J. HENDERSON.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED OCT. 8, 1917.

1,352,127.

Patented Sept. 7, 1920.

2 SHEETS—SHEET 1.

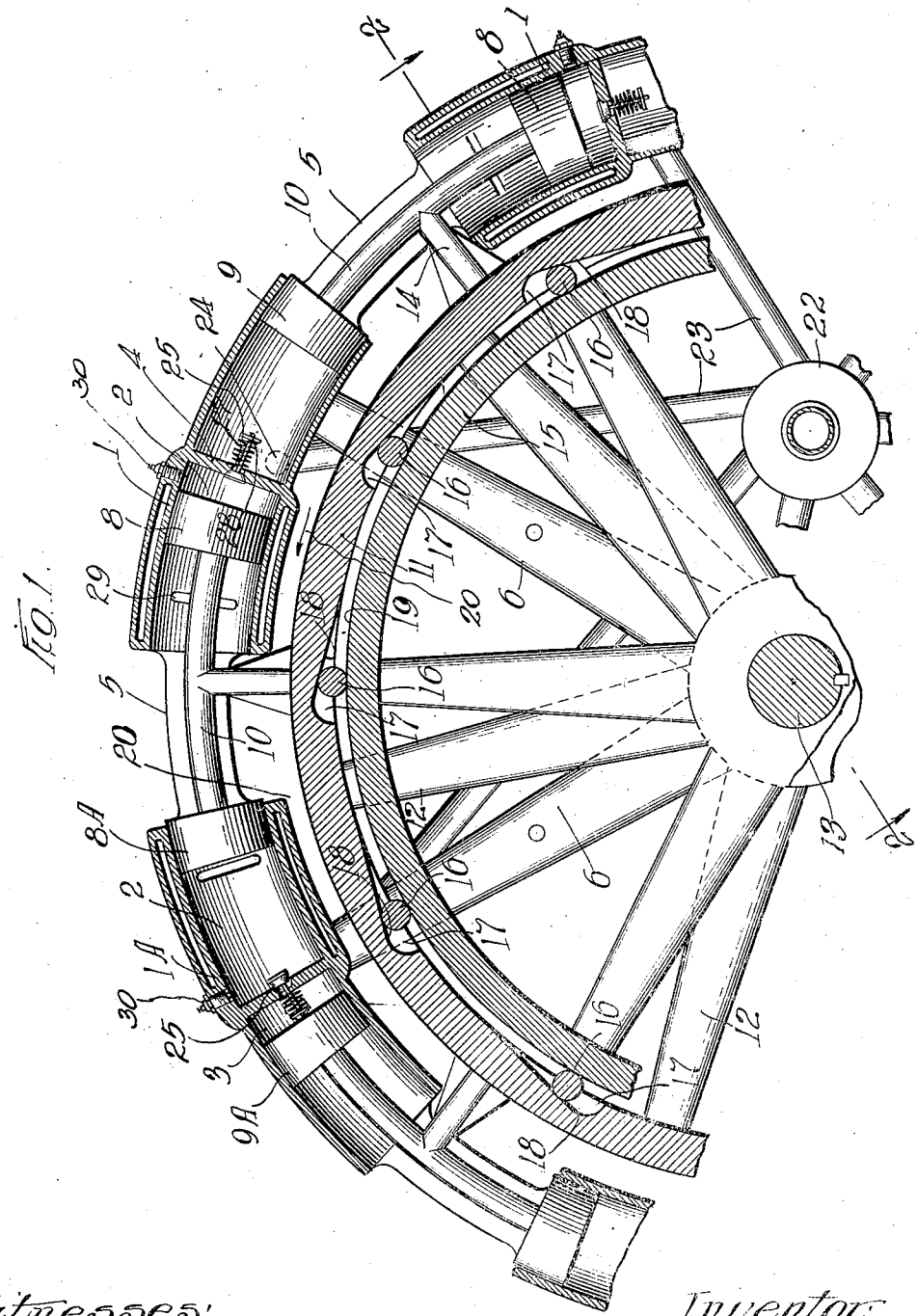


FIG. 1.

