R. A. NORLING.

MECHANICAL MOVEMENT.

APPLICATION FILED DEC. 14, 1910.

1,027,214.

Patented May 21, 1912.

2 SHEETS—SHEET 1.

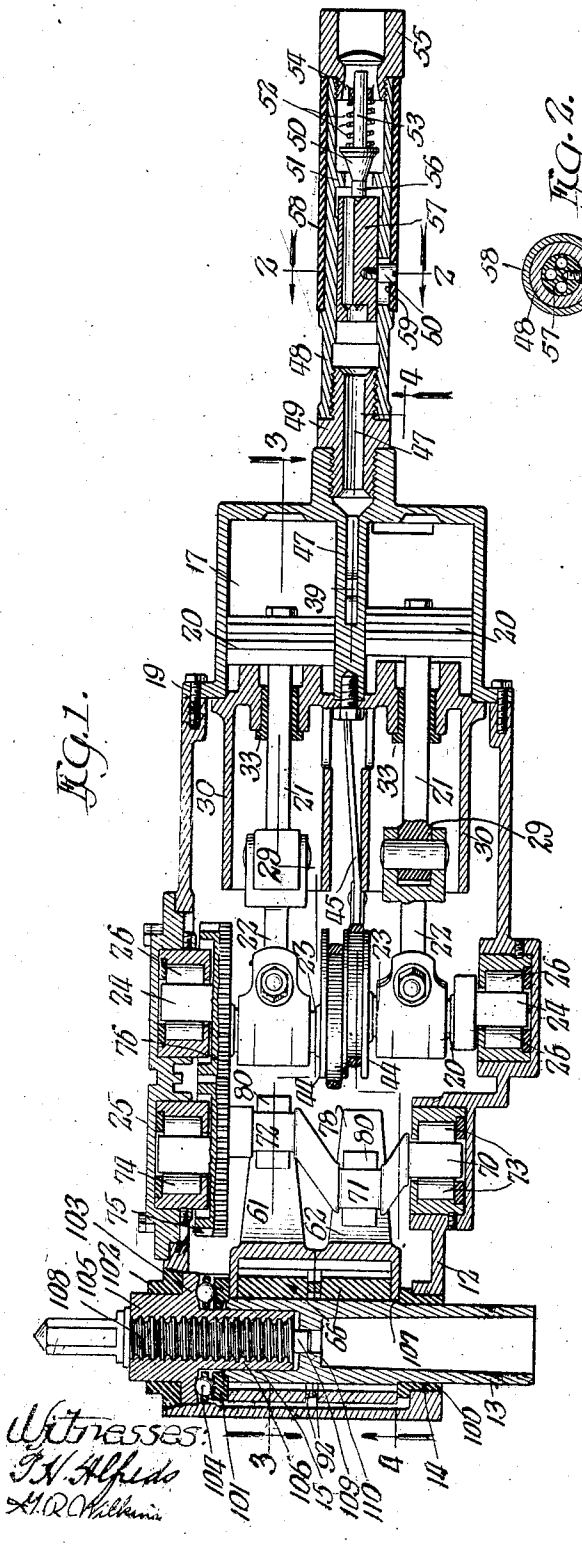

FIG. 1.

FIG. 2.

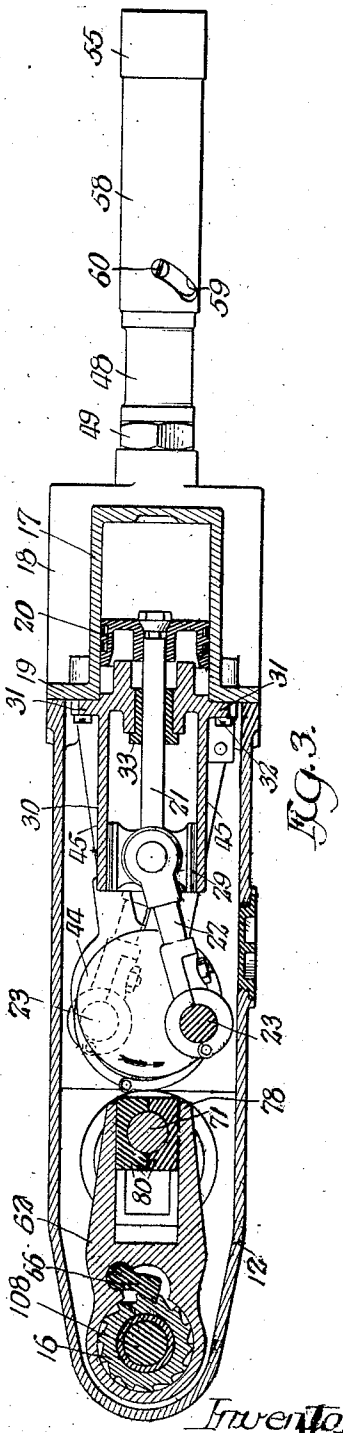

FIG. 3.

