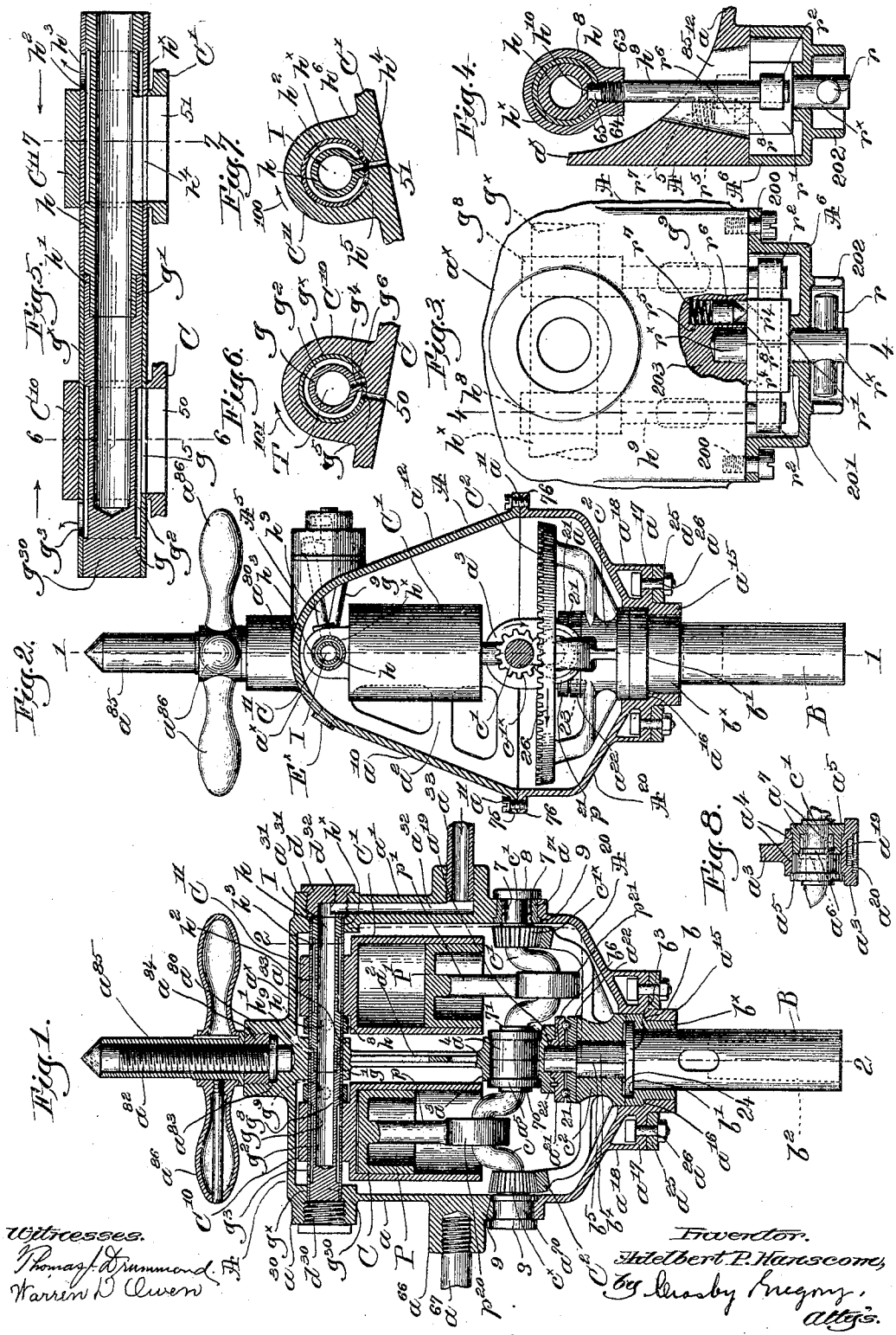
No. 822,367. PATENTED JUNE 5, 1906.

A. P. HANSCOM.

PNEUMATIC DRILL.

APPLICATION FILED AUG. 27, 1903.



Witnesses.
Thomas J. Drummond.
Warren B. Owen

Inventor.
Hilbert P. Hanscome,
by Crosby Gregory,
Attys.

UNITED STATES PATENT OFFICE.

ADELBERT P. HANSCOM, OF MALDEN, MASSACHUSETTS.

PNEUMATIC DRILL.

No. 822,367. Specification of Letters Patent. Patented June 5, 1906.

