

Sept. 2, 1930.

A. TROSCH

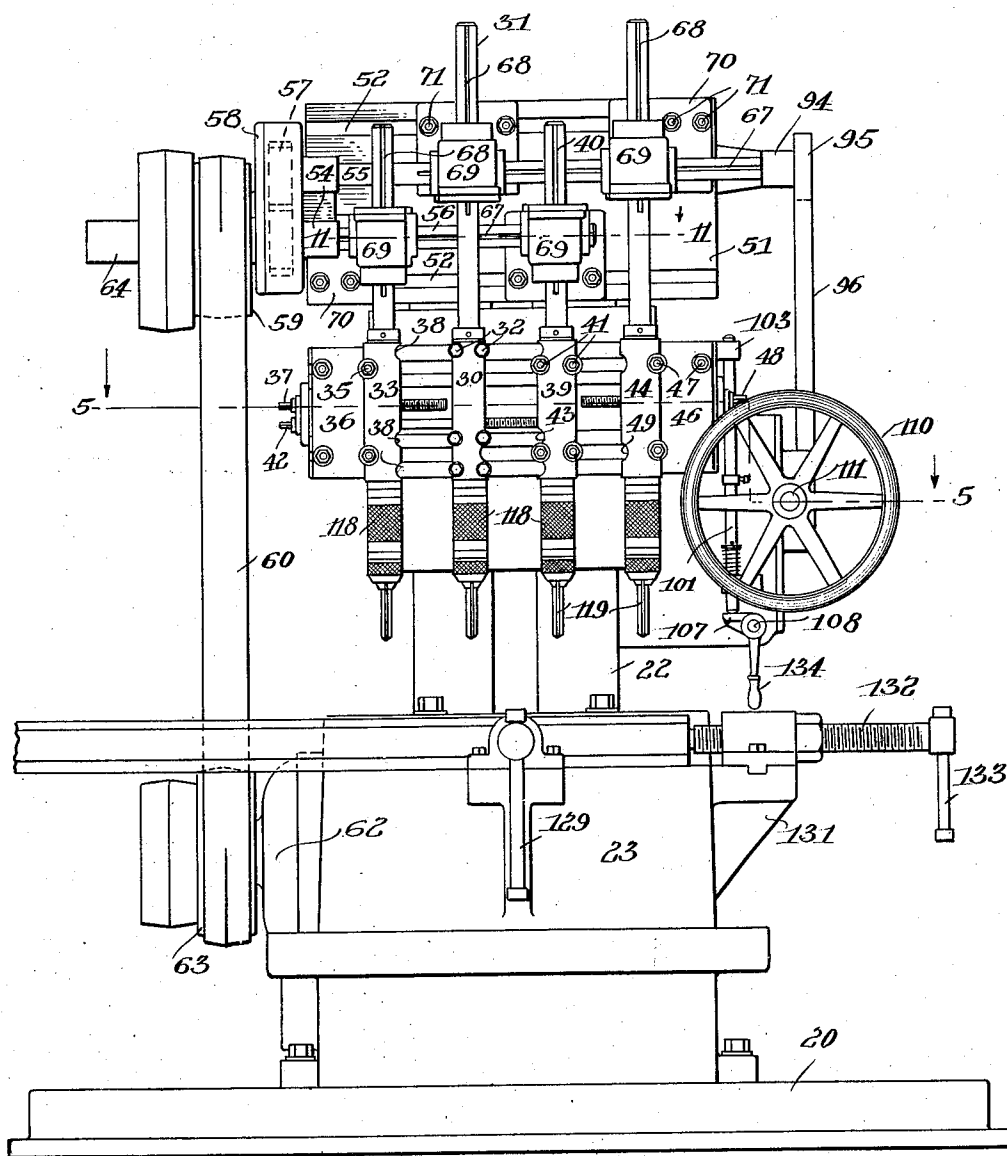
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MULTIPLE DRILL

Filed April 8, 1927

7 Sheets-Sheet 1

Fig. 1



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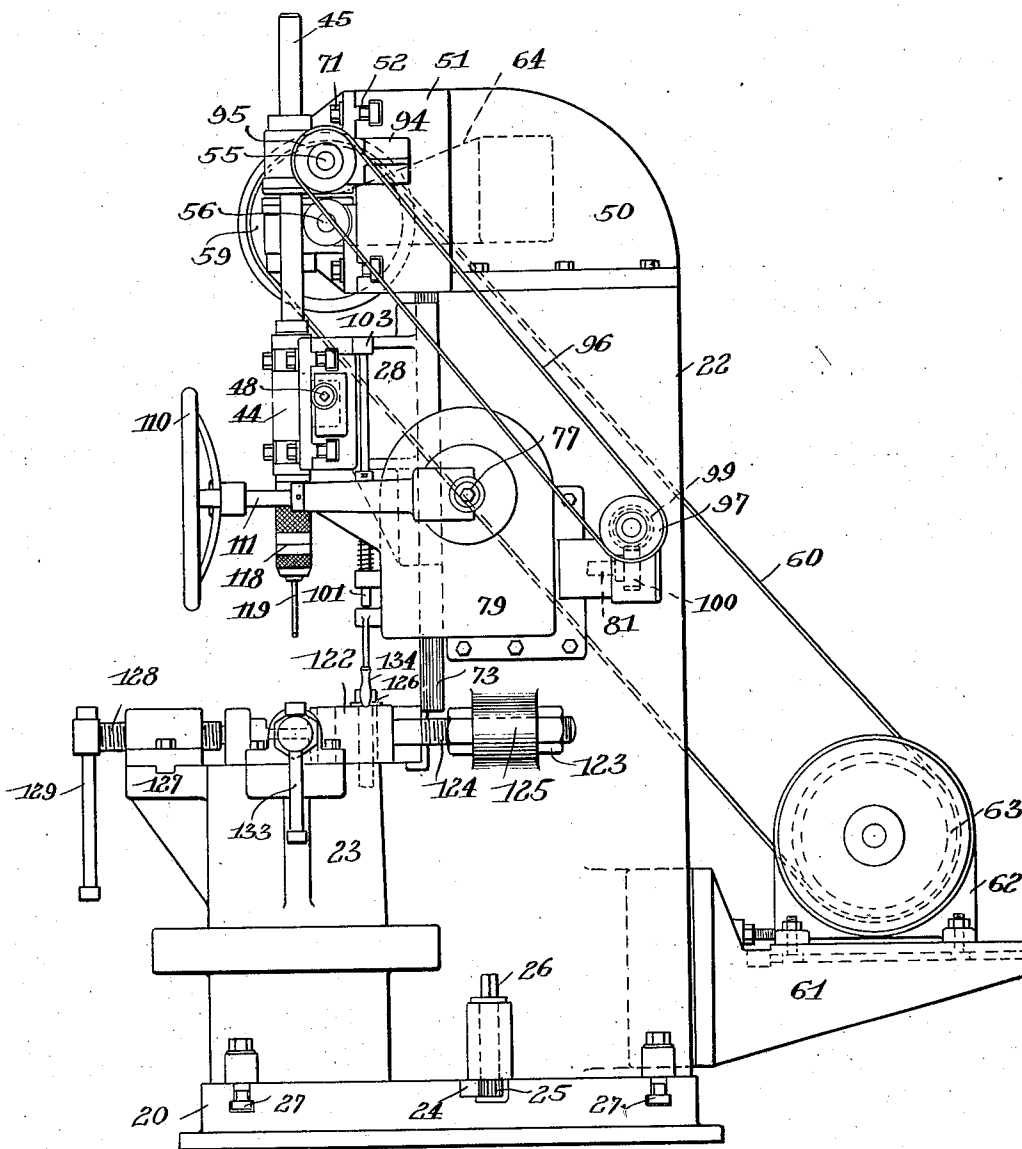
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MULTIPLE DRILL

