Aug. 31, 1943. C. GALL ET AL 2,328,002

METALWORKING MACHINE

Filed Sept. 7, 1939 6 Sheets-Sheet 1

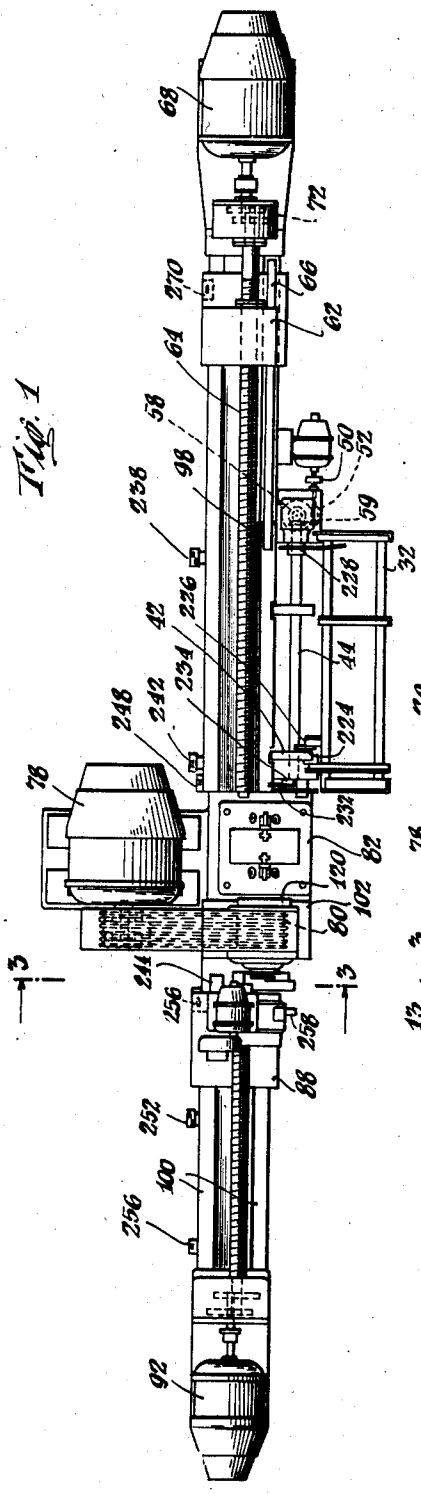


Fig. 1

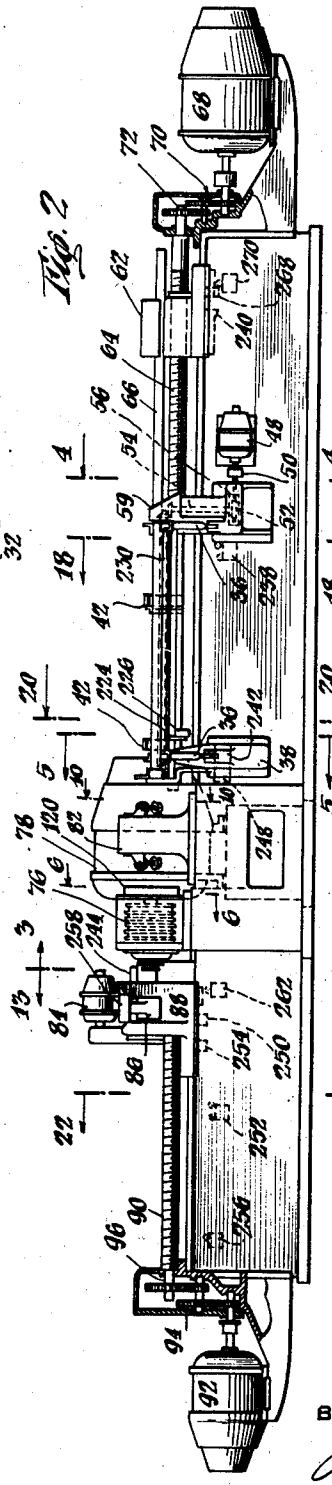


Fig. 2

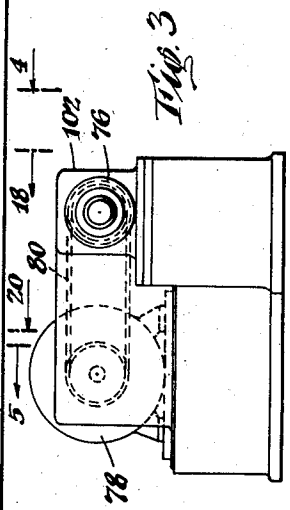


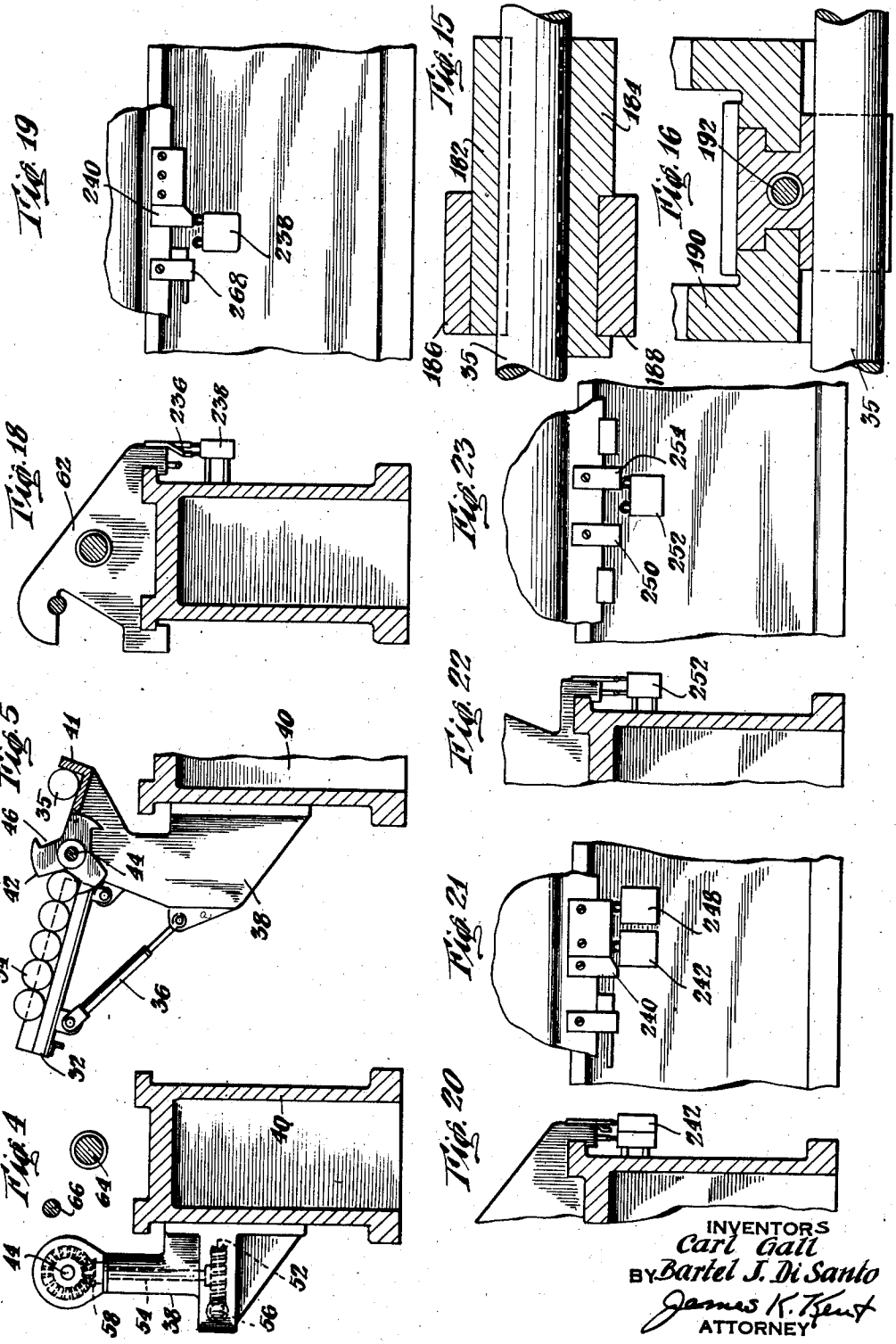
