H. M. DARLING & W. RUNGE.

GEARING FOR MACHINE TOOLS.

APPLICATION FILED MAR. 8, 1905.

917,015. **Patented Apr. 6, 1909.**

9 SHEETS—SHEET 1.

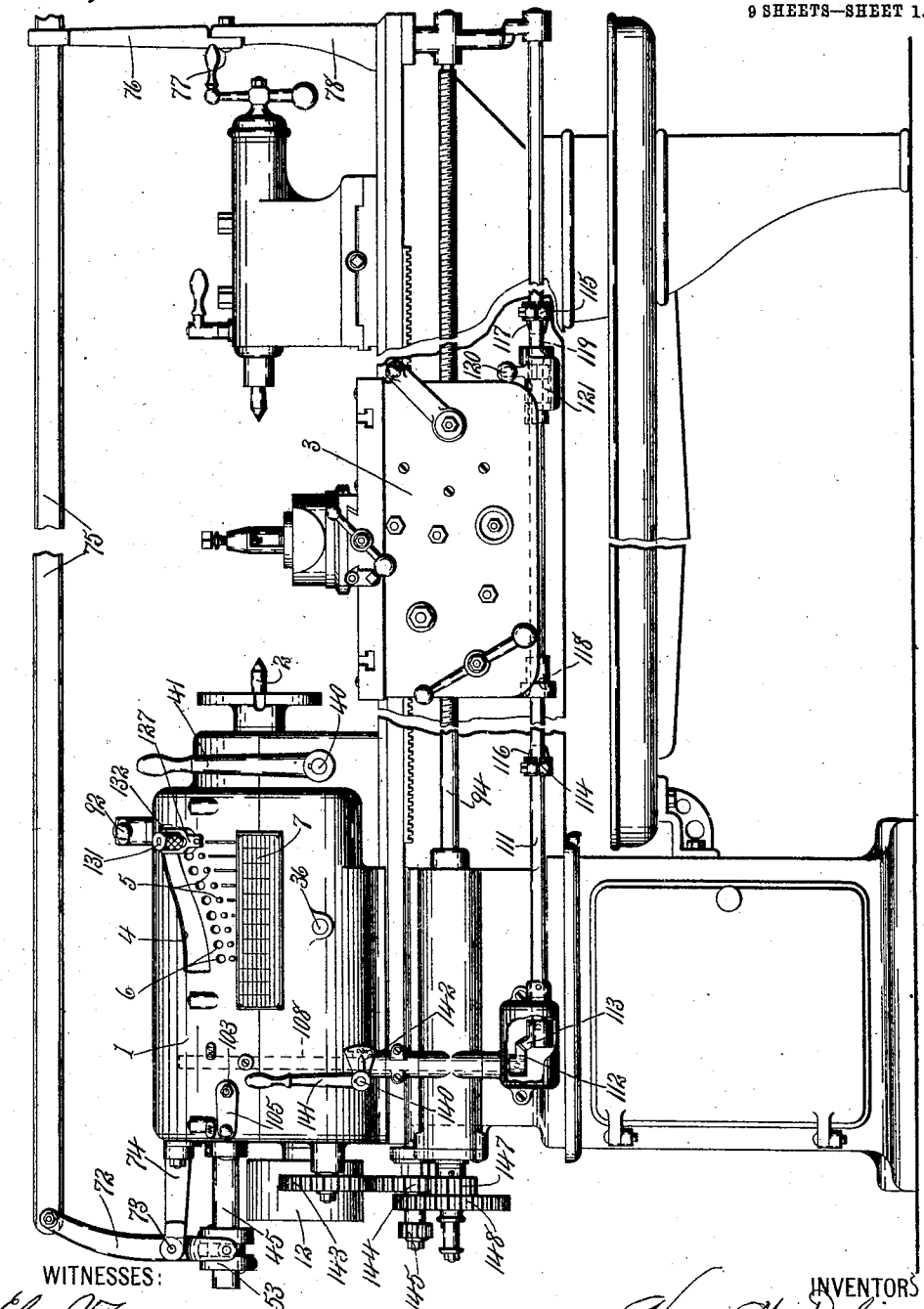


Fig. 1.

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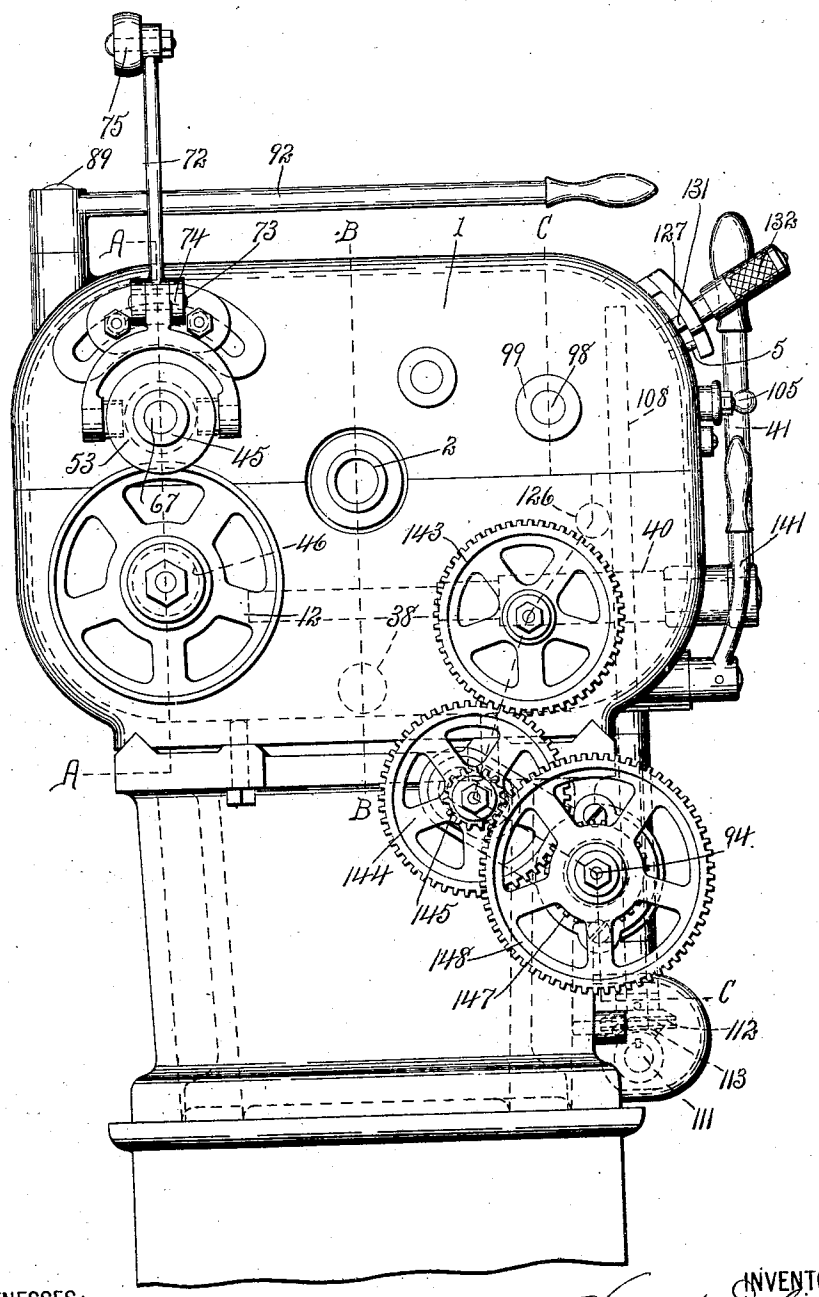
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9 SHEETS—SHEET 2.

Fig. 2.



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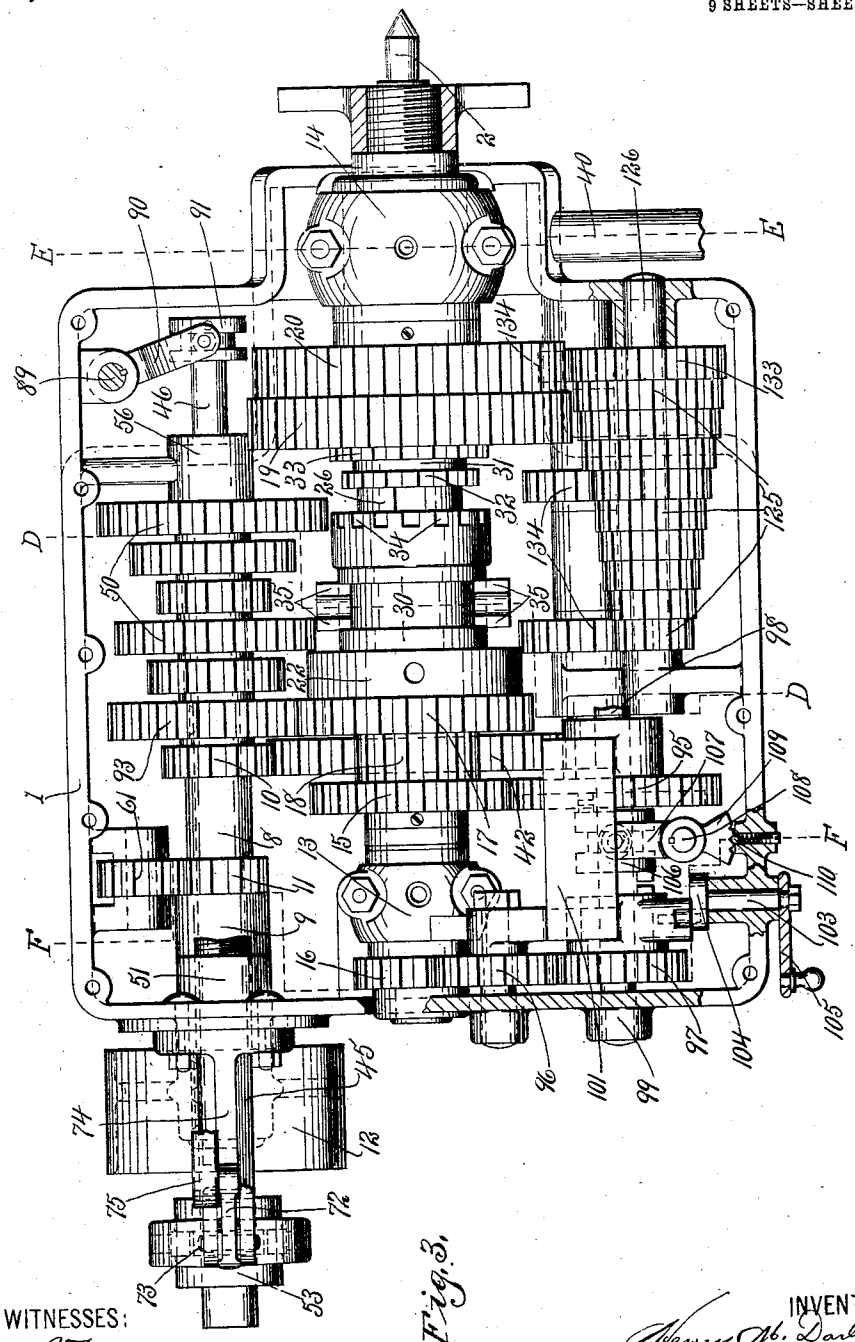


Fig. 3.

