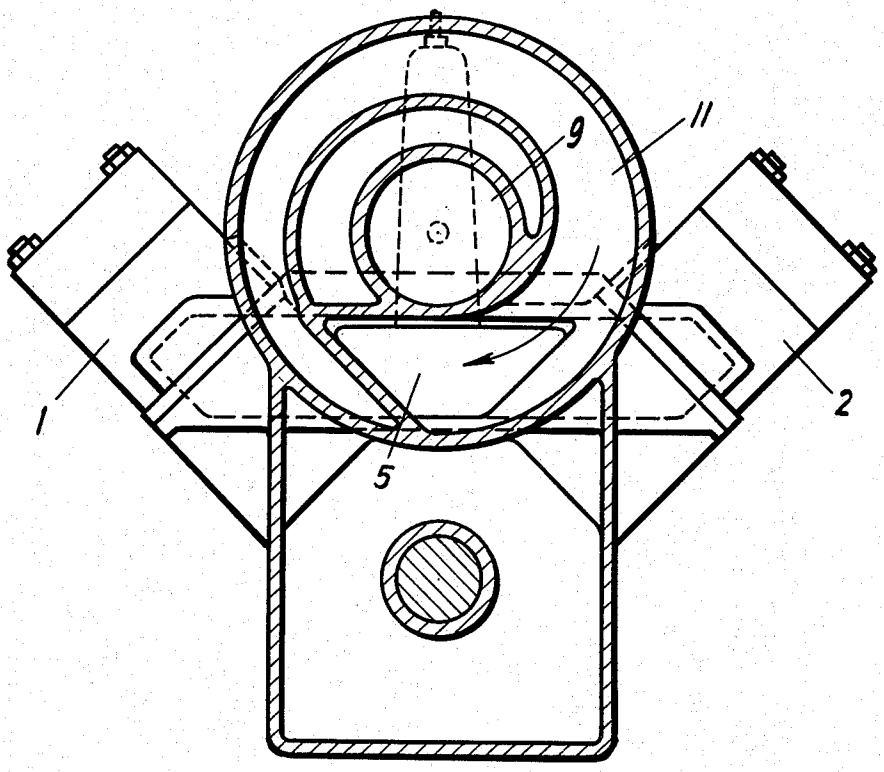
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Nov. 24, 1953 J. KOPF ET AL 2,660,156

