Nov. 2, 1926.

1,605,712

G. H. GILMAN

DRILLING MACHINE

Filed Jan. 10, 1920

4 Sheets-Sheet 1

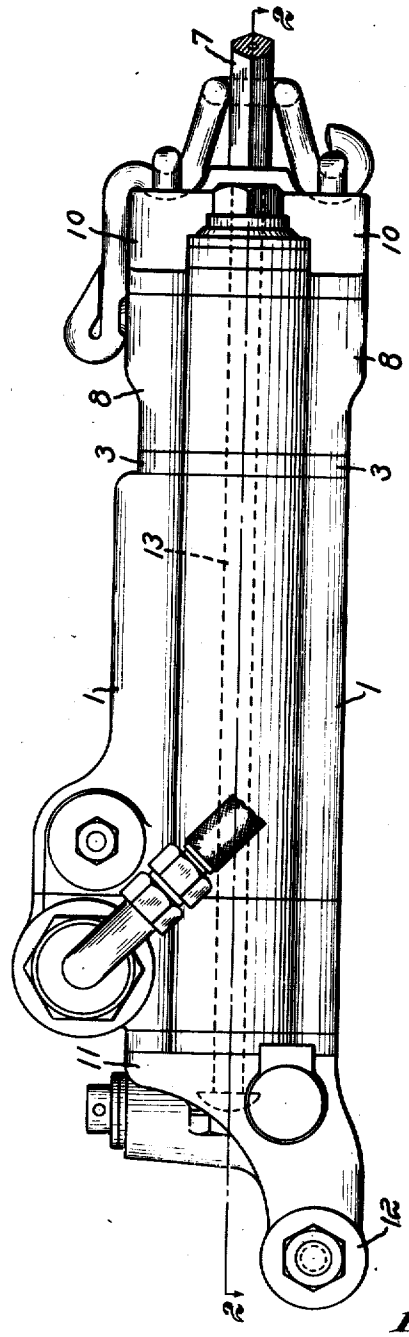


Fig. 1.

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Filed Jan. 10, 1920 4 Sheets-Sheet 2

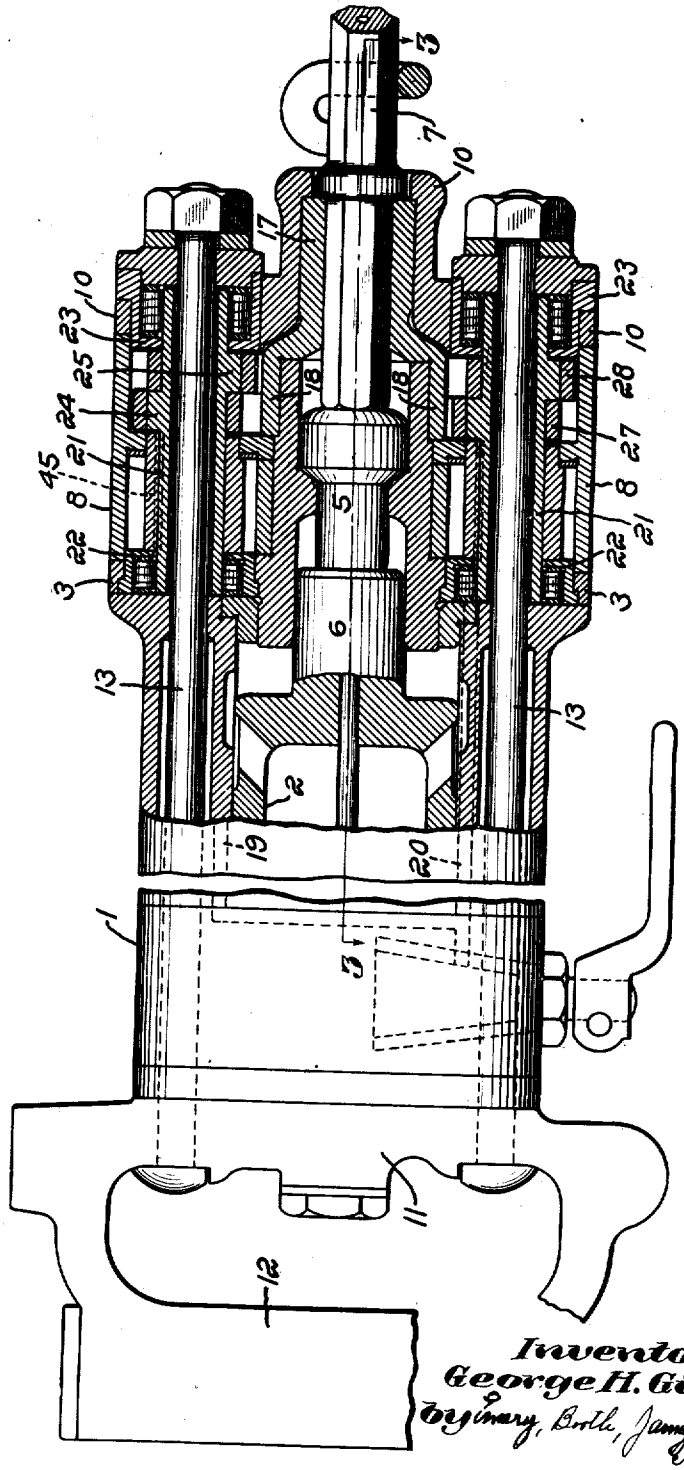


Fig. 2.