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Fig. 2



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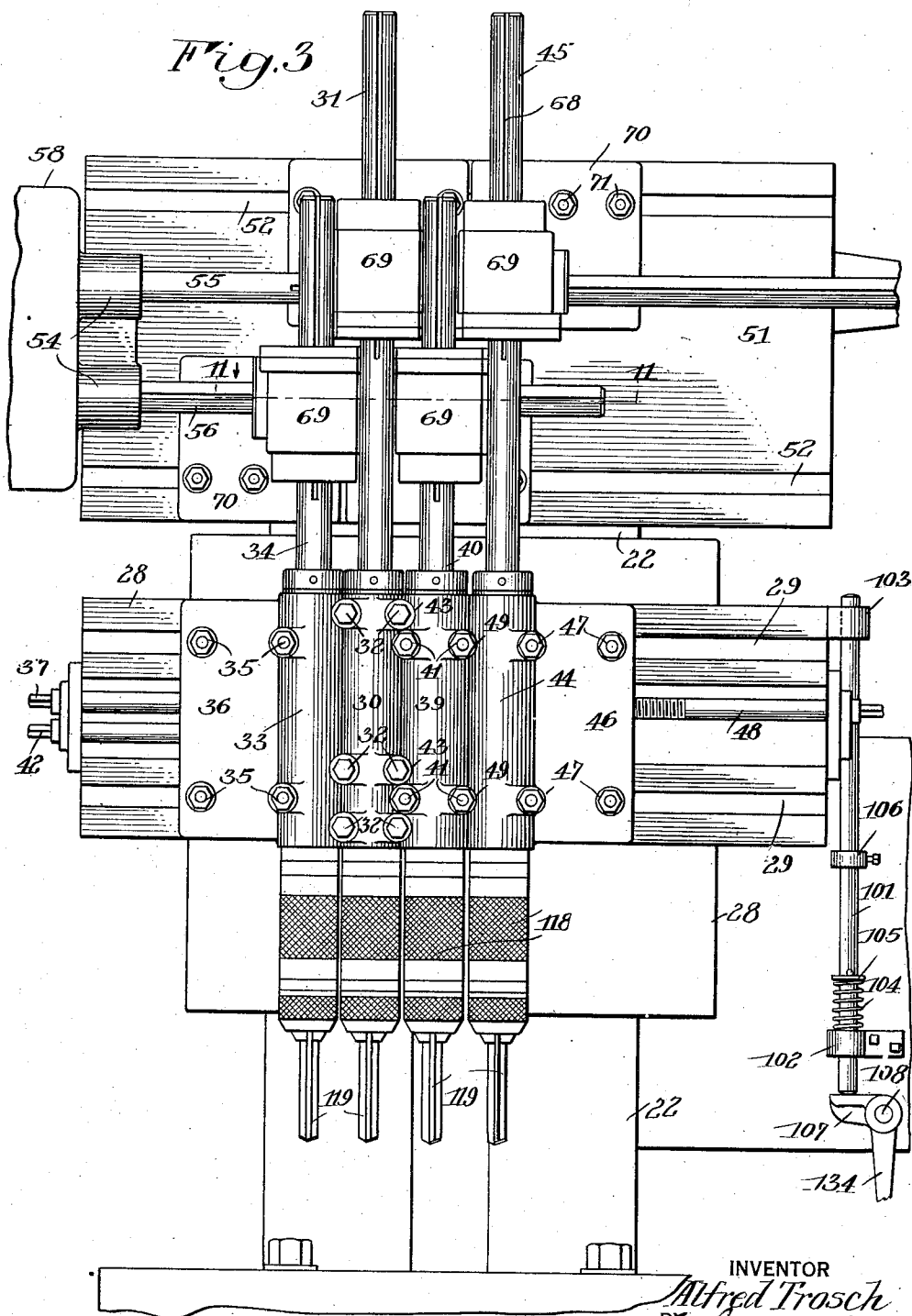
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MULTIPLE DRILL