Application filed August 27, 1903. Serial No. 170,893.

To all whom it may concern:

Be it known that I, ADELBERT P. HANSCOM, a citizen of the United States, and residing at Malden, in the county of Middlesex and State of Massachusetts, have invented an Improvement in Pneumatic Drills, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to pneumatic drills, and more particularly to that type of such apparatus wherein a plurality of pistons and cylinders actuate, by or through suitable speed-changing mechanism, a centrally-arranged arbor by which the drill is carried.

One of the objects of my present invention is the arrangement of the various working parts of the apparatus in a compact, strong, and durable manner, the engine or motor being so disposed with relation to the drill-carrying arbor that maximum power may be imparted thereto with an efficient balancing of parts.

Another object of my invention is the improvement and simplification of the valve mechanism which controls the ingress of the motive fluid to and its exhaust from the cylinders of the engine or motor.

Another object of my invention is the production of a simple and convenient reversing device to change the direction of rotation of the arbor.

The various novel features of my invention will be fully described in the subjoined specification and particularly pointed out in the following claims.

Figure 1 is a vertical sectional view of a pneumatic drill embodying one form of my invention, taken on the line 1 1, Fig. 2, a portion of the transmitting-gearing and the arbor being shown in elevation. Fig. 2 is a vertical section in a plane at right angles thereto on the irregular line 2 2, Fig. 1, looking toward the left with the arbor in elevation, the engine-pistons being shown at full stroke, as in Fig. 1. Fig. 3 is an enlarged detail in plan and partly broken out, showing the reversing means for the engine. Fig. 4 is sectional detail thereof on the line 4 4, Fig. 3, looking toward the left. Fig. 5 is an enlarged longitudinal section on line 5 5, Figs. 6 and 7, of the means for controlling the passage of motive fluid to and from the cylinders and which also serves as the common fulcrum or trunnion on which the cylinders oscillate, the heads of the latter being shown in section. Figs. 6 and 7 are cross-sections on the lines 6 6 and 7 7, respectively, Fig. 5, showing the arrangement of inlet and exhaust ports for the cylinders, the latter being shown at half-stroke. Fig. 8 is a detail in elevation and part section of the center bearing for the crank-shafts of the motor.

In the present embodiment of my invention the motor and transmitting mechanism are inclosed within a case comprising a top portion A, having parallel end walls a a', Fig. 1, and oppositely-sloping side walls a^{10} a^{12}, joined at their upper ends by an arched portion $a^{\times}$ and connected at their lower ends by suitable means, as screw-bolts a^{11}, with the casing-bottom A^{20}, the bolts passing through circular flanges 75 and 76 on the casing top and bottom portions, respectively.

The top portion A is strengthened by a central web a^2, parallel to the end walls and extended from one side wall part way across the portion A, the web being provided with a suitable seat a^3 for a bearing for the inner adjacent and alined ends of two crank-shafts c c', (see Fig. 1,) the outer ends of said shafts being supported in bearings a^{70} a^{71}, shown as thimbles held jointly by the top and bottom members of the case and preferably provided with antifriction-rolls 7, Fig. 1.

Each thimble has a flanged head 8 and a lateral annular flange 9 at its inner end, the flanges entering correspondingly-shaped seats in the casing and coöperating with the flanged heads 8 to retain said bearings from longitudinal movement.

Referring to Figs. 1 and 8, the center bearing is shown as comprising two bushings a^4, set into the seat a^3 from opposite ends and having flanged heads a^5 to enter the counterbored ends of the seat, the inner ends of the bushings abutting, and separate disks a^6 fit into said inner ends to form a backing for the antifriction-rolls a^7, surrounding the ends of the crank-shafts. The two crank-shafts are thus alined and located on opposite sides of the central web a^2, each one having a bevel-pinion, as $c^{\times}$ $c'^{\times}$, secured thereon adjacent the inner ends of the thimbles or bushings a^{70} a^{71}, respectively, while collars 70 and 71 on the shafts abut against the outer ends of the bushings a^4.

The bottom portion A^{20} of the casing is circular in cross-section and tapers toward its

lower end, terminating in a cylindrical boss a^{15}, provided with an internal annular shoulder a^{16} and having a plurality of external radially-extended ears a^{17}, shown in Figs. 1 and 2 as connected with the portion A^{20} by strengthening-webs a^{18}.

