Nov. 10, 1959 J. LAMB 2,911,999

COMBINED STARTING AND RELIEF VALVES FOR INTERNAL COMBUSTION ENGINES

Filed March 7, 1956 4 Sheets-Sheet 1

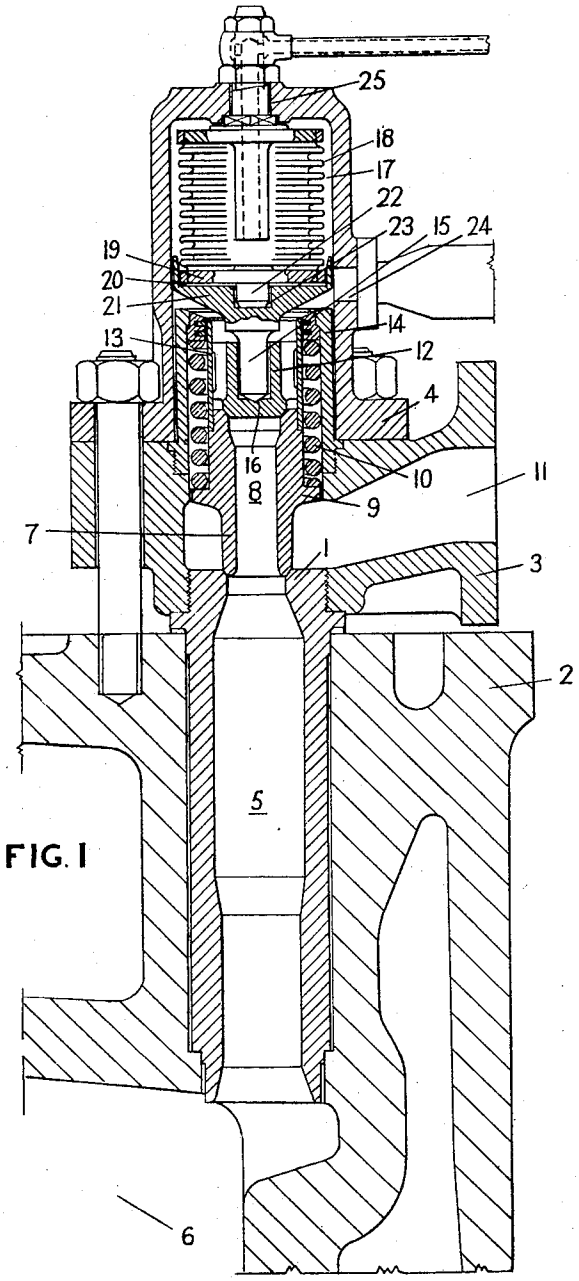


FIG. 1

INVENTOR

John Lamb

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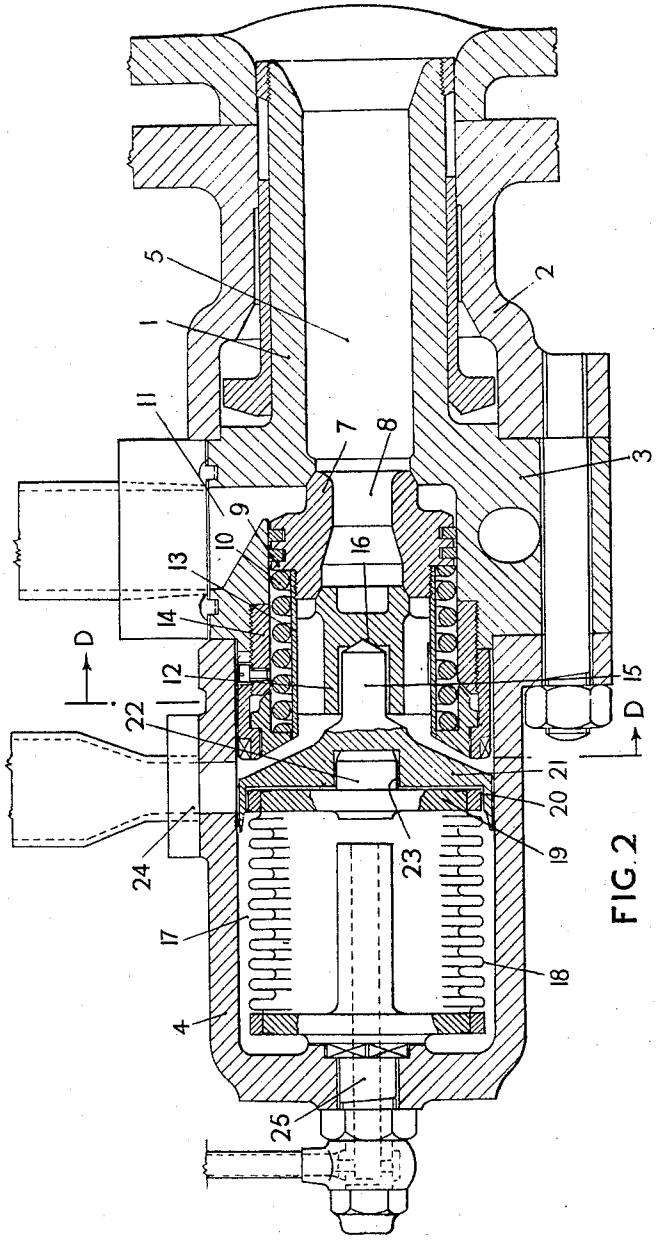


