This invention relates to improvements in vertical continuous drilling machines more particularly adapted for drilling a large number of like parts. A further object of the invention is to provide a vertical continuous drilling machine having a plurality of drilling spindles arranged to permit continuous drilling and reaming of pistons, yokes, connecting rods, and so forth, which may be mounted on a moving part of the machine at one point and removed at another point, the drilling or reaming operation being completed between the two points.

A further object of the invention is to provide a vertical continuous drilling machine in which the drills or other work instrumentalities are automatically raised from the work when the operation is completed to permit removal of the completed parts and the mounting of other parts to be worked upon.

A further object of the invention is to provide a vertical continuous drilling machine with pick-off gears between drive and transverse shaft and between transverse shaft and machine rotating shaft to permit various relative speed changes of the parts.

A further object of the invention is to provide a vertical continuous drilling machine in which the drill spindles and the supporting table are adjusted vertically to permit use of drills of different lengths and work of varying sizes.

A further object of the invention is to provide a vertical continuous drilling machine having a force feed oiling means for oiling the parts and the drills while cutting material.

A further object of the invention is to provide a vertical continuous drilling machine having equalizing drive to spindles and rotation of machine and table.

A further object of the invention is to provide a vertical continuous drilling machine having means for taking the end thrust of the tooth pressure of the gears.

A further object of the invention is to provide a vertical continuous drilling machine in which the double spur gear is mounted in a novel manner to eliminate friction.

A further object of the invention is to provide a vertical continuous drilling machine which is of simple construction, is strong and durable and is well adapted for the purposes described.

With the above and other objects in view the invention consists of the improved vertical continuous drilling machine and its parts and combinations as set forth in the claims, and all equivalents thereof.

In the accompanying drawings in which the same reference characters indicate the same parts in all of the views:

Fig. 1 is a vertical sectional view of the improved vertical continuous drilling machine;

Fig. 2 is a horizontal sectional view thereof taken on line 2—2 of Fig. 1;

Fig. 3 is a similar view taken on line 3—3 of Fig. 1;

Fig. 4 is a vertical sectional view taken on line 4—4 of Fig. 1;

Fig. 5 is a horizontal sectional view taken on line 5—5 of Fig. 1;

Fig. 6 is a sectional detail of the cam and adjacent parts for moving the drill spindles vertically;

Fig. 7 is a detail perspective view on a larger scale showing the means for adjustably supporting the spindle actuating cam;

Fig. 8 is a detail view partly in section of one of the spindles and connected parts;

Fig. 9 is a horizontal sectional detail view taken on line 9—9 of Fig. 8; and

Fig. 10 is an enlarged detail sectional view of one of the ring gear spindle bearings. Referring to the drawings the numeral 10 indicates a base member or support to which a vertical tubular standard 11 is connected. A circular casing or frame 12, formed for convenience of manufacture in several parts, is fixedly mounted on the upper end portion of the standard and at its upper end portion a horizontal shaft 13 is journaled and enclosed therein. An electric motor 14 mounted on the upper portion of the casing 12 has a gear train connection 15 with one end of the upper horizontal shaft 13. The upper horizontal shaft also has a pair of bevel gears 16 mounted medially of its length and a
clutch 17 mounted on the end portion of said shaft opposite to the end connected to the gear train 15. The complementary clutch member 18 which is clutched to the shaft 13 by the clutch 17, has connected thereto a gear 19. Said gear forms part of a gear chain 20 mounted on short shafts 21 and 22 journaled in the circular casing. All of said shafts mentioned rotate in ball bearings 23 to reduce friction.

A clutch lever 17’ depending from the casing 12 provides for moving the clutch member into and out of clutching engagement with its complementary clutch member.

A casing cover 12’ permits access to the gear train 20 so that said gears may be removed and replaced by others of different relative diameters to change the speed ratio of the parts to suit the work involved.

A lower horizontal worm shaft 24 journaled in the circular casing and extending at right angles to the upper shaft 13 has a bevel gear driving connection 25 with the short shaft 22, and at its opposite ends is provided with worms 26. The worms 26 mesh with worm wheels 27 which are mounted on the upper ends of short vertical shafts 28. Said vertical shafts are journaled in ball bearings 29 mounted in the circular casing 12, and at their lower end portions are provided with pinions 30.

