April 26, 1938. R. H. SCHNEIDER 2,115,180

TWO-CYCLE ENGINE

Filed May 22, 1934 2 Sheets-Sheet 1

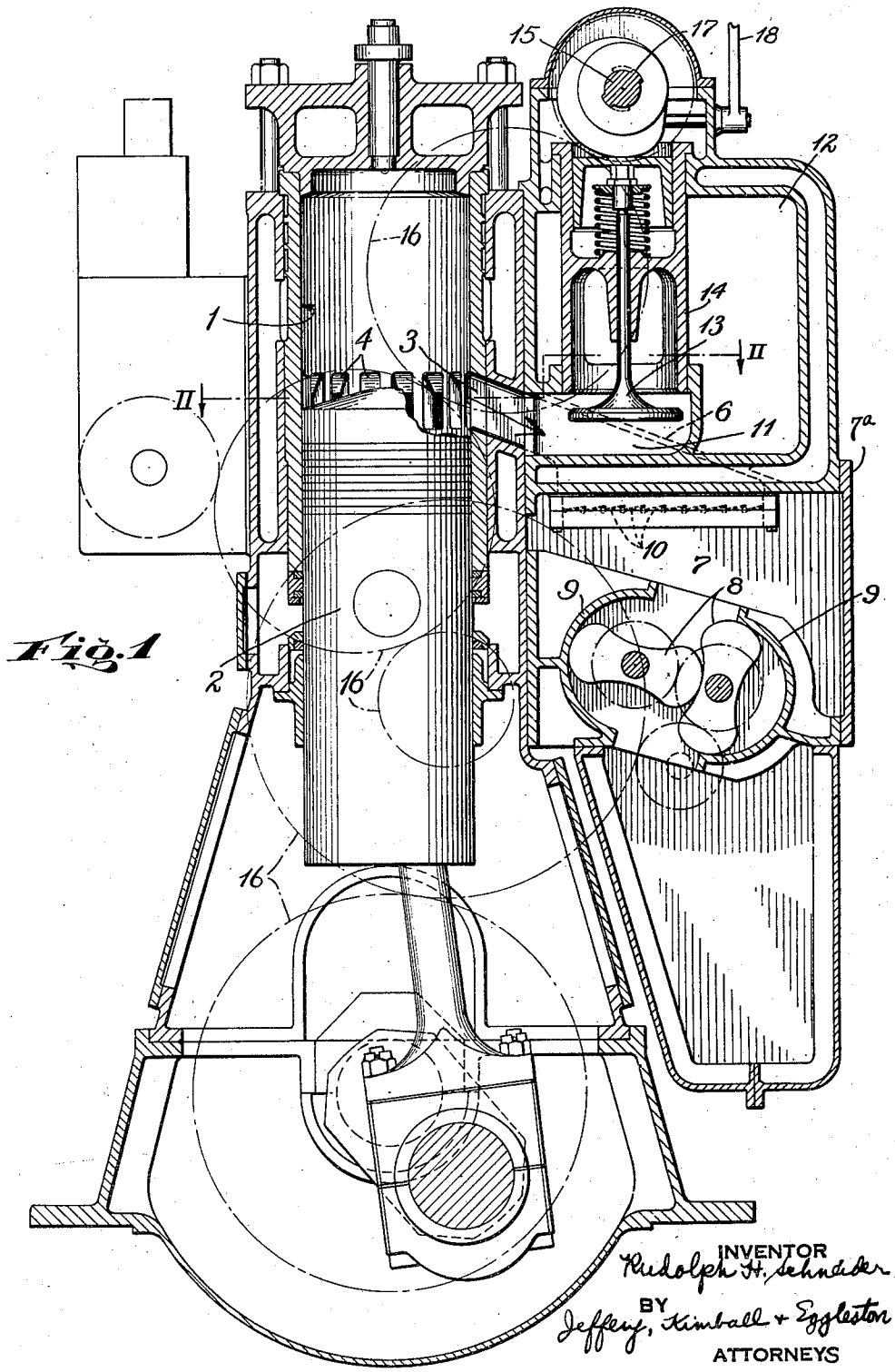


Fig. 1

INVENTOR
Rudolph H. Schneider
BY
Jeffery, Kimball & Eggleston
ATTORNEYS

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Fig. 2

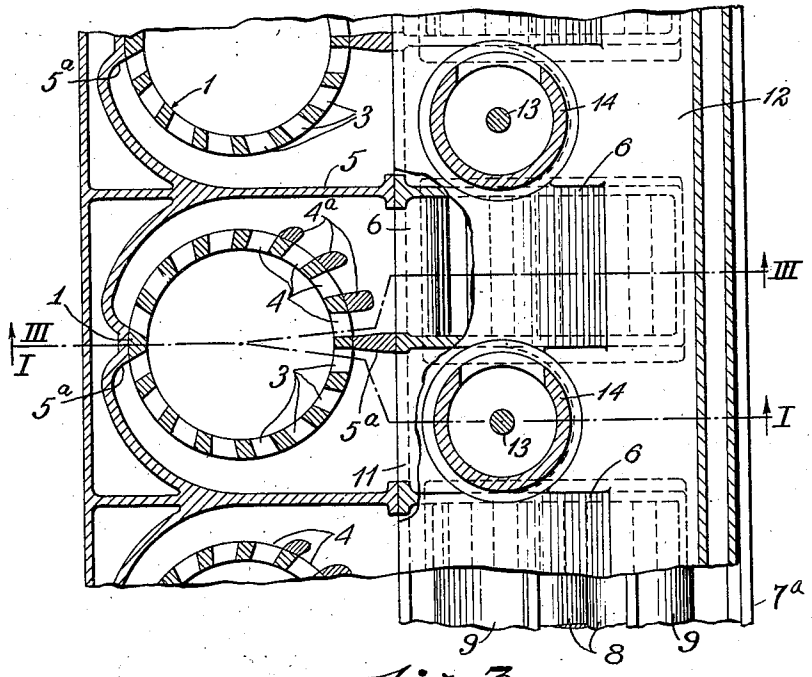
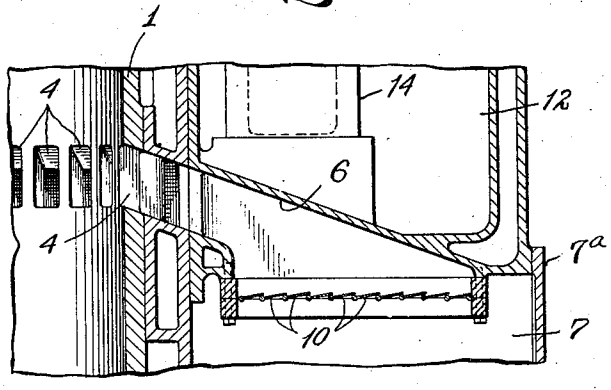


Fig. 3



INVENTOR
Rudolph H. Schneider
BY
Jeffery, Kimball & Eggleston
ATTORNEYS

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TWO-CYCLE ENGINE

Rudolph H. Schneider, St. Louis, Mo., assignor to Busch-Sulzer Bros.-Diesel Engine Company, St. Louis, Mo., a corporation of Missouri

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16 Claims. (Cl. 123—65)

This invention is an improved mode of construction and operation of two-cycle engines in which the scavenging and exhaust are done through piston-controlled ports in the cylinder walls and its object is better general efficiency of such engines, obtained in part through an improved arrangement of the scavenging and exhaust systems and by the mutual organization of such systems in a way to give more effective use of the scavenging air for super-charging and by other features and combinations of features which will be made apparent in the description which follows, referring to an engine embodying the new principles and shown for exemplification thereof in the accompanying drawings. In the latter,

Fig. 1 is an axial section through one of the cylinders of the engine on line I—I of Fig. 2;

Fig. 2 is a section of Fig. 1 on line II—II, and

Fig. 3 is a section of Fig. 2 on line III—III.

