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TWO-STROKE CYCLE INTERNAL COMBUSTION ENGINE.

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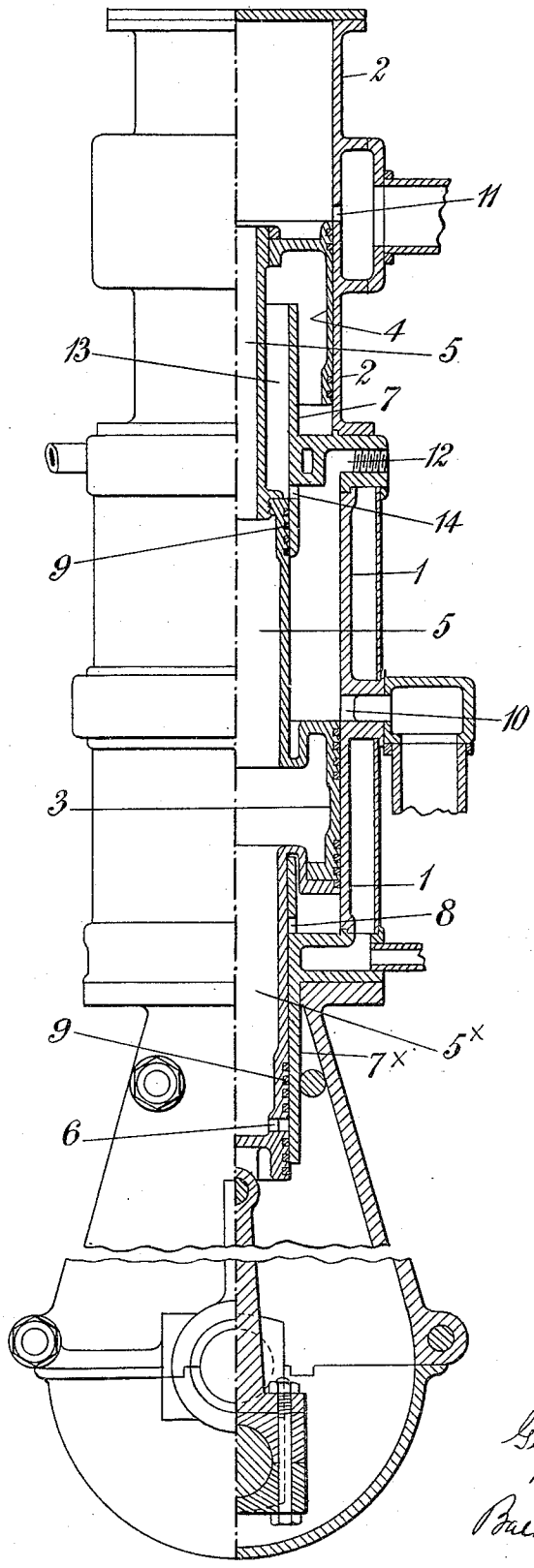
955,144. Patented Apr. 19, 1910.



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UNITED STATES PATENT OFFICE.

GEORGE ENDERBY, OF HARROGATE, ENGLAND, ASSIGNOR OF ONE-THIRD TO HENRY JOHNSON, OF HARROGATE, ENGLAND.

TWO-STROKE-CYCLE INTERNAL-COMBUSTION ENGINE.

955,144. Specification of Letters Patent. **Patented Apr. 19, 1910.**

Application filed October 21, 1909. Serial No. 523,820.

To all whom it may concern:

Be it known that I, GEORGE ENDERBY, mechanical engineer, a subject of the King of Great Britain, residing at 13 Mayfield Grove, Harrogate, Yorkshire, England, have invented new and useful Improvements in Two-Stroke-Cycle Internal-Combustion Engines, of which the following is a specification.

This invention relates to improvements in or connected with internal combustion engines of the type in which (in the case of a single acting engine) there is one explosion or one working stroke to each revolution of the crank shaft (and in the case of a double acting engine two explosions) and in which the working cylinder is scavenged by an explosive or carbureted mixture of air and fuel sufficient in volume to fill the whole of the cylinder (compression space included) delivered to it at or near the top or end of the compression space of the cylinder immediately after the exhaust gases have escaped and while the exhaust ports are still open from a pump cylinder adjoining the working cylinder in which such charge has been stored and compressed during the working portion and early period of the exhaust.

According to this invention in a double acting engine one end of one cylinder is periodically put into communication with one end of the other cylinder through a hollow piston rod fixed to and passing through the two pistons and extending beyond the working piston, the extension having a port in it which permits the carbureted mixture to enter the working cylinder under pressure and displace any remaining exhaust gases during the brief remainder of the working stroke and for a short period of the compression stroke. The other ends of the two cylinders are periodically put into communication with each other through an annular passage between a portion of the piston rod connecting the two pistons (which is of smaller diameter than the other portion) and a sleeve which acts as a guide for the larger portion. The extension in the piston rod works in a similar sleeve and these sleeves are of sufficient length to prevent piston rings on the piston rod and its extension from escaping. In single acting engines either of these methods of connecting the two cylinders may be employed.

The drawing is a sectional elevation of a double acting engine constructed according to this invention.

1 is the working cylinder and 2 the pump cylinder and 3, 4 are the pistons in them.