Fig. 3

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METALWORKING MACHINE

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METALWORKING MACHINE

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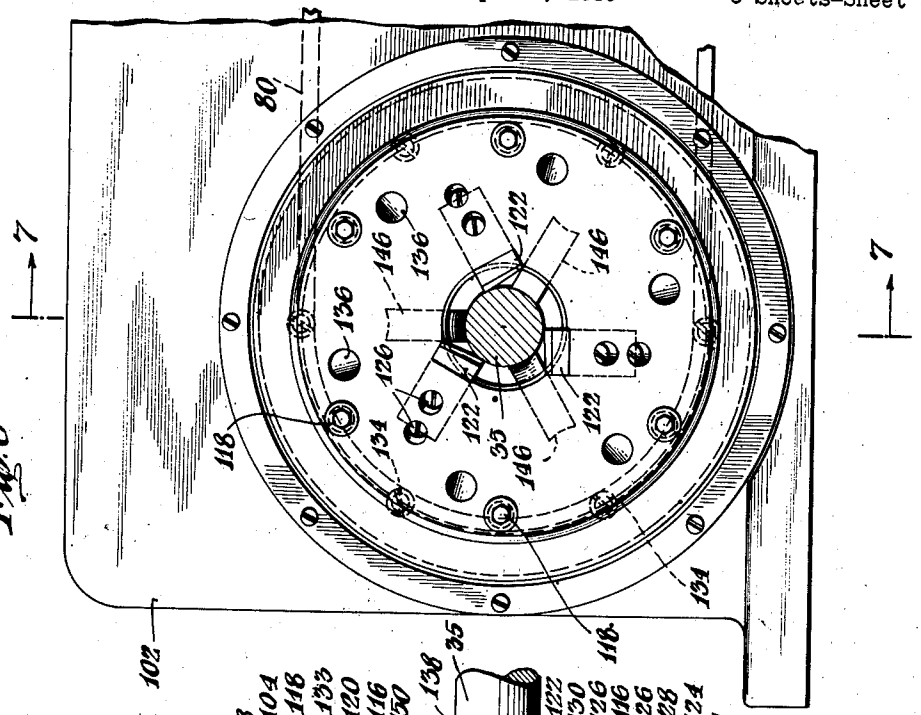


