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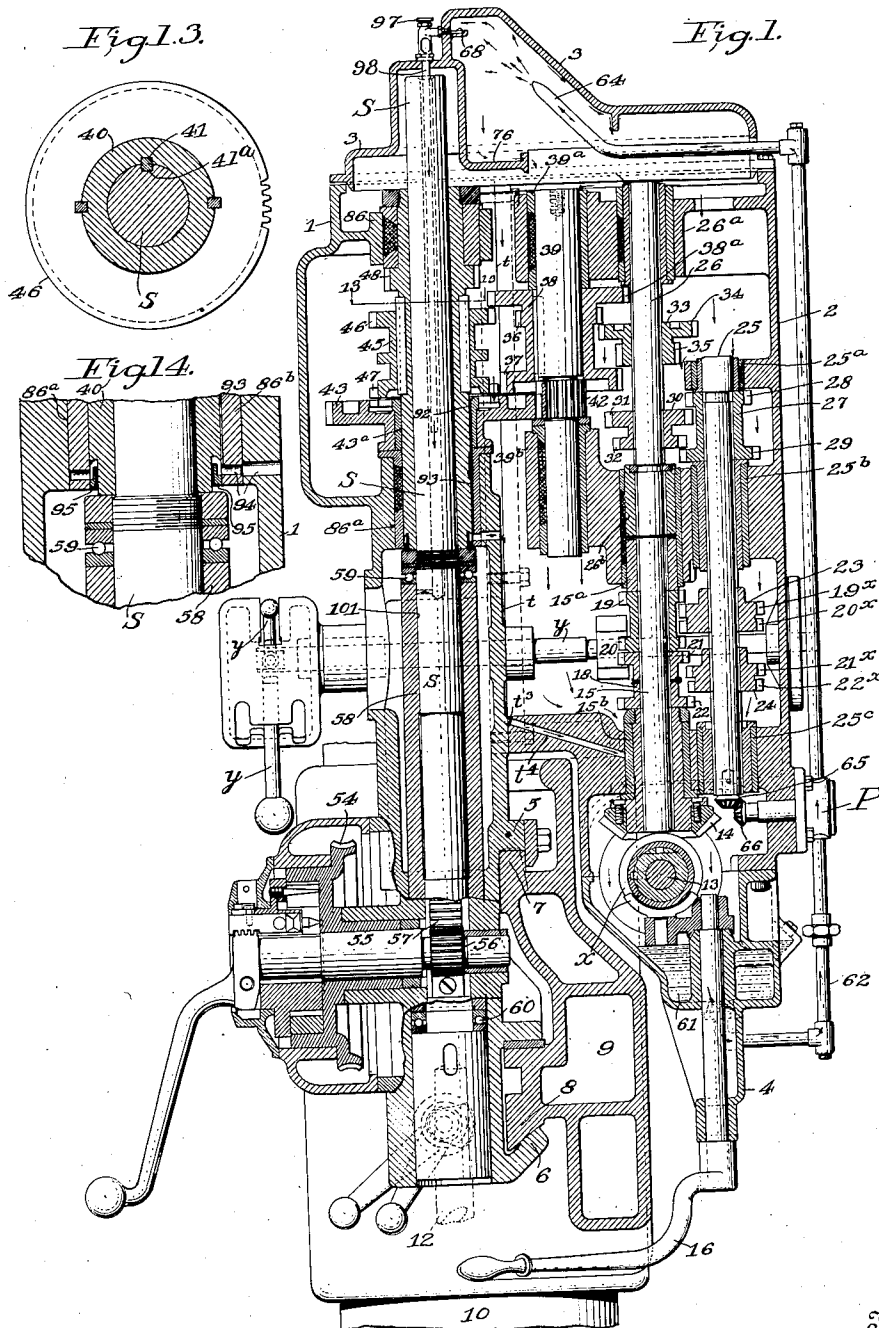
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LUBRICATING SYSTEM FOR DRILL HEADS

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4 Sheets-Sheet 1



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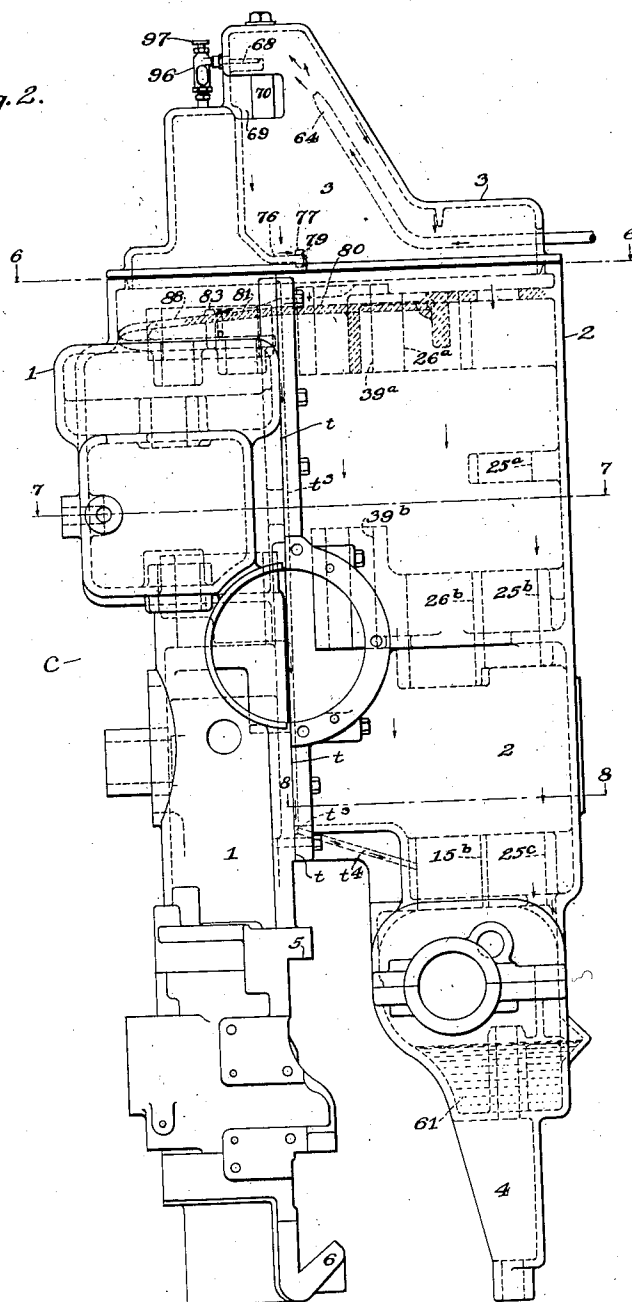
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LUBRICATING SYSTEM FOR DRILL HEADS

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Fig. 2.