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7 Sheets-Sheet 3



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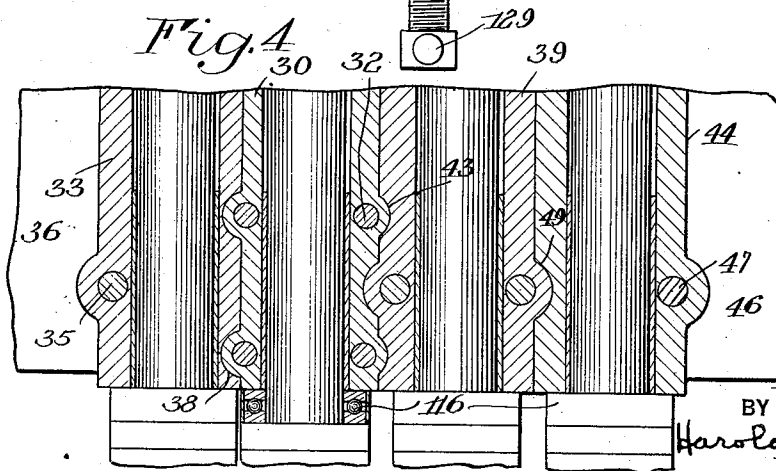
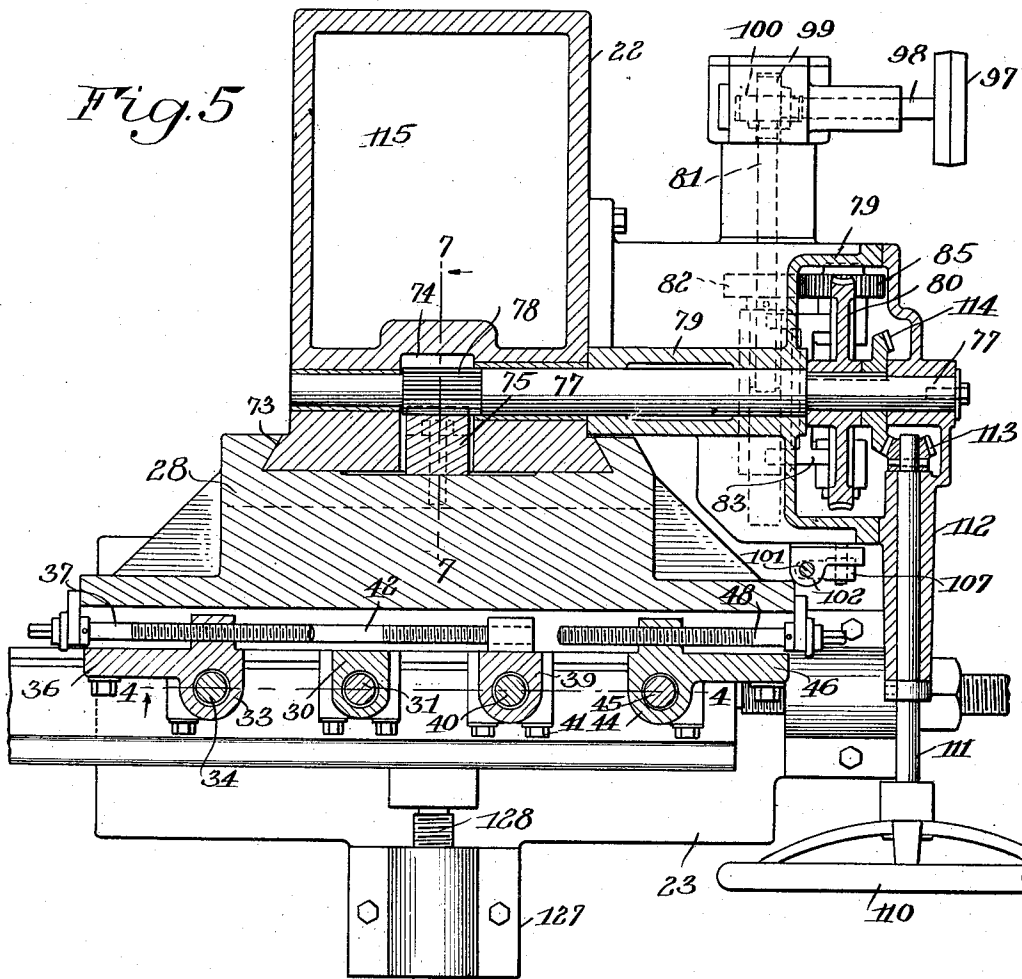
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MULTIPLE DRILL

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7 Sheets-Sheet 4



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1,775,005

MULTIPLE DRILL

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7 Sheets-Sheet 5

Fig. 6

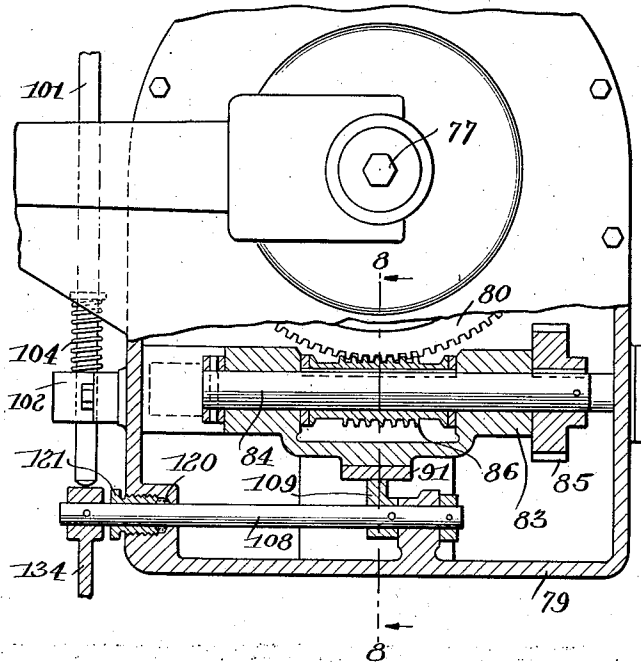


Fig. 7

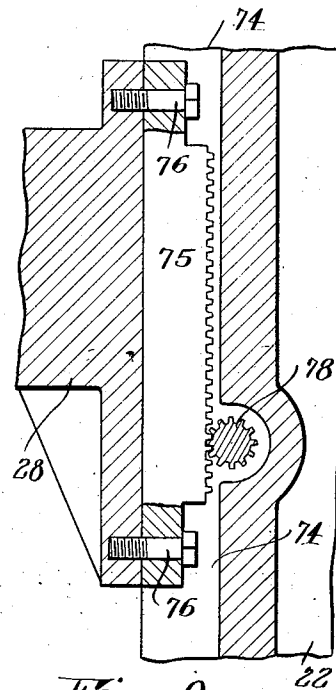


Fig. 8

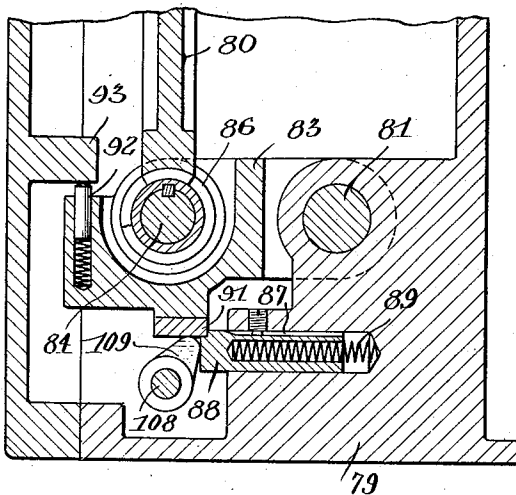
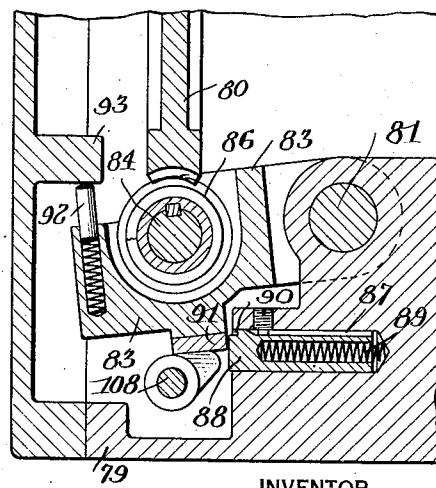


