

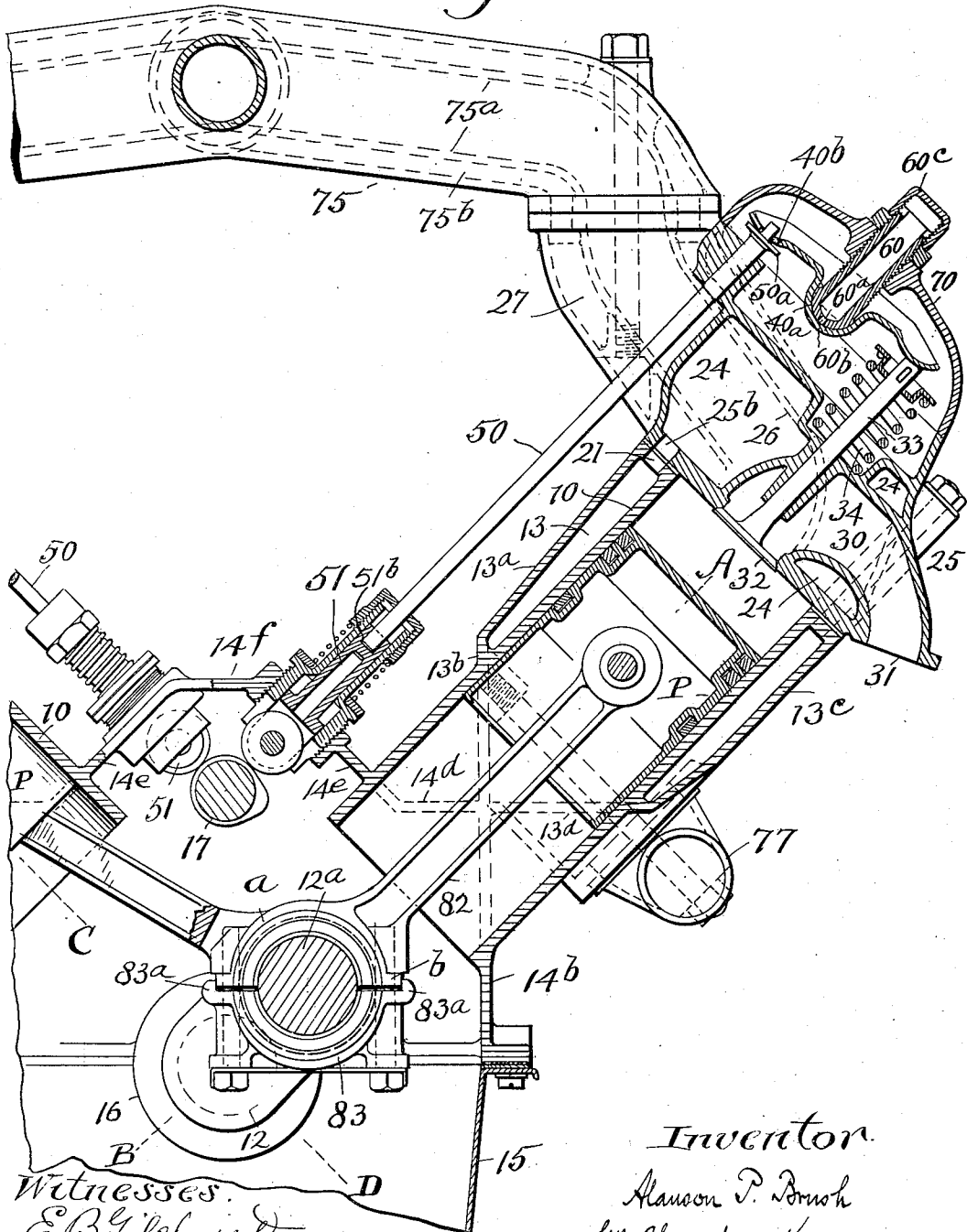
A. P. BRUSH.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED, NOV. 30, 1914.