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9 SHEETS—SHEET 4.

Fig. 4.

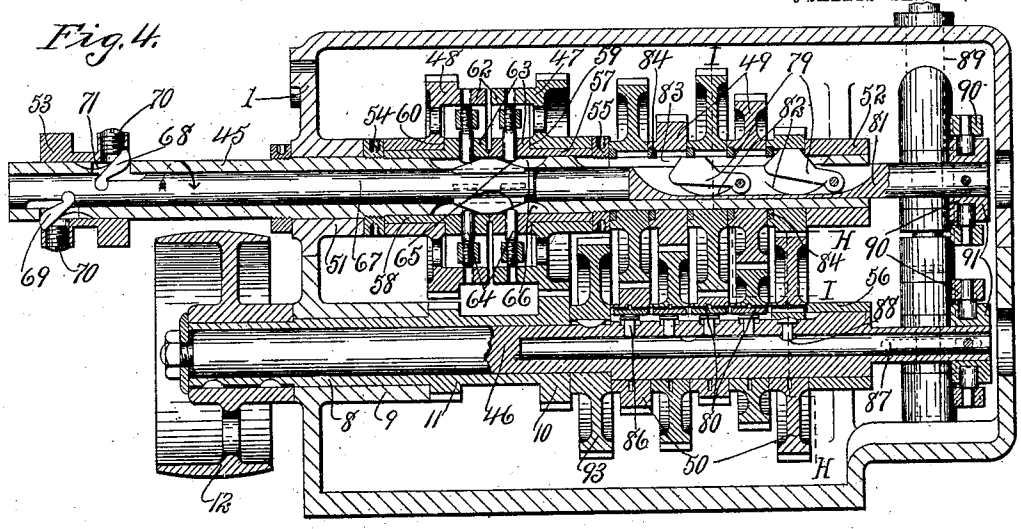
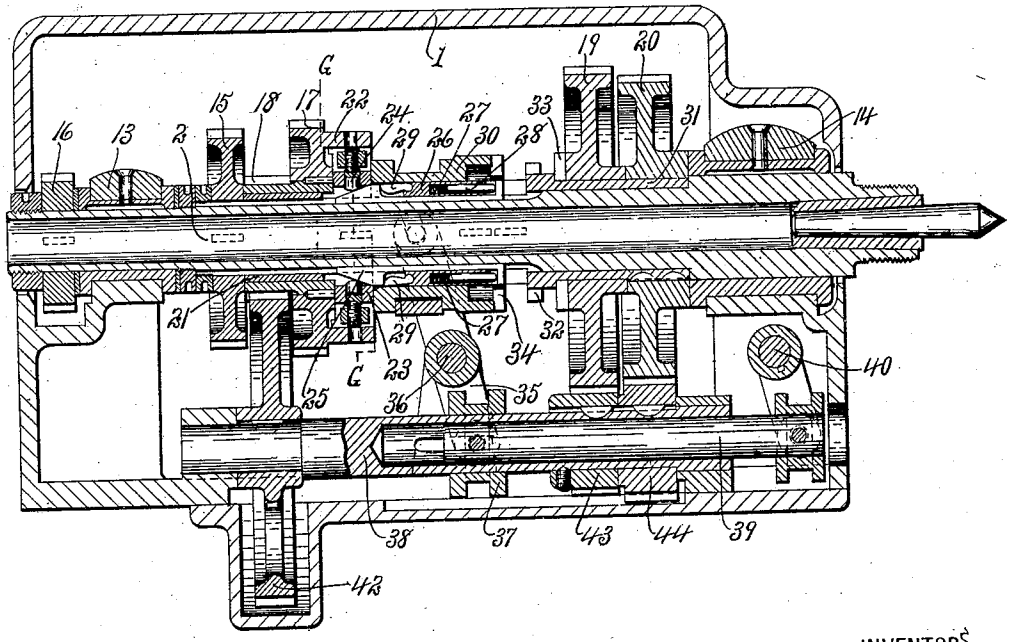


Fig. 5.



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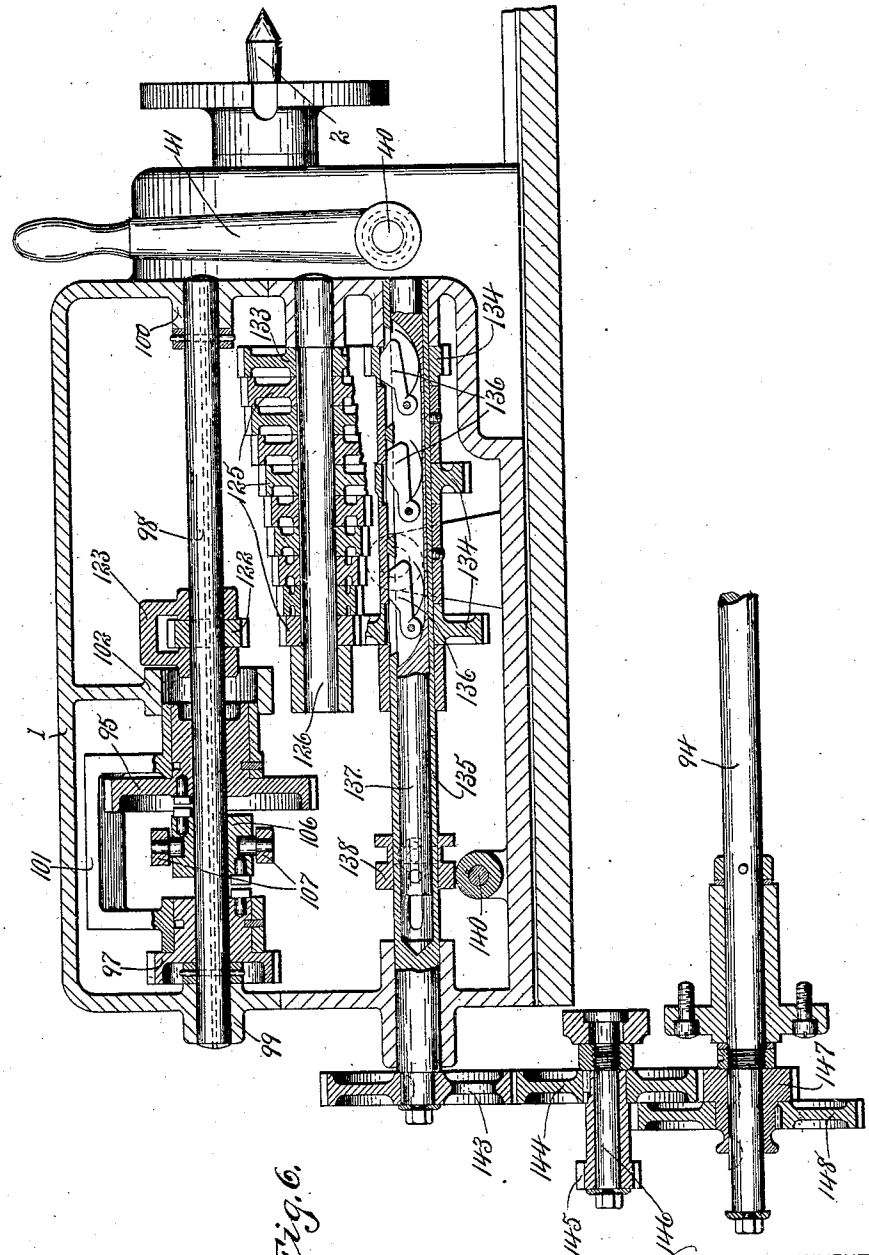


Fig. 6.

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9 SHEETS—SHEET 6.

Fig. 7.