A bushing $b^{\times}$, having an external annular shoulder b to seat on the shoulder a^{16}, is inserted in the boss a^{15} into the position shown best in Fig. 1, the upper end of the bushing only partly filling the boss above the shoulder a^{16}, and an internal annular shoulder b' is formed in the bushing.

The tool-carrying arbor B, internally recessed at b^2 to receive the shank of the drill or other tool, enters the bushing $b^{\times}$ with a running fit and has an annular enlargement b^3 to seat on the shoulder b' of said bushing.

Above the enlargement b^3 the arbor is reduced in diameter at b^4 to enter the hub c^2 of a large bevel-gear C^2 in mesh with the bevel-pinions $c^{\times}$ $c'^{\times}$, a key b^5, Fig. 1, being employed to rigidly connect said gear with the arbor to rotate in unison.

The extremity of the arbor above the part b^4 is still further reduced in diameter, as at b^6, and it enters a socket a^{19} in the bottom of the seat a^3, said socket being counterbored at a^{20}. (Shown most clearly in Fig. 8.)

The counterbore a^{20} serves to position a hardened-steel disk a^{21}, forming one half of a raceway for a series of balls 21, the disk being pinned to the bottom of the seat a^3 at 22, (see Fig. 1,) while the other half of the raceway is shown as a disk a^{22}, also of hardened steel, pinned at 23 to the top of the hub c^2, the part b^6 of the arbor passing loosely through both disks, the pin 23 being dotted in Fig. 2.

As will be manifest, the disks and balls form an antifriction end-thrust bearing for the arbor, the thrust being transmitted through the seat a^3 to and being taken up by the web a^2.

Referring to Figs. 1 and 2, it will be seen that the externally-cylindrical base of the hub c^2 fits into the boss a^{15} above the top of the bushing $b^{\times}$ and rests upon the latter, the sides of the boss affording a lateral bearing to assist in positioning the hub.

A strengthening-ring a^{25} is secured by bolts a^{26} to the ears a^{17}, said ring surrounding the boss a^{15} near its lower end and serving to stiffen and strengthen it, this ring being removed when the angle attachment is applied, as will be described.

In order to prevent any binding of the gear C^2 by or through end thrust of the arbor, the bottom of the gear-hub is slightly recessed at 24, Fig. 1, above the enlargement b^3 of the arbor, the thrust being transmitted from the upper end of part b^4 of the arbor to the thrust-bearing.

Inasmuch as the bevel-pinions engage the gear C^2 at diametrically opposite points, it is necessary to provide two separate crank-shafts, rotating oppositely, as herein shown, the direction of rotation of the gear C^2 being indicated by the arrow 26, Fig. 2.

The pinions and bevel-gear form transmitting means intermediate the motor or engine, to be described, and the tool-carrying arbor B.

The end walls a and a' are provided with two opposite circular apertures bored to provide true bearing-surfaces for the valve structure, which latter also constitutes a trunnion or support on which the cylinders of the motor are mounted to oscillate, the apertures being surrounded by internally-threaded nipples a^{30} a^{31}, respectively, Fig. 1.

Threaded plugs d^{30} d^{31} are screwed into said nipples after the trunnion is in place, preventing longitudinal movement thereof, the plug d^{30} being solid, while plug d^{31} has a passage d^{32} through it to admit motive fluid, such as compressed air, to the apparatus, the outer end of the passage registering with the upper end of a conduit a^{32} in the wall a'.

An inlet-pipe a^{33}, Fig. 1, communicating with the lower end of the conduit, conducts motive fluid thereto from any suitable source of supply.

The construction of the trunnion is best shown in Figs. 1 and 5.

Two cylindrical tubes g and h, having a common bore, are driven tightly into outer tubes $g^{\times}$ $h^{\times}$, respectively, the outer tubes having their inner ends butted together, while one of the inner tubes, as g, is counterbored at its inner end, as at g', to snugly receive the reduced end h' of the tube h, one of said tubes being capable of rotative movement, however, relative to the other.

Before assembling the tubes g and h are externally cut away for a part of their length and extending nearly around their outer circumferences, leaving clearance-spaces g^2 h^2 between the inner and outer tubes, the latter being provided with holes g^3 h^3, respectively, communicating with the clearances, which constitute exhaust-chambers. As shown in Figs. 1 and 5, the end of the tube g adjacent the plug d^{30} is closed, as at g^{30}.

The mode of construction described is very simple and convenient, a strong and efficient trunnion and valve being provided at small cost.

