Dec. 13, 1932. G. B. COE 1,890,803

METHOD AND APPARATUS FOR WORKING METAL

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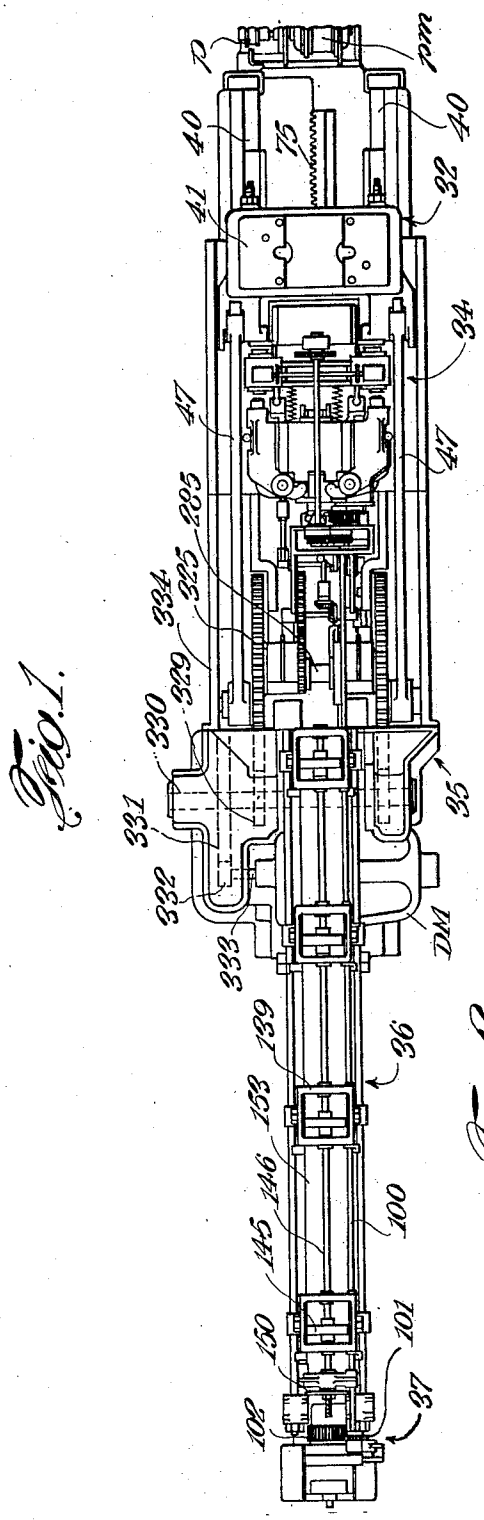


Fig. 1.

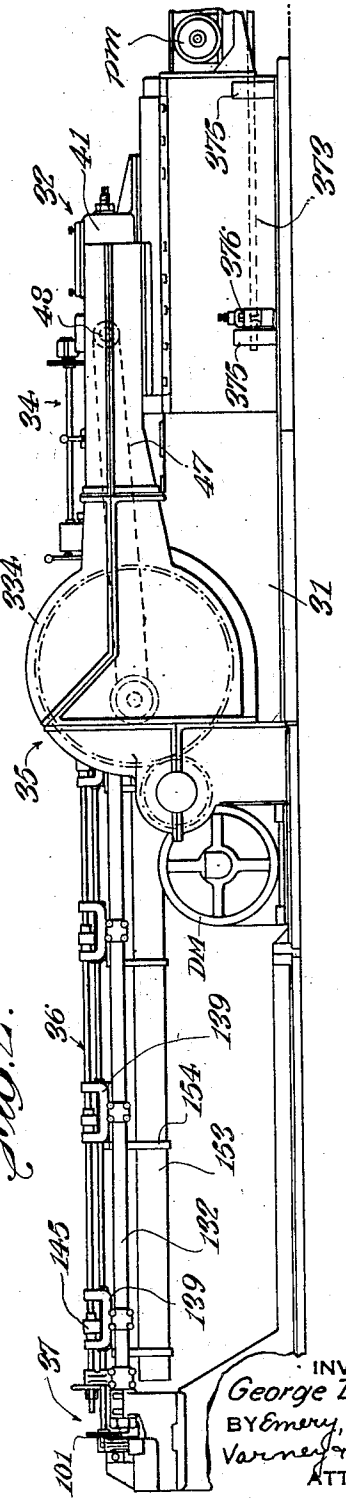


Fig. 2.

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Fig. 1b.

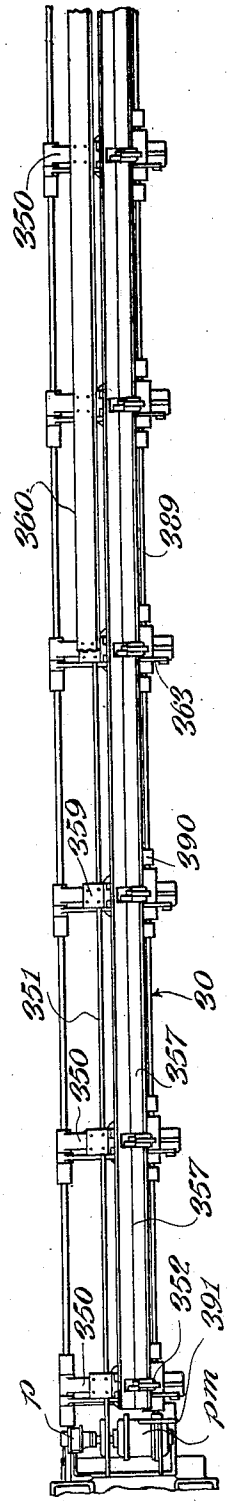
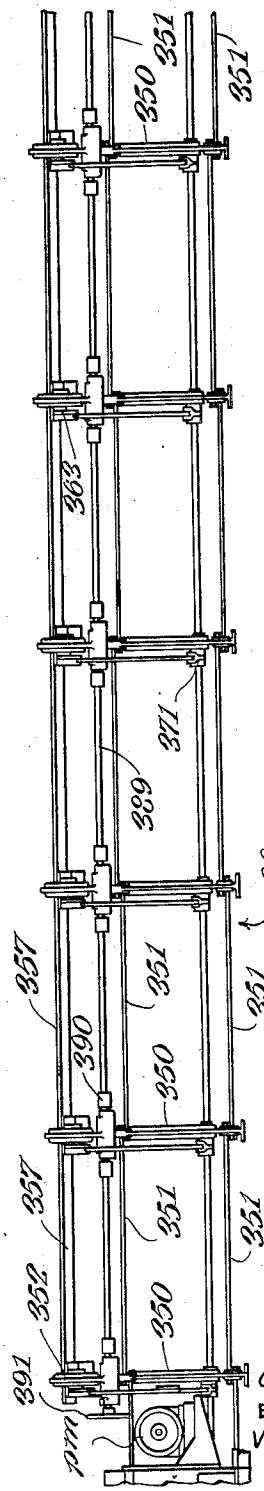


Fig. 2b.



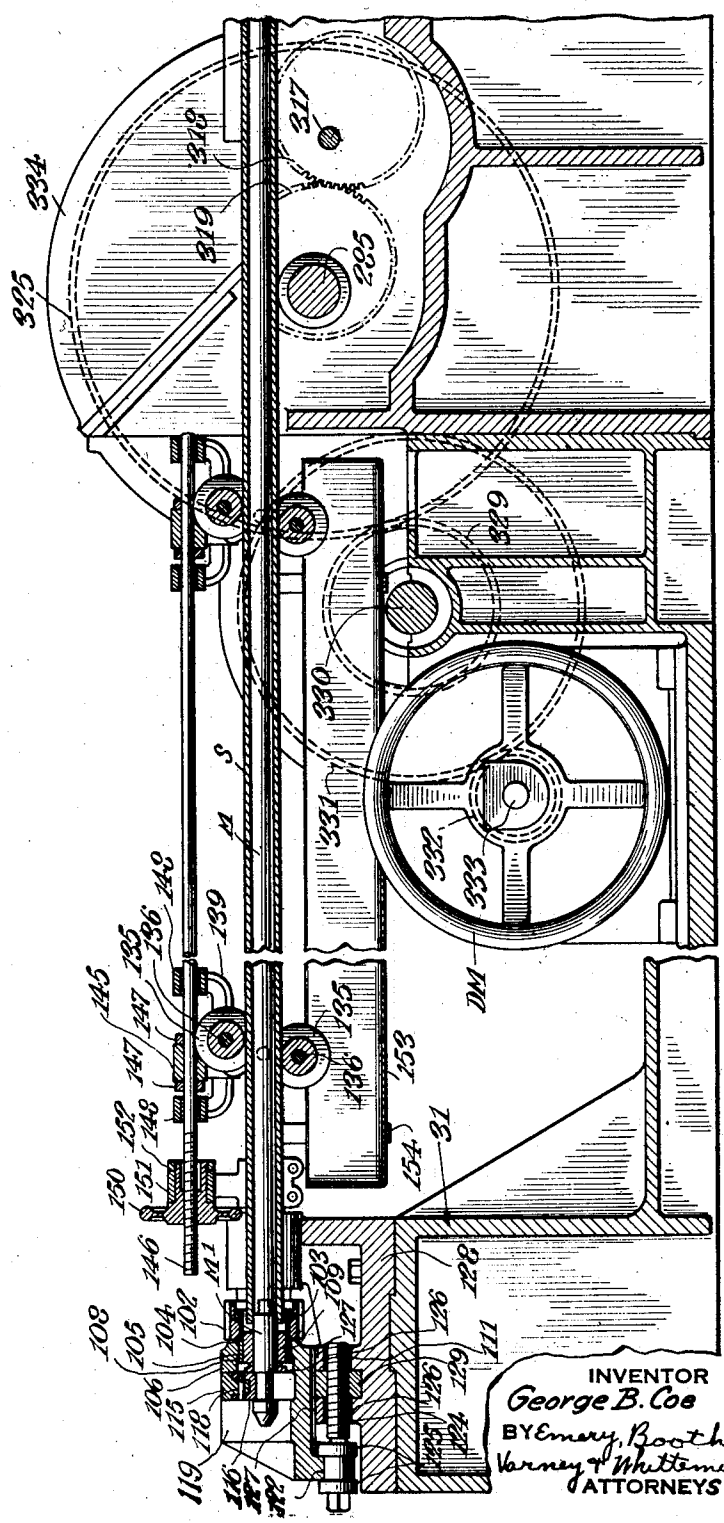
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Fig. 3.



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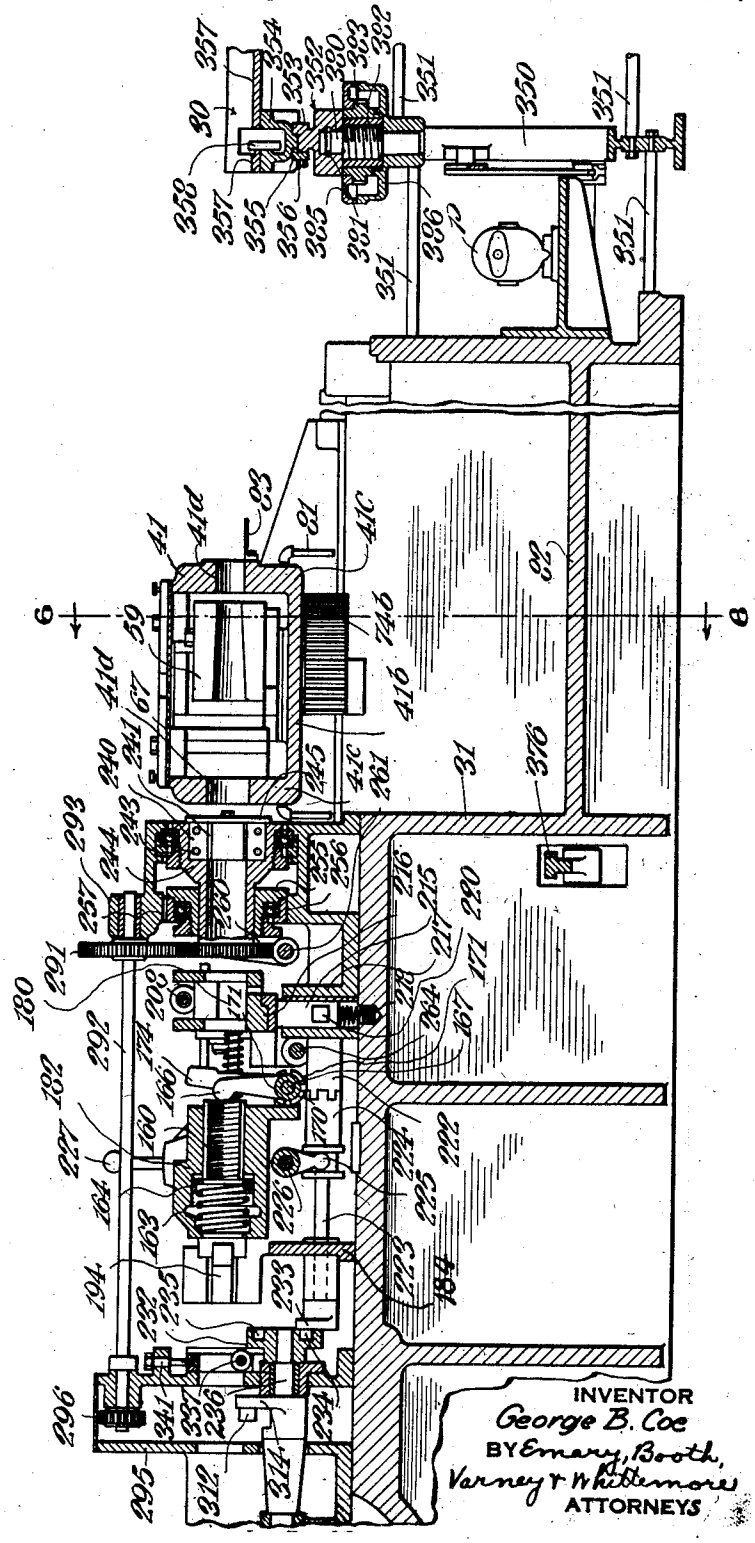


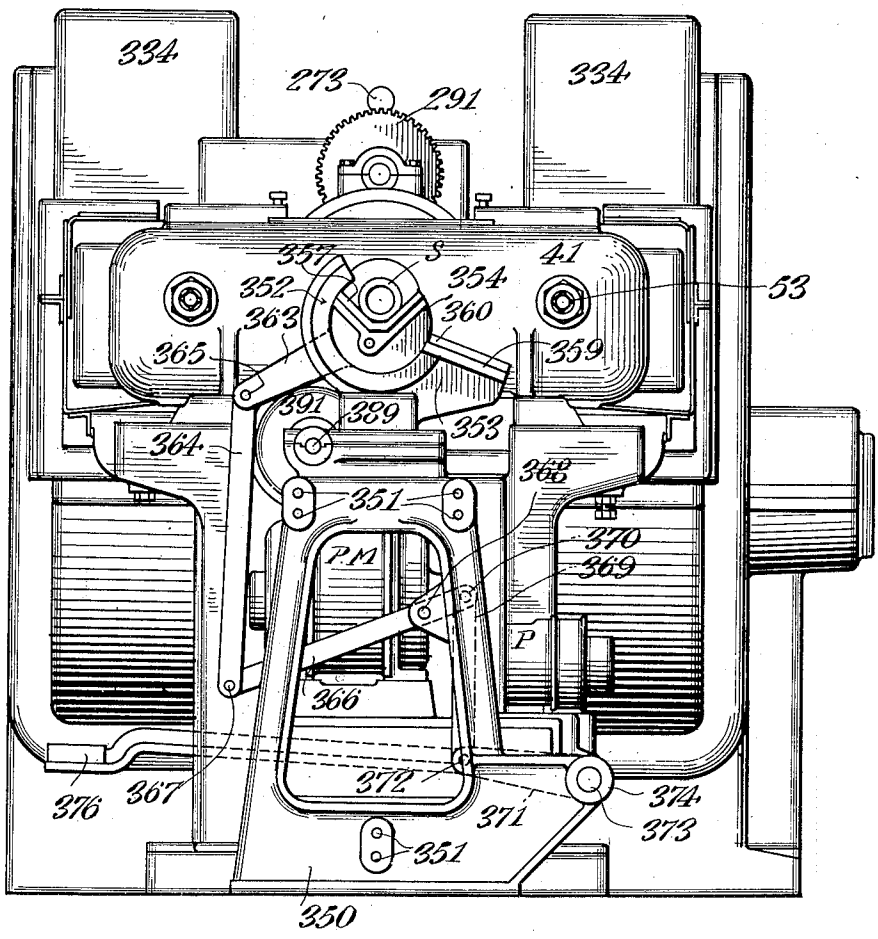
Fig. 36.