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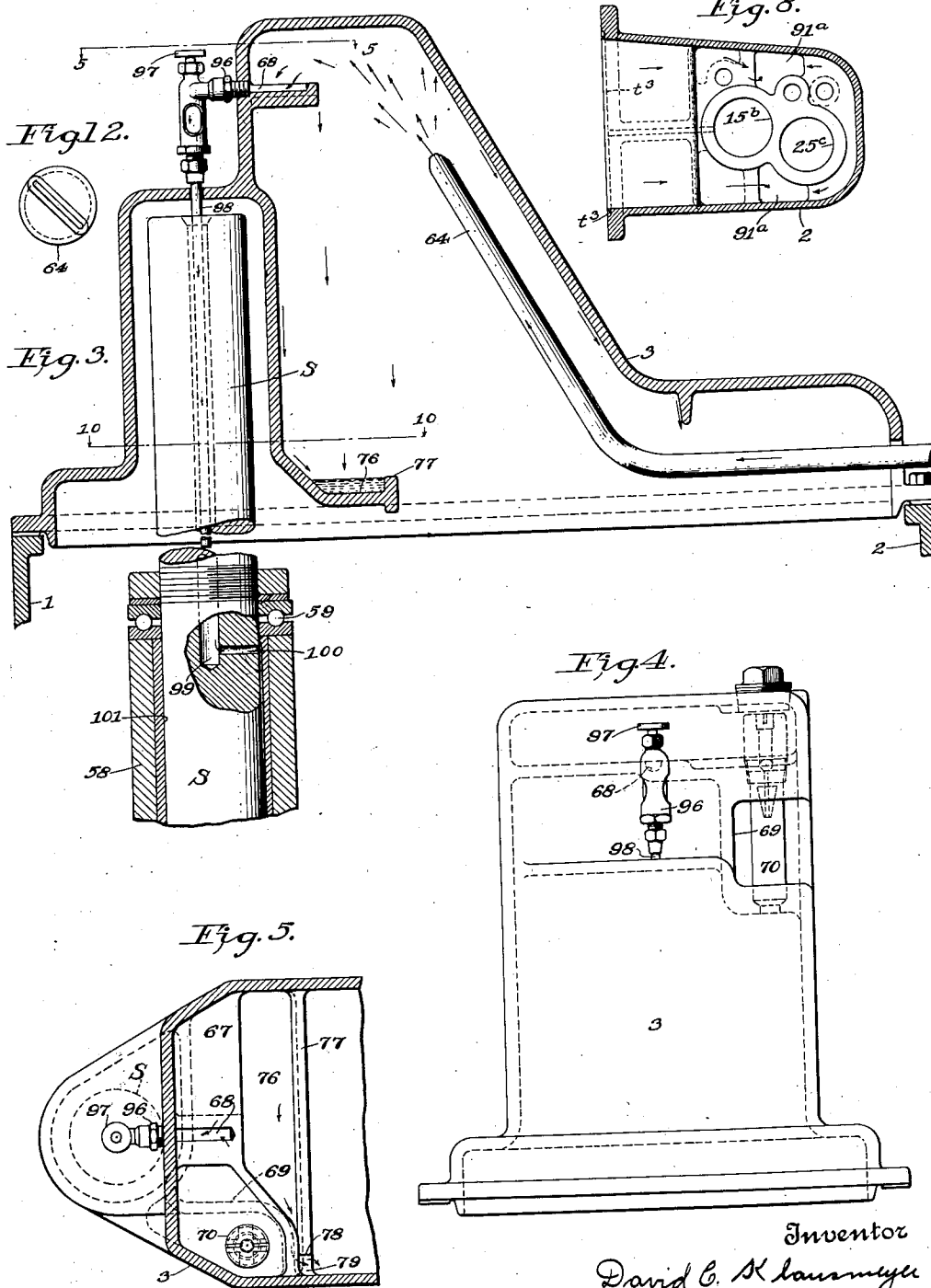
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LUBRICATING SYSTEM FOR DRILL HEADS