In the multi-cylinder engine taken for illustration, the cylinders 1 are arranged in a row, water-jacketed as usual and provided with individual cylinder heads containing the fuel injection valves centrally thereof. The pistons 2, near the ends of their outward strokes, uncover the zones of exhaust ports 3 and scavenging air ports 4, formed in the cylinder walls as usual in this type of engine, but instead of being respectively on opposite sides of the engine, as customary,—the zones are arranged in what may be termed a fore and aft relation, that is to say, each zone of air ports is on one side of a vertical plane transverse to the crankshaft through the axis of its cylinder, and the zone of exhaust ports is on the other side of that plane and, as shown and preferred, the respective zones are on homologous sides of the cylinders.

The exhaust ports 3 are indicated as of the same height as the scavenging ports, so that both are covered and uncovered simultaneously by the piston, but the porting may be according to any preferred arrangement. Preferably the air ports are all in one horizontal row or tier as shown and slanted upwardly or toward the cylinder head and also they are set obliquely in the cylinder wall so as to produce a whirling or rotary motion of the cylinder contents. The exhaust ports are preferably set at an angle the reverse of that of the air ports, so that they lie in positions which conform more or less to the direction of whirling during the scavenging period, thus facilitating outflow through them and to some extent assisting in the rotary motion.

The adjacent zones of ports are separated by partition walls 5 and 5a which are provided in the cylinder block or jacket structure and which, with the complementary parts of the composite manifold structure below referred to, constitute ducts for conducting the air to the cylinders and the exhaust therefrom. These ducts are adjacent and substantially parallel and lead to the same side of the engine.

The duct marked 6 leads from the air manifold 7 which extends alongside the row of cylinders, common to all of them, and is supplied with air under pressure from any suitable source. Preferably this air source is an elongated Roots type blower mounted on the cylinder block with its long rotors 8 turning on horizontal axes parallel to the air manifold. The elongated dimension, substantially coextensive with the row of cylinders, enables the rotors with their casing walls 9 to serve as the floor or bottom of that manifold, thereby economizing weight and also space since with the blower in this position space does not have to be provided for it elsewhere in the engine room and by reason of its narrowness the width of the engine is not unduly extended as will be apparent. Such a blower can be practically operated to supply air at a rate considerably in excess of the stroke volume of the engine per engine revolution and at a pressure appropriate for supercharging as well as scavenging. The top of the air manifold is formed by the bottom wall of the exhaust manifold 12 and its sides are closed in by the cylinder block wall on the one hand and a removable side plate 7a on the other.

The air supplied by the blower is passed upwardly from this manifold through check-valves 10 secured to the bottom of the exhaust manifold and through the upwardly inclined sections of the ducts 6 which are formed in the exhaust structure as indicated and which register with the other sections of the ducts 6 formed in the block. Since these ducts are directly subject to the exhaust heat, it will be appreciated that the entering air is accordingly warmed and somewhat expanded in transit to the ports. The air guides marked 4a are for giving a proper distribution of the air to the individual air ports. The check valves 10 may be of any suitable design and are shown as of the horizontal louvre type (Fig. 3), one for each air duct. They obstruct reverse flow from the cylinders but open freely to pass air to the cylinders at that point in the stroke when the blower pressure exceeds the cylinder pressure and as will be understood.

The exhaust ports 3 discharge through their

ducts 11 into the exhaust manifold 12 which registers therewith and is water-jacketed and preferably disposed directly above the air manifold 7 to form the top or roof of the latter as already stated. This composite manifold structure comprehends all the passages for air supply and exhaust purposes and further economizes on space and weight. The location of both manifolds on the same side of the engine offers numerous advantages in injection type engines, and especially in large size engines, since it leaves the opposite side clear for the fuel and lubricating pumps and for various adjunctive apparatus which require more or less continual supervision or attention.

