L. A. BORN.

ENGINE.

APPLICATION FILED JULY 27, 1918.

1,343,612. **Patented June 15, 1920.**

3 SHEETS—SHEET 1.

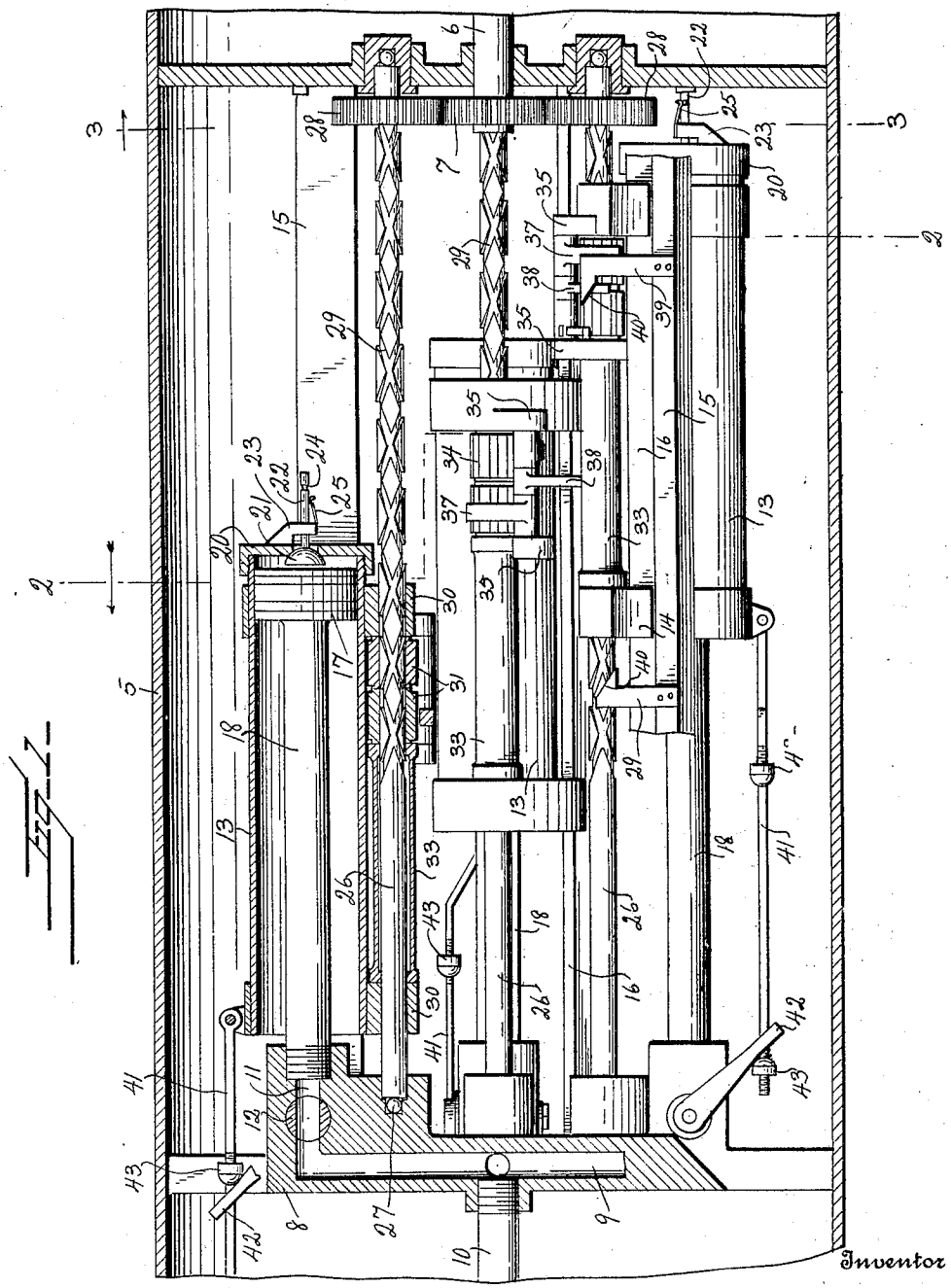


Fig. 1.