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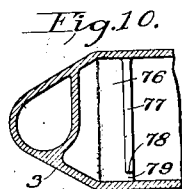
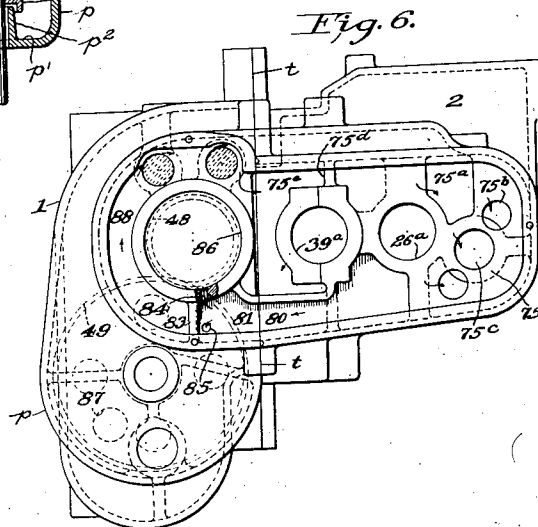
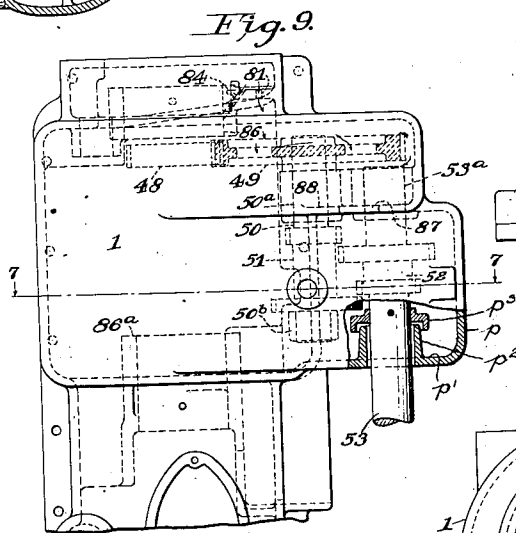
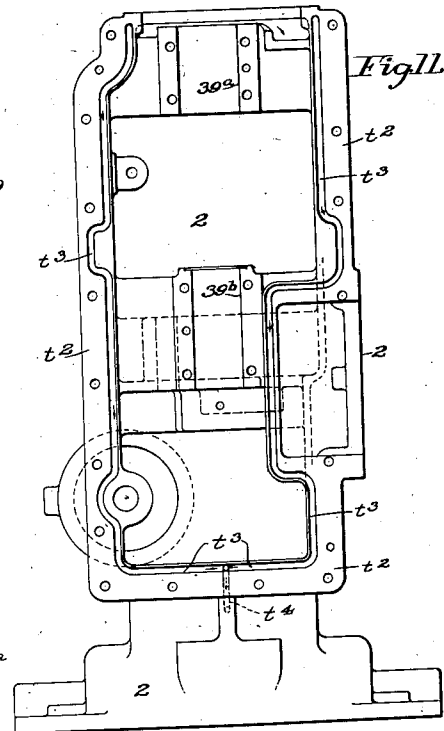
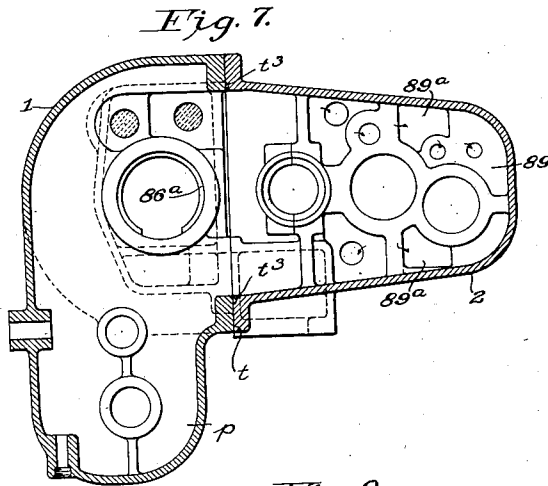
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LUBRICATING SYSTEM FOR DRILL HEADS

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4 Sheets-Sheet 4



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LUBRICATING SYSTEM FOR DRILL HEADS.

Application filed December 9, 1924. Serial No. 754,761.

This invention relates to machine tools and it deals more particularly with means for continuously lubricating the mechanism embodied in a radial-drill head.

5 Radial drills, as commonly constructed, comprise a base, an upright column, an arm extending radially from said column and a drill-head translatably mounted on the arm. Within the drill-head is rotatably journaled
10 a spindle adapted to carry a drill-point which is fed into the work by endwise movement of the drill-spindle. Power to rotate the drill-spindle and to feed it vertically is usually taken from a shaft journaled length-
15 wise of the arm and rotated from any suitable source of power, such for example as a motor mounted upon an extension of the arm or upon the base at the foot of the column and operatively connected with the
20 arm shaft. Inasmuch as these machines are adapted to operate on various types of work with various types and sizes of tools, such as drills and taps of varying diameters, and as each tool requires a different speed of
25 rotation for maximum efficiency, it is necessary that means be provided for regulating the speed of rotation of the drill-spindle. Until more or less recently this has been accomplished by embodying in the trans-
30 mission, adjacent the prime mover, a speed controller which provided a number of speed changes, usually about six. These speed changes were multiplied by a set of speed change gears (known as the back-gears)
35 located within the drill-head. These back-gears usually produced four speed changes which, in combination with the six speeds provided by the first named speed-controller, rendered available twenty-four spindle
40 speeds which selectively could be employed.

Recently, however, machine-tools of this type have been greatly improved and the shifting of the gears to produce any desired spindle speed greatly facilitated by an im-
45 provement in the drill-head which includes the embodiment therein of all of the speed-change gears. This improvement rendered it practicable to provide a substantially greater number of speed changes for the
50 spindle and to provide gear-shifting means carried by the drill-head and within easy reach of the operator, whereby he could selectively employ any available spindle speed without moving from his position at his
55 work. While this installation of all of the

change-gears in the head resulted in a decided improvement in radial drills, it will readily be perceived that it also presented the problem of proper lubrication for all of the many shaft bearings and gears necessarily employed. It is this problem that this invention has solved in a very efficient and ingenious manner.

In embodying all of the speed change gears in the drill-head it has been necessary
65 to employ many bearings and many gears located in various horizontal and vertical planes. To the end that dirt, small particles of abrasives etc., (which are always present to more or less degree in machine
70 shops) out of the bearings and gears it has been found desirable, if not actually imperative, to have these parts wholly enclosed within a suitable casing. This also has
75 added to the problem of proper lubrication of the parts. Furthermore certain of the bearings, such as for example the bearings for the spindle, are necessarily open at one end and therefore should not be supplied with an over-abundance of lubricant other-
80 wise the lubricant will drip from the bearing upon the work and upon the operator, much to his annoyance and discomfort.

This invention therefore has for an object to provide a lubricating system adapted to
85 be embodied in the drill-head of a radial-drill which will continuously and abundantly lubricate all of the gears and bearings within the drill-head.