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2 SHEETS—SHEET 2.

FIG. 6.

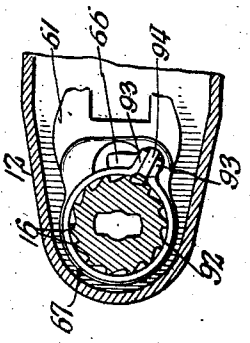


FIG. 4.

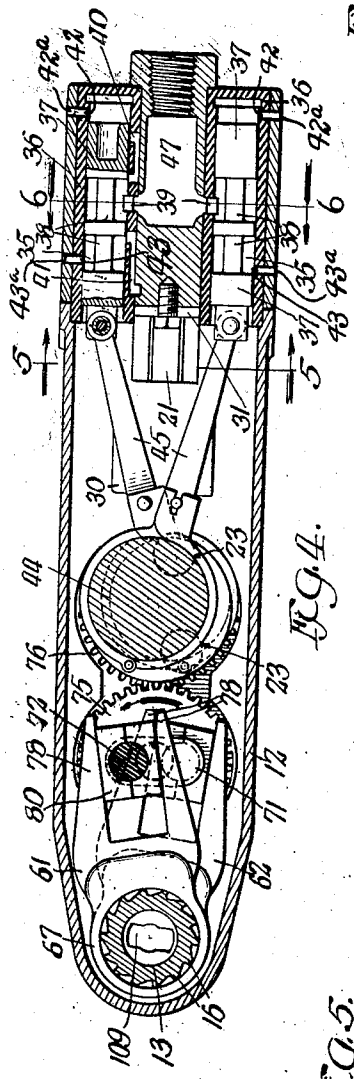


FIG. 7.

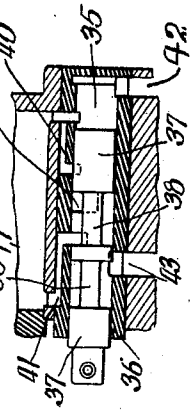
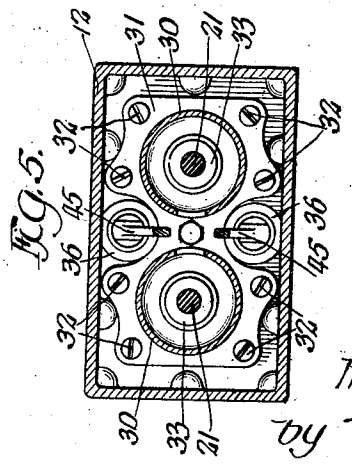


FIG. 5.



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UNITED STATES PATENT OFFICE.

REINHOLD A. NORLING, OF AURORA, ILLINOIS, ASSIGNOR TO AURORA AUTOMATIC MACHINERY COMPANY, OF AURORA, ILLINOIS, A CORPORATION OF ILLINOIS.

MECHANICAL MOVEMENT.

1,027,214. Specification of Letters Patent. Patented May 21, 1912.

Original application filed May 7, 1907, Serial No. 372,407. Divided and this application filed December 14, 1910. Serial No. 597,311.

To all whom it may concern:

Be it known that I, REINHOLD A. NORLING, a citizen of the United States, and a resident of the city of Aurora, county of Kane, and State of Illinois, have invented certain new and useful Improvements in Mechanical Movements; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to an improved mechanical movement for transmitting rotative motion to a driven shaft from two reciprocating prime movers, having equal reciprocatory movement, in opposite directions and in parallel paths.

The invention consists in the matters hereinafter set forth and more particularly pointed out in the appended claims.

The mechanical movement embodying my invention is more particularly adapted for use in drilling machines, wherein the two reciprocating prime movers constitute the pistons in the two double-acting cylinders of a pneumatic motor, and the rotative driven shaft is employed for giving rotative movement to a drill or like tool.