1,250,426.

Patented Dec. 18, 1917.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses.
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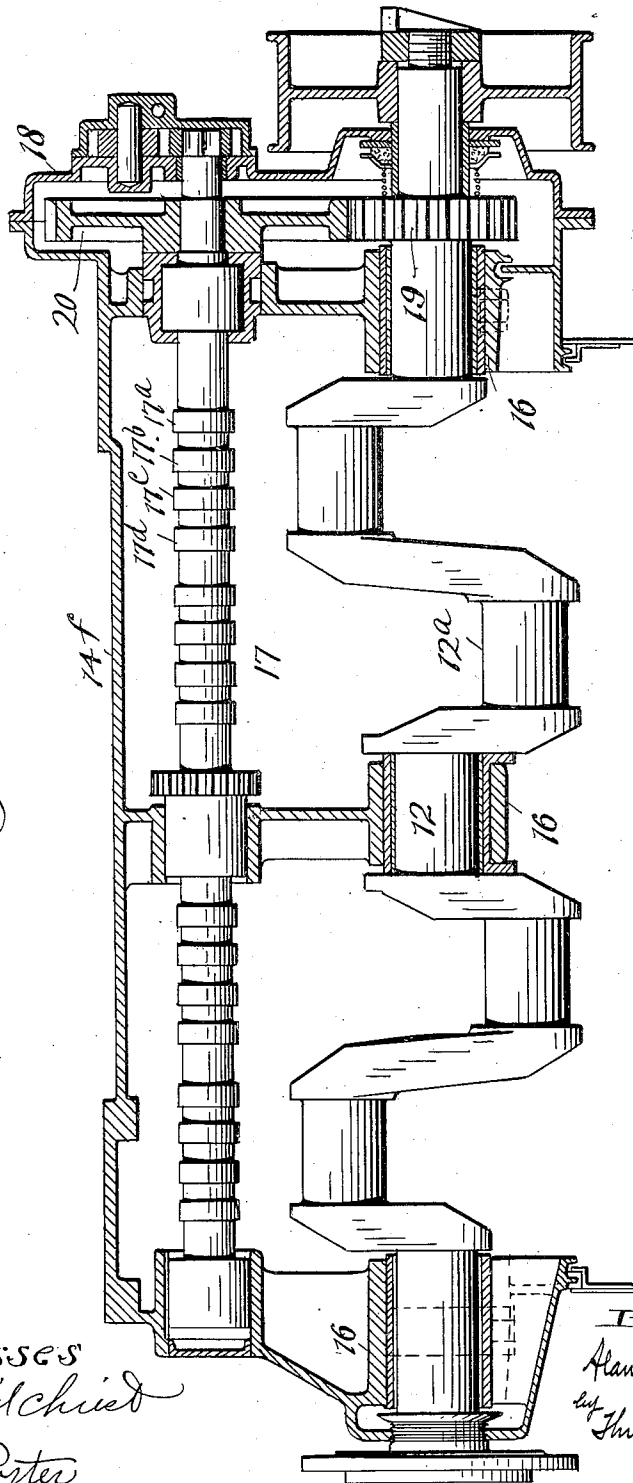
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Fig. 2.