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4 Sheets-Sheet 3

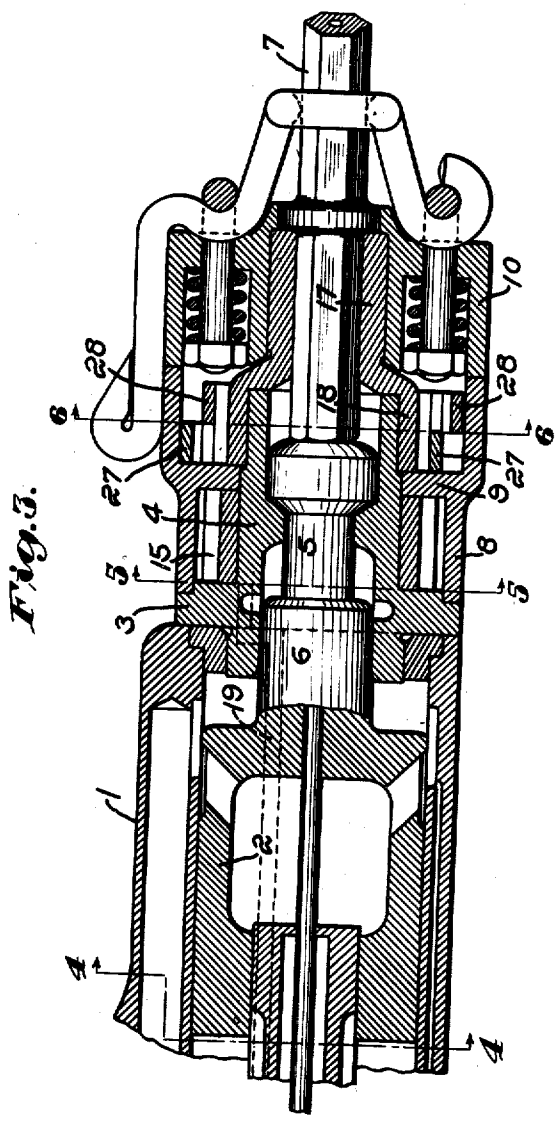


Fig. 3.

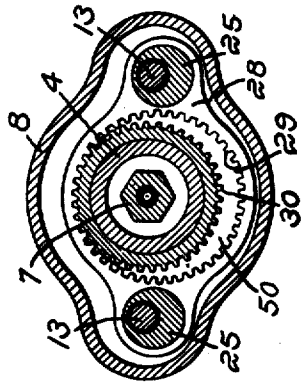


Fig. 6.

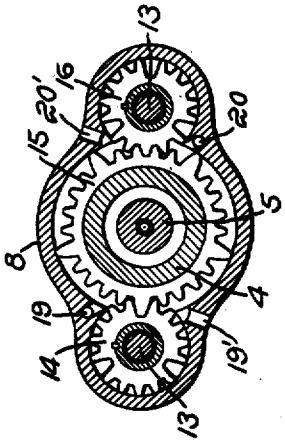


Fig. 5.

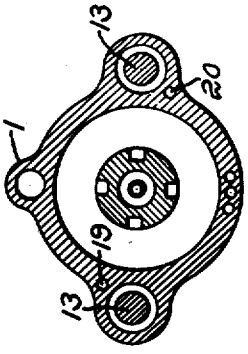


Fig. 4.

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4 Sheets-Sheet 4

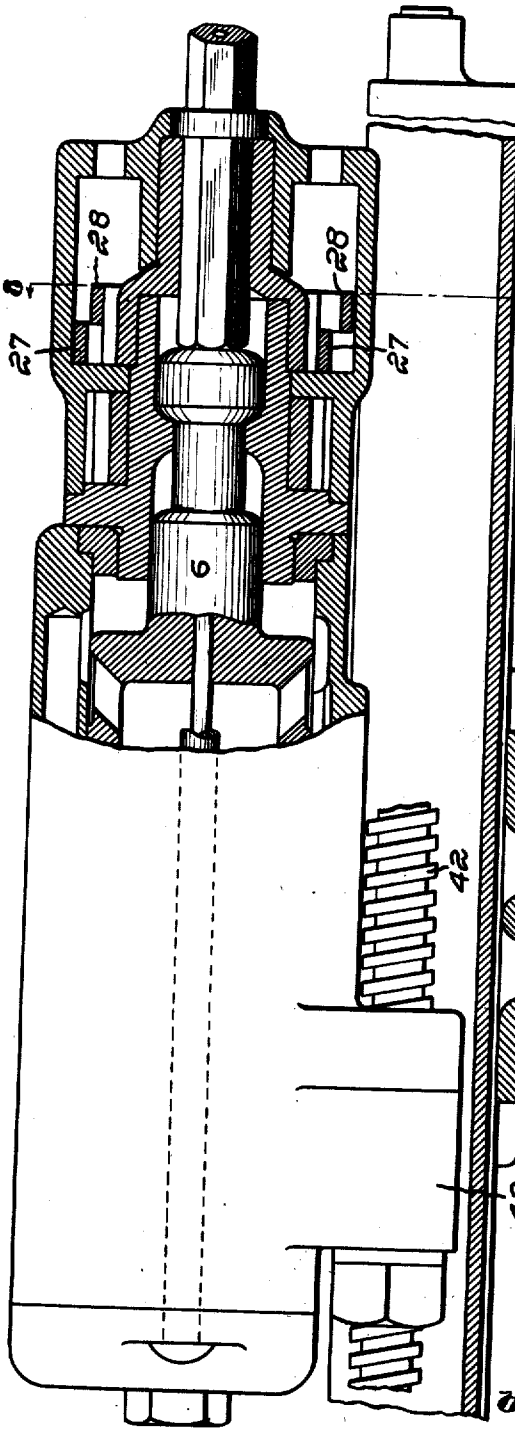


Fig. 7.