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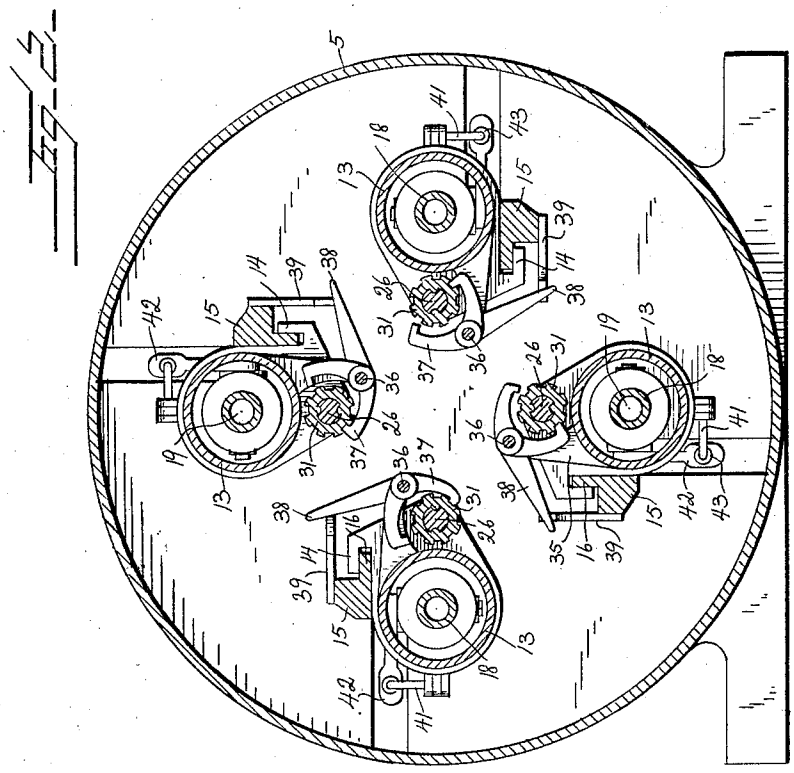
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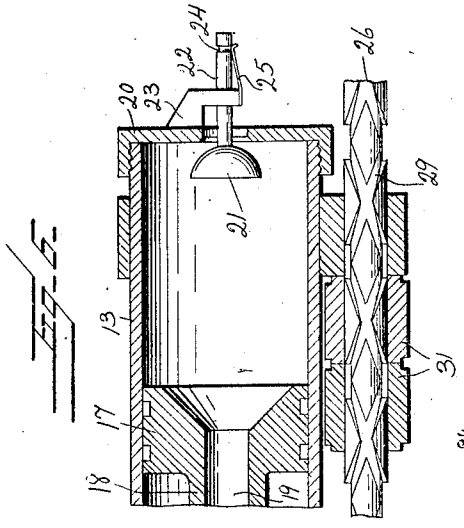
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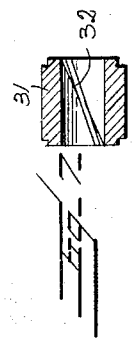
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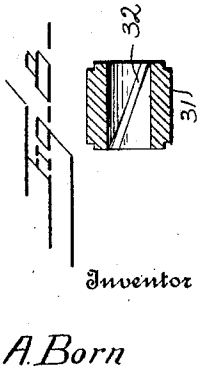
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3 SHEETS—SHEET 2.









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3 SHEETS—SHEET 3.

