E. S. SEAVEY.

METHOD AND APPARATUS FOR PERFORATING METAL SHAPES.

APPLICATION FILED NOV. 6, 1918.

1,414,589.

Patented May 2, 1922.

5 SHEETS—SHEET 1.

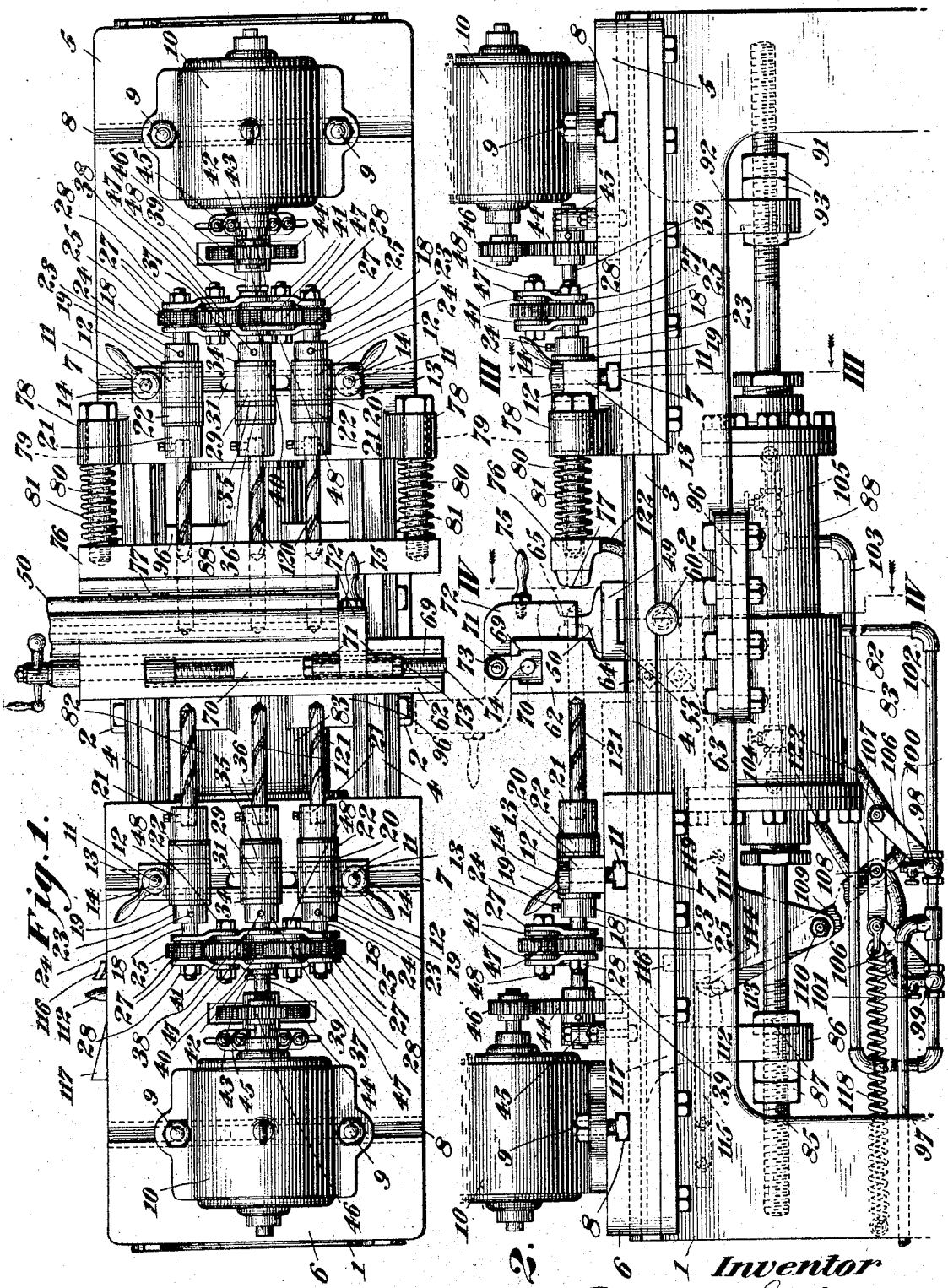

Fig. 1.

Fig. 2.

Inventor

Emer S. Seavey.

E. S. SEAVEY.

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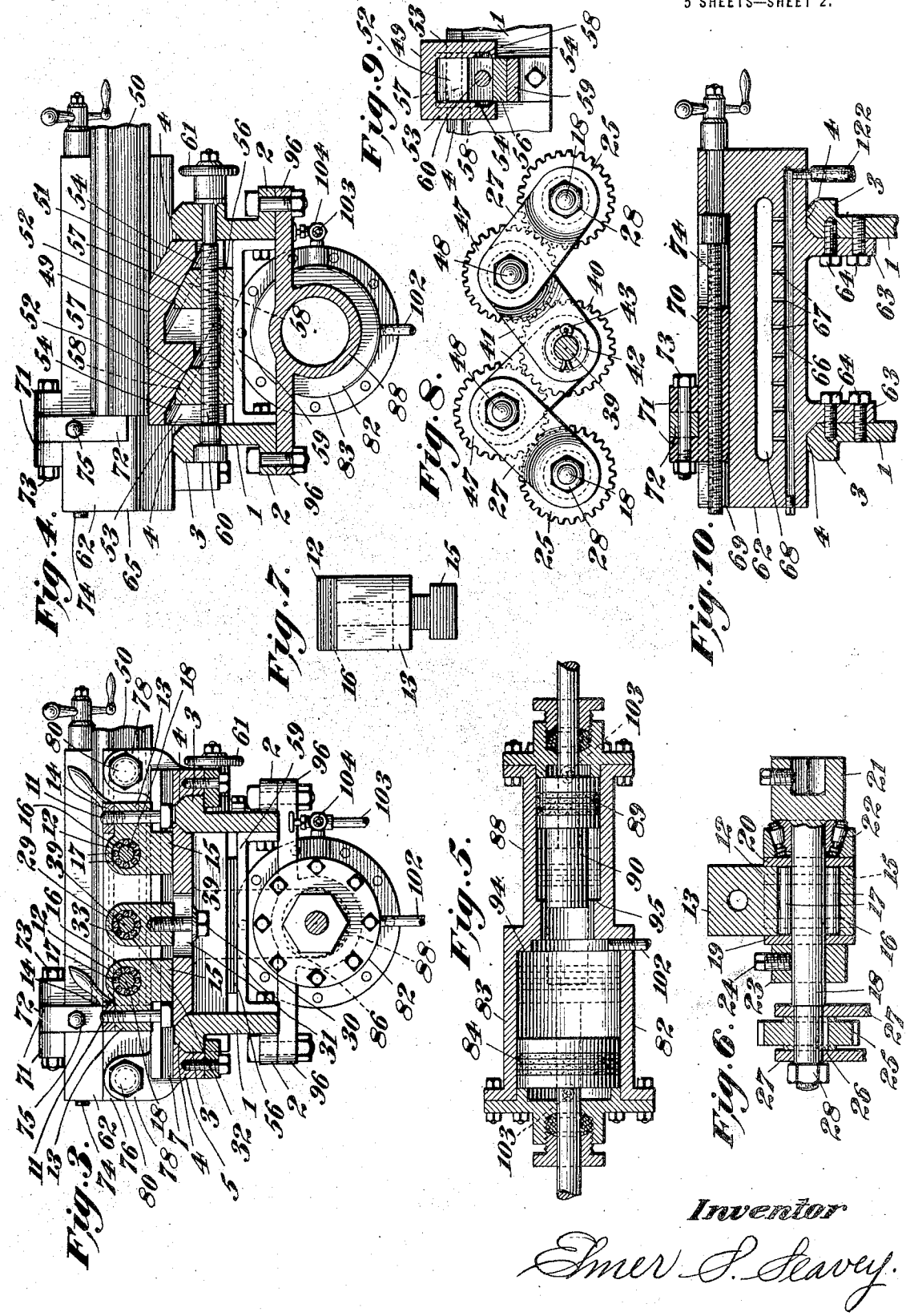

Fig. 4.