5 is a hollow piston rod the upper end of which passes through the piston 4 and opens into the cylinder 2 while the lower end passes through and extends beyond the piston 3 the extension having in it ports 6 opening into the cylinder 1. The ports 6 are closed in all positions except when the piston is near the upper end of its stroke by the sleeve $7^{\times}$ forming a guide in which the piston rod 5 works but when the ports 6 coincide with ports 8 in the sleeve $7^{\times}$ the cylinders 1 and 2 are in communication with each other.

9 are packing rings to make a tight joint between the piston rod 5 and its extension $5^{\times}$ and the sleeves 7 and $7^{\times}$.

10 are exhaust ports in the cylinder 1 and 11 are induction ports in the cylinder 2.

12 is a hole for the insertion of one of the firing plugs; the hole for the other is not shown.

When the piston 3 of the working cylinder 1 is at the other end of its stroke to that shown, the lower end of the cylinder is receiving a charge of compressed gas from the upper end of the cylinder 2; by such time as it has traveled a very short distance on the down stroke the port 6 in the extension $5^{\times}$ of the piston rod 5 delivering the charge into the cylinder 1 is closed, and immediately afterward the piston 3 passes over and closes the exhaust ports 10 sealing the charge in the cylinder 1 and compresses it until the bottom of the stroke, when it may be fired electrically or otherwise. At the same time that the piston 3 is compressing the charge in the cylinder 1 the piston 4 in the cylinder 2 is moving downward creating a vacuum inside the cylinder until it uncovers the ports 11 of the induction pipe just before the end of its stroke when the vacuum created inside the cylinder 2 causes it to fill itself immediately with carbureted mixture. When the piston 4 begins to travel upward the piston ring passes over the induction ports 11 closing them and the mixture is compressed. The ignition and explosion then take place and the piston 3 performs its upward stroke, near the top of which it passes and opens the exhaust ports

10 when the exhaust gases immediately escape. Just before the piston gets to the end of its stroke the ports 6 in the extension 5ˣ of the piston rod deliver a compressed charge of carbureted mixture from the cylinder 2 into the cylinder 1 charging it for the next cycle. The other or adjacent ends of the cylinders 1 and 2 are put into and out of communication with each other as follows:—The upper end of the piston rod 5 is of less diameter than the lower end so that in the position shown there is an annular passage 13 between the piston rod 5 and the upper end of the sleeve 7 and at the bottom of this passage there are ports 14 opening into the upper end of the cylinder 1, such ports being uncovered as shown by the piston rod 5 when the pistons are in their lowest positions, thus allowing the compressed explosive mixture in the lower end of the cylinder 2 to pass into the upper end of the cylinder 1 and sweep out the products of combustion through the exhaust ports 10. As the piston 3 rises the piston rod 5 first closes the ports 14 and immediately afterward the piston itself closes the ports 10.

What I claim is:—

1. The combination of a working cylinder and a pump cylinder co-axial with each other, pistons in the cylinders, a hollow piston rod passing through and connecting the pistons and extending beyond the working piston, a sleeve serving as a guide for the extension of the piston rod, and a port near the end of the extension generally covered by the sleeve but opening into the working cylinder and connecting the two cylinders through the hollow piston rod when the piston nears the end of the explosion stroke.

2. The combination of a working cylinder and a pump cylinder co-axial with each other, pistons in the cylinders, a hollow piston rod passing through and connecting the pistons and extending beyond the working piston, piston rings on the extension of the piston rod, a sleeve serving as a guide for the extension and of sufficient length to prevent the escape of the piston rings, and a port near the end of the extension generally covered by the sleeve but opening into the working cylinder and connecting the two cylinders through the hollow piston rod when the piston nears the end of the explosion stroke.

3. The combination of a working cylinder and a pump cylinder co-axial with each other, pistons in the cylinders, a hollow piston rod passing through and connecting the pistons and extending beyond the working piston, a portion of the said rod between the pistons being of greater diameter than the other portion, a sleeve between the cylinders serving as a guide for the larger portion of the piston rod, a port in the sleeve usually covered by the larger portion of the piston rod but opened near the end of one stroke and then connecting the adjacent ends of the two cylinders, a sleeve serving as a guide for the extension of the piston rod and a port near the end of the extension generally covered by the sleeve but opening into the working cylinder and connecting the other ends of the two cylinders through the hollow piston rod near the end of the other stroke.

4. The combination of a working cylinder and a pump cylinder co-axial with each other, pistons in the cylinders, a hollow piston rod passing through and connecting the pistons and extending beyond the working piston, a portion of the said rod between the pistons being of greater diameter than the other portion, piston rings on the larger portion, a sleeve between the cylinders serving as a guide for the larger portion and of sufficient length to prevent the escape of the piston rings, a port in the sleeve usually covered by the larger portion of the piston rod but opened near the end of one stroke and then connecting the adjacent ends of the two cylinders, piston rings on the extension of the piston rod, a sleeve serving as a guide for the extension and of sufficient length to prevent the escape of the rings and a port near the end of the extension generally covered by the sleeve but opening into the working cylinder and connecting the other ends of the two cylinders through the hollow piston rod near the end of the other stroke.

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Witnesses:

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