June 24, 1952 K. P. SCHOEPPNER ET AL 2,601,562

PRIMARY APPARATUS FOR INTERNAL-COMBUSTION ENGINES

Filed Feb. 16, 1950 3 Sheets-Sheet 1

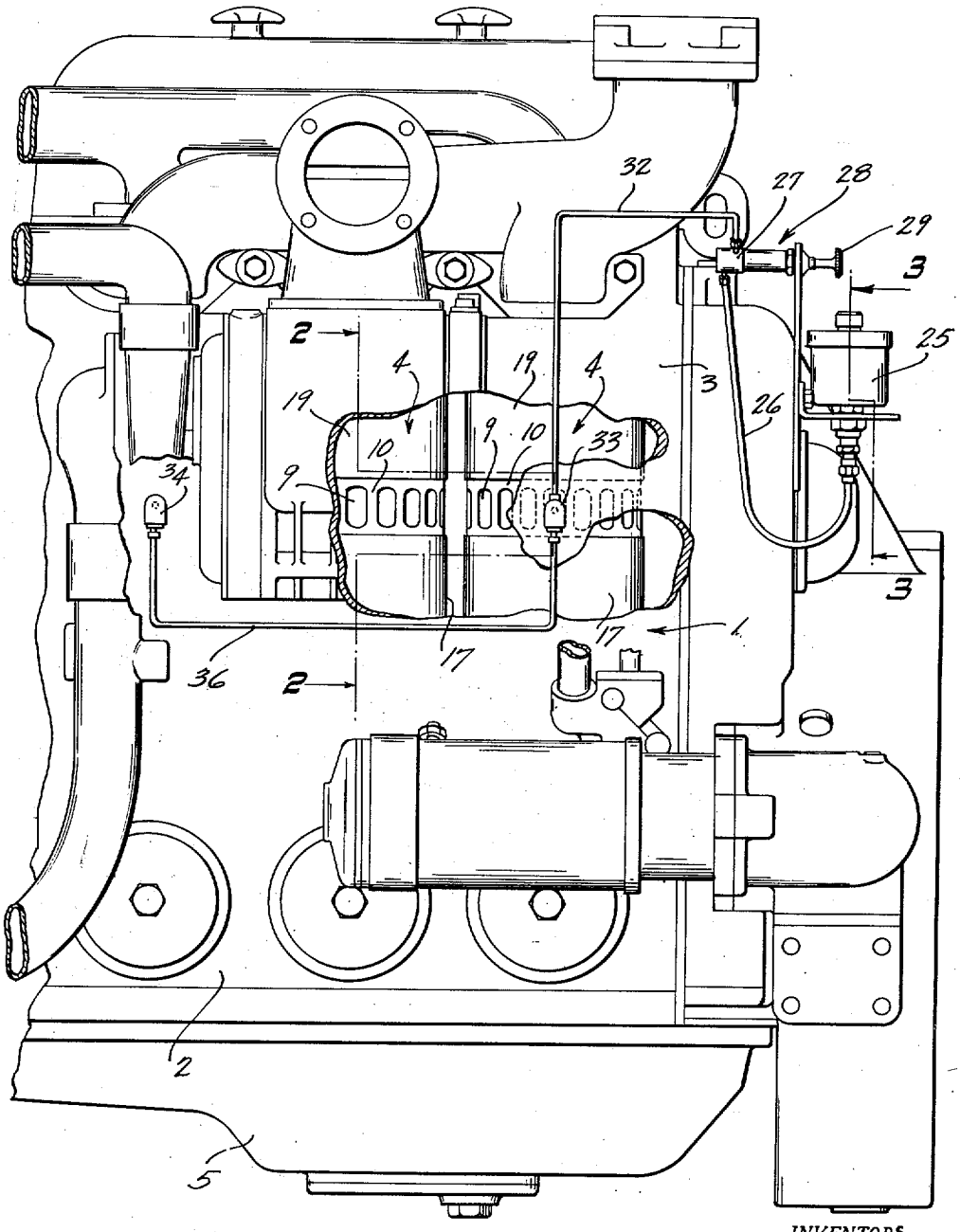