A further object of the invention is to
90 provide a lubricating system for drill-heads in which the amount of lubricant supplied to certain of the bearings is positively controlled.

A still further object of the invention is
95 to provide a continuously acting lubricating system for radial drill-heads wholly embodied in the drill-head and so arranged as not to be effected by translation of the drill-head on the radial arm.
100

Still another object is to provide a drill-head with a self-contained circulatory lubricating system in which the amount of lubricant supplied to certain of the moving parts is substantially constant regardless of the
105 speed of rotation of the spindle.

Another object of the invention is to provide a drill-head with a self-contained continuously operating lubricating system of which one portion is circulatory and another
110

portion is non-circulatory, and independent means for observing the action of each portion.

These objects have been attained in a drill-head comprising a closed housing within which is located all of the mechanism necessary selectively to rotate the spindle at any one of a considerable number of different speeds from a single speed shaft journaled lengthwise of the arm, and mechanism to translate the spindle vertically to cause the drill point carried thereby to be fed into the work. For the purpose of continuously and generously lubricating the parts, the housing is formed in its lower end with a lubricant reservoir and a continuously operating pump, also carried by the housing, draws lubricant from the reservoir, elevates it through suitable piping to the top of the housing where it is ejected from a nozzle and permitted to cascade down over all of the mechanism in the housing and through the various bearings. The spindle necessarily projects through the lower end of its bearing and to prevent an over-abundance of oil being supplied to the bearing, which would result in the oil dripping therefrom, means is provided for regulating the flow of oil thereto. This is preferably accomplished by supplying oil to the bearing through an oil tube connected at one end to an auxiliary reservoir located in the upper end of the housing and having its other end extending downwardly into a bore in the spindle. A transverse aperture of small diameter extends from the bore through the wall of the spindle and permits a slight seepage of oil to the spindle bearing. A sight feed oiler, connected to the upper end of the tube and provided with an adjustable needle valve affords means for regulating and indicating the rate of flow of oil into the spindle bore. A second sight feed oiler adapted to receive a substantial amount of the oil ejected from the nozzle, affords means by which the operator may readily determine the action of the pump.

While this invention is herein shown and described in connection with a drill-head having all of the speed-change gears embodied therein, it is to be understood that it is likewise adaptable to various other types of drill-heads such, for example as those which contain only the back-gears.

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 a 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 central vertical section of a radial-drill head embodying the present invention. Fig. 2 is a side elevation of the entire drill-head casing which for convenience of manufacture preferably comprises front, rear, cover and reservoir sections. Fig. 3 is a vertical section of the upper section of the drill-head casing, hereinafter called the cover. Fig. 4 is a front elevation of the cover showing more particularly certain sight-feed oilers later to be referred to. Fig. 5 is a section on the line 5—5 of Fig. 3. Fig. 6 is a view on the line 6—6 of Fig. 2 showing in plan the front and rear sections of the drill-head casing. Fig. 7 is a section on the lines 7—7 of Figs. 2 and 9. Fig. 8 is a section on the line 8—8 of Fig. 2. Fig. 9 is a front elevation of the upper portion of the front head section and showing in dotted lines certain spindle feed gears later to be referred to. Fig. 10 is a section on the line 10—10 of Fig. 3. Fig. 11 is an inner face view of the rear head section. Fig. 12 is an end view of the lubricant nozzle. Fig. 13 is a section on the line 13—13 of Fig. 1. Fig. 14 is an enlarged section showing a drain for the spindle-sleeve bearing.

Referring more particularly to the drawings, the invention is disclosed as embodied in drill-head constructed as a closed casing C within which is housed all of the mechanism required to rotate and translate the drill spindle S at any one of a plurality of speeds. For convenience of manufacture, and to facilitate the assembling of the parts therein, the casing is preferably made of a plurality of sections, viz, front and rear sections 1 and 2 respectively, a cover-section 3 and a section 4 within which the reservoir is formed. As common in machine-tools of this type the drill-head is provided with guide-ways 5 and 6 slidably fitted to guides 7 and 8 provided by the usual radial arm 9. The arm 9 is slidably mounted upon an upright column 10 and the head is adapted to be moved horizontally on the arm 9 but inasmuch as the mechanism for giving these parts their vertical and horizontal movements form no part of this invention, illustration thereof is deemed unnecessary.

Rotatably and translatably journaled in the section 1, is the drill-spindle S which carries, in its lower end, the usual drill-point the shank of which is indicated at 12 in Fig. 1. Power to rotate and translate the drill-spindle is brought into the drill-head as by means of a shaft 13 journaled lengthwise of the arm and adapted to be driven by any suitable means, such as for example, a motor located on a rearward extension of the arm or on the machine base

at the foot of the column. The shaft 13 passes through a portion of the drill-head and has journalled co-axially with it, within the drill-head, two bevel-gears (of which one only is shown) maintained permanently in mesh with a similar gear 14 fixed upon a vertical shaft 15 journalled in bearings 15^a and 15^b within the section 2. A clutch device, indicated generally as x is provided for selectively rendering the first named bevel-gears effective to rotate the shaft 15 in opposite directions. The clutch x is adapted to be controlled by a lever 16 shown in Fig. 1. From the foregoing it will be apparent that the shaft 15 selectively may be rotated in either direction at the same speed as the speed of rotation of the shaft 13. This single speed may be multiplied into thirty-two speeds in the spindle by change-gear mechanisms now to be described.

Fixed to the shaft 15 are gear-units 17 and 18 providing gears 19 and 20, and 21 and 22 respectively. These gears are adapted to be meshed with gears 19^{*}, 20^{*}, 21^{*} and 22^{*}, provided by gear-units 23 and 24 splined to a shaft 25 journalled parallel to the shaft 15, in bearings 25^a, 25^b and 25^c. The gear-units 23 and 24 are adapted to be shifted on the shaft 25 by gear-shifting mechanism designated generally as y . Thus the single speed of the shaft 15 may be multiplied into four speeds in the shaft 25. These four speeds may be further multiplied into eight speeds in a shaft 26 journalled in bearings 26^a and 26^b in the section 2, co-axial with the shaft 15. This may be effected by means of a gear-unit 27 secured to the shaft 25 and providing gears 28 and 29 adapted selectively to be engaged by gears 30 and 31 respectively provided by a gear-unit 32 splined to the shaft 26. The speed changes just described correspond to the speed changes which, until more or less recently, were usually effected by a speed-controlling device located adjacent the prime-mover and remote from the operator when stationed at his work.