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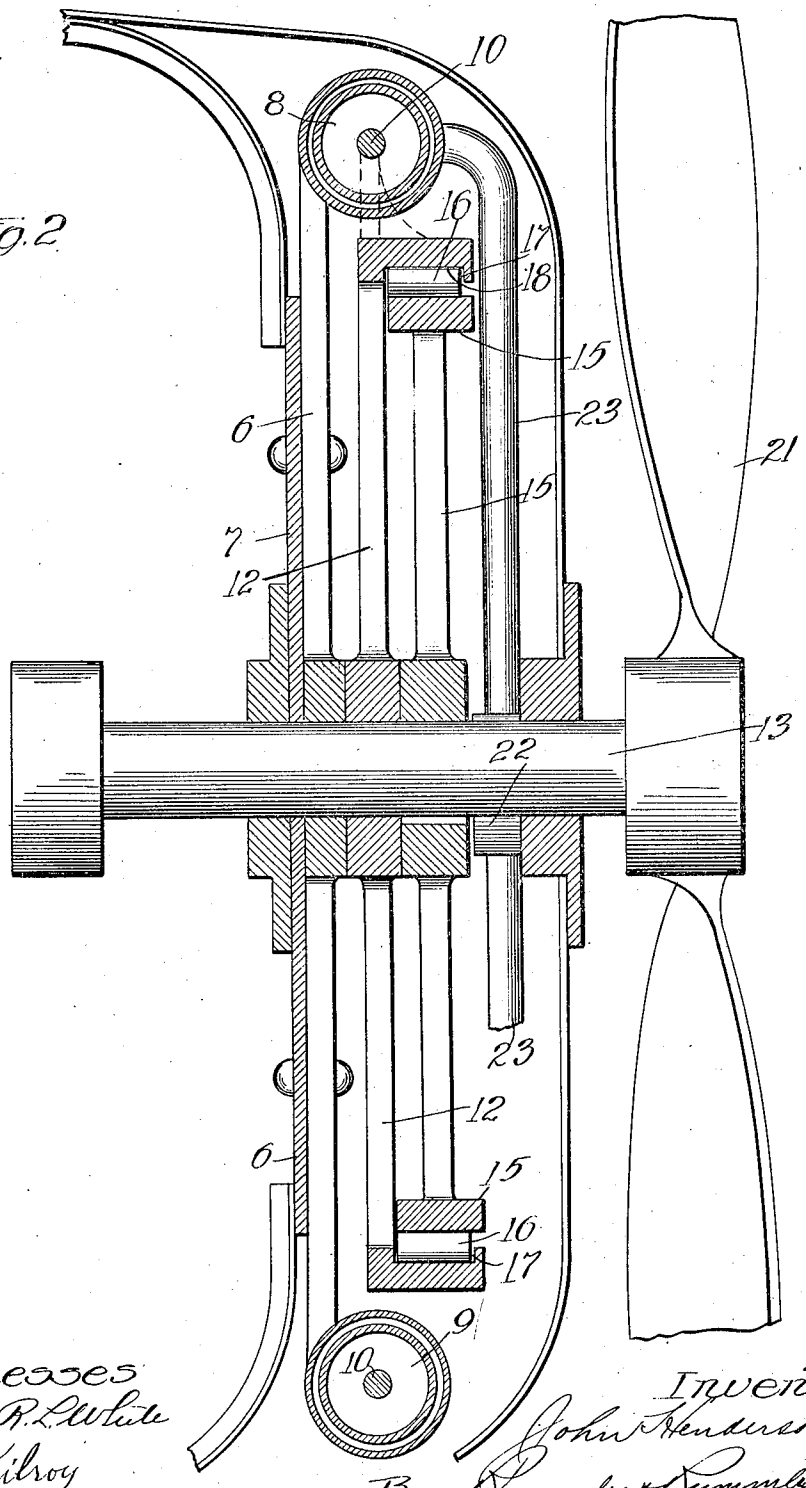
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2 SHEETS—SHEET 2.

Fig. 2



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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

1,352,127. Specification of Letters Patent. Patented Sept. 7, 1920.

Application filed October 8, 1917. Serial No. 195,341.

To all whom it may concern:

Be it known that I, JOHN HENDERSON, subject of the King of Great Britain, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

The main objects of this invention are to provide an improved form of internal combustion engine; to provide an improved construction and arrangement of the cylinders and pistons in the formation of a multi-cylinder unit; to provide an improved construction and arrangement of the working and pumping chambers for an engine of the two-cycle type; to provide an improved connection of the pistons for controlling the compression and expansion of fuel gases; to provide improved means for converting the oscillating movement of the pistons into a rotary movement; and to provide an improved construction and arrangement of the parts of engines and pumps in general.