FIG. 2

INVENTOR

John Lamb

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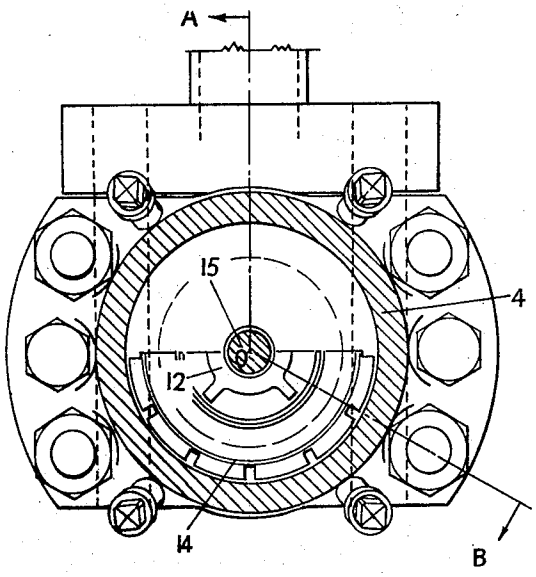


FIG.3

INVENTOR
John Lamb

Nov. 10, 1959 J. LAMB 2,911,999

COMBINED STARTING AND RELIEF VALVES FOR INTERNAL COMBUSTION ENGINES

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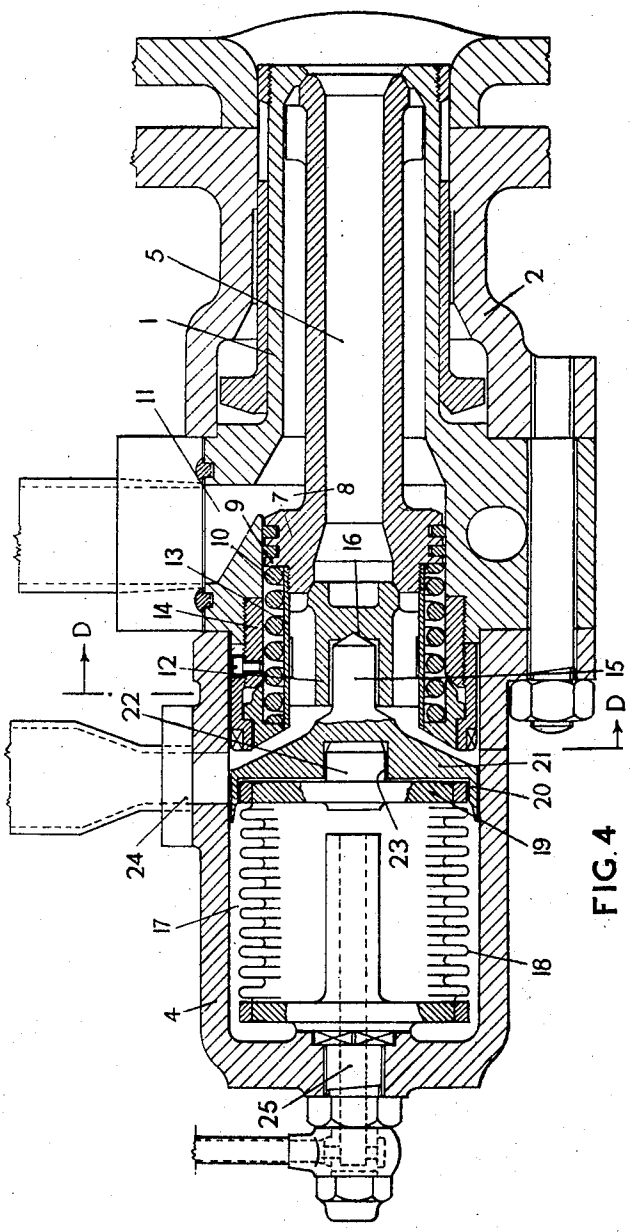