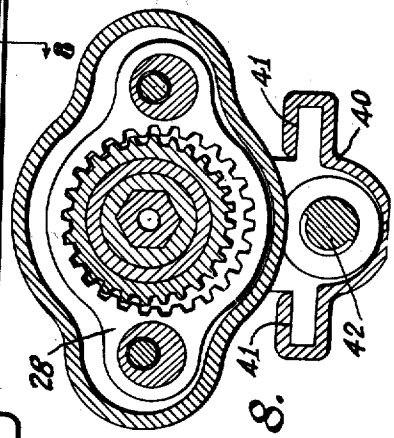


Fig. 8.

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Patented Nov. 2, 1926. 1,605,712

UNITED STATES PATENT OFFICE.

GEORGE H. GILMAN, OF BOSTON, MASSACHUSETTS.

DRILLING MACHINE.

Application filed January 10, 1920. Serial No. 350,577.

My invention relates to drilling machines and will be best understood from the following description when read in the light of the accompanying drawings of several specific embodiments of my invention selected for illustrative purposes, while the scope of my invention will be more particularly pointed out in the appended claims.

In the drawings:

Fig. 1 shows an elevation of one embodiment of my invention.

Fig. 2 shows an elevation at right angles to Fig. 1 and partial section on the line 2—2 of Fig. 1.

Fig. 3 shows a section on the line 3—3 of Fig. 2.

Figs. 4, 5 and 6 respectively show sections on the lines 4—4, 5—5 and 6—6 of Fig. 3.

Fig. 7 shows an elevation of a mounted hammer drill parts being shown in section, and

Fig. 8 shows a section on the line 8—8 of Fig. 7.

My invention is shown in Figs. 1 to 6 as embodied in a hand hammer and in Figs. 7 and 8 is embodied in a mounted hammer drill. These machines generally speaking comprise a hammer piston which is adapted to impart percussion to a drill steel, the latter being held in a chuck rotated by a rotary fluid pressure motor provided with reduction gearing operatively connected to the chuck. My invention although it comprehends percussive tools is not limited exclusively thereto and includes within its scope drills which cut by rotative action alone.

Referring particularly to Figs. 1 to 6 I have illustrated a cylinder member 1 provided with a piston 2 reciprocated by fluid pressure controlled by any suitable means, and closing the front end of the cylinder a cylinder head 3 herein formed separately from the cylinder member and provided with an extension or sleeve 4 providing a reduced diameter portion for the cylinder within which is received a striking pin 5 and the hammer bar 6 which serve to transmit the momentum of the piston 2 to the drill steel. It will be understood by those skilled in this art that the striking pin may be omitted and the hammer bar alone be used to transmit the momentum of the piston to the steel and in which case the hammer bar shown may be lengthened approximately a distance equal to the longitudinal dimension of the striking pin.

In this illustrative embodiment of my invention surrounding the sleeve member 4 of the cylinder is a casing 8 provided with a transverse portion 9 bearing on the sleeve and forwardly of the casing 8 is a second casing 10 while rearwardly of the cylinder member is a rear cylinder head 11 which carries the handle 12, the parts just enumerated being held in assembled relation by means of the side bolts 13 which herein extend from the rear cylinder head 11 to the front end of the casing 10 as is clearly shown in Fig. 2. As illustrated the casing 8 serves as the motor casing for the chuck rotating motor which herein comprises the gear members 14, 15 and 16, and to house a reduction gearing hereinafter described, and further serves as a spacing means between the cylinder head 3 and the casing 10. The casing 10 hereinafter termed the chuck casing has mounted therein the forward portion of a chuck 17, said chuck as illustrated being provided with an enlarged portion 18 which has a bearing on the forward end of the sleeve portion 4 of the cylinder.

In the particular embodiment of my invention illustrated the gear member 15 of the motor, which as shown is rotatably mounted on the sleeve 4, forms a rotary piston with which mesh the gear members 14 and 16 forming rotary abutments for this piston. Motive fluid, preferably compressed air, is supplied the motor by suitable passages herein indicated at 19 and 20, which passages communicate in any convenient manner with the source of motive fluid supply for the machine and open into the interior of the casing 8 adjacent the points of intersection of the gear members 14 and 16 with the gear member 15.

As illustrated the gear members 14 and 16, herein constituting rotary abutments for the gear member or rotary piston 16, are carried by shafts 21 situated at opposite sides of the sleeve member 4 in parallelism therewith, the gear members 14 and 16 being illustrated herein as secured in non-rotatable relation to the respective shafts 21 by keys 45 (Fig. 2). The shafts 21 are herein mounted in bearings 22 and 23 respectively situated in the front cylinder head 3 and in the chuck casing 10, and as illustrated formed integrally with

each shaft are pairs of eccentrics 24 and 25 positioned approximately 180° apart as clearly indicated in Fig. 2, which figure for convenience of illustration shows the eccentrics rotated around 90° from the position of the eccentrics in the other figures. As illustrated, connecting opposite eccentrics are a pair of yokes 27 and 28 provided with cylindrical openings 50 which adapt them to surround the rearward portion 18 of the chuck the inner periphery of the openings being provided with internal gear teeth 29 meshing with gear teeth 30 formed on the chuck. In order among other things to neutralize vibration I have herein provided two yokes both of which are provided with gear teeth meshing with the chuck, and the eccentrics are set with relation to each other as above specified to give each yoke a gyratory motion which at any given time moves one yoke in the opposite direction to the other. As the yokes gyrate the toothed portions thereof roll about the toothed portion of the chuck and for one revolution of the teeth of the yoke the chuck is advanced a distance corresponding to the difference between the number of teeth on the respective parts thereby providing a great speed reduction.

It will be observed from the foregoing description that I have provided fluid pressure actuated means for rotating the chuck comprising an annular gear mounted for gyratory movement.