Fig. 9



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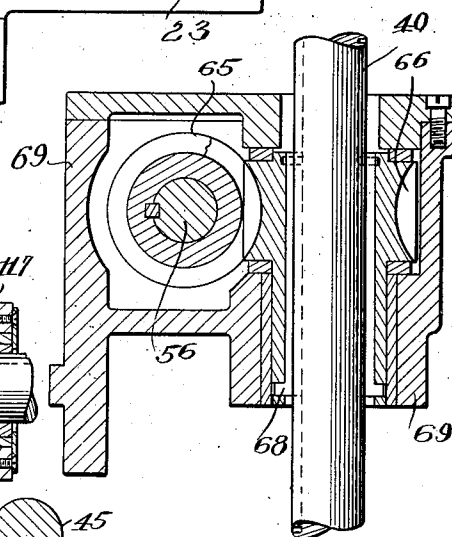
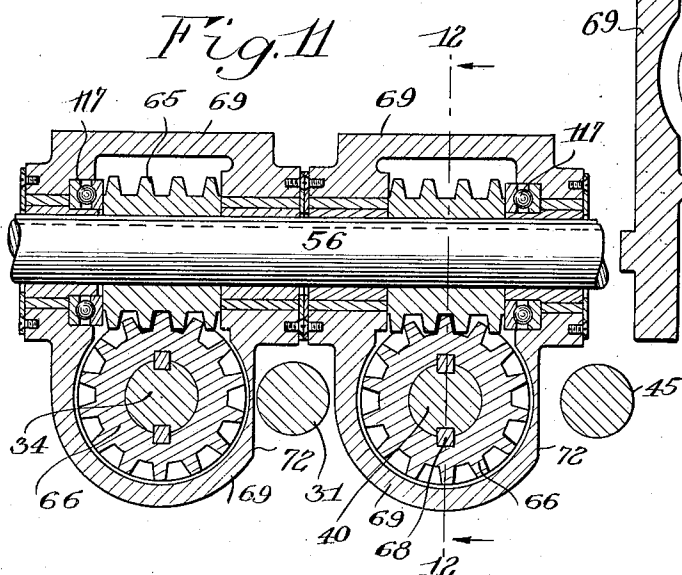
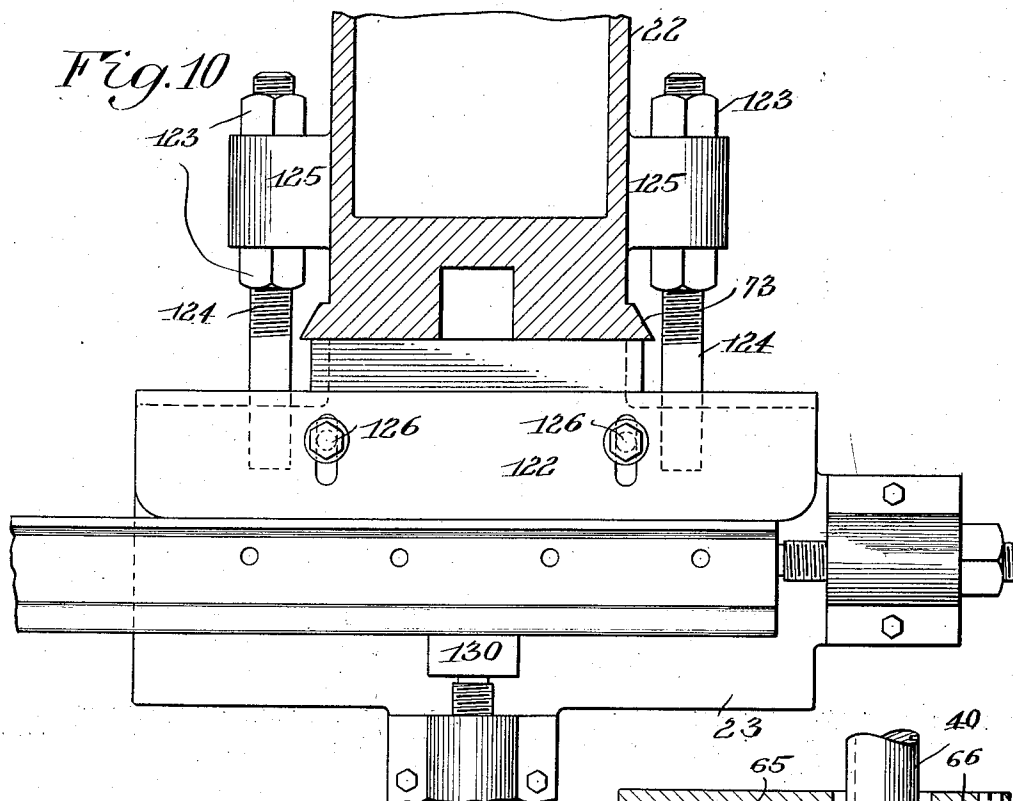
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MULTIPLE DRILL

Filed April 8, 1927

7 Sheets-Sheet 6



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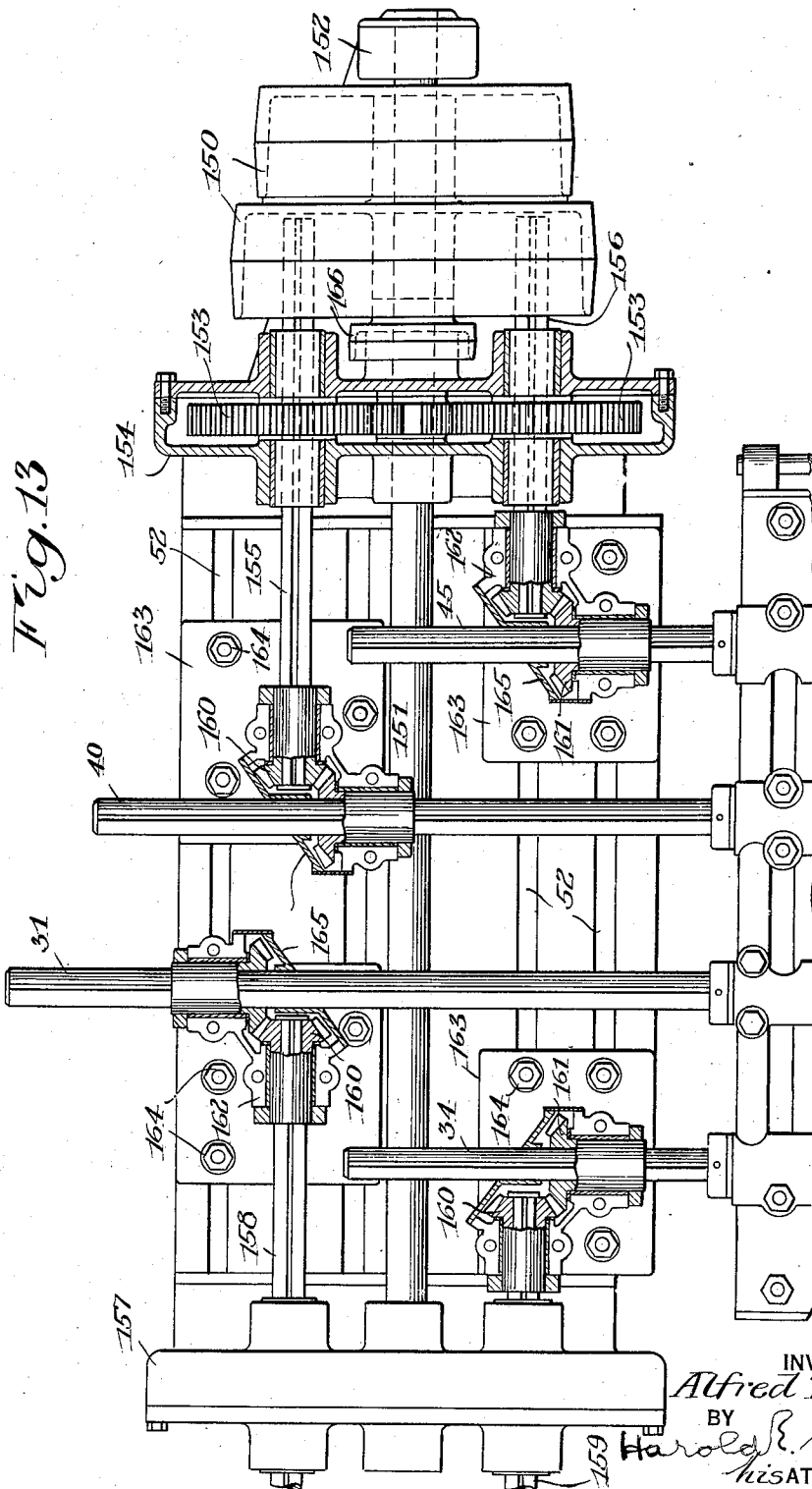
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MULTIPLE DRILL