I have illustrated my invention in the accompanying drawings in connection with a drilling machine of the kind stated, the same being substantially like that shown and described in my prior Patent No. 969,394, dated September 6, 1910; this application being a division of the application for said Patent, Serial Number 372,407, filed May 7, 1907. The drilling machine shown in the accompanying drawings is also substantially like that shown and described in my prior application, Serial Number 558,616, filed April 30, 1910, which is also a division of said application, Serial No. 372,407, on which said Letters Patent No. 969,394 was issued.

In the accompanying drawings:—Figure 1 is a central vertical section of a motor for a drilling machine embodying my invention, said section being taken axially through the drill spindle. Fig. 2 is a cross-section, taken on line 2—2 of Fig. 1. Fig. 3 is a longitudinal section, taken on line 3—3 of Fig. 1. Fig. 4 is a longitudinal section, taken on the indirect line 4—4 of Fig. 1. Fig. 5 is a transverse section, taken on line 5—5 of Fig. 4. Fig. 6 is a cross-section, taken on line 6—6 of Fig. 4. Fig. 7 is a detail section illustrating the valve for controlling the admission of the motive fluid to the motor cylinders.

As shown in said drawings, 12 designates an elongated hollow frame or casing in one end of which is mounted a drill-spindle 13 and to the opposite end of which is attached the power cylinders of an engine or motor. Said drill spindle 13 constitutes the driven shaft of the mechanical movement constituting my invention. Said casing constitutes the principal part of a crank-case for the motor, and also an inclosure and support for the bearings of the drill spindle 13 and the mechanism by which the drill spindle is operated from the motor. At one end the drill spindle 13 is provided with a socket to receive the shank of the drill, and extends through the wall of the casing, turning in a bearing 14 in said wall. At its opposite end said spindle engages a bearing member 15 affixed to the adjacent wall of the casing, as hereinafter described. Said spindle is also provided, within the casing or frame, with a series of elongated ratchet teeth 16 arranged parallel with the axis of the spindle and constituting part of the mechanism for driving or rotating said spindle.

The motor as herein shown has the form of a two cylinder pneumatic engine, and embraces two parallel power cylinders 17, 17 located side by side and formed in a single casting 18 having at its inner end a flange 19 by which it is bolted or otherwise secured to the adjacent end of the casing or frame 12, as clearly shown in Figs. 1 and 7. The pistons 20, 20 of said motor are connected by piston rods 21, 21 and connecting rods 22, 22 with the two cranks 23, 23 of the crank-shaft 24, which latter is mounted at its ends in the side walls of the frame 12. Said pistons 20, 20 constitute the two reciprocating prime movers of the mechanical movement which forms the subject of this invention. A portion of one side wall of the casing is removable and constitutes a cap or closure 25, the removal of which permits access to the interior of the casing for the insertion and removal of the crank-shaft

and its associated parts, as well as the mechanism for communicating motion from the crank-shaft to the drill spindle. The crank-shaft 24 engages at its ends antifriction roller bearings 26 mounted in one side wall of the frame and in the opposing removable cap 25. The said piston rods have cross-heads 29 which slide in cross-head guides 30 shown in the drawings as of cylindric form. The cross-head guides are formed on plates 31 which constitute the inner cylinder heads and are attached by bolts to the flange 19 on the inner end of the cylinder casing, said plates 31 and the flange 19 constituting an end wall for the end of the casing 12 adjacent to the cylinders. Said inner cylinder heads are equipped with bushings 33 through which the piston rods slide.

