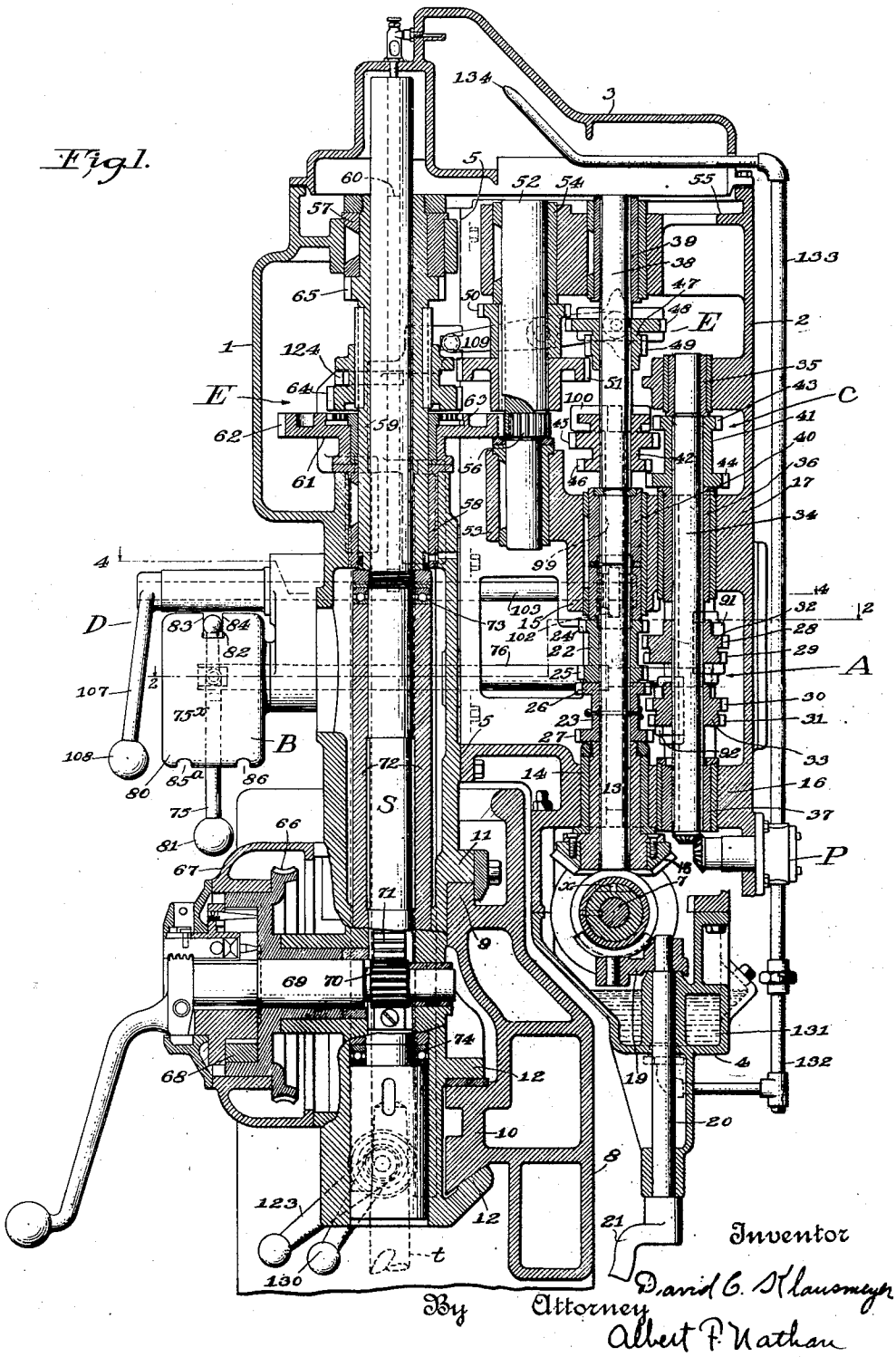
June 17, 1930. D. C. KLAUSMEYER 1,763,713

SELF OILING CENTRALIZED CHANGE GEARS

Filed Jan. 6, 1925 3 Sheets-Sheet 1

Fig 1.



June 17, 1930. D. C. KLAUSMEYER 1,763,713

SELF OILING CENTRALIZED CHANGE GEARS

Filed Jan. 6, 1925 3 Sheets-Sheet 2

Fig. 3.