The eight speeds in the shaft 26 may be multiplied into thirty-two speeds in the spindle by means of a set of back-gears now to be described. Splined to the shaft 26 is a gear-unit 33 providing gears 34 and 35 adapted selectively to be meshed with gears 36 and 37 provided by a gear-unit 38. This gear-unit 38 is keyed to a shaft 39 journalled in bearings 39^a and 39^b in the section 2, parallel with the shaft 26 which also carries a small gear 42 later to be referred to. Journalled within the section 1 of the drill-head is a spindle-driving sleeve 40 within which the spindle is secured as by means of a spline 41 (see Fig. 13). 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 jour-

naled upon the sleeve 40 is a gear 43 permanently in mesh with the gear 42 on the shaft 39 and provided with clutch-teeth 44. A gear-unit 45 providing a gear 46 and a clutch-member 47, is splined to the sleeve 40 and adapted selectively to be shifted into engagement with clutch-teeth 44 or with a gear 38^a forming a part of the gear-unit 38.

In addition to its rotations the drill-spindle is adapted to be moved endwise in the sleeve 40. Power to give the spindle its endwise movements is preferably taken from a gear 48 formed on the spindle-driving sleeve. The gear 48 meshes with a gear 49 forming a part of a spindle feed-mechanism a portion of which is indicated in dotted lines in Fig. 9. The gear 49 is fixed to a shaft 50, journalled in bearings 50^a and 50^b provided by the casing section 1. This shaft also carries a gear-unit 51 providing a plurality of gears adapted selectively to be meshed with gears provided by a similar gear-unit 52 secured to a shaft 53 journalled at its upper end in a bearing 53^a. These parts of the feed mechanism are located within an off-set portion p of the section 1 and are lubricated by means later to be described. The shaft 53 carries, at its lower end, a worm (not shown) which drives a worm-wheel 54 secured to a shaft 55 (see Fig. 1) to which is also secured a pinion 56 in mesh with a rack 57 carried by a non-rotatable sleeve 58 surrounding the spindle and slidably mounted in the front section of the drill-head casing. Relative endwise movement between the spindle and sleeve 58 is prevented by thrust-bearings 59 and 60. Thus rotation of the pinion 56, through the mechanism described results in translation of both the sleeve 58 and the spindle in the drill-head while permitting the spindle to rotate independently of the sleeve.

The foregoing illustrates the type of machine-tool head and the mechanism therein that this invention is adapted generously and continuously to lubricate during the operation of the machine-tool. It is to be noted that the mechanism to be lubricated is located within a closed casing and is disposed in various horizontal and vertical planes.

Within the lower portion of the casing C, and preferably in the section 4, is formed a reservoir 61 adapted to hold a supply of lubricant. A continuously operating pump P draws lubricant from the reservoir through a pipe 62, elevates it through a pipe 63, and forcibly ejects it from a nozzle 64 within the upper portion of the drill-head casing, preferably in the cover 3. The pump may be driven by any suitable means such for example, as bevel-gears 65 and 66 of which the former is secured to the shaft 26 and the latter is fixed to the pump shaft. In the embodiment of the invention shown in Fig. 1 the pump and piping are located

exteriorly of the head but it is to be understood that this invention also contemplates locating all or part of the mechanism within the closed casing.

5 The lubricant ejected from the nozzle 64 strikes within the cover 3 from which the greater portion flows downwardly through all of the bearings and over all of the mechanism in the head and back to the reservoir as later will be described. The flow of lubricant from the reservoir over the mechanism and back to the reservoir is indicated by arrows.

15 The cover 3 is formed, adjacent its upper end, with a horizontally disposed wall or shelf 67 provided with a depression 68 forming an auxiliary reservoir of small capacity. The shelf is also formed with a larger depression or receptacle 69 which communicates with a sight-feed tube 70 maintained between the shelf 67 and a horizontal wall 71 also provided by the cover 3. Between the shelf and the wall 71 the side wall of the cover is depressed as at 72 to expose to view the tube 70 which is made of transparent material such as glass. A part of the lubricant ejected from the nozzle is received by the shelf 67 and serves to maintain the auxiliary reservoir filled and also to produce a steady stream through the tube 70 by means of which the operator is assured of the proper functioning of the pump. A substantial amount of the lubricant from the nozzle flows down the inclined upper wall 73 of the cover 3 until it reaches a baffle rib- 74 which causes the lubricant to flow downwardly upon the upper horizontal wall 75 of the section 2. This wall 75 supports the shaft bearings 26^a and 39^a which are kept well lubricated by the descending oil.

40 Beneath the shelf 67 is a second horizontally disposed wall 76 upon which the lubricant, passing through the sight tube 70, descends. This wall is formed at its free edge with an up-standing rib 77 which terminates at 78 short of one of the side walls of the cover, thus forming a sluice 79 through which the lubricant flows. The wall 76 forms a shield or baffle to deflect the lubricant laterally away from the upper end of the spindle-driving sleeve thereby to prevent it from entering the spindle-bearing therein and way 41^a in which the spline 44 moves. This prevents an excessive amount of oil from passing downwardly through the spindle-bearing which, due to the bearing being open at its lower end otherwise would cause dripping of oil from the spindle, much to the annoyance and discomfort of the operator.