FIG. 4

INVENTOR

John Lamb

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2,911,999

COMBINED STARTING AND RELIEF VALVES FOR INTERNAL COMBUSTION ENGINES

John Lamb, London, England, assignor to John Lamb Publications and Inventions Limited, London, England, a British company

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Claims priority, application Great Britain March 8, 1955

3 Claims. (Cl. 137—506)

This invention is concerned with combined starting and relief valves for internal combustion engines and especially large internal combustion engines such as compression ignition engines. It should be mentioned that by large internal combustion engines we mean engines of a size too large conveniently to be set in motion manually, for example engines of about 100 H.P. and larger; such engines may have a single cylinder or may have more than one cylinder.

The present method of starting large internal combustion engines is to admit highly compressed air (termed starting air) into the working cylinders at a predetermined time in the cycle of operations. The timing of the admission and cut-off of the starting air is effected by cam means or by a piston-operated spring return type valve. When using a piston-operated spring return type valve compressed air (termed operating air) acts on the piston and opens the valve. The closing of the valve, and consequently the cut-off of starting air to the cylinder, is effected by a heavy spring when permitted by rotation of the cam, or by cutting off the supply of operating air as the case may be.

In conventional engines each cylinder is also provided with a separate escape valve to release excess pressure resulting from pre-ignition or other causes. These known escape valves are generally of the spring loaded type, although there is a type which is loaded by compressed air and which has several advantages over spring-loading. These advantages will be referred to hereinafter in this specification.

The above known method of starting large internal combustion engines and of providing for the release of excess pressure therefore entails the use of two entirely separate valves in each cylinder and of two pockets in which the valves can be accommodated. The greater the number of valve pockets the more intricate becomes the construction of the cylinder end covers. In the case of opposed piston engines the construction of the cylinder liner and cylinder water jacket is complicated as the number of valve pockets and valve openings is increased. This known construction therefore increases the liability of fracture due for example to heat and to pressure stresses.

It is an object of the present invention to provide an improved and novel construction of valve mechanism for large internal combustion engines especially compression ignition engines, in order to provide more simple and more reliable cylinder castings and to reduce manufacturing and maintenance costs.

The underlying idea of the present invention is to provide a single valve pocket within a cylinder and to provide a single opening in the cylinder wall to receive a combined starting and release valve adapted both to admit starting air and also to release excess pressure.

According to one aspect of the present invention there is provided an internal combustion engine having a single valve opening in each cylinder to receive a combined starting and relief valve adapted to admit pressure air to

the cylinder for starting the engine and also to release excess pressure during normal working and also to receive loading air for the valves, each of said valves normally being held on its seating by the loading air pressure.

The present invention is characterized by the provision of an axially flexible and compressible corrugated bellows member the interior of which receives loading air whereby the bellows may operate to hold both portions of the CSR valve on their respective seatings.

It will be understood that the combined starting and relief valve (hereinafter simply called the CSR valve) functions in effect as a single valve and that it therefore eliminates one valve per cylinder. The mechanism for starting and reversing an engine incorporating one or more than one CSR valve is more simple and less costly than those mechanisms now in use.