Filed April 8, 1927

7 Sheets-Sheet 7



UNITED STATES PATENT OFFICE

ALFRED TROSCH, OF ROCHESTER, NEW YORK, ASSIGNOR TO CONSOLIDATED MACHINE TOOL CORPORATION OF AMERICA, OF ROCHESTER, NEW YORK, A CORPORATION OF DELAWARE

MULTIPLE DRILL

Application filed April 8, 1927. Serial No. 182,105.

This invention relates to a multiple drill, with more particular reference to the type of machine adapted for drilling holes in the webs of rails.

5 A primary object of the invention is to provide a drive mechanism which will permit easy and close adjustment of the drill spindles toward and from each other without necessitating any changes in the position
10 of the drive mechanism, or causing interference of any parts.

A further object of the invention is to provide mechanism of simple form which will stop the feeding of the drills when they reach
15 a predetermined point, by automatically disconnecting gears in the feed mechanism.

Another object of the invention is to produce a mechanism possessing extreme simplicity of design, and greater ruggedness, durability and efficiency than prior types of machines of this class.

To these and other ends, the invention consists in the form and arrangement of parts that will appear clearly from the following
25 description, when read in conjunction with the accompanying drawings, the novel features being pointed out in the claims following the specification.

In the drawings:

30 Figure 1 is a front elevation of one embodiment of the invention;

Figure 2 is a side elevation thereof;

35 Figure 3 is an enlarged partial front elevation showing the drill spindles adjusted to their closest position;

Figure 4 is a partial vertical section through the drill spindles in the position shown in Figure 3 taken approximately along
40 the line 4—4 of Figure 5;

Figure 5 is a horizontal section through the machine taken approximately on the line
45 5—5 of Figure 1;

Figure 6 is an end view partly in section
and partly in elevation of the feeding mechanism;

Figure 7 is a vertical section through the feed rack and pinion taken approximately
50 on the line 7—7 of Figure 5;

Figure 8 is a vertical section through the

feed mechanism taken on the line 8—8 of Figure 6;

Figure 9 is a sectional view similar to Figure 8 showing the controlling gears of the feed mechanism in disengaged position; 55

Figure 10 is a view partly in plan and partly in section showing the clamping mechanism for holding the rail or other work to be drilled;

Figure 11 is a horizontal sectional view through the drive mechanism for the drill spindles, taken approximately on the line
60 11—11 of Figure 3;

Figure 12 is a vertical sectional view through the same taken approximately on the
65 line 12—12 of Figure 11, and

Figure 13 is a front elevation partly in section showing a modified form of drive for the drill spindles.

Referring particularly to Figures 1 and 2, numeral 20 indicates the bed of the machine on which is mounted the integral frame comprising an upright 22 and a work support 23 which is wider than the upright 22 and holds the rail or other work to be drilled. The
75 frame may be adjusted relative to the bed 20 by means of a rack and pinion connection consisting of a rack 24 fixed on the bed and a pinion 25 mounted on the frame, the pinion being turned by a suitable tool applied to the shaft 26 thereof. When properly adjusted, the frame is clamped to the bed by T-headed bolts 27 engaging the usual slots in the bed.

On the front of the upright 22 is mounted a vertically slidable carrier 28 provided with horizontal guides 29. On the front of the carrier 28 and a little to the left of the center is fixed a housing 30, which forms a bearing for a drill spindle 31. This housing may be attached to the carrier 28 by means of bolts 32. To the left of the housing 30 is a housing 33 carrying a drill spindle 34, this housing not being rigidly attached to the carrier 28 but being secured by bolts 35 to a suitable slides movable in the guides 29. An extension 36 may be provided at one side of the housing to provide a broader and firmer bearing against the front of the carrier. A long screw 37, mounted upon the carrier 28, is threaded through a hole in a lug on the back
95 100

of the housing 33, and serves as a means for adjusting the housing and its drill spindle relative to the fixed housing 30 and its drill spindle 31. It will be noted that notches 38 are formed in the edges of the housing 33 at points opposite the bolts 32 on the housing 30. This is so that the bolts will not interfere with the housing 33 being moved close to the housing 30, these housings being adjustable tight against each other, as shown in Figures 3 and 4, when it is desired to drill holes a minimum distance apart.

To the right of the stationary housing 30 is another movable housing 39 carrying a drill spindle 40 and attached by bolts 41 to slides working in the guides 29. A long screw 42 serves as a means for adjusting this housing back and forth relative to the stationary housing 30 in the same way in which the screw 37 adjusts the housing 33. The housing 39 is notched at 43 opposite the bolts 32 in a manner similar to the notches in the housing 33, so that this housing 39 may be placed tight against the housing 30 in the position shown in Figures 3 and 4.