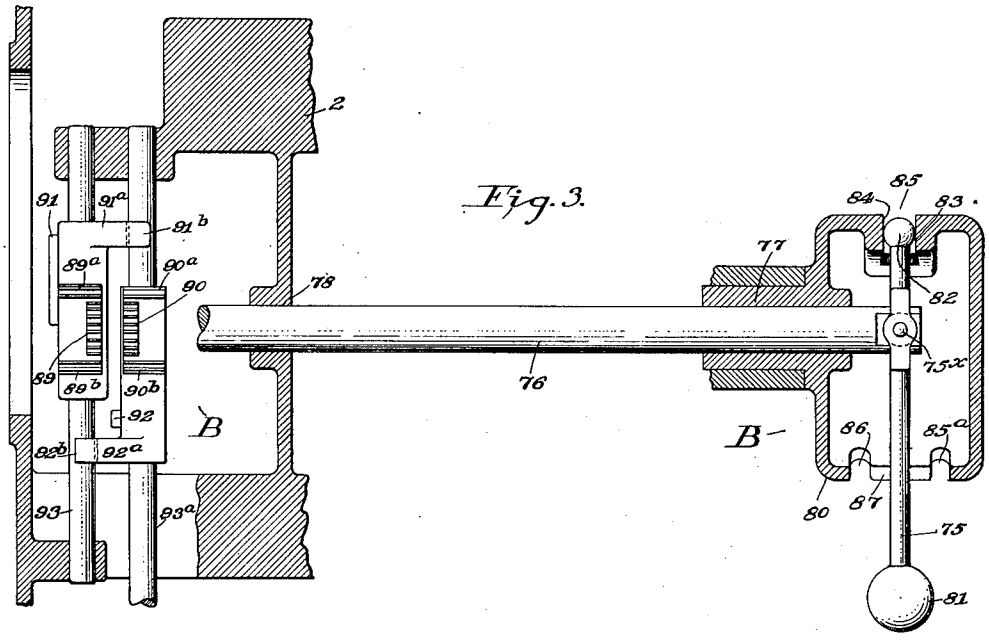


Fig. 2.

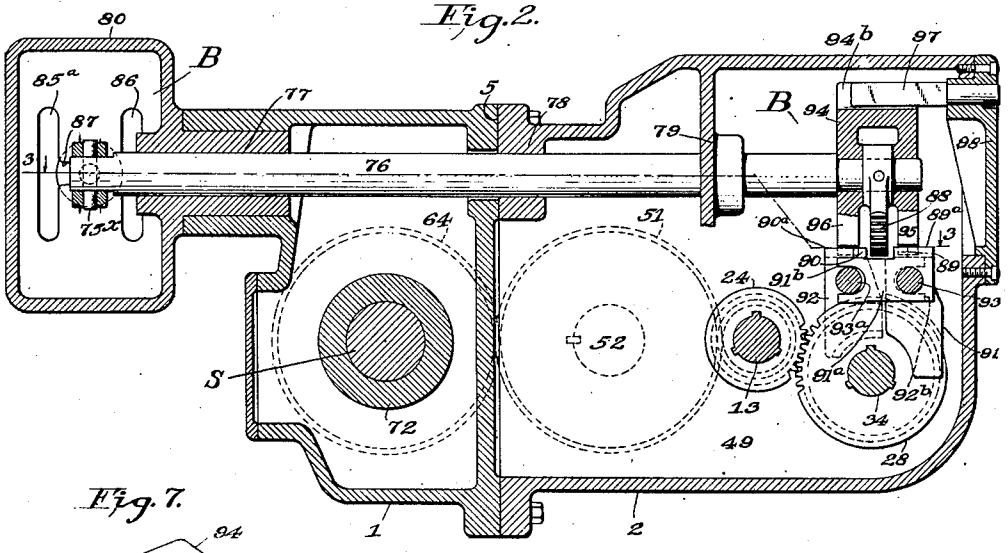
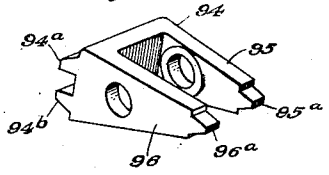


Fig. 7.



Inventor

David C. Klausmeyer

By Attorney

Albert F. Nathan

June 17, 1930. D. C. KLAUSMEYER 1,763,713

SELF OILING CENTRALIZED CHANGE GEARS

Filed Jan. 6, 1925 3 Sheets-Sheet 3

Fig. 5.