A vertically extending sleeve 31 journaled on the standard 11 is provided with a lower bearing portion 32 which rests upon the base member 10 to support and permit the free turning of the sleeve thereon. Said bearing portion is extended to form an oil chamber 33 having a frustra-conical shaped cover 34 which extends into the oil chamber and is supported upon an annular rib 35 extending inwardly from a medial portion of the outer wall of the oil chamber. The inclined wall of the cover directs the oil which drops from the work along its peripheral edge and into the oil chamber while preventing the metal borings from the work from entering the said chamber. A rotary pump 36 mounted within the chamber is driven by and has a geared connection with a vertical shaft 37, which has a geared connection 37’ with one of the spindle shafts 52. A flexible hose 38 connected to the pump and extending upwardly to a discharge means 38’ to points of use, is adapted to supply oil to the work tools during their operation.

The upper circular casing 12 adjacent the upper end of the standard 11 and beneath the horizontal shaft 13 is provided with ball bearings 39 to receive short vertical shafts 40. Said shafts 40 are positioned on diametrically opposite sides of the standard 11 and the upper ends thereof are provided with bevel gears 41 which are in mesh with and driven by the bevel gears 18. The lower ends of the vertical shafts 40 are provided with pinions 42 which are in mesh with the upper gear part 43 of a double gear ring 44.

A large ring gear 45 of angular form in cross-section surrounds and is rigidly mounted on the upper end portion of the vertically extending sleeve 31 and the teeth 45’ forming the gear are on the outer periphery thereof and are in mesh with the pinions 30 which rotate the ring gear in end connected parts.

A plurality of vertical rollers 46 journaled on shafts 47 projecting radially from the ring gear 45 support the double gear ring 44 and a plurality of horizontal rollers 47’ journaled on vertical shafts 48 arranged in spaced relation around the ring gear 45 bear against the inner periphery of the double gear ring and in combination with the vertical rollers form the bearing for said double gear ring and take the side thrust of the tooth pressure of meshing pinions.

A spindle sleeve tool carrier 49 mounted fast on the vertical sleeve 31 is provided with outwardly projecting vertically extending bearings 50 for slidable receiving spindle bearings 51 of the ball bearing end thrust type to reduce end thrust friction. Rotary spindles 52 journaled in said spindle bearings 51 extend slidably upwardly therefrom through rotary bearings 53 journaled in the ring gear 45. The portions 52’ of the spindles which extend slidably through the rotary bearings 53 are longitudinally grooved or castellated to slidably connect with pinions 54 through which they extend. The hub portions of the pinions 54 extend above the bearings 53 to engage and rotate the spindles 52 while the pinions are in mesh with and rotated by the lower and larger diameter gear 55 forming part of the double gear ring 44.

The lower ends of the spindles have socket 163 means 56 for receiving and holding drills or other work instrumentalities 57 for working on articles clamped to the supporting table or tables 58 vertically adjustable mounted on the vertical sleeve 31 and turning therewith. The tables 58 are provided with dovetail grooves 59 for convenience in clamping work or work holding jigs thereto.

The lower portion of the upper circular casing 12 is provided with depending flat 115 bolts 60 having lower end points. The bolts are adjustable clamped to the casing 12 by a bolted band 61 between which and the casing the bolts extend and nuts 62 threaded on the bolts for adjusting the lower edges of the band and the casing to limit the upward movement of the bolts. A cam member 63 bolted to the inner side of the ends of the bolts 60 extends, at a vertical angle, circumferentially approximately three quarters of the distance around the outer sides of the spaced reciprocal bearings 51. Ball bearing rollers 64 journaled radially of the sleeves 31 extend on the outer side portions of the reciprocal bearings 51 beneath the cam member 63.
are positioned to engage the lower edge portion of the cam member 63 to be moved downwardly thereby while the sleeves 61 are turning around the standard.

The bearings 51 are provided with vertically adjustable collars 65 having outwardly projecting guide portions 65' which extend between guides 66 extending between the bearings 50 and the casing 12 to prevent turning of the said bearings. Said collars are provided with openings 67 which intersect the bores, through which the bearings 51 extend, to permit the insertion of a toothed key 67' to engage the rack teeth 67'' to vertically adjust the bearings with relation to the collars. Bolts 85 clamp the collars in adjusted positions on the bearings.

Chains or cables 69 connected to the collars 65 and extending over pulleys 70 downwardly therefrom in wells 71, formed in the tool carrier or spindle sleeve 49, and are connected to springs or counterweights 72 to yieldingly hold the rollers 64 bearing against the cam and the spindles in their upper position.