An elongated inlet-port is made in each section or half of the trunnion, the ports being shown at g^4 h^4 in Figs. 6 and 7, respectively, and establishing communication between the bore I of the trunnion, which may be termed the "inlet-chamber," and the exterior of said trunnion, each port extending from the chamber I through the outer tubes $g^{\times}$ and $h^{\times}$, respectively.

On opposite sides of and adjacent the said ports the tubes $g^{\times}$ and $h^{\times}$ are each provided with two ports, as g^5 g^6 and h^5 h^6, (shown in Figs. 6 and 7,) communicating with the exhaust-chambers g^2 h^2, respectively.

Upon the trunnion are vibratorily mounted and suspended the twin cylinders C C′, having equal length and diameter and provided with suitable pistons P P′, respectively, Fig. 1, the piston-rods p p' being shown as rigid with or forming part of the pistons and extending out through the lower open ends of the cylinders. The upper ends of the latter are closed with the exception of ports 50 51, (see Figs. 6 and 7,) and said ends are provided with tubular extensions C^{10} C^{11}, which surround the trunnion with an easy but steam-tight fit to rock thereupon. It will be understood that the several inlet and exhaust ports formed in the trunnion are elongated to conform to the length of the ports 50 or 51 in the cylinder ends, the cylinders by their oscillation moving their ports into and out of register with the ports of the valve structure or trunnion. Each end of the latter is thus provided with three ports—a central one for the admission of motive fluid to a cylinder and one on each side for the exhaust.

The material of the outer tubes $g^{\times}$ or $h^{\times}$, which separates the central inlet-ports from the contiguous exhaust-ports, is of such width in each instance as will just cover the port in the cylinder.

Inasmuch as the crank-shafts rotate in opposite directions, the cylinders will vibrate or oscillate in the same direction rather than oppositely, as would be the case if the crank-shafts were connected and rotated in the same direction.

When the two pistons are at full stroke, as in Fig. 1, the cylinders will be up and down and the two cranks one hundred and eighty degrees apart, while at half-stroke the cranks will be just passing each other and the cylinders will be inclined at one or the other side of the vertical axis of the apparatus.

In Fig. 7 the piston of the cylinder C′ is supposed to be at half-stroke, the cylinder taking motive fluid through ports h^4 and 51, and when the outward stroke is completed and the inward stroke begins the port 51 will begin to register with the exhaust-port h^5.

As to cylinder C, from Fig. 6 it will be manifest that its piston is at mid-stroke, the cylinder exhausting through ports 50 and g^5, the piston being on its inward stroke.

The exhaust is discharged through the ports or outlets g^3 h^3 into the casing and escapes thence to the outer air by means of an outlet-nipple $E^{\times}$, Fig. 2.

The ports g^6 and h^6 are utilized when the valve structure is shifted to reverse the motor, so that the arbor-gear C^2 and arbor B will be rotated oppositely to the arrow 26, Fig. 2.

When the motor is to be reversed, by means to be described the right-hand half of the valve structure, Fig. 1, will be partly turned in direction of arrow 100, Fig. 7, while simultaneously the left-hand half will be turned oppositely in direction of arrow 101, Fig. 6, it being remembered that Figs. 6 and 7 are viewed from opposite ends of the valve structure.

The top portion A of the casing is provided with a housing A^5, Figs. 2, 3, and 4, extended laterally from the wall a^{12} and surmounted by an internally-threaded boss a^{80} in alinement with the arbor B for a purpose to be described, the housing opening into the interior of the casing, as at 85, Fig. 4.

Collars g^8 h^8 are secured to the tubes g and h at opposite sides of the sleeve-like center bearing a^{33} for the valve structure, (see Fig. 1,) formed in the web a^2, each collar having a threaded boss 63, Fig. 4, to receive the threaded end 64 of a reversing-arm, said arms g^9 h^9 being clearly shown in Figs. 2 and 3 and slightly tapered, as at 65, beyond the thread to pass through a hole in the outer tube and enter a socket g^{10} or h^{10} in the inner tube. By thus engaging both tubes of a pair they are turned in unison without any twisting strain, though it will be understood that the two tubes are rigidly secured together by forcing the inner one into the outer one.

The reversing-arms extend from the valve structure at right angles thereto and pass through the housing A^5 into a chambered cover-plate A^6, detachably held in place by suitable screws 200, Fig. 3, the cover-plate having a central bearing-boss 201 and an external flange 202 for a purpose to be described.