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Fig. 4.



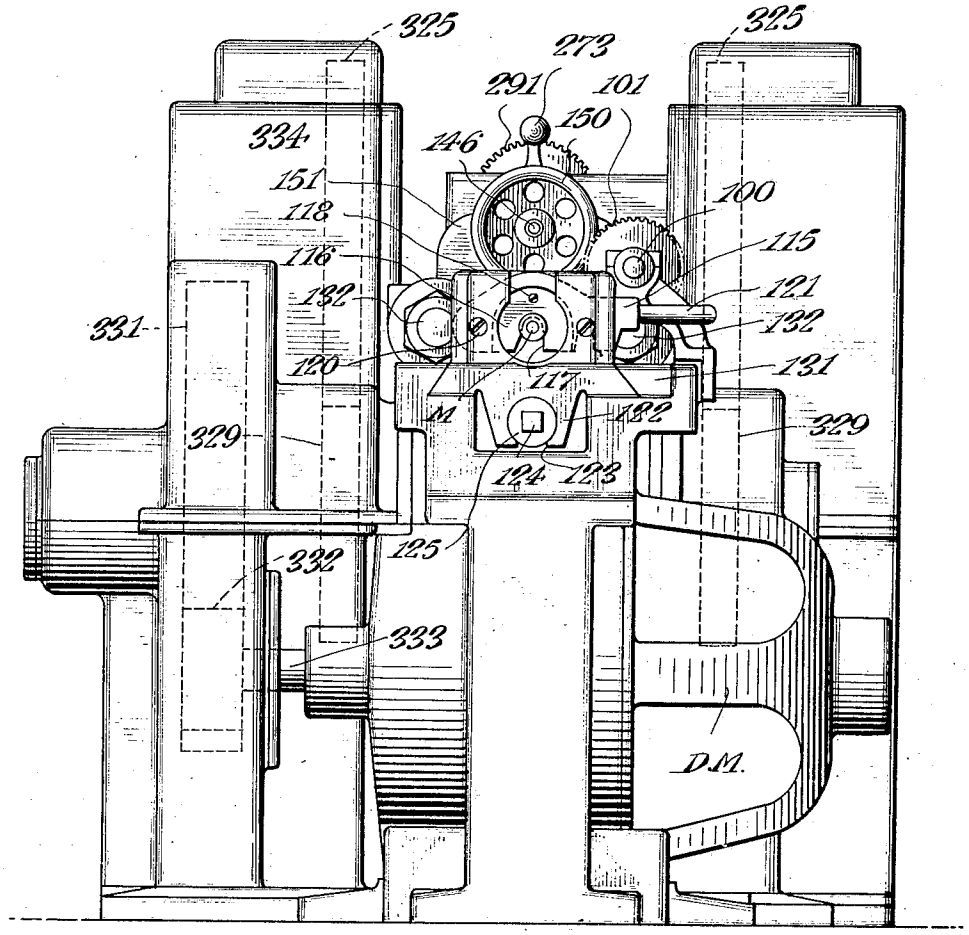
INVENTOR
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Fig. 5.



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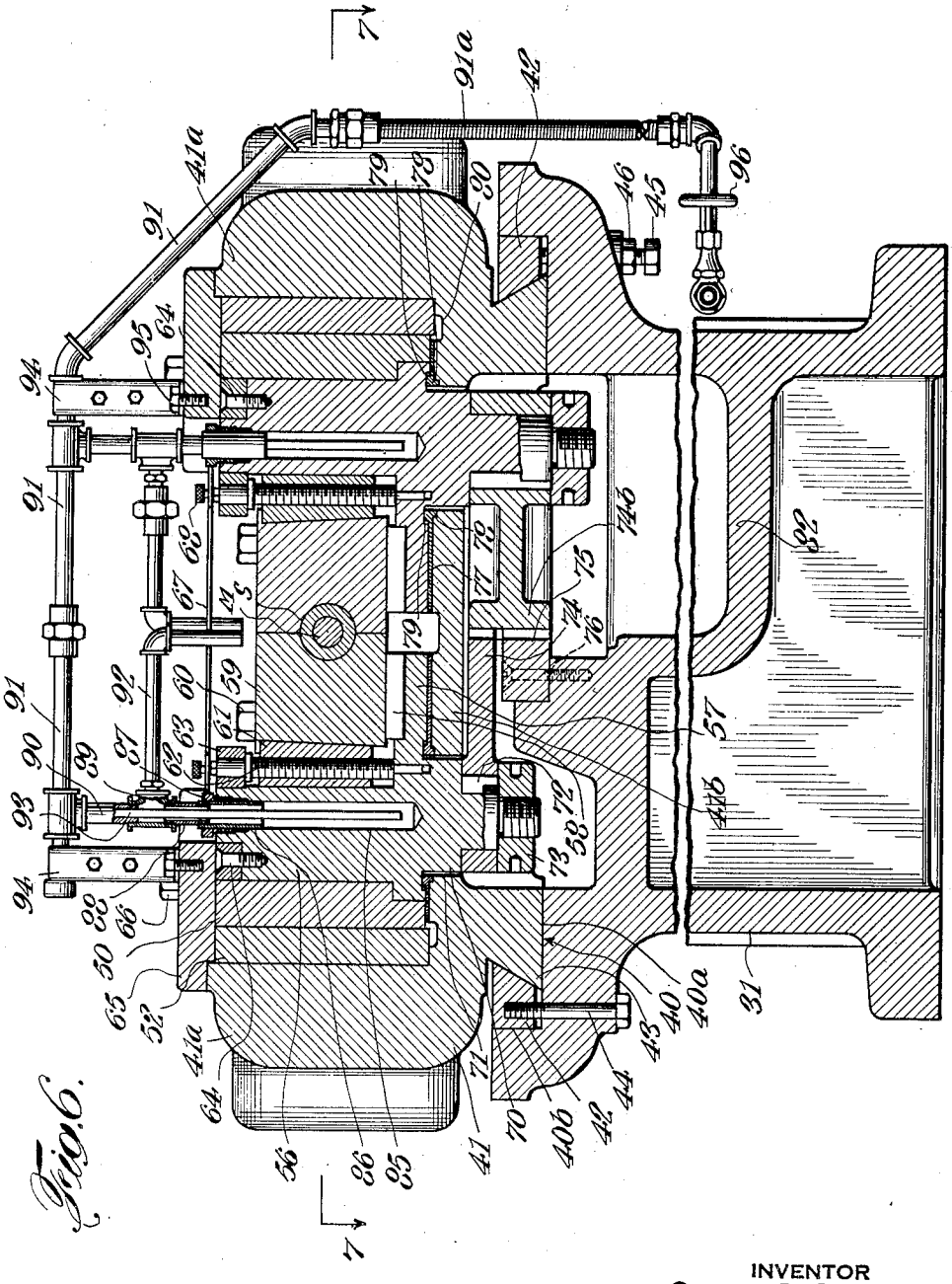


Fig. 6.

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Fig. 7.

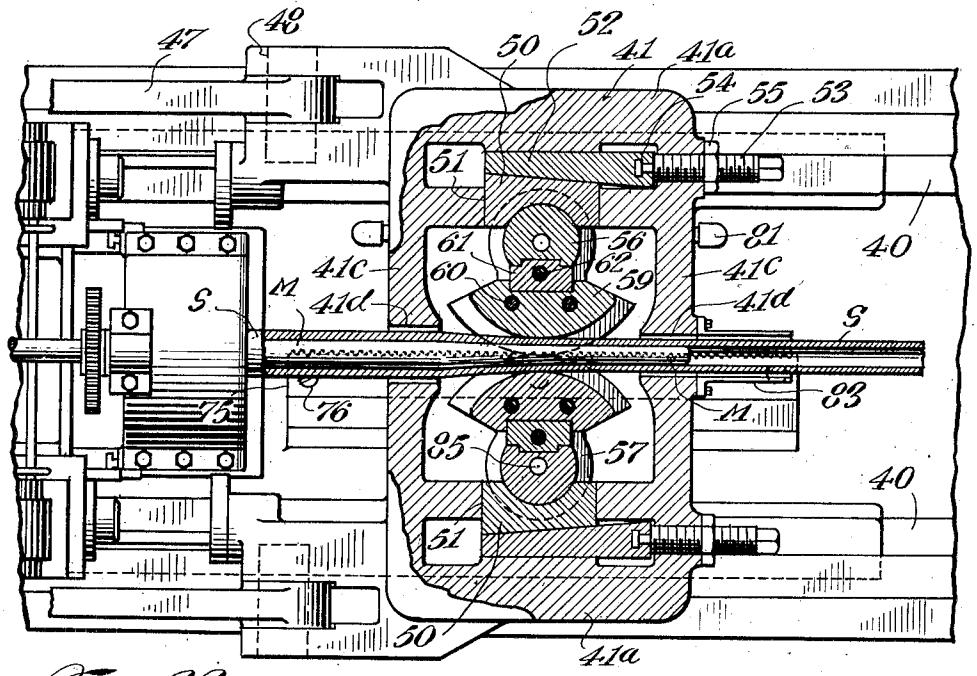
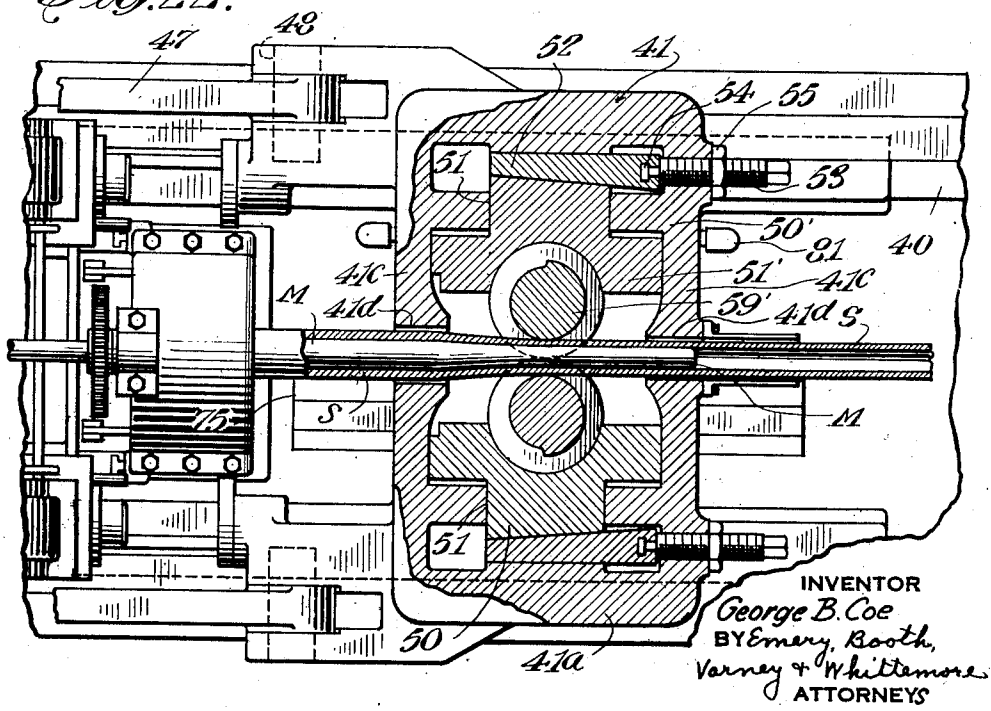


Fig. 22.



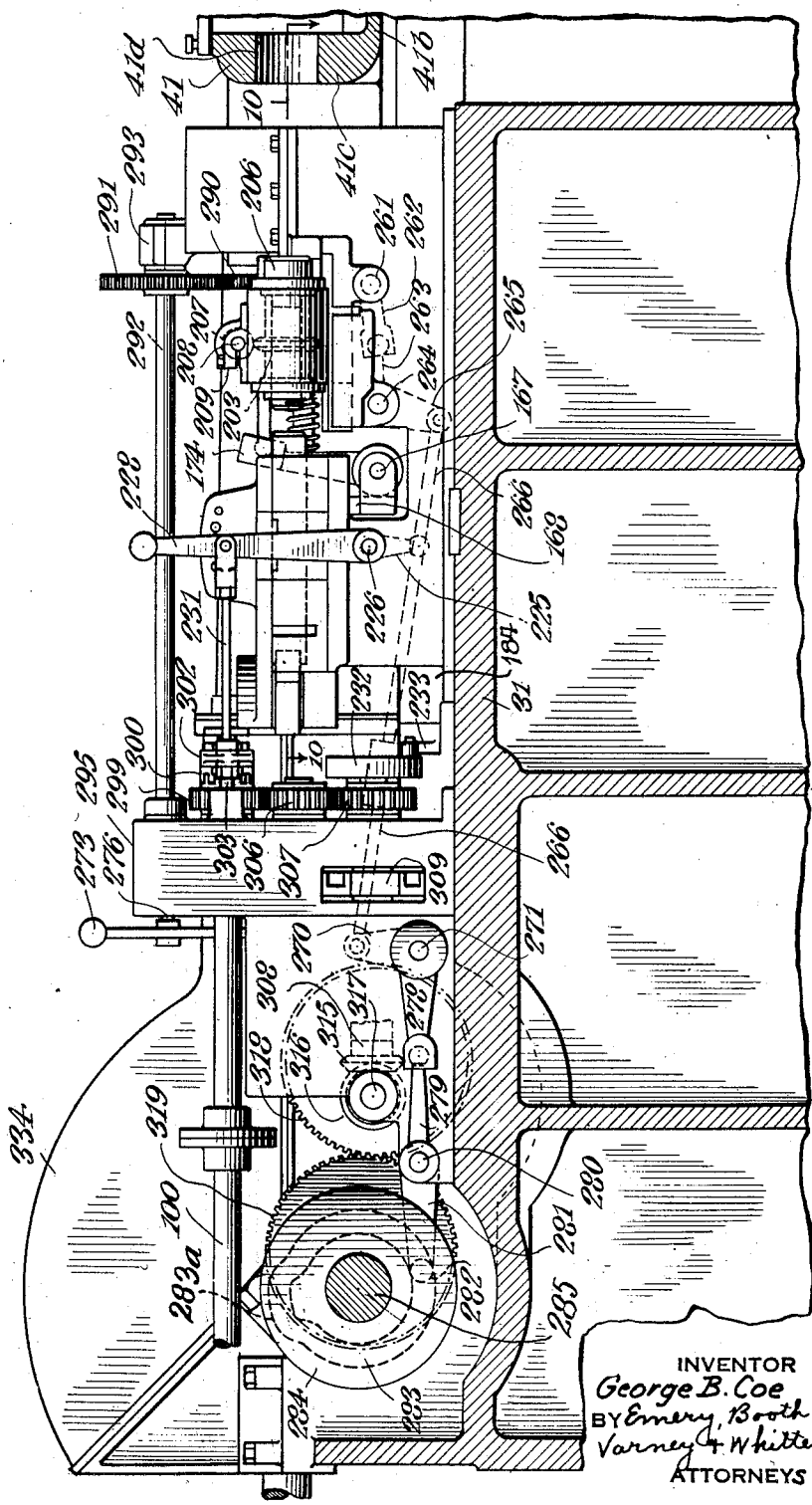
INVENTOR
George B. Coe
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Fig. 8.