Fig. 9.

Fig. 8.

Fig. 10.

Fig. 7.

Fig. 3.

Fig. 5.

Fig. 6.

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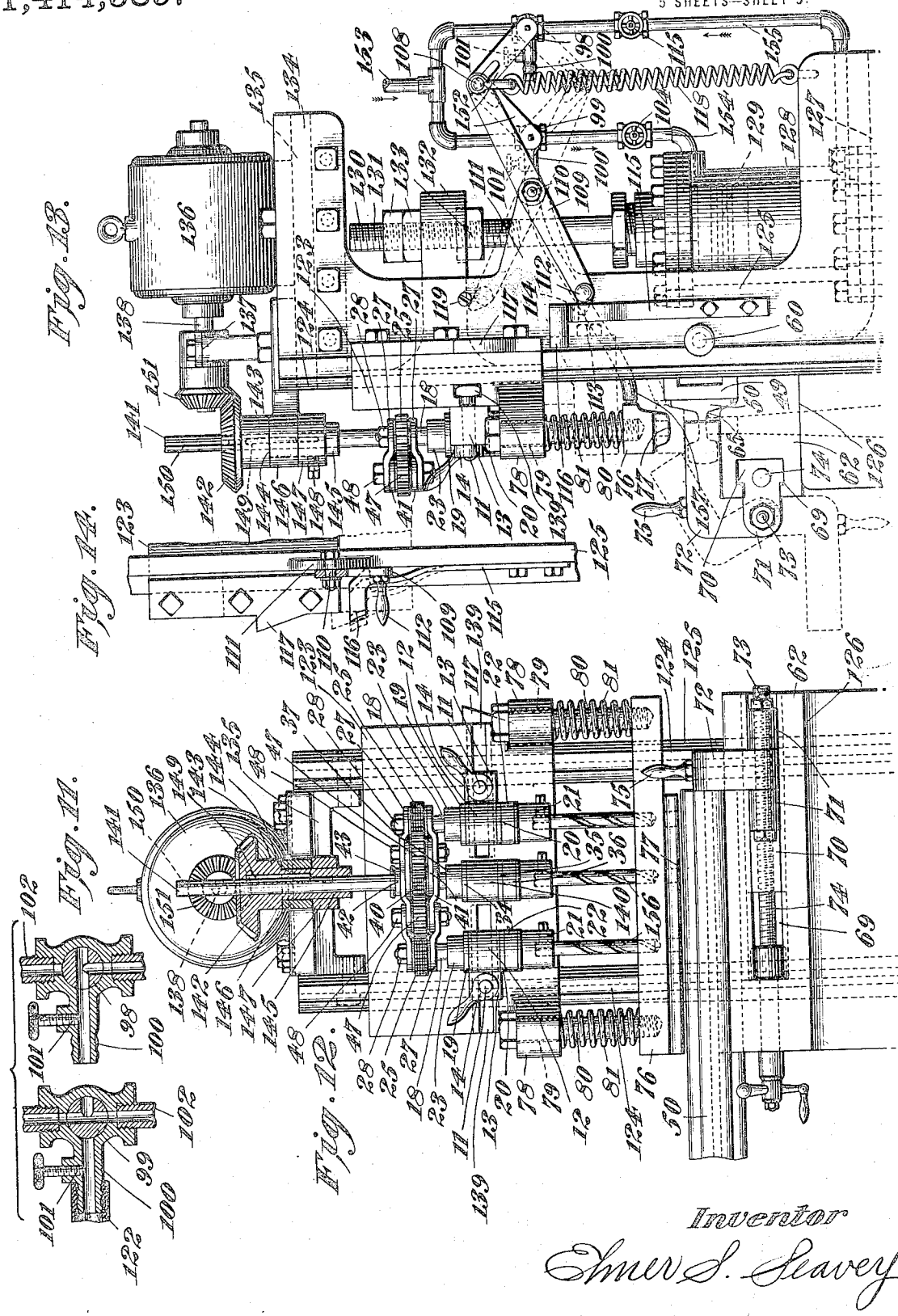

Fig. 13.

Fig. 14.

Fig. 11.

Fig. 12.

Inventor

Emer S. Seavey.

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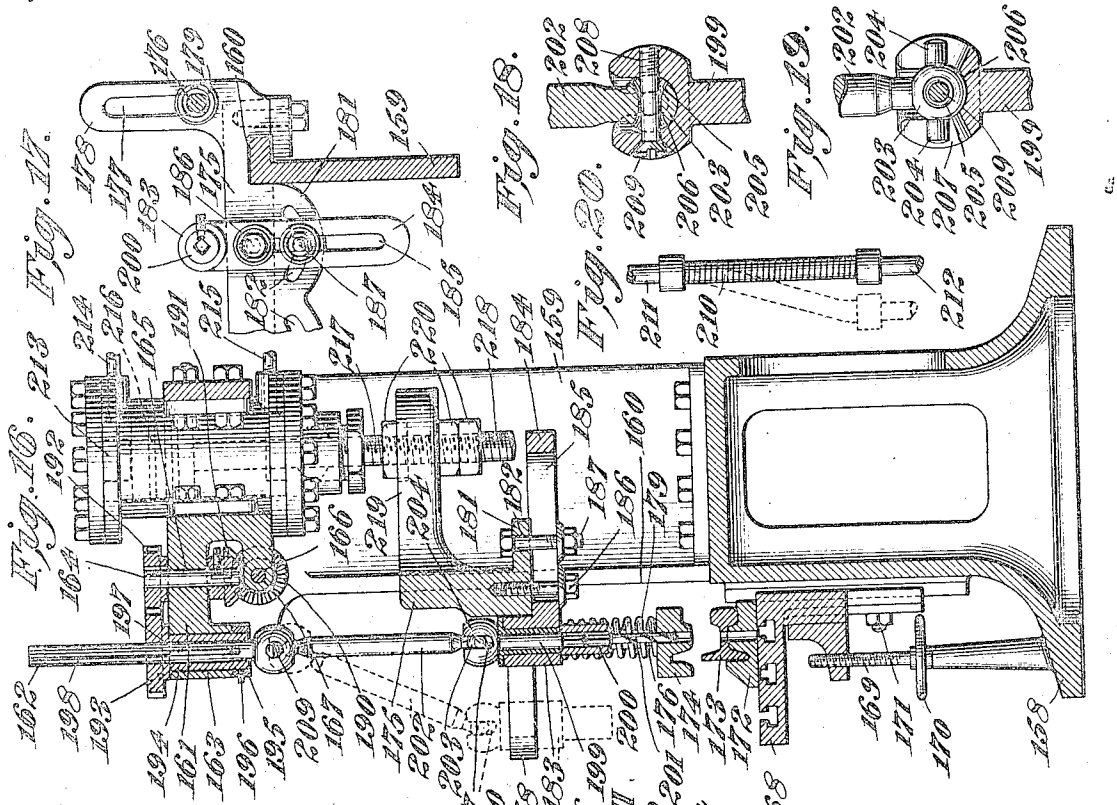

Fig. 17.

Fig. 16.

Fig. 18.

Fig. 20.

Fig. 19.