INTERNAL-COMBUSTION ENGINE WITH SCAVENGING AIR BLOWER

Filed April 5, 1949 5 Sheets-Sheet 2

Fig. 2



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INTERNAL-COMBUSTION ENGINE WITH SCAVENGING AIR BLOWER

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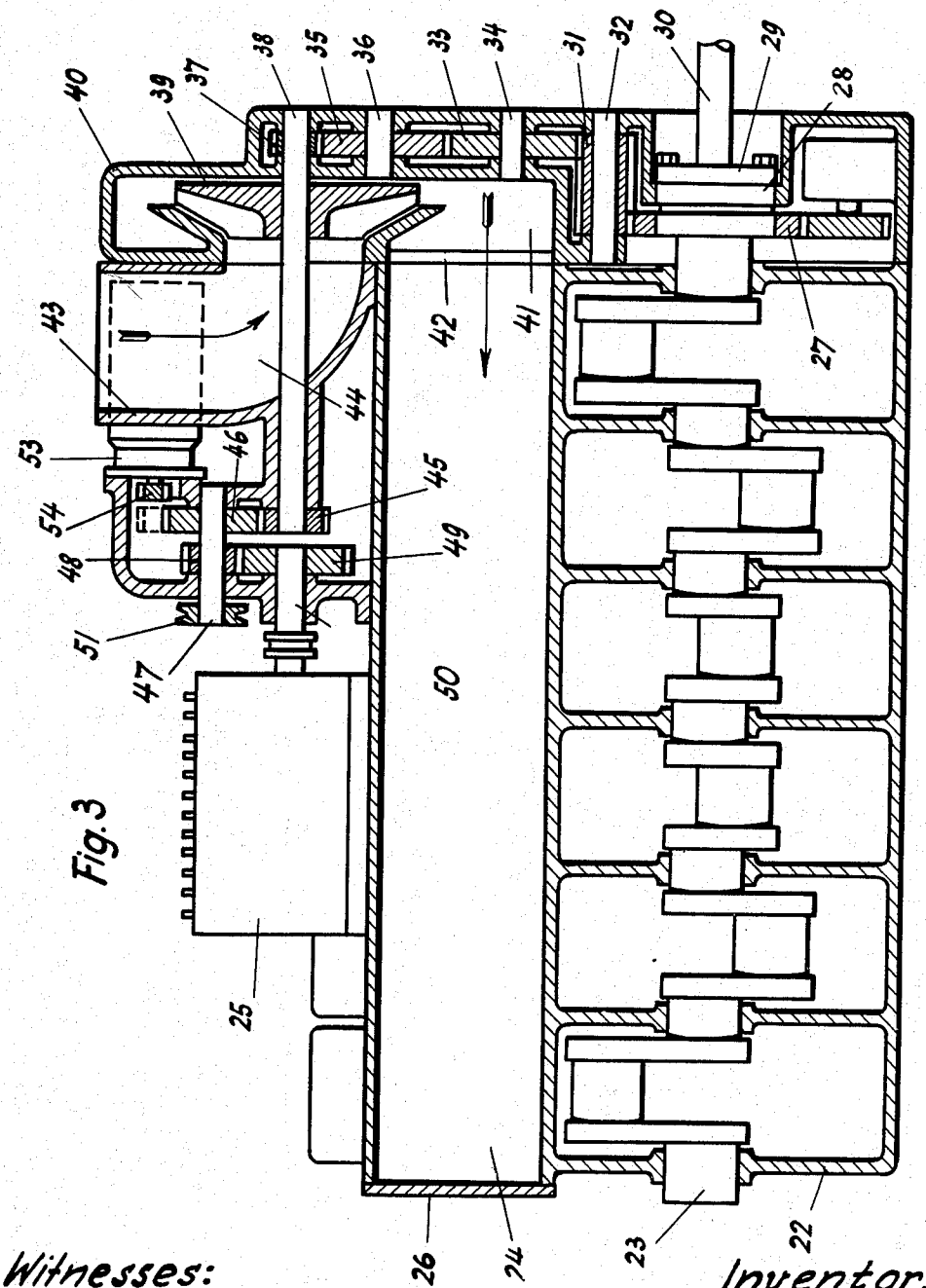


Fig. 3

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INTERNAL-COMBUSTION ENGINE WITH SCAVENGING AIR BLOWER

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Fig. 4

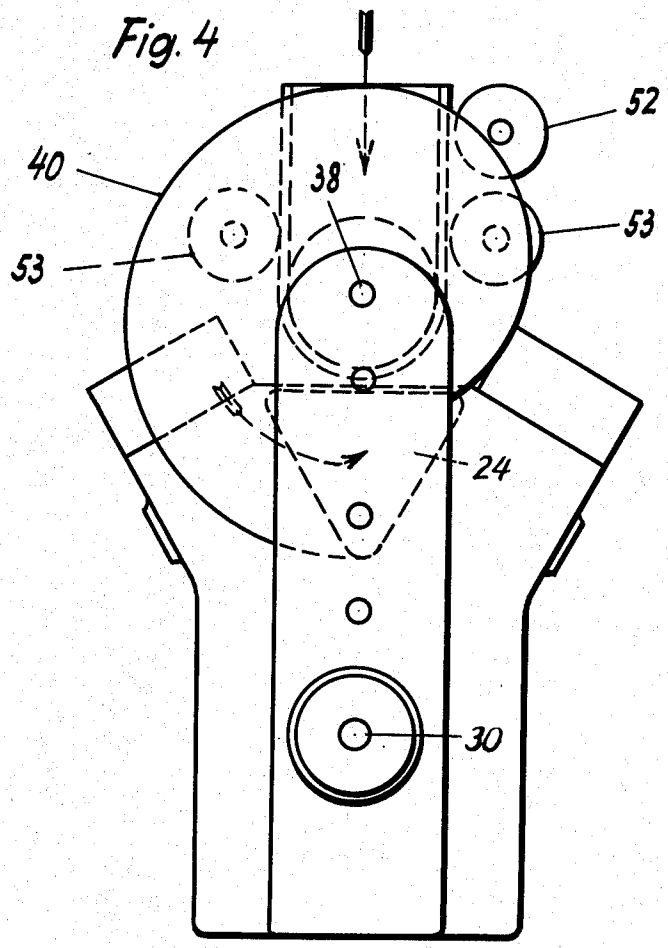
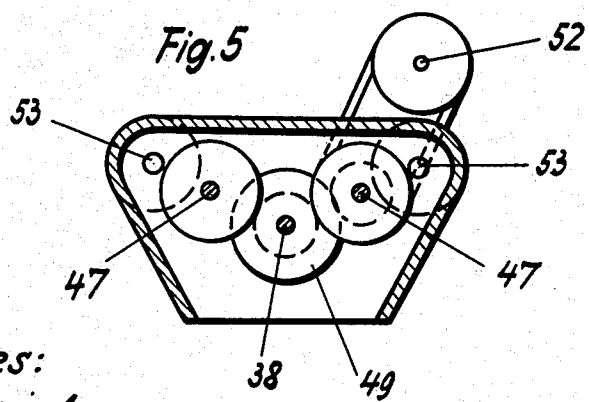