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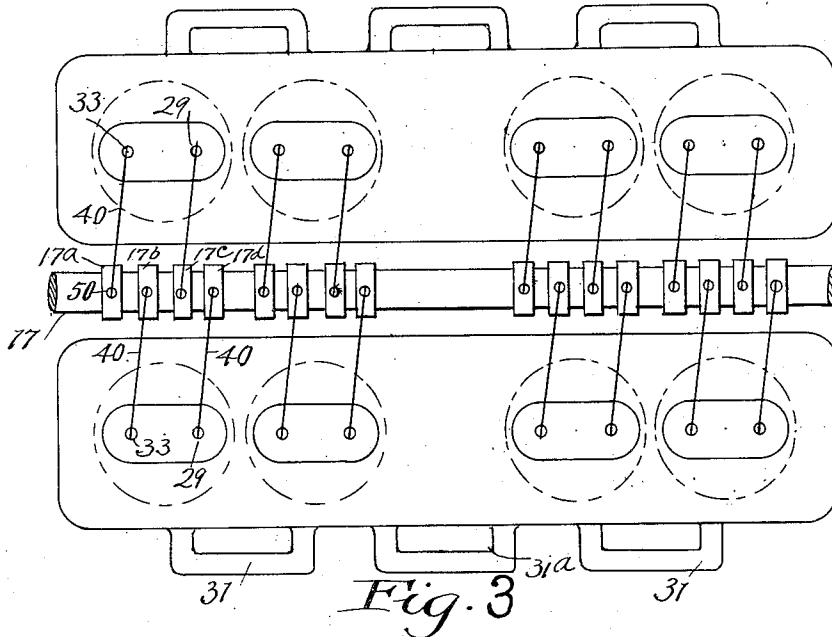
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Witnesses

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Fig. 4.

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UNITED STATES PATENT OFFICE.

ALANSON P. BRUSH, OF DETROIT, MICHIGAN.

INTERNAL-COMBUSTION ENGINE.

1,250,426.

Specification of Letters Patent.

Patented Dec. 18, 1917.

Application filed November 30, 1914. Serial No. 874,607.

To all whom it may concern:

Be it known that I, ALANSON P. BRUSH, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented a certain new and useful Improvement in Internal-Combustion Engines, of which the following is a full, clear, and exact description.

This invention relates to multi-cylinder internal combustion engines of the V-type; and particularly to the mechanism by means of which the valves of such engines will be operated in proper sequence. The objects are to provide valve operating mechanism in such form that it is not only efficient and relatively inexpensive in itself, but which also contributes to the reduction of cost of the engine.

The invention consists in the construction and combination of parts shown in the drawings and hereinafter described and pointed out definitely in the appended claims.

The accompanying drawings do not show a complete engine of the V-type, but they do show completely everything having to do with this invention which lies on one side of the central longitudinal vertical plane. So much of the engine as is shown on one side of this central plane is symmetrically duplicated on the other side thereof, and a part of said duplicated mechanism is shown in the drawing, wherefore the drawing thoroughly discloses the invention.

In the drawings, Figure 1 is a sectional front elevation through one cylinder and crank case and part of an opposed cylinder of an engine embodying the invention; Fig. 2 is a central vertical longitudinal section through the crank case and bearings for the crank shaft and cam shaft and it shows also these two shafts; Fig. 3 is a diagrammatic view showing the relative position of the cylinders of the engine, of the cam shaft, and cams thereon, and of the valves and operating mechanisms therefor; and Fig. 4 is a plan view of one of the removable head plates of the engine.

Certain parts of the engine which is shown in the above mentioned drawings and hereinafter described but not claimed have been made the subject matter of three applications which have been filed as divisions of this application, to wit:

Serial No. 28,455, filed May 15, 1915,
Serial No. 28,456, filed May 15, 1915,

Serial No. 29,743, filed May 22, 1915, which latter application resulted in Patent No. 1,188,405.