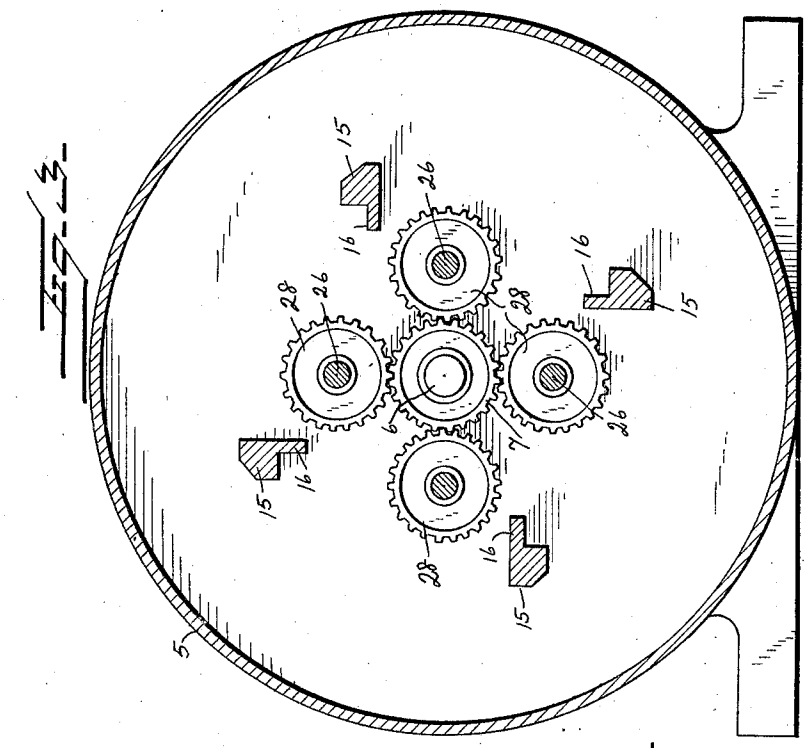


FIG. 3.

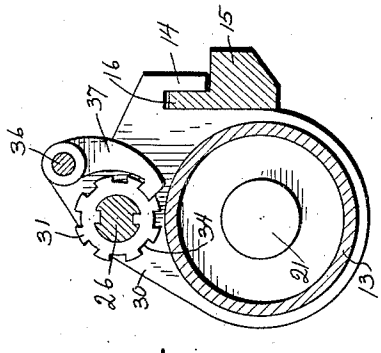


FIG. 4.

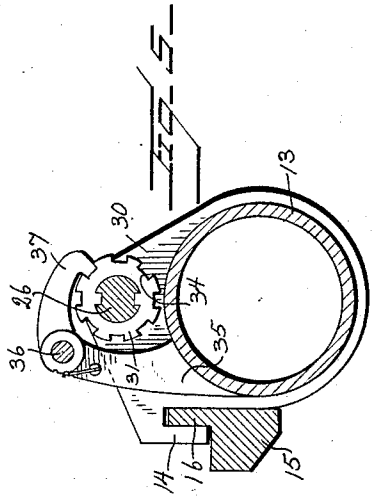


FIG. 5.

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UNITED STATES PATENT OFFICE.

LOUIS A. BORN, OF WASHINGTON, DISTRICT OF COLUMBIA.

ENGINE.

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Application filed July 27, 1918. Serial No. 247,027.

To all whom it may concern:

Be it known that I, LOUIS A. BORN, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Engines, of which the following is a specification, reference being had to the accompanying drawings.

This invention relates to engines, and more particularly to a reciprocating engine of the multi-cylinder type, operable by means of compressed air, steam, gas, or other suitable fluid actuating medium.

It is the primary object of my invention to provide a high power engine, wherein the several parts are very compactly arranged so that the engine will occupy relatively little space and may be advantageously employed for the driving of torpedoes, aeroplanes, or other machines where simplicity and compactness of arrangement is the primary consideration.

It is a more particular object of the invention to provide a reciprocating multi-cylinder engine having fixed pistons and relatively movable cylinders, and means for imparting a continuous rotation to the driven shaft from said cylinders.