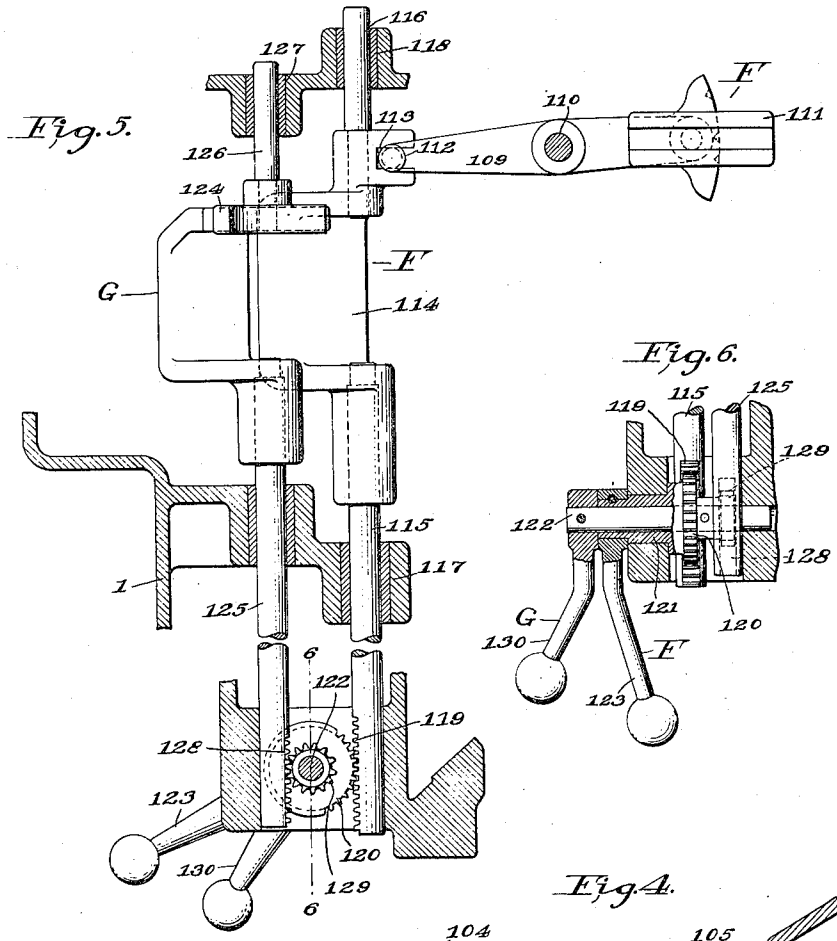
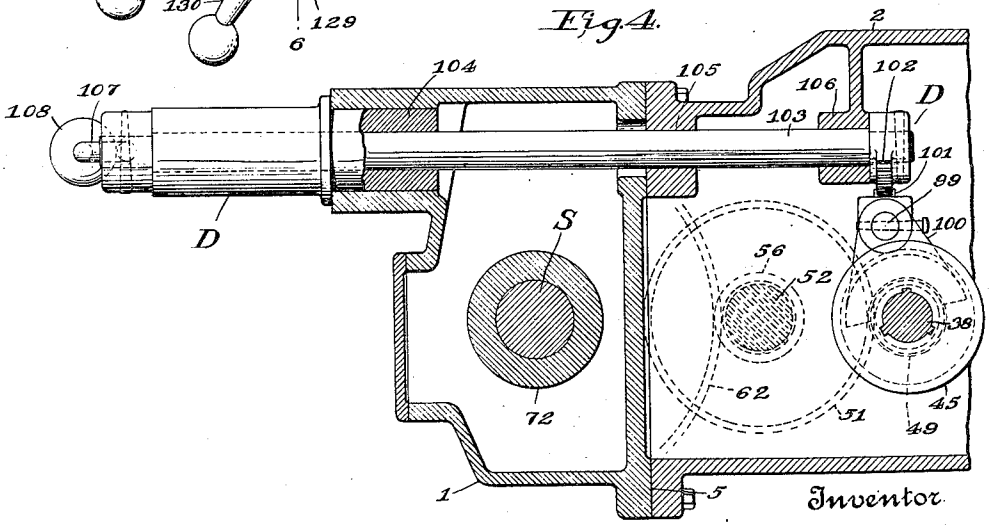


Fig. 6.

Fig. 4.



Inventor

David C. Klausmeyer

By Attorney

Albert F. Nathan

Patented June 17, 1930 1,763,713

UNITED STATES PATENT OFFICE

DAVID C. KLAUSMEYER, OF CINCINNATI, OHIO, ASSIGNOR TO THE CINCINNATI BICKFORD TOOL COMPANY, OF CINCINNATI, OHIO, A CORPORATION OF OHIO

SELF-OILING CENTRALIZED CHANGE GEARS

Application filed January 6, 1925. Serial No. 804.

This invention deals with machine-tools and it relates more particularly to the construction of radial-drill heads wherein there is embodied a tool-spindle adapted to be rotated and translated in the head. These spindles are adapted to carry various types and sizes of tools such as drills and taps of varying diameters and inasmuch as each of these tools requires a different speed of rotation for maximum efficiency it is essential that means be provided for regulating the speed of rotation of the spindle.