Each exhaust duct 11 is governed by a mechanical or timed valve 13 of poppet type, one for each duct. The casings 14 of these valves are within the composite manifold structure and more specifically within the exhaust header itself but the valves are operated from the exterior as by means of the cam shaft 15 also carried on the manifold. The valve design and operation will be clear from the drawings. The cam shaft is geared to the engine crank shaft through appropriate gearing indicated in the present case by a gear-train shown by the dotted pitch-circles 16, which train also serves to drive the blower. Each exhaust valve is opened and closed by its cam in the appropriate sequence and once in each cycle and preferably the angular relation of each cam on its shaft is made subject to variation, so that it can be closed by its cam earlier or later as desired. For this purpose the cam in Fig. 1 is shown connected to its shaft by helical splines 17 and shiftable thereon by a lever 18, but any of the known valve-timing gearing will suffice.

The function of the exhaust valve is to terminate the outflow from the exhaust ports of its cylinder at a certain point in the period of air admission, that is to say, at or about the moment when the combustion products have substantially departed and before air has begun to escape in appreciable amount, thereby allowing the rest of the air, which enters while the piston-controlled air ports remain open, to raise the pressure within the cylinder and thus establish a supercharge therein. The extent of supercharge, obtained in this way, obviously depends on the blower pressure and the duration of the open period of the air ports after the closing of the exhaust valve, but by the proper adjustment or regulation of the exhaust valve a considerable supercharge is obtainable under any condition and is subject to increase by advancing the time of closing up to the point where too large a body of combustion products is retained in the cylinder to permit efficient combustion of the fuel therein. It will be apparent that this action is not dependent on the composite manifold construction nor on the particular port arrangement although it is best carried out with the ports and manifolds disposed as described, and similarly the composite manifold structure will afford its advantages independently of the function of the exhaust valve, so that it will be understood that these features in combination and independently, constitute this invention without limitation except as particularly noted in the following claims, and further that there is no intended limitation to the specific design of these ports as shown in the drawings, also except as required by the claims.

What is claimed is:

1. A multi-cylinder engine, comprising a row of two-cycle cylinders having piston-controlled air and exhaust ports, a composite header structure secured to one side of the row containing air and exhaust manifolds and including an elongated blower serving as one of the longitudinal walls of the air manifold.

2. A multi-cylinder two-cycle engine having piston-controlled air and exhaust ports in the walls of its cylinders and a composite header structure including an elongated air blower and air and exhaust manifolds parallel thereto, the air manifold being formed by the space between said blower and the exhaust manifold.

3. A multi-cylinder engine having a row of two-cycle cylinders formed with piston-controlled air and exhaust ports, air and exhaust manifolds respectively therefor, extending both along one side of the row, the exhaust manifold being above the air manifold and an elongated blower mounted on the engine below the air manifold and serving the same.

4. A composite manifold structure for multi-cylinder two-cycle engines having piston-controlled air and exhaust ports, comprising a horizontal exhaust conduit, air ducts formed in the bottom wall thereof and check valves for said ducts secured to said wall and other walls enclosing the check-valved openings constituting the air manifold for the engine.

5. A composite manifold structure for multi-cylinder two-cycle engines having piston-controlled air and exhaust ports, comprising a horizontal exhaust conduit secured to the cylinder block, a blower secured to the block below said conduit, the space between said blower and conduit constituting an air manifold, and air ducts formed in the wall of said conduit for passing air from said air manifold to the air ports.

6. A multi-cylinder engine comprising a row of two-cycle cylinders each having zones of piston-controlled air and exhaust ports, all of the ports of one of said zones being located on the side of its cylinder that is adjacent the next cylinder in the row and all of the ports of the other zone being located on the opposite side of the cylinder, and air and exhaust manifolds both located on the same side of the row and respectively in communication with said air and exhaust zones.

7. A multi-cylinder engine comprising a row of two-cycle cylinders each having zones of piston-controlled air and exhaust ports, all of the ports in one of said zones being located on the side of its cylinder that is adjacent the next cylinder in the row and all of the ports in the other zone being located on the opposite side of the cylinder, and air and exhaust manifolds both located on the same side of said row and respectively in communication with the air and exhaust-port zones of the several cylinders, said manifolds being incorporated in a composite header having a common dividing wall between them.