35, 35 designate valve chambers, formed in the cylinder casing and located at the opposite sides and between said cylinders. In said cylinder casting are formed the various ports leading to the cylinders and the supply passage for the motive fluid, as will hereinafter appear. Said valve chambers are open at their inner ends and closed at their outer ends by the end walls of the bushings. Reciprocating in said valve chambers are piston valves, each designated as a whole by 37. Each of said piston valves is provided with two reduced parts 38, 38 which form three longitudinally separated, cylindric enlargements, by means of which, during the reciprocation of each valve, communication is afforded alternately between the inlet port 39 of said valve chamber, and ports 40, 41 communicating with the valve chamber and the opposite ends of the cylinders, as shown most clearly in Figs. 4 and 8. 42, 43 designate exhaust ports opening into the atmosphere, one at each end of the valve chamber through apertures 42^a, 43^a, formed in the casing 18, as shown in Figs. 4 and 6, and said exhaust ports are brought alternately into communication with the cylinder ports 40, 41 through reciprocation of the piston valves, as will be clear from an inspection of Fig. 7. As shown in Fig. 7, the valve 37 is at the limit of its forward movement, and the motive fluid then enters from the supply passage 47 (Fig. 4) through the inlet port 39 and the cylinder port 41 which, in this position of the valve, is in direct communication with the inlet port 39 through the chamber formed between the rearward and middle enlargements of the valve 37. The motive fluid flowing through said ports while said valve 37 is in the position shown in said Fig. 7, enters the cylinder 17 and acts on the piston 20 therein and causes the same to make its rearward stroke. Said piston 20 in its rearward movement exhausts the fluid from the rear end of said cylinder through the port 40 which communicates with the exhaust port 42 through the chamber formed between the end of the valve chamber 35 and the rearward enlargement of said valve 37. When the valve 37 is moved rearwardly to the limit of its movement in that direction, the rearward enlargement on said valve closes communication between said cylinder port 40 and the exhaust port 42 and the adjacent reduced part 38 of the valve opens communication between the inlet port 39 and the cylinder port 40, while the middle enlargement on said valve 37 passes over the cylinder port 41 and opens communication between the exhaust port 43 and said cylinder port through the space between the middle and forward enlargements of the valve. In this rearward position of said valve 37, the motive fluid acts on the piston 20 in said cylinder 17, to give to said piston its forward stroke; the exhaust then passing from the exhaust port 43. The piston valve 37 for the other cylinder 17 of the pair operates similarly to the one as described, so that the description of one will suffice for both. Said valves 37 are reciprocated from eccentrics 44 on the main crank-shaft 24 through the medium of eccentric rods 45 connected at their ends respectively with eccentric straps surrounding said eccentrics 44 and with the piston valves, (Fig. 4). The inlet ports 39 of the valve chambers communicate with a centrally located supply passage 47 formed in the cylinder casting connected at its outer end with a tube 48 which is connected with the cylinder casting by means of a screw-threaded nipple, as shown in Figs. 1, 3 and 4, and through which the motive fluid is supplied to the motor cylinders.

A throttle valve is located within the tube 48 for controlling the flow of the motive agent therethrough. Said valve embraces a conical valve or plug 50 adapted to engage a correspondingly shaped seat 51 formed on an annular flange within said tube. The valve member is held normally against its seat by a spring 52 surrounding the stem 53 of the valve member and interposed between the valve member and an inwardly facing shoulder of a nipple 55 which has screw-threaded engagement with the outer end of said tube. The said valve member is provided with an inward axial extension or stud 56, which engages at its inner end the outer end of a hollow plug 57 located within and having endwise sliding engagement with the tube 48. The valve member 50 is lifted from its seat through the medium of a sleeve 58 surrounding and having rotative movement on the tube 48 and confined between the inner end of the nipple 55 and an annular exterior shoulder on said tube. Said sleeve is provided with an inclined slot 59, (Fig. 3) through which ex-

tends a screw-stud 60 which has screw-threaded engagement with the hollow plug 57 before referred to. The tube 48 and its surrounding sleeve constitute a handle which is grasped by one hand of the operator in using the tool. Rotation of said sleeve in one direction operates through the action of said inclined slot on the stud 60 to slide the hollow plug 57 and throttle valve 50 outwardly and thereby open the valve. Said inclined slot 59 is provided at its outer end with a transverse end portion adapted to be engaged by the stud to hold the valve closure in its open position. The valve and mechanism for operating the same constitute no part of the present invention and the construction and operation thereof need not be further herein described.