Heretofore this has usually been accomlished by providing, adjacent the prime-mover, and remote from the drill-head, a speed-change mechanism (hereinafter termed the speed-box) adapted to provide a plurality of speeds, usually six, which were transmitted to a shaft journaled lengthwise of the radial-arm. These six speeds were usually multiplied by four by another speed-change mechanism, commonly known as the back-gears, which were located in the drill-head and operatively connected with the tool-spindle. Thus by manipulation of both of the speed-change mechanism any one of twenty-four speeds selectively could be secured in the tool-spindle from a single speed in the prime-mover. The differences in ratio afforded by the speed-box are necessarily small since there is considerable mechanism actuated thereby and great differences in ratio would effect abrupt changes and cause strains that would be detrimental to the parts. Inasmuch as only the spindle is actuated by the back-gears the speed-changes provided therein may be materially greater than those provided by the speed-box.

To effect a predetermined speed in the spindle it has heretofore been necessary for the operator first, by manipulation of certain control levers carried by the drill-head, to shift the back-gears and thereby obtain the nearest approximate speed obtainable therein; and second, to leave his position at his work and go to the opposite end of the machine, where, by manipulation of the speed-box control-lever, he effected the finer and more accurate speed setting. This remote location of the finer speed changes renders their frequent manipulation inconvenient and unhandy and therefore the tendency of the operator is to ignore the finer speed settings and to rely on the nearest speed obtainable in the back-gears which he may shift from his position at his work. This employment of improper spindle speeds results in loss of efficiency and is likely to prove detrimental to the tool should too great a speed be employed.

This invention has for an object to provide an improved drill-head embodying within itself all of the speed-change mechanism necessary to produce at least as many speed-changes in the spindle as has heretofore usually been provided by both the primary and secondary speed change devices located in the head and adjacent the prime-mover respectively.

A further object of the invention is to provide means within easy reach of the operator, when stationed at his work, for selectively effecting any available spindle speed.

Another object of the invention is to provide a drill-head having all of the speed-change mechanism embodied therein, and so to arrange the parts that a maximum number of speeds may be obtained by a minimum number of gears.

Still another object of this invention is to provide a drill-head having all of the speed-change mechanism embodied therein and so to arrange and locate the shaft-bearings and gears that all of the bearings and all of the speed-change gears may be generously and continuously lubricated by a lubricating system also embodied in the drill-head.

A still further object is to provide in a drill-head mechanism capable of attaining all of the above-noted objects and comprising a minimum number of parts arranged in a compact manner.

Another object of this invention is to provide a drill-head comprising a plurality of casing sections adapted to be secured together and so to arrange speed-change mechanism in each section that the parts thereof may readily and conveniently be assembled before the sections are united.

These objects have been attained in a drill-head comprising a plurality of sections adapted to be bolted together to form an oil-tight casing. Within the casing are journaled a tool-spindle and a plurality of shafts upon which are arranged three separate and independent speed-change mechanisms each adapted to be controlled by a lever located in a position where it is within easy reach of the operator when stationed at his work. The speed-changes afforded by the three speed-change mechanisms are 4×2×4 thus providing thirty-two speeds in the spindle from a single speed in a suitable drive-shaft. Thus not only does this invention provide speed-change gears located where they may more readily be shifted and where they, together with the shaft-bearings, may be continuously lubricated but it also provides a greater number of speed-changes than has heretofore been provided with the usual speed-box and back-gear speed changes. Each of the casing sections is provided with a plurality of bearings for the gear-supporting shafts and these bearings are so arranged that they may readily be machined and so that the shafts and gears carried thereby may readily be assembled therein or removal therefrom without disturbing the mechanism in the adjacent section.

Other objects and advantages will be in part indicated in the following description and in part rendered apparent therefrom in connection with the annexed drawings.

To enable others skilled in the art so fully to apprehend the underlying features hereof that they may embody the same in the various ways contemplated by this invention, drawings depicting a preferred typical construction have been annexed as part of this disclosure and, in such drawings, like characters of reference denote corresponding parts throughout all the views, of which:—

Fig. 1 is a vertical section of a radial drill-head embodying the present invention, certain of the parts being shown slightly out of their normal positions, for the sake of clearness. Fig. 2 is a horizontal section on the line 2—2 of Fig. 1. Fig. 3 is a vertical section substantially on the line 3—3 of Fig. 2, looking in the direction of the arrows. Fig. 4 is a horizontal section substantially on the line 4—4 of Fig. 1. Fig. 5 is a vertical section showing the means for shifting certain of the gears of the back-gear mechanism. Fig. 6 is a section substantially on the line 6—6 of Fig. 5. Fig. 7 is a perspective view of a gear-shifter locking element later to be referred to.