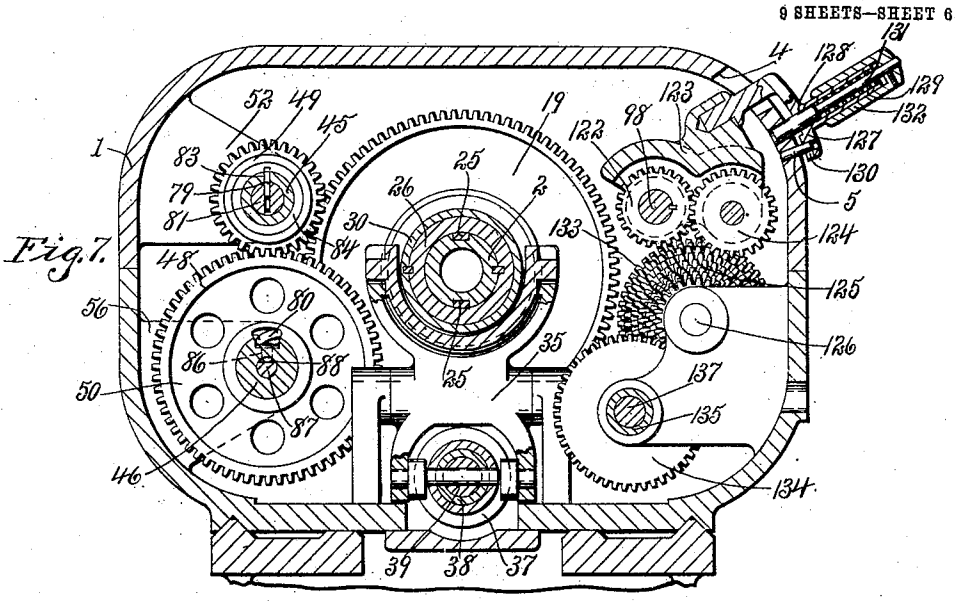
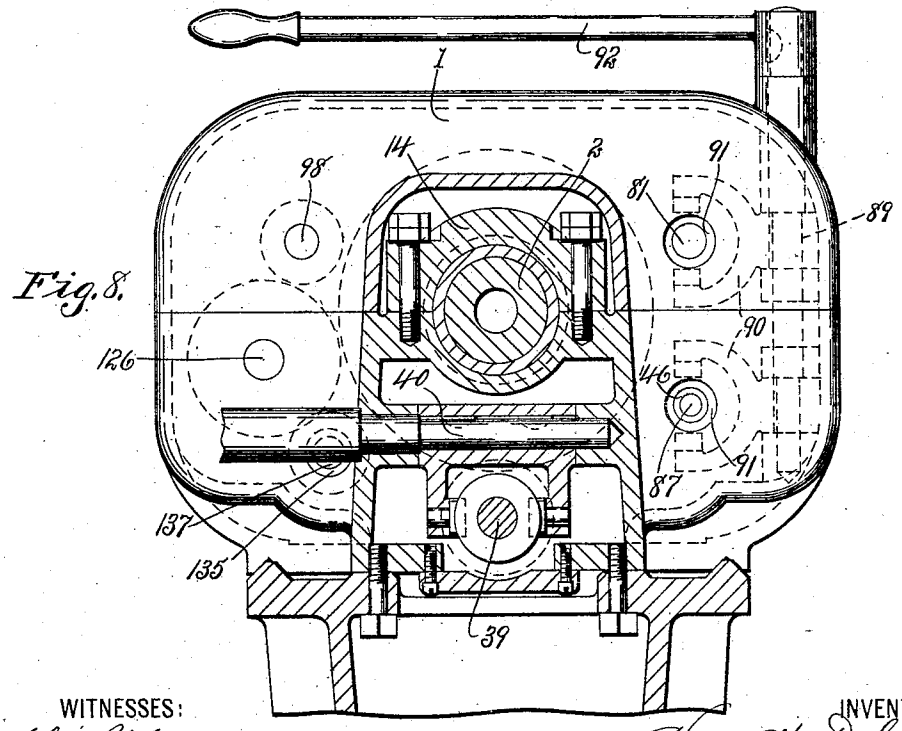


Fig. 8.



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9 SHEETS—SHEET 7.

Fig. 9.

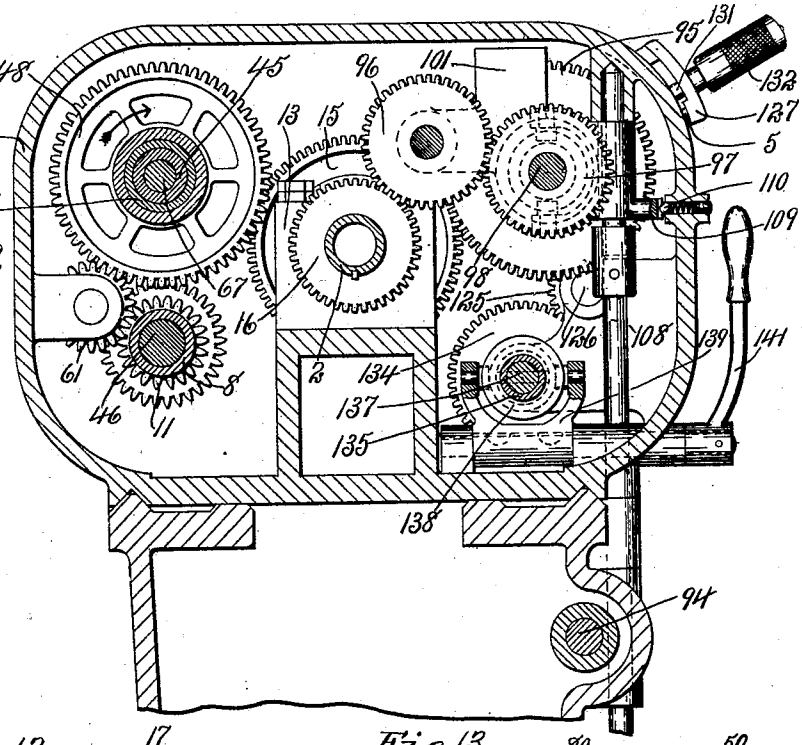


Fig. 12.

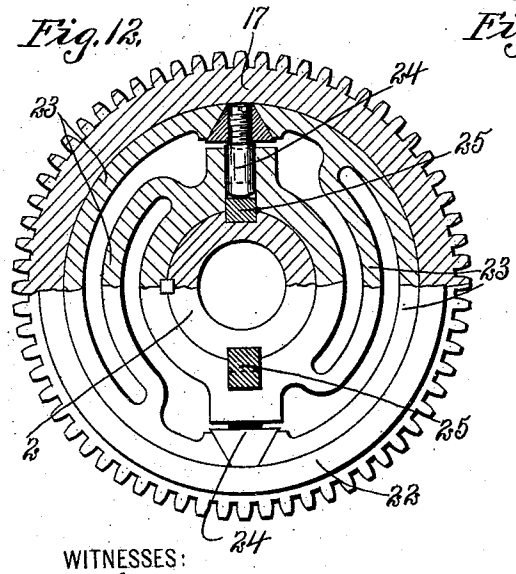
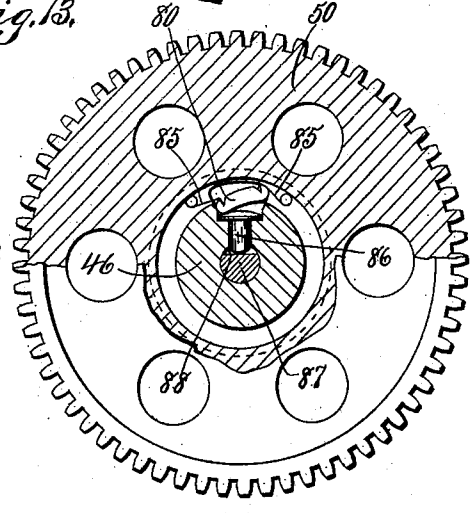


Fig. 13.



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9 SHEETS—SHEET 8.

Fig. 10.

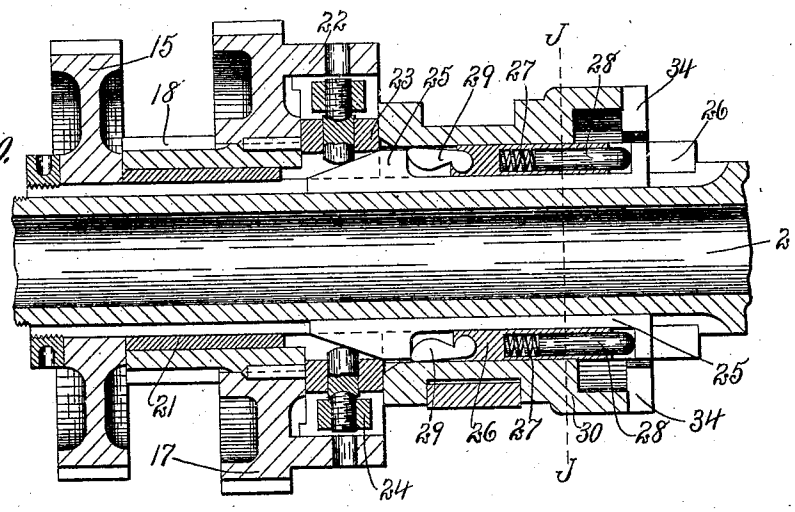


Fig. 11.

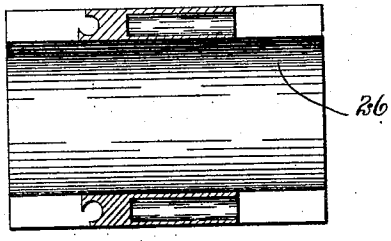
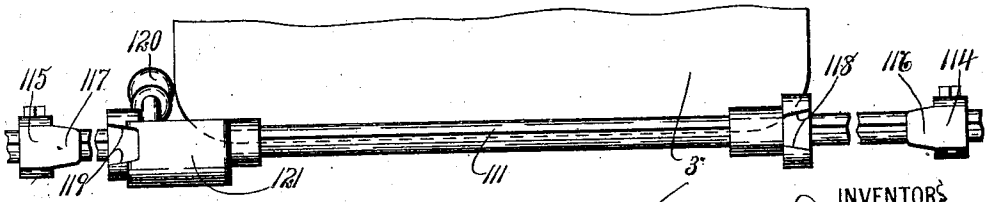


Fig. 19.



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9 SHEETS—SHEET 9.

Fig. 14.

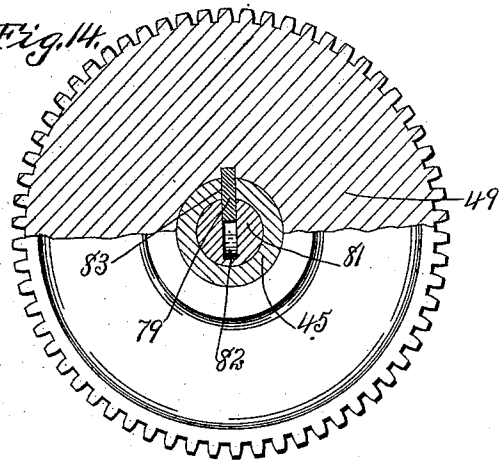


Fig. 15.