Referring now to the mechanism for transmitting motion from the crank-shaft 24 to the drill spindle, said mechanism embraces two swinging levers 61, 62 disposed one over or at the side of the other and arranged to turn or rotate about the axis of the drill spindle, and provided each with a pawl 66 adapted to engage the ratchet teeth 16 on the drill spindle and turn the latter, when the lever is swung or moved in one direction, and to pass over said teeth when the lever is swung in a reverse or backward direction. Said levers are arranged to swing or oscillate reversely in such manner that when one of the levers is swung in a direction to rotate the drill spindle forwardly the other lever is swung or moved backwardly or retracted; each lever being moved or swung forwardly, or in a direction to rotate the spindle while the other lever is being restored to its starting point. The said reversely swinging levers are so connected with the mechanism which operates the same that the retracted lever is reversed and engages the drill spindle in a manner to turn the same forwardly before the lever which is then completing its forward swing is released from the drill spindle, whereby the rotation of the drill is made continuous. The said pawl carrying levers may be pivotally supported or mounted in any suitable way in the machine frame or casing, but, as shown in the accompanying drawings, they are provided at their outer or forward ends with hubs 67 having smooth cylindric apertures which fit over and have bearing on the toothed part of the drill spindle.

The levers are swung or vibrated through the medium of a secondary crank-shaft 70, parallel with the main crank-shaft 24, and provided with two crank-pins 71, 72 corresponding with the cranks of the main crank-shaft. The secondary crank-shaft is rotatively mounted at its ends in antifriction roller bearings 73, 74 mounted, one set in one side wall of the frame, and the other set in the cap or closure 25. The said secondary crank-shaft is rotated from the main crank-shaft through the medium of intermeshing gear-wheels 75 and 76 on the secondary and main crank-shafts, respectively, said gear wheels being arranged to drive the secondary shaft at the same speed that the primary crank-shaft is driven. The said levers are provided at their inner or swinging ends with laterally separated arms 78 between which the crank-pins 71, 72 of the secondary crank-shaft operate. Said fork-arms 78 of the pawl bearing levers have smooth inner parallel bearing surfaces, and the crank-pins 71, 72 of the secondary crank-shaft are provided with bearing blocks 80, 80, (each made of two halves or parts to facilitate the fitting thereof over the crank-pins) which have smooth side or lateral faces for engagement with the inner faces of the fork arms of said pawl-bearing levers. It is obvious that the enlargement of the crank-pins of the secondary crank-shaft will produce the same effect as the bearing blocks described, but, for convenience of manufacture and to increase durability, the separate bearing blocks are preferred.

The operation of the secondary crank-shaft, acting through the pawl bearing levers and their pawls to continuously rotate the drill spindle is as described in my said application No. 558,616. The pawl and ratchet driving connection between the vibrating levers and the drill spindle or driven shaft, made as hereinbefore set forth, affords a simple and effective means for giving rotative movement to the said spindle from said vibrating levers, but it is to be understood that the same general effect in the operation of the parts constituting my improved mechanical movement, may be obtained when, in place of said pawl and ratchet connection, is employed some other well known form of connecting means analogous in character to a pawl and ratchet mechanism, adapted to transmit, from the vibrating levers, turning movement to the drill spindle, constantly in one direction.

Inasmuch as the secondary crank-shaft 70 rotates in the direction indicated by the arrow in Fig. 3 and each crank-pin thereof rotates, during its power stroke, in the arc, farthest away from the drill spindle, it will be seen that the greatest force of the pawl bearing devices is exerted in mid-position as shown in Fig. 3, and the greatest power is required to turn the drill spindle, as it is then moving at its maximum speed. The lever is, however, at this time exerting its greatest leverage because its associated crank-pin of the second secondary crank-shaft is at the same time operating on the part of the lever farthest from the spindle. I arrange the crank-pins on said main crank-shaft at such angular distances apart that said crank-shaft exerts its greatest power to

reciprocate the pawl bearing levers at a time when most needed, or at a time when the advancing pawl bearing lever is in its mid-position, as shown in Fig. 3. It will be understood that a double acting engine having parallel cylinders and arranged with the crank-pins of the crank-shaft at right angles to each other gives substantially uniform power throughout the full rotation of the crankshaft and further that if the crank-pins be placed at 180 degrees apart, the power of the two pistons will be exerted simultaneously with the result, however, that both crank-pins will be simultaneously on a dead center at the end of each stroke. In order to more effectively transmit power from the two pistons to the vibrating levers I arrange the crank-pins of the main crank-shaft so that the pistons act on both of said crank-pins when the latter are in position requiring the greatest power to turn the same, to wit, when the crank-pins of the secondary crank-shaft are passing through that part of their circular path farthest from the axis of oscillation of the levers.