60 The lubricant passing through the sluice 79 descends into a basin or trough 80 formed in the upper surface of the upper horizontal wall 75 of the section 2. A like basin 81 formed in the upper side of a wall 82 pro-

vided by the section 1 is so arranged that when the sections 1 and 2 are bolted together the two basins form a single receptacle adapted to receive the lubricant from the sluice 79 (see Fig. 6). The basin 81 terminates at one end in a vertical wall 83 later to be referred to. Communicating with the basin 81 are two ports 84 and 85. The port 84 leads through a vertically disposed bearing wall 86 providing an upper bearing for the spindle sleeve 40. The port 85 leads downwardly from the basin and is arranged above the gear 49 forming a part of the spindle feed-mechanism hereinbefore referred to. A portion of the oil received upon the gear 49 is distributed to the upper bearings of the shafts 50 and 53 and a portion thereof flows through an aperture 87 formed in a horizontal wall 88 connecting the bearings. The oil flowing through the aperture 87 lubricates the lower bearings of the shafts 50 and 53 and the other gears of the spindle feeding mechanism. The oil having passed through the bearings of the spindle feed mechanism and over the gears thereof it is drained back into the section 2 and finally flows back to the reservoir. The height of the wall 83 is less than the height of the other walls of the basins 80 and 81 and therefore forms a spillway over which the excess lubricant flows. The lubricant flowing over the wall 83 enters an inclined passageway 88 and is conducted back into the section 2.

100 The upper horizontal wall 75 is formed with apertures 75^a, 75^b and 75^c which permit a portion of the lubricant received by the wall to flow downwardly therethrough over the gears and through the bearings therebeneath. The wall terminates at 75^d which affords a passage-way 75^e through which the lubricant flows upon the gears of the back-gear mechanism hereinbefore described.

110 A portion of the oil passing over the back-gears finds its way into the lower bearing 86^a of the spindle-sleeve 40 through oil-grooves 92 and 93 provided by bearing bushings 43^a and 86^b for the gear 43 and sleeve 40 respectively. To prevent this oil from escaping from the lower end of the bearing 86^a and flowing down the spindle an escape port 94 is formed through the bushing 86^b and through the wall of the section 1. An oil-deflecting ring 95 having a portion extending above the port 94 serves to deflect the oil out through the port 94 and back into the section 2.

120 An intermediate horizontal wall 89 supports the bearings 15^a, 25^b, 26^b and 39^a and these bearings are kept well lubricated by the oil flowing down from the parts above. The wall 89 is also provided with a plurality of apertures to permit passage of the oil to the parts therebelow. These apertures are indicated at 89^a in Fig. 7. Having passed 130

through the bearings 15^a, 25^b, 26^b and 39^a and over the gear-units 17, 18, 23 and 24 the oil descends upon a third horizontal wall 91 supporting the bearings 15^b and 25^c through which a portion of the oil flows. This wall is also provided with oil passages 91^a to permit flow of the oil over the main driving and reversing gears and back to the reservoir 61.

As hereinbefore described the lower end of the spindle-bearing is open, and to prevent the lubricant from dripping therefrom it is desirable that only a small quantity be supplied to this bearing. This has been accomplished in a very ingenious manner now to be described. Threaded into the cover 3, in registry, with the auxiliary reservoir 68, is a sight-feed oiler 96 provided with a feed-regulating screw 97. The oiler 96 is preferably of inverted L-shape and to the lower end is attached an oil tube 98 which extends into the cover 3 and down into a bore 99 formed in the spindle. This tube being telescopically connected with the spindle affords means for supplying lubricant to the bore 99 in all of the vertical positions of the spindle. A transverse bore 100 of small diameter connects the bore 99 with the spindle bearing 101 and permits a constant seepage of oil to that bearing. It is to be noted that the auxiliary reservoir 68 is of small capacity and it is kept filled at all times from the nozzle 64. Due to the small capacity of the auxiliary reservoir the sight-feed oiler 96 is maintained pressure-free, therefore there is no variance in the amount of oil let into the bore 99.

As shown in Figs. 1, 2, 6 and 7 the sections 1 and 2 are bolted together along the vertical line *t*. To prevent the lubricant from seeping out between these sections the section 2 is formed in its abutting face *t*² with an oil-groove *t*³ which extends around three sides of the section. Thus any oil that might seep outwardly between the two sections will be received by the groove *t*³ and conducted to the lowest point therein and into an inclined port *t*⁴ which directs the oil into the bearing 15^b from which it flows back to the reservoir.

It is to be noted that the pump P is connected with the driving mechanism between the controlling clutch *x* and the spindle and therefore when the clutch is shifted to its neutral position to stop rotation of the spindle the pump is brought to rest. With this arrangement movement of the lever 16 simultaneously effects both the spindle driving mechanism and the lubricant pump.

The lower wall *p*¹ of the off-set portion *p* is formed with an upstanding annular wall *p*² surrounding the shaft 53. An oil-deflecting canopy *p*³ is fixed to the shaft 53 adjacent the upper end of the wall *p*² and has

its lower edges overhanging said wall. Thus oil flowing down from the gear-unit 52 is deflected away from the shaft and finally returned to the reservoir, thereby being prevented from following down the shaft and escaping from the casing.

From the foregoing it will be perceived that there has been provided simple and efficient means, wholly embodied in a radial drill-head for continuously and generously lubricating all of the bearings and mechanism located in various vertical and horizontal planes. Also that means has been provided for continuously supplying lubricant to the open-end spindle bearing in such amounts as to preclude dripping of oil from the bearing.

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. In a drill-head, in combination, a casing; a drill-spindle rotatably mounted in said casing; a power shaft; speed-change mechanism arranged in a plurality of vertical and horizontal planes within the casing to rotate said spindle at any one of a plurality of speeds from said power shaft; and a circulatory lubricating system wholly incorporated in said drill-head for continuously lubricating said speed-change mechanism, said lubricating system comprising a lubricant reservoir in the lower portion of the casing; a pipe having one end entering said reservoir and its other end open and located in the upper portion of said casing; a pump to force lubricant from said reservoir through said pipe to eject it into the upper end of said casing; and baffles intermediate the open end of said pipe and said speed-change gearing to deflect the lubricant horizontally thereby permitting it to descend by gravity onto said gearing.