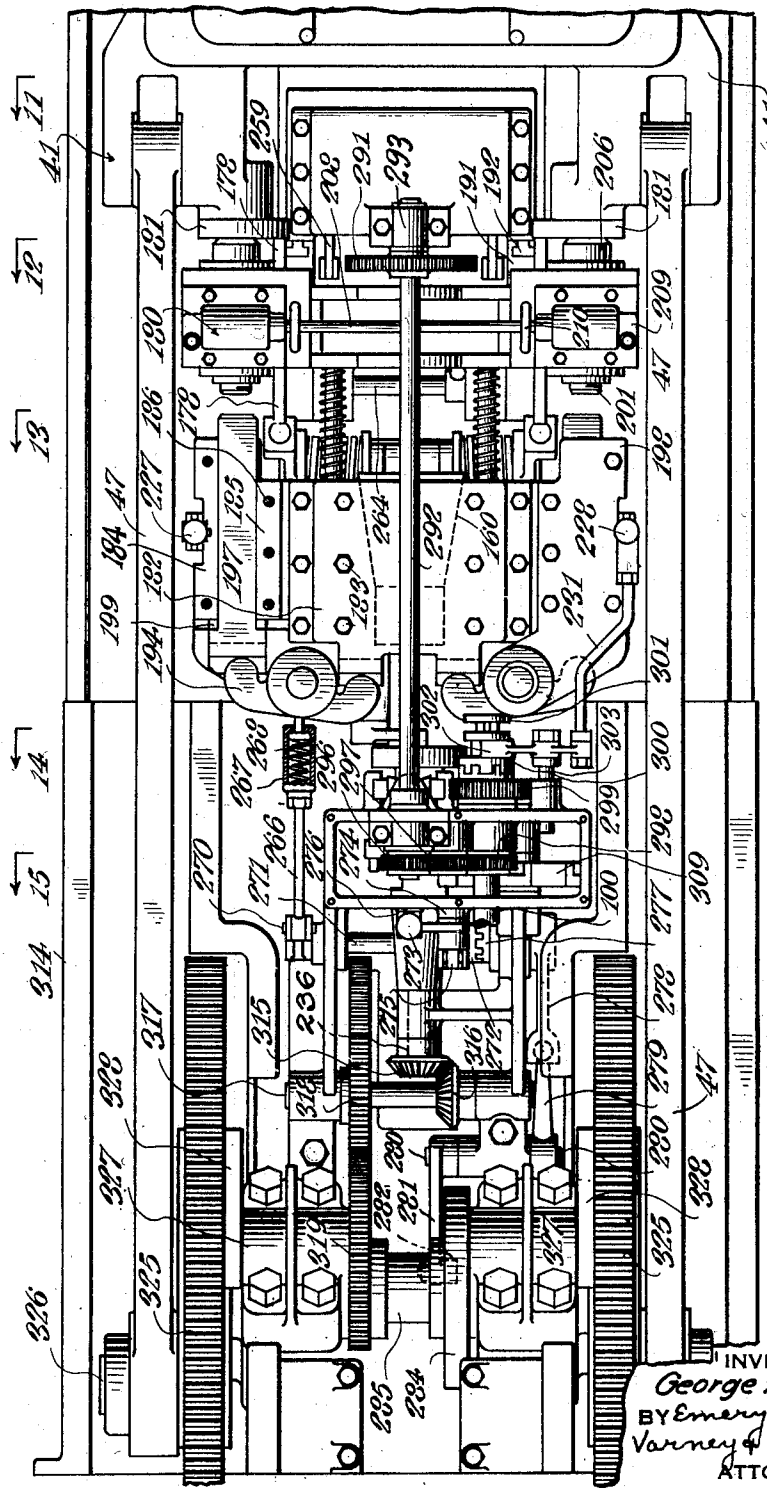
INVENTOR
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Fig. 9.



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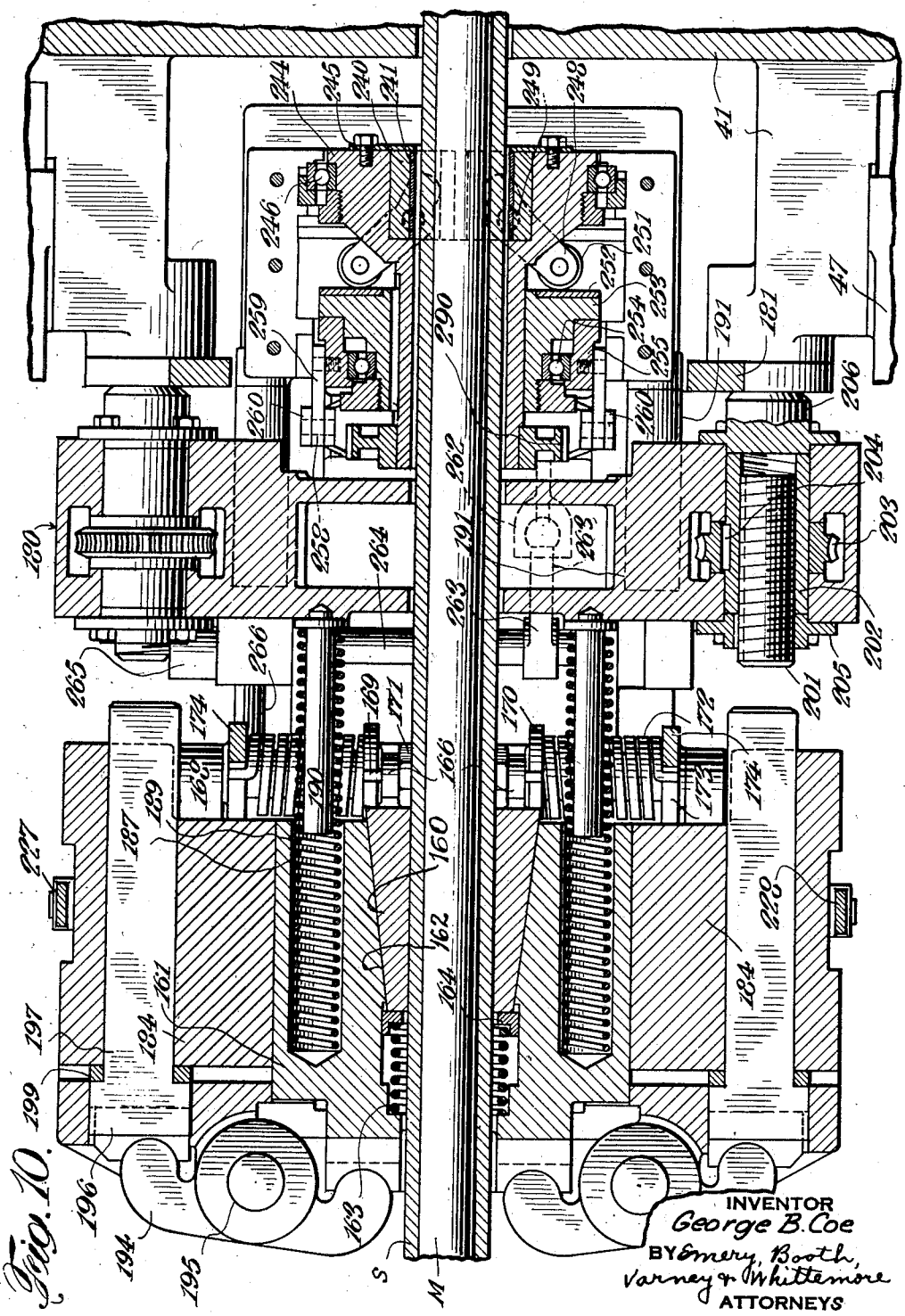


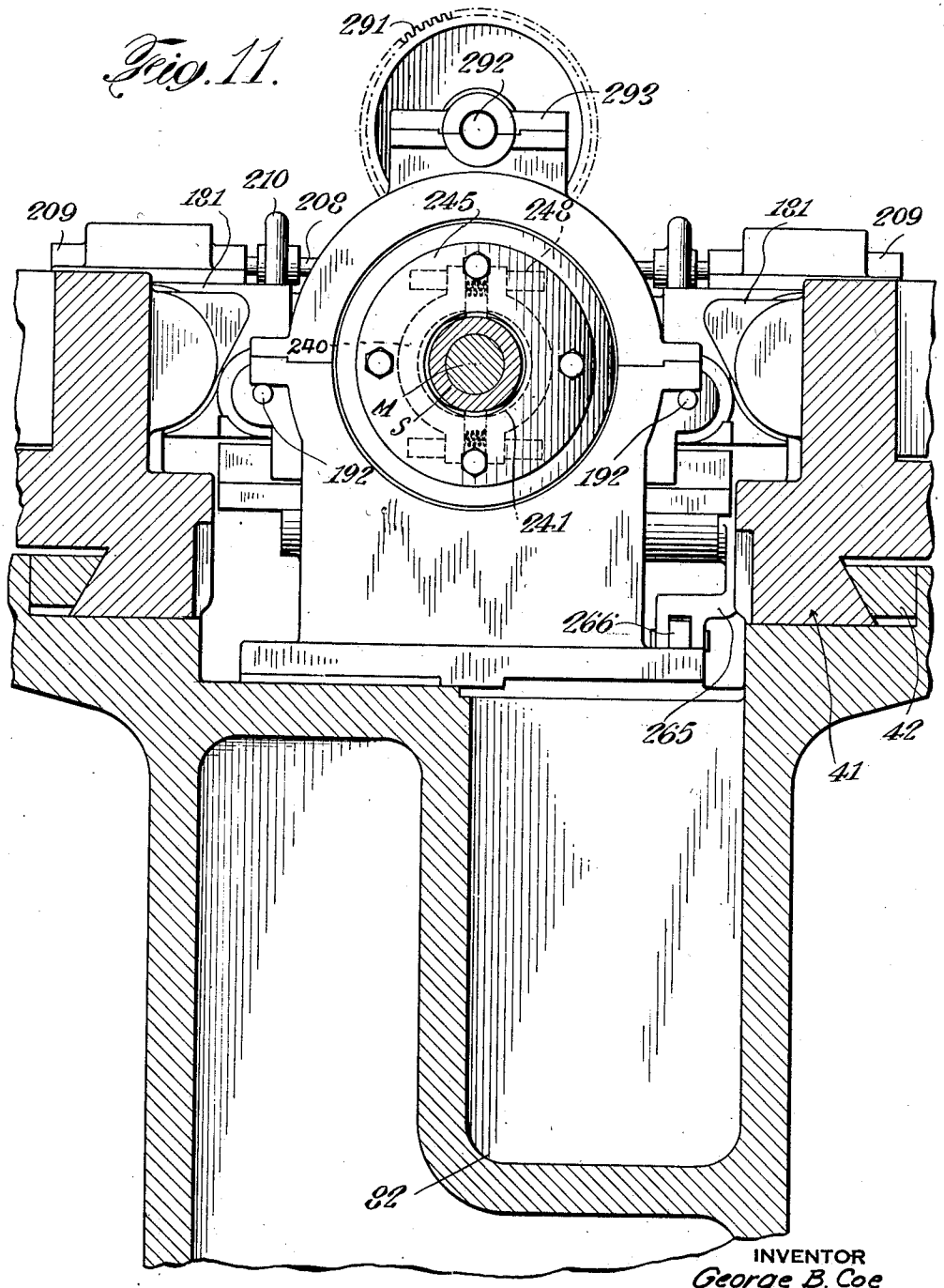
Fig. 10.

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Fig. 11.



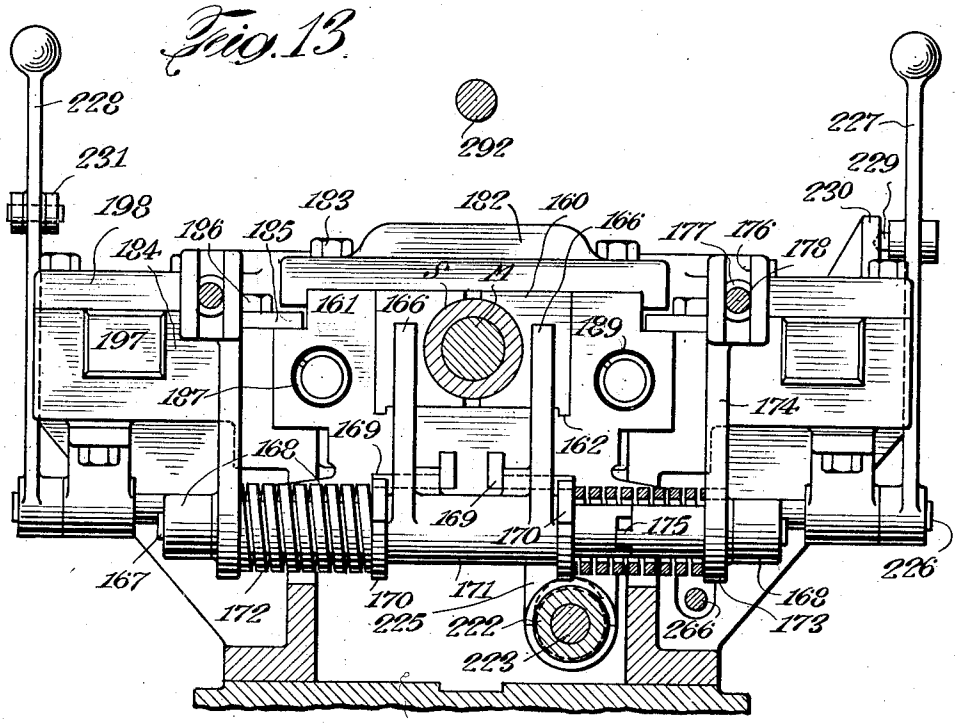
INVENTOR
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METHOD AND APPARATUS FOR WORKING METAL

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Fig. 13.



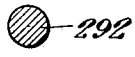
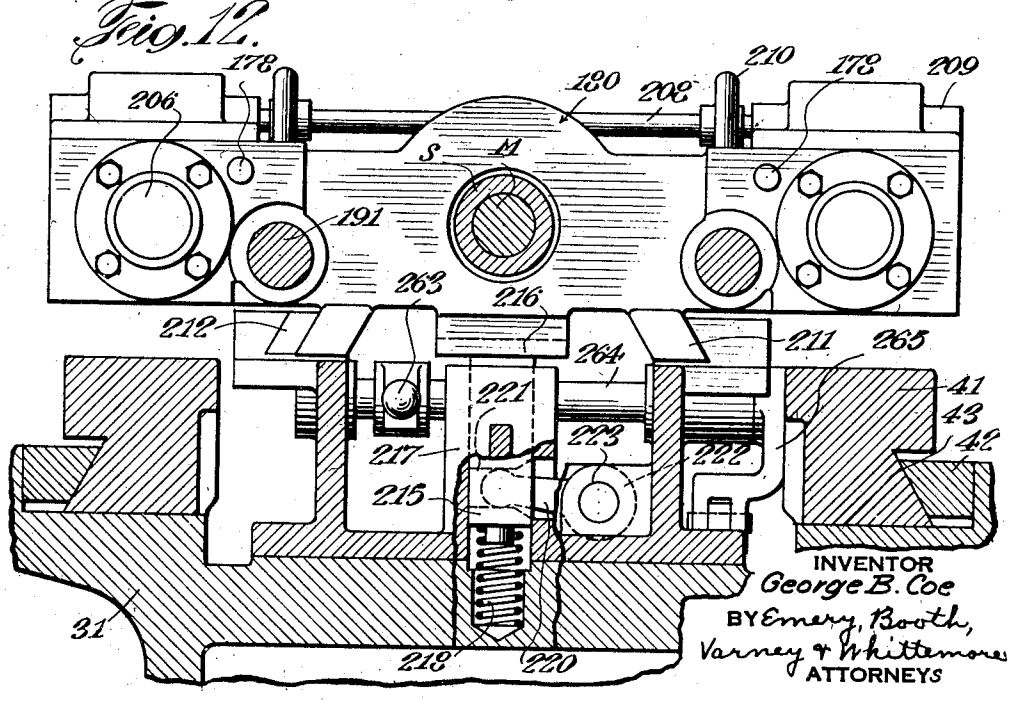


Fig. 12.