To the right of the housing 39 is another adjustable housing 44 carrying a drill spindle 45. This housing has a broad extension 46 similar to the extension 36 and is attached by bolts 47 to slides working in the guides 29. A long screw 48 adjusts this housing in a manner similar to the other housings heretofore described. The edge of the housing 44 is notched at 49 opposite the bolts 41 so that it may be placed close to the housing 39, as shown in Figures 3 and 4, when it is desired to drill holes a minimum distance apart.

It will be seen from the construction heretofore described that I have provided a plurality of drill spindles easily adjustable by means of screws so as to drill holes at any desired distance apart within the maximum and minimum limits of the machine.

The drive for the drill spindles will now be described, reference being had particularly to Figures 1, 2, 3, 5, 11 and 12. To the top of the upright 22 is secured a bracket 50 having near its front a portion 51 of approximately the same width as that of the carrier 28. Formed in this portion are longitudinal slots 52 forming guideways for a purpose hereafter described. Mounted in suitable bearings 54 at the left hand end of the member 51 are two parallel shafts 55 and 56 geared together so as to rotate in unison by means of the gears 57 within the housing 58. One of these shafts, such as 56, is extended leftward and has mounted thereon one or more pulleys 59 for driving said shafts through a belt 60 from any suitable source of power. Preferably I provide a bracket 61 at the rear of the upright 22, on which bracket is secured a motor 62, the drive shaft of which carries one or more pulleys 63 for driving the belt 60, as shown especially in Figures 1 and 2. The

free end of the shaft 56 may be provided with an outboard bearing 64 in the nature of a bracket extending from the side of the member 50.

The drill spindles heretofore described may be operated in any suitable manner, and in the form of the invention shown in Figure 1, they are operated from the drive shafts 55 and 56 through worm gearing comprising worms 65 mounted upon the drive shafts and cooperating with worm wheels 66 on the drill spindles. Keyways 67 extend approximately the full length of the shafts 55 and 56, and it will be understood that the worms 65 are loosely keyed on these shafts so as to be slidable lengthwise of the shafts, though always rotating therewith. Similar long keyways 68 are provided on the drill spindles, there being preferably two keyways diametrically opposite to each other. The worm wheels 66 driven by the worms 65 are likewise loosely keyed upon the drill spindles in such a manner that they are movable lengthwise of the spindles but that any rotary motion imparted to the worm wheels will be transmitted to the drill spindles. Around each worm and worm wheel is a housing 69 for keeping the worm and worm wheel in proper cooperative relationship to each other. Each housing 69 has flanges 70 which may be adjustably attached to the member 51 by T-headed bolts 71 fitting in the slots 52.

By reference to Figures 1 and 3, it will be seen that two of the spindles are connected to the lower drive shaft 56 while the other two are connected to the upper drive shaft 55, adjacent spindles being connected to different shafts. The purpose of this arrangement is so that the spindles can be adjusted to a closer position than would be possible if they were all driven from the same shaft. The width of the gear housings 69 is necessarily considerably more than the width of the spindle housings 30, 33 etc., heretofore described, and unless a staggered drive such as I employ is used, the minimum distance at which holes could be drilled would be limited by the width of the gear housings 69 rather than by the width of the narrower spindle housings 30 etc. Figure 1 shows the drill spindles at approximately their maximum distance apart while Figures 3, 4 and 11 show them at their minimum spacing. It will be noted, especially from Figures 3 and 11, that in this position the spindle housings 30, 33, 39 and 44 are tight together and the gear housings 69 mounted on the same drive shaft for driving alternate spindles are likewise tight together, but the sides of the gear housings are cut away as at 72 in Figure 11 to provide clearance for the drill spindles which are driven from the other driving shaft.

It will now be seen that I have provided a simple and effective drive for a plurality of drill spindles and one which permits easy

adjustment of the spindles to drill holes at various distances apart. In order to adjust the machine for holes at different positions, it is necessary only to loosen the bolts 35, 41 and 47 holding the spindle housings, and the bolts 71 holding the gear housings. The screws 37, 42 and 48 may then be turned to bring the spindles to the desired position. The movement of the spindles will result in sliding the housings 69 and their worms 65 along their drive shafts, and when the spindles have been brought to the desired position, the bolts may again be tightened and the machine is ready for use. It will be seen that it is not necessary to take any gearing apart, to disconnect any shafting, or to go through any other complex operations. The only tool necessary to set the drill spindles for any desired spacing is a wrench for loosening and tightening the bolts and for turning the adjusting screws.

The feeding device, or mechanism for feeding the drill spindles longitudinally, will now be described. Referring particularly to Figures 2 and 5, the front edge of the upright 22 is provided with guides 73 which cooperate with guides on the carrier 28, heretofore mentioned, so that the carrier 28 is vertically movable. A vertical recess 74 is formed in the front of the upright 22, and in this recess is a rack bar 75 secured by lug bolts 76 to the carrier 28. A shaft 77 rotating in suitable bearings in the upright 22 carries a pinion 78 meshing with the rack bar 75. Preferably this pinion is formed integrally with the shaft 77 by milling teeth on the same. The shaft 77 is extended to the right of the machine where it is journaled in a suitable bracket or housing 79, and it carries a worm wheel 80. Below and at right angles to the shaft 77 is another shaft 81 having a spur gear 82 fixed thereto. Within the housing 79 and pivoted to rotate about the shaft 81 as a center is a movable member, which may consist of a swingable frame 83 in which is mounted a short shaft 84 approximately in the same plane with the worm wheel 80. A spur gear 85 fixed to the shaft 84 meshes with the gear 82 on the shaft 81. The shaft 84 also carries a worm 86 which meshes with the worm wheel 80 when the swingable frame is in its uppermost position as shown in Figure 8. In the recess 87 in the housing 79 is a locking bolt 88 pressed outwardly by a spring 89. A notch 90 in the upper edge of this bolt cooperates with a corner 91 on the swingable frame 83, to hold the frame in its upper position as shown in Figure 8, and it is obvious that the frame cannot be lowered until the bolt 88 is pushed inward. To assist the force of gravity in lowering the swingable frame when it has been released by the locking bolt, a spring-pressed plunger 92 may be mounted upon the frame so as to press against a lug 93 on the housing and thus exert a constant

tendency to shove the swingable frame downward.

This feeding mechanism may be driven by any suitable means, such as by a separate motor or by any suitable form of connections from the main drive motor. Preferably I drive the mechanism from the spindle drive shaft 55, which is extended to the right of the machine and provided with a bearing 94 at the side of the member 51, as shown in Figures 1 and 2. At its end the shaft 55 is provided with a pulley 95 which, through a belt 96, drives a pulley 97 on the short shaft 98 mounted on a bracket on the rear of the housing 79. This shaft carries a spiral gear 99 driving another spiral gear 100 on the end of the shaft 81. Thus motion is transmitted from the main driving motor to the drive shaft 55 in the manner described above, and from 55 to the shaft 98 through the belt 96. The shaft 98 rotates the shaft 81 which through gears 82 and 85 rotates the shaft 84 mounted in the swingable frame 83. When the swingable frame is in its normal or uppermost position, the worm 86 carried by the shaft 84 drives the worm wheel 80 on the shaft 77, thus rotating the pinion 78 to move the rack 75 to feed the member 28 downward, forcing the drills into the rail or other work being operated upon. It will be understood that during this feeding operation the drill spindles slide downward through the housings 69 but are meanwhile being rotated by the gears 66, this being possible because the gears 66 are loosely keyed on the drill spindles and not rigidly fixed thereto.