The invention and the various parts thereof are applicable to engines of the V-type, however many cylinders they may have. The invention is shown in connection with an eight cylinder engine. Four of the cylinders are in one row with their axes lying in the same inclined plane, and four other cylinders are in another row with their axes in the same inclined plane, which is at right angles to the first mentioned plane, and intersects it in a line which is coincident with the axis of the crank shaft 16. All of the cylinders are rigid with, and may be formed, as shown, integral with the upper half 14 of the crank case. The upper parts of all of the cylinders are surrounded by water jackets 13. The cylinders as shown are formed without heads; but the upper ends of all of the cylinders of each row are closed by a single head plate 25. The two head plates 25, as shown are exactly alike, and therefore interchangeable, merely by turning them end for end. The description of one head plate and its associated parts will therefore answer for both. Within each head plate are four cored out inlet ports 26, and four cored out exhaust ports 30, one inlet port and one exhaust port for each cylinder. The four inlet ports are merged together within the head plate as shown in dotted lines in Fig. 4, and are in communication with the tube 27 which projects inward to a point intermediate between the ends of the two head plates, and may be considered as a part of the inlet manifold. By "inward" is meant into the space between the two rows of cylinders. The exhaust ports 30 which are associated with the two end cylinders lead respectively to short projecting exhaust tubes 31 which project outward and are located at equal distances from the ends of the head. Two exhaust ports associated with the middle cylinders communicate with the exhaust tube 31^a which projects outward and is located midway between the ends of the head, and said tubes are constructed so that they may be conveniently connected with an exhaust manifold. These inlet and exhaust ports are surrounded within the head by water circulating space 24. Holes 25^b in the bottom of the head are formed in registering relation with holes 21 in the upper walls of the

water jackets 13, so that water may pass through said holes in the water circulating space in the head.

All of the described inlet and exhaust ports communicate through the bottom of the head plate with the cylinders, one inlet and one exhaust port for each cylinder.

An ordinary puppet valve is provided for closing the inner end of each inlet and each exhaust port. The valves may be all alike and are of familiar construction. One of the valves,—an exhaust valve 32 is shown in Fig. 1. It is provided with an upwardly extended stem 33 which is engaged by a spring 34 acting to close the valve. The inlet valves which as stated may be of precisely the same construction, have their upwardly extended stems indicated by 29.

All of the valves (eight) carried by a head plate are alined from end to end of said head plate, whereby the axes of the stems of all of said valves lie in the same inclined plane, which should be either parallel or coincident with the inclined plane which contains the axes of the cylinders of the associated row. This appears clearly in the diagrammatic Fig. 3, which also shows the position of the valve stems in the two heads with respect to each other, and to the cams on the cam shaft. The two exhaust valves associated with the two front cylinders one in each row are directly opposed to one another, that is to say, the axes of the stems of said valve are in the same vertical plane which is at right angles to the axis of the cam shaft. All of the other valves of each head are similarly placed with respect to the corresponding valve in the other head.

The operating means associated with each valve is, generally speaking, of familiar form, and is known as overhead valve mechanism. It includes a pivoted rocker 40 which engages at one end with the associated valve stem, and engages at its other end with the upper end of a valve push rod 50, which as shown is composed of the push rod proper, and tappet rod 51 which engage endwise with each other. The lower part of said push rod, viz., the tappet rod, engages directly a cam on the cam shaft 17. The cam shaft 17 is parallel with the crank shaft 12. It is mounted in bearings in the crank case 14, and is driven from the cam shaft by any suitable or well known mechanism. On this cam shaft are as many cams as there are valves associated with both cylinders.

These cams are divided into groups of four; each of said groups being associated with two opposite cylinders in the two rows. The first and third cams 17^a and 17^c of each group are associated respectively with the exhaust and inlet valves of a cylinder in the left hand row, while the second and

fourth cams 17^b, 17^d, of each group are respectively associated with the exhaust and inlet valves of the opposed cylinder in the right hand row. Each cam is engaged directly by a part, which may as shown be a roller 51^a, of an endwise movable tappet rod 51. The several tappet rods project through and are slidably mounted in the wall of the crank case. Each tappet rod is associated with an endwise movable push rod 50 which is alined with the tappet rod, the lower end of the push rod resting upon the tappet rod. As shown, the push rod projects into a socket 51^b in the upper end of the tappet rod and thereby the alinement of the adjacent ends of these two parts is preserved. While the two rods 50, 51, are shown disconnected and relatively movable, this is not at all necessary, the two rods are in effect a push rod which is moved endwise by a cam, and in turn engages and rocks a rocker.