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METHOD AND APPARATUS FOR WORKING METAL

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Fig. 13.

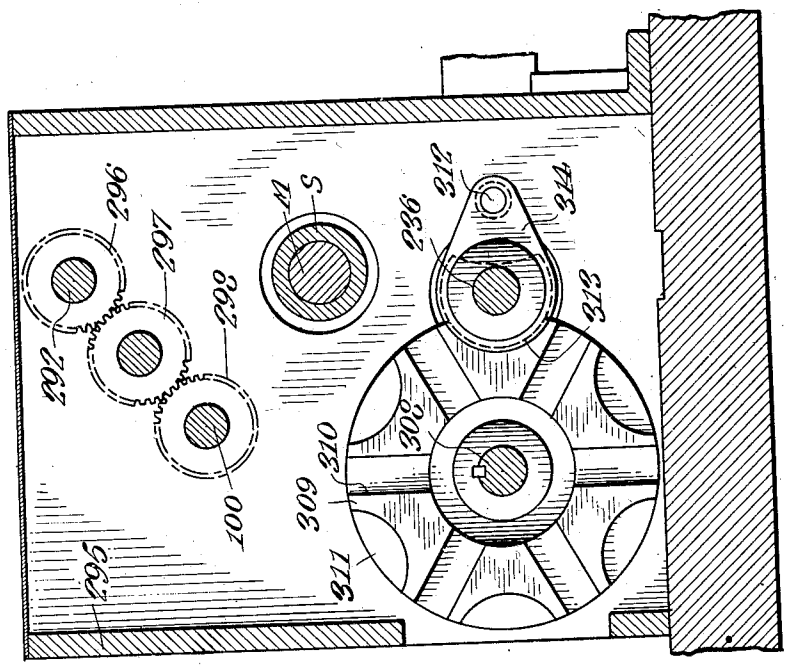
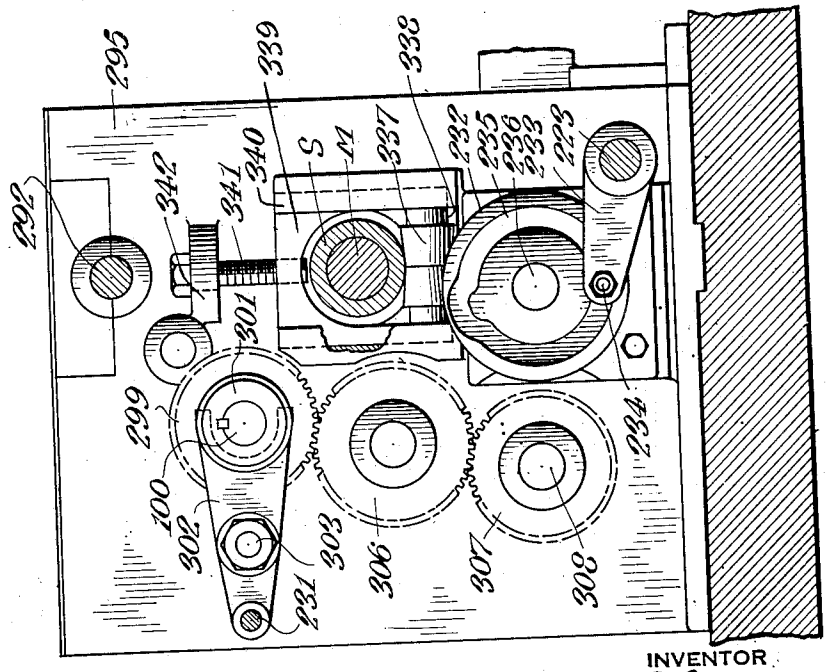


Fig. 14.



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METHOD AND APPARATUS FOR WORKING METAL

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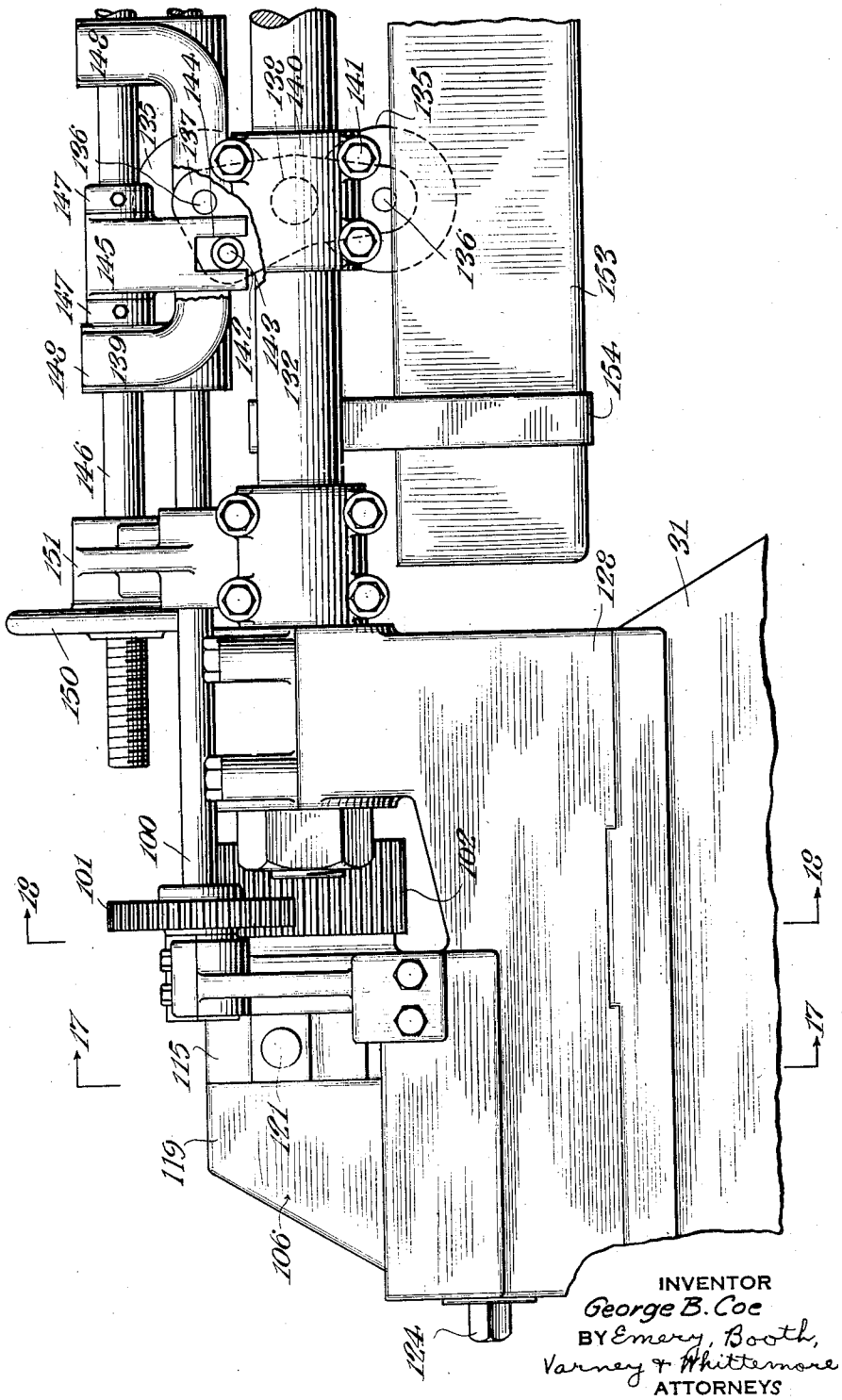


Fig. 16.

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METHOD AND APPARATUS FOR WORKING METAL

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Fig. 16.

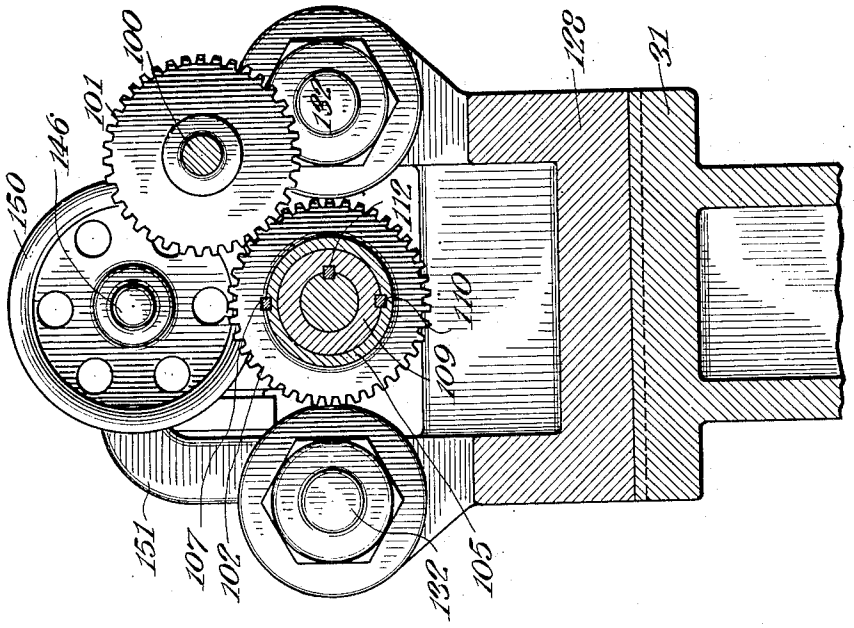
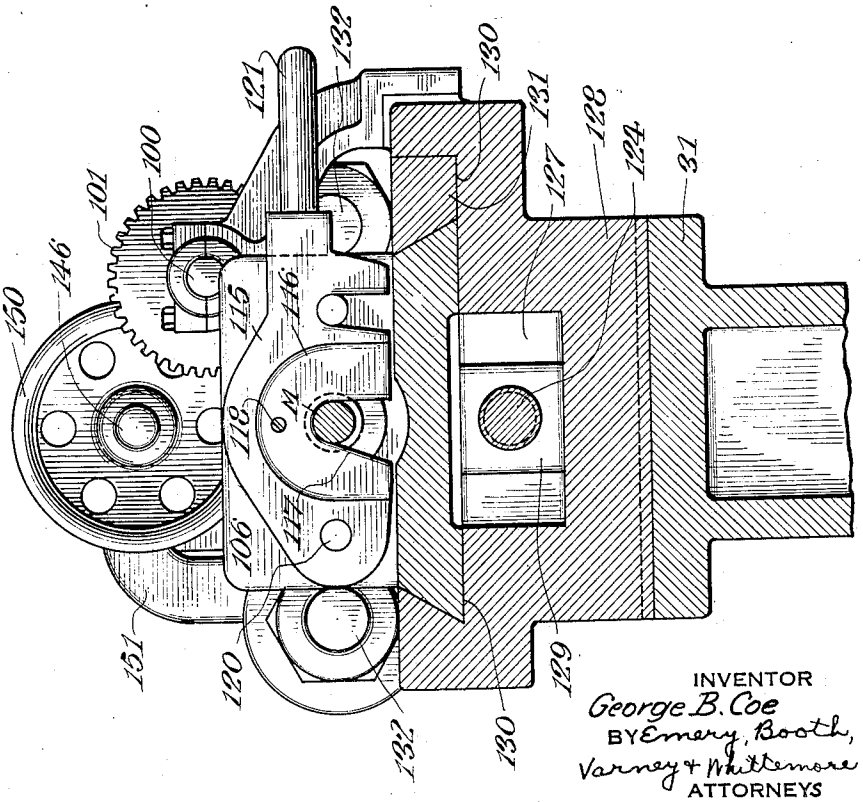


Fig. 17.



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Fig. 21.

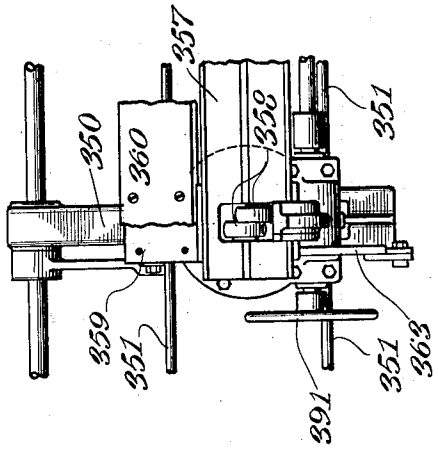


Fig. 20.

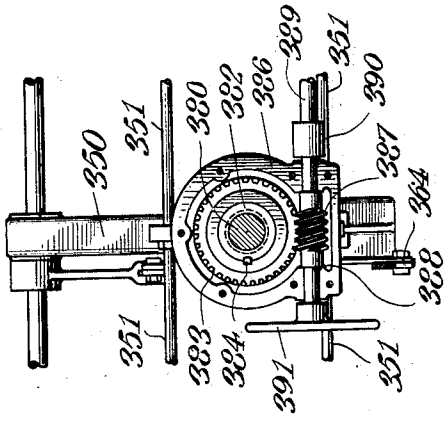
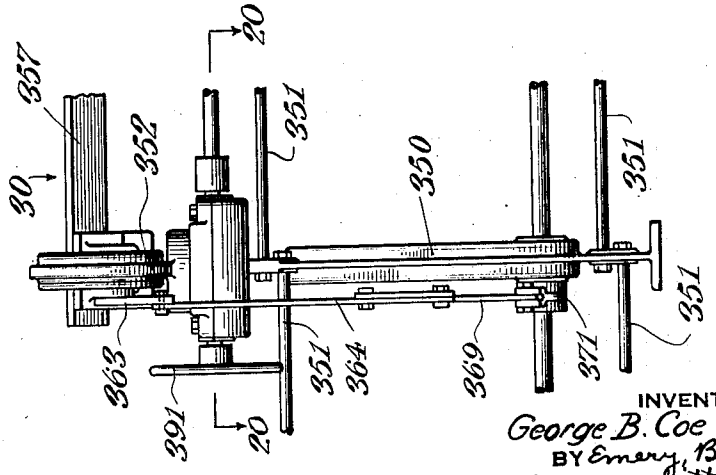


Fig. 19.