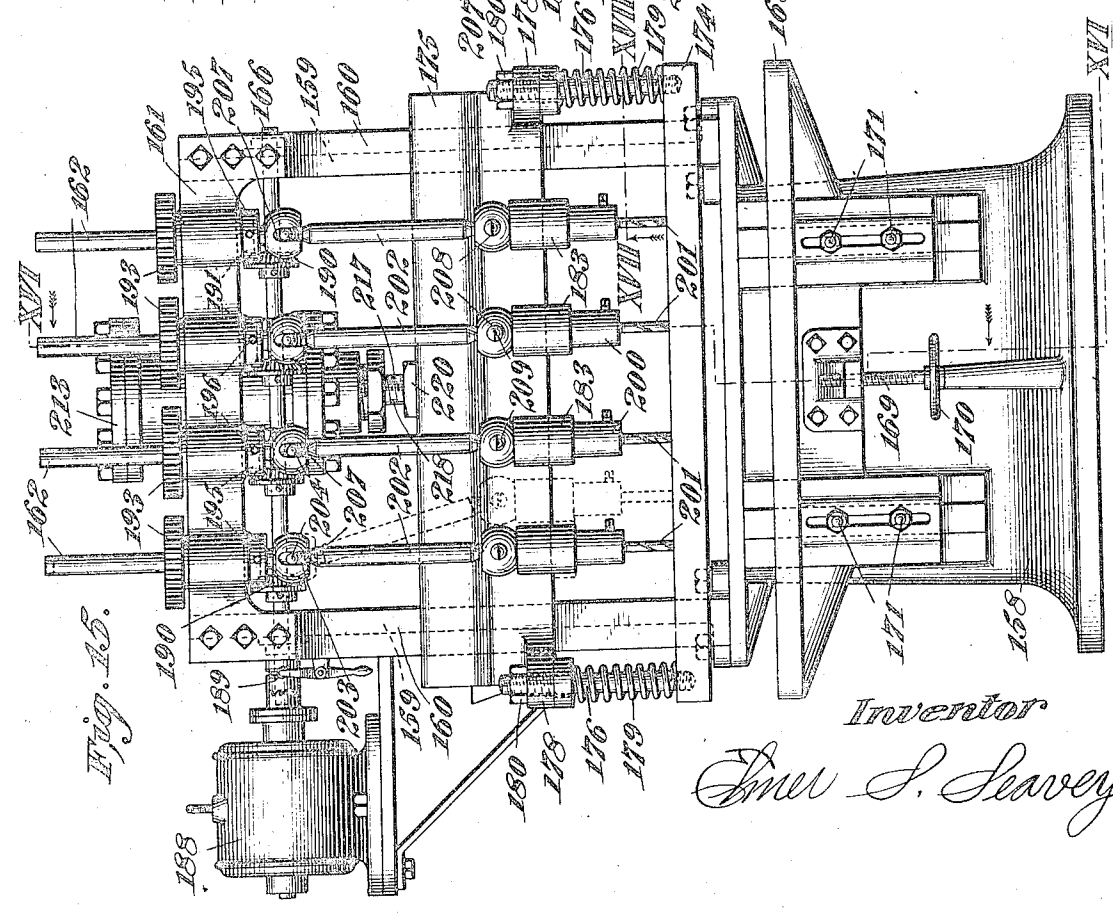

Fig. 15.

Inventor

Ener S. Seavey.

E. S. SEAVEY.

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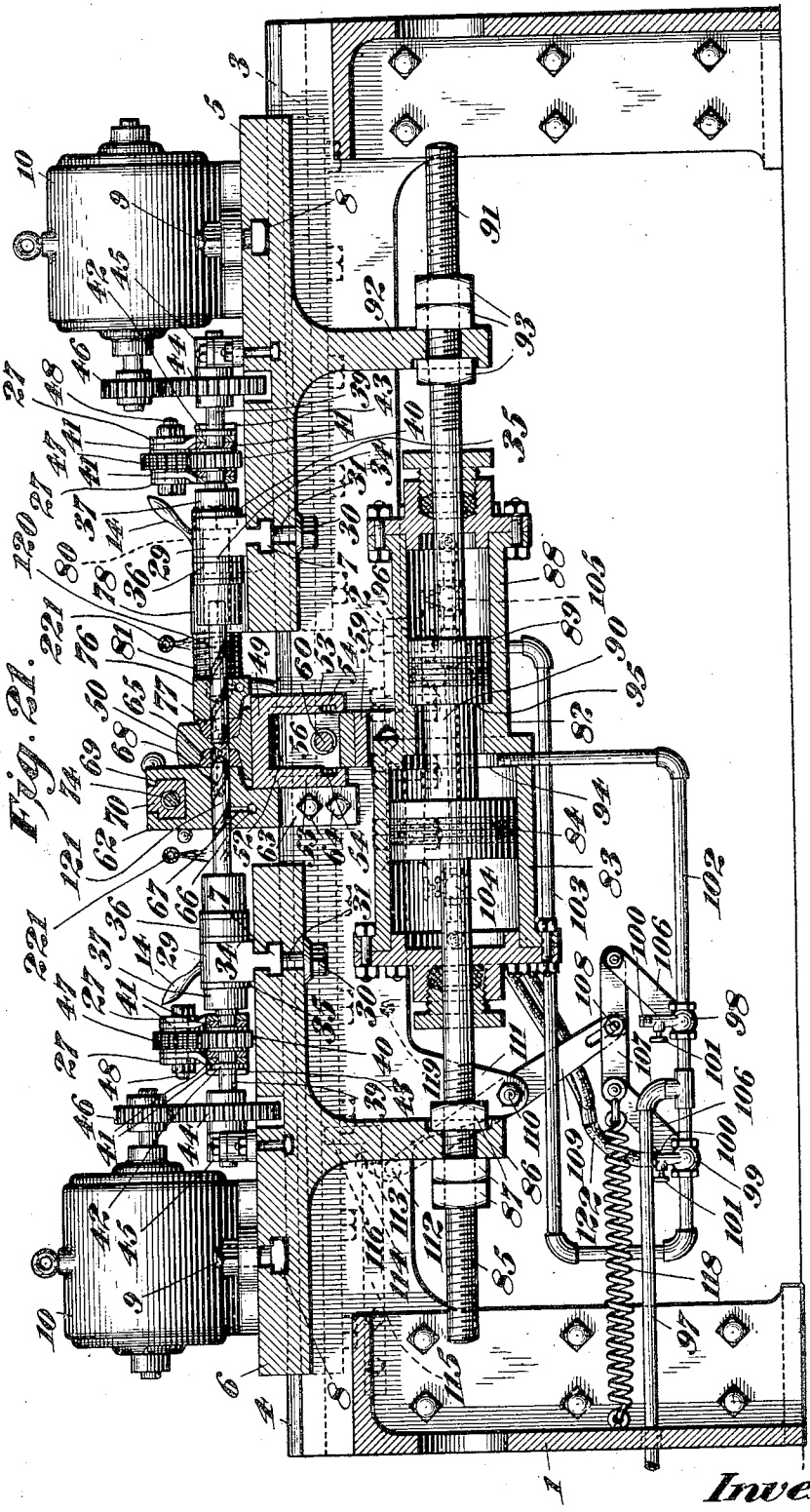

Fig. 21.

Inventor

Emery S. Seavey.

UNITED STATES PATENT OFFICE.

ELMER S. SEAVEY, OF JOHNSTOWN, PENNSYLVANIA.

METHOD AND APPARATUS FOR PERFORATING METAL SHAPES.

1,414,589. Specification of Letters Patent. Patented May 2, 1922.

Application filed November 6, 1918. Serial No. 261,346.

To all whom it may concern:

Be it known that I, ELMER S. SEAVEY, a citizen of the United States, and residing in the city of Johnstown, in the county of Cambria and State of Pennsylvania, have invented certain new and useful Improvements in Methods and Apparatus for Perforating Metal Shapes; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to perforating rolled metal shapes, such as railway rails, angles, I-beams, channels, flats, rounds and the like, and is more especially adapted for the perforation of railway rails, just after they have been rolled and hot sawed and while still in a red hot or heated condition.

Heretofore it has been customary after a railway rail bar leaves the final or finishing roll pass for it to be received on a roller feed table at the side of which it is held stationary for a few seconds and cut into the desired lengths by means of rotary hot saws. After having cut the railway rail bar into the desired lengths the rails are conveyed to a hot-bed to cool. After cooling, the ends of the rails are chipped or milled to remove the burred edges of the bar caused by hot-sawing, and the rails are then conveyed to a drill press where holes are drilled near the ends of each rail, through which the rail splicing joint bolts pass when the ends of the rails are spliced together to form a railway track.

The above manner of finishing the rails requires considerable handling and loss of time and labor, and it is the object of my invention to reduce the time and labor required to finish a railway rail section and thereby reduce the cost of production.