In order to secure a compact arrangement in the submitted embodiment of my invention the shafts 21 are made hollow and surround the side bolts 13. It will be noticed that the cylinder head 3 and the chuck casing form closures for the casing 8 which herein forms the motor casing for the chuck rotating motor and contains the reduction gearing, and that the bolts 13 act as securing means for holding these parts in assembled relation.

It will be observed by comparison of Figs. 3, 4, 5 and 6 that in the submitted embodiment of my invention the motor, gearing, and cylinder member are each generally elliptical in outline, having their respective minor and major axes substantially in the same planes and having their corresponding transverse dimensions or cross-sectional areas substantially embraced within the confines of the corresponding projected dimensions or cross-sectional areas of each of the others. In other words, Figs. 4, 5, and 6 each show sections generally elliptical in outline and having minor and major axes of substantially the same length, and illustrate parts which in the assembled rock drilling machine are organized in coaxial relation to each other in such manner that one is symmetrically superimposed upon the other, the cylinder, chuck, yokes, and motor herein in the assembled machine being in encircling relation to the axial line of said cylinder. It will be understood that herein the yokes move about the axial line of the piston so that the yokes as operating parts remain in substantially coaxial relation therewith, their major and minor axes not deviating during such motion in marked degree from the planes defined by the corresponding major and minor axes of the motor and cylinder.

For many kinds of rock drilling reciprocating motors for rotating the chuck and mechanical means for the same purpose have proven unsatisfactory. To overcome the difficulties incident to these forms of mechanism for rotating the chuck it has been proposed to employ an independent rotary motor for the purpose, and heretofore in attempting to solve this problem it has been found that a rotary motor when organized with the other parts of the machine creates a structure which is so cumbersome and bulky that the machine can be used in confined situations, as for example close to a wall or in a cleft between rocks, only with extreme difficulty, if at all. It will be observed that with machines constructed according to the submitted embodiments of my invention, as for example the hand hammer constructed according to Fig. 1, these disadvantages of prior rock drills employing independent motors are eliminated by the employment of a rotary motor and reduction gearing, each of which is generally of the same cross-sectional shape and size as the cylinder and is coaxial therewith, the motor and gear further being substantially annular to permit them to be compactly arranged with the cylinder. It will further be observed that in this embodiment of my invention I have provided flattened structures for housing the motor and the reduction gearing, and that the minor transverse dimension of these structures is substantially that of the corresponding dimension of that part of the cylinder which houses the large diameter portion of the piston. In other words, it will be observed that both the motor and reduction gearing are of such character and shape as to permit them to be organized with the conventional forms of rock drills without forming a bulky structure, the rock drill, for example that herein constructed according to Fig. 1, being capable of use in substantially the same restricted situations as if the motor and reduction gearing were omitted. At the same time the reduction gearing possesses the merits of simplicity and ruggedness and can be organized with the motor without undue complexity of transmission mechanism.

In the modification shown by Figs. 7 and 8 my invention is shown as embodied in a mounted drill comprising a cradle 40 provided with guide-ways 41 and a feed screw

42 coacting with the nut 43 and serving to move the drilling machine along the guides. In other respects this modification is similar to that shown by Figs. 1 to 6.

It will be understood by those skilled in the art that in common practice in drilling rock the drill steel is changed for every two to three feet of advance of the drill hole, and as the drill hole is advanced on the average of from 12 to 30 inches per minute the drill steel in consequence must be changed frequently. It is therefore of importance in a mounted machine, such as is illustrated by Figs. 7 and 8, to form the machine with an absence of protuberances which will prevent ready withdrawal of the drill steel from the drill hole and insertion of a new drill steel during the operation of changing drill steels. In all mounted rock drills heretofore proposed in which a rotary chuck motor is provided a bulky structure has resulted extending beyond the normal confines of the dimensions of the cylinder body, and with such machines the changing of drill steels has been rendered exceedingly difficult, and especially when the motor has been located at the front end of the machine. It will be appreciated that if the machine interferes with the withdrawal of the drill steel the cradle must be moved in order to permit this operation, with the result that the amount of rock drilled during a shift will be materially decreased. It will further be observed from Figs. 7 and 8 that I have herein provided a mounted machine in which the motor and reduction gear permit the hammer drill to be placed close to the feed screw and without forming a structure which will interfere with the drill steel during the operation of changing drill steels. Placing the hammer close to the feed screw minimizes the stresses set up in the feed screw by the recoil of the hammer drill.

Although I have described several modifications of my invention it is to be understood that within the scope of the appended claims the same is susceptible of other modifications without departing from the spirit thereof.

Claims:—

1. In a rock drill, a percussive motor comprising a cylinder member, a drill chuck, a chuck rotating motor comprising three meshing gear members arranged side by side and acted upon by fluid pressure, reduction gearing comprising a gyratory member operatively connecting said motor and chuck, the middle gear member of said chuck rotating motor and said reduction gearing being axially aligned with said cylinder member, and said motor and reduction gearing being substantially embraced within the confines of the projected cross-sectional area of said cylinder member.

2. In a rock drill, a percussive motor cylinder member, a chuck, a chuck rotating motor comprising a plurality of meshing gear members acted upon by fluid pressure, gyratory reduction gearing substantially coaxial with said chuck operatively connecting said chuck and its rotating motor, said chuck rotating motor and gearing each being carried by said cylinder member, and as operative wholes having each a long and a short axis, the corresponding axes of each substantially lying in the same longitudinal of said cylinder member.

3. In a rock drill, a percussive motor cylinder member, a chuck, a chuck rotating motor comprising three gear members acted upon by fluid pressure and lying diametrically side by side, the middle gear member of said motor being coaxial with said chuck, gyratory reduction gearing substantially coaxial with said chuck operatively connecting said chuck and said motor, said chuck rotating motor and gyratory gearing each being carried by said cylinder member and as operative wholes having each a long and a short transverse axis, the corresponding axes of each substantially lying in the same plane longitudinal of said cylinder member and the short axes being substantially embraced within the corresponding transverse dimension of said cylinder.