Fig. 1

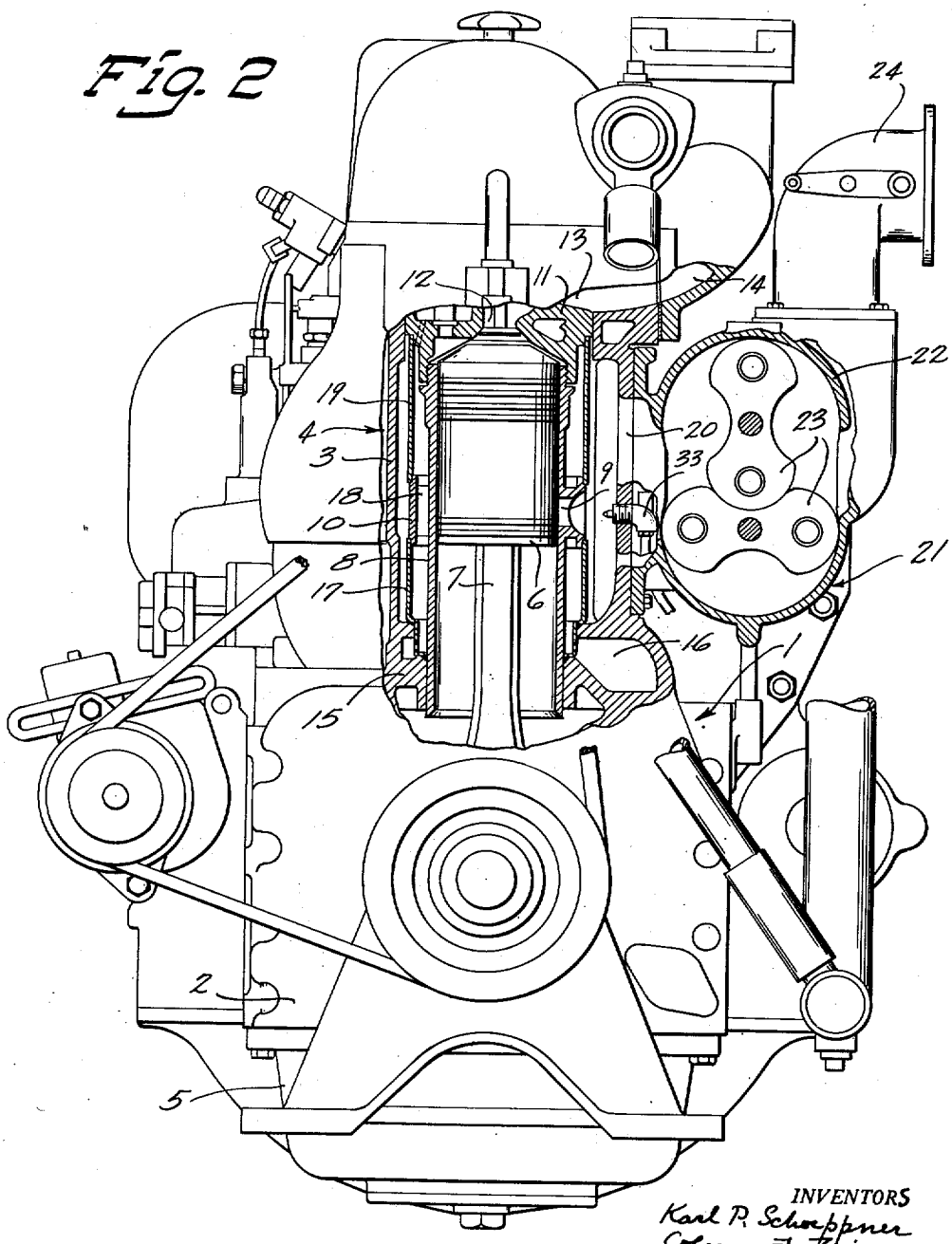
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PRIMARY APPARATUS FOR INTERNAL-COMBUSTION ENGINES