The central solid portion of the housing is provided with a socket 203, Fig. 3, for the inner end of a stud $r^{\times}$, rotatably mounted in the boss 201 and projecting therethrough into the space inclosed by the flange 202, a handle r of any suitable construction being secured to the stud.

Between the boss 201 and the adjacent end of the housing a yoke-block r' is secured to the stud, said block having elongated eyes r^2 on opposite sides to receive loosely the free ends of the reversing-arms g^9 h^9, so that by turning the stud by means of the handle r' the said arms will be moved oppositely. Such movement of the arms turns the two halves of the valve structure in opposite directions to reverse the operation of the motor—that is, if the valve structure is in the position shown in Figs. 6 and 7 and the reversing-stud $r^{\times}$ is turned the valve halves will be turned to bring the exhaust-ports g^6 and h^6 into operative position and render the ports g^5 h^5 inoperative. Thus by a turn of the hand the operator can reverse the motor, the flange 202 acting as a shield for the handle r^2 and preventing the stud $r^{\times}$ from being turned accidentally.

As shown in Fig. 3, the inner face of the yoke-block r' has two pits or depressions therein, as r^4, and the solid center of the housing A^5 is recessed at each side of the center at

r^5, each to receive a locking bolt or plunger r^6, pressed outward by a spring r^3 and having a pointed or conical top r^8.

The depressions r^4 are so located on the block that when the stud $r^\times$ is in position for forward or backward operation one of the bolts r^6 will enter a depression and hold the stud in the proper position. The locking-bolts thus indicate to the operator when the valves are in the correct position, as at such time one or the other of said bolts will snap into its depression r^4.

The internally-threaded boss a^{80}, Fig. 1, is socketed to receive the inner end of a threaded stud a^{82}, having an annular flange a^{83} fast upon it to enter the boss, a heavy retaining-bushing a^{84} being screwed into said boss and bearing upon the flange a^{83}, so that the stud a^{82} is rigidly held in position and in alinement with the axis of the arbor B. An internally-threaded back center a^{85} is screwed upon the stud and provided with handles a^{86}, by which it may be more readily revolved, the operation of the back center being familiar to those skilled in the art and requiring no further description.

Opposite the inlet a^{33} the part A of the casing is provided with a hub or boss a^{66}, into which is screwed a handle-bar a^{67}, (see Fig. 1,) by which the positioning of the apparatus is facilitated.

The free ends of the piston-rods p p' are enlarged, as at p^{20} p^{21}, respectively, Fig. 1, to support bearing-boxes of any suitable character for the cranks of the two crank-shafts, boxes provided with rolls or similar antifriction means being preferable.

From the foregoing description, in connection with the drawings, the operation of the apparatus will be readily understood, the transmitting means intermediate the crank-shafts and arbor acting also as a speed-reducer, so that the engine or motor may be run at high speed.

The construction is simple, compact, and efficient, the power being applied to the large gear C^2 at two diametrically opposite points, and the support for the arbor both as to end thrust and lateral bearings is strong and rigid.

Having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In apparatus of the class described, a casing, an arbor rotatably mounted in and extended through one end thereof, a pair of oscillating cylinders each having a piston, a combined trunnion and valve structure supported within the casing and on which the cylinders are mounted side by side, at their ends, two separate crank-shafts operatively connected with the pistons and mounted in alinement, a pinion on each crank-shaft, and a gear operatively connected with the arbor and with which said pinions mesh at diametrically opposite points.

2. In apparatus of the class described, a casing, an arbor rotatably mounted in one end thereof, a pair of oscillating cylinders each having a piston, a combined trunnion and valve structure supported within the casing and on which the cylinders are mounted side by side, two crank-shafts operatively connected with the pistons and mounted in alinement, a pinion on each crank-shaft, a gear operatively connected with the arbor and with which the pinions mesh at diametrically opposite points, a central web in the casing, between the cylinders, a bearing on said web for the center of the trunnion, and a second bearing sustained by the web for the inner ends of the crank-shafts.

3. In apparatus of the class described, a casing comprising separable top and bottom portions, the former having an integral central web and the latter having a boss at its end, a combined trunnion and valve structure supported by the casing top and web, transversely to the latter, oscillating cylinders mounted at their ends on said trunnion at opposite sides of the web and each provided with a piston, a center bearing sustained by the web, a plurality of alined and independent crank-shafts operatively connected with the several pistons and supported at their adjacent ends in said center bearing, bearings for the outer ends of the shafts, mounted jointly in the top and bottom of the casing, an arbor rotatably mounted in the boss of the casing-bottom, and transmitting means intermediate the crank-shafts and arbor, to rotate the latter.