2. In a radial drill-head, in combination, a closed casing; a drill-spindle rotatably mounted in said casing; a power-shaft; a plurality of serially arranged speed-change mechanisms within said casing adapted to rotate said spindle at different speeds from said power shaft, said speed-change mechanisms being located in a plurality of hori-

zontal and vertical planes; and means for effecting a constant flow of lubricant over said speed-change mechanisms.

3. In a radial drill-head, in combination, 5 a spindle rotatably journaled in said drill-head; a power shaft; an operative connection between the power shaft and the spindle including a plurality of shafts journaled in bearings in the drill-head and a plurality 10 of relatively shiftable gears carried by said shafts, said gears and shaft bearings being in a plurality of vertical and horizontal planes; and a circulatory lubricating system including lubricant circulating mechanism 15 and lubricant deflecting walls incorporated in said head and adapted continuously to lubricate said bearings and said gears.

4. In a radial drill-head, in combination, a casing; a spindle rotatably journaled in 20 said casing; a lubricant reservoir formed in said casing; a power shaft; means, including a plurality of shafts journaled in bearings in the drill-head and a plurality of gears carried by said shafts, for rotating 25 said spindle from said power shaft, said gears and shaft bearings being located in a plurality of horizontal and vertical planes; and means including a power-driven pump and suitable piping, carried by the drill- 30 head, for elevating lubricant from said reservoir and ejecting it into the upper portion of said casing, above said gears and bearings, and a plurality of lubricant collecting walls within said casing overlying said gears and 35 bearings and provided with passages through which the lubricant flows by gravity over the various gears and through the various bearings back to said reservoir.

5. In a drill-head, in combination, a casing; a spindle rotatably journaled in said 40 casing; a plurality of vertically spaced horizontal walls within said casing each providing a plurality of horizontally spaced bearings and a plurality of horizontally separated and vertically disposed lubricant passages; a plurality of vertically disposed 45 shafts journaled in said bearings; a power shaft; a driving connection between said power shaft and one of said vertical shafts; a plurality of intermeshing gears carried by 50 said vertical shafts for rotating said spindle from said power shaft; a lubricant reservoir; means for elevating lubricant from said reservoir and ejecting it in said drill-head 55 above the upper of said horizontal walls, said bearings, gears and lubricant passages being so constructed and arranged that the lubricant flowing through said passages passes over all of said gears and through 10 all of said bearings in flowing back to said reservoir.

6. In a drill-head, in combination, a casing; a spindle rotatably journaled in said casing; a lubricant reservoir formed in said 15 casing; a power shaft; means, including a

plurality of shafts journaled in bearings in the drill-head and a plurality of gears carried by said shafts, for rotating said spindle from said power shaft; means, including a power-driven pump and suitable piping, 70 carried by the drill head, for elevating lubricant from said reservoir and ejecting it into the upper portion of said casing, above said gears and bearings, from which the lubricant flows by gravity over the various 75 gears and through the various bearings back to said reservoir; and a sight-feed oil-tube adapted to receive and pass a substantial part of the lubricant ejected by said pump by means of which the operator may deter- 80 mine the action of said pump.

7. In a drill-head comprising front, rear, cover and reservoir sections adapted to be bolted together to form a closed casing; a 85 spindle rotatably mounted in said front section; a plurality of shafts journaled in bearings in said rear section and adapted to rotate said spindle at anyone of a plurality of speeds; driving means operatively connected 90 with one of said shafts; means for elevating lubricant from a reservoir in said reservoir section and ejecting it into said cover-section for subsequent descent over said gears and through said bearings; means within said 95 cover-section for collecting a substantial part of the lubricant ejected into the cover-section; and a transparent oil tube visible from the exterior of the casing adapted to receive and conduct the lubricant from said collecting means thereby to indicate the action of 100 said lubricant elevating means.

8. In a drill-head, in combination, a casing, a spindle-driving sleeve rotatably journaled in bearings carried by said casing; a 105 spindle held to rotate with said sleeve; change-gear mechanism adapted to rotate said sleeve and spindle at any one of a plurality of speeds; means to continuously lubricate said change-gear mechanism and the bearings for said sleeve; and means to 110 prevent oil from dripping from the lower sleeve bearing, said means comprising an oil-passage through the wall of the casing and an oil-deflecting device adapted to cause the oil passing through the bearing to be 115 deflected through said passage and back into the closed casing.

9. In a drill-head, in combination, a casing; a non-rotatable sleeve translatably 120 mounted in said casing; a spindle rotatably journaled in said sleeve; means to rotate said spindle; means including a lubricant conducting pipe to continuously lubricate the spindle-bearing in said sleeve; and an adjustable sight-feed oiler connected with 125 said pipe to regulate and indicate the amount of lubricant applied to said bearing.

10. In a drill-head, in combination, a casing; a non-rotatable sleeve translatably 130 mounted in said casing; a spindle rotatably

journalled in said sleeve; means to rotate said spindle; means to continuously lubricate the spindle-bearing in said sleeve; said means comprising a reservoir located above said spindle bearing, means to keep said reservoir filled with lubricant, a lubricant passage from said reservoir to said bearing; and an adjustable sight-feed oiler embodied in said passage to regulate and indicate the flow of lubricant through said passage.

11. In a drill-head, in combination, a casing; a non-rotatable sleeve translatably journalled in said casing; a spindle rotatably but non-translatably journalled in said sleeve; means to rotate and translate said spindle in said casing; means to continuously lubricate the spindle-bearing in said sleeve in all of the vertical positions of said spindle, said lubricating means comprising a reservoir, means to keep said reservoir filled with lubricant, a lubricant chamber in said spindle having a passage to said bearing, and an extensible connection between said reservoir and said lubricant chamber.