An object of my invention is to provide a method and means whereby the drills are advanced and retracted quickly and at the same time the drills are rotated at high speed, to prevent tearing of the metal as the drills pass through the bar being drilled.

Another object of my invention relates to controlling the speed of the forward movement of the drills during the drilling operation, whereby the drills may be advanced very quickly, as is required when drilling hot rolled bars, to prevent the drills from losing their temper, or comparatively slow when cold bars are drilled.

A further object of my invention relates to automatically retracting the drills quickly, at the completion of the drilling operation.

Another object of my invention relates to advancing by fluid pressure the carriage upon which the spindle bearings are mounted.

A further object of my invention relates to the manner I have of adjusting the spindle bearings and means for holding the gearing always in mesh, regardless of the lateral spacing of the spindles and bearings.

Another object of my invention is the manner I have of clamping and releasing the bar to be drilled simultaneously with the advancing or retracting carriage, and a still further object of my invention relates to the manner I have of cooling the drills at the completion of the drilling operation.

Other objects of my invention will appear hereinafter.

Having thus given a general description of my invention, I will now, in order to make the same more clear, refer to the accompanying five sheets of drawings in which like characters of references indicate like parts:—

Figure 1 is a top plan view of one form of my improved machine, the rail being fed into the machine in an upright or standing position; with its web vertical, with sets of rapidly rotating drills, made to advance toward each other on either side of the rail web, alternately pierce the rail web from either side thereof, and with the spindle rotating motors mounted on the movable carriage.

Figure 2 is a side elevation of the machine illustrated in Figure 1.

Figure 3 is a vertical transverse sectional elevation taken on the line III—III of Figure 1.

Figure 4 is a vertical transverse sectional elevation taken on the line IV—IV of Figure 1.

Figure 5 is a longitudinal sectional elevation of the fluid pressure cylinder.

Figure 6 is a detail longitudinal sectional elevation of one of the spindle bearings and mechanism.

Figure 7 is a side elevation of one of the spindle bearings.

Figure 8 is a detail view in elevation of the spindle gearing and connections.

Figure 9 is a vertical transverse sectional elevation taken centrally through the table.

Figure 10 is a vertical longitudinal sectional elevation of the adjustable guide and rail bearing block.

Figure 11 is a detail section of the fluid pressure controlling valves.

Figure 12 is a front elevation illustrating a modified form of my improved machine, in which the rail is fed into the machine on its side, with the web of the rail horizontal, and with a single set of drills, the motor for driving the spindles and attached drills, being rigidly secured to the frame of the machine.

Figure 13 is a side elevation of the machine shown in Figure 12.

Figure 14 is a detail of the catch for holding and releasing the lever for operating the controlling valves.

Figure 15 is a front elevation of another modified form of a machine, in which I use universal spindle shafts.

Figure 16 is a vertical transverse sectional elevation taken on the line XVI—XVI of Figure 15.

Figure 17 is a detail sectional elevation taken on the line XVII—XVII of Figure 15, showing the end of the carriage.

Figures 18 and 19 illustrate in detail one of the spindle universal coupling heads, the figures being taken in sectional elevation and at right angles to each other; Figure 20 illustrates a modified form of flexible spindle, and Figure 21 is a vertical longitudinal sectional elevation of the machine shown in Figures 1 and 2, the section being taken substantially on the center line of the machine.

Referring now to the characters of reference on the drawings; and especially to Figures 1 to 11 inclusive, and Figure 21, the numeral 1 indicates the base side-frame of the machine, the lower intermediate parts of which are outwardly flanged as at 2, for attaching the fluid-pressure cylinder, the upper edges each having an outwardly flanged edge 3 and a slide-way 4.

Carriages 5 and 6 are mounted on the slide-ways 4, at each end of the machine, having mounted thereon the drilling and power mechanism, both of which being of substantially the same construction, a description of one set will apply to both. T-slots 7 and 8, extend transversely across the top of each carriage 5 and 6, receiving the heads of the bolts 11 for securing the spindle-bearings 12; and the bolts 9 for adjustably securing the motors 10 to the carriages.

In the drawings each carriage has mounted thereon three spindles, but it will be readily understood that more or less may be used without departing from the spirit of my invention.

The T-slots 7 receive the heads of the clamping bolts 11, for securing the outside spindle-bearings 12 thereto. These bearings 12, have a flanged projection 13, with a hole for the bolt 11 on the upper end of which is the clamping nut 14, a downwardly extending inverted T-shaped base 15 for extending into the slot 7; and a central roller-bearing 16, with rollers 17.

The spindle 18, is mounted in the roller-bearing 16, with washers 19 and 20 on each side of the bearing 16, for retaining the rollers 17 and serving as wear-plates. This spindle has an enlarged forward head 21, with a drill-socket formed therein. A roller-bearing 22, is mounted on the spindle-shaft 18, between the enlarged head 21; and the washer 20; and acts as a thrust-bearing, while a collar 23, is secured to the spindle-shaft against the washer 19, by means of a set-bolt 24, thus retaining the several parts in the desired position. A gear-wheel 25 is mounted on the rear slightly reduced end of the spindle-shaft; and is secured thereto by means of a spline 26 and at either side of the gear-wheel on said spindle-shaft are mounted one end of the connecting links 27, these parts being retained on the shaft by a nut 28.

The intermediate spindle-bearing 29, is constructed without the flanged projection 13, to allow for greater lateral adjustment, the clamping bolt 30, extending upwardly through a slot 31; in the bottom of the carriage, otherwise the construction is similar, having a roller-bearing 32, with rollers 33, retained by washers 34 and 35, roller-bearing 36, sleeve 37; retained in position by set-bolt 38.

The intermediate spindle-bearing 29 may also if desired be made integral with the carriage where a three-spindle machine is used, as it will only be necessary to adjust the outer spindles as will be readily understood.

The spindle-shaft 39, however serves as the main drive-shaft and is somewhat different, being made with the enlarged drill socketed forward end, with the spindle-shaft extending rearwardly beyond the sleeve 37, where a gear-wheel 40, is keyed to the shaft; and links 41 are similarly mounted and retained in position by means of a washer 42; and cotter pin 43. The rear end of the spindle-shaft 39, has a gear 44 mounted thereon and journaled in an adjustable bearing 45. This gear 44, meshes with a pinion 46 on the forward end of the motor-shaft. Meshing with gears 25 and 40, are idler-gears 47, mounted on bolts 48, which pass through the ends of the links 27 and 41; which hold them at all times in mesh regardless of adjustment; as will be readily understood by referring to Figure 8.

Mounted centrally between the side-frame is a table 49, upon which the end of the rail

50 rests during the boring operation. The top of the table has a beveled-edge 51, and the under side of the table has inclined-ways 52, with downwardly extending sides 53; with inclined under-cut grooves 54 therein. A wedge-block 56 has inclined upper faces 57; with flanged edges 58, for contacting with the inclined-ways 52; and extending into the grooves 54. This wedge-block rests upon a tie-bracket 59, and has screw-threaded openings for receiving a screw-threaded shaft 60, at the outer end of which is a hand-wheel 61; by the turning of which the table may be raised or lowered, as will be readily understood by referring to Figures 4 and 9 of the drawings.

At one side of the table 49, is a stationary clamping-block 62 having downwardly extending flanges 63, attached to the base-frame by bolts 64. This clamping-block 62; extends transversely across the top of the base-frame the outer end portion resting on top of the slide-ways 4, a portion of its face 65, projects over the table 49; and is made to conform to the contour of the side of the rail 50; and serves as a fixed jaw for clamping the rail. 66 indicates a duct; having jet openings 67, communicating with the slot 68; through which the drills reciprocate when in operation. This slot allows the spindle-bearings and drills to be adjusted laterally and may extend entirely through the bock, but I prefer to have the face of the block which contacts with the rail, made in a separate piece, as more clearly shown in Figure 21, with holes the size of the drill properly spaced therein, in this manner only the face of the block will have to be changed, when the different sized rails are bored.