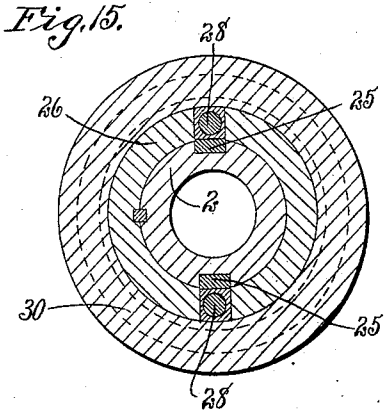


Fig. 16.

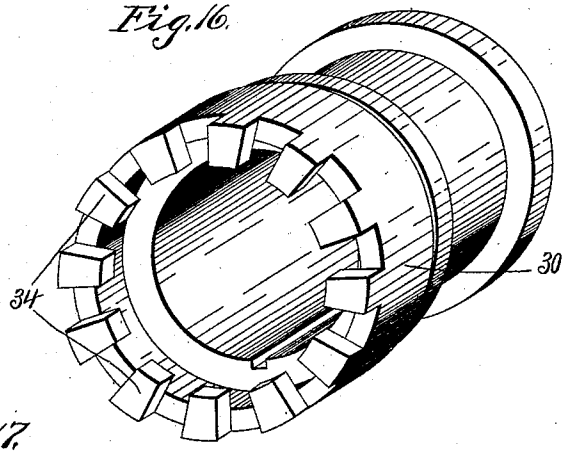


Fig. 17.

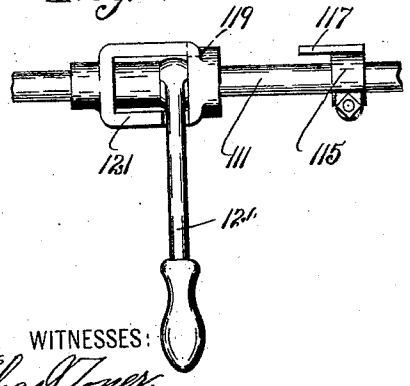
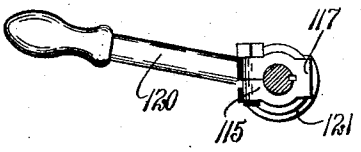


Fig. 18.



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UNITED STATES PATENT OFFICE.

HENRY M. DARLING AND WILLIAM RUNGE, OF SENECA FALLS, NEW YORK, ASSIGNORS TO THE SENECA FALLS MANUFACTURING COMPANY, OF SENECA FALLS, NEW YORK, A CORPORATION OF NEW YORK.

GEARING FOR MACHINE-TOOLS.

No. 917,015. Specification of Letters Patent. Patented April 6, 1909.

Application filed March 8, 1905. Serial No. 248,971.

To all whom it may concern:

Be it known that we, HENRY M. DARLING and WILLIAM RUNGE, of Seneca Falls, in the county of Seneca and State of New York, have invented a certain new and useful Gearing for Machine-Tools, of which the following is a specification.

Our invention has for its object the production of a gearing for machine tools, which is particularly simple in construction and highly practical, durable and effective in use; and to this end, it consists in the novel combinations and constructions hereinafter set forth and claimed.

In describing this invention, reference is had to the accompanying drawings, in which like characters designate corresponding parts in all the views.

Figure 1 is a front elevation, partly broken away, of a lathe embodying one construction of our invention. Fig. 2 is an enlarged end elevation, of the head-stock and contiguous portions of the lathe. Fig. 3 is a top plan of a number of the parts within the head-stock case, a portion of said case, and some of the contiguous parts at the outside thereof being also illustrated. Figs. 4, 5 and 6 are vertical sectional views, partly in elevation, taken, respectively, on lines A—A, B—B and C—C, Fig. 2, parts being omitted in Fig. 4. Figs. 7, 8 and 9 are vertical sectional views, partly in elevation, taken, respectively, on lines D—D, E—E and F—F, Fig. 3. Fig. 10 is an enlarged view of a portion of the mechanism seen in Fig. 5. Fig. 11 is a sectional view of a sleeve on the live spindle. Figs. 12, 13 and 14 are enlarged sectional views, partly in elevation, taken, respectively, on lines G—G, Fig. 5, and H—H and I—I, Fig. 4. Fig. 15 is a sectional view on line J—J, Fig. 10. Fig. 16 is an isometric view of the sliding part or sleeve for connecting to the live spindle any one of the gears loosely mounted thereon. Figs. 17 and 18 are, respectively, top plan and side elevation of a part of the means for controlling the movement of the carriage. Fig. 19 is an inner face view of portions of the carriage and the means for controlling the movement thereof.

The illustrated embodiment of this invention comprises, generally, a head-stock case 1, a driven shaft, at the live spindle 2, a carriage 3, a driving element, and power-transmitting means between the driving element and the live spindle, and between the live spindle and the carriage, said power-transmitting means being largely contained in the case.

The head-stock case 1, live spindle 2, and carriage 3 are of any desirable form, size and construction, suitable for use with the remaining parts of our invention, the case 1 being formed with bearings, presently described, an inclined slot 4, Fig. 1, a series of pins 5 arranged along one side of the slot substantially equidistant therefrom, and a series of sockets 6, one for each pin, interposed between the pins 5 and the contiguous edge of the slot. Said case may also be provided with a detachable upper section and with a suitable chart or table 7 for indicating the different operations of the machine.

The driving element, Figs. 3 and 4, comprises a sleeve 8 journaled in the bearing 9 of the case 1, and provided with a pair of pinions 10, 11 revoluble therewith, and having one end extended outside of the case and provided with an actuating wheel 12. Although the pinions 10, 11 are here shown as integral with the sleeve 8, it is obvious that they may be separable therefrom and suitably connected to the sleeve 8 to rotate therewith. Preferably, the opposing surfaces of the pinion 11 and the wheel 12 abut against the ends of the bearing 9 and prevent endwise movement of the driving element relatively to said bearing.

The live spindle 2, Figs. 3 and 5, is journaled at its ends in opposing bearings 13, 14 of the case 1, and is provided with pinions 15, 16 suitably fixed thereto, as by keys, gears 17, 18, 19, 20 loose thereon, and suitable means for connecting any of the gears 17, 19, 20 to the live spindle, said gears 17, 19, 20 constituting driven members. The gears 17, 18 are fixed together in any desirable manner and are journaled upon a sleeve 21, Figs. 5 and 10, encircling the spindle 2 and abutting against the opposing face of the gear 15. The face of the gear 17 opposed to the gear 19 is provided with a cylindrical flange 22 having an internal face adapted to be engaged by opposing arc-shaped expanding pieces 23, which are fixed to the spindle 2 and are forced into operative position by expanders 24, Fig. 12,

arranged radially relatively to the live spindle. These expanders 24 are engaged by cam-slides 25, Figs. 5 and 10, movable in reverse directions in lengthwise guides in the live spindle and in a sleeve 26 abutting against opposing faces of the sleeve 21 and the gear 19. The slides 25 are forced by springs 27 to their inoperative positions for permitting the natural spring of the expanding pieces 23 to relieve the flange 22 from engagement thereby, these springs 27 being preferably seated in sockets in the sleeve 26 and engaging corresponding ends of pins 28 having their opposite ends engaged with shoulders of the slides 25. Rocking parts 29 are utilized to force the slides 25 against the action of the springs 27 and move the expanders 24 outwardly for engaging the expanding pieces 23 with the inner face of the flange 22, and thereby locking the gear 17 to the live spindle 2. Corresponding ends of these rocking parts 29 are formed rounding and pivoted in sockets of similar shape in the sleeve 26, and their opposite ends are movable beyond the periphery of said sleeve and provided with outwardly curved faces which engage shoulders on the adjacent ends of the slides 25 and move said slides endwise, as the free ends of these rocking parts are forced inwardly within the periphery of the sleeve 26.

A movable part or sleeve 30 suitably keyed to the sleeve 26 and movable endwise relatively thereto is utilized to actuate the rocking parts 29, and thus connect the gear 17 to the live spindle 2. The gear 20 is preferably provided with a hub 31, and the gear 19 is journaled on said hub. The end of the hub 31 and the side of the gear 19 adjacent to the part or sleeve 30 are, respectively, provided with clutch surfaces or teeth 32, 33, which are arranged out of vertical alinement and are successively engaged by clutch surfaces or teeth 34 on said part or sleeve, as the same is moved endwise on the live spindle 2. Either of the gears 19, 20 is thus connected by the part or sleeve 30 to the live spindle 2. It will be understood that the described means for connecting any of the gears 17, 19 and 20 to the spindle 2, is particularly simple and effective, and that any other suitable means may be used for this purpose.

The part or sleeve 30 may be moved endwise on the live spindle 2 by any desirable means, here shown, Figs. 5 and 7, as a lever 35 within the case 1 pivoted intermediate of its ends at 36 and having one end suitably connected to the sleeve 30 and its other end connected to a collar 37 reciprocally movable on a shaft 38 arranged beneath the live spindle 2 and substantially parallel therewith. The collar 37 is connected to one end of a rod 39 reciprocally movable in a lengthwise socket in the shaft 38, and having its other end suitably connected to a rock-shaft 40 journaled in the case 1 and provided with an operating lever 41, Fig. 1, at the outside of the case. Said shaft 38 is provided with a plurality of gears 42, 43, 44 revoluble therewith and constantly meshing with the gears 18, 19, 20. When the gear 17 is locked to the live spindle by the part or sleeve 30, the gear 18 meshing with the gear 42, rotates the shaft 38 and the gears 43, 44, but no motion is transmitted from said gears 43, 44 because the gears 19, 20 revolve loosely on the spindle 2. On the contrary, when either of the gears 19, 20 is locked to the live spindle, and the gears 17, 18 revolve loosely thereon, motion is transmitted to the live spindle by the gear 42, shaft 38 and the gear on said shaft meshing with the gear locked to the live spindle.