8. A multi-cylinder engine comprising a row of two-cycle cylinders each having zones of piston-controlled air and exhaust ports, all of the ports of one of said zones being located on the side of its cylinder that is adjacent the next cylinder in the row and all of the ports of the other zone being located on the opposite side of the cylinder, and a composite header secured to one side of said row containing air and exhaust manifolds respectively in communication with said air and exhaust zones.

9. A multi-cylinder engine comprising a row of two-cycle cylinders each having zones of piston-controlled air and exhaust ports, all of the ports of one of said zones being located on the side of

its cylinder that is adjacent the next cylinder in the row and all of the ports of the other zone being located on the opposite side of the cylinder, and a composite header secured to one side of said row containing air and exhaust manifolds in communication with said air and exhaust zones, and also containing valve structures controlling the communication.

10. A multi-cylinder engine comprising a row of two-cycle cylinders each having zones of piston-controlled air and exhaust ports, all of the ports of one of said zones being located on the side of its cylinder that is adjacent the next cylinder in the row and all of the ports of the other zone being located on the opposite side of the cylinder, and a header secured to one side of the row incorporating air and exhaust manifolds connected respectively with said zones, said header carrying non-return valves for the connections of the air manifold with said air port zones.

11. A multi-cylinder engine comprising a row of two-cycle cylinders each having zones of piston-controlled air and exhaust ports, all of the ports of one of said zones being located on the side of its cylinder that is adjacent the next cylinder in the row and all of the ports of the other zone being located on the opposite side of the cylinder, and a header structure secured to one side of the row incorporating air and exhaust manifolds respectively in communication with said air and exhaust zones, and containing and carrying timed exhaust valves adapted for terminating the exhaust outflow from the exhaust zones to the exhaust manifold.

12. A multi-cylinder engine comprising a row of two-cycle cylinders each having zones of piston-controlled air and exhaust ports, all of the ports of one of said zones being located on the side of its cylinder that is adjacent the next cylinder in the row and all of the ports of the other zone being located on the opposite side of the cylinder, air and exhaust manifolds both located on the same side of the row and respectively in communication through separate ducts with said air and exhaust zones, and valves contained in said manifolds governing all of said ducts.

13. A multi-cylinder engine comprising a row of two-cycle cylinders each having zones of piston-controlled air and exhaust ports, all of the ports in one of said zones being located on the side of its cylinder that is adjacent the next cylinder in the row and all of the ports in the other zone being located on the opposite side, said air ports being inclined so as to whirl the cylinder contents and the exhaust ports being inclined in the reverse sense, and air and exhaust manifolds both located on the same side of said row and respectively in communication with said air and exhaust-port zones.

14. A multi-cylinder engine comprising a row of two-cycle cylinders each having zones of piston-controlled air and exhaust ports, all of the ports in one of said zones being located on the side of its cylinder that is adjacent the next cylinder in the row and all of the ports in the other zone being located on the opposite side of the cylinder, and a header structure secured along one side of said row containing air and exhaust manifolds for said air and exhaust-port zones respectively and incorporating a rotary blower for supplying air to said air manifold.

15. A multi-cylinder engine comprising a row of two-cycle cylinders each having zones of piston-controlled air and exhaust ports, the air ports being individually inclined to their respective cylinder radii so as to whirl the cylinder contents about the cylinder axis and the exhaust ports being reversely individually inclined to their respective radii to facilitate that action, air and exhaust manifolds respectively in communication with said air and exhaust port zones and respectively provided with check-valved air ducts serving said air ports and timed-valved exhaust ducts serving said piston-controlled exhaust ports.

16. A multi-cylinder engine comprising a row of two-cycle cylinders each having zones of piston-controlled air and exhaust ports, all of the ports of one of said zones being located on the side of its cylinder that is adjacent the next cylinder in the row and all of the ports of the other zone being located on the opposite side of the cylinder, the air ports being individually inclined with respect to their respective radii to whirl the cylinder contents and the exhaust ports being individually inclined to their respective radii in the reverse sense.

RUDOLPH H. SCHNEIDER.