In a CSR valve in accordance with the present invention the relief portion of the valve operates substantially in a normal manner but may be loaded by compressed air instead of the usual heavy helical spring, while the starting portion of the valve is operated pneumatically but in a completely novel manner.

In a large internal combustion engine the CSR valve serves the following purposes:

(1) It admits starting air at the correct time and for the desired period in order to start the engine.

(2) It permits the escape of excess pressure when the engine is working on fuel.

(3) It vents the cylinder during the compression stroke and creates a vacuum in the cylinder on the working stroke, thus bringing the engine to rest quickly when the fuel supply is shut off.

In order that the invention may be clearly understood and readily carried into effect reference is now directed to the accompanying drawings given by way of example and in which:

Fig. 1 shows a CSR valve in longitudinal section as applied to a single piston engine;

Fig. 2 is a longitudinal sectional view of a CSR valve as applied to an opposed piston engine the section being taken on the line A.O.B. of Figure 3;

Fig. 3 is a cross-section taken on the line D.D. of Figure 2; and

Fig. 4 is a longitudinal sectional view equivalent to Figure 2 but illustrating a modified construction of CSR valve.

Referring now to Figure 1 of the drawings which illustrates a CSR valve for a single piston (per cylinder) type diesel engine it will be observed that a lower valve body section 1 of the valve housing is mounted in the cylinder head 2. A middle valve body section 3 is in screw threaded engagement with the section 1 and an upper valve body section 4 is bolted to the middle section 3. The lower section 1 of the body is formed as a tube with a central passageway or outlet port 5 opening at its lower end into the working cylinder 6. The passageway 5 forms an excess pressure relief passage for the cylinder 6 and also forms a starting air inlet passage.

The bore 5 is adapted to communicate with a sleeve valve 7 which forms a part of the starting portion of the CSR valve and which has an axial bore 8. The sleeve 7 has a flange 9 which forms a seating for a helical spring 10. The sleeve 7 sits in the seat at the mouth of the bore 5 and normally seals off the bore 5 from a starting air inlet port 11 formed in the side of the middle section 3 of the valve body. The upper end of the bore 8 of the sleeve 7 has a seat closed by a thimble valve member 12, forming a part of the relief portion of the CSR valve, and the closed end of which is adapted to co-act in a fluid-tight manner with a conical valve seat formed in the sleeve 7. Tubular members 13 and 14 as shown surround the thimble valve 12 and enclose the spring 10.

The lower end of a valve operating pin 15 projects into the bore of the thimble valve member 12 and ends in a conical point 16 bearing on the bottom of the bore in a corresponding conical depression. The upper end of the valve operating pin 15 extends into a cylindrical chamber 17 formed within the upper section 4 of the valve body.

The cylindrical chamber 17 accommodates the cylindrical bellows member 18 which may have a peripheral wall made of stainless steel or of 3-ply construction and is of a corrugated cross-section so as to be axially flexible and collapsible. The upper end of the bellows is fixed to the body section 4 and the movable lower end of the bellows is closed by a rigid disc 19 which is seated within a recess 20 in a piston 21 formed at the top of the operating pin 15. The disc 19 has a depending stem 22 which is sealed within a central recess 23 in the upper surface of the piston 21.

A gas escape or relief port 24 is provided in the side wall of the upper section 4 of the valve body and a loading air port 25 is provided at the top of the upper section 4 of the body.

As described above and as illustrated in Figure 1, the CSR valve may be situated in the cylinder head in an engine having a single piston per cylinder while in an opposed piston engine as illustrated in Figures 2 and 3 the CSR valves may be situated on the side of the cylinder casting. In the preferred construction of CSR valve see for example Figure 1 the thimble 12 of the relief portion of the valve is contained in the larger diameter starting portion of the valve. Both portions of the CSR valve are held on their respective seats and consequently in the closed position by compressed air acting through the loading air port 25 and inside the expandable and compressible corrugated bellows 18 which is illustrated situated above and in line with the two portions of the valve. The arrangement is such that the compressed air acting inside the bellows 18 exerts a downward pressure on the two portions of the CSR valve. An additional downward pressure is exerted on the starting portion only of the CSR valve by the helical spring 10 which is so proportioned that the load on the starting portion of the valve is greater than the load on the relief portion of the valve by an amount which will ensure that the relief portion of the valve may open or lift when required without unseating the starting portion of the valve.