Referring to Fig. 6 the numeral 73 indicates the point of engagement of the spindle bearing rollers with the cam and the number bearing 74 the point of disengagement of said rollers while the space 75 between said points is the time period during which the spindles are not moved vertically and the articles are either clamped to or removed from the tables while the vertical sleeve upon which the tables are mounted is relatively, slowly turning around the standard.

In operation the articles to be worked are mounted on jigs or other holding means on the tables and as the tables turn to have their spindle bearing rollers engage the cam portion 73 and the work instrumentality will be gradually moved downwardly to engage the work or the articles, and by the time each article reaches the point corresponding to the cam disengaging position of its respective spindle bearing roller, the work will be completed and the article removed and replaced by another during the travel through the space 75 to provide for continuous operation of the machine. The clutch lever 17' provides for the manual control of the rotation of the vertical sleeve 31 and connected parts, and if it is desired to change the speed of the tool carrier with relation to the speed of rotation of the tools, other gears are substituted for the gears 20 to provide the desired ratio.

From the forgoing description it will be seen that the vertical continuous drilling machine is of simple construction, is strong and durable and is well adapted for continuous and large production of work.

What I claim as my invention is:

1. A vertical continuous drilling machine, comprising a base member having a vertical standard and a cam extending partly around the upper portion of the standard, a sleeve journaled on the standard and having at its upper end a plurality of circumferentially spaced and vertically reciprocal end thrust bearings, a ring gear mounted on the upper end portion of the sleeve, a vertical shaft having a pinion in mesh with the ring gear for rotating the sleeve, means for rotating the vertical shaft, pinions journaled on the ring gear in vertical alignment with the bearings, tool spindles for holding work tools journaled in and extending through the bearings and slidably engaging the pinions and rotated thereby, a double gear ring journaled on rollers carried by the ring gear and in mesh with the pinions for rotating the tool spindles while they are being reciprocated and being carried by the sleeve, a vertical shaft carried by the standard and having a pinion meshing with one of the gears of the double gear ring for rotating said double gear ring, work holding members carried by the sleeve and positioned below the tool spindles, an oil receiver located below the work holding members, a pump means for forcing oil from the receiver to the tool spindles, said bearings and tool spindles being moved downwardly towards the work holding members by the cam, and means for moving the bearings and the tool spindles away from the work holding members when the end of the cam is reached.

2. A vertical continuous drilling machine, comprising a base member having a vertical standard and a cam extending partly around the upper portion of the standard, a sleeve journaled on the standard and having at its upper end a plurality of circumferentially spaced and vertically reciprocal end thrust bearings, a ring gear mounted on the upper end portion of the sleeve, vertical shafts positioned on opposite sides of the ring gear and having pinions in mesh therewith and at their upper ends having worm wheels, a horizontal shaft having worms in mesh with the worm wheels, a second horizontal shaft having a driving connection with a motor, a clutch and geared connection between the two horizontal shafts, pinions journaled on the ring gear in vertical alignment with the bearings, tool spindles for holding work tools journaled in and extending through the bearings and having a splined and slidably engaging with the pinions journaled on the ring gear, a double gear ring journaled on rollers carried by the ring gear and in mesh with the tool spindle pinions, vertical shafts carried by the standard and positioned on opposite sides of the double gear ring and having pinions in mesh with one of the gears of said double gear ring, the upper end portions of said last mentioned vertical shafts having a geared connection with the second horizontal shaft, work holding members carried by the sleeve and positioned below the
tool spindles, said spindles and bearings moved towards the work holding members by the cam, and means for moving the spindles and bearings away from the work holding members when the end of the cam is reached.

3. A vertical continuous drilling machine, comprising a base member having a vertical standard and a cam extending partly around the standard, said cam member being vertically adjustable connected to the standard, a sleeve journaled on the standard and having at its upper end a plurality of circumferentially spaced and vertically reciprocal end thrust bearings, a ring gear mounted on the upper end portion of the sleeve, vertical shafts positioned on opposite sides of the ring gear and having pinions in mesh therewith and at their upper ends having worm wheels, a horizontal shaft having worm wheels in mesh with the worm wheels, a second horizontal shaft having a driving connection with a motor, a clutch and geared connection between the two horizontal shafts, pinions journaled on the ring gear in vertical alignment with the bearings, tool spindles for holding work tools journaled in and extending through the bearings and having a splined and slidable engagement with the pinions journaled on the ring gear, a double gear ring journaled on rollers carried by the ring gear and in mesh with the tool spindle pinions, vertical shafts carried by the standard and positioned on opposite sides of the double gear ring and having pinions in mesh with one of the gears of said double gear ring, the upper end portions of said last mentioned vertical shafts having a geared connection with the second horizontal shaft, work holding members carried by the sleeve and positioned below the tool spindles, said spindles and bearings moved towards the work holding members by the cam, and means for moving the spindles and bearings away from the work holding members when the end of the cam is reached.