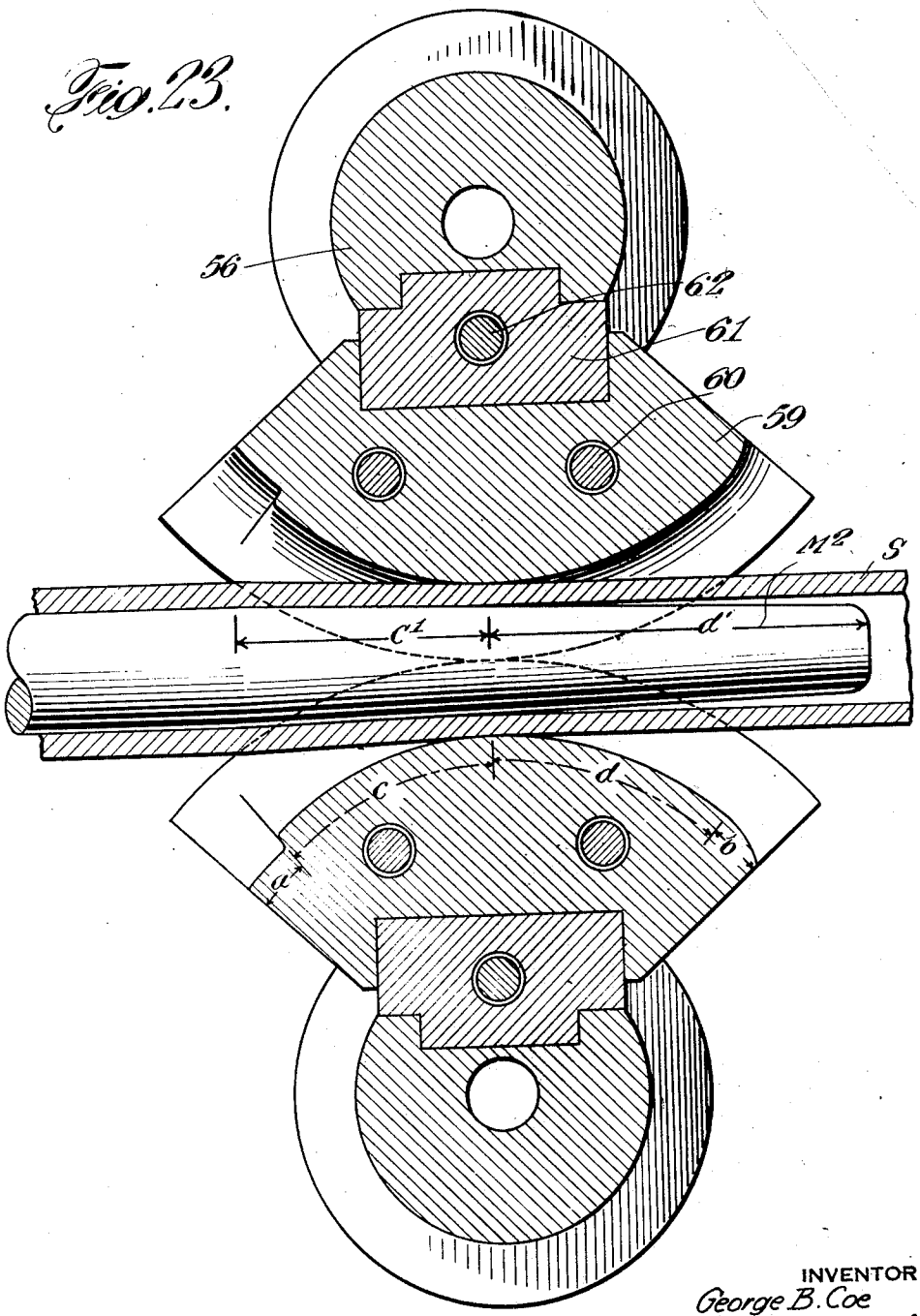
INVENTOR
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METHOD AND APPARATUS FOR WORKING METAL

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Fig. 23.



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Patented Dec. 13, 1932

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UNITED STATES PATENT OFFICE

GEORGE B. COE, OF WATERBURY, CONNECTICUT, ASSIGNOR, BY MESNE ASSIGNMENTS, TO TUBE REDUCING CORPORATION, OF WILMINGTON, DELAWARE, A CORPORATION OF DELAWARE

METHOD AND APPARATUS FOR WORKING METAL

Application filed April 29, 1930. Serial No. 448,222.

The present invention relates to an apparatus for and method of working metal, whereby the cross-sectional area of the metal stock acted upon is reduced with an accompanying elongation of the stock; the object of the invention being to provide apparatus and method whereby the desired results may be accomplished in a practicable and efficient manner without harmful action upon the metal.

The invention may find its most general application to the reduction of hollow or tubular stock and, therefore, a preferred embodiment of the invention particularly adapted to the reduction of tubular stock has been selected for purposes of illustration and description herein.

The present invention is particularly adapted to work metal in a cold state and provides for substantial wall reduction or reduction in size of tubular stock, or both reduction in wall and size, without deleterious effect upon the metal and without resort to frequent annealings.

The apparatus aims to provide smooth and efficient operation thus producing better stock and enhancing the life of the apparatus itself.

More specifically, the objects of the invention are: to improve the tools which act upon the stock as well as the mounting for the tools, whereby they are made stronger, more accurate, and less subject to breakage or misadjustment; to control the movement of the stock by direct action thereon as well as by action upon the stock-supporting mandrel; to provide improved driving gear, insuring balanced and effective action; to provide improved stock guiding mechanism; to provide improved mandrel controlling means which among other things secures longitudinal adjustment of the mandrel for better cooperation with the reducing tools; to provide convenient run-out mechanism for the finished stock; to provide for ready interchangeability or adjustment of parts to accommodate different sizes of stock; to provide a bed which will readily accommodate different types of operating mechanism; and to provide various other desirable constructional and operating features and advantages which will appear hereinafter.

The present invention will be described in connection with a selected illustrative embodiment thereof in apparatus shown in the accompanying drawings wherein:

Fig. 1 is a plan view of the reducing machine proper;

Fig. 1*b* is a continuation of Fig. 1, showing the run-out mechanism;

Fig. 2 is a side elevation of Fig. 1;

Fig. 2*b* is a side elevation of Fig. 1*b*;

Fig. 3 is a central vertical section of the rear end of the machine, part of the length being cut away;

Fig. 3*b* is a continuation of Fig. 3 showing the front end of the machine and part of the run-out mechanism;

Fig. 4 is a front end elevation;

Fig. 5 is a rear end elevation;

Fig. 6 is a transverse section taken on the line 6—6 of Fig. 3*b*, showing the reducing rocker assembly;

Fig. 7 is a horizontal section taken on the line 7—7 of Fig. 6;

Fig. 8 is a side elevation, partly in section showing mechanism near the mid-front of the machine;

Fig. 9 is a corresponding plan view;

Fig. 10 is a horizontal section on the line 10—10 of Fig. 8;

Fig. 11 is a transverse vertical section on the line 11—11 of Fig. 9;

Fig. 12 is a transverse vertical section on the line 12—12 of Fig. 9;

Fig. 13 is a transverse vertical section on the line 13—13 of Fig. 9;

Fig. 14 is a transverse vertical section on the line 14—14 of Fig. 9;

Fig. 15 is a transverse vertical section on the line 15—15 of Fig. 9;

Fig. 16 is a side elevation of the tail stock;

Fig. 17 is a transverse vertical section on the line 17—17 of Fig. 16;

Fig. 18 is a transverse vertical section on the line 18—18 of Fig. 16;

Fig. 19 is an elevation of one unit of the run-out mechanism;

Fig. 20 is a horizontal section on the line 20—20 of Fig. 19;

Fig. 21 is a plan view of Fig. 19;

Fig. 22 is a horizontal section corresponding to Fig. 7 but showing a modified form of rocker; and

Fig. 23 is a similar view showing a preferred type of mandrel.

The apparatus chosen for particular illustration and description herein comprises, as shown in Figs. 1 and 2, the reducing machine proper and, Figs. 1*b* and 2*b*, run-out mechanism 30 especially adapted for use with the reducing machine. The reducing machine comprises a bed 31 which may be built as an integral unit or as an assembled unit of rigid design, reducing mechanism 32, stock feeding and turning mechanism 34, driving mechanism 35, stock guiding mechanism 36, and mandrel holding and turning mechanism 37, sometimes referred to as the tail stock.

Reducing mechanism

The reducing mechanism 32 selected for illustration herein is of the type in which the working tools or reducing devices are mounted in a reciprocatory frame. It is shown in detail in Figs. 3*b*, 6 and 7. Normally the stock S is supported upon a mandrel M.

As shown particularly in Fig. 6 the bed 31 is provided with guideways 40 for the reciprocatory frame or saddle 41. The ways 40 include horizontal supporting portions 40*a* and vertical portions 40*b*. Gibs 42 bear against the vertical portions 40*b* of the ways and upon the inclined surfaces of slides 43 formed on the saddle. The gibs 42 are pulled downward (see the left side of Fig. 6) by cap screws 44 and are limited in their downward adjustment by set screws 45 provided with lock nuts 46. The gibs on opposite sides of the saddle provide adjustment in either direction so that the saddle axis may be placed in the vertical plane of the longitudinal axis of the machine along which the stock moves. This obviates whipping action of the stock which would tend to break the mandrel. The gibs of course also take up for wear.

The saddle is reciprocated by connecting rods 47 connected at each side to the saddle by wrist pins 48. The axes of the wrist pins are in alignment and pass through the longitudinal axis of the machine along which the stock moves. By this arrangement the driving movement is imparted to the saddle in an even manner without undue twist, binding in the ways or whipping of the stock. The connecting rods as shown in Fig. 2 are relatively long so that the angle of movement of the connecting rods caused by the crankpin motion will be relatively small.

The saddle is formed as a single cast box of extremely strong metal in order to limit expansion as much as possible under heavy work. The box comprises sides 41*a*, bottom 41*b* and ends 41*c*, the ends having aligned apertures 41*d* for the passage of stock of the largest size to be reduced. This shape gives great strength and rigidity to the saddle yet leaves the top open for quick access to parts disposed therein.

Bearing blocks 50 placed in suitable guides 51 are adjustable toward and from the longitudinal central axis of the machine by adjusting devices in the form of wedges 52. The wedges are positively moved in either direction by horizontally disposed adjusting screws 53 threaded through the end of the saddle. The screws 53 are turnably secured to the wedges by heads 54 and are locked in adjusted position by lock nuts 55.

Horizontal adjusting wedges lessen the liability of adjusting the reducing devices vertically off the axis of the work. Also, since the wedges and adjusting bolts are aligned with the axis of movement of the saddle there are no projections laterally of the axis of saddle movement and this reduces the likelihood of injuring the operator.

The bearings provide backings for the reducing devices which are directly behind the stock thus avoiding shaft spring which would exist if projecting shafts were employed. The reducing devices employed are broadly of the segmental roll type and more specifically of the oscillating roll or rocker type. This includes either devices which have a small rocking movement or those which have a great rocking movement, say as much as a complete turn (360°). In either case the actual working surface will have a gap of sufficient length to release the stock.

The reducing devices shown in Figures 3*b*, 6 and 7 are of the first type having a limited rocking movement. They comprise journal members 56 provided with horizontal bases 57 carrying radial keys 58 and supporting swaging sectors or rocker dies 59. The rocker dies are thus replaceable for different sizes of stock or other purposes. The dies are held to the horizontal bases 57 by cap bolts 60 threaded into the bases but fitting in oversized holes in the sectors.

A slight adjustment may be given the dies by wedges 61 moved by adjusting screws 62 threaded in the wedges and having shoulders bearing respectively against the bases 57 and cap plates 63. The plates 63 are rigidly retained on the journal members 56 by screws 64. Whereas the wedges 52 adjust the whole rocker assemblies from either side to make them work accurately on the vertical plane through the longitudinal axis of the machine along which the stock moves, the wedges 61 adjust the radial distance from the working faces of the dies to the axis of oscillation so that the effective radius of both dies of the pair (or all of a set, if more than two) will be the same, or a different radius it may be, if desired for any reason.

The entire assembly of mechanism is re

tained within the saddle by plates 65 secured by cap bolts 66. Within the surrounding heavy plates 65 there are thin cover plates 67 retained by thumb screws 68.

Means are provided for controlling the movements of the rockers, the means herein illustrated cooperating with movements of the rocker saddle. As shown in Fig. 6, the journal members 56 are provided with lower extensions 70 passing through oversized holes 71 in the bottom 41*b* of the rocker saddle. The holes 71 are at least sufficiently oversized in a transverse plane to permit the required adjustment of the journal members by the wedges 52.

Secured to these extensions 70 by keys 72 and nuts 73 are meshing gear sectors 74 and 74*b*, the latter being vertically thicker than the former. The sector 74*b*, besides meshing with the other sector 74, also meshes with a fixed gear rack 75 secured by countersunk screws 76 or other appropriate means to the bed 31. The teeth selected are of such a nature as to provide adjustment as to depth of mesh without alteration of the action of the gears.

The upper surface of the saddle bottom 41*b* beneath the moving parts is provided with anti-friction lining 77 and at the hubs is provided with annular rims 78 mating roughly (except that adjustment is permitted) with annular edges 79 on the journal members 56. This construction prevents leakage of liquid or abrasive matter such as scale or grit to the gears. Various grooves 80 are provided on the bottom 41*b* to drain such material to outlet pipes 81 which empty as they reciprocate above a catch basin 82, the basin in the present machine being formed in the bed casting. A drip spout 83 is provided on the front end of the saddle to lead liquid dripping from finished stock back into the saddle chamber.

Coolant system

Means are provided for supplying a coolant fluid to the rocker journals. This coolant may also have lubricating properties and be supplied to the working faces of the rockers. As seen in Fig. 6, the rocker journals 56 are provided with bores 85, in the upper ends of which are secured bushings 86. Leakage around the bushings is prevented by hydraulic packing secured by packing glands 87. Nipples 88 connect the bushings 86 to T-couplings 89. The couplings connect upwardly with supply nipples 90 leading from a supply pipe 91 and laterally with elbow pipes 92 for supplying the fluid to the working faces of the rockers. Within the supply nipples 90 there are tightly fitted long tubes 93 which supply fluid to the bottoms of the journal bores 85. There is an annular space left between the tubes and the surrounding couplings and lower nipples whereby the fluid may flow upward into the lateral elbow pipes 92.

Pipe supports 94 attached to the saddle by cap bolts 95 secure the supply pipe in place.

To accommodate the reciprocating movement of the saddle, the supply pipe 91 is furnished with a relatively long flexible section 91*a* capable of bending and twisting as required.

The supply pipe 91 leads to a pump P (refer to Fig. 1) operated by a pump motor P. M. The piping connections between the supply pipe shown in Fig. 6 and the pump are not shown but obviously may be run as desired. A hand valve 96 controls the flow of fluid.

The spent fluid falls to the bottom of the saddle and flows off by the outlet pipes 81 to the catch pan 82 as already described. From the pan the fluid is returned to the pump in any usual manner, a sump being commonly interposed.

Mandrel holding turning and adjusting mechanism—the tail stock

This mechanism is best shown in Figs. 3, 5, 16, 17 and 18. It is designed to secure accurate turning of the mandrel—and thereby the stock which is squeezed upon it—without over-turning due to inertia when working heavy stock; to provide longitudinal adjustment of the mandrel to secure proper relationship between the mandrel and reducing swages; to hold the mandrel securely in adjusted positions; to permit quick insertion of stock; to allow convenient interchange of mandrels; and to accomplish other important results as will be made apparent.

An intermittently rotated shaft 100 at its rear end carries a gear 101 driving a broad-faced gear 102 fast by a nut 103 against a shoulder 104 upon a sleeve 105 rotatably mounted in the tail piece 106. A key 107 (Fig. 18) may also be used between the gear and sleeve. The sleeve is retained by a head flange 108 working against a shoulder in the bore of the tail piece.

Removably splined to the outer sleeve 105 by a feather 110 is an inner sleeve 109 having a hand-grip flange 111. The inner sleeve 109 integrally carries the feather 110 while the outer sleeve has the corresponding slot. This provides the full opening of the outer sleeve bore for insertion of stock when the inner sleeve is removed. Interiorly the removable sleeve 109 carries an integral feather 112 cooperating with a slot formed longitudinally from the end of the mandrel M. In the present instance the rear end of the mandrel is formed of a separate hardened piece M1 which may be welded to the mandrel for small sizes and screwed to the mandrel, as shown, for large sizes. The front end of the mandrel may likewise be formed of a

special hardened piece to cooperate with the reducing devices.

The means provided for holding the mandrel against longitudinal movement comprises a latch 115 carrying a removable holding block 116 provided with an edge slot 117 rotatably engaging the mandrel in an annular groove. The removable block provides ready adjustment in a small hardened piece of metal for different mandrel sizes, avoiding the expense and trouble of changing the entire latch. The block is held in the latch by side and top splines and a screw 118.

The latch closely fits within the space between the body of the tail piece 106 and the integral upstanding brackets 119 so as to be securely held against longitudinal movement. The latch is pivoted at one end by a pivot pin 120 and at its other end carries a handle 121 convenient for the operator.

Usually the mandrel will have some taper in the region of the reducing devices. If the action of the rockers and the size of the finished stock are to be good, it is desirable to maintain a definite positional relationship between the mandrel and the reducing devices. To state the matter another way, there must be no longitudinal shifting of the mandrel and devices relative to each other, so that for each action the same point of the reducing devices will fall above the same point of the mandrel. In order to establish or maintain whatever relationship may prove desirable between the reducing devices and the mandrel, means are provided to give them a longitudinal adjustment relative to each other. In the present instance the mandrel is the part which is adjusted and this adjustment is effected by moving the part or parts which hold it longitudinally, that is to say, by longitudinal adjustment of the latch or latches and the mounting therefor.

