T. G. SMITH
COMBINED INTERNAL COMBUSTION ENGINE AND AIR
COMPRRESSOR, AND CYLINDER HEAD THEREFOR
Filed April 13, 1934

Inventor.

Thomas G. Smith,

By

Baldwin Y. Wight

Patent drawings for combined internal combustion engine and air compressor, and cylinder head.
This invention relates to combined engine-compressors and to cylinder heads therefor. More particularly the invention relates to a cylinder head assembly for converting a conventional multicylinder internal combustion engine into a combined engine and compressor, and to the combination of such a cylinder head with the cylinders of a conventional internal combustion engine.

In accordance with my invention I provide a cylinder head assembly of novel form and construction adapted to replace the usual cylinder head of a multicylinder internal combustion engine and being so constructed as to cause one or more of the cylinders to function as engine cylinders and one or more as air compressor cylinders, the arrangement being such that the engine may be converted into an engine-compressor unit with a minimum of changes.

An object of my invention is to provide a cylinder head of the general character referred to above which is of simple and economical construction and which may be used economically to adapt a conventional engine for the purpose specified.

Another object is to provide a novel combination of cylinder head and engine cylinders in a combined engine and compressor.

A further object is to provide, in a combined engine-compressor, means for holding the poppet valves of one or more of the cylinders firmly on their seats for maintaining the associated cylinder passages closed. Other objects will become apparent from a reading of the following detailed description, the appended claims and the accompanying drawings in which:

Figure 1 is a view in side elevation of a four cylinder internal combustion engine with parts shown in section and with a cylinder head embodying my invention applied thereto;

Figure 2 is a longitudinal vertical sectional view of the upper part of a cylinder group and a head embodying the invention;

Figure 3 is a bottom plan view of a cylinder head embodying the invention;

Figure 4 is a perspective view of a cylinder head assembly embodying the invention, the assembly being viewed as from the back of Figure 1;

Figure 5 is a sectional view taken on the line 5-5 of Figure 2 and drawn on an enlarged scale;

Figure 6 is a sectional view taken on the line 6-6 of Figure 2 and drawn on an enlarged scale; and

Figure 7 is a detail sectional view taken on the line 7-7 of Figure 6. The invention is illustrated in the accompanying drawings to show a four cylinder internal combustion engine A which, in the form shown, is of the same general construction as the Ford Model A and Model B engine. A head B constructed and arranged in accordance with the invention is shown connected to the engine in Figures 1, 2, 5 and 6.

The engine A includes the usual four cylinder and piston groups 1, 2, 3 and 4, the cylinders of which are formed with the usual passages or ports 1", 2", 3" and 4" which in ordinary use as an engine provide for the admission of fuel to the cylinders and the exhausting of burnt products of combustion therefrom. The cylinders 1 and 4 at the opposite ends of the cylinder group are provided with the usual cam operated poppet valves associated with the ports 1" and 4" for controlling the admission of fuel charges to the cylinders 1 and 4 and the exhausting of the products of combustion therefrom. The construction and arrangement of the poppet valves associated with the cylinders 1 and 4 is conventional and therefore need not be illustrated or described in detail, it being understood that these valves are operated as is customary in engines of the Ford Model A and Model B type.

In accordance with the invention the cylinder passages 2" and 3", usually employed for controlling the inlet of fuel to and the exhaust of burnt gases from the middle cylinders 2 and 3, are maintained closed to adapt the cylinders 2 and 3 for use as air compressor cylinders and in order to prevent leakage of compression in these cylinders it is important that these passages be sealed tightly. In accordance with my invention this is accomplished effectively and economically by means of modified valve elements 2b and 3b which are formed from standard poppet valves by cutting off their stems at 2b and 3b, respectively. The push pin or cam followers 2r and 3r, being thus disconnected from the valve elements 2b and 3b are rendered ineffective and will merely rise and fall idly. The modified valve elements 2b, 3b are held down on their seats by the head B as will be explained more fully hereinafter. The head B includes a body section having end portions 5 and 6, the undersides of which are formed with piston clearance spaces 5a and 6a, respectively, and valve clearance spaces 5b and 6b, respectively, these spaces serving to permit a small amount of travel of the pistons in the associated cylinders 5 and 6 above the tops of the cylinders proper and also to permit operation of the poppet valves associated with the respective cylinders. The end portions 5 and 6 of the head body section are formed with water jacket spaces 5 and 6 and with spark plug openings 5d and 6d, respectively, the cylinders 5 and 6 being thus equipped with the usual and
necessary appurtenances for enabling these cylinders to function as internal combustion engine cylinders. Preferably the water jacket spaces are arranged to communicate with each other by means of a connection 56. Between its two ends the head body section is provided with portion 7 of reduced thickness intervening between the end portions 5 and 6 and on the underside of which are provided piston clearance spaces 8 and 9 for permitting the pistons in the cylinders 2 and 3 to travel somewhat above the associated cylinder proper. However, as will be noted from inspection of Figure 3, the intervening portion 7 of the head body section is not provided with valve clearance spaces and on the contrary this portion of the head is flat throughout with the exception of the piston clearance spaces 8 and 9, the flat marginal portion of the head resting directly upon the tops of the modified valve elements 22 and 23 and maintaining them tightly on their seats so as to provide tight sealing of the cylinders 2 and 3. The head body section may be secured to the cylinder group by means of the usual stud bolts 10.