The power-transmitting means between the driving element and the live spindle 2 comprises a pair of shafts 45, 46, Fig. 4, two gears 47, 48, a plurality of pairs of gears 49, 50, means movable relatively to the shafts 45, 46 for simultaneously locking the units of any one pair of gears 49, 50 to said shafts, and means connecting the shaft 46 to the live spindle, this last-mentioned means including the gears 17, 18, 42, the shaft 38 and the gears 43, 44, 19 and 20. The shaft 45 is journaled in opposing bearings 51, 52 of the case 1, and one end thereof projects outside of the case and is provided with a collar 53 revoluble therewith and movable endwise relatively thereto. Said shaft 45 is also provided with opposing collars 54, 55 within the case 1, the collar 54 abutting against the bearing 51, and the collar 55 abutting against one of the gears 49. The shaft 46 is arranged in axial alinement with the driving element, one end of said shaft being journaled in the sleeve 8 of the driving element, and its other end being journaled in a bearing 56 opposed to the bearing 9. The gears 47, 48 which are loose on the shaft 45, are preferably mounted upon sleeves 57, 58 encircling said shaft, the hubs of the gears abutting against opposing surfaces of the collars 55, 54, and annular shoulders 59, 60 upon said sleeves. Opposing ends of the sleeves 57, 58 abut against each other, and their opposite ends abut against the collars 55, 54. The gears 47, 48 are constantly in mesh, respectively, with the pinion 10 and an intermediate gear 61, Fig. 9, in mesh with the pinion 11. The opposing sides of the gears 47, 48 are provided with annular flanges 62 which are engaged by expanding pieces 63 fixed to the sleeves 57, 58 and actuated by the expanders 64, said parts 62, 63, 64 being arranged and constructed similar to the parts 22, 23, 24, previously described. The expanders 64 are actuated by oppositely-arranged cam-faces 65 extending through grooves 66 in the shaft 45 into en-

gagement with the expanders 64 and carried by an operating member or rod 67 slidable longitudinally in the shaft 45 and provided with oppositely extending movable parts 68, 69 similar to the corresponding parts 29, previously described. Adjacent ends of the parts 68, 69 are pivoted in rounding bearings in the ends of grooves in the rod 67 and the opposite or free ends of said parts 68, 69 extend through openings in the shaft 45 into engagement with bearing parts or screws 70 adjustable longitudinally in the collar 53, and are provided with rounding cam-faces for engaging contiguous surfaces of the openings in the shaft. Suitable springs 71 engage the parts 68, 69 for preventing undue outward movement of their free ends.

When the collar 53 is moved to the left, the free end of the part 69 is depressed within the periphery of the shaft 45, thus moving said rod 67 to the right and causing the right-hand cam-faces 65 to operate the corresponding expanders 64 and the expanding pieces 63 to lock the gear 47 to the shaft 45 and cause said shaft to rotate forwardly or in the direction indicated by the arrows in Figs. 4 and 9. A reverse movement of the collar 53 forces the free end of the part 68 within the periphery of the shaft 45 and moves the rod 67 endwise to the left, thus causing the left-hand cam-faces 65 to actuate the corresponding expanders 64 and expanding pieces 63 and lock the gear 48 to the shaft 45 for revolving said shaft in the reverse direction. The collar 53 may be moved endwise relatively to the shaft 45 by any desirable means, as a lever 72, Figs. 1 and 2, pivoted intermediate of its ends at 73 to an arm 74 projecting from the case 1, and adjustable relatively thereto about the axis of the shaft 45, one end of the lever 72 being connected to said collar 53, and its other end being pivoted to a bar 75 sliding in a support 76 which is adjustable about an axis substantially alined with the axis of the shaft 45, and is shown as pivoted at 77 to a standard 78 rising from the bed of the lathe.

The gears 49 are of dissimilar diameter and are loosely mounted on the shaft 45 between the collar 55 and the bearing 52, and the gears 50 are also of dissimilar diameter, are loosely mounted on the shaft 46, and are constantly in mesh with the gears 49. Said gears 49, 50 form a plurality of pairs, the units of each pair being in mesh and loosely mounted, respectively, on the shafts 45, 46.

The means movable relatively to the shafts 45, 46 for locking the units of any one pair of gears 49, 50 to said shafts consists of suitable locking parts 79, 80 and coacting means. The locking parts 79 are arranged one in advance of the other within the shaft 45, are pivoted at corresponding ends to a rod 81 movable in reverse directions in the shaft 45, and are engaged by springs 82 which force the opposite or free ends of the locking parts 79 outwardly through a slot 83 in the shaft 45 into key-ways in the contiguous faces of the gears 49. Said locking parts 79 are so arranged that only one is in operative position at a time, the other having its free end engaged by one of a series of rings 84 interposed between opposing surfaces of the gears 49.

The locking parts 80, Fig. 13, consist of double-ended pawls which are forced into operative position by springs 85 engaging the respective ends thereof, and are forced out of operative position by longitudinally sliding parts 86 arranged in radial guides in the shaft 46 and detachably coacting with the locking parts 80 and with a rod 87 movable in reverse directions in said shaft and provided with cutouts 88 for permitting the parts 86 to move inwardly toward the axis of the shaft 46, in order that the springs 85 may force the locking parts or pawls 80 into operative position. It will be understood that the cutouts 88 are so arranged that only one part 86 may be in its inward or inoperative position at a time, in order that only one gear 50 may be locked to the shaft 46 at a time. The rods 81, 87 are suitably connected to a rock-shaft 89, Figs. 4 and 8, which is here shown as having forked arms 90 engaging collars 91 on the rods 81, 87, and as journaled in the case 1 and provided with an operating member or hand-lever 92 at the outside of said case. By moving this hand-lever 92, the desired pair of gears 49, 50 are simultaneously connected to the shafts 45, 46.

The means connecting the shaft 46 to the live spindle 2, as here illustrated, includes a gear 93 fixed to the shaft 46 and constantly meshing with the gear 17 on the live spindle, said gear 93 rotating in the same direction and at the same speed as the shaft 46 and transmitting all motion from said shaft.

As will be understood by those skilled in the art, the shaft 46 and its gear 93 may be driven in either direction and at different speeds by shifting the slide 75 and the hand-lever 92, and the live spindle may be driven at different speeds relatively to said shaft 46 and gear 93 by shifting the lever 41.

The power-transmitting means between the live spindle and the carriage 3 comprises a driven shaft, as the lead-screw 94, Figs. 1 and 6, connected to the carriage, and means, which will now be described, between the lead-screw and the live spindle for rotating said lead-screw in reverse directions and at different speeds relatively to the live spindle. The last-mentioned means is actuated by the pinions 15, 16, Figs. 3 and 9, on the live spindle which are in mesh, respectively, with a gear 95, and an intermediary 96, the latter being in mesh with a gear 97. Said

gears 95, 96 are normally out of mesh with the pinions 15, 16 and are slidable axially with the gear 97 lengthwise of a shaft 98, Fig. 6, the gears 95, 97 being loosely mounted on said shaft 98 which is journaled in bearings 99, 100 provided on opposite sides of the case 1. A suitable yoke 101 serves as a means for sliding the gears 95, 96, 97 axially, one end of this yoke being mounted on a hub provided on the gear 97, and its other end being mounted on a hub on the gear 95 and supported in a bearing 102 which encircles the shaft 98 and closely fits a hub on said yoke. This yoke 101 is moved to and fro by a rock-shaft 103 journaled in the case 1, and having one end provided with a crank 104 suitably connected to the yoke, and its other end provided with a hand-piece 105 at the outside of the case, the crank 104 being so arranged that it is on its dead points when the yoke is in either of its extreme positions, in order that the yoke may be locked in such positions.

In the preferable construction of this invention, the gears 95, 97 are locked to the shaft 98 by a clutch-member 106, Figs. 3 and 6, which is suitably secured to the shaft 98, as by a key, and is slidable axially thereon into engagement with clutch-surfaces provided on opposing faces of the gear 95 and the hub of the gear 97. This clutch-member 106 normally occupies a neutral position and is moved into and out of engagement with the gears 95, 97 by a fork 107 mounted upon the upper end of a vertical rock-shaft 108 journaled in the case 1, and having the lower portion thereof extended outside of the case. The shaft 108 is provided at its upper end with an arm 109 which is engaged by a spring-actuated locking member 110 for holding the shaft 108 and the clutch-member 106 in their different positions.

The rock-shaft 108 is actuated by a rock-shaft 111 extending parallel to the lead-screw 94, contiguous ends of the shafts 108, 111 being provided with intermeshing toothed segments 112, 113. This shaft 111 is provided with arms 114, 115, Figs. 1, 17 and 19, spaced apart and adjustably clamped thereto, so that said arms may be adjusted toward and from each other and also about the axis of the shaft 111, to the desired position. Opposing sides of the arms 114, 115 are provided with lateral extensions 116, 117 having cam-surfaces which are engaged by corresponding surfaces 118, 119, Fig. 19, at opposite sides of the carriage 3, so that when the carriage reaches the limit of its movement in either direction, one of the cam-surfaces 118, 119 will encounter the cam-surface on the one of the arms 116, 117 having its free end depressed or elevated, and will rock said free end and the shaft 111 either upwardly or downwardly to the position assumed when said shaft 111 has actuated the shaft 108 to shift the clutch-member 106 to its neutral position. A suitable hand-lever 120 is keyed to the shaft 111 and movable endwise thereon with the carriage 3, being shown as journaled in a yoke 121 provided at one side of the carriage. By means of this lever 120, the shaft 111 may be rocked by hand when desired.