4. In a rock drill, a cylinder, a reciprocatory fluid actuated hammer piston in said cylinder, a chuck carried by said cylinder in rotatable relation thereto, said chuck formed for carrying a drill steel in non-rotatable relation thereto, an internal gear surrounding said chuck, external gear teeth carried by said chuck and meshing with said internal gear, eccentrics at opposite sides of said chuck, said internal gear being mounted on said eccentrics and being gyrated thereby about the axis of said chuck, a gear aligned with each eccentric and connected in driving relation thereto, a third gear coaxial with said hammer piston and meshing with each of said first mentioned gears, a casing for said gears forming therewith a rotary expansible chamber type motor, and means for admitting motive fluid to said casing for operating said motor.

5. In a rock drill, a cylinder, a reciprocatory fluid actuated hammer piston in said cylinder, a chuck carried by said cylinder in rotatable relation thereto, said chuck formed for carrying a drill steel in non-rotatable relation thereto, an annular series of gear teeth carried by said chuck, a member having a second annular series of gear teeth eccentric to and meshing with said series carried by said chuck, eccentrics at opposite sides of said chuck carrying said member for gyrating said member about the axis of said chuck, a gear aligned with each eccentric and connected in driving relation thereto, a third gear coaxial with said

hammer piston and meshing with each of said first mentioned gears, a casing for said gears forming therewith a rotary expansible chamber type motor, and means for admitting motive fluid to said casing for operating said motor.

6. In a rock drill, a cylinder, a chuck carried by said cylinder in rotatable relation thereto, said chuck formed for carrying a drill steel in non-rotatable relation thereto, percussive mechanism for forming the drill hole including a reciprocatory fluid actuated hammer piston in said cylinder, a fluid operated chuck rotating motor having a fluid actuated rotary member in the form of a ring mounted coaxially with said piston and surrounding said percussive mechanism, eccentrics at opposite sides of said chuck, means connecting said eccentrics to said motor for driving them in the same direction, said chuck carrying an annular series of gear teeth coaxially arranged therewith, a member having an annular series of gear teeth meshing with and eccentric to said annular series carried by said chuck, and said member being carried by said eccentrics and being gyrated thereby about the axis of said chuck.

7. In a drilling machine, a cylinder, a fluid actuated hammer piston, a chuck formed for carrying a drill steel, a fluid actuated chuck rotating motor delivering continuous uni-directional motion, reduction gearing connecting said motor and chuck, said reduction gearing comprising a gyratory yoke surrounding said chuck and having an annular series of gear teeth eccentric to and meshing with an annular series of gear teeth operatively connected to said chuck, said yoke and chuck encircling the axial line of said piston, and said yoke gyrating about said line.

8. In a drilling machine, a cylinder, percussive mechanism for forming the drill hole comprising a hammer piston in said cylinder, a chuck formed for carrying a drill steel, a fluid pressure operated chuck rotating motor comprising three meshing gear members arranged substantially diametrically side by side, the central one of said gear members being in the form of a ring surrounding said percussive mechanism, and reduction gearing connecting the outside of said gear members to said chuck.

9. In a drilling machine, a cylinder, a hammer piston in said cylinder, a chuck formed for carrying a drill steel, a fluid pressure operated chuck rotating motor comprising three meshing gear members arranged substantially diametrically side by side, reduction gearing comprising a gyratory yoke surrounding said chuck and operatively connecting one of the outside of said gear members to said chuck, said yoke and the central one of said three gear members encircling the axial line of said piston, and said yoke gyrating about said line.

10. In a drilling machine, a cylinder, a hammer piston in said cylinder, a chuck formed for carrying a drill steel operated by said hammer piston, a yoke having an annular portion through which said chuck extends, oppositely disposed eccentric members exteriorly of said chuck carrying and adapted to gyrate said yoke about the axis of said chuck, shafts on which said eccentric members are mounted, means including a motor carried by said cylinder for driving said shafts in unison, and a spur gear connection between said annular portion of said yoke and chuck.

11. In a drilling machine, a cylinder, percussive mechanism for forming the drill hole comprising a hammer piston, a chuck formed for carrying a drill steel, a yoke operatively connected to said chuck and having an annular portion surrounding said percussive mechanism, oppositely disposed eccentric members for gyrating said yoke, shafts at the side of said machine and on which said eccentric members are mounted, means for driving said shafts in unison comprising gear wheels mounted on said shafts and an intermediate gear meshing with said first named gears, said intermediate gear being coaxial with said piston and surrounding said percussive mechanism, and fluid pressure motor means for rotating said gears.

12. In a drilling machine, a cylinder carrying a hammer piston, a chuck formed for carrying a drill steel, a ring gear substantially aligned with said chuck and rotatably supported relatively to said cylinder, a yoke surrounding said chuck and operatively connected thereto, a pair of smaller oppositely disposed gears meshing with said aligned gear, motor means for rotating said gears, shafts aligned with and driven by said second mentioned gears, and means on said shafts for gyrating said yoke, said ring gear being substantially coaxial with said cylinder and said yoke encircling the axial line of said cylinder.

13. In a drilling machine, a percussive motor comprising a cylinder having a front head structure, a chuck formed for carrying a drill steel, said clutch supported in said front head structure for rotation relatively to said cylinder, motor means for rotating said chuck, a reduction gear for transmitting the motion of said motor to said chuck and comprising a gyrating yoke housed in said front head structure, said yoke having an annular portion geared to and encircling said chuck.