A T-shaped guide-way 69, is formed in the top of the clamping-block 62, in which a guide-block 70, having a pair of upwardly extending ears 71, between which the end of an L-shaped stop or gage 72, is pivoted by means of a bolt 73, this stop-block is made to reciprocate by means of a feed-screw 74, for setting the stop or gage 72, in the desired position; and its forward overhanging end may be raised and lowered by means of a handle 75.

76 indicates a movable clamping-block, having a front face portion 77, conforming in contour to the side of the rail to be drilled. This movable clamping-block also has a duct, jet-openings, and is similar in this feature of construction, to the stationary clamping-block 62.

At the forward corners of the carriage 5, are upwardly extending ears 78, having bolt-holes 79 therethrough, for the bolts 80; which are loosely mounted therein. The forward ends of the bolts being screwed into the movable clamping-block 76; and a spring 81 surrounds the body of the bolt between the ears 78; and the movable clamping-block, thereby holding the block at all times in an extended position.

A fluid-pressure cylinder 82, controls the movement of the carriages 5 and 6. This fluid-pressure cylinder, is a compound cylinder having a large cylinder 83, in which the large piston 84 reciprocates, its outward extending piston-rod having its end screw-threaded; as at 85 for adjustably attaching the downwardly extending arm 86, of the carriage 6 thereto; by means of the nuts 87. The smaller cylinder 88, in which the smaller piston 89; with reduced extending portion 90 reciprocates, its outward extending piston-rod having its end screw-threaded as at 91, for adjustably attaching the downwardly extending arm 92 of the carriage 5 thereto, by means of nuts 93.

In operation the piston 84, is limited in its forward movement by the shoulder 94; and the smaller piston 89, by the shoulder 95. This compound cylinder 82, has outwardly extending flanges 96, which are attached to the outwardly extending flanges 2, on the base side-frame by bolts.

97 indicates the main fluid supply pipe, having a connection between the three-way controlling-valves 98 and 99, details of which are shown in Figure 11. These valves are both alike in construction having an exhaust nipple 100, for coupling; and with a needle-valve 101 for controlling the exhaust. Valve 98 controls the flow of fluid-pressure through pipe 102, to or from the center of the cylinder 82, while valve 99, controls the flow of fluid-pressure through pipe 103, to or from the ends of the cylinder 82. Pipe 103; also has adjusting valves 104; and 105, for further controlling the amount of fluid-supply.

Valve arms 106; each having one end attached to the valve stem of each of the three-way valves 98 and 99, the opposite ends of said valve arms being connected together by a link 107; and pivoted at 108, to the lower end of the controlling-lever 109, this lever being fulcrumed at 110 to a downwardly extending flange 111, on the base-frame 1. The controlling-lever 109, extends upwardly at the side of the side-frame 1; and has a handle 112; on its upper end for operating the lever and an engaging dog 113; for engaging a catch 114 on the leaf-spring 115; attached to the side-frame. This spring has an upwardly extending contact member 116, for engaging the cam-face 117; on the side of the carriage 6. When the catch releases the controlling-lever, the spring 118; reverses the position of the valves, the dog 113; contacting with the stop 119.

The operation of my method and apparatus is as follows:—Assuming that the parts of the apparatus are in the position

shown in full lines in Figures 1, 2 and 5, the controlling-lever 109; being in the position shown, valve 99 will be in the open position while 98 in the exhaust position, fluid-pressure will flow into both ends of the cylinder 82; and advance both pistons toward each other. The smaller piston; which is connected to the carriage 5, will advance more rapidly than the larger piston connected to the carriage 6. The smaller piston 89 will therefore advance until it reaches the shoulder 95; on the inside of the cylinder 88, the carriage 5, with the movable clamping-block 76; rigidly holding the rail; and the point of the drills 120; just passing through the web of the rail, as indicated in dotted lines in Figure 1 and in full lines in Figure 21. When the smaller piston has completed its forward stroke and contacts with the shoulder 95, the reduced end 90; of the piston will extend a short distance into the larger cylinder, in the meantime the larger piston 84 attached to the carriage 6 has been advanced; and immediately after the completion of the full stroke of the smaller piston; the forward end of the large piston will contact with the forward end of the smaller piston forcing it backward on account of its smaller size; until the larger piston 84; contacts, or nearly contacts with the shoulder 94, at this point the carriage 6 has advanced the drills 121 through the web of the rail, as indicated in dotted lines in Figure 2. At this position however the controlling-lever 109 has been released by means of the extending contact member 116; of the leaf-spring 115; contacting with the cam surface 117; on the carriage 6, and the spring 118 reverses the position of the valves. The valve 99 will then permit the exhaust to pass through the flexible connection 122; into the clamping-blocks through ducts 66, and jet-openings 67 into the slots 68, so that when the drills are retracted they will be sprayed by the water and always remain cold for the beginning of the drilling operation. However if compressed-air or steam is used in the fluid-pressure cylinder, I may use a separate connection for supplying a cooling medium for the drills; on the return movement of the carriages 5 and 6, as indicated at 221 in Figure 21 of the drawings.

In Figures 12 to 14 inclusive, I have shown a modified form of a machine, in which the rail is fed into the machine on its side; with the web of the rail horizontal; and with a single set of spindle-shafts and bearings mounted on a carriage which reciprocates vertically on the slide-ways of an upright side-frame, the motor for rotating the spindles being rigidly secured to the frame of the machine. In these three figures, a part of the details of construction are the same as described for Figures 1 to 11; and in such cases the same reference numerals will be given them. In this modification the carriage 123; is mounted to reciprocate vertically on the slide-ways 124 of an upright frame 125, the base of said frame having a forwardly extending table or ledge 126 for the reception of the stationary clamping-block 62; and a rearwardly extending ledge 127 for attaching a fluid-pressure cylinder 128; having a single piston 129 with an extending piston-rod 130; the outer end being threaded as at 131 and adjustably attached to the extending arm 132; of the carriage 123; by means of nuts 133.

At the top of the upright side-frame 125, are rearwardly extending brackets 134; between which is bolted a channel-shaped member 135, having mounted thereon the motor 136; and bearing 137; for the motor-shaft 138.

The carriage 123 has T-slots 139; for receiving the T-shaped base 15; of the spindle-bearing 12; and heads of the clamping-bolts 11. In this modification I prefer to have the T-lots stop short of the central spindle-bearing 140; and form said bearing integral with the carriage 123. The central spindle 141 extends upwardly some distance beyond the bearing 140 and has mounted thereon a beveled-gear 142, which has an extending sleeve 143; with a shoulder 144 and reduced portion 145; journaled in a bearing 146, which extends from the base of the motor-shaft bearing, and a collar 147 is secured to the lower end of the sleeve beneath the bearing by means of a set-screw 148. The beveled-gear 142 is keyed to the spindle-shaft 141 by a key 149; which extends into the keyway 150 in the spindle. This beveled-gear 142; also meshes with a small beveled-gear 151 attached to the outer end of the motor-shaft 138.

In this modification I have shown the outer end of the controlling-lever 109; connected directly to the ends of the valve-arms 152; by means of the pivot-pin 108.

The operation of this modification is similar to that described for Figures 1 to 11 and 21, and is as follows:—The fluid-pressure is received from a suitable source through the main supply-pipe 153, which is connected to branch pipes 154 and 155, which extends to the ends of the fluid-pressure cylinder 128; and is controlled by the valves 98 and 99, as illustrated. These valves are in the position shown in Figure 11, the valve 99 being open; and the piston is at the beginning of the working stroke, as the piston is forced downward by the fluid-pressure; the carriage is carried downward with the drills rotating rapidly, the movable clamping-block 76; engaging the side of the rail and securely holding the end of the rail in position. The carriage continues to move downward the drills 156 passing entirely through the rail until

the contact member 116; engages the cam-face 117; raises the leaf-spring 115; and releases the controlling-lever 109; and the spring 118 reverses the position of the valves; and the fluid from the cylinder is exhausted through pipe 157 into the movable clamping-block 76; for cooling the drills on their return movement.