Referring more particularly to the drawings the invention is disclosed as embodied in a drill-head comprising front and rear casing sections 1 and 2 and top and bottom sections 3 and 4 respectively. The front and rear sections are adapted to be bolted together on the line 5 and contain all of the mechanism necessary to provide thirty-two speed changes in the tool-spindle. The top or cover-section 3 is secured upon the upper ends of the sections 1 and 2 and the bottom section 4 is secured to the lower end of the section 2. The section 4 contains a reversing mechanism and a lubricant reservoir both later to be described.

Rotatably and translatably journaled in the section 1 is the tool-spindle S which carries, in its lower end, the usual tools, the shank of one of which is indicated by t in Fig. 1. Power to rotate the spindle is brought from a prime-mover, which may be located at any convenient place, into the tool-head by a shaft 7 journaled lengthwise of the usual radial arm 8. As is common to machine-tools of this type the arm is provided with longitudinal guides 9 and 10 upon which the tool-head is slidably fitted as by ways 11 and 12 provided by the head. From the shaft 7 the power flows to an upright shaft 13 journaled in bearings 14 and 15 supported by lower and intermediate horizontal walls 16 and 17 respectively provided by the section 2. Loosely journaled coaxial with the shaft 7 are two bevel gears (one only of which is shown) which are maintained permanently in mesh with opposite sides of a similar bevel gear 18 fixed to the shaft 13. A suitable clutch device indicated generally as x is provided for selectively rendering either of the two first named bevel-gears effective to rotate the shaft 13 in opposite directions from the shaft 7. This clutch device may be operated by shifting mechanism comprising an arm 19 fixed upon one end of a shaft 20 journaled in the section 4 and an actuating lever 21 fixed upon the other end of the shaft. From the foregoing it will be apparent that the shaft 13 selectively may be rotated in either direction from, and at the same speed as, the shaft 7. This single speed may be multiplied into thirty-two speeds in the spindle by change-gear mechanism now to be described.

Fixed to the shaft 13 are gear-units 22 and 23 providing gears 24 and 25, and 26 and 27, respectively. These gears are adapted selectively to be meshed with gears 28 and 29 and 30 and 31 provided by gear-units 32 and 33 splined upon a shaft 34. The shaft 34 is journaled parallel to the shaft 13 in bearings 35, 36 and 37 supported by the casing section 2, the bearings 36 and 37 being carried by the horizontal walls 17 and 16 respectively. These gear-units 22, 23, 32 and 33 form a first speed-change device A and affords four speeds in the shaft 34 from a single speed in the shaft 13. The gears of the speed-change device A are adapted selectively to be meshed by gear-shifting mechanism designated generally as B (see Figs. 1, 2 and 3) later to be described.

The four speeds in the shaft 34 may be further multiplied into eight speeds in a shaft 38 journaled in bearings 39 and 40 supported in the section 2 co-axial with the shaft 13 by a second speed-change mechanism C. This last named mechanism comprises gear-units 41 and 42. Of these the former is fixed to the shaft 34 and provides gears 43 and 44 adapted selectively to be engaged by gears 45 and 46 provided by the gear-unit 42. The gear-unit 42 may be shifted lengthwise of the shaft 38 by gear-shifting mechanism designated generally as D (see Figs. 1 and 4) later to be described. The speed-change devices A and C just described correspond to and afford the speed-changes which, heretofore have usually been effected by a speed-box located adjacent the prime-mover and remote from the operator when stationed at his work. It is to be noted, however, that this simple compact and readily shiftable mechanism affords eight speed changes whereas in the remote speed-box usually only six speed-changes were provided.

Intermediate the shaft 38 and the spindle S is a third speed-change mechanism E usually termed the back-gears. These back-gears provide four speed-changes which multiply the eight speeds available in the shaft 38 into thirty-two speeds in the spindle as will now be described. Splined to the shaft 38 is a gear-unit 47 providing gears 48 and 49 adapted (by means of a gear-shifter F) to be brought into mesh with gears 50 and 51 respectively secured upon a shaft 52 thus providing sixteen speeds in the shaft 52 from eight speeds in the shaft 38. The shaft 52 is journaled in bearings 53 and 54 supported by the intermediate wall 17 and an upper horizontal wall 55 respectively forming a part of the section 2. The shaft 52 also carries a small gear 56 later to be referred to. Journaled within bearings 57 and 58 supported by the section 1 of the tool-head is a spindle-driving sleeve 59 within which the spindle S is translatably held as by a spline 60 shown in dotted lines only in Fig. 1. This connection between the sleeve and spindle causes the spindle to be rotated with the sleeve but permits it to be moved endwise therein for purposes well understood. Loosely journaled upon the sleeve 59 is a gear-member 61 providing a gear 62, permanently in mesh with the small gear 56, and a clutch element 63. A gear 64 is splined to the sleeve 59 and is adapted selectively to be shifted (by a gear-shifter G see Figs. 5 and 6) either into engagement with the gear 51 or the clutch-element 63 to give to the sleeve 59 thirty-two speeds of rotation from the sixteen speeds available in the shaft 52.