Automatic stop mechanism for stopping the feeding operation at any desired point may be used. Preferably I employ the form illustrated in Figures 1 and 3 in which a vertical rod 101 is mounted at one end in the bracket 102 on the housing 79, the other end extending through an opening in a lug 103 on the carrier 28. A spring 104 surrounding the shaft 101 between the bracket 102 and a collar 105 keeps the shaft 101 normally elevated. A collar 106 is secured on the shaft by means of a set screw and may be adjusted to any position thereon in order to change the point at which the feed is stopped. During the feeding operation of the drills, carrier 28 carrying the drill housings and drill spindles moves downward until finally the lug 103 comes in contact with the collar 106, thus forcing the shaft 101 downward. The bottom of this shaft rests upon an arm 107 fixed to a shaft 108 and thus the shaft 108 is rotated slightly when the lug 103 comes in contact with the collar. The shaft 108 extends through the housing 79 and is journaled therein. At a point opposite the locking bolt 88 it carries a cam 109, shown in Figures 6, 8 and 9. When the shaft 108 is rotated in a clockwise direction, as seen in Figures 8 and 9, it will force the locking bolt 88 inward and allow the

frame 83 to drop down to the position shown in Figure 9, further downward movement thereof being prevented by contact of the lower side of the frame with the cam 109.

Thus it will be seen that when the carrier 28 carrying the drill housings and drill spindles reaches a predetermined point in the feeding operation, the shaft 108 is automatically rotated and the frame 83 is dropped, thus unmeshing the worm 86 from the worm wheel 80 and stopping the feeding operation.

For returning the carrier 28 and the drill spindles upwardly, a hand wheel 110 is provided. This hand wheel is mounted on a shaft 111 journaled in an extension on the cover plate 112 of the housing 79. The shaft carries a bevel gear 113 meshing with a bevel gear 114 fixed to the shaft 77, as shown in Figure 5. Thus upon rotation of the hand wheel 110 in the proper direction, the shaft 77 is rotated and the carrier 28 is elevated to the proper position prior to beginning a new drilling operation. Rotation of the hand wheel 110 in the opposite direction will move the carrier 28 downwardly, and thus the drills may be fed by hand if for any reason it is desired not to use the automatic feed. The weight of the carrier 28 and of the housings and drill spindles and other parts connected thereto is counterweighted by weights (not shown) within the space 115 in the upright 22.

A handle 134 at the front end of the shaft 108 is used for meshing the worm 86 with the worm wheel 80 when it is desired to start the automatic feed. This handle is moved to rotate the shaft in a counterclockwise direction, as seen in Figures 8 and 9, and as will be apparent from Figure 9, the counterclockwise rotation of the cam 109 will raise the swingable frame 83 by contacting with the lower part thereof. When the cam reaches the position shown in Figure 8, the worm and worm wheel will be properly meshed and the locking bolt 88 will be pushed outward by its spring 89 to lock the swingable frame in its normal position.

Obviously, the handle 134 may be used to rotate the shaft 108 to stop the automatic feed at any time desired, without waiting for it to be stopped automatically by the mechanism 103, 106, above described.

Since the swingable frame is pivoted about the shaft 81 as a center, it is obvious that the gear 82 on the shaft 81 will always be properly meshed with the gear 85 on the shaft 84 carried in the swingable frame no matter in what position the swingable frame may be.

The bearings for the various shafts and spindles have not been particularly alluded to in the foregoing description, since it is understood that suitable bearings, preferably of anti-friction type, are provided throughout. Ball bearings 116, Figure 4, have been shown in connection with the drill spindles, and also ball bearings 117, Figure 11, in con-

nection with the worms for driving the drill spindles, but it should be understood that ball bearings or roller bearings are preferably used at all points at which considerable friction occurs. Lubrication is, of course, provided for all bearings through the machine. I have not shown any particular form of lubricating means, since any well known means may be used. Preferably, I make the housing 79 oil tight so that the feed worm and worm wheel may run in a bath of oil if desired. Where the shaft 108 extends through the wall of the housing 79, it is therefore provided with packing 120 held in place by a gland 121.

The lower ends of the drill spindles are provided with the usual drill chucks 118 holding drills 119.

In Figures 1, 2 and 10, I have shown mechanism for accurately positioning the rail or other work to be drilled with respect to the drills. This mechanism comprises a back-block 122 which may be adjusted by means of nuts 123 on screws 124 extending through lugs 125 on the sides of the upright 22. When adjusted to the desired position, the block may be further held securely by tightening the lug bolts 126. At the front of the support 23 is a bracket 127 carrying a screw 128 provided at one end with a handle 129 and at the other end bearing against a block 130, thus forming a vise for clamping the rail against the back-block 122. At the right hand side of the machine, a similar bracket 131 carries a similar screw 132 having a handle 133, this screw forming a convenient means for making a very fine longitudinal adjustment of the rail or other material to be drilled.

In Figure 13, I have shown a modified form of drive for the drill spindles. It should be understood that in this form of the invention the spindle housings, the feeding mechanism, and other details of the machine are as heretofore described, but the driving pulleys on the motor 62 are placed at the right hand side of the machine instead of at the left. A belt connected to a pulley on the motor shaft drives the pulleys 150 on the shaft 151 mounted in suitable bearings on the bracket 51, this shaft forming an actuating member for the drive mechanism. An outboard bearing 152 may be provided at the end of the shaft 151 outside of the pulleys 150. Operating gears 153 within the housing 154 at the right hand side of the machine rotate two drive shafts 155 and 156 from the actuating member. Similar gears at the other end of the member 151 within a housing 157 rotate two other drive shafts 158 and 159. Each of these four drive shafts 155, 156, 158 and 159 have a keyway running substantially the whole length thereof, and these shafts are not fixed rigidly to their operating gears but are slidable longitudinally through the gears. Each of these four shafts carries at the end nearest the gen-