12. In a drill-head, in combination, a casing; a non-rotatable sleeve translatably journalled in said casing; a spindle rotatably journalled in said sleeve and movable axially therewith; means to rotate said spindle in said sleeve; means to translate said sleeve in said casing; means to continuously lubricate the spindle-bearing in said sleeve in all of the vertical positions of said spindle, said lubricating means comprising a reservoir, means to keep said reservoir filled with lubricant, a lubricant chamber in said spindle having a passage to said bearing, an extensible connection between said reservoir and said lubricant chamber; and a sight-feed oiler embodied in said extensible connection to regulate and indicate the flow of lubricant to said bearing.

13. In a drill-head, in combination, a casing; a non-rotatable sleeve translatably journalled in said casing; a spindle rotatably journalled in said sleeve and movable axially therewith; means to rotate said spindle in said sleeve; means to translate said sleeve in said casing; means to continuously lubricate the spindle-bearing in said sleeve in all of the vertical positions of said spindle, said lubricating means comprising a reservoir, means to keep said reservoir filled with lubricant, a bore lengthwise of said spindle; a transverse bore connecting said first named bore with the spindle-bearing surface, and a tube connected with said reservoir and extending telescopically into said first named spindle bore.

14. In a drill-head, a casing; a sleeve rotatably journalled in said casing and provided with a spindle receiving bore; a spindle translatably mounted in said bore; means for continuously supplying a stream of lubricant within said drill-head above said

sleeve; and means to deflect the lubricant away from the upper end of said sleeve to prevent it from entering said spindle-bore.

15. In a drill-head, in combination, a casing including a cover-section; a spindle rotatably journalled in said casing; driving means; a plurality of change-speed gears operatively connecting said driving means with said spindle; a lubricant reservoir formed in said casing; means for continuously elevating lubricant from said reservoir and ejecting it into said cover-section; an auxiliary reservoir sustained by said cover-section and maintained filled by the lubricant ejected into the cover-section; a second lubricant receptacle provided by the cover-section; means to convey lubricant from said auxiliary reservoir to the spindle bearing; means to convey lubricant from said second receptacle to said speed-change gears; and means embodied in each of said conveying means to indicate the flow of lubricant therethrough.

16. In a drill-head, in combination, a casing; a sleeve translatably but non-rotatably mounted in said casing; a spindle rotatably journalled in bearings provided by said sleeve; a power-shaft; a plurality of shafts and change-gears operatively connecting said power-shaft with said spindle; a continuously acting circulatory lubricating system for lubricating said change-gears; and a continuously acting non-circulatory means for lubricating the spindle-bearings.

17. In a drill-head, in combination; a closed casing; a drill-spindle rotatably journalled therein; a power shaft; a plurality of vertically disposed shafts journalled in bearings within said casing, said bearings being located in a plurality of vertical and horizontal planes; a reservoir in the lower portion of said casing; means for continuously elevating lubricant from said reservoir and ejecting it into the upper portion of said casing; basins in said casing for catching the ejected lubricant; ports provided by said basins for flooding the uppermost bearings with lubricant; and means permitting said lubricant to cascade down over said gears and through said bearings back to said reservoir.

18. In a drill-head, in combination, a casing; a spindle-rotating sleeve rotatably journalled in bearings therein; a spindle splined within said sleeve; a power shaft; an operative connection between said power shaft and said sleeve, said connection including a plurality of speed-change gears; means including speed-change gears for translating said spindle; a lubricant reservoir; means for elevating lubricant from said reservoir and ejecting it into said casing above said change-gears; means to deflect the lubricant away from the upper bearing of said sleeve; means below said de-

flecting means to receive the deflected lubricant and to conduct a portion thereof back to the said upper bearing at a point below its upper surface and a portion thereof to
 5 said spindle translating change-gears; and means permitting said lubricant to return to said reservoir.

19. In a drill-head, in combination, a casing; a spindle driving sleeve rotatably
 10 journaled in vertically spaced bearings in said casing; means to rotate said sleeve; a reservoir in said casing; means for transferring lubricant from said reservoir to said casing above said sleeve; means to de-
 15 flect lubricant away from the upper bearing for said sleeve; a basin located beneath said deflecting means to receive the deflected lubricant; means to conduct a portion of said deflected lubricant back to the upper
 20 sleeve bearing at a point below its upper surface; an overflow for said basin; and means to conduct back to said reservoir the oil passing said overflow.

20. In a drill-head, in combination, a casing; a drill-spindle rotatably and translat-
 25 ably journaled in said casing, said means including a spindle-rotating sleeve; a spindle translating sleeve; a power-shaft; a speed-change driving connection between
 30 said power shaft and said spindle rotating sleeve; a driving connection between said spindle rotating sleeve and said spindle translating sleeve; a lubricant reservoir; means to effect a constant flow of lubricant
 35 from said reservoir to within said casing above said sleeves; means to deflect lubri-

cant away from the said spindle rotating sleeve; and means to receive the deflected lubricant and to conduct it back adjacent said sleeve and to deposit a portion thereof
 40 on said spindle translating gears.

21. In a drill-head, in combination, a plurality of sections adapted to be secured together to form a closed casing; a spindle rotatably journaled in said casing; means to rotate
 45 said spindle; means to effect a continuous circulation of oil over said spindle-rotating means; and means to prevent leakage of oil from between two of said sections, said last-named means comprising an oil con-
 50 ducting channel formed in the meeting face of one of said sections and means to drain said channel.

22. In a drill-head, in combination, a closed casing; a spindle-driving sleeve rotatably journaled in vertically disposed bearings provided by said casing; a spindle head
 55 to rotate with said sleeve; means to rotate said sleeve and thereby said spindle; means to continuously lubricate the bearings for said sleeve; and means to prevent dripping of oil from the lower sleeve bearing, said means comprising an annular oil collecting
 60 chamber at the lower end of said spindle sleeve; and an oil duct leading from said annular chamber into said closed casing to return the oil from the lower end of said bearing
 65 back into said casing.

In witness whereof, I have hereunto subscribed my name.

DAVID C. KLAUSMEYER.