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Fig. 2



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Fig. 3

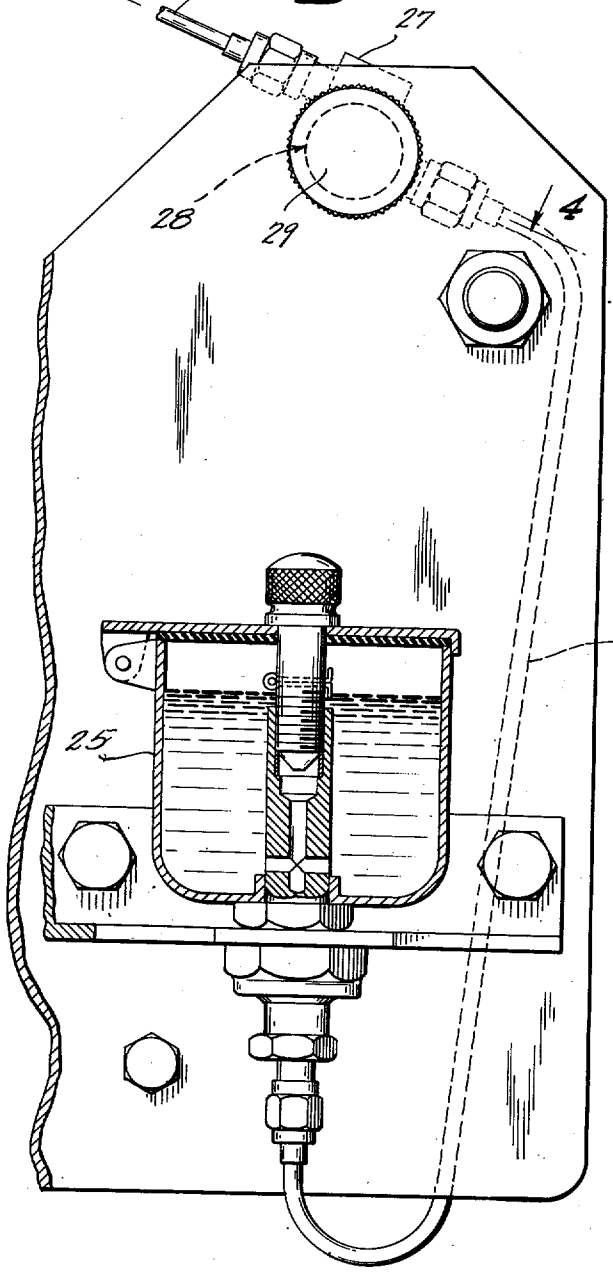
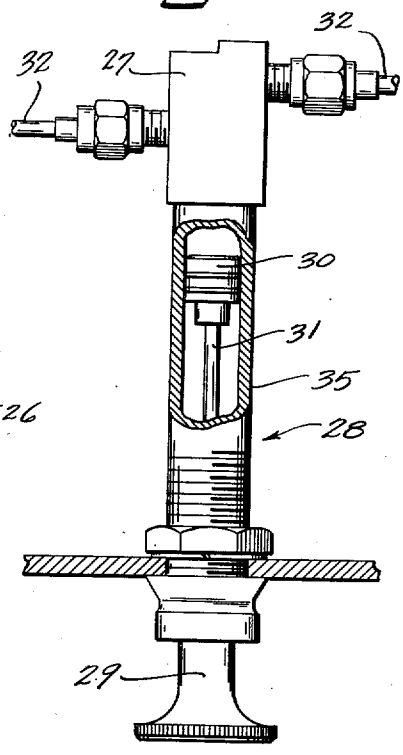


Fig. 4



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PRIMING APPARATUS FOR INTERNAL-COMBUSTION ENGINES

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5 Claims. (Cl. 123—187.5)

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This invention relates to priming apparatus for cold starting internal combustion engines of the two cycle type having separate blowers for supplying air for scavenging or supercharging and cylinders with piston controlled air inlet ports enclosed in an air box with a blower mounted on the air box to supply air under pressure thereto, said priming means having jets or spray nozzles for discharging volatile priming fuel into the air box between the blower and the cylinders so positioned that the priming fuel is entrained in the air at the time the latter enters the cylinders, while the position and direction of the jets assist in propelling the priming fuel along with the air directly into the cylinders.