It is to be noted that none of the four push rods associated with two opposed cylinders are in the same vertical plane, which includes the axes of said two cylinders. In fact, it would be impossible for all of the four push rods to be in this plane if they are to engage directly with the four associated cams on the cam shaft; and it is one of the objects of this invention to bring about this direct engagement, thereby eliminating the adjunctive part, such as levers, which it has heretofore been customary to interpose between some of said rods and the operating cams therefor.

Each of the push rods adjacent to its upper end engages with the lower face of a pivoted rocker 40, which at its other end engages the upper end of the associated valve stem. These rockers do not lie in a vertical plane which is at right angles to the crank shaft, but on the contrary, they extend from the associated valve stems toward the associated push rods in directions which are oblique to said vertical plane. The rockers associated with one row of cylinders extend obliquely toward the front end of the engine from their associated valve stems to the associated push rods; while the rockers associated with the other row of cylinders extend obliquely toward the rear end of the engine from the associated valve stems to the associated push rods. As a result, the rockers associated with both rows of cylinders are substantially parallel, as appears in diagrammatic Fig. 3. If the said rockers were not positioned as described and shown, the two head plates could not be made interchangeable as before described.

Since the rockers are disposed obliquely as stated, it is quite obvious that their fulcrums can not be alined from end to end of the head plate. To provide a pivot for each rocker and disalined bearings for the pivots

of the several rockers would be expensive. In order that these rockers 40 may be positioned as stated, and rendered effective, each rocker may be substantially U-shaped in vertical section; and it is provided about
 5 midway between its ends with a one-direction bearing preferably in the form of a spherically concave socket 40^a, which receives the spherical end 60^a of a fulcrum
 10 stud 60. All of these studs are adjustably secured to a cap 70 which is removably bolted to the head plate over the valves. Each stud is screwed through the top of the cap, and is therefore adjustable. Preferably
 15 each stud is hollow so that it may serve as a lubricant well; and in that event must have one or more holes 60^b through its spherical inner end. The lubricant may be put into this well, and the stud closed by a
 20 screw plug 60^c; and the lubricant may flow out through said hole and directly onto the engaging surfaces of the rocker and stud. These rockers are of such shape that they may be formed from pressed steel, and preferably they are so made.

The lower surface of one end of each rocker is convex and engages the upper end of the associated valve stem. The lower surface of the other end of the rocker is
 25 likewise convex for engagement with an enlarged shoulder 50^a just below the upper end of the associated push rod 50. In the end of the rocker which engages this shoulder there is a slot 40^b through which the upper
 30 end of the associated push rod projects. This slot facilitates the proper assembling of the rockers with respect to the valve push rods and fulcrum studs. To effect this result the several rockers are hung on the ends
 35 of the push rods, that is, the push rods are allowed to project through the slots 40^b. The other ends of said rockers are then placed in engagement with the ends of the valve stems. Then when the cap 70 is put
 40 on all the fulcrum studs 60 will enter the spherical sockets 40^a. The said studs by reason of their engagement with the spherical socket 40^a, and the valve rod by reason of
 45 their passage through the slot 40^b will keep the rockers in the oblique operative positions shown, which they must occupy to operatively engage the several valve stems.

Having described my invention, I claim:

1. In a multi-cylinder internal combustion
 55 engine, the combination of two rows of cylinders arranged in V-form, that is to say, in two angularly disposed rows, each cylinder being provided with an inlet and an outlet valve, and the said valves associated with
 60 each row of cylinders being all in alinement from one end of the row to another, a crank case common to all of said cylinders, a crank shaft rotatably mounted in said crank case, a single cam shaft which is also rotatably
 65 mounted in said crank case and is provided

with as many cams as there are valves associated with both rows of cylinders, a push rod associated with and engaging directly
 70 with each cam, a valve rocker for each valve which engages at one end with the associated valve stem and is engaged at the other end by the associated push rod, each of said
 75 valve rockers being disposed obliquely with respect to the line which passes through all of the valve stems of the associated row of cylinders.