As shown in Figure 3, the tail piece 106 is provided with a depending bracket 122 having a central notch 123 (Fig. 5) open at its lower end to receive an adjusting screw 124. The adjusting screw is provided with an annular groove formed by spaced collars 125 which engage the bracket on its opposite sides. The screw passes with a close turning fit through aligned apertures 126 of spaced upstanding brackets 127 formed on the tail stock base 128. The base 128 is bolted or otherwise secured to the bed 31. The screw is threaded through a nut 129 closely fitting between the brackets, the nut being insertable laterally into the recess between the brackets and being held from rotation by having a flat side engaging the bottom or sides of the recess. By this arrangement the mandrel may be positively moved longitudinally in either direction and securely held in adjusted positions. The tail piece (Fig. 17) moves along guides 130 and is retained by an adjustable gib 131. The gear 102 on the mandrel sleeve is sufficiently broad to remain in mesh with its driving gear 101 in all adjusted positions of the tail piece. The tail stock is connected to the front portion of the bed by heavy tie rods 132.

Stock and mandrel guide mechanism

Means are provided for guiding and supporting the stock and mandrel between the tail stock and the feeding mechanism. Preferably this means will take care of all sizes of stock which the machine is designed to handle. Figures 1, 2, 3 and 16 illustrate this mechanism to best advantage.

The immediate guide means comprises a plurality of sets or pairs of grooved guide rollers 135 mounted upon journals 136 secured at each end in the tiltable frames 137. Each of these frames 137 is mounted upon aligned stub shafts 138 having bearings in the sides of a branching arch member 139 secured to the tie rods 132 by caps 140 and bolts 141. The common axis of the aligned stub shafts 138 passes through the longitudinal axis of the stock and mandrel so that the grooved rollers during adjustment move equally from and toward the longitudinal axis. Thus, no matter what the size of the stock its axis will always fall at the same place.

The tiltable frames 137 at each side carry tabs 142 provided with exterior actuating studs 143. The studs are engaged by slots 144 formed in the lower ends of an adjusting yoke 145 carried upon an adjusting rod 146 between set collars 147.

The adjusting rod 146 is guided by bushed bores 148 formed in the arch members 139. The arch members also have other bushed bores providing bearings for the mandrel turning shaft 100. At its rear end the adjusting rod is threaded in a hand adjusting wheel 150 rotatably mounted in an arch member 151 secured to the base frame. The hand wheel is retained in its bearing by a nut 152.

A drip pan 153 extending from the tail stock forward is secured beneath the mandrel by straps 154 suspended from the rods 132. This is desirable because the tubular stock in normally coated both inside and outside by a lubricant before insertion in the machine.

Stock feeding mechanism

An explanation has already been given of the reducing mechanism or rockers, the mechanism for holding and turning the mandrel and permitting quick introduction of stock, and the stock guiding means. In the beginning it was explained that the present machine was of that class in which the stock is fed forward and reduced in successive increments. Now there will be described exemplary mechanism for feeding the stock. The present selected feeding mechanism may

be referred to as the "mechanical" type since all parts are directly actuated by mechanical gearing from other moving parts of the machine as distinguished from being driven electrically, hydraulically, pneumatically or otherwise in whole or in part and merely being timed mechanically.

This mechanism is best shown in Figs. 1, 2, 3*b*, and 8 to 15 inclusive. Referring to Figs. 3*b*, 9 and 10, interiorly roughened mating jaws 160 are slidably mounted in a feed frame 161 as by being splined (Fig. 13) to rearwardly convergent guides 162 formed on the frame. The jaws are normally pressed forward to stand open by a coil spring 163 disposed within a bore in the frame 161 and acting upon the jaws through an annular thrust ring 164, the spring and ring being sufficiently large to permit passage therethrough of the largest sizes of stock taken by the machine.

The action of the feed mechanism provides that the feed jaws 160 are first pressed rearwardly to converge so as to grip the stock and subsequently the feed frame 161 is moved forward together with the jaws to feed the stock by a given increment of length along the mandrel. The forward movement of the frame serves to grip the jaws more firmly upon the stock due to the convergent jaw guide surfaces. At the same time, however, the jaws are resiliently urged rearwardly to insure their closing. Both the closing of the jaws and the feeding forward are here accomplished by mechanical means—and in the preferred embodiment illustrated, by the rocker saddle as it approaches the rear end of its stroke, but the gripping by the jaws and the feeding are accomplished independently. The gripping mechanism will be described first.

Gripping means

The jaws (Fig. 3*b*) are engaged on their front ends by round-ended arms 166 loose on a grip shaft 167 mounted (Fig. 13) in suitable bearing brackets 168 carried by the fixed frame in which the feed frame 161 is mounted. Slidable pins 169 passing through arms 166 at the hub thereof selectively engage one of a plurality of notches in locking plates 170 loose on the hub 171 of the arms 166. One end of a torsion spring 172 is secured to each of the plates 170 as by having its end bent and hooked into a notch thereof. The other ends of the torsion springs may be secured in a similar manner to the hubs 173 of plunger arms 174 also loosely mounted on the shaft 167. As seen at the right of Fig. 13 the hubs 171 and 173 are provided on their adjacent ends with mating teeth 175 but considerable circumferential space is left between them. This limits the action of the arms 166 on the jaws so they will not always be urged into gripping position.

The ends of the plunger arms 174 are provided with under-cut slots 176 receiving slide blocks 177 carrying (Fig. 9) the round headed ends of grip plunger rods 178. These plunger rods 178 are slidably mounted in bores in a slidable cross-head 180.

The front ends of the plunger rods 178 are engaged by extensions of hardened striker plates 181 carried by extended portions of the saddle 41, these extended portions being the same as those to which the main connecting rods 47 are attached.

As seen in Fig. 13, the jaws 160 are retained within the feed frame 161 by a cover plate 182 and bolts 183. This provides easy removal of the jaws. The cover has side flanges to prevent spreading of the frame.

Feeding means

Referring to Fig. 13, the feed frame 161 is slidably mounted in a fixed frame 184. It is held down by retaining plates 185 and bolts 186. The feed frame is constantly urged toward its rearward position and the cross-head 180 is constantly urged toward its forward position by coil springs 187 having one end disposed within a bore 189 in the frame and the other end engaging the flange of guide pins 190 embraced by the springs and held in a socket formed in the cross-head.

The cross-head is cushioned in its movements, as shown in Figs. 9 and 10, by dash pot pistons 191 operating with a close sucking fit within bores in the cross-head which are supplied with fluid such as oil. The pistons 191 at their front ends are connected by a head-and-slot joint with studs 192 secured in the front portion of the fixed frame 184.

The feed frame 161 is moved forward in equalized manner by symmetrically arranged rocker levers 194 mounted upon bearing journals 195 secured in the fixed frame 184. The opposite ends of the levers 194 are actuated by the hardened slotted heads 196 of feed plungers 197 slidably mounted in bores of the fixed frame 184. The plungers are retained (Fig. 9) by cover plates 198 which also form part of the support for the journals 195. The feed frame 161 is limited in its rearward movement by the heads of the plungers 197 engaging hardened stop washers 199 located at the rear ends of the bores for the plungers.

The plungers 197 are operated by adjustable cross-head pins 201 threaded in sleeves 202. For adjusting, the sleeves 202 are rotated by worm gears 203 fast thereon by keys 204 and the cross-head pins 201 are prevented from turning by a keyed plate 205 bolted to the cross-head. The sleeves 202 are retained by the plates 205 just mentioned and flanged striker heads 206 bolted to the cross-head.

As shown in Figs. 8 and 9, the worm gears 203 are rotated to adjust both pins 201 simultaneously by worms 207 fast on a shaft 208

carried in clamp bearings 209. Hand wheels 210 permit adjustment by the operator from either side of the machine.

The adjustment regulates the amount of feed of stock. It is to be noted that the striker plates 181 always engage the striker heads 206 when the saddle has reached the same given point on its return stroke. The clamping also occurs when the saddle is in a given position but before the feeding begins. Fig. 10 shows the position of parts after the clamping has been effected but before the feeding has been started. In this case the cross-head pins are adjusted for small feed and the cross-head must travel some distance before the pins 201 engage the plunger, but for maximum feed the pins 201 would be run out so that feeding would begin at once.

The cross-head (Fig. 12) is provided with slides 211 operating on guides formed on the fixed frame and is retained by a gib 212 which is adjustable to take up for wear.

The operation of the clamp and feed mechanism will be obvious from the above description. The mechanism provides independent clamping and feeding whereby the size of stock clamped does not affect the amount of feed.

Cross-head latch mechanism

It is desirable to hold the stock after it has been fed forward until the reducing devices have started to work on it. This is especially so when a new length of stock is started, since the reducing devices may tend to kick the stock rearwardly. This tendency is more pronounced if the taper of the reducing devices is great or if they are not flared in cross section. Other conditions may also have a bearing on the tendency to kick back. The present invention embodies means for thus holding the stock and herein these means are associated with the stock gripping and feeding means.

As shown in Figs. 3*b* and 12, a latch 215 engages a depending notched plate 216 on the cross-head when the latter reaches its rearmost position, the latch being mounted within a barrel 217 formed on the fixed frame and being constantly urged upward by a coil spring 218.

Means are provided for releasing the latch after the reducing devices have started action upon the stock, i. e. in the present apparatus, after the rocker saddle has moved forward a predetermined distance. This means as illustrated comprises a latch release arm 220 having a rounded end engaging a transverse slot 221 formed in the latch 215 to move it down against its spring. When released the cross-head moves forward by the action of parts already described to release the stock.

The release arm is formed integral with a clutch sleeve 222 loosely mounted upon a release shaft 223. As shown in Fig. 3*b*, this sleeve 222 carries teeth adapted to mesh with teeth on a mating slidable clutch sleeve 224 splined to the shaft 223. The sleeve 224 has an annular groove engaging a shift fork 225 fast on a fork shaft 226.

The shaft 226 may be turned from either side of the machine (Fig. 13) by shift handles 227, 228, the first of which 227 seen at the right of Fig. 13, carrying a spring pressed detent 229 engaging notches in a fixed sector 230 and the latter 228 carrying (see also Figs. 8 and 9) a turn-stop rod 231 for rendering inoperative the stock and mandrel turning drive mechanism to be described presently.

The relsase shaft 223 is operated in timed relation with the reciprocation of the rocker saddle (Fig. 3*b*) by a rotary cam 232, the shaft having a rigid arm 233 carrying a cam follower 234 operating in the face groove 235 (Fig. 14) of the cam. The cam is rigidly mounted (Fig. 9) upon the front end of a Geneva arm shaft 236 to be described presently.

Stock turning mechanism.

Means are provided for turning the stock independently of the turning of the mandrel but in coordination with the mandrel turning. The illustrative embodiment of these means is shown in Figs. 3*b* and 8 to 13 inclusive.

In Figs. 3*b*, 10 and 11, turning jaws 240 lined with friction gripping material 241, for example, leather, are arranged on opposite sides of the stock. They are held open by coil springs disposed in sockets upon dowel pins 243. The jaws are retained by shoulders in a rotary housing 244 and by an annular plate 245 bolted to the front of the housing.

The housing is mounted in the fixed frame by a ball bearing assembly 246 at its front end, the bearing assembly providing rotation of the housing but resisting endwise movement.

Clamp operating linkage

The jaws are clamped upon the stock at proper times by jaw clamp levers 248 mounted upon pivots 249 secured in the rotary housing. There are four of these levers. They have cam shaped ends engaging flanges formed on the jaws. They act in equalized manner on opposite sides of the stock axis to avoid lateral displacement of the stock and mandrel.

The outer ends of the levers 248 carry rollers 251 engaged by a hardened annular clamp plate 252 firmly secured to the front end of a push sleeve 253 splined to the rotary housing. The push sleeve is secured by a ball bearing assembly 254 within a slidable but non-rotatable actuating sleeve 255. The push sleeve can rotate within the actuating sleeve but is not free to slide endwise relative thereto. Both sleeves, however, may slide relative to the rotatable housing and the fixed frame.

In Fig. 3b guide surfaces 256 are shown on the fixed frame for sliding movement of the sleeve 255. A key 257 prevents rotation of the sleeve.

The actuating sleeve 255 (Fig. 10) is connected by stud pins 258 to thrust links 259 pivoted to thrust arms 260 secured (Fig. 3b) to a thrust shaft 261. As shown in Figs. 8 and 10, the thrust shaft 261 is provided with a rigid socket arm 262 operated by a ball-ended arm 263 fast on a shaft 264. The shaft has another fast arm 265 pivotally connected to a thrust rod 266 which is pivotally connected at its other end (Fig. 9 also) to an arm 270 fast on a transverse clutch shaft 271.

The rod 266 is provided with a telescopic thrust joint 267 including a heavy coil spring 268. This provides resilient gripping of stock even if it has variations in size. The jaws will be changed for different sizes of stock, this being readily effected because of the convenient assembly.

The clutch shaft 271 has splined thereto a slidable toothed clutch sleeve 272 operated by a clutch lever 273 pivoted upon a pin carried by a boss 274 of the fixed frame. The lever has a shift fork 275 engaging an annular groove in the sleeve 272 and at its upper end is provided with a spring pressed detent 276 holding the lever in set positions. The clutch shaft 271 also carries a mating toothed sleeve 277 which is rotatable but not slidable on the shaft.

The sleeve 277 is provided with an integral socket arm 278 operated by a ball-ended arm 279 fast on a short shaft 280. The lever 280 at its other end carries a cam follower lever 281 provided with a cam follower 282 operating within the groove 283 of a turn-clamp cam 284 fast on the main crank shaft 285 of the machine. The shape and disposition of the cam groove 283 are shown in Fig. 8. It has only a short raised portion 283a for clamping, for the clamping and turning are accomplished in a very short period of time when the saddle is at one end of its stroke—the opposite end from that shown in the drawings according to the present preferred cycle of operation.

It will be seen that the jaw clamp linkage for the turning mechanism is so designed as to put all parts under thrust when clamping the jaws, thus avoiding loose motion and improper operation.

Housing turning gear

As shown in Fig. 10, the rear end of the housing 244 is provided with a gear 290 fast thereon. This gear (Fig. 8) meshes with and is driven by a gear 291 fast on a longitudinal shaft 292 mounted at its front end in a bearing bracket 293 and at its rear end in a bearing in the upper part of a gear casing 295.

Inside the gear casing 295 the shaft 292 is provided with a rigid gear 296 meshing with an intermediate gear 297 which is driven by a gear 298 fast on the shaft 100 previously noted for driving the mandrel turning devices at the tail stock.

On its portion extending outside the front of gear casing 295 the shaft 100 carries a loose gear 299 having a toothed hub cooperating with a similarly toothed clutch sleeve 300 splined to the shaft 100 and retained by a set collar 301. The clutch sleeve is operated by a shift fork 302 slidably mounted on a fixed stud 303, the fork at one end engaging an annular groove in the sleeve and at the other end being attached to the turn-stop rod 231 previously described.

By this system of gearing the stock will be turned in synchronism with and in the same direction as the mandrel and the turning for both may be discontinued whenever the stock is kept clamped by the stock feeding mechanism.

Means are provided for turning the stock and mandrel in synchronism with the saddle movements and the operation of the feeding mechanism. These means provide quick operation when the reducing devices are released from the stock and is designed to turn the stock and mandrel through any desired angle. Such turn as is given begins and ends gradually and stops the stock definitely in the intended position.

As shown in Figs. 8 and 14, the loose gear 299 on shaft 100 is driven by an idler gear 306 which in turn is driven by a gear 307 fast on a Geneva disc shaft 308. The gears 299, 306 and 307 may all be readily removed off the front ends of their shafts and replaced by others to provide different degrees of turning.