In prior methods of cold weather priming and starting of two cycle internal combustion engines having forced air supply, the priming fuel has been introduced into the air on the inlet side of the blower. This has lacked effectiveness because the volatile fuel becomes so diffused in the air that by the time it has passed through the blower and the air box an insufficient concentration of the fuel reaches any one cylinder. By means of the present invention a concentrated charge of high volatile priming fuel is entrained with the rapidly moving air immediately as it enters the air inlet ports of one or more cylinders when the pistons are in lowered position an action which is aided by the propulsive effect of the spraying action itself. When the pistons move upward the air inlet ports are closed and the injected fuel in relatively high concentration and air are compressed to ignition temperature.

In the drawings:

Figure 1 is a side view in elevation of a two cycle internal combustion engine with the outer wall of the air box broken away to show the air inlet ports in the cylinder sleeves and showing a priming apparatus constructed in accordance with the invention,

Figure 2 is a front end view in elevation and partly in section of the engine shown in Fig. 1, with the parts shown in section viewed through the plane 2—2 indicated in Fig. 1,

Figure 3 is an enlarged detailed rear end view in elevation and partly in section of the priming fuel supply tank viewed through the plane 3—3 indicated in Fig. 1,

Figure 4 is a detailed, tilted, top plan view of the priming fuel injection pump with a part broken away viewed through the plane 4—4 indicated in Fig. 3.

Like parts are identified by the same reference numerals throughout the several views.

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The priming apparatus of this invention is adapted to assist the cold starting of compression ignition internal combustion engines of the two cycle type in which the air for combustion is arranged to be supplied by separate air forcing means. One form of such an engine of the uniflow type is illustrated in Figs. 1 and 2 of the drawings. The engine there illustrated is provided with a main engine frame designated generally by the numeral 1. The lower portion of the frame 1 forms the upper half 2 of a crank case closed on the bottom by a pan 5, while the upper part of the frame 1 forms an air box 3 which serves also as an entablature for the mounting of three unitary, water-jacketed cylinder sleeves designated generally by the numeral 4, two of which appear in Fig. 1.

Mounted for reciprocation within the cylinder barrels 8 of the sleeves 4 are pistons 6, which are connected by rods 7 with a crank shaft, not shown, mounted in known fashion within the crank case. The barrels 8 are provided with circumferential belts 10 of increased thickness pierced by circumferentially spaced air inlet ports 9 positioned to be uncovered by the pistons 6 at the lower ends of their strokes, thus providing air admission passages extending from the air box 3 into the interior of the barrels 8. The sleeves 4 are closed at the top by heads 11 joined securely to the barrels 8 to form combustion chambers above the pistons 6. The heads 11 are formed to closely fit openings provided therefor in the upper wall of the air box 3 so as to securely position the upper ends of the sleeves 4 and to close the upper end of the air box 3 against escape of air therefrom.

Mounted within the heads 11, as shown, are exhaust valves 12 arranged to be actuated in timed relation to the rotation of the crank shaft, by means not shown, so as to be opened when the pistons 6 are in the lower parts of their strokes. Exhaust gas, permitted to escape by the valves 12, is carried away through exhaust ports 13 and exhaust manifold 14. The lower ends of the sleeves 4 are received in closely fitting relationship to openings provided therefor in a barrier 15 in the frame 1, which barrier divides the crank case from the air box 3. In this way the sleeves 4 are securely positioned at their lower ends and the lower wall of the air box 3 is closed against escape of air therefrom.