2. In a multi-cylinder internal combustion engine, the combination of two rows of cylinders arranged in V-form, a crank case which is common to all of said cylinders, a
 80 single cam shaft which is rotatably mounted in said crank case and which has as many cams as there are valves to all of the cylinders, an inlet valve and an exhaust valve for each cylinder, all of the valves associated
 85 with the cylinders of each row being arranged in alinement from one end to the other of said row, push rods which severally engage said cams on the cam shaft, and a plurality of valve rockers each of which
 90 engages at one end with a valve stem and at the other end with a push rod, all of the rockers associated with each row of cylinders being parallel with one another and being oblique with respect to the line in
 95 which the associated valve stems lie.

3. In a multi-cylinder internal combustion engine in combination, two rows of cylinders arranged in V-form all of the cylinders of each row being directly opposite the
 100 corresponding cylinder in the other row, a crank case common to all of said cylinders, a cam shaft which is rotatably mounted in said crank case and is common to all of said cylinders and which carries twice as many
 105 cams as there are cylinders, an inlet valve and an outlet valve for each cylinder,—all of the valves for the cylinders in either row being arranged in line from the front to the rear end of said row, an endwise movable
 110 push rod engaging each cam, pivoted rockers each of which at one end engages a valve stem and at the other end engages an associated push rod, each of said rockers having
 115 at that end which engages said push rod a slot through which the end of the push rod passes and each push rod having below said rocker a flange with which said rocker engages.

4. In a multi-cylinder internal combustion
 120 engine the combination of two rows of cylinders arranged in V-form, a cam shaft which is common to both rows of cylinders and which carries twice as many cams as there are cylinders, an inlet valve and an
 125 outlet valve for each cylinder, all of the valves for the cylinders in either row being arranged in line from front to rear of said row, an endwise movable push rod engaging each cam, a pivoted rocker which at one
 130

end engages a valve stem and at the other end engages a push rod,—each rocker having in that end which engages said push rod a slot through which the end of the push rod passes and each push rod having below said rocker a flange with which said rocker engages, the fulcrum of each rocker being a one-direction bearing which extends downward into engagement with said rocker from a fixed overhead part of the engine.

5. In a multi-cylinder internal combustion engine the combination of two rows of cylinders arranged in V-form, a cam shaft which is common to both rows of cylinders and which carries twice as many cams as there are cylinders, an inlet valve and an outlet valve for each cylinder, all of the valves for the cylinders in either row being arranged in line from front to rear of said row, an endwise movable push rod engaging each cam, a pivoted rocker which at one end engages a valve stem and at the other end engages a push rod, a cap for each row of cylinders removably secured thereto over said rockers, and a plurality of fulcrums fixed to and projecting downward from said cap into engagement with the several rockers whereby said rockers are fulcrumed.

6. In a multi-cylinder internal combustion engine the combination of two rows of

cylinders arranged in V-form, a cam shaft which is common to both rows of cylinders and which carries twice as many cams as there are cylinders, an inlet valve and an outlet valve for each cylinder, all of the valves for the cylinders in either row being arranged in line from front to rear of said row, a plurality of push rods, one for each cam, and a pivoted rocker for each valve,—each rocker engaging at one end with a valve stem and at its other end with the associated push rod, all of said rockers of one row being parallel to each other and being extended from their associated valves toward the front of the engine at an angle to the line which passes through all of the valve stems in the said row, and all of the rockers in the other row being parallel with each other and with the rockers of the first mentioned row and being extended from their associated valves toward the rear of the engine at an angle to the line which passes through the valve stems of the associated row.

In testimony whereof, I hereunto affix my signature in the presence of two witnesses.

ALANSON P. BRUSH.

Witnesses:

E. L. THURSTON,

L. I. PORTER.