An illustrative embodiment of this invention is shown in the accompanying drawings in which—.

Figure 1 is a diagrammatic front sectional elevation of a segment of an engine unit embodying this invention.

Fig. 2 is a diagrammatic side sectional elevation taken on the line 2—2 of Fig. 1.

A structure embodying this invention comprises a plurality of cylinders arranged in a circle with the axes thereof in circumferential alinement and with the pistons thereof connected to an oscillating member whereby they will act in unison, the oscillating member being connected by suitable ratchet mechanism with a rotor whereby the movement of the oscillating member in one direction will cause the rotor to rotate in a corresponding direction, and the movement of the oscillating member in the opposite direction will be free of the rotor.

The specific embodiment herein shown is designed to operate on the two-cycle principle which is well known in internal combustion engine construction. Accordingly the cylinders 1 are each formed with an expansion chamber 2 and a pumping chamber 3 separated by a wall 4.

The cylinders 1 are arranged in a circle with the axes thereof in circumferential alinement with each other and, with the exception of one cylinder, disposed so that with regard to adjacent cylinders the expansion chambers 2 are opposed to the pumping chambers 3. The adjacent cylinders are rigidly connected together by webs 5 and are also rigidly secured to a spider formation 6 by means of which they are rigidly mounted to a base member or plate 7.

Pistons 8 are reciprocatingly mounted in the expansion chambers 2 and other pistons 9 are similarly arranged in the pumping chambers 3. The pistons in opposed chambers of adjacent cylinders 1 are connected together by an arcuate-shaped arm or bar 10.

The one cylinder which, as hereinbefore explained, is not arranged in accordance with the others, is cylinder 1^A, which is disposed in the opposite manner from the other cylinders. That is, the expansion chamber 2 is opposed to the expansion chamber of the adjacent cylinder on one side and the pumping chamber 3 is opposed to the pumping chamber of the adjacent cylinder on the other side. The purpose of this arrangement, as will more fully hereinafter appear, is to provide for the return movement of the pistons after they have completed their expansion stroke.

The reciprocating mechanism by which the pistons 8 and 9 are caused to travel back and forth in their respective chambers in unison comprises a ring-shaped member 11 carried at the ends of spokes 12 by which the ring is journaled on a shaft 13, the axis of which is coincident with the axis around which the cylinders 1 are arranged. Arms 14 rigidly carried on the ring 11 are connected to the arms or bars 10 whereby all of the pistons are connected with the ring 11 and are caused to move in unison.

The ratchet mechanism by which the oscillating movement of the ring 11 is transferred to the rotating member 15, comprises a plurality of rollers 16 located in pockets 17 formed in the face of ring 11 which is opposed to rotating member 15. These pockets are formed with inclined faces 18 so that the rollers 16 are adapted to bind between said inclined faces and the face 19 of the rotating member 15 when the ring 11 moves in the direction of the arrow 20, whereby the ring 11 and member 15 are temporarily locked together. When the ring moves in the opposite direction the rollers are released so that the ring 11 moves free of the member 15. It will thus be observed

that the oscillation of the ring 11 under the action of the pistons 8 causes an intermittent driving of the member 15.

The member 15 is keyed to the shaft 13 upon which the driving member, herein shown in the form of a propeller 21, is mounted.

A common source of fuel supply, such as a carbureter 22, is located adjacent to the cylinders 1 and is connected by pipes 23 to the inlets 24 in the respective pumping chambers 3.

Communication between the respective pumping chambers 3 and the expansion chambers 2 of cylinders 1 is afforded by a passage 25 controlled by a valve 26. A spring 27 normally urges the valve into its closed position and the stem 28 thereof is arranged so that through its engagement with the piston 9 the opening and closing of the passage 25 is controlled as is indicated in cylinder 1^A, Fig. 1.

The expansion chambers 2 are provided with suitably arranged exhaust ports 29 and with the usual form of spark plugs 30.