4. A continuous drilling machine, comprising a base member having a standard and a cam extending partly around the standard, a sleeve journaled on the standard and having a plurality of circumferentially spaced reciprocal end thrust bearings, a ring gear mounted on the sleeve, a shaft having a pinion in mesh with the ring gear for rotating the sleeve, means for rotating the shaft, pinions journaled on the ring gear in alignment with the bearings, tool spindles for holding work tools journaled in and extending through the bearings and slidably engaging the pinions and rotated thereby, a double gear ring journaled on the ring gear and in mesh with the pinions for rotating the tool spindles while they are being reciprocated and being carried by the sleeve, a shaft carried by the standard and having a pinion meshing with one of the gears of the double gear ring for rotating said double gear ring, work holding members carried by the sleeve and positioned at an end of the tool spindles, an oil receiver located near the work holding members, a pump means for forcing oil from the receiver to the tool spindles, said bearings and tool spindles being moved towards the work holding members by the cam, and means for moving the bearings and the tool spindles away from the work holding members when the end of the cam is reached.

5. A continuous drilling machine, comprising a base member having a standard and a cam extending partly around the standard, a sleeve journaled on the standard and having a plurality of circumferentially spaced reciprocal end thrust bearings, a single ring gear mounted on the sleeve, shafts positioned on opposite sides of the ring gear and having pinions in mesh therewith and also carrying worm wheels, a second shaft having worms in mesh with the worm wheels, a third shaft having a driving connection with a motor, a clutch and geared connection between said second and third shafts, pinions journaled on the ring gear in alignment with the bearings, tool spindles for holding work tools journaled in and extending through the bearings and having a splined and slidable engagement with the pinions journaled on the ring gear, a double gear ring journaled on said single ring gear and in mesh with the tool spindle pinions, shafts carried by the standard and positioned on opposite sides of the double gear ring and having pinions in mesh with one of the gears of said double gear ring, the upper end portions of said last mentioned vertical shafts having a geared connection with the second horizontal shaft, work holding members carried by the sleeve and positioned at an end of the tool spindles, said spindles and bearings moved towards the work holding members by the cam, and means for moving the spindles and bearings away from the work holding members when the end of the cam is reached.

6. A continuous drilling machine, comprising a base member having a standard and a cam extending partly around the standard, said cam member being adjustably connected to the standard, a sleeve journaled on the standard and having a plurality of circumferentially spaced reciprocal end thrust bearings, a single ring gear mounted on the sleeve, shafts positioned on opposite sides of the ring gear and having pinions in mesh therewith and also having worms, a second shaft having worm wheels in mesh with the worms, a third shaft having a driving connection with a motor, a clutch and geared connection between said second and third shafts, pinions journaled on the ring gear in alignment with the bearings, tool spindles for holding work tools journaled in and extending through the bearings and having a splined and slidable engagement with the pinions and rotated thereby, a double gear ring journaled on the ring gear and in mesh with the pinions for rotating the tool spindles while they are being reciprocated and being carried by the sleeve, a shaft carried by the standard and having a pinion meshing with one of the gears of the double gear ring for rotating said double gear ring, work holding members carried by the sleeve and positioned at an end of the tool spindles, an oil receiver located near the work holding members, a pump means for forcing oil from the receiver to the tool spindles, said bearings and tool spindles being moved towards the work holding members by the cam, and means for moving the bearings and the tool spindles away from the work holding members when the end of the cam is reached.
gagement with the pinions journaled on the single ring gear, a double gear ring journaled on rollers carried by the single ring gear and in mesh with the tool spindle pinions, shafts carried by the standard and positioned on opposite sides of the double gear ring and having pinions in mesh with one of the gears of said double gear ring, the end portions of said last mentioned shafts having a geared connection with said third shaft, work holding members carried by the sleeve and positioned at an end of the tool spindles, said spindles and bearings being movable towards the work holding members by the cam, and means for moving the spindles and bearings away from the work holding members when the end of the cam is reached.

In testimony whereof, I affix my signature.

FRANK M. DAVIS.