Fig. 5



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INTERNAL-COMBUSTION ENGINE WITH SCAVENGING AIR BLOWER

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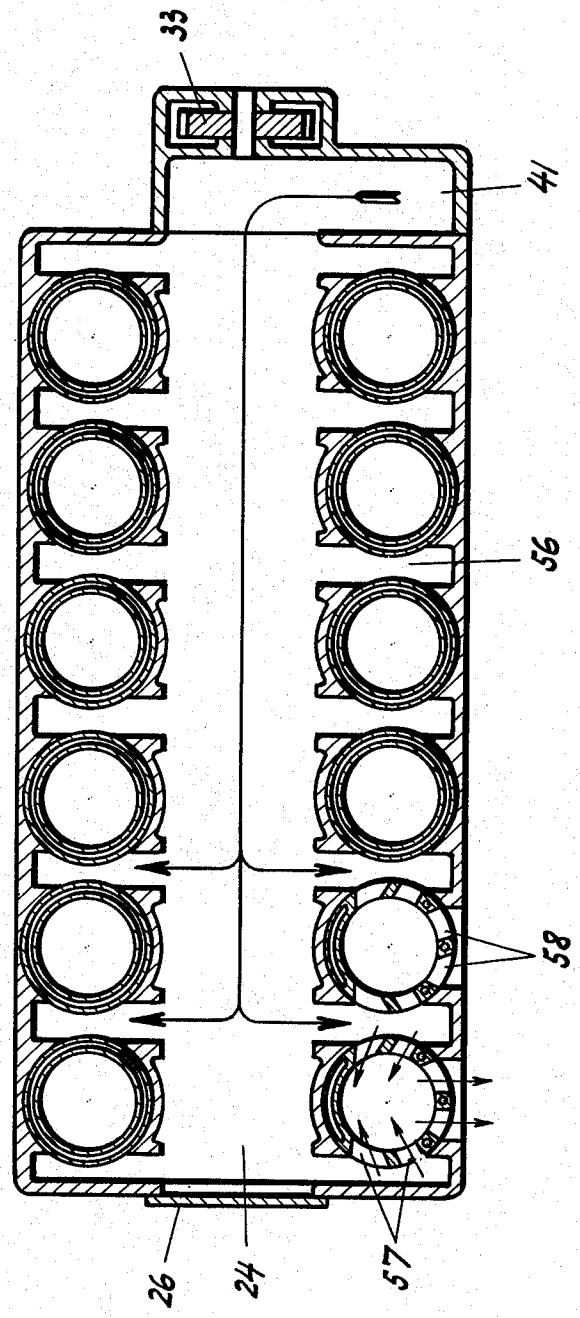


Fig. 6

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Patented Nov. 24, 1953 2,660,156

UNITED STATES PATENT OFFICE

2,660,156

INTERNAL-COMBUSTION ENGINE WITH SCAVENGING AIR BLOWER

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Application April 5, 1949, Serial No. 85,492

Claim priority, application Germany October 1, 1948

2 Claims. (Cl. 123—55)

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The invention relates to multicylinder two-stroke internal combustion engines of the V-type, fitted with a centrifugal gear-driven scavenging blower and with an air receiver, located inside the engine crankcase between the two cylinder banks.

The objects of the invention are to design and arrange the centrifugal blower and its drive in such a way that (*a*) the overall dimensions of the engine can be kept small, (*b*) that the air enters the air receiver and the cylinders through short and smooth passages with a minimum of resistance, and (*c*) that the blower drive can be utilized for driving one or more accessories.

According to the invention, the centrifugal blower is positioned either at the flywheel end or at the opposite end of the engine so that the intake side of the blower lies immediately on top of one end of the air receiver, pointing in opposite direction to the impeller drive, i. e. towards the space between the two cylinder banks. The impeller shaft of the blower is arranged parallel to the crankshaft and is driven from either end of said crankshaft, preferably by a train of gearwheels. The diffuser is of the customary type, having a volute casing of gradually increasing sectional flow area, comparatively narrow but of large diameter. The delivery end of the volute casing is turned downwards, pointing towards the air receiver, and joins said receiver at the point where the sectional flow area of the diffuser is a maximum. The air, therefore, enters the blower from the space on top of the receiver, between the two cylinder banks and coaxial with the impeller shaft, is diverted and accelerated in the impeller, decelerated in the diffuser, and eventually discharged into the air receiver in a direction opposite to the entrance direction, i. e. parallel to, but some distance below, the impeller shaft. The air passages are short, wide and smooth, and the air flows into the receiver with a minimum of disturbance and with small frictional losses.