The intervening portion 7 of the head is formed with inlet and outlet opening 80 and 90, respectively, located directly above the piston clearance space 8 and with inlet and outlet passages 8 and 9, respectively, located directly above the piston clearance space 9. These are the only passages in the cylinders 2 and 3 or the head capable of providing for the ingress and egress of air to and from the cylinder. In order to provide for the controlling of the ingress and egress of air to and from the cylinders 2 and 3 I have provided a separable head section B' adapted to be secured on the intervening portion 7 between the water jackets 65 and 66 and valve mechanism mounted in the head assembly. The separable section B' is formed with separate inlet passages 8 and 9 adapted to communicate respectively with the inlet passages 8 and 9 of the head body section; and is also formed with an outlet manifold chamber 89 and outlet opening 890 adapted to communicate with the cylinders 2 and 3 by means of the passages 8 and 9, respectively. Suitable valves are provided for controlling the flow of air from the passages 8 and 9 and through the passages 8 and 9 and from the passages 8 and 9 to the manifold chamber 89. Preferably, I employ "strip" valves which may for example be of the kind disclosed in the patent to MeYer, 1,919,883 of March 5, 1912. As embodied in an engine and compressor in accordance with my invention, the inlet valve for the cylinder 2 comprises a strip 82 of flexible material adapted normally to close the openings 8, but being capable of moving downwardly at its central portion when the piston in the cylinder 2 moves downwardly to permit a suction stroke. A cage or retainer 8' secured to the bottom side of the separable head section B' engage the ends of the strip 8' thereby holding the strip in operative position. One side of the retainer 8' is of an arcuate shape so as to permit downward flexing movement of the strip but to limit such movement to a predetermined extent. The inlet valve 94 associated with the cylinder 2 is of identical construction and arrangement. The outlet valve 99 associated with the cylinder 2 includes a strip 88 of flexible material adapted normally to close the opening 8 in the intervening section 7 of the head body portion but is capable of flexing upwardly intermediate its ends when the piston in the cylinder 2 performs an upward compressing stroke so as to uncover the opening 8' and to permit compressed air to be discharged into the manifold chamber 89. A cage or retaining element 98 is secured to the top face of the intervening portion 7 of the head body section and engages the end portions of the strip 98 for maintaining the latter in operative position. The bottom face of the retainer 98 is of arcuate form so as to permit upward flexing of the strip 98 intermediate its ends and also to limit such flex movement to a predetermined extent. The outlet valve 99 associated with the cylinder 3 is identical in construction and arrangement with the outlet valve 98. If desired unloaders such as those generally designated 82 and 98 may be provided for holding the intake valves 82 and 98 open so as to prevent compressing of air in the cylinders 2 and 3 and to thereby provide for light operation of the unit.

The firing order of a Model A or Model B engine is 1—2—4—3 and it is therefore preferable to employ the end cylinders 1 and 4 as the engine cylinders and the central cylinders 2 and 3 as the compressor cylinders. This arrangement has been found by test to provide evenly divided power strokes and a smoothly running engine-compressor unit. It has been found that the unit will run in balance with no more vibration than when operating purely as an engine with all four cylinders firing. To adapt the engine for operation as described above, it is necessary only to replace the standard equipment head with a head embodying my invention, to seal the usual cylinder passages of the two middle cylinders as for example by means of the arrangement of modified valve elements as described above, and to ground the high tension leads which otherwise would run from the distributor 10 to the spark plugs of cylinders 2 and 3. From the foregoing it will be apparent that by employing a cylinder head embodying the features described above and connecting it to an ordinary multi-cylinder engine in the manner explained, a very efficient self-driven compressor unit may be provided quite economically. The only changes to the engine which are made are the replacement of the cylinder passages associated with the two compressor cylinders. It is not necessary to make any changes in the timing mechanism or bearings. Practically all wearing parts are obtainable from automobile dealers and are therefore readily accessible to users who often are at points remote from dealers in parts for air compressors. Although the embodiment of the invention illustrated and described herein has been found to be practical under test conditions, it is the inventor, preferred by me, it will be understood that various changes will be made in the construction and relative arrangement of the parts without departing from the invention as defined in the claims.