It is also one of the detail objects of the invention to provide an operating screw associated with each of the reciprocating cylinders and having reversely extending intersecting spiral grooves in its periphery, a pair of nuts on the screw, and latch means automatically actuated in the reciprocating movement of the cylinder to operatively connect the nuts alternately with the respective grooves in the operating screw.

And it is also a further general object of my invention to provide an engine as above characterized wherein the several parts are of relatively simple construction, not liable to get out of order, and highly serviceable and efficient in practical operation.

With the above and other objects in view, my invention consists in the novel features of construction, combination, and arrangement of parts to be hereinafter more fully described, claimed and illustrated in the accompanying drawings, in which:

Figure 1 is a longitudinal section through the engine case, one of the cylinders being also shown in section and certain of the parts broken away;

Fig. 2 is a section taken on the line 2—2 of Fig. 1;

Fig. 3 is a section taken on the line 3—3 of Fig. 1;

Fig. 4 is an enlarged detail section illustrating one of the latch fingers engaged with the associating traveling nut;

Fig. 5 is a similar view showing the other latch finger in the pair engaged with the other nut;

Fig. 6 is an enlarged detail section through the end of one cylinder;

Figs. 7 and 8 are detail sectional views of the pair of operating nuts associated with each power transmission stroke.

Referring in detail to the drawings, 5 designates a suitable case or housing within which the various elements of the engine structure are mounted or contained. In one end wall or head of this casing, the driven shaft 6 is suitably journaled and has a gear 7 fixed thereon within said casing.

8 designates a spider which may constitute the other end wall or head of the engine casing or may be suitably fixed within said casing. The central portion of this spider is of solid construction and is formed with a chamber 9 to receive the fluid actuating medium which is admitted thereto from the pipe 10 connected to the supply source. A plurality of equi-distantly spaced outlet ports 11 communicate with the cylinder 9, and a valve 12 is associated with each of these ports and is automatically actuated or controlled in the manner to be hereinafter described, whereby the actuating fluid is supplied to the respective cylinders of the engine at the proper times.

13 designates the engine cylinders. Any desired number of these cylinders may be employed, though for purposes of convenient illustration I have disclosed in the present embodiment of the invention a quadruple arrangement of said cylinders. Each cylinder is provided at its opposite ends with a hooked lug or finger 14, which is operatively engaged with the flange 16 of a guide rail 15 fixed at its ends to the heads of the engine casing. A relatively stationary piston 17 is engaged in each of the cylin-

ders 13, the piston rod 18 being threaded or otherwise detachably connected to the body of the spider 8. This piston and piston rod is formed with an axially extending bore or passage 19, which is in communication with the port 11 of the spider 8. The end of the cylinder 13 opposed to the spider is open while the opposite end thereof is equipped with a removable head 20 having a central opening therein, normally closed by the exhaust valve 21. This valve is provided with a stem 22 movable through a guide arm 23 formed on the cylinder head. The stem 22 is provided in its periphery with an annular groove 24 to receive the end of a leaf spring 25 fixed to the guide arm 23, whereby said exhaust valve may be retained in its open position.

Screws 26 are mounted at their opposite ends in the spider 8 and the head of the casing respectively, suitable thrust bearings indicated at 27 preferably being provided. One of these screws is associated with each of the engine cylinders and has a power transmission gear 28 fixed upon one of its ends which is in constant meshing engagement with the gear 7 on the driven shaft. Each screw 26 is formed with oppositely extending intersecting spiral grooves 29 in its periphery. This screw is loosely engaged through the lugs 30 on opposite ends of the cylinder 13. A pair of nuts 31 are also engaged upon each of the screws 26. The bore of each nut is formed with a spirally disposed key or rib 32, said ribs extending in relatively opposite directions and being engaged in the respective spiral grooves 29 of the screw. These nuts are arranged between one of the lugs 30 and the end of a sleeve 33 loosely engaged upon the screw between said nuts and the other lugs 30 on the cylinder. Thus the nuts 31 are held against longitudinal movement on the screw relative to the cylinder 13. Each nut 31 is externally formed in the periphery thereof with spaced parallel channels 34.