Fig. 6

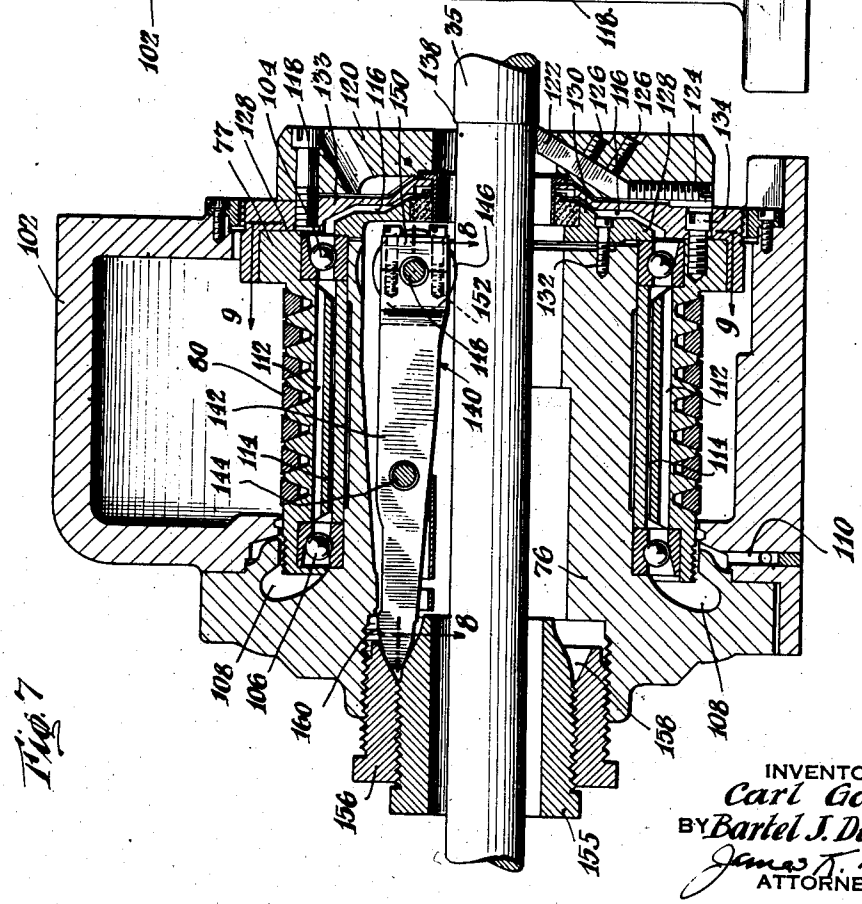


Fig. 7

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METALWORKING MACHINE

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Fig. 9

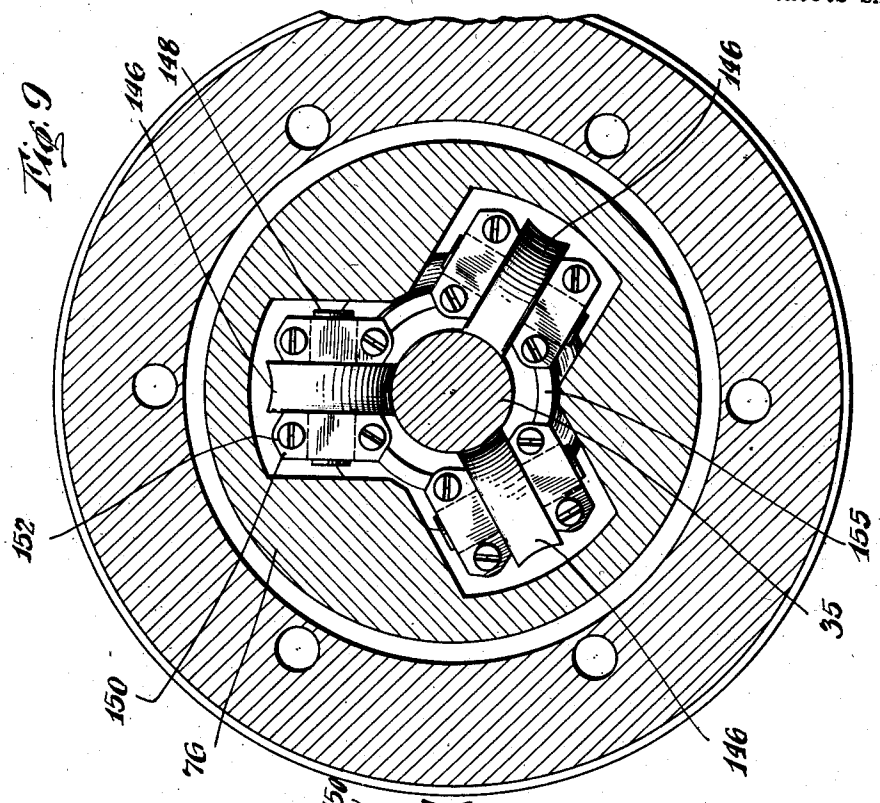
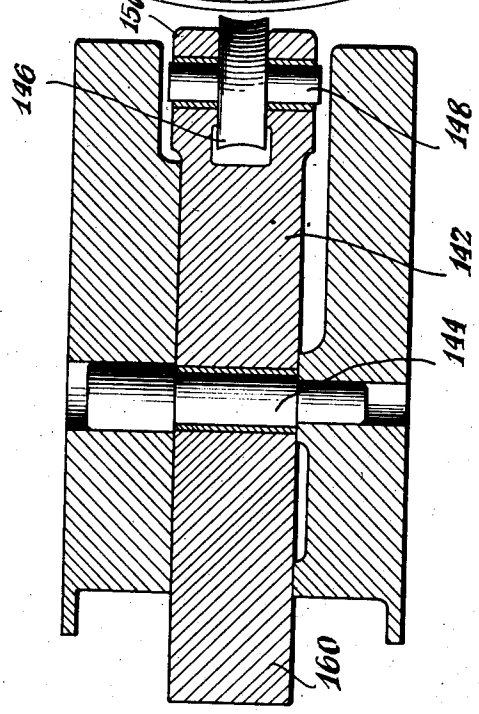