14. In a drilling machine, a percussive motor comprising a cylinder having a front head structure, a motor having spaced rotary members housed in said front head structure, a chuck housed in said front head structure

and supported for rotation relatively to said cylinder, a yoke housed in said front head structure and having an annular portion eccentric to the axis of said cylinder, means driven by said rotary members for gyrating said yoke about the axis of said cylinder, and means for admitting motive fluid to said head structure for operating said motor.

15. In a drilling machine, a percussive motor cylinder member having a front head structure the minimum transverse dimension of which is substantially that of the corresponding transverse dimension of said cylinder, shafts in said front head structure at opposite sides thereof, eccentrics on said shafts, a yoke in said front head structure carried by said eccentrics, a chuck surrounded by said yoke and operatively connected to said yoke, and motor means for rotating said shafts in unison.

16. In a drilling machine, a percussive motor cylinder, a front head structure therefor, members securing said structure to said cylinder, a chuck, a yoke for rotating the same, shafts mounted concentrically with said securing means, means on said shafts for gyrating the yoke, and means for rotating the shafts.

17. In a drilling machine, a percussive motor cylinder, a front head structure therefor, members securing said structure to said cylinder, a chuck, a yoke for rotating the same, and means mounted concentrically with said securing members for gyrating the yoke.

18. In a drilling machine, a percussive cylinder containing a hammer piston and having a cylinder head, a chuck formed for carrying a drill steel, a chuck casing, a spacing member between said head and casing, a chuck rotating motor and reduction gearing comprising a gyrating yoke having an annular portion surrounding means for transmitting percussion to the bit of said drill steel, said motor and gearing being housed by said spacing member and said spacing member forming a motor casing for said motor, means for admitting motive fluid to said motor casing for operating said motor, and means for securing said chuck casing to said cylinder.

19. In a drilling machine, a percussive cylinder containing a hammer piston and having a cylinder head, a chuck formed for carrying a drill steel, a chuck casing, a spacing member between said head and casing, means securing said chuck casing to said cylinder, a gyratory yoke operatively connected in driving relation to said chuck and having an annular portion surrounding means for imparting percussion to the bit of said drill steel, said yoke being housed by said spacing member, a pair of eccentrics in said spacing member for gyrating said yoke, a motor in said spacing member comprising a plurality of rotary members, and means for admitting motive fluid to said casing for driving said rotary members of said motor.

20. In a drilling machine, a casing, front and rear closures therefor, bearings in said closures supporting oppositely arranged shafts, means for rotating said shafts, a yoke, means operated by said shafts for gyrating said yoke, a chuck connected to said yoke, and securing means for said closures extending through said shafts.

21. In a drilling machine, a cylinder member, a cylinder head having an extension, a chuck, a chuck casing, said chuck having an exterior bearing on said chuck casing and an interior bearing on said extension, a spacing member between said head and chuck casing, means for securing said chuck casing to said cylinder member, a motor and reduction gearing for rotating the chuck, and said motor and gearing being housed by said spacing member.

22. In a drilling machine, a cylinder, a cylinder head having an extension, a geared member surrounding said extension, a chuck, said chuck having a bearing on said extension, driving mechanism between said geared member and chuck comprising a second geared member located at the side of said first mentioned geared member and in mesh therewith, and a gyratory yoke surrounding said extension and driven by said second mentioned geared member.

23. In a drilling machine, a cylinder, a cylinder head having an extension, a geared member surrounding said extension, a chuck, driving mechanism between said geared member and chuck comprising a second geared member located at the side of said first mentioned geared member and in mesh therewith, and a gyratory yoke having an annular portion surrounding said chuck and driven by said second mentioned geared member.

24. In a drilling machine, a cylinder, a hammer piston having a hammer bar, a cylinder head having an extension, said hammer bar adapted to enter said extension, a fluid pressure operated motor member surrounding said extension and mounted for rotation, a chuck, and gearing adapted to connect said motor member and chuck comprising a gyratory annular gear surrounding said extension.

25. In a drilling machine, a support, a percussive motor slidably mounted on said support, said percussive motor having a cylinder relatively close to said support, a chuck, reduction gearing comprising a gyratory gear operatively connected to said chuck, said gyratory gear being aligned with said cylinder and having a transverse dimension relatively longer than the trans-

verse dimension at right angles thereto, said longer dimension being substantially parallel to the plane of the support, and means for moving said percussive motor along the support.

26. A drilling machine having in combination, a fluid operated hammer drill comprising a casing in which is mounted a reciprocatory hammer piston and a rotary chuck formed for carrying a drill steel, a mounting for said casing having longitudinally extending guides supporting said casing in relatively close relation thereto for longitudinal feeding movement, a motor and reduction gearing for rotating said chuck, said motor and reduction gearing being housed by said casing, said motor having three meshing gears arranged diametrically side by side on diameters in a plane parallel to the plane of said guides, the central gear being coaxial with said casing, eccentrics aligned with and driven by the outer two of said three gears, an annular member mounted on said eccentrics and gyrated thereby about the axis of said casing, and a gear connection between said annular member and chuck.

27. A drilling machine having in combination, a fluid operated hammer drill comprising a casing in which is mounted a reciprocatory hammer piston and a rotary chuck formed for carrying a drill steel, a mounting for said casing having longitudinally extending guides supporting said casing in relatively close relation thereto for longitudinal feeding movement, a feed screw relatively close to said casing for moving said casing along said guides, a motor and reduction gearing for rotating said chuck, said motor and reduction gearing being housed by said casing, said motor having three meshing gears arranged diametrically side by side on diameters in a plane parallel to the plane of said guides, the central gear being coaxial with said casing, eccentrics aligned with and driven by the outer two of said three gears, an annular member mounted on said eccentrics and gyrated thereby about the axis of said casing, and a gear connection between said annular member and chuck.