Upon the cylinder 13, spaced lugs or ears 35 are provided in which a rock shaft 36 is mounted at its ends. Upon this shaft, spaced latch fingers 37 are fixed, said latch fingers projecting from relatively opposite sides of said shaft and adapted to respectively coact with the nuts 31. Between the latch fingers 37, an arm 38 is fixed on the shaft 36. This arm at the end of the movement of the cylinder 13 in one direction engages with a trip member 39 fixed upon the guide rail 15. This trip member has an obliquely inclined edge 40, against which one edge of the arm 38 rides so as to rock the shaft 36 in one direction and thereby disengage one of the latch fingers 37 from one nut 31 and operatively engage the other latch finger with the other of said nuts.

It will be understood from Fig. 1 of the drawing that when the cylinder reaches the opposite end of its stroke, the beveled edge 40 of the other trip member 39 on the guide rail will engage the relatively opposite edge of the arm 38 and rock the shaft 36 in an opposite direction. In this manner the nuts 31 are alternately locked to the cylinder 13 so that one of said nuts will impart positive rotation to the screw 26 while the other nut will rotate with said screw. Thus all of the screws 26 will be constantly rotated in one direction so that there will be no interruption in the transmission of power to the driven shaft 6.

To one end of each cylinder 13, a rod 41 is connected. This rod is loosely engaged through an opening in the arm or lever 42 fixed to one end of the admission valve 12. Spaced nuts 43 are carried by the rod 41 and as will be noted from reference to Fig. 1, at the end of the travel of the cylinder 13 in one direction, one of these nuts engages the arm 42 and moves the valve 12 to open position so as to admit the actuating fluid through the bore of the piston to the closed end of the cylinder 13. At the end of the movement of said cylinder under the expansive action of the fluid, the other nut 43 engages the arm 42 and closes the valve 12, thus cutting off the further supply of the actuating fluid. Simultaneously with this closing of the admission valve 12, the stem 22 of the exhaust valve strikes the head of the case 5 or an abutment thereon to move the valve 21 inwardly to its open position and until the end of the leaf spring 25 engages in the groove 24 of the valve stem whereby the valve will be held in such open position. Thus the actuating fluid is permitted to escape through the exhaust port so that the reverse movement of the cylinder in the continued rotation of the screw 26 associated therewith will not be cushioned or retarded.

The exhaust valve 21 will remain open until the exhaust valve strikes the flaring wall of the duct 19, when further inward movement will cause the exhaust valve to close. Then steam or other motive fluid passes through the valve 12 and the pressure of this motive fluid on this exhaust valve will hold it closed until the valve is again forcibly opened by striking the head of the cylinder 5.

From the above description, taken in connection with the accompanying drawings, it is believed that the construction, manner of operation and several advantages of my improved engine will be fully and clearly understood. The actuating fluid is admitted to the several cylinders of the engine at such times whereby at least one of the power transmission screws 26 in the series will be positively rotated to drive the shaft 6.

Preferably, however, the admission of the actuating fluid is so timed that two of the cylinders will be upon their power strokes while the other two cylinders are moving on the reverse stroke, whereby the operation of the engine will be properly balanced. It will be readily seen that by means of an engine constructed in the manner described, a maximum of power may be obtained and a large number of cylinders employed, with a very compact assemblage of the several parts. Thus the engine is well adapted for use in torpedoes and other instances where economy of space is of prime importance. By the provision of the stationary pistons and movable cylinders and the power transmitting means, as above set forth, I am also able to reduce the number of parts required to a minimum, while at the same time the length of stroke of the cylinder may be increased indefinitely to secure a maximum driving power from each of the power transmission screws. I have herein referred to a particular means for actuating the supply and exhaust valves and for operatively connecting the traveling nuts to the engine cylinders. It is, however, to be borne in mind that these detail features of my improved engine may be variously modified and alternative means substituted therefor whereby the desired results may be satisfactorily attained. Accordingly, in the possible development of the invention, I reserve the right to resort to all legitimate modifications or changes of which the several parts of the invention may be susceptible within the spirit and scope of the appended claims.