In addition to its rotation the tool-spindle is adapted to be moved endwise in the sleeve 59 to cause the tool (the shank of which is indicated at *t* in Fig. 1) carried thereby to enter and emerge from the work. Power to give the spindle its downward movement is preferably taken from a gear 65 provided by the driving spindle 59. This gear is operatively connected (by gears, shafts and a worm not shown) to rotate a worm-wheel 66 located within a housing 67 secured upon the front portion of the section 1. This worm-wheel is adapted to be connected, at certain times, through a clutch device designated generally as 68, with a shaft 69 transverse to the tool spindle. The shaft 69 carries a pinion 70 maintained permanently in mesh with a rack 71 affixed to a non-rotatable sleeve 72 surrounding the tool-spindle and slidably mounted in the front section 1 of the casing. Relative endwise movement between the spindle and the sleeve 72 is prevented by thrust bearings 73 and 74. Thus rotation of the pinion 70, through the mechanism described results in translation of both the sleeve 72 and the spindle S in the tool-head while permitting the spindle to be rotated independently of the sleeve.

Referring now more particularly to the means for shifting the various gear-units, the shifting device B for the first speed change mechanism A comprises a lever 75 pivoted at 75^x intermediate its ends to an endwise movable shift 76 slidably mounted in bearings 77, 78 and 79 provided in a housing 80 and in the casing section 2. One end of the lever 75 is provided with a hand-grasp 81 and the opposite end is formed as a ball 82 which is held against movement lengthwise of the shaft by walls 83 and 84 of a slot 85 formed in the housing 80. The ball 82 and the walls 83 and 84 constitute a fulcrum for the lever 75 whereby the shaft 76 may be shifted lengthwise to either of two positions as later will be described. Intermediate the hand-grasp 81 and the pivot 75^x the lever 75 passes through an **H**-slot formed in the housing 80. For convenience the **H**-slot may be described as comprising left and right positions 85^a and 86 respectively and a central or connecting portion 87. To the inner end of the shaft 76 is secured a gear-segment 88 adapted, upon endwise movement of the shaft, to engage either of two racks 89 or 90 formed on the bases of gear-shifting forks 91 and 92 respectively. These gear shifting forks are slidably mounted upon rods 93 and 93^a fixed within the casing section 2 and engage the gear-units 32 and 33 respectively. The gear-shifter 91 is formed with a laterally projecting portion 91^a having a bifurcated end 91^b embracing the rod 93^a to prevent rotation of the gear-shifter about the rod. The shifter 92 is likewise provided with a laterally projecting portion 92^a bifurcated at 92^b and embracing the rod 93 for the same purpose. It will readily be understood that by swinging the lever through the central portion 87 of the **H**-slot the shaft 76

will be moved lengthwise and thereby cause the gear-segment 88 to engage either one or the other of the racks 89 or 90 dependent upon which direction the lever is moved from its neutral position shown in Figs. 1 and 2. The lever having been moved through the central slot and into either the slot 85[a] or 86 and the segment engaged with the rack of one of the gear-shifters 91 or 92 the lever may then be swung in either direction transverse to the axis of the shaft 76. This movement oscillates the shaft 76 and causes the gear-shifter then engaged by the segment to be moved up or down dependent upon the direction of movement of the lever 75.

A locking device is provided for holding the gear-shifters 91 and 92 against accidental movement when not engaged by the segment 87. This locking device comprises a U-shaped yoke 94 carried by the inner end of the shaft 76 and having arms 95 and 96 maintained on opposite sides of the gear segment 87. The arms 95 and 96 each have their forward ends formed as a single tooth 95[a] and 96[a], respectively, adapted to fit between the teeth of the racks 89 and 90. Referring now to Fig. 2 it will be seen that when the segment is in its neutral position the rack 89 is engaged by the arm 95 and the rack 90 is engaged by the arm 96. Now if the shaft 76 is moved inwardly, or to the right as viewed in Fig. 2 the yoke 94 and the segment 87 move with it with the result that the tooth 95[a] releases the rack 89 and the segment 87 is engaged therewith. The tooth 96[a] likewise moves to the right but remains in engagement with the rack 90 thus locking the gear-shifter 92 against movement. Upon movement of the shaft to the left from its position in Fig. 2, a like action takes place, the tooth 96[a] releasing the rack 90 which is then engaged by the segment and the tooth 95[a] remaining in engagement with the rack 89 thereby preventing movement of the gear-shifter 9. Adjacent the ends of the racks 89 and 90 there are formed teeth 89[a], 89[b] and 90[a], 90[b] which are substantially longer than the teeth of the racks 89 and 90. Upon shifting of the forks 91 and 92 these teeth engage the single teeth 95[a] or 96[a] and thereby limit the movement of the gear-shifters.