The barrier 15 is ported as shown at 16 to admit coolant fluid to the cooling spaces surrounding barrels 8 formed by lower cooling jackets 17. The jackets 17 are sealed at their

lower ends by gaskets as shown and are hermetically joined with the belts 10 at their upper ends. Belts 10 in turn are provided with vertical coolant transfer passages 18 which alternate with the air inlet passages 9 around the circumference of the belts 10. The coolant transfer passages 18 extend upwardly into cooling spaces surrounding the upper parts of the barrels 8 formed by upper cooling jackets 19. Coolant delivered in the space enclosed by the jackets 19 escapes upwardly therefrom through passages provided therefor in head 11.

The air box 3 is closed at its ends against escape of air by continuous end walls at its back by a continuous back wall and at its front by a front wall which is continuous except for a main air entrance 20. The air entrance 20 is, however, tightly joined with the discharge port of a positive displacement blower 21 having a casing 22 within which intermeshing impellers 23 are caused to rotate by a gear train connected with the crank shaft but not shown. Thus when the crank shaft rotates, air is drawn into the blower 21 through an air intake 24 and delivered under pressure into the air box 3. The air under pressure within the air box 3 may escape therefrom only through the cylinder air inlet passages 9 when the pistons 6 are in the lower parts of their strokes. The displacement of the blower 23 for each revolution of the crank shaft in accordance with known practice is made such as to insure substantially complete scavenging of exhaust gases from the cylinders each time the parts assume exhaust position. As a result rapid and forceable entrance of air through the ports 9 takes place each time a piston 6 reaches the bottom of its stroke and this condition prevails, although in a diminished degree due to leakage in the blower 21, even at the time of starting of the engine, after not more than one or two revolutions of the crank shaft.

For the purpose of introducing volatile priming fuel, when required, a reservoir 25 is conveniently mounted as shown in Fig. 1 and connected by a delivery pipe 26 with a manually operated priming pump generally designated by the numeral 28. The pump 28 is provided with a barrel 35. As illustrated in Fig. 4 the barrel 35 is broken away to show priming fuel pump piston 30 connected to hand knob 29 by piston rod 31.

Pump 28 is connected to priming fuel supply pipes 32 by a manifold 27. As shown in Fig. 1 supply pipe 32 is connected with priming fuel injection jet or spray nozzle 33 and supply pipe 36 connects nozzle 33 with nozzle 34.

In the operation of the apparatus shown, referring to Fig. 1, volatile priming fuel supplied to tank 25 is drawn through pipe 26 into manifold 27 by hand operation of priming pump 28, operated by hand knob 29. From manifold 27 the priming fuel is forced through supply pipes 32 to jets or spray nozzles 33 and 34. Nozzle 33 is shown directly opposite one of ports 9, evently spaced around cylinder sleeves 4. A view in side elevation of jet 33 is illustrated in Fig. 2 in which also are illustrated cylinder sleeves 4, air box 3, air blower 21 and engine piston 6. Air entering blower 21, through intake 24, is forced through entrance 20 into air box 3 by the action of pump impellers 23. When piston 6, actuated by the engine starting motor, moves downward and clears air inlet port 9, priming fuel ejected under pressure from nozzle 33 is entrained in the air forced out from air box 3 through ports 9 and projected into cylinder barrels 8.

Petroleum ether is the preferred volatile priming fuel. When it is desired to start the engine in cold weather the operator presses the switch button of the engine starting motor (not shown) with one hand while actuating the priming fuel injection pump with the other hand. Two to three revolutions of the crank shaft generally are sufficient to start the engine even in extremely cold weather.

It will be noted that with the improved priming apparatus of this invention the volatile priming fuel is injected into a comparatively small volume of air in the air box at or in the near vicinity of the cylinder air inlet ports. This small volume of air is easily and immediately saturated by the spray and the saturated air is propelled immediately into the cylinder so that the assistance of the supplementary starting fuel is available at the very outset of the cranking operation of the engine at a time when the available battery charge for cranking purposes is at a maximum and the rate of turning of the engine is greatest.