ter of the machine a bevel gear 160 fixed to its respective shaft. Each bevel gear meshes with a bevel gear 161 on one of the drill spindles 31, 34, 40 and 45. The bevel gears on the drill spindles, however, are not fixed rigidly to the spindles but are loosely keyed thereto and slidable longitudinally thereon to permit the spindles to be fed downward through the bevel gears. A housing 162 surrounds each pair of bevel gears 160 and 161 and holds them in cooperative relation to each other. Flanges or extensions 163 on these housings bear against the front of the bracket 51 and are secured thereto by T-headed bolts 164 engaging in the guideways 52. It will be noted that the corners of the housings 162 are cut away, the walls 165 being formed at an angle. The angular walls of adjacent housings are formed in opposite directions or complementary to each other. For instance, the housing connecting the shaft 158 with the spindle 31 is cut away at the lower right hand corner while the housing connecting the shaft 155 with the spindle 40 is cut away at its upper left hand corner. This avoids interference between the two housings when it is desired to adjust these spindles to their minimum distance apart, since the housings can be moved very close together until the faces 165 are almost in contact with each other, one housing being positioned partially beneath the other. In order to obtain this arrangement, it is necessary to place one of the spindle bevel gears 161 below its driving gear 160, while the next spindle bevel gear on the adjacent spindle is above its driving gear, as is plainly shown in Figure 13.

It will be obvious from the foregoing description that the adjustment of the spindles with this form of the invention is as easy and simple as in the form heretofore described. The bolts on the spindle housings are loosened just as in the other form of drive, and the bolts 164 are likewise loosened, thus permitting the housings 162 to be moved sideways when the spindles and their housings are adjusted to the desired position by the screws 37, 42 and 48. In this form of the invention however, the driving gear does not slide upon its driving shaft as the spindle moves to its new position, but on the contrary, the driving gear 160 and its driving shaft both move in unison during the lateral movement of the drill spindle, thus pulling or pushing the driving shaft in one direction or the other through the gearing 153. The driving shafts 155, 156, 158 and 159 are of sufficient length to reach from the gearing 153 to their respective drill spindles when the spindles are crowded together in their closest possible position. When the spindles are moved toward the sides of the machine, however, so as to bore holes at greater distances apart, the driving shafts 155, 156, etc., simply extend on past the gears 153 and project slightly at the

sides of the machine, as is clearly shown in the figure.

In this form of the invention, the feed mechanism drive pulley 97 may be driven by a belt from the pulley 166 mounted on the shaft 151 between the pulleys 150 and the housing 154.

It will now be apparent that I have disclosed a multiple drill of sturdy and durable construction, and having a simplified drive mechanism of few parts, and arranged to permit easy adjustment for drilling holes at different distances apart. I have arranged the mechanism especially so as to decrease the minimum limit at which holes can be drilled, and I have provided means for adjusting the drill spindles easily and quickly to any setting required. The adjustment is very simple, requiring no other tools than suitable wrenches.

Also I have provided an automatic feed mechanism for feeding the drills, which is stopped automatically at any predetermined point and which may be easily returned to its initial position.

While I have shown certain specific embodiments of my invention, I do not desire to be limited to the precise details disclosed, but intend to cover all modifications and equivalents thereof falling within the purport of the invention or the scope of the appended claims.

I claim:

1. A multiple drill comprising a series of drill spindles all arranged in a single vertical plane and adjustable toward each other in said plane into juxtaposition, a separate drive shaft for each spindle disposed at right angles thereto in the same vertical plane therewith and in different horizontal planes to permit close adjustment of the spindles, and operative connections between said drive shafts and spindles comprising gears fixed on the drive shafts meshing with gears slidable on the spindles.

2. A multiple drill comprising a series of drill spindles all arranged in a single vertical plane and adjustable toward each other in said plane into juxtaposition, a separate drive shaft for each spindle disposed at right angles thereto in the same vertical plane therewith and in different horizontal planes to permit close adjustment of the spindles, and operative connections between the drive shafts and spindles, said drive shafts being longitudinally movable with the spindles and having gears fixed thereon meshing with gears slidable on the spindles.

3. A multiple drill comprising a plurality of pairs of drill spindles all arranged in a single vertical plane and adjustable toward each other in said plane into close juxtaposition, a separate drive shaft for each spindle disposed at right angles thereto in the same vertical plane therewith and extending in opposite directions from the spin-

dles to permit adjustment of the latter, the drive shafts being longitudinally movable with the spindles during adjustment but fixed against feeding movement while the drill spindles are movable axially with refer-
 5 ence to the drive shafts for feeding, and operative connections between the drive shafts and spindles.

4. A multiple drill comprising a plurality of drill spindles all arranged in the same vertical plane and adjustable toward each other in said plane into close juxtaposition, a separate drive shaft for each spindle disposed at right angles thereto and in the same vertical plane, the drive shafts for the inner spindles being located in a different horizontal plane from the drive shafts for the outer spindles and the drive shafts in each horizontal plane extending in opposite directions from the respective spindles, said drive shafts being movable with the spindles during adjustment, and operative connections between the drive shafts and spindles.

5. A multiple drill comprising a plurality of spindles all located in the same vertical plane and adjustable in said plane into juxtaposition, a separate drive shaft for each spindle extending at right angles thereto in said vertical plane, gearing slidable on the spindles but fixedly relatively to the drive shafts for connecting said drive shafts with the spindles, and housings for the gearings between the drive shafts and the respective spindles, said housings being complementally formed to permit one housing being located partially beneath the other housing when the spindles are adjusted close together.

6. A multiple drill comprising a plurality of drill spindles arranged in the same vertical plane and adjustable in said plane in juxtaposition, a separate drive shaft for each spindle extending at right angles thereto and in opposite directions in pairs and located in said vertical plane, gearing connecting the drive shafts and spindles, the drive shafts being movable with the spindles during adjustment, and housings surrounding said gearings and having inclined walls in parallel relationship and positionable one immediately under the other when the spindles are adjusted close together, said drive shafts being fixed against longitudinal movement in said housings but rotatable therein and the spindles being slidably connected therewith.

7. A multiple drill comprising a plurality of spindles all arranged in the same vertical plane and adjustable in said plane into juxtaposition, a separate drive shaft for each spindle located in said vertical plane and extending in opposite directions from the spindles, said drive shafts being located in the same horizontal plane and movable with the spindles during adjustment of the latter, a

bevel gear on the inner end of each drive shaft and a mating bevel gear on the corresponding spindle, the last mentioned bevel gears being disposed respectively above and below the drive shafts to permit adjustment of the spindles into close relation with each other.

8. A multiple drill comprising a series of drill spindles all arranged in the same vertical plane and adjustable into juxtaposition with each other, a separate drive shaft for each spindle arranged at right angles thereto in said vertical plane and movable with said spindles during lateral adjustment of the latter, and gearing connecting the drive shafts with respective spindles, said spindles being slidably connected with said gearing and the drive shafts for the inner spindles being located in a horizontal plane above the drive shafts for the outer spindles.

In witness whereof, I have hereunto signed my name.

ALFRED TROSCH.