4. In apparatus of the class described, a casing comprising separable top and bottom portions, the former having an integral flat central web and the latter having a boss at its end, crank-shaft bearings mounted jointly in said parts of the casing, a center bearing on the web, a plurality of oscillating cylinders mounted within the casing-top and each provided with a piston, a plurality of independent crank-shafts operatively connected with the pistons and mounted at their inner ends in the center bearing, the outer ends of the said shafts entering the bearings in the casing, an arbor rotatably mounted in the boss of the casing-bottom at right angles to said crank-shafts, transmitting connections between the latter and the arbor, to rotate the latter, and means to govern admission of motive fluid to and exhaust thereof from the cylinders.

5. In apparatus of the class described, a two-part casing, a flat central web in one of said parts, a pair of oscillating cylinders mounted in said part on opposite sides of the web and each provided with a piston, independent crank-shafts operatively connected

with the pistons and arranged in alinement, bearings for their outer ends, on the casing, a common bearing for their inner ends, carried by and transverse to the web, an arbor rotatably mounted in and extended through the other part of the casing at right angles to the crank-shafts, an end-thrust bearing for the arbor, sustained by the web, immediately adjacent the crank-shaft bearing, and gearing intermediate the crank-shafts and arbor to rotate the latter.

6. In apparatus of the class described, a two-part casing, a central web in one of said parts, a pair of oscillating cylinders mounted in said part on opposite sides of the web and each provided with a piston, independent crank-shafts operatively connected with the pistons and arranged in alinement, bearings for their outer ends, on the casing, an arbor rotatably mounted in and extended through one part of the casing, a gear connected with the arbor and rotating therewith, and a pinion on each crank-shaft, in mesh with the gear, said pinions engaging the latter at diametrically opposite points, the crank-shafts rotating in opposite directions.

7. In apparatus of the class described, a two-part casing, a central web in one of said parts, a pair of oscillating cylinders mounted in said part on opposite sides of the web and each provided with a piston, independent crank-shafts operatively connected with the pistons and arranged in alinement, bearings for their outer ends, on the casing, a seat on the web, roller-bearings mounted thereon for the inner ends of the crank-shafts, an arbor rotatably mounted in and extended through the bottom part of the casing at right angles to said crank-shafts, an attached gear, a ball-bearing interposed between the arbor and the seat, to take up end thrust of the arbor, and a pinion on each crank-shaft near its outer end, in mesh with and to rotate the arbor-gear at reduced speed.

8. In apparatus of the class described, a casing, an arbor rotatably mounted in the bottom thereof, a gear keyed to said arbor within the casing, an engine mounted in the top of the latter and comprising two oscillating cylinders arranged side by side, each provided with a piston, a tubular extension at one end of each cylinder, having a port into the cylinder, means to rotate said gear by or through reciprocating movement of the pistons, and a combined trunnion and valve structure for the cylinders, comprising two alined and relatively rotative tubes constituting an inlet-chamber and provided with outlet-ports, an outer tube on and fixed to each of said tubes with an annular clearance therebetween to constitute two separate exhaust-chambers, and an inlet and an outlet port for each, the outlet-ports opening into the casing, the inlet-port of each exhaust-chamber being adapted to coöperate with the cylinder-port alternately with the outlet-port of the inlet-chamber, the tubular extensions of the cylinders surrounding the outer tube of each pair of tubes.

9. In apparatus of the class described, a casing, a trunnion mounted therein, and comprising two pairs of tubes in alinement and sleeved together, the two inner tubes communicating and constituting an inlet-chamber, the outer tubes being secured to their inner tubes with annular clearances between them to constitute two exhaust-chambers, each outer tube having an inlet-port communicating with the inlet-chamber, and two exhaust-ports on opposite sides of said inlet-port, each pair of exhaust-ports communicating with an exhaust-chamber, a cylinder mounted to oscillate on the outer one of each pair of tubes and having a single port, an arbor rotatably mounted in the casing, pistons for the cylinders, crank-shafts with which they are operatively connected, gearing between the crank-shafts and arbor to rotate the latter, and means to effect opposite angular movement of the two pairs of tubes constituting the trunnion, to effect reversal of the engine, and consequently reverse the rotation of the arbor.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ADELBERT P. HANSCOM.

Witnesses:

JOHN C. EDWARDS,

MARGARET A. DUNN.