The rear side of the yoke 94 is provided with spaced walls 94[a] and 94[b] which engage a square pin 97 carried by a plate 98 fixed to the casing section 2, thus preventing rotation of the yoke about the shaft 76.

It is to be noted that the lever for shifting the gears of the initial speed-change device A is located at the front of the tool-head and in a position where it is within easy reach of the operator when stationed before his work.

The gear-unit 42 is preferably shifted lengthwise of the shaft 38 to cause its gears 45 and 46 to be meshed with the gears 43 and 44 by means now to be described. Translatably journaled in the section 2 is an upright shaft 99 (see Figs. 1 and 4) upon the upper end of which is secured a fork 100 adapted to engage the gear-unit 42. To the shaft 99 is secured a rack 101 which is engaged by a gear-segment 102 fixed upon the inner end of a shaft 103 journaled horizontally in bearings 104, 105 and 106 supported by the sections 1 and 2. A hand-lever 107, provided with a hand-grasp 108, is fixed upon the outer end of the shaft 103 and affords means to rotate the shaft, thereby to shift the gear-unit 42. It is also to be noted that the lever 107 also is located at the front of the tool-head and where it is readily accessible to the operator.

The shifting mechanism for the back-gears are shown more particularly in Figs. 1, 5 and 6. This comprises two separate devices, F and G, the first for the gear-unit 47 and the second for the gear 64. The shifting device F comprises a lever 109 pivoted intermediate its end upon a stud 110 carried by the section 2. One end of the lever carries a fork 111 embracing the gear 48 and the opposite end carries a stud or roller 112 engaged by a fork 113 of a member 114 fixed upon an endwise movable shaft 115 slidable in a bearing 117 in the section 1. The upper end of the member carries a pin 116 slidable in a bearing 118 in the section 1. The member 114 is formed so as to avoid interference with the gears 62 and 64. The lower end of the shaft 115 is provided with a rack 119 engaged by a gear 120, the hub 121 of which is loosely journaled on a shaft 122 carried by the lower end of the section 1. A lever 123 fixed to the hub 121 affords means to rotate the gear 120 thereby, through the mechanism described, to shift the gear-unit 47. The shifting device G is somewhat similar to the device F and comprises a gear-shifting fork 124 fixed upon a shaft 125 and engaging the gear 64. The fork 124 also carries a guide-pin 126 slidable in a bearing 127 provided by the section 1. The shaft 125 is provided with a rack 128 which is engaged by a pinion 129 fixed upon the shaft 122. A lever 130 fixed to the shaft 122 affords means for actuating the mechanism to shift the gear 64.

The gear-shifting levers 123 and 130 are also located at the front of the tool-head and in positions when they are within easy reach of the operator when stationed at his work.

From the foregoing it will be apparent that I have provided a tool-head embodying within itself all of the mechanism necessary to rotate the spindle at a great number of different speeds from a single speed in the arm shaft. Furthermore that the thirty-two speed changes are provided by a minimum number of gears. Still further all of the gear shifting levers are located at the front of the head and in positions where the operator may selectively employ any available spindle

speed without moving from his work. It is also to be noted that the parts are so arranged within the head that the bearings therefore may readily be finished and all of the mechanism assembled in the sections before they are secured together. This construction and arrangement is also particularly adaptable to a continuous lubricating system as fully disclosed in my Patent No. 1,653,576 dated Dec. 20, 1927.

For the purposes of this application it will suffice to say that the lubricating system forming the subject of my above noted application includes a reservoir 131 formed in the lower section 4 and a pump P continuously rotated from the shaft 34 and connected with the reservoir by a pipe 132. Another pipe 133 extends upwardly from the pump and enters the cover section 3 and terminates in a nozzle 134 which ejects a stream of lubricant into the upper portion of the tool-head. The lubricant ejected into the head cascades down over all of the gears and through all of the bearings and finally returns to the reservoir. It will readily be perceived that the present compact arrangement of the gears and vertical alignment of the bearings greatly facilitates the continuous and generous lubrication of the parts by the lubricating device.

Without further analysis, the foregoing will so fully reveal the gist of this invention that others can, by applying current knowledge, readily adapt it for various utilizations by retaining one or more of the features that, from the standpoint of the prior art, fairly constitute essential characteristics of either the generic or specific aspects of this invention and, therefore, such adaptations should be, and are intended to be, comprehended within the meaning and range of equivalency of the following claims.

Having thus revealed this invention, I claim as new and desire to secure the following combinations and elements, or equivalents thereof, by Letters Patent of the United States.