The normal pressure of compressed air in the bellows may be in the region of a hundred pounds per square inch but if desired the pressure may be higher or lower, it being simply a matter of decreasing or increasing the diameter of the bellows 18 to produce the desired load on the relief portion of the valve which is normally about 800 pounds per square inch.

When the engine is working on fuel the compressed air pressure in the bellows 18 is maintained at a substantially constant value but when starting the engine the pressure in the bellows 18 of a CSR valve is caused to alternate from atmospheric pressure to the normal loading pressure which may be approximately 100 pounds per square inch. The pressure of the starting air is usually about 350 pounds per square inch. The pressure within the bellows 18 of a CSR valve when starting the engine is atmospheric for the period that the starting portion of the valve is required to be open for the admission of starting air into the cylinder through the starting air inlet port 11. The pressure in the bellows 18 is at about 100 pounds per square inch for the remainder of a cycle of operations that is to say for the period during which starting air is to be shut off. When starting air is admitted through the part 11, the air pressure acts on the underside of the flange 9 and lifts the sleeve 7 against the action of the spring 10 thus allowing the starting air to enter the cylinder through the passageway 5 to act upon the piston and set the engine in motion.

Referring now to Figures 2 and 3 there is illustrated a

CSR valve as applied to an opposed piston engine. The construction and operation of the CSR valve is essentially the same as in the embodiment described and illustrated in relation to Figure 1, the equivalent parts have been given the same references as in Figure 1 and it is believed that the construction and operation of the embodiment of Figures 2 and 3 will be readily understood.

In the embodiment according to Figure 4 the construction and operation is also similar to that previously described but in the construction illustrated in Figure 4 the starting air inlet part of the CSR valve is modified to the extent that the sleeve 7 is extended downwardly substantially to the end of the lower section 1 of the valve body so that the bore 5 is formed in the extension of the sleeve.

In the construction described above the starting portion of the CSR valve moves outward from the cylinder when opening. This is contrary to usual practice although there is no reason why a valve which opens outward should be less efficient than one which opens into the cylinder. All relief valves open outward and have proved satisfactory.

Although the invention is primarily applicable for the starting of large internal combustion engines known as compression ignition engines, it may be used with advantage for internal combustion engines inconveniently placed for starting by manual means.

What is claimed is:

1. A combined starting and relief valve adapted to control the admission of air under pressure to an internal combustion engine for starting of the engine and also to relieve excess pressure during the operation of the engine, including a valve housing having a chamber therein, an inlet port and an outlet port in communication with said chamber, a valve seat formed in the chamber at the entrance to said outlet port, a sleeve valve having a pressure responsive surface formed thereon exposed to inlet pressure and a seat at one end to cooperate with said valve seat, said sleeve valve being biased closed by a surrounding helical spring, said sleeve valve at its other end having a seat formed thereon, a cylindrical axially collapsible and expansible bellows member which is air loaded and which has one end fixed in said chamber to the valve housing and is movable at the other end, a relief port in communication with said chamber, a relief valve adapted to seat upon the seat formed upon the other end of said sleeve valve to control flow from the outlet port through the relief port, said relief valve being operatively connected to the movable end of said bellows member and biased closed by the air loading therein, said sleeve valve being held on its outlet port seat by the force of the helical spring and by the loading air of the bellows member acting on the sleeve valve through the medium of the relief valve.

2. The device as defined in claim 1 wherein said relief valve includes a thimble valve member engageable with said seat formed upon said other end of said sleeve valve, a piston operatively connected to the movable end of said bellows member, and an operating pin carried by said piston and operatively engaging said thimble valve member.

3. The device as defined in claim 2 wherein said thimble valve member is provided with a conical depression, said operating pin having a pointed end seated in said depression.

References Cited in the file of this patent

UNITED STATES PATENTS

1,122,008	Kramer	Dec. 22, 1914
1,122,009	Kramer	Dec. 22, 1914
1,523,716	Raymond	Jan. 20, 1925
2,342,301	Peters	Feb. 22, 1944
2,587,960	Bletcher	Mar. 4, 1952