Motion is transmitted from the shaft 98 by a gear 122 slidable on said shaft between the bearings 100, 102 by means of a shifting frame 123 which rocks in a plane at an angle to the axis of the gear 122 and carries a tumbler-gear 124 meshing with the gear 122, and movable with the frame 123 about the axis of the shaft 98 and into and out of engagement with a plurality of gears 125 of dissimilar diameter revoluble with a shaft 126 journaled within the case 1, said gears 125 corresponding to the pins 5 and sockets 6 of the case 1. The frame 123 extends through the slot 4 of the case 1 and is provided with a part 127 overlapping one side of said slot and formed with an opening 128 extending through said part, and with a tubular member 129 having its lengthwise opening alined with the first-mentioned opening 128. The lower side of the part 127 is provided with a notch 130 which extends in the direction of the rocking movement of the frame 123 and receives the pins 5 as the free end of the frame 123 is rocked downwardly into position for engaging the gear 124 with one of the gears 125. When shifting the gears 122, 124 and the frame 123 lengthwise of the shaft 98, it is necessary to first rock the free end of the frame 123 upwardly until the notch 130 is above the pin 5, previously arranged therein, thus preventing shifting of said parts until the gears 124, 125 are disengaged, and avoiding injury to the corners of the teeth of said gears. The opening 128 and the tubular member 129 receive a suitable spring-actuated locking bolt 131 provided with a hand-piece 132 which encircles the outer end of the tubular member 129, and also serves as the handle of the frame 123.

The gears 125 and an additional gear 133 fixed to the shaft 126 are constantly in mesh with a plurality of gears 134 of dissimilar diameter loosely mounted on one end of a shaft 135 journaled within the case 1. Suitable locking parts 136 of the same construction and operation as the parts 79, previously described, serve to lock one of the gears 134 to the shaft 135. The operation of these locking parts is controlled by a rod 137 slidable endwise in the shaft 135 and suitably connected by a collar 138 on the shaft 135 to an arm 139 provided on the rock-shaft 140 which extends to the outside of the case and is provided with a hand-lever 141. The position of this lever 141 is determined by a suitable indicator 142. The

other end of the shaft 135 is extended outside of the case 1 and is provided with a gear 143. To those skilled in the art, it will be understood that this gear 143 rotates in reverse directions determined by the direction of movement of the live spindle and the position of the clutch-member 106, and that the speed of this gear may be varied relatively to that of the live spindle by the gears connecting the shaft 135 to said spindle.

The gear 143 meshes with a gear 144 fixed to a gear 145 of less diameter, these gears 144, 145 being mounted on a stud 146 fixed to the lathe-bed, and being, respectively, engaged by a pair of gears 147, 148 slidable axially on the lead-screw for engaging one of the gears 147, 148 with one of the gears 144, 145, which coacts therewith. It is thus apparent that the lead-screw 94 may be rotated at different speeds relatively to the gear 143.

The construction and operation of our gearing for machine tools will be readily understood by those skilled in the art, and it will be noted that the live spindle or the lead-screw may be rotated in reverse directions and at a number of different speeds as desired, and that all of the mechanism for actuating the live spindle and the greater portion of the mechanism for actuating the lead-screw is contained within the case 1, these various mechanisms being manipulated readily by merely shifting hand-levers. The construction of the component parts of our gearing for machine tools may, obviously, be more or less varied without departing from the spirit of our invention and any other driven shafts or parts may be used instead of the live spindle and the lead-screw.

Having thus fully described our invention, what we claim as new and desire to secure by Letters Patent, is:—

1. In a gearing for machine-tools, a shaft, a driving element, a plurality of driven elements loosely mounted on the shaft, means for detachably locking any one of the driven elements to the shaft, and power-transmitting means between the driving and driven elements comprising, a pair of shafts, a plurality of pairs of members for varying the speed of the driven elements, said members being loosely mounted on said pair of shafts, means for detachably connecting the speed-varying members to the pair of shafts, members coöperating with the driving element for rotating one of the pair of shafts in opposite directions, said second-mentioned members being normally disconnected from said one of the pair of shafts, and means for connecting either of the second-mentioned members to said one of the pair of shafts, substantially as and for the purpose described.

2. In a gearing for machine-tools, a shaft, a driving element, a plurality of driven elements loosely mounted on the shaft, means for detachably connecting any one of the driven elements to the shaft, and power-transmitting means between the driving and driven elements comprising, two pinions mounted on and revoluble with the driving element, two gears coöperating respectively with the pinions to transmit motion therefrom, said gears being arranged in axial alinement and normally disconnected from the driven elements, and means for connecting either of the gears to the driven elements, substantially as and for the purpose specified.

3. In a gearing for machine-tools, a shaft, a driving element, and power-transmitting means between the shaft and the driving element comprising, a pinion revoluble with the driving element and mounted thereon concentrically thereof, a plurality of shafts, a gear mounted on one of said plurality of shafts and coöperating with the pinion revoluble with the driving element for rotating said one of the plurality of shafts, a plurality of pairs of members of dissimilar size for connecting said one of the plurality of shafts and a second shaft of said plurality of shafts, whereby the speed of said second shaft is varied, and members for connecting said second shaft and the first-mentioned shaft whereby the speed of the first-mentioned shaft is varied relatively to said second shaft of said plurality of shafts, substantially as and for the purpose set forth.

4. In a gearing for machine-tools, a shaft, a case, a driving element, power-transmitting means within the case between the shaft and the driving element comprising, two hollow shafts journaled in the case, and a plurality of pairs of gears within the case, the units of each pair being in mesh and loosely mounted respectively on the hollow shafts, and means for locking the units of any one pair of the gears to the hollow shafts, including rods movable endwise in the hollow shafts, and an operating member supported by the case and extending to the outside thereof, said member being connected to the rods, substantially as and for the purpose specified.

5. In a gearing for machine-tools, a case, a shaft, a plurality of gears of dissimilar diameter loosely mounted thereon, a second shaft, gears mounted thereon meshing with the first-named gears whereby motion is transmitted from one of the first-named gears to the second-mentioned shaft and from the latter to the others of said first-named gears, a driving element, power-transmitting means between the driving element and said one of the first-named gears for transmitting motion at varying speeds to the latter, including a third shaft, a gear

fixed to the third shaft and constantly in driving connection with said one of the first-named gears, and change-speed gearing between the last-mentioned shaft and the driving element, and means movable relatively to the first-mentioned shaft for locking thereto any one of the gears loosely mounted thereupon, substantially as and for the purpose described.

6. In a gearing for machine-tools, a shaft, a case, a driving element, power-transmitting means within the case between the shaft and the driving element comprising, two hollow shafts journaled in the case, two gears loosely mounted within the case on one of the hollow shafts for rotating said hollow shaft in reverse directions, means for locking either of the gears to said one of the hollow shafts including, a part movable within said hollow shaft and extending to the outside of the case, a plurality of pairs of gears within the case, the units of each pair being in mesh and loosely mounted respectively on said hollow shafts, and means for locking the units of any one pair of gears to said hollow shafts, the last-mentioned means including parts movable within the hollow shafts, substantially as and for the purpose described.

7. In a gearing for machine-tools, a case, a shaft, a driving element comprising a sleeve and a pinion fixed thereto, said sleeve being journaled in the case and having one end projecting outside of the same, means for preventing endwise movement of the sleeve in the case an actuating wheel at the outside of the case connected to said projecting end of the sleeve, a driven element associated with the shaft, and power-transmitting means between the driving and driven elements including, a shaft having one end journaled in the case and its opposite end journaled in the sleeve, and change-speed members connecting said pinion and the second-mentioned shaft, substantially as and for the purpose specified.

8. In a gearing for machine tools, a shaft, a driving element, driven elements loosely mounted on the shaft, gearing for transmitting motion from one of the driven elements to another of the driven elements, and power-transmitting means including a shaft, a gear revoluble with the second-mentioned shaft and connected to said one of the driven elements, such gear transmitting all motion from the second-mentioned shaft to the driven elements, a plurality of gears loosely mounted on the second-mentioned shaft, members for connecting the last-mentioned gears independently to the driving element, and means for locking any one of said last-mentioned gears to the second-mentioned shaft, substantially as and for the purpose specified.

9. In a gearing for machine-tools, a shaft, a driving element, driven elements loosely mounted on the shaft, gearing for transmitting motion from one of the driven elements to another of the driven elements, means for independently connecting the driven elements to the shaft, and power-transmitting means including, a shaft in axial alinement with the driving element, a gear mounted on the second-mentioned shaft and revoluble therewith, said gear being connected to said one of the driven elements, a plurality of gears loosely mounted on the second-mentioned shaft, members for connecting the last-mentioned gears independently to the driving element, and means for locking any one of said last-mentioned gears to the second-mentioned shaft, substantially as and for the purpose described.

10. In a gearing for machine-tools, a shaft, a driving element comprising a sleeve and a pinion revoluble therewith, a driven element associated with the shaft, and power-transmitting means including, a shaft having one end journaled in the sleeve, a gear fixed on the second-mentioned shaft and connected to the driven element, a plurality of gears loosely mounted on the second-mentioned shaft, members for connecting the last-mentioned gears independently to the pinion of the driving element, and means for locking any one of said last-mentioned gears to the second-mentioned shaft, substantially as and for the purpose specified.

11. In a gearing for machine-tools, a case having opposing bearings, a shaft, a driving element comprising a sleeve and a pinion revoluble therewith, said sleeve being journaled in one of the bearings, driven elements loosely mounted on the shaft, gearing for transmitting motion from one of the driven elements to another of the driven elements, means for independently connecting the driven elements to the shaft, and power-transmitting means including, a shaft having one end journaled in the other bearing and its opposite end journaled in the sleeve, a gear mounted on the second-mentioned shaft and revoluble therewith, said gear being connected to said one of the driven elements, a plurality of gears loosely mounted on the second-mentioned-shaft, members for connecting the last-mentioned gears independently to the pinion of the driving element, and means for locking any one of said last-mentioned gears to the second-mentioned shaft, substantially as and for the purpose set forth.

12. In a gearing for machine-tools, a shaft, a driving element, two pinions revoluble with the driving element, driven elements loosely mounted on the shaft, gearing for transmitting motion from one of the driven elements to another of the driven elements, means for independently connect-

ing the driven elements to the shaft, and power-transmitting means including, a shaft, a gear mounted on the second-mentioned shaft and revoluble therewith, said gear being connected to said one of the driven elements, a plurality of gears loosely mounted on the second-mentioned shaft, members for connecting the last-mentioned gears independently to the pinions of the driving element and thereby effecting forward and reverse movement of the driven elements, and means for locking any one of said last-mentioned gears to the second-mentioned shaft, substantially as and for the purpose described.