Referring now to Figures 15 to 20 inclusive, these figures illustrate another modified form of my improved machine; in which 158 indicates the base-frame of the machine, having upwardly extending side-frames 159; with slide-ways 160; and connected at the upper ends of the side-frames by a cast cross bar 161; in which is formed the bearings for the upper portions of the spindles 162; as at 163, gear-shafts 164, as at 165; and for the drive-shaft 166, as at 167.

An adjustable table 168 extends from the base-frame 158, having an adjusting-screw 169; operated by a hand-wheel 170; for raising or lowering the table and set-bolts 171; for rigidly clamping the table in the required position when desired. Upon the table may be secured the stationary clamping-block 172 upon which the bar or rail 173 rests; and is securely clamped when the movable clamping-block 174 is lowered; by the movable carriage 175; to which it is attached by the bolts 176. These bolts 176 are screwed into the movable clamping-block 174; near each end and the upper ends extend through slots 177 in forwardly extending brackets 178 on the carriage 175. A spring 179 surrounds the bolts between the movable clamping-block and the brackets, and a nut 180 is screwed upon the upper end of each bolt, in this manner the movable clamping-block may be adjusted forward or backward as desired.

In the drawings I have illustrated a multiple machine having four spindles, but more or less may be used as desired, and as they are all similar in construction a description of one of the spindles and driving mechanism will apply to all four sets.

The carriage 175 has a rearwardly extending bottom flange 181 with arc-shaped slots 182 therein. 183 indicates the adjustable bearing for the lower end of the spindle and has a rearwardly extending clamping member 184, slotted as at 185, through which pass pivot-bolts 186; that are screwed into the lower face of the carriage and clamping-bolts 187; that pass through the arc-shaped slots 182. By loosening these bolts the adjustable bearing may be moved forward, backward or laterally as desired, and when the bolts are tightened the bearings will be rigidly held in position.

A motor 188 is mounted upon a bracket attached to the side-frame near its upper end, having its shaft attached to the drive-shaft 166 and may be thrown into or out of engagement therewith by means of a clutch 189. This drive-shaft 166 has mounted thereon beveled-gears 190; meshing with beveled-gears 191 on the lower ends of each of the gear-shafts 164, and the upper ends of said shafts 164 have mounted thereon pinions 192; meshing with gears 193, said gears each having an extending sleeve 194 journaled in the bearings 163 of the cross-bar 161, and a collar 195 is attached to the lower end of each of the sleeves 194; by a set-bolt 196, thus holding the gears 193 rotatable but against vertical movement.

The upper end of the drill-spindle 162 is reciprocally journaled in the gear 193; and its sleeve 194; having a key 197; in the sleeve, and extending into a key-way 198, in the upper end of the spindle 162. The lower end of the spindle 199 is journaled in the adjustable bearing 183, having a drill-socket 200 at its lower end for holding the drill 201. The upper end of the spindle 162 and the lower end 199 are connected together by a spindle-coupling 202 and forming a universal-joint connection between the two ends. This universal-coupling connection is more clearly illustrated in Figures 18 and 19, the two sections being shown drawn at substantially right angles to each other. The ends of the spindle-coupling 202; each have a spherical head 203; with trunnion extensions 204 at the sides thereof and a hole 205; the edges of which are of larger diameter than the central portion of the hole.

The lower end of each of the upper portions 162 of the spindle and the upper end of each of the lower portions 199, are formed into sockets, each having a central socket 206, a transverse slot 207 in which the trunnions 204 extend, and holes 208 for the bolt 209; which passes through the hole 205.

In Figure 20 I have shown a modified form of spindle-coupling which I may use composed of a helical wire coupling 210 connecting the upper end of the spindle-shaft 211 with its lower end 212.

A fluid-pressure cylinder 213; with pipe connections 214 and 215; is attached to the rear side of the cross-bar 161, having a piston 216 and extending piston-rod 217, its outer end screw-threaded as at 218 and adjustably attached to the rearwardly extending arm 219 of the carriage 175 by nuts 220.

Although I have not shown in Figures 15 and 16; the pipe connections and controlling-lever etc., this part of the operation will be substantially the same as that described for Figures 11 and 13.

It will be noted by referring to the drawings, that I have allowed for vertical, lateral and longitudinal adjustment, which can be accomplished by either adjusting the table, carriage, or spindles; singly, or all of them may be adjusted to give the desired result.

Although I have shown and described my

invention in considerable detail, I do not wish to be limited to the exact and specific details shown and described, but may use such substitutions, modifications or equivalents thereof as are embraced within the scope of my invention or as pointed out in the claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:—

1. In a machine for perforating metal shapes, comprising a frame, slide-ways thereon, a carriage mounted on the slide-ways, drill-actuating spindles mounted upon the carriage, means for rapidly rotating the drill-actuating spindles and fluid-pressure means for reciprocating the carriage.

2. In a machine for perforating metal shapes, comprising a stationary frame, slide-ways thereon, a carriage mounted on the slide-ways having an extending arm, a fluid-pressure cylinder attached to the stationary frame, a piston working in said fluid-pressure cylinder having an outwardly extending piston-rod attached to the arm of the carriage, means for adjusting the reciprocating stroke of the carriage, a plurality of drill-actuating spindles mounted upon the carriage, and means for rotating the drill-actuating spindles.

3. In a machine for perforating metal shapes, a stationary frame, slide-ways on the stationary frame, a carriage working on the slide-ways, spindle-bearings mounted upon the carriage, means for laterally adjusting the spindle-bearings, a spindle journaled in each spindle-bearing, means for rapidly rotating the spindles and fluid-pressure means for reciprocating the carriage.

4. In a machine for perforating metal shapes, a stationary frame, slide-ways on the stationary frame, a carriage working on the slide-ways, a plurality of spindle-bearings mounted upon the carriage, clamping means for laterally adjusting the spindle-bearings, a spindle journaled in each spindle-bearing, intermeshing-gears for connecting the spindles together, means for rotating the spindles and fluid-pressure means for reciprocating the carriage.

5. In a drilling machine, a stationary frame, slide-ways on the stationary frame, a carriage working thereon, a transverse slot formed in the face of the carriage, a plurality of adjustable spindle-bearings having base-projections extending into the slot in the face of the carriage, clamping bolts for holding the spindle-bearings after adjustment, a spindle journaled in each spindle-bearing, a gear keyed to each spindle, an idler-gear between and intermeshing with the gears attached to the spindles, a motor for rotating the spindles and fluid-pressure means for reciprocating the carriage.

6. In a drilling machine, comprising a reciprocating carriage, a plurality of rapidly rotating drills mounted on the carriage, fluid-pressure means for advancing the carriage and rapidly rotating drills and thereby projecting the said rapidly rotating drills into the material to be drilled.

7. In a drilling machine, comprising a carriage, a plurality of rapidly rotating drills mounted on the carriage, fluid-pressure means for advancing the carriage and rapidly rotating drills mounted thereon and thereby projecting the said rapidly rotating drills into the material to be drilled, and fluid-pressure means for retracting the carriage and drills.

8. In a machine for perforating metal shapes, comprising a work-receiving table, a stationary clamping-block at one side of the work-receiving table, a carriage, a movable clamping-block attached to the forward end of the carriage on the opposite side of the table to the stationary clamping-block, a plurality of drills mounted upon the carriage and adapted to extend through the movable clamping-block, means for rapidly rotating the drills, fluid-pressure means for advancing the carriage and rapidly rotating drills mounted thereon and thereby projecting the rapidly rotating drills into the material to be drilled, and fluid-pressure means for retracting the carriage and drills from the material drilled.

9. In a drilling machine, comprising a work-receiving table, a stationary clamping-block at one side of the work-receiving table, a carriage, a movable clamping-block attached to the forward end of the carriage on the opposite side of the table to the stationary clamping-block, a plurality of spindles mounted in journal-bearings upon the carriage, a drill attached to the forward end of each spindle, said drills being adapted to extend through the movable clamping-block, means for rapidly rotating the drills, a fluid-pressure cylinder, a piston reciprocating therein having an outwardly extending piston-rod, an arm extending from the carriage and attached to the piston-rod and means for controlling the flow of fluid-pressure to and from the cylinder.