According to another feature of the invention, the impeller shaft is used for driving the injection pump, which is arranged on top of the air receiver, by means of a reduction gear. The same reduction gear may also serve to transmit to the crankshaft the torque of a starter motor to be mounted on a bracket on or near the induction pipe. This eliminates the necessity for a toothed flywheel and places the starter motor in a position where it is easily accessible and where it does not take up much space.

The diagrammatic drawings Figs. 1–6 show two

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examples of engines designed in accordance with the invention.

Fig. 1 is a longitudinal section through the centre plane of a four cylinder engine, showing the centrifugal blower, the induction pipe, and the air receiver. The impeller is driven from the front end, and the injection pump from the rear end (flywheel end) of the crankshaft.

Fig. 2 is a cross section through the diffuser casing of the engine in Fig. 1.

Fig. 3 is a longitudinal section of a twelve cylinder engine through the centre plane, showing the air receiver inside the crankcase, the blower, the blower drive, and the reduction gear for the injection pump.

Fig. 4 is a view of the engine, seen from the flywheel end, showing the diffuser casing and the engine accessories, attached to the blower drive.

Fig. 5 is a cross section of the reduction gear for the injection pump.

Fig. 6 is a developed horizontal plan of the engine in Figs. 3 and 4, the section passing through the air receiver, the cylinders, and through the blower drive.

In Figs. 1 and 2, the cylinders of the left hand bank are indicated by 1 and those of the right hand bank by 2. The crankshaft 3 carries the flywheel 4. Two connecting rods are assembled side by side on each crankpin, so that one cylinder bank is offset relative to the other by the width of one rod-end bearing. The air receiver 5, forming part of the crankcase, extends throughout the whole length of the latter between the bottom parts of the cylinders. Scavenging air is supplied to the receiver by a centrifugal blower whose impeller 6 is mounted on an impeller shaft 7, a pinion 8 being keyed to the shaft. The impeller shaft is arranged parallel to the crankshaft but not necessarily in the centre plane of the engine; it may be slightly offset relative to the centre plane.

The air intake 9 of the blower points towards the space between the two cylinder banks and is situated immediately above the left hand side of the air receiver. The air passes to the intake 9 through an induction pipe 10 which bends upwards or is otherwise suitably shaped, so that it does not interfere with the injection pump. In case of petrol engines or diesel engines, fitted with vacuum controlled governors, the air intake may be controlled by some throttle device fitted in the induction pipe 10.

The diffuser casing 11 of the blower is located between the impeller and the outside wall of the crankcase carrying the front main bearing, i. e.

the bearing opposite the flywheel end of the engine. The delivery end of the diffuser casing points downwards towards the air receiver 5 and joins the latter so that the air passes into the receiver in a more or less axial direction. The flow of the air is indicated by arrows in Figs. 1 and 2.

The blower is driven by a train of gears, consisting of a gear 13 keyed to the crankshaft, an intermediate gear 14, and the pinion 8 of the impeller shaft. If a fan 15 is required it may be journalled, as shown in Fig. 1, on a stub axle 16 formed by the extension of the outer impeller shaft bearing 17. The injection pump 12 is located on top of the air receiver 5 and is driven by a train of gear wheels, 18, 19 and 20 from the rear end (flywheel end) of the crankshaft. Shown also is a gear 21 for driving a lubricating oil pump.

Figs. 3–6 show a twelve cylinder engine with a crankcase 22, a crankshaft 23, an air receiver 24, and an injection pump 25, the latter being mounted on top of the air receiver. The air receiver has a cover 26 which makes the interior of the air receiver accessible for inspection and cleaning. A gear wheel 27 is keyed to the crankshaft. The crankshaft is fitted with a flange 28 whose circumference serves as an oil seal toward the crankcase. This flange is bolted to or otherwise connected with the coupling flange 29 of some take-off shaft, for instance, a propeller shaft 30. The coupling, therefore, is housed inside the crankcase or, as shown in Fig. 3, in a casing which is attached to the crankcase and houses the blower drive.