I claim:

1. A combination, a multicylinder internal combustion engine piston and cylinder group having the usual cylinder ports; valves operatively associated with the ports of one of the cylinders whereby said cylinder will function as an internal combustion engine cylinder; valve elements adapted to seat and close the ports of one of the other cylinders, said last named cylinder being a compressor cylinder; a cylinder head mounted
on the cylinders of said group, said head being formed to provide clearance for operation of said engine cylinder valves, and said head engaging the valve elements associated with said compressor cylinder and maintaining them tightly on their seats; and air inlet and outlet passages in said compressor cylinder.

2. In combination, a multicylinder internal combustion engine piston and cylinder group having the usual cylinder ports; valves operatively associated with the ports of one of the cylinders whereby said cylinder will function as an internal combustion engine cylinder; valve elements adapted to seat and close the ports of the other cylinders, said last named cylinder being a compressor cylinder; a cylinder head means for all of said cylinders formed to provide clearance for operation of said engine cylinder valves, and said head engaging the valve elements associated with said compressor cylinder and maintaining them tightly on their seats; and valve air inlet and outlet passages in said compressor cylinder.

3. In combination, a four cylinder internal combustion engine piston and cylinder group, the cylinders having the usual ports; cam followers; valves operatively associated with certain of said followers and with the ports of the two end cylinders whereby said cylinders will function as combustion engine cylinders; poppet valve elements adapted to seat and close the ports of the two central cylinders, said valve elements being altered so as to have no operative connection with the cam followers; cylinder head means mounted on the cylinders, said head means being formed to provide clearance for operation of the valves associated with the end cylinder and said head engaging the poppet valve elements associated with said central cylinders and maintaining them tightly on their seats; and valve air inlet and outlet passages associated with said central cylinders.

4. In a combined air compressor and engine the combination of a plurality of piston and cylinder assemblies; a common crank shaft; engine operated valves associated with at least one of the cylinders; stationary valve elements associated with the ports of a second cylinder and serving to maintain said ports closed; cylinder head means for all of said cylinders formed to provide clearance for operation of said engine operated valves and engaging said stationary valve elements and maintaining them in port closing position; and valve air inlet and outlet passages in said head means and associated with said second cylinder.

5. A cylinder head assembly for converting a multicylinder internal combustion engine into a combined engine and air compressor comprising a body adapted to extend across and close the ends of the cylinders and being formed with air inlet and outlet passages extending through said body at the end of one of the cylinders; a separable head section secured to said body over said inlet and outlet passages; and strip valves operatively associated with said air inlet and outlet passages.

6. A cylinder head assembly for converting a multicylinder internal combustion engine into a combined engine and air compressor comprising a body adapted to extend across and close the ends of the cylinders and being formed with air inlet and outlet passages extending through said body at the end of one of the cylinders; a separable head section secured to said body over said inlet and outlet passages; and strip valves operatively associated with said air inlet and outlet passages.

7. A cylinder head assembly for converting a multicylinder internal combustion engine into a combined engine and air compressor comprising a body adapted to extend across and close the ends of the cylinders, said body being formed with water jacket sections over certain of the cylinders and having a non-water-jacketed portion over another cylinder; air inlet and outlet passages extending through said non-water-jacketed portion; a separable head section secured to said body over said non-water-jacketed portion and having air inlet and outlet passages adapted to communicate respectively with the inlet and outlet passages in said body; and valves operatively associated with said assembly for controlling such communication.

8. A cylinder head assembly for converting a multicylinder in-line internal combustion engine into a combined engine and air compressor comprising a body adapted to extend across and close the ends of the cylinders, said body being formed at its ends to provide ordinary internal combustion engine cylinder head portions for the two end cylinders, an intervening portion of said body being formed with air inlet and outlet passages extending through the body; a separable head section secured to said body and being provided with air intake and outlet passages adapted to communicate respectively with the passages in said body; and valves operatively associated with said passages for controlling such communication.

9. A cylinder head assembly for converting a four cylinder, in-line internal combustion engine into a combined engine and air compressor comprising a body adapted to extend across the ends of the cylinders, said body being formed at its ends with water jacketed combustion cylinder head portions for the end cylinders and being formed with an intervening portion of reduced thickness extending across the two central cylinders; a separable head section secured on said intervening portion and fitting between the water jackets of the end portions, said separable portion being formed with air intake passages extending through said central cylinders to communicate with the air intake passages in said intervening head portion; and air inlet and outlet valves mounted in said assembly for controlling the ingress and egress of air to and from said central cylinders.

10. In combination, a multicylinder internal combustion engine piston and cylinder group having the usual cylinder ports; valves operatively associated with the ports of one of the cylinders whereby said cylinder will function as an internal combustion engine cylinder; valve elements adapted to seat and close the ports of the other cylinders, said last named cylinder being a compressor cylinder; a cylinder head means mounted on the cylinders of said group, said head engaging the valve elements associated with said compressor cylinder and maintaining them tightly on their seats; and valve air inlet and outlet passages in said compressor cylinder.

THOMAS G. SMITH.