As shown in the accompanying drawings, the crank-pins of the main crank-shaft are placed at approximately 135 degrees apart, as indicated in Figs. 3 and 4, and as a result, when the pawl bearing lever, which is making its driving or power stroke, is at mid-position, both of the crank-pins of the main crank-shaft are in position to receive maximum power from the pistons acting thereon. As shown in Fig. 4, the pawl bearing levers are at the limits of their vibratory movement. In this position one of the crank-pins of the main crank-shaft has just passed the dead center while the other crank-pin is approaching its dead center. When, however, the parts are in the position shown in Fig. 3, and one of the vibratory levers is in the middle of its advance or power stroke and the other is being retracted, one of the crank-pins of the main crank-shaft will be approaching the point in its path at which the crank-shaft receives maximum power from its associated piston, while the other crank-pin will have passed such point. It follows that the work of impelling each lever, during the power or driving stroke of the same, will be divided between, or participated in by, both pistons. That is to say, one of the crank-pins of the main crank-shaft will come into such position that its associated piston will exert its maximum driving power on the crank shaft when one of the levers is approaching, and until it reaches, a point midway of its power stroke, and the other crank pin will then come immediately into such position that its associated piston will exert its maximum power on the crank shaft, to complete the power stroke of such lever. The construction described, therefore, has the advantage that the two pistons act conjointly and successively to exert maximum turning power on the crank shaft during the time that each lever is effecting its driving or power stroke. Moreover, the construction described has the further advantage that one of the motor-shaft crank pins will be in position for the action of its associated piston during the effective part of the stroke of said piston, when the other crank pin is on its dead center.

The construction of the tool spindle and its bearings in the frame or casing is the same as set forth in my prior Patent No. 969,394. One wall of the casing or frame is provided with a bushing 100 which constitutes the bearing for the lower cylindric portion of the spindle. On the upper or inner end of the said drill spindle is mounted a ring or collar, constituting the rotative member of a thrust bearing, the non-rotative member of which consists of an annular flange 103, formed on a tubular bearing member 105, which is secured in the top wall of the casing in axial alinement with the drill spindle by means of a locking ring 102 which has screw-threaded engagement with the surrounding casing wall and clamps the flange 103 against an upwardly facing shoulder on said wall. Antifriction balls 104 are interposed between the rotative ring 101 and the flange 103. The hubs of the levers 61 and 62 are confined between and held from movement endwise of the drill spindle by contact with the bushing 100, and the ring 101. The sleeve 105 is extended downwardly or inwardly to form an externally cylindric bearing member 106 which fits within a cylindric bearing recess formed in the upper end of the drill spindle. The bearings for holding the spindle laterally in place thus comprise the exterior bushing 100 at its lower end and the interior extension 106 of the fixed sleeve 105 at its upper end. The upward end thrust of the tool spindle is resisted by the thrust-bearing formed by the ring 101, the flange 103, and the balls 104. The said tool spindle is held from downward endwise movement by an annular shoulder 107 thereon, which bears against the upper or inner end of the bushing 100.

The upper sleeve 105 is made hollow and interiorly screw-threaded to receive a feed-screw 108 by which the drill is fed to its work, in a familiar manner. The said feed-screw is provided at its inner end with an axial projection 109 that extends through an aperture in a transverse diaphragm or wall 110 that constitutes the stop for the drill shank, said extension 109 being adapted to engage the drill shank in a manner to eject the same from the tool holder.

As will be understood from the foregoing, the two pistons in the double-acting cylinders of the pneumatic motor illustrated and

described, constitute the prime movers of a mechanical movement designed for efficiently transmitting movement from such prime movers to a constantly rotating driven shaft, which constitutes my invention, and, in the embodiment of a mechanical movement, made in accordance with my invention, such prime movers may consist either of the reciprocating pistons of two pistons that are given power strokes in both directions through the action of a fluid under pressure in the opposite ends of motor cylinders, or of any other parts that are given reciprocatory motion in parallel paths to equal distances and in opposite directions, and which are given such reciprocatory motion by the action of any other means or source of power; the principal object of my invention being to provide such a construction in a mechanical movement or motion-transmitting device, of this kind, that the two prime movers will act conjointly and successively to exert maximum turning power on the driven shaft or spindle during the time that each swinging lever is acting on the driven shaft or spindle in making its driving or power stroke.