13. In a gearing for machine-tools, a shaft, a driving element comprising a sleeve and a pinion revoluble therewith, a driven element mounted on the shaft, and power-transmitting means including, a shaft having one end journaled in the sleeve, a gear mounted on the second-mentioned shaft and fixed thereto, said gear being connected to the driven element and abutting against the sleeve, a plurality of gears loosely mounted on the second-mentioned shaft and abutting against the first-mentioned gear, members for connecting the last-mentioned gears independently to the pinion of the driving element, and means for locking any one of said last-mentioned gears to the second-mentioned shaft, substantially as and for the purpose specified.

14. In a gearing for machine-tools, a shaft, a driving element, a driven element and power-transmitting means between the driving and driven elements comprising, a hollow shaft having a radial guide, a rotatable member loosely mounted on the second-mentioned shaft, a part interposed between the hollow shaft and the rotatable member for locking said member to the hollow shaft, a spring for forcing said part into operative position, a sliding part detachably engaging the first-mentioned part and movable longitudinally in the guide of the hollow shaft for forcing said first-mentioned part against the action of the spring, and a rod movable endwise in the hollow shaft and detachably engaging the second-mentioned part, substantially as and for the purpose set forth.

15. In a gearing for machine-tools, a shaft, a driving element, two pinions revoluble with the driving element, a driven element associated with the shaft, and power-transmitting means comprising, a shaft, opposing collars on the second-mentioned shaft, sleeves on the second-mentioned shaft having their opposing ends abutting against each other and provided with annular shoulders and their opposite ends abutting against said collars, members connecting said pinions and the driven element for rotating the driven element in opposite directions, said members including, two gears loosely mounted on the sleeves and abutting against the shoulders thereof and opposing faces of the collars, said gears coöperating respectively with the pinions, and means for locking either of the gears to the second-mentioned shaft, substantially as and for the purpose described.

16. In a gearing for machine-tools, a shaft, a driving element, a driven element associated with the shaft, power-transmitting means between the driving and driven elements comprising, a hollow shaft, rotatable members loosely mounted on the hollow shaft and revoluble in reverse directions, and means for locking either of the rotatable members to the hollow shaft, an operating member movable endwise in the hollow shaft for actuating said locking means, a collar movable endwise on the outside of the hollow shaft, and means interposed between the operating member and the collar and movable relatively to said collar for transmitting motion therefrom to the operating member, substantially as and for the purpose specified.

17. In a gearing for machine-tools, a shaft, a driving element, a driven element associated with the shaft, power-transmitting means between the driving and driven elements comprising, a hollow shaft having a slot extending from its internal cavity through the periphery thereof, a rotatable member loosely mounted on the hollow shaft, and means for locking said member to the hollow shaft, an operating member movable endwise in the hollow shaft and provided with a groove having a bearing at one end thereof, a collar movable endwise on the outside of the hollow shaft, and a movable part pivoted in the bearing in the groove of the operating member and extending through the slot of the hollow shaft into engagement with the collar, substantially as and for the purpose set forth.

18. In a gearing for machine-tools, a shaft, a driving element comprising, a sleeve and a pair of pinions fixed thereto, a driven element associated with the shaft, and power-transmitting means between the driving and driven elements comprising, a shaft having one end journaled in the sleeve, a gear mounted on the second-mentioned shaft and revoluble therewith, a third shaft, a pair of gears loosely mounted on the third shaft and coöperating respectively with the pair of pinions, means for locking either of the pair of gears to the third shaft, a plurality of pairs of gears, the units of each pair intermeshing and being loosely mounted, respectively, on the second- and third-mentioned shafts, and means for locking the units of any one of said pairs of gears to the respective shafts provided therewith, substantially as and for the purpose described.

19. In a gear for machine-tools, a driving element, a shaft to be driven, a gear loosely

mounted on the shaft intermediate of the ends thereof and provided with a hub, having a clutch-surface on the projecting end thereof, a second gear mounted on the hub and having a clutch-surface on its side adjacent to the projecting end of the hub, the last-named clutch surface being arranged at one side of the first-mentioned clutch-surface, a part mounted on the shaft and revoluble therewith, said part having a clutch-surface at its end adjacent to the gears and common to the clutch-surfaces of said hub and the gear mounted thereon, and adapted to separately engage said clutch-surfaces, and power-transmitting means for connecting the driving element, respectively, to the part revoluble with the shaft and to said gears, substantially as and for the purpose described.

20. In a gearing for machine-tools, a driving element, a shaft, and power-transmitting means between the driving element and the shaft comprising, a plurality of gears loosely mounted on the shaft, means for revolving the gears at dissimilar speed, one of the gears being provided with a hub, and another of the gears being loosely mounted on said hub, a part revoluble with the shaft and movable relatively thereto, said part having means for coacting with said hub and the gear mounted thereon and friction means for locking said part to another of the gears, substantially as and for the purpose set forth.

21. In a gearing for machine-tools, a driving element, a shaft, a sleeve revoluble with the shaft and provided with a guide, and power-transmitting means between the driving element and the shaft comprising, a plurality of gears arranged concentric with the shaft, means for revolving the gears at dissimilar speed, a part revoluble with the sleeve and movable relatively thereto, said part having means for detachably engaging one of the gears, a slide movable in the guide of the sleeve, and means coacting with the slide, one of the gears and said part for locking the same together, substantially as and for the purpose described.

22. In a gearing for machine-tools, a driving element, a shaft, a sleeve revoluble with the shaft and provided with a guide, and power-transmitting means between the driving element and the shaft comprising, a plurality of gears, one being loosely mounted on the sleeve, another being provided with a hub, and another being loosely mounted on such hub, a part revoluble with the sleeve and movable relatively thereto, said part having means for detachably engaging said hub and the gear mounted thereon, a slide movable in the guide of the sleeve, and means coacting with the gear mounted on the sleeve, said part, and the slide for locking the same together, substantially as and for the purpose specified.

23. In a gearing for machine-tools, a driving element, a shaft, and power-transmitting means between the driving element and the shaft comprising, a gear loosely mounted on the shaft, a plurality of gears of dissimilar diameter also loosely mounted on the shaft, means for locking said gears independently to the shaft, means for rotating the first-mentioned gear, a plurality of gears of dissimilar diameter arranged eccentric to the shaft and connected respectively to said plurality of gears on the shaft, and means for transmitting motion to the last-mentioned gears from the first-mentioned gear, substantially as and for the purpose set forth.

24. In a gearing for machine-tools, a driving element, a shaft, and power-transmitting means between the driving element and the shaft comprising, a gear loosely mounted on the shaft, a shaft connected to the gear, a plurality of gears of dissimilar diameter mounted on the second-mentioned shaft, means for connecting said plurality of gears independently to the first-mentioned shaft, means for connecting to the first-mentioned shaft the gear loosely mounted thereon, and an operating member supported by the second-mentioned shaft and connected to the last-mentioned means for actuating the same, substantially as and for the purpose described.

25. In a gearing for machine-tools, a driving element, a shaft, and power-transmitting means between the driving element and the shaft comprising, a gear loosely mounted on the shaft, a plurality of gears of dissimilar diameter also loosely mounted on the shaft, a shaft connected to the first-mentioned gear, an operating member supported by the second-mentioned shaft and movable relatively thereto, means between the operating member and said gears for locking the same independently to the first-mentioned shaft, means for rotating the first-mentioned gear on said first-mentioned shaft, and a plurality of gears of dissimilar diameter mounted on the second-mentioned shaft, and connected respectively to said plurality of gears of dissimilar diameter on the first-mentioned shaft, substantially as and for the purpose specified.

26. In a gearing for machine-tools, a driving element, a shaft, a driven element, power-transmitting means connected to the driving element for rotating the driven element at different speeds, power-transmitting means between the shaft and the driven element for rotating the shaft at different speeds relatively to said driven element, and means including an operating member for connecting the driven element or the last-mentioned

power-transmitting means to the shaft, substantially as and for the purpose set forth.

27. In a gearing for machine-tools, a driving element, a shaft, a driven element loosely mounted on the shaft, power-transmitting means actuated by the driving element for rotating the driven element at different speeds, a plurality of gears loosely mounted on the shaft, means between the driven element and the gears for revolving said gears at dissimilar speeds, and means for connecting the shaft to the driven element or to either of said gears, substantially as and for the purpose described.

28. In a gearing for machine-tools, a driving element, a shaft, and power-transmitting means between the driving element and the shaft comprising, a plurality of members loosely mounted on the shaft for varying the speed thereof, means for connecting said members independently to the shaft, additional members for varying the speed of the first-mentioned members arranged eccentric to the shaft, said additional members being connected independently to the first-mentioned members, and a member loosely mounted on the shaft and connected to the driving member and to said additional members, substantially as and for the purpose set forth.

29. In a gearing for machine-tools, a driving element, a shaft, and power-transmitting means between the driving element and the shaft comprising, two shafts, members connecting the second-mentioned shafts for varying the speed of one relatively to the other, one of the members being mounted on the first-mentioned shaft, members connecting one of the second-mentioned shafts to the first-mentioned shaft, and means connecting the driving element to the other of the second-mentioned shafts, substantially as and for the purpose described.

30. In a gearing for machine-tools, a driving element, a shaft, and power-transmitting means between the driving element and the shaft comprising, a plurality of members loosely mounted on the shaft, two shafts, one being connected to the driving element and conected independently of the other of said two shafts to one of the members on the first-mentioned shaft, and said other of the two shafts being connected to said one of the members on the first-mentioned shaft and to another of said members, and means for locking said members independently to the first-mentioned shaft, substantially as and for the purpose specified.