The Geneva disc shaft 308 carries fast thereon (Fig. 15) the Geneva disc 309 having a sufficient number of radial slots 310 and arcuate notches 311 to provide smooth movement. As shown, there are six slots and a corresponding number of notches cooperating respectively with a pin 312 and an arcuate hub 313 of a Geneva arm 314 on the Geneva arm shaft 236 previously mentioned.

At its rear end (Fig. 9) the Geneva arm shaft 236 carries a bevel gear 315 driven by a bevel gear 316 on an eccentric gear shaft 317. An eccentric gear 318 on shaft 317 is driven by a mating eccentric gear 319 on the main crank shaft 285.

These eccentric gears provide fast movement at times and slow movement at other times while the Geneva gear provides periods of movement and others of complete rest. The combined action of the eccentric gears and Geneva gear provides the proper turning action.

Main drive

The main crank shaft 285 carries a pair

of drive gears 325 provided with crank pins 326 for the main connecting rods 47. This permits the crank shaft to be disposed well up toward the stock so as to impart the driving force to the saddle as nearly as possible in line with its movement. The crank shaft is mounted in bearings 327 split on an angle from the horizontal to place the thrust well within the linings of the bearings rather than in the split portions. The crank shaft is balanced as by balance weights 328 secured to the gears 325 to avoid vibration.

Referring to Figs. 1, 2 and 3, the gears 325 are driven by pinions 329 on a counter shaft 330. The shaft 330 carries a large gear 331 driven by a pinion 332 of the shaft 333 of a main drive motor D. M. The motor and its controls provides for inching the machine, i. e., moving it in small amounts at a time so that it may be stopped or started from any position. Guards 334 are provided to shield the gears, connecting rods and related moving parts.

Referring to Figs. 3*b* and 14, the stock may be supported upon the gear casing 295 by a support roller 337 provided with journals 338 carried in a slide 339 movable in vertical guides 340. The slide is adjusted for different sizes of stock by a screw 341 threaded in the slide and turnably supported by a head in a hole formed in a bracket 342 formed on the gear casing. If desired the saddle may carry a similar adjustable stock support.

Run out mechanism

The present machine is designed to handle long lengths of stock. Often the ratio of reduction between original and finished stock is great so that the finished stock emerges in much longer lengths. In any case it is desirable to provide means to receive the stock as it is finished to hold it straight, to avoid whipping which would be injurious to the stock and the reducing apparatus, and to discharge the stock properly when it is finished. A preferred form of such apparatus is illustrated in Figs. 1*b*, 2*b*, 3*b*, 4, 19, 20 and 21.

A plurality of spaced stands 350 are secured to a suitable base, either the floor or some structure resting on the floor. Only a few stands are shown in Figs. 1*b*, 2*b* and 3*b* but it will be understood that as many will be provided as necessary. The stands are held together in spaced relation by tie rods 351.

The stands are surmounted by guide heads 352 provided with cut away circular guide segments 353 receiving circular dump segments 354. These segments 354 provide V-shaped notches opening upward for receiving and guiding the stock. A flange 355 and bolts 356 hold each dump segment 354 for oscillation on the guide segment 353.

The dump sectors support a V-shaped run out trough 357 providing a continuous smooth run way for the stock. Guide rollers 358 having rounded surfaces extend slightly above the surface of the trough for facilitating turning movement of the stock entailed by the reducing apparatus. The rollers are mounted on journals on the dump sectors 354 within gaps left in the trough 357.

Discharge brackets 359 are formed on the heads 353. They are inclined and register with one side of the V-notch of the dump sectors when turned to dumping position so the stock will roll off. If desired a running board 360 may be secured to the brackets 359. For clarity of the drawings this board 360 is shown only at the right of Fig. 1*b*.

Normally the sectors 354 may stand with the V-notch upward as shown in Fig. 4 but means are provided for turning them to dump the stock. This comprises a sector arm 363 secured to each sector, a sector link 364 connected to the arm 363 by a pivot pin 365, a sector lever 366 connected to the link 364 by a pivot pin 367 and journaled to the stand upon a pin 368, a lower sector link 369 connected to the lever 366 by a pivot pin 370, an arm 371 connected to each lower sector link 369 by a pivot pin 372, a common longitudinal treadle shaft 373 carrying all of the arms 371, the shaft being mounted in bearings 374 on the stands and bearings 375 on the main bed 31, and a foot treadle 376 secured to the shaft 373.

The foot treadle 376 may be placed on either side of the machine depending on which is more convenient for the operator, the bed being provided with properly located anchors for bearings 375 for this purpose. To change over it is necessary to assemble the stands in reverse position.

For stock of different outside diameters the run-out heads 352 should be shifted up or down correspondingly. The details of the head mounting for accomplishing this are shown in Figs. 3*b* and 20.

The head is provided with a threaded column 380 fitting tightly within a bore of the head and secured therein by anchor pins 381. A nut 382 is threaded on the column and is mounted within a ring gear 383, a key 384 being used to prevent rotation between nut and gear. The ring gear is held down by an annular cap 385 bolted to the casing 386 formed on the stand.

The ring gear is actuated by a worm gear 387 mounted on stub journals 388 extending outside the casing 386. Shoulders on the worm prevent axial movement within the casing. In order to raise and lower all of the heads simultaneously, the worm journals 388 are all connected together by shaft sections 389 and couplings 390 to turn as a unit. A hand wheel 391 secured to one of the journals 388 nearest the operator's station provides convenient control.

Modified rockers

Fig. 22 illustrates reducing rockers 59′ of small diameter but with a working groove extending substantially around the complete circumference. The stroke of saddle 41 serves to impart practically a complete rotation to the rockers at each reciprocation. The rockers 59′ are held as in other cases for proper coordination by a rack and are mounted in bearing blocks 50′ slidable in guides 51′ formed on the saddle. All other parts are the same as previously described and the same reference numerals are employed. The modified rockers and bearing blocks may be substituted in the saddle for those shown in Fig. 7.

Mandrel

The breakage of mandrels is a matter of considerable importance in this art. Special metals which are very expensive are required and the breakage which heretofore has been frequent causes annoyance and loss of time. In the present apparatus the parts cooperating with the mandrel have been designed especially with a view to minimizing mandrel breakage. Further, the working portion of the mandrel which must be of superior metal is arranged to be welded or otherwise attached to the non-working portion so as to be readily replaceable and less expensive.

But with all these precautions mandrel breakage is still considerable with ordinary mandrel shapes. The present invention provides a mandrel of an improved working shape which has much less tendency to break and which actually gives an improved action in cooperation with the rockers.

Referring to Fig. 23, the above-described rocker assembly is shown, including the rocker journals 56, adjusting wedges 61, adjusting screws 62, rocker dies 59, and securing bolts 60. The die grooves include enlarged portions *a* and *b* at each end to permit release of the stock for feeding and turning, an eccentric portion *c* and a concentric portion *d*.

The mandrel M2 is tapered to correspond with the eccentric portion of the rockers as in the length *c′*, or if greater reduction in wall thickness is desired this portion of the mandrel may be made substantially straight but nevertheless large enough to cooperate with the rockers to effect reduction of the stock. Practically, this portion of the mandrel will always have at least a very small amount of taper to facilitate stripping the stock from the mandrel.

The part *d′* of the mandrel beyond the portion *c′* to the end is made of smaller diameter than the stock will be when acted upon by the portions *d* of the rockers. Effectively the mandrel terminates at the end of the portion *c′* but the portion *d′* is added to avoid having a sharp edge at the end of the mandrel which would produce concentric grooves inside the stock.

The part *d′* may have the same taper as the part *c′* or any other convenient taper desired.

Ordinarily the mandrel is given considerable taper beneath the eccentric portions of the rockers so as to permit free and unobstructed forward flow of the metal. This avoids excessive strains on the machine and heavy wear on the mandrel and rocker grooves. If the mandrel were straight following the tapered portion *c′* the metal would be squeezed thereupon, so as to resist forward flow. Also the metal would flow down the slope and wear an annular groove at the foot of the slope thus rendering forward flow still more difficult. Particularly when cold-working metal, is it desirable to employ this mandrel because cold metal is only slightly plastic and will not flow away readily along a mandrel without taper, and cold metal when dammed against flow imposes unusually high strains upon the apparatus.

Operation

Preferably the machine is operated so as first to effect a reduction in the presence of or accompanied by an increment of feed of the stock and subsequently to effect a consolidation of the stock out of the presence of or unaccompanied by an increment of feed. By consolidation is meant the smoothing up of the stock, rounding up of the stock, loosening the stock from the mandrel, and rearrangement of the structure of the metal of the stock or any of these results alone or in any combination.

In the present machine these results may be accomplished by the following preferred cycle of operation. Starting from the position of parts shown in the drawings, the stock is first fed forward relative to the mandrel by a given increment of length but without rotation; next, a reducing stroke is effected by moving the saddle forward; next, when the saddle is at the forward ends of its stroke and the stock has been freed from the rockers the stock is turned by the desired amount but without an increment of feed; and finally the consolidating stroke is effected by moving the saddle rearward. Of course some reduction may be effected on the consolidating stroke but it is slight and will cause no confusion in the stroke designations used above.

The turning will be sufficient to bring that portion of the stock which received the slightest action of the rockers into a position where it will receive a greater action, it being borne in mind that the bottoms of the grooves in the planes of the rockers exert a greater reduction than the edges of the rockers in a plane transverse to the rocker plane. With the illustrated gearing this turning is 60°. This has been found to give somewhat better re-

sults than turning 90° as is usual when two rockers are used in a set. The metal seems to be crowded around in a circumferential direction more easily by turning 60° and since the rockers work several times upon any given point on the stock before it passes from them, the final rounding and smoothing action is as satisfactory as when turning 90°. The angle of turning, however, may as explained be readily changed by interchanging the removable gears 299, 306, 307.

If desirable a lubricant may be used between the stock and mandrel to assist longitudinal slippage. This will not affect turning of the stock with the mandrel because of the provision of turning mechanism acting both upon the stock and the mandrel and further because at the time of turning the stock is squeezed down upon the mandrel and tends to turn with it because of friction.

The operation of the various parts of this particular machine acting according to the preferred cycle will be explained in order to furnish a better understanding of the same but without any implied limitations upon either the possible forms of mechanism or cycle.

Supposing the machine to be inoperative, one or more lengths of stock is fed through the tail stock upon the mandrel M, the latch 115 (Fig. 3) being raised and the hand sleeve 109 being removed off the end of the mandrel to permit of the introduction of the stock. After the stock has been fed in the sleeve 109 is replaced and the latch 115 is dropped back into the notch of the mandrel. The sleeve then connects the mandrel with the turning mechanism driven (Figs. 14, 15, 16) through shaft 100 and the associated Geneva gear 309, 314, 307, 306 and clutch 300.

The stock guiding rollers 135 (Figs. 3 and 16) may already be adjusted for the size of stock which is fed but if not, the hand wheel 150 is turned to swing the roller frames 137 about their pivot pins 138 so as to cause the rollers to assume the desired position.

The stock is run up along the mandrel until the front end enters the gripping jaws 160, it being assumed that the jaws are open. This may be at a time when the rocker saddle is approaching the rear end of its stroke but before it has started acting upon the feed jaws. The stock is pushed through the open jaws at this time until the end comes adjacent the rockers.

As the rocker saddle continues its rearward movement (Fig. 9) the hardened striker plates 181 come against the plunger rods 178 and (Fig. 10) acting through the plunger arms 174, shaft 167, and jaw-engaging arms 166 cause the jaws to move rearwardly in their inclined guides 161 to close the jaws upon the stock. After the jaws have been closed, any further rearward movement of the rocker saddle is absorbed in the springs 172 coiled upon the shaft 167.

When the jaws have been clamped the plates 181 come against the striker heads 206 of the slidable cross-head 180 and move it rearwardly thereby causing the cross-head pins 201 to actuate the feed plungers 197 to move the feed frame 161 and jaws forward. The stock moves forward with the jaws but the mandrel does not partake of this forward movement. The stock thereby is fed in between the rockers for they have opened at this time to receive it.

The crosshead (Fig. 35) when moved rearwardly is engaged and held by the crosshead latch 215.

Of course, if the crosshead latch has not been released from the previous operation there will be no movement of the crosshead and jaw frame and hence no feed of the stock. This will occur when the clutch 222, 224 has been disengaged through action of the fork 225 on shaft 226 by (Fig. 9) manual shift levers 227 or 228. If the jaws have been left closed it will be necessary that the stock turning mechanism both for the mandrel and the stock itself be disconnected. This is accomplished (Fig. 9) by the interlocked mechanism including the rod 231 and shift fork 302 for disengaging the clutch 300 which controls the turning mechanism. The stock is always thus held against feeding when new stock is being introduced if the machine is left running since otherwise the mandrel will be moved longitudinally out of correct position.

But reverting to the normal cycle of operations, when the stock is fed forward (and at this time no turning occurs) the rocker saddle reverses its direction of movement and the rockers bite into the stock and begin to reduce it. Shortly after this bite has occurred and there is assurance that further action of the rockers will not push the stock backwards out of their grooves, the cross head latch is released—(Fig. 12) arm 220, shaft 223 (Fig. 14) cam 232, shaft 236, (Fig. 9) bevel gears 315, 316, shaft 317, eccentric gears 318, 319 and the main shaft 285—and the crosshead moves forward and the jaw frame moves backward under the mutual action (Fig. 10) of the springs 187. The jaw clamping mechanism is released when the saddle moves forward but if the jaw frame is not released the jaws will still grip the stock.

When the rocker saddle approaches the front end of its stroke the turn-grip mechanism (Fig. 10) begins to act upon the jaws 240—levers 248, push sleeve 253, links 259, thrust arms 260, (Fig. 8) shaft 261, arm 262, arm 263, shaft 264, arm 265, rod 266, arm 270, shaft 271, clutch 272, 277, arm 278, arm 279, shaft 280, cam ram 281 and cam 284—to grip the stock. In case it is not desired to grip the stock itself but to rely upon turning the

stock by turning the mandrel, the clutch 272, 277 is disengaged by the hand lever 273.

After the rocker saddle has reached the front end of its stroke and the rockers have released the stock and mandrel are turned quickly by the eccentric gear and Geneva gear mechanisms, the connections for the stock turning mechanism being clearly shown in Fig. 3*b* to comprise the driven gear 296, shaft 292, gear 291 thereon and the gear 290 on the rotary housing 244 upon which the clamp levers 248 are mounted.

No feeding of the stock occurs at the forward end of the stroke, though obviously it might if the stock gripping and turning mechanism were not operated.

Upon the return stroke of the rocker saddle consolidation occurs as previously stated and the cycle is completed ready for feed to occur again.

While one specific embodiment of the invention has been described in detail it is to be understood that various modifications and changes are permissible within the spirit of the invention as set forth in the following claims.

What I claim is:

1. Apparatus for reducing tubular stock comprising, means for intermittently working upon and releasing said stock, means for turning said stock at times when released from said working means, intermittent gripping means for feeding said stock forward at other times and means for holding said stock forward by said gripping means after it has been fed forward and means for causing said gripping means to release the stock before the turning means is rendered active.

2. Mechanism for reducing solid or tubular stock by intermittently acting swaging devices relative to which the stock is fed longitudinally in successive increments, and in which the swaging devices act successively upon the stock with an accompanying increment of feed to reduce it and in which means is provided for intermittently consolidating the stock without an accompanying increment of feed, and characterized by this: that means are provided for holding the stock against retrograde movement during the reducing action on the stock together with means for releasing it before the consolidating action begins.

3. The method of reducing stock by intermittently acting swaging devices relative to which the stock is fed longitudinally in successive increments which comprises acting successively upon the stock with an accompanying increment of feed to reduce it, holding the stock for a part of the time it is being reduced and then releasing it, and subsequently consolidating the stock without an increment of feed.