Fig. 8



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METALWORKING MACHINE

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Fig. 12

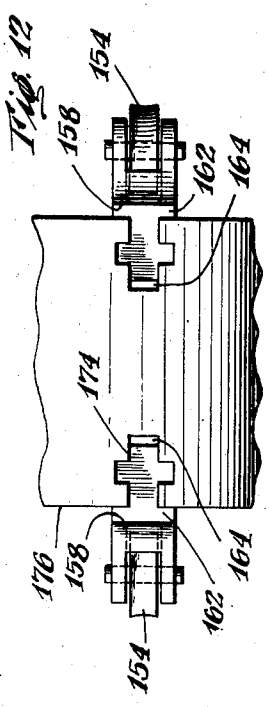


Fig. 11

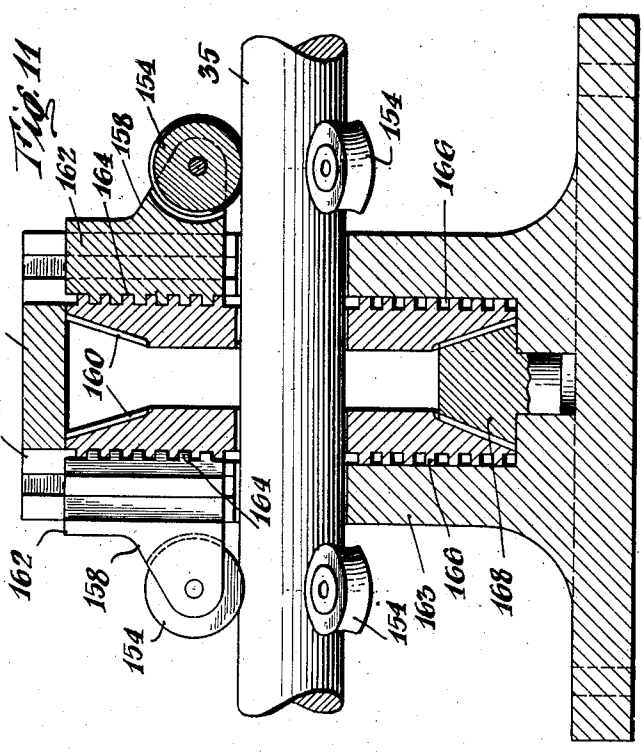