1. A drill-head combining a closed oil-tight casing comprising a plurality of complemental sections secured together; a tool spindle rotatably journaled wholly in one of said casing sections; a power shaft; and driving mechanism including first, second and third speed-change mechanisms intermediate said power-shaft and said spindle, two of said speed change mechanisms being located wholly within one of said casing sections and arranged one above the other.

2. A drill-head combining a housing; a spindle rotatably journaled in said housing; a plurality of horizontally disposed walls within said housing; a plurality of vertically aligned bearings supported by said walls; a single speed power shaft extending through said housing; shafts journaled in said bearings; three sets of change-speed gearings carried by said shafts intermediate said walls, said sets affording respectively four, two and four speeds, one of said sets being connected with said spindle; and means selectively to mesh the gears of said speed change gearing to transmit to the spindle any one of the 32 available speeds, from a single speed in the power shaft.

3. A drill-head combining a housing; a spindle journaled in said housing, three sets of vertically aligned bearings, said sets consisting respectively of two, three and four bearings; a single shaft journaled in said set of two bearings; a single shaft journaled in said set of three bearings; two shafts journaled co-axially in said four bearings; an operative connection between said first named shaft and said spindle; a power shaft; an operative connection between said first named shaft and said power shaft including two sets of speed-change gearing carried by said two co-axial shafts and the shaft journaled in said three bearings; and means for shifting the shiftable gears of said two sets of speed-change gearing.

4. In a drill-head, in combination, a housing; a spindle rotatably journaled in the housing; a drive-shaft; an operative connection between said drive-shaft and said spindle including three serially arranged sets of speed-change gears providing respectively four, two, and four speed-changes the first of said gear sets being actuated by the drive shaft and the third set being connected with the spindle, the second set operatively connecting the first and third sets; and means for selectively meshing the gears of each of said sets to produce any one of thirty-two speeds in said spindle.

5. In a drill-head, in combination, a housing; a spindle rotatably journaled in said housing; a drive-shaft; an operative connection between said drive-shaft and said spindle including first, second and third speed-change devices each comprising shiftable and non-shiftable gear-units, said first and third speed-change devices having two shiftable gear-units and said second speed-change device having one shiftable gear-unit; a single shifting mechanism for the two shiftable gear-units of the first speed-change device; independent shifting mechanism for the two shiftable gear-units of the third speed-change device; an independent shifting mechanism for the single shiftable gear-unit of the second speed-change device, each of said gear shifting including an actuating element located at the front of said head.

6. A drill-head combining a plurality of casing sections adapted to be secured together to form a closed housing; a drill-spindle rotatably journaled in a first one of said casing sections; a plurality of pairs of vertically

aligned bearings within a second of said sections; shafts rotatably journaled in said pairs of bearings; a plurality of sets of speed-change gears carried by said shafts, two of said sets being arranged wholly within one of said sections; a gear forming a part of a third gear set rotatably journaled co-axial with the spindle; a driving connection between said last named gear and said spindle; a single gear, also forming a part of the third gear set, secured upon a shaft in the second section in alignment with the gear co-axial with the spindle; and means to secure said sections together with said single gear in mesh with the gear co-axial with said spindle.

7. In a drill-head, in combination, an oil-tight housing provided with guideways by means of which the drill-head is slidably mounted upon the usual drill-arm said housing comprising a plurality of sections adapted to be secured together in a vertical plane intersecting the drill-arm and extending lengthwise thereof; a drive shaft; a spindle rotatably journaled in one of said housing sections; two speed-change devices arranged one above the other wholly in another of said sections and operatively connected with said drive shaft; and a set of back-gears located partly in each of said sections to operatively connect said first named speed-change devices with said spindle.

8. A drill-head combining a housing; a spindle rotatably journaled therein; a drive shaft extending through said housing; a first driven shaft journaled in said housing transverse to said drive shaft; a driving connection between said driving and driven shafts; a second driven shaft journaled in said drill head parallel with the first driven shaft; a third driven shaft journaled in said drill head with its axis in line with the axis of the first driven shaft; a first speed change mechanism comprising relatively shiftable complemental gears on said first and second driven shafts; a second speed change mechanism comprising relatively shiftable complemental gears on said second and third shafts; and a third speed change mechanism between said third driven shaft and said spindle.

9. In a drill-head, in combination a spindle-driving sleeve; a spindle splined within said sleeve; a drive-shaft; a driving connection between said drive-shaft and said spindle, said driving connection including first, second, third and fourth driven shafts, said first and third shaft being journaled with their axes in alignment; a first speed-change mechanism between said first and second shafts; a second speed-change mechanism between said second and third shafts; a third speed-change mechanism comprising gears carried by said third and fourth shafts and by said spindle driving sleeve; and means selectively to mesh the gears of each of said speed-change mechanisms.

In witness whereof, I have hereunto subscribed my name.

DAVID C. KLAUSMEYER.