Gear 27 engages an intermediate pinion 31, running on an axle 32. Pinion 31 is of considerable width as the following intermediate gear 33, running on an axle 34 is not in the same plane as gear 27. Gear 33 meshes with another intermediate gear 35 on an axle 36; and gear 35 meshes with a pinion 37 keyed to the shaft 38 of the impeller 39. The diffuser casing 40, in this particular design, is cast integral with the casing for the impeller drive and is bolted to the crankcase. The delivery end 41 of the diffuser casing joins the open end 42 on the right hand side of the air receiver 24 so that the scavenging air passes directly from the blower into the receiver, as indicated by arrows in Fig. 3.

The casing 43, located on top of the air receiver and bolted to the blower casing 40, is cast integral with the induction pipe 44 and houses the reduction gear for the injection pump. The impeller shaft 38 of the blower extends through the induction pipe and is supported on its left end by a bearing. It carries a pinion 45, meshing with a gear 46 keyed to a countershaft 47. The same countershaft carries a somewhat smaller gear 48 which meshes with a gear 49 keyed to a shaft 50. Shaft 50 is coupled with the injection pump.

The impeller shaft 38 rotates at a considerably higher speed than the crankshaft, the gear ratio being between 5:1 and 10:1. The high speed of the impeller shaft is reduced by the train of gears 45, 46, 48 and 49, so that shaft 50, driving the injection pump, is running at crankshaft speed. A pulley 51 on shaft 47 is available for driving, through a V-belt, the dynamo 52 or some other engine accessory. A starter motor 53 is attached to the casing next to the induction pipe. During the starting operation, the pinion 54, sliding on the splined shaft of the starter motor, is shifted axially to the left (Fig. 3) and engages gear 46, thus transmitting the torque of the starter through the reduction gear and the blower drive to the crankshaft. This arrangement provides a

gear ratio particularly suitable for starting purposes and dispenses with the conventional starter pinion geared to a toothed flywheel ring. Large engines may be equipped with two starter motors 53 which, as shown in Figs. 4 and 5, are then arranged on either side of the air induction casing; in this case two countershafts 47 have to be employed.

In Fig. 6 the air flow from the delivery end 41 of the diffuser casing into the receiver 24 and from there to the cylinders is indicated by arrows. The air receiver has lateral ducts 56 leading to the inlet ports 57 of the cylinders. The scavenging system employed is on the reverse loop scavenging principle, having the inlet ports arranged on either side of the exhaust passages 58. The air flow entering the cylinders is directed, as indicated by arrows, towards the cylinder wall opposite the exhaust passages and is then deflected upwardly towards the combustion room.

The invention is not limited to the engines described and shown in the accompanying drawings. It also applies to other engines of the same type, incorporating minor changes of design but retaining the basic features of the invention, especially the arrangement of the blower, the air receiver, and the drive of the accessories. Instead of the gear trains, described and shown in the drawings, chain drives can be used or combined drives, consisting of shafts and bevel gears or worm gears. The invention applies to diesel engines as well as to gasoline engines.

What we claim is:

1. In a two-cycle engine having a crankcase, a crankshaft and two banks of cylinders V-arranged on said crankcase and forming an angular space between each other, the combination of a fuel injection pump and scavenging air supply means, said supply means comprising an air receiver extending along said banks and being joined with said crankcase at the bottom of said angular space, a centrifugal blower having an impeller shaft parallel to said crankshaft and extending above said receiver, said blower having an intake conduit and a diffuser, said injection pump being mounted on said receiver within said angular space and being connected with said impeller shaft, blower drive means connecting said impeller shaft with said crankshaft and being disposed immediately adjoining one axial end of the engine, said blower being positioned at the axial end of said space immediately adjacent to said drive means and having said intake conduit located at the axial blower side inwardly of the engine, and said diffuser having an air outlet disposed at the bottom of the diffuser and merging with the space of said receiver.

2. In a two-cycle engine having a crankcase and a crankshaft and two banks of cylinders V-arranged on said crankcase and forming an angular space between each other, the combination of scavenging air supply means comprising a centrifugal blower disposed at one axial end of the engine and having an impeller shaft parallel to the crankshaft, said blower having an intake opening facing inwardly of the engine and having an intake conduit extending from said opening, a diffuser surrounding said blower, an air receiver extending in said space along said banks of cylinders, said intake conduit being located immediately above one end of said receiver, said diffuser having an air outlet disposed at the bottom of the diffuser and merging directly with said end of said receiver, a fuel injection pump mounted in said space on top of said receiver at

the side of said conduit inwardly of the engine, said impeller shaft extending through said conduit and being connected with said pump for driving the latter.

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OTTO ELWERT.

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