I claim as my invention:—

1. The combination with two prime movers having reciprocating motion through equal distances in opposite directions in parallel paths, and a driven shaft, of a primary crank shaft provided with two crank pins with which said prime movers are severally connected, two swinging actuating levers, means affording driving connection between each actuating lever and said driven shaft during each stroke of the actuating lever in one direction, and an intermediate or secondary crank shaft arranged parallel with said primary crank shaft and the driven shaft and provided with crank pins located at equal angular distances apart and severally acting on said swinging actuating levers, said crank pins and actuating levers being so arranged that the forward or driving stroke of each actuating lever is effected in the movement of the crank pin acting thereon through the part of its path remote from the driven shaft, and gearing connecting said primary crank shaft with said secondary crank shaft, said primary crank shaft having its crank pins arranged at less than 180° apart and so arranged with relation to the crank pins of the secondary crank shaft that power to turn said primary crank shaft is exerted on the latter by both prime movers during the time each actuating lever is making its power or driving stroke.

2. The combination with two prime movers having reciprocating motion through equal distances in opposite directions in parallel paths, and a driven shaft, of a primary crank shaft provided with two crank pins with which said prime movers are severally connected, two swinging actuating levers, means affording driving connection between each actuating lever and said driven shaft during each stroke of the actuating lever in one direction, and an intermediate or secondary crank shaft arranged parallel with said primary crank shaft and the driven shaft and provided with crank pins located at equal angular distances apart and severally acting on said swinging actuating levers, said crank pins and actuating levers being so arranged that the forward or driving stroke of each actuating lever is effected in the movement of the crank pin acting thereon through the part of its path remote from the driven shaft, and gearing connecting said primary crank shaft with said secondary crank shaft, the crank pins of said primary crank shaft being arranged at less than 180° apart and in such angular relation to each other that when one crank pin is on a dead center the other crank pin will be in driving position, and said crank pins of the primary crank shaft being arranged in such relation to the crank pins of the secondary crank shaft that power for turning said primary crank shaft is exerted on the latter by both prime movers when each actuating lever is making its power or driving stroke.

3. The combination with two prime movers having reciprocating motion through equal distances in opposite directions in parallel paths, and a driven shaft, of a primary crank shaft provided with two crank pins with which said prime movers are severally connected, two swinging actuating levers, means affording driving connection between each actuating lever and said driven shaft during each stroke of the actuating lever in one direction, and an intermediate or secondary crank shaft arranged parallel with said primary crank shaft and the driven shaft and provided with crank pins located at equal angular distances apart and severally acting on said swinging actuating levers, said crank pins and actuating levers being so arranged that the forward or driving stroke of each actuating lever is effected in the movement of the crank pin acting thereon through the part of its path remote from the driven shaft, and gearing connecting said primary crank shaft with said secondary crank shaft, the crank pins on said primary crank shaft being so arranged relatively to each other that when one crank pin is on its dead center the other crank pin will be in driving position, and the crank pins of said primary crank shaft being so arranged relatively to each other and to those of the secondary crank shaft that said crank pins of the primary crank shaft will come successively into driving position and the prime movers will act conjointly to ex-

ert power on the primary crank shaft during the time each actuating lever is making its power or driving stroke.

4. The combination with two prime movers having reciprocating motion through equal distances in opposite directions in parallel paths, and a driven shaft, of a primary crank shaft provided with two crank pins with which said prime movers are severally connected, two swinging actuating levers, means affording driving connection between each actuating lever and said driven shaft during each stroke of the actuating lever in one direction, and an intermediate or secondary crank shaft arranged parallel with said primary crank shaft and the driven shaft and provided with crank pins located at equal angular distances apart and severally acting on said swinging actuating levers, said crank pins and actuating levers being so arranged that the forward or driving stroke of each actuating lever is effected in the movement of the crank pin acting thereon through the part of its path remote from the driven shaft, and gearing connecting said primary crank shaft with said secondary crank shaft, said primary crank shaft having its two crank pins located at approximately 135° apart and arranged in such relation to the crank pins on the secondary crank shaft that power is exerted by both of the prime movers on said primary crank shaft during the time each actuating lever is making its power or driving stroke.

In testimony, that I claim the foregoing as my invention I affix my signature in the presence of two witnesses, this 9th day of December, A. D. 1910.

REINHOLD A. NORLING.

Witnesses:
C. A. BURGESS,
ALOIS C. WARKEN.