28. In a rock drill, a cylinder, a piston in said cylinder having a hammer bar, a chuck, a chuck rotating motor comprising an annular rotary member actuated by fluid pressure positioned to surround said hammer bar in at least one position of the piston, an annular casing for said rotary member, means for admitting pressure fluid to said casing for effecting rotation of said rotary member, means comprising an annular gyratory gear for operatively connecting said rotary member to said chuck; said rotary member being substantially coaxial with said piston and said gyratory gear encircling and gyrating about the axial line of said piston, and means for securing said casing to said cylinder.

29. In a drilling machine, a piston having a larger and a smaller diameter portion, means forming a casing for said piston, said casing having a smaller and larger diameter portion, a chuck, a motor for driving said chuck and comprising a rotary member operated upon by fluid pressure and surrounding said smaller diameter portion of said casing, a reduction gear for driving said chuck comprising an annular gear gyrated by said motor about the axis of said rotary member, said rotary member and annular gear encircling the axial line of said piston.

30. In a drilling machine, a piston having a larger and a smaller diameter portion, means forming a casing for said piston, said casing having smaller and larger diameter portions, a chuck, a motor for driving said chuck and having a pair of meshing rotary gears operated upon by fluid pressure one of which surrounds the smaller diameter portion of said casing, and a reduction gearing operatively connected to the other of said rotary gears and comprising an annular gear; said rotary gear which surrounds said casing and said annular gear both encircling the axial line of said piston.

31. In a rock drill, a cylinder, a hammer piston in said cylinder, a rotary chuck formed for carrying a drill steel, a gear coaxial with said piston, relatively smaller gears meshing with said first named gear, eccentrics aligned with and driven by said smaller gears, a yoke for driving said chuck and having an annular portion surrounding the axis of said cylinder, said yoke being mounted on said eccentrics, the three meshing gears having their axes in a plane corresponding to the median position of the major axis of said yoke, and the minor axis of said yoke and said gear coaxial with said piston being embraced in the major projected cross-sectional area of said cylinder.

32. A rock drill having in combination, a casing, a hammer piston reciprocably mounted in said casing, a chuck formed for carrying a drill steel and being rotatably mounted in said casing, fluid pressure actuated means for rotating said chuck comprising a yoke surrounding the rearward end of said chuck, means including an eccentric for effecting gyratory motion of said yoke, and internal gear teeth on said yoke meshing with gear teeth on said chuck.

33. A rock drill having in combination, a casing, a hammer piston reciprocably mounted in said casing, a chuck formed for carrying a drill steel and being rotatable relatively to said casing, fluid pressure actuated means for rotating said chuck com-

prising a yoke mounted for gyratory movement and carrying an annular series of gear teeth eccentrically to the axis of said chuck, and a second annular series of gear teeth in operative relation to said chuck for driving said chuck and meshing with the first mentioned annular series of gear teeth.

34. A rock drill having in combination, a casing, a hammer piston reciprocably mounted in said casing, a chuck formed for carrying a drill steel and being rotatable relatively to said casing, fluid pressure actuated means for rotating said chuck comprising a yoke mounted on a plurality of spaced eccentrics for gyrating movement and carrying an annular series of gear teeth eccentrically to the axis of said chuck, and a second annular series of gear teeth in operative relation to said chuck for driving said chuck and meshing with the first mentioned annular series of gear teeth.

35. A rock drill having in combination, a casing, a hammer piston reciprocably mounted in said casing, a chuck formed for carrying a drill steel, said chuck being rotatable relative to said casing, fluid pressure actuated means for rotating said chuck comprising an annular gear mounted for gyratory movement and having an annular series of gear teeth eccentric to the axis of said chuck, a second annular series of gear teeth in operative relation to said chuck for driving the latter and meshing with the first mentioned series of gear teeth, said annular gear and chuck encircling the axial line of said piston, and said gear gyrating about said line.

36. A rock drill having in combination, a casing, a hammer piston reciprocably mounted in said casing, a chuck formed for carrying a drill steel, said chuck being rotatable relative to said casing, motor and reduction gearing means actuated by fluid pressure for driving said chuck comprising an annular member mounted for gyratory movement, said annular member and said chuck encircling the axial line of said piston, and said gear gyrating about said line.

37. In a drilling machine, a cylinder, a chuck formed for carrying a drill steel, fluid actuated percussive means within said cylinder for operating said steel, said chuck mounted for rotation relatively to said cylinder, reduction gearing including a gyratory gear for driving said chuck, said gear with respect to its axis of movement being coaxial with said chuck, a fluid actuated rotary motor comprising a gear member surrounding said cylinder and a second gear member located at the side of said cylinder and meshing with said first gear member, and driving means for said gyratory gear at the side of said cylinder operatively connecting said second mentioned gear member to said reduction gearing.

38. In a drilling machine, a cylinder, a chuck formed for carrying a drill steel, fluid actuated percussive means within said cylinder for operating said steel, reduction gearing comprising a gyratory gear for driving said chuck, said gear with respect to its axis of movement being coaxial with said chuck, a rotary motor comprising a gear member surrounding said cylinder, a plurality of gear members at the side of said cylinder and meshing with said first mentioned gear member, and driving means operatively connecting one of said last mentioned gear members to said gyratory gear comprising an eccentric for effecting gyration of said gyratory gear.

39. In a drilling machine, a cylinder, a chuck formed for carrying a drill steel, fluid actuated percussive means within the cylinder for operating said steel, said chuck journalled on said cylinder, a fluid actuated rotary motor surrounding said cylinder and comprising a member journalled on said cylinder, and reduction gearing connecting said motor and chuck for rotating the latter, said reduction gearing comprising a gyrating yoke geared to said chuck and surrounding said cylinder.