10. In a drilling machine, a stationary frame, a slide-way formed thereon, a reciprocating carriage mounted on the slide-way, a plurality of spindles journaled in bearings attached to the carriage, means for rapidly rotating the spindles, an arm extending from the carriage, a fluid-pressure cylinder attached to the stationary frame, a piston working in said fluid-pressure cylinder having an outwardly extending piston-rod attached to the arm of the carriage, means for adjusting the reciprocating stroke of the carriage and means for controlling the flow of fluid-pressure to and from the cylinder.

11. In a drilling machine, a stationary

frame, a slide-way formed thereon, a carriage mounted on the slide-way, journal bearings mounted upon the carriage, a spindle journaled in each journal-bearing, an arm extending from the carriage, a fluid-pressure cylinder attached to the stationary frame, a piston working in said fluid-pressure cylinder having an outwardly extending piston-rod attached to the arm of the carriage, means for adjusting the reciprocating stroke of the carriage and means for controlling the flow of fluid-pressure to and from the carriage.

12. In a drilling machine, a stationary frame, a slide-way formed thereon, a carriage mounted on the slide-way, spindles journaled in bearings attached to the carriage, a fluid-pressure cylinder for reciprocating the carriage attached to the stationary frame, valves for controlling the fluid-pressure to and from the fluid-pressure cylinder, means for operating the valves to advance the carriage and spindles mounted thereon; and means for operating the valves to retract the carriage and spindles.

13. In a drilling machine, a stationary frame, a slide-way formed thereon, a carriage mounted on the slide-way, spindles journaled in bearings attached to the carriage, a fluid-pressure cylinder for reciprocating the carriage attached to the stationary frame, valves for controlling the fluid-pressure to and from the fluid-pressure cylinder, means for simultaneously operating the valves to advance the carriage and spindles mounted thereon, and means by the advanced movement of the carriage for simultaneously operating the valves to retract the carriage and spindles.

14. In a drilling machine, a stationary frame, slide-ways formed thereon, a carriage mounted on the slide-ways, spindles journaled in bearings attached to the carriage, a fluid-pressure cylinder for reciprocating the carriage attached to the stationary frame, valves for controlling the fluid-pressure to and from the fluid-pressure cylinder, an operating-lever pivoted to the side frame, one end of said operating-lever being connected to the valves while the opposite end is made to engage a catch to hold the lever after operating the valves to advance the carriage, and a cam on the carriage for releasing the catch and allowing the operating-lever to simultaneously operate the valves to retract the carriage and spindles.

15. In a drilling machine, a stationary frame, slide-ways formed thereon, a carriage mounted on the slide-ways, a plurality of spindles journaled in bearings on the carriage, fluid-pressure means for reciprocating the carriage, valves for controlling the fluid-pressure, a lever for controlling the fluid-pressure valves, means for advancing the carriage, a catch for holding the lever, means on the carriage for releasing the lever from the catch and means for operating the valves for retracting the carriage.

16. In a drilling machine, a carriage, a plurality of spindles mounted upon the carriage, means for rapidly rotating the spindles, fluid-pressure means for advancing the carriage, means for regulating the advancing movement of the carriage and fluid-pressure means for automatically retracting the carriage.

17. In a drilling machine, a plurality of adjustable spindles mounted upon the carriage, means for rapidly rotating the spindles, fluid-pressure means for advancing the carriage, a needle-valve for regulating the speed of the advancing movement of the carriage, adjusting means for controlling the length of the reciprocating stroke of the carriage and fluid-pressure means for automatically retracting the carriage.

18. In a drilling machine, a stationary frame, slide-ways formed thereon, a work-receiving table, a carriage mounted upon the slide-ways at either side of the work-receiving table, a plurality of spindles journaled in bearings attached to each carriage, the axis of the spindles on one carriage on one side of the work-receiving table being in alignment with the axis of the spindles on the carriage on the opposite side of the work-receiving table and fluid-pressure means for reciprocating the carriages.

19. In a drilling machine, a stationary frame, slide-ways formed thereon, a work-receiving table, a carriage mounted upon the slide-ways at either side of the work-receiving table, a plurality of spindles journaled in adjustable bearings attached to each carriage, the axis of the spindles on one carriage on one side of the work-receiving table being in alignment with the axis of the spindles on the carriage on the opposite side of the work-receiving table, fluid-pressure means for advancing the carriages simultaneously toward each other and fluid-pressure means for simultaneously retracting the carriages from each other.

20. In a drilling machine, a stationary frame, slide-ways formed thereon, a work receiving table, a carriage mounted upon the slide-ways at either side of the work-receiving table, a plurality of spindles journaled in laterally adjustable bearings attached to each carriage, the axis of the spindles on one carriage on one side of the work-receiving table being in alignment with the axis of the spindles on the carriage on the opposite side of the work-receiving table, fluid-pressure means for advancing the carriages simultaneously toward each other, means for partially retracting one carriage by the ad-

vanced movement of the opposite carriage and fluid-pressure means for simultaneously retracting the carriages from each other.

21. In a drilling machine, a stationary frame, slide-ways formed thereon, a work-receiving table, a carriage mounted upon the slide-ways at either side of the work-receiving table, a plurality of spindles journaled in laterally adjustable bearings attached to each carriage, the axis of the spindles on one carriage on one side of the work-receiving table being in alignment with the axis of the spindles on the carriage on the opposite side of the work-receiving table, a fluid-pressure cylinder, a piston reciprocating within each end of the cylinder, one of the said pistons being of smaller diameter than the other and each having an outwardly extending piston-rod, an arm extending from each carriage and attached to their respective piston-rods, fluid-pressure means for advancing the pistons and carriages toward each other, a projection extending from one of the pistons for contacting with the opposite piston for retracting the smaller piston by the advanced movement of the larger piston and fluid-pressure means for retracting both pistons and carriages simultaneously.

22. In a drilling machine, a carriage, spindles mounted in laterally adjustable bearings on the carriage, a drill attached to the forward end of each of the spindles, a work-receiving table, clamping-blocks on either side of the work-receiving table, holes through the clamping-blocks for the passage of the drills, a fluid-pressure cylinder for reciprocating the carriage and a connection between the fluid-pressure cylinder and the clamping-blocks for exhausting a cooling medium into the clamping-blocks around the drills when retracting the drills.

23. In a drilling machine, a carriage, spindles mounted in adjustable journal bearings upon the carriage, fluid-pressure means for advancing the carriage, means for controlling the speed of the advancing movement of the carriage and fluid-pressure means for retracting the carriage.

24. In a drilling machine, a stationary frame, slide-ways formed thereon, a carriage mounted upon the slide-ways, a plurality of spindles journaled in adjustable bearings on the carriage, fluid-pressure means for advancing the carriage, a valve for controlling the speed of the advancing movement of the carriage and fluid-pressure means for retracting the carriage.

25. In a drilling machine, a stationary frame, slide-ways formed thereon, a carriage mounted upon the slide-ways, a plurality of journal bearings mounted upon the carriage, a spindle mounted within each journal bearing, a drill attached to the forward end of each spindle, a work-receiving table secured to the stationary frame, clamping-blocks on either side of the work-receiving table, slots through the clamping-blocks, a duct in the clamping-blocks having jet-openings communicating with the slots, a fluid-pressure means for advancing the carriage and fluid-pressure means for retracting the carriage.

26. In a drilling machine, a stationary frame, a carriage mounted thereon, having a downwardly extending arm, spindles mounted upon the carriage, drills attached to the spindles, a work-receiving table secured to the stationary frame, clamping-blocks on either side of the work-receiving table, slots through the clamping-blocks for the passage of the drills, ducts in the clamping-blocks having jet-openings connecting with the slots, a fluid-pressure cylinder attached to the stationary frame, a piston working in said fluid-pressure cylinder having an outwardly extending piston-rod attached to the arm of the carriage for reciprocating the carriage and a connection between the duct and the exhaust from the fluid-pressure cylinder.