4. In apparatus for reducing tubular stock by an intermittent action thereon, in combination, a rotary mandrel for supporting the stock, reducing dies mounted and operated so as to have a normal definite longitudinal relationship to said mandrel, and means for adjusting said mandrel longitudinally to change said relationship, said means including a tail stock having means to hold said mandrel against longitudinal movement relative thereto, and means for adjusting said mandrel longitudinally.

5. In apparatus for reducing tubular stock by an intermittent action thereon, in combination, a rotary mandrel for supporting the stock, reducing dies mounted and operated so as to have a normal definite longitudinal relationship to said mandrel, and means for adjusting said mandrel longitudinally to change said relationship.

6. In apparatus for reducing tubular stock in combination, reducing means, a stock supporting mandrel, and means for holding said mandrel against longitudinal movement including a member positioned near an annular groove in the mandrel and a hardened interchangeable wear member secured to said holding member for directly engaging the groove in the mandrel, said members being mounted for releasably engaging said mandrel to permit stock to be passed thereover.

7. In apparatus for reducing tubular stock by an intermittent action thereon, in combination, a mandrel supporting the stock, reducing means intermittently acting upon and releasing the stock, and means for rotating the mandrel, including a removable sleeve splined to the mandrel, a gear sleeve splined to said removable sleeve, and means for rotating said gear sleeve in one direction with initial accelerated and final decelerated movement during the time the stock is released from said reducing means.

8. In apparatus for reducing tubular stock in combination, an intermittently acting swaging die provided with a conico-cylindrical groove and a mandrel associated therewith provided with a conical taper coinciding generally with the conical portion of the die groove, and terminating for effective action approximately at the end of the conical portion of said die, the apparatus producing straight tubing.

9. Apparatus as set forth in claim 8 in which the mandrel is continued in length beyond the end of the conical portion of the die but being of a size too small to cooperate with the succeeding portion of the die to prevent forming annular grooves in the interior of the stock.

10. In apparatus of the character described, stock guide and support means comprising a pair of transverse members disposed on opposite sides of the stock axis and means moving said members simultaneously toward said axis to guide different sizes of stock.

11. In apparatus of the character de-

scribed, stock guide and support means comprising a pair of grooved rollers disposed on opposite sides of the stock axis, a roller-supporting member having a transverse axis of rotation intersecting said stock axis, and means for turning said member about its axis to move said rollers to guide different sizes of stock.

12. Apparatus as set forth in claim 11 in which a plurality of said units is disposed along said stock and means for adjusting all of said units simultaneously, said adjusting means including slotted arms engaging adjusting pins on said roller-supporting members, a longitudinal rod carrying said slotted arms, guides for said rod, and a hand screw for adjusting the longitudinal position of said rod.

13. Apparatus as set forth in claim 11 in which a plurality of said units is disposed along said stock, and means for adjusting all of said units simultaneously.

14. Apparatus for reducing tubular stock comprising in combination, means for intermittently reducing the stock and releasing it, and means for intermittently feeding the stock at times when released, said means including gripping jaws, and means for operating said jaws in equalized manner from opposite sides of the stock.

15. In apparatus for reducing tubular stock, stock feeding means comprising in combination, gripper jaws, means for clamping the jaws upon the stock and moving them longitudinally to feed the stock, and means for effecting said gripping and feeding actions independently whereby variations in the size of stock will not affect the amount of feed.

16. In apparatus for reducing tubular stock, stock feeding means comprising in combination, stock gripper jaws, means for clamping the jaws upon the stock, means for moving the jaws longitudinally to feed the stock, means for causing said clamping means to act first, and means for causing said jaw-moving means to act subsequently and independently of said clamping means whereby variations in the size of stock will not affect the amount of feed.

17. Stock feeding means for apparatus which reduces stock in successive increments, in combination, stock gripping jaws, a holding frame for said jaws, means acting opposite to the direction of feed for clamping said jaws upon said stock and means acting in the direction of feed for moving said frame and jaws to feed the stock.

18. Stock feeding means for apparatus which reduces stock in successive increments, in combination, gripper jaws for feeding the stock intermittently in short increments of length, yielding means for clamping said jaws upon the stock, and positive non-yielding means for intermittently feeding the stock forward.

19. Stock feeding means for apparatus which reduces stock in successive increments, in combination, a reciprocable feed frame, feed jaws mounted on inclined guides in said frame so that longitudinal movement will close the jaws upon the stock, resilient means normally biasing said jaws longitudinally in the direction to keep them open, resilient means for moving the jaws oppositely to grip the stock, resilient means biasing said frame to a rearward position, and positive means for moving said frame forward after being gripped by said jaws for feeding said stock.

20. Stock feeding means for apparatus which reduces stock in successive increments, in combination, gripper jaws, resilient means biasing said jaws open, resilient means for clamping said jaws upon the stock, a feed frame supporting said jaws, resilient means biasing said frame into one position, and means having a definite length of movement for moving said frame forward to feed said stock.

21. Apparatus as set forth in claim 20 which further includes in combination means to vary the effective length of movement of said feeding means upon said frame.

22. Stock feeding means for apparatus which reduces stock in successive increments, in combination, a reciprocatory saddle, reciprocatory stock feeding means, and an intermediate means interposed between said saddle and said feeding means whereby movement is imparted to the latter from the former and for imparting to said intermediate means movements which do not correspond to movements of either said saddle or said feeding means.

23. Stock feeding means for apparatus which reduces stock in successive increments, in combination, a reciprocatory saddle, reciprocatory stock feeding means, and an interposed cross-head actuated by said saddle for actuating said stock feeding means.

24. Stock feeding means for apparatus which reduces stock in successive increments in combination, a reciprocatory saddle, stock gripping means including a reciprocatory part, a feed frame having reciprocatory movement, a free cross-head interposed between said saddle and said gripping means and frame, said saddle including means for actuating said reciprocatory gripping part, and means actuated by said cross-head for subsequently actuating said feed frame.

25. Stock feeding means for apparatus which reduces stock in successive increments, in combination, a reciprocatory saddle, gripping jaws, a reciprocatory feed frame carrying said jaws, a rock shaft carrying jaw-operating arms and shaft-actuating arms connected to the first said arms by torsion

springs, a free cross-head, a link attached to said actuating arms and actuated by said saddle, a striker member for actuating said feed frame, and means on said cross-head for adjusting the point at which said striker member begins actuation of said feed frame.

26. Stock feeding means for apparatus which reduces stock in successive increments, in combination, gripper jaws for gripping the stock, a feed frame for reciprocating said jaws to feed said stock, a reciprocatory saddle for actuating said frame to feed said stock forward when the saddle approaches one end of it stroke, and means to lock said feed jaws upon said stock and said feed frame against rearward movement after feeding said stock forward until a subsequent stage in the movement of said saddle.

27. Apparatus as set forth in claim 26 in which said locking means includes a latch which is automatically engaged when said feed frame is moved forward.

28. Apparatus as set forth in claim 26 in which said locking means includes a latch which is automatically engaged when said feed frame is moved forward, and means for disengaging said latch to permit return of the feed frame and disengaging of said feed jaws.

29. Apparatus as set forth in claim 26 in which a free cross-head actuates said jaws and feed frame and the locking means acts upon the cross-head to hold it in position and thereby hold the jaws clamped and the feed frame in forward position.

30. Apparatus as set forth in claim 26 in which means are provided for unlocking said locking means, and means for rendering said unlocking means inoperative.

31. Stock feeding means for apparatus which reduces stock in successive increments, in combination, gripper jaws for feeding the stock, a feed frame for reciprocating said jaws to feed the stock, a reciprocatory cross-head for actuating said frame to feed said stock forward at intervals, means for locking said cross-head after it has moved said frame to hold the stock in position, means for releasing said locking means, stock turning means, and means for rendering said releasing means and said stock turning means inoperative.

32. Apparatus for reducing stock by intermittently acting swaging devices, comprising in combination, means acting intermittently upon the outer surface of the stock to feed it in successive increments to said reducing devices, and means for holding said stock against longitudinal movement.

33. Apparatus for reducing stock by intermittently acting swaging devices, comprising in combination, means including gripper jaws acting intermittently upon the stock to feed it in successive increments to said reducing devices, and means including gripper jaws for holding said stock against longitudinal movement.

34. Apparatus for reducing tubular stock by an intermittent action thereon, comprising in combination, swaging means acting upon the stock and intermittently releasing it, means intermittently engaging the stock to feed it in increments at certain times when released from the swaging means, and means intermittently engaging the stock to turn it at certain times when released from the swaging means.

35. Apparatus for reducing tubular stock by an intermittent action thereon, comprising in combination a mandrel supporting the stock, swaging means intermittently acting upon and releasing the stock, means acting upon the mandrel for intermittently turning the mandrel with the stock thereon, and means acting upon the stock for intermittently turning it independently of but in synchronism with said mandrel rotating means.

36. Apparatus for reducing tubular stock by an intermittent action thereon, comprising in combination, swaging means intermittently acting upon and releasing the stock, and means including gripper jaws acting directly upon the stock for turning it when released from said swaging means.

37. In apparatus for reducing tubular stock by an intermittent action thereon, the combination in means for rotating the stock comprising, jaws for intermittently gripping the stock, a rotary mounting for said jaws, means for moving said jaws together to clamp said stock regardless of the rotated position of said jaw mounting, and means for intermittently rotating said mounting when said jaws have clamped said stock.

38. Apparatus as set forth in claim 37 in which said rotating means includes a Geneva gear and eccentric gear drive, whereby the turning means may remain idle at times and move with accelerated speed at other times when turning the stock.

39. Apparatus as set forth in claim 37 in which said rotating means includes a Geneva gear drive whereby the turning means may remain idle at times and move with accelerated speed at other times when turning the stock.

40. Apparatus for reducing tubular stock by an intermittent action thereon, in combination, swaging means for intermittently acting upon and releasing the stock, means for rotating the stock at times when released, and means for causing said rotating means to turn the stock positively in one direction with an accelerated initial movement and a decelerated final movement for the purposes set forth.

41. Apparatus for reducing stock comprising gripper jaws for turning the stock and means for closing said jaws upon the stock,

including cam operated linkage all parts of which are put under compression when actuating the jaws.

42. Apparatus as set forth in claim 41 in which said linkage includes a telescopic spring-extended joint for absorbing excess movement beyond that necessary for clamping the jaws.

43. Apparatus for reducing stock which is movable along a substantially fixed longitudinal axis, comprising in combination, a bed, guideways on said bed, a saddle mounted to reciprocate on said guideways, oscillating swaging devices mounted in bearings in said saddle, means for adjusting said saddle on said guides from opposite sides to maintain the saddle axis in coincidence with said stock axis, means to adjust said swaging devices from both sides of said axis to maintain said bearing axes at equal distances from said stock axis, and means to adjust the effective radial length of said swaging devices.

44. Apparatus for reducing stock which is movable along a substantially fixed longitudinal axis, comprising in combination, a bed, guideways on said bed, a saddle mounted to reciprocate on said guideways, reducing devices mounted on said saddle and means for adjusting said saddle on said guides from opposite sides to maintain the saddle axis in coincidence with said stock axis.

45. Apparatus for reducing stock which is movable along a substantially fixed longitudinal axis, a bed, a saddle reciprocable upon said bed, reducing devices mounted in said saddle, and means for adjusting said reducing devices from opposite sides of said stock axis, said adjusting means extending longitudinally of the direction of travel of said saddle.

46. Apparatus for reducing stock, in combination, a rocker supporting frame, rocker bearings mounted therein, rocker journal members mounted in said bearing, said journal members being provided with laterally extending plate portions, and rocker dies mounted on said journal members with one side bearing against said plate portions and means to adjust said dies radially with respect to said journal.

47. In apparatus of the character described, in combination, a saddle frame made in the shape of a box with four sides and a bottom made integral, said frame being open at the top for the full area required for the introduction of swaging members, swaging devices mounted in said frame, and said frame having aligned apertures on opposite sides for the movement of stock.

48. In apparatus of the character described, in combination, a rocker frame, rockers mounted in said frame, said frame having sides and bottom and the journals of said rockers having ends extending through said bottom, gears on said journal ends below said bottom and a gear rack for operating said gears located beneath said bottom whereby scale, grit and other injurious substance is kept away from said gears.

49. In apparatus of the character described, in combination, a rocker saddle including a boxlike frame having a fluid tight bottom, rockers mounted in said frame, means to supply fluid to the interior of said frame, means on said frame for draining fluid therefrom, and an extended catch basin beneath said draining means for receiving fluid during reciprocation of said saddle.

50. In apparatus of the character described, in combination, a reciprocatory saddle, rockers journaled therein, a cooling bore in each rocker journal, and fluid conducting means leading fluid into each bore and receiving the outflow therefrom and discharging it between the rockers.

51. Apparatus as set forth in claim 50 in which the fluid conducting means travelling with said saddle is connected with a fixed pipe for supplying the fluid, said connection including an elongated section of flexible tubing disposed normal to the line of travel of said saddle.

52. Apparatus for reducing tubular stock, comprising in combination, means for reducing the stock while intermittently turning and feeding it, and run-out mechanism for taking the finished lengths of stock, said run-out mechanism holding the stock in alignment with its axis in the reducing apparatus and including means supporting the stock for rotary movement.

53. Apparatus for reducing tubular stock, comprising in combination, means for reducing stock while intermittently turning and feeding it, and run-out mechanism for taking the finished lengths of stock, said run-out mechanism holding the stock in alignment with its axis in the reducing apparatus and including means supporting the stock for rotary movement, said run-out mechanism including means for adjusting the height of the supporting means to accommodate the different sizes of stock.

54. Apparatus for reducing tubular stock, comprising in combination, means for reducing the stock while intermittently turning and feeding it, and run-out mechanism for taking the finished lengths of stock, said run-out mechanism holding the stock in alignment with its axis in the reducing apparatus and including means supporting the stock for rotary movement, said run-out mechanism including a plurality of stands provided with elevating heads, and means for raising or lowering all of said heads simultaneously.

55. Apparatus for reducing tubular stock, comprising in combination, means for reducing the stock while intermittently turning and feeding it, and run-out mechanism for

taking the finished lengths of stock, said run-out mechanism holding the stock in alignment with its axis in the reducing apparatus and including means supporting the stock for rotary movement, said run-out mechanism including a longitudinal trough and means to tilt said trough to discharge a length of stock in a lateral direction when finished by the reducing apparatus.

56. The method of reducing tubular stock to smaller cross section and of uniform size which comprises, working the metal under compression down the taper of a supporting mandrel, and smoothing the reduced stock without a supporting mandrel.

57. The method of reducing tubular stock to smaller cross section and of uniform size which comprises, working the metal down the taper of a supporting mandrel by the eccentric portion of gapped rolls and smoothing the reduced portion by the concentric portion of the rolls while unsupported by the mandrel.

58. Mechanism for reducing tubular stock by grooved swaging devices which work longitudinally of the stock, characterized by the fact that a tapered mandrel is employed and the swaging devices have a reducing action followed by a smoothing action, the reducing action being effected upon the tapered mandrel and the smoothing action being effected without the mandrel.

59. The method of reducing tubular stock by intermittently acting swaging devices relative to which the stock is fed longitudinally in successive increments which comprises acting successively upon the stock with an accompanying increment of feed to reduce it and holding the stock for a part of time it is being reduced and then releasing it.

60. Stock feeding means for apparatus which reduces stock in successive increments, in combination, a reciprocating saddle actuating the stock reducing devices, intermittently acting stock gripping jaws, and means including striker mechanism and related resilient means operated by said saddle for operating said jaws whereby said jaws are first caused to securely grip the stock before the feeding movement of the jaws is begun.

In testimony whereof, I have signed my name to this specification this 28th day of April 1930.

GEORGE B. COE.

CERTIFICATE OF CORRECTION.

Patent No. 1,890,803. December 13, 1932.

GEORGE B. COE.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 10, line 12, for "desirable" read "desired"; page 11, line 5, after "stock" insert the words "the stock"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 28th day of February, A. D. 1933.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.