40. In a drilling machine, a cylinder, a chuck formed for carrying a drill steel, fluid actuated percussive means within said cylinder for operating said steel, a gear carried by said chuck, a rotary motor comprising a rotary member actuated by fluid pressure and surrounding said cylinder, a second rotary member at the side of said cylinder operatively connected in driving relation to the first mentioned rotary member, and reduction gearing for connecting said second rotary member to said chuck comprising a gyrating yoke surrounding the cylinder and having gear teeth meshing with said first mentioned gear.

41. In a drilling machine, a cylinder, a chuck formed for carrying a drill steel, a gear for said chuck, fluid actuated percussive means within said cylinder for operating said steel, a rotary motor comprising a gear member surrounding said cylinder and journalled thereon and a plurality of gear members at the side of said cylinder, a gyrating yoke surrounding said cylinder, means including a pair of eccentrics driven by the side gear members for gyrating said yoke, and said yoke having a gear meshing with said gear for said chuck.

42. In a percussive drilling machine, a cylinder member, a hammer piston in said cylinder, a chuck formed for carrying a drill steel actuated by said hammer piston, said chuck supported in rotatable relation to said cylinder, a fluid pressure motor for rotating said chuck, said motor having an annular member provided with gear teeth

and a second member provided with gear teeth, the gear teeth of said several members meshing, said annular member and said chuck surrounding said cylinder, reduction gearing connecting said motor and chuck, said reduction gearing comprising an annular gear surrounding said cylinder, an eccentric driven by said motor for gyrating said annular gear, and casings for said motor and gearing surrounding said cylinder and being supported in non-rotatable relation thereto.

43. In a percussive drilling machine, a cylinder member, a hammer piston in said cylinder, a chuck formed for carrying a drill steel actuated by said hammer piston, said chuck supported in rotatable relation to said cylinder, a fluid pressure motor for rotating said chuck, said motor having an annular member provided with gear teeth and a second member provided with gear teeth, the gear teeth of said several members meshing, said annular member and said chuck surrounding said cylinder, reduction gearing connecting said motor and chuck, said reduction gearing comprising an eccentric driven by said second member and an annular gear gyrated by said eccentric, and a casing for said motor and gearing surrounding said cylinder and being supported in non-rotatable relation thereto.

44. In a drilling machine, a chuck formed for carrying a drill steel, a percussive cylinder, a hammer piston in said cylinder for operating said steel, a pair of intermeshing gear members located at the side of and parallel to said cylinder, a casing for said gear members, means for admitting motive fluid to said casing and causing it to act upon and to rotate said gear members, said chuck being rotatable relative to said cylinder, and a reduction gearing for operatively connecting said chuck and said gear members.

45. In a rock drill, a cylinder, a hammer piston in said cylinder, a chuck formed for carrying a drill steel operated by said hammer piston, said chuck having a rearwardly extending sleeve surrounding said cylinder, external gear teeth carried by said chuck, a gear surrounding said cylinder and meshing with a gear at the side of said cylinder, an eccentric at the side of said cylinder driven by said gear at the side of said cylinder, and a yoke carrying internal gear teeth surrounding said cylinder and meshing with said external gear teeth carried by said chuck.

In testimony whereof, I have signed my name to this specification.

GEORGE H. GILMAN.

and a second member provided with gear teeth, the gear teeth of said several members meshing, said annular member and said chuck surrounding said cylinder, reduction gearing connecting said motor and chuck, said reduction gearing comprising an annular gear surrounding said cylinder, an eccentric driven by said motor for gyrating said annular gear, and casings for said motor and gearing surrounding said cylinder and being supported in non-rotatable relation thereto.

43. In a percussive drilling machine, a cylinder member, a hammer piston in said cylinder, a chuck formed for carrying a drill steel actuated by said hammer piston, said chuck supported in rotatable relation to said cylinder, a fluid pressure motor for rotating said chuck, said motor having an annular member provided with gear teeth and a second member provided with gear teeth, the gear teeth of said several members meshing, said annular member and said chuck surrounding said cylinder, reduction gearing connecting said motor and chuck, said reduction gearing comprising an eccentric driven by said second member and an annular gear gyrated by said eccentric, and a casing for said motor and gearing surrounding said cylinder and being supported in non-rotatable relation thereto.

44. In a drilling machine, a chuck formed for carrying a drill steel, a percussive cylinder, a hammer piston in said cylinder for operating said steel, a pair of intermeshing gear members located at the side of and parallel to said cylinder, a casing for said gear members, means for admitting motive fluid to said casing and causing it to act upon and to rotate said gear members, said chuck being rotatable relative to said cylinder, and a reduction gearing for operatively connecting said chuck and said gear members.

45. In a rock drill, a cylinder, a hammer piston in said cylinder, a chuck formed for carrying a drill steel operated by said hammer piston, said chuck having a rearwardly extending sleeve surrounding said cylinder, external gear teeth carried by said chuck, a gear surrounding said cylinder and meshing with a gear at the side of said cylinder, an eccentric at the side of said cylinder driven by said gear at the side of said cylinder, and a yoke carrying internal gear teeth surrounding said cylinder and meshing with said external gear teeth carried by said chuck.

In testimony whereof, I have signed my name to this specification.

GEORGE H. GILMAN.

Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,605,712, granted November 2, 1926, upon the application of George H. Gilman, of Boston, Massachusetts, for an improvement in "Drilling Machines," errors appear in the printed specification requiring correction as follows: Page 2, line 64, strike out the word and comma "cylinder,"; page 3 line 76, after the word "same" insert the word *plane;* and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 4th day of January, A. D. 1927.

[SEAL.]

M. J. MOORE,
Acting Commissioner of Patents.

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