This is in strong contrast with the conditions prevailing where the priming fuel is supplied as heretofore at a point on the air inlet side of the blower. Introduction of the priming fuel ahead of the blower results in the necessity of establishing an effective concentration of vapor throughout the entire air content of the air inlet to the blower, the blower itself and the air box before any assistance to the firing of a cylinder is made available. Such demands several revolutions of cranking action, by which time the battery charge becomes substantially diminished and the possibility of successful starting is pro tanto diminished.

Under conditions of actual comparison an engine provided with the novel priming apparatus of this invention has therefore been found to start more easily and certainly under cold weather conditions than engines equipped with priming apparatus as heretofore employed.

We claim:

1. In an improved priming apparatus for an internal combustion engine of the two cycle type having an air box, cylinder sleeves mounted in said box, air inlet ports in said sleeves forming a communicating passage between said air box and the interior of said sleeves, pistons within said sleeves movable to cover said air inlet ports when in upper position and to clear said ports when in lowered position, and an air forcing means connected to said air box to deliver a continuous flow of air under pressure thereto to continuously maintain pressure therein in excess of atmospheric pressure, the improvement in said priming apparatus for such an engine which comprises priming fuel pressure applying means, spray nozzles connected thereto to be supplied thereby, said nozzles being positioned between said air forcing means and said air inlet ports of said engine, at least one of said nozzles being positioned opposite inlet ports of at least one of the engine cylinders and directed to inject priming fuel through said air inlet ports into said cylinder.

2. In an improved priming apparatus for an internal combustion engine of the two cycle type having an air box, cylinder sleeves mounted in said air box, air inlet ports in said sleeves forming a communicating passage between said air box and the interior of said sleeves, pistons within said sleeves movable to cover said air inlet

ports when in upper position and to clear said ports when in lowered position, and air forcing means connected to said air box to deliver a continuous flow of air under pressure thereto to continuously maintain pressure therein in excess of atmospheric pressure, the improvement in said priming apparatus for such an engine which comprises priming fuel injection jets mounted in said air box in position opposite air inlet ports of at least one of said cylinders having discharge openings positioned to direct priming fuel toward said air inlet openings and means for supplying volatile priming fuel to said jets under pressure.

3. In an improved priming apparatus for an internal combustion engine of the two cycle type having an air forcing means communicating with an air box to continuously maintain pressure therein in excess of atmospheric pressure, air ports forming a communicating passage between said box and the interior of the cylinders of said engine, the improvement in said priming apparatus which comprises spray nozzles mounted in said air box, and priming fuel forcing means connected thereto, said spray nozzles being positioned to direct priming fuel through said air ports into the interior of said cylinders.

4. In an improved priming apparatus for an internal combustion engine of the two cycle type having an air forcing means communicating with an air box to continuously maintain pressure therein in excess of atmospheric pressure, said air box being positioned to encompass cylinder barrels of said engine, and air ports within said box communicating with the interior of the cylinder barrels of said engine, the improvement in said priming apparatus which comprises spray

nozzles mounted in said air box, and priming fuel forcing means connected thereto, said nozzles being positioned between said air forcing means and said air ports, and positioned to direct priming fuel into the air in said box in the vicinity of said air ports.

5. In an improved priming apparatus for an internal combustion engine of the two cycle type having an air forcing means communicating with an air box to continuously maintain pressure therein in excess of atmospheric pressure, said air box being positioned to encompass cylinder barrels of said engine, air ports within said box communicating with the interior of the cylinder barrels of said engine, the improvement in said priming apparatus for such an engine which comprises priming fuel injection nozzles mounted in said air box between said air forcing means and said air outlet ports and positioned to direct priming fuel toward said air ports, and manually actuated means for supplying priming fuel to said nozzles under pressure.

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