I claim:—

1. In an engine, a plurality of fixed tubular pistons, each having a head, a cylinder coacting with each piston and within which the head fits, inlet valves controlling the inlet of motive fluid through said several pistons, means for alternately opening the inlet valves to thereby cause a longitudinal movement of the cylinder relative to the piston in one direction, means for causing the reverse movement of any one cylinder by the power movement of another cylinder, an exhaust valve for each cylinder and disposed therein and moving therewith, and means for causing the opening of said exhaust valve when the cylinder has reached the limit of its power movement, holding said exhaust valve open during the time the cylinder is moving reversely and closing said exhaust valve when the cylinder has reached the end of its reverse stroke.

2. An engine of the character described including a casing, a power shaft extending through the casing, a member supported at one end of the casing and constituting a manifold and connected to a source of motive fluid, a plurality of tubular pistons extending from said member and carrying a piston head, valves in each member controlling the passage of motive fluid through said pistons, a shaft mounted in said casing in concentric relation to the several pistons, a reciprocating cylinder associated with each piston and having an exhaust valve in one end, means for translating the rectilinear movement of the several cylinders into a continuous rotary movement of said shaft, means for intermittently opening the inlet valves of certain of the cylinders and closing the inlet valves of other cylinders to cause the propulsion under power of the several cylinders whose valves are opened, means for causing the reverse movement of the cylinders whose valves are closed, and means for opening the exhaust valve of each cylinder when the cylinder has reached the outer end of its stroke and holding the exhaust valve opened on its return stroke and then closing the exhaust valve.

3. An engine of the character described including a hollow head connected to a source of motive fluid, a plurality of fixed pistons extending from said hollow head, each piston being tubular throughout its length, valves controlling the passage of motive fluid from the head into and through each piston, a plurality of reciprocatable cylinders mounted upon the pistons, guides for the cylinders, a power shaft, means for transmitting power to said shaft comprising a shaft for each cylinder having reversed screw-threads thereon, reverse nuts carried by each cylinder and engaging the screw-threads of the shaft, means for rendering one of said nuts idle and the other nut active upon the forward stroke of each cylinder and rendering the previously active nut idle and the previously idle nut active upon a reverse stroke of the cylinder, gearing connecting said screw-threaded shafts to the first named shaft, means actuated by each cylinder for opening the inlet valve thereof when the cylinder has reached its innermost position and closing said inlet valve when the cylinder has moved a predetermined distance on its power stroke, an exhaust valve at one end of each cylinder, and means for opening the exhaust valve when the cylinder has reached its outermost position and holding said exhaust valve opened while the cylinder is moving inward on its return stroke.

4. An engine of the character described including a fixed, tubular piston having a head at one end, a cylinder within which the head fits and reciprocating relative to the piston, means for causing motive fluid to pass through the tubular piston and urge the cylinder in one direction, means for then cutting off the flow of motive fluid, means for causing the return movement of the cylinder, an exhaust valve mounted in the end of the cylinder and having a pro-

jecting stem, means engaging said stem at the end of the outward stroke of the cylinder and causing the inward movement of the exhaust valve to an open position, means for holding said exhaust valve, in its inwardly moved position during the return stroke of the cylinder, the exhaust valve at the end of the return stroke engaging with the head of the piston and being shifted thereby to its closed position.

In testimony whereof I hereunto affix my signature.

LOUIS A. BORN.