27. In a drilling machine, a stationary frame, a slide-way formed thereon, a carriage mounted on the slide-way, a plurality of spindles journaled in bearings attached to the carriage, means for rotating the spindles, a fluid-pressure cylinder, a connection between the carriage and the fluid-pressure cylinder for reciprocating the carriage, a work-receiving table, clamping-blocks on either side of the work-receiving table, slots in the clamping-blocks, ducts in the clamping-blocks having jet-openings communicating with the slots, and a connection between the ducts and the exhaust from the fluid-pressure cylinder.

28. In a drilling machine, a stationary frame, slide-ways formed thereon, a carriage mounted on the slide-ways, a plurality of spindles journaled in bearings attached to the carriage, means for rotating the spindles, a fluid-pressure cylinder, a connection between the carriage and the fluid-pressure cylinder for reciprocating the carriage, a work-receiving table, a stationary clamping-block at one side of the table, a movable clamping-block on the opposite side of the table resiliently mounted on the forward end of the carriage, slots in the clamping-blocks, ducts in the clamping-blocks having jet-openings communicating with the slots and a fluid-supply connection between the ducts and the exhaust from the fluid-pressure cylinder.

29. In a drilling machine, comprising a work-receiving table, a stationary clamping-block at one side of the work-receiving

table, an adjustable-stop mounted upon the stationary clamping-block, a reciprocating carriage, a movable clamping-block attached to the forward end of the carriage on the opposite side of the table to the stationary clamping-block, a plurality of spindles mounted in journal bearings upon the carriage, a drill attached to the forward end of each spindle, said drills being adapted to extend through the movable clamping-block, means for rotating the drills, a fluid-pressure cylinder, a piston reciprocating therein having an outwardly extending piston-rod, an arm extending from the carriage and attached to the piston-rod, means for controlling the flow of fluid-pressure to and from the cylinder and means for spraying the drills with a cooling medium on the return movement of the carriage.

30. In a drilling machine, a carriage, spindles adjustably mounted upon the carriage, means mounted upon the carriage for rotating the spindles, fluid-pressure means for advancing the carriage and fluid-pressure means for retracting the carriage.

31. In a drilling machine, a carriage, a plurality of spindles journaled in laterally adjustable bearings mounted upon the carriage, a motor mounted upon the carriage for rotating the spindles, fluid-pressure means for advancing the carriage and fluid-pressure means for automatically retracting the carriage at the end of the forward movement of the carriage.

32. In a machine for perforating metal shapes, comprising a stationary frame, slide-ways formed thereon, a work-receiving table mounted at an intermediate position on the stationary frame between the slide-ways, a carriage on the slide-ways on each side of the work-receiving table, a plurality of spindles journaled in adjustable bearings attached to each carriage, the axis of the spindles mounted on one carriage being in alignment with the axis of the spindles mounted on the opposite carriage, means mounted upon the carriages for rotating the spindles, fluid-pressure means for simultaneously advancing both carriages and fluid-pressure means for automatically retracting both carriages from each other.

33. The method of perforating a hot-rolled bar of metal having a relatively thin portion, which consists in first holding the bar in the desired position, and then advancing from some distance from the bar by a flexible fluid-pressure feed a rapidly rotating drill through the relatively thin portion of the bar.

34. The method of drilling a hot-rolled bar of metal having a relatively thin web portion, which consists in first placing the bar in the desired position to be drilled, and then simultaneously advancing from some distance from the bar by a flexible fluid-pressure feed, clamping means for holding the bar and a plurality of rapidly rotating drills which are advanced through the relatively thin web portion of the bar.

35. The method of drilling a hot-rolled bar of metal having a relatively thin web portion, which consists in first placing the bar upon a work-receiving table in the desired position to be drilled, and then simultaneously advancing from some distance from the bar by a flexible fluid-pressure feed, clamping means for holding the bar and a set of rapidly rotating drills from either side of the bar which are advanced through the relatively thin web portion of the bar from each side thereof, the set of drills on one side of the bar being advanced until the points of the drills pass through the thin web portion of the bar, then advancing the other set of drills on the other side of the bar through the holes formed by the first set of drills, and fluid-pressure means for automatically retracting the drills and clamping means at the end of the working stroke.

36. The method of drilling a hot-rolled bar of metal, which consists in first placing the bar upon a work-receiving table in the desired position to be drilled, and then simultaneously advancing from some distance from the bar by a flexible fluid-pressure feed clamping means for holding the bar and a set of rapidly rotating drills advanced in multiple from either side of the bar through the bar, the set of drills on one side of the bar being advanced until the points of the drills pass through the thin web portion of the bar, then advancing the other set of drills on the other side of the bar through the holes formed by the first set of drills, and fluid-pressure means for automatically retracting the drills and clamping means at the end of the working stroke.

37. The method of drilling a hot-rolled bar of metal, which consists in first placing the bar upon a work-receiving table in the desired position to be drilled, then simultaneously advancing from some distance from the bar by a fluid-pressure feed, clamping means for holding the bar and a plurality of rapidly rotating drills advanced in multiple from each side of the bar into the bar, automatically retracting the drills and clamping means at the end of the working stroke by fluid-pressure, and then quenching the drills.

38. The method of drilling a hot-rolled bar of metal, which consists in first placing the bar upon a work-receiving table in the desired position to be drilled, then simultaneously advancing from some distance from the bar by fluid-pressure, clamping means for holding the bar and a set of rapidly rotating drills advanced in multiple from each

side of the bar through the bar, the set of drills on one side of the bar being in alignment with the set of drills on the opposite side of the bar, the set of drills on one side of the bar being advanced until the points of the drills pass through the thin web portion of the bar, then advancing the other set of drills on the other side of the bar through the holes formed by the first set of drills, automatically retracting the drills and clamping means at the end of the working stroke by fluid-pressure, and then quenching the drills.

39. The method of drilling a hot-rolled bar of metal, having a relatively thin web portion, which consists in first placing the bar upon a work-receiving table in the desired position to be drilled, then simultaneously advancing from some distance from the bar by fluid-pressure clamping means for holding the bar, and a set of rapidly rotating drills advanced in multiple from each side of the bar, through the relatively thin web portion of the bar, the set of drills on one side of the bar being in alignment with the set of drills on the opposite side of the bar, each of the drills partially perforating the relatively thin web portion of the bar, the set of drills on one side of the bar being advanced until the points of the drills pass through the thin web portion of the bar, then advancing the other set of drills on the other side of the bar through the holes formed by the first set of drills, automatically retracting the drills and clamping means at the end of the working stroke by fluid-pressure, and then quenching the drills.

40. The method of drilling a hot-rolled bar of metal having a relatively thin web portion, which consists in first placing the bar upon a work-receiving table in the desired position to be drilled, simultaneously clamping the bar and advancing in multiple a plurality of rapidly rotating drills on each side of the bar by fluid-pressure, the drills on one side of the bar being in alignment with the drills on the opposite side of the bar, each of the drills partially perforating the relatively thin web portion of the bar, and fluid-pressure means for automatically retracting the drills and clamping means at the end of the working stroke.

41. The method of drilling a hot-rolled bar of metal having a relatively thin web portion, which consists in first placing the bar upon a work-receiving table in the desired position to be drilled, advancing by fluid-pressure a plurality of drills from some distance from the hot-rolled bar and from opposite sides thereof into the relatively thin web portion of the bar, each drill only partially perforating the web of the bar.

42. The method of drilling a hot-rolled bar of metal having a relatively thin web portion, which consists in first placing the bar upon a work-receiving table in the desired position to be drilled, advancing by fluid-pressure a set of drills from opposite sides of the bar into the relatively thin web portion of the bar, the set of drills on one side of the bar being in alignment with the set of drills on the opposite side of the bar, the set of drills on one side of the bar being advanced first into the relatively thin web portion of the bar for partially perforating the thin web portion of the bar, then advancing a second set of drills on the opposite side of the bar to complete the partial perforations formed by the first set of drills.

In witness whereof I hereunto affix my signature.

ELMER S. SEAVEY.