The operation of the device shown is as follows:

The pistons 8, in all but the cylinder 1^A, move forwardly in the direction of the arrow 20 under the influence of expanding gases ignited by the spark plugs 30. The ring 11, moving with the pistons, transmits a corresponding motion to the member 15 through the rollers 16, as hereinbefore explained. As the pistons 8 thus move forward, the pistons 9, with the exception of that in cylinder 1^A, are moved forward in their corresponding chambers 3 so as to compress the fuel therein, preparatory to transferring it into the chambers 2. As the pistons 8 approach the limit of their forward strokes, the ports 29 are uncovered and the burnt gases exhausted. At the same time the pistons 9 engage the valve stems 28 and open the passages 25 so that the compressed fuel in the chambers 3 is admitted to the chambers 2. The opening of the valves 28 is so timed that the entrance of the fuel gases into the chambers 2 occurs while the ports 29 are still partially uncovered so as to effect the usual scavenging required in two-cycle engines.

The cylinder 1^A being disposed opposite to the other cylinders, the cycle of operations is just the reverse of that for the other cylinders, so that as the pistons 8 in all but cylinder 1^A reach the limit of their forward movement, the piston 8^A has completed the compression of fuel gases in the cylinder 1^A, and which are ignited so as to drive the piston 8^A in a direction opposite to the arrow 20 and force the pistons 8 to compress the fuel gases in their respective chambers 2.

As the cylinders 8 are thus moved to compress the gases in their respective cylinders, the ring 11 is moved in a direction opposite to the arrow 20 and the pistons 9 are retracted so as to draw in a quantity of fuel gas into the chambers 3 preparatory to again compressing it for transfer to the chambers 2. When the pistons 8 have completed their full return stroke, ignition takes place and they are again driven forward in the direction of the arrow 20 so that the cycle of operations just explained is repeated.

As the cylinders 8 are being moved in the direction opposite the arrow 20 to compress the gases, the piston 9^A is being moved so as to compress the gases in its respective pumping chamber and transfer them into the chamber 2 preparatory to being compressed as the piston 8^A is returned through the movement of the pistons 8.

Although but one specific embodiment of this invention has been herein shown and described, it will be understood that numerous details of the construction shown may be altered or omitted without departing from the spirit of this invention as defined by the following claims. For the purpose of conciseness and clearness, I have confined the foregoing description to a specific example of the application of the invention to an internal combustion engine of the "two-cycle" type, but it will be readily seen that many of the features of construction herein shown are applicable to other types of heat engines, pumps, and compressors.

I claim:

1. In an internal combustion engine, the combination of a plurality of cylinders, each comprising a pumping chamber and an expansion chamber, said cylinders being arranged in a circle and disposed with the pumping chamber of one cylinder opposed to the expansion chamber of the adjacent cylinder, means providing communication between the adjacent pumping and expansion cylinders for transferring gas from one to the other, pistons in said chambers, means connecting the pistons in opposed chambers, an oscillating member connected to said piston-connecting means, a rotating member, and means connecting said oscillating member with said rotating member.

2. In an internal combustion engine, the combination of a plurality of cylinders, each comprising a pumping chamber and an expansion chamber, said cylinders being arranged in a circle and, except one, all disposed with the pumping chamber of one cylinder opposed to the expansion chamber of the adjacent cylinder, said one cylinder being arranged with its expansion chamber directed in a direction opposite that of the expansion chamber of the other cylinders and with its pumping chamber correspondingly arranged with regard to the pumping chambers of said other cylinders, means providing communication between the pump-

ing chambers and the respective expansion chambers for transferring gas from one to another, pistons in said chambers, means connecting the pistons in opposed chambers, an oscillating member connected to said piston-connecting means, a rotating member, and means connecting said oscillating member with said rotating member.

3. In an internal combustion engine, the combination of a plurality of cylinders, each comprising a pumping chamber and an expansion chamber, said cylinders being arranged in a circle and disposed with the pumping chamber of one cylinder opposed to the expansion chamber of the adjacent cylinder, pistons in said chambers, means connecting the pistons in opposed chambers, an oscillating member connected to said piston-connecting means, a rotating member, means connecting said oscillating member with said rotating member, a common source of fuel supply connected with each of said pumping chambers, and valve mechanism controlling communication between the pumping chamber of each of said cylinders and its respective expansion chamber.