31. In a gearing for machine-tools, a driving element, a shaft, and power-transmitting means between the driving element and the shaft comprising, a plurality of gears loosely mounted on the shaft, a plurality of shafts, variable speed gearing connecting the driving element and one of the plurality of shafts, a gear fixed on said one of the plurality of shafts for transmitting all motion therefrom, said gear being permanently connected to one of the gears loosely mounted on the first-mentioned shaft, and gears on another of said plurality of shafts for connecting said one of the gears on the first-mentioned shaft to the other gears on said first-mentioned shaft, substantially as and for the purpose set forth.

32. In a gearing for machine-tools, a driving element, two pinions revoluble therewith, a shaft, a driven element loosely mounted on the shaft, power-transmitting means comprising, a shaft, members connecting the pinions and the driven element for rotating the driven element in opposite directions, said members including two gears loosely mounted on the second-mentioned shaft and coöperating respectively with the pinions, and means for locking either of the gears to the second-mentioned shaft, a plurality of gears mounted on the first-mentioned shaft, means between the driven element and the plurality of gears for revolving said gears at dissimilar speeds, and means for connecting the first-mentioned shaft to the driven element or to either of said plurality of gears, substantially as and for the purpose described.

33. In a gearing for machine-tools, a case, a shaft journaled in the case, a second shaft exterior of the case, power-transmitting means within the case for rotating the first-mentioned shaft in reverse directions, a driven element within the case connected to the second-mentioned shaft, and power-transmitting means within the case between the first-mentioned shaft and the driven element for rotating the driven element, substantially as and for the purpose specified.

34. In a gearing for machine-tools, a shaft, a second shaft, two pinions revoluble with the second-mentioned shaft, and power-transmitting means between said shafts comprising, a third shaft, two gears loosely mounted and slidable axially on the third shaft and coöperating respectively with the pinions revoluble with the second-mentioned shaft to transmit motion therefrom in reverse directions, and means for locking either of the gears to said third shaft, substantially as and for the purpose specified.

35. In a gearing for machine-tools, a shaft, a case having opposing bearings, a shaft journaled in the case, two pinions revoluble with the second-mentioned shaft, and power-transmitting means between said shafts comprising, a third shaft journaled in one of the bearings, two gears loosely mounted and slidable axially on the third shaft and cooperating respectively with the pinions revoluble with the second-mentioned shaft to transmit motion therefrom in reverse directions, a yoke connecting the gears and

provided with a hub supported in the other bearing, and means for locking either of the gears to said third shaft, substantially as and for the purpose set forth.

36. In a gearing for machine-tools, a shaft 137, a second shaft 2, and power-transmitting means between said shafts comprising, a plurality of shafts extending lengthwise of the second-mentioned shaft, members connecting the second-mentioned shaft and one of the plurality of shafts for driving the latter in reverse directions, a plurality of gears of dissimilar diameter fixed on a second shaft of said plurality of shafts, a gear mounted on and revoluble with said shaft of the plurality of shafts connected to the second-mentioned shaft, said gear being slidable relatively to the plurality of gears, means for connecting the slidable gear with any one of said plurality of gears, a plurality of gears loosely mounted on the first-mentioned shaft and connected independently to said plurality of gears, and means for locking to the first-mentioned shaft any one of the gears loosely mounted thereon, substantially as and for the purpose described.

37. In a gearing for machine-tools, a shaft, a case formed with a slot, a second shaft, and power-transmitting means within the case between the shafts comprising, a third shaft connected to the second-mentioned shaft, a fourth shaft, a plurality of gears of dissimilar diameter on said fourth shaft, a gear mounted on and revoluble with said third shaft, said gear being also slidable axially relatively to the gears of dissimilar diameter, a shifting-frame connected to the sliding-gear and projecting through the slot in the case, and an intermediary gear carried by the frame and meshing with said sliding-gear, and adapted to mesh with any one of the gears of dissimilar diameter, substantially as and for the purpose specified.

38. In a gearing for machine-tools, a case formed with a slot and a series of sockets arranged along the slot, a shaft, and power-transmitting means comprising, a shaft, and mechanism within the case for varying the speed of the second-mentioned shaft relatively to the first-mentioned shaft, said mechanism including, a third shaft connected to the first-mentioned shaft, a fourth shaft, a plurality of gears of dissimilar diameter on the fourth shaft corresponding to said sockets, a gear mounted on and revoluble with said third shaft, the gear being also slidable axially relatively to the gears of dissimilar diameter, a shifting-frame connected to the sliding-gear and projecting through the slot in the case, said frame having a part thereof overlapping the contiguous portion of the case and provided with an opening extending therethrough, and with a projecting tubular member having its opening alined with the first-mentioned opening, a locking bolt arranged in said tubular member and movable through the first-mentioned opening into said sockets, a hand-piece slidably mounted on the tubular member and connected to said bolt, and means carried by the frame for connecting the slidable gear with any one of said plurality of gears, substantially as and for the purpose set forth.

39. In a gearing for machine-tools, a case formed with a slot and a series of pins arranged along the slot, a shaft, and power-transmitting means comprising, a shaft, and mechanism within the case for varying the speed of the second-mentioned shaft relatively to the first-mentioned shaft, said mechanism including, a third shaft connected to the first-mentioned shaft, a fourth shaft, a plurality of gears of dissimilar diameter on the fourth shaft corresponding to said pins, a gear mounted on and revoluble with said third shaft, the gear being also slidable axially relatively to the gears of dissimilar diameter, a shifting-frame connected to the sliding gear and rocking in a plane at an angle to the axis of the sliding gear, said frame projecting through the slot in the case and having a part thereof overlapping the contiguous portion of the case and provided with a notch extending in the direction of the rocking movement of the frame, and receiving said pins, and means carried by the frame for connecting the slidable gear with any one of said plurality of gears, substantially as and for the purpose described.

40. In a gearing for machine-tools, a bed, a shaft, a case, a second shaft journaled in the case, power-transmitting means within the case for rotating the second shaft at different speeds and in reverse directions, and power-transmitting means between the shafts comprising, a third shaft journaled in the case and projecting outside of the same, gearing within the case between the second-mentioned shaft and the third shaft for rotating said third shaft at different speeds relatively to the second-mentioned shaft, a gear at the outside of the case mounted on said third shaft, a pair of gears of dissimilar diameter supported by the bed, one of the gears being in mesh with the first-mentioned gear, and a pair of gears revoluble with and slidably axially on the first-mentioned shaft and respectively engaging the gears of dissimilar diameter, substantially as and for the purpose set forth.

41. In a gearing for machine-tools, a shaft, a second shaft, a driven element connected to the first-mentioned shaft, power-transmitting means between the second-mentioned shaft and the driven element, a movable member for connecting and disconnecting the power-transmitting means and the driven element, and means for moving

said movable member out of operative position when the first-mentioned shaft has made a predetermined movement, said means comprising a rock-shaft extending lengthwise of the first-mentioned shaft and having an arm movable in a direction at substantially a right-angle to the axis of the rock-shaft, substantially as and for the purpose described.

42. In a gearing for machine-tools, a shaft, a second shaft, a driven element connected to the first-mentioned shaft, power-transmitting means between the second-mentioned shaft and the driven element, a movable member for connecting and disconnecting the power-transmitting means and the driven element, and means for moving said movable member out of operative position when the first-mentioned shaft has made a predetermined movement, said means comprising a rock-shaft extending lengthwise of the first-mentioned shaft, an arm movable in a direction at substantially a right-angle to the axis of the rock-shaft, said arm having a cam-face, and a hand-lever for rocking the last-mentioned shaft slidably mounted thereon, substantially as and for the purpose specified.

43. In a gearing for machine-tools, a shaft, a second shaft revoluble in reverse directions, power-transmitting means between the shafts for rotating the first-mentioned shaft in reverse directions, and means for changing the direction of movement of the first-mentioned shaft when the same has made a predetermined movement, said means including a rock-shaft extending lengthwise of the first-mentioned shaft, and an arm projecting laterally from the rock-shaft and having a cam-face, said arm being adjustable lengthwise of the rock-shaft for varying the position of its cam-face, substantially as and for the purpose set forth.

44. In a gearing for machine-tools, the combination with a case, of a shaft journaled therein, gears loosely mounted on the shaft for rotating the same in reverse directions, means guided axially of the shaft for connecting one, or the other, of said gears thereto, a set of transmission-gears loosely mounted on the shaft, a second means guided axially of the shaft for connecting any one of the members of said set of gears thereto, a second shaft, a companion set of transmission-gears loosely mounted on the second shaft and intermeshing with the members of the first set of transmission gears, means for connecting any one of the companion set of transmission gears to the second shaft, driving pinions mounted in axial alinement with said companion set of transmission-gears one of the pinions meshing directly with one of the first-named gears, an idler interposed between the other of said pinions and another of said first-mentioned gears, and transmission-means fixed to said second shaft, substantially as and for the purpose described.

45. In a gearing for machine-tools, the combination with a case, of a shaft journaled therein, gears loosely mounted on the shaft for rotating the same in reverse directions, means guided axially of the shaft for connecting one, or the other, of said gears thereto, a set of transmission-gears loosely mounted on the shaft, a second means guided axially of the shaft for connecting any one of the members of said set of gears thereto, a second shaft, a companion set of transmission gears loosely mounted on the second shaft and intermeshing with the members of the first set of transmission gears, means for connecting any one of the companion set of transmission gears to the second shaft, driving pinions mounted in axial alinement with said companion set of transmission-gears one of the pinions meshing directly with one of the first-named gears, an idler interposed between the other of said pinions and another of said first-mentioned gears, a shaft to be driven, a plurality of gears of dissimilar diameter loosely mounted thereon, means for connecting said gears independently to said last-mentioned shaft, and transmission-means between the last-named gears and the second shaft including a gear-wheel fixed to the second shaft and constantly connected with one of the plurality of gears associated with said shaft to be driven, substantially as and for the purpose set forth.

In testimony whereof, we have hereunto signed our names in the presence of two attesting witnesses, at Seneca Falls, in the county of Seneca, in the State of New York, this 6th day of March, 1905.

HENRY M. DARLING.
WILLIAM RUNGE.

Witnesses:
J. C. DAVIS,
L. V. FILLINGHAM.