4. In an internal combustion engine, the combination of a plurality of cylinders, each comprising a pumping chamber and an expansion chamber, said cylinders being arranged in a circle and disposed with the pumping chamber of one cylinder opposed to the expansion chamber of the adjacent cylinder, pistons in said chambers, means connecting the pistons in opposed chambers, an oscillating member connected to said piston-connecting means, a rotating member, means connecting said oscillating member with said rotating member, a common source of fuel supply connected with each of said pumping chambers, and valve mechanism controlling communication between the pumping chamber of each of said cylinders and its respective expansion chamber, the operation of said valve mechanisms being regulated by the respective pumping pistons.

5. In an internal combustion engine, the combination of a plurality of cylinders, each comprising a pumping chamber and an expansion chamber, said cylinders being arranged in a circle and disposed with the pumping chamber of one cylinder opposed to the expansion chamber of the adjacent cylinder, means providing communication between the pumping chambers and the respective expansion chambers for transferring gas from one to another, pistons in said chambers, means connecting the pistons in opposed chambers, an oscillating member connected to said piston-connecting means, a rotating member, ratchet mechanism connecting said oscillating member with said rotating member, whereby the movement of said oscillating member in one direction will cause the rotation of said rotating member in the same direction and the movement of said oscillating member in the opposite direction will be free of said rotating member, all being arranged to oscillate said oscillating member and thereby rotate said rotating member.

6. In an internal combustion engine, the combination of a plurality of cylinders, each comprising a pumping chamber and an expansion chamber, said cylinders being arranged in a circle and disposed with the pumping chamber of one cylinder opposed to the expansion chamber of the adjacent cylinder, means providing communication between the pumping chambers and the respective expansion chambers for transferring gas from one to another, pistons in said chambers, means connecting the pistons in opposed chambers, an oscillating member and a rotating member concentrically journaled relative to each other and to said cylinders, means connecting said oscillating member with said pistons, said oscillating member having pockets formed in the face thereof opposed to said rotating member, and rollers arranged in said pockets and adapted to bear between said members so as to constitute ratchet mechanism, whereby the movement of said oscillating member in one direction will cause the rotation of said rotating member in a corresponding direction and the movement of said oscillating member in the opposite direction will be free of said rotating member, all being arranged to oscillate said oscillating member and thereby rotate said rotating member.

7. In an internal combustion engine, the combination of a plurality of cylinders, each comprising a pumping chamber and an expansion chamber, said cylinders being arranged in a circle and, except one, all disposed with the pumping chamber of one cylinder opposed to the expansion chamber of the adjacent cylinder, said one cylinder being arranged with its expansion chamber directed in a direction opposite that of the expansion chamber of the other cylinders and with its pumping chamber correspondingly arranged with regard to the pumping chambers of said other cylinders, means providing communication between the pumping chambers and the respective expansion chambers for transferring gas from one to another, pistons in said chambers, means connecting the pistons in opposed chambers, an oscillating member connected to said piston-connecting means, a rotating member, and ratchet mechanism connecting said oscillating member with said rotating member, whereby the movement of said oscillating member in one direction will cause the rotation of said rotating member in the same direction and the movement of said oscillating member in the opposite direction will be free of said ro-

tating member, all being arranged to oscillate said oscillating member and thereby rotate said rotating member.

8. In an internal combustion engine, the combination of a plurality of cylinders, each comprising a pumping chamber and an expansion chamber, said cylinders being arranged in a circle and, except one, all disposed with the pumping chamber of one cylinder opposed to the expansion chamber of the adjacent cylinder, said one cylinder being arranged with its expansion chamber directed in a direction opposite that of the expansion chamber of the other cylinders and with its pumping chamber correspondingly arranged with regard to the pumping chambers of said other cylinders, means providing communication between the pumping chambers and the respective expansion chambers for transferring gas from one to another, pistons in said chambers, means connecting the pistons in opposed chambers, an oscillating member and a rotating member concentrically journaled relative to each other and to said cylinders, means connecting said oscillating member with said pistons, said oscillating member having pockets formed in the face thereof opposed to said rotating member, and rollers arranged in said pockets and adapted to bear between said members so as to constitute ratchet mechanism, whereby the movement of said oscillating member in one direction will cause the rotation of said rotating member in a corresponding direction and the movement of said oscillating member in the opposite direction will be free of said rotating member, all being arranged to oscillate said oscillating member and thereby rotate said rotating member.

Signed at Chicago this 2d day of October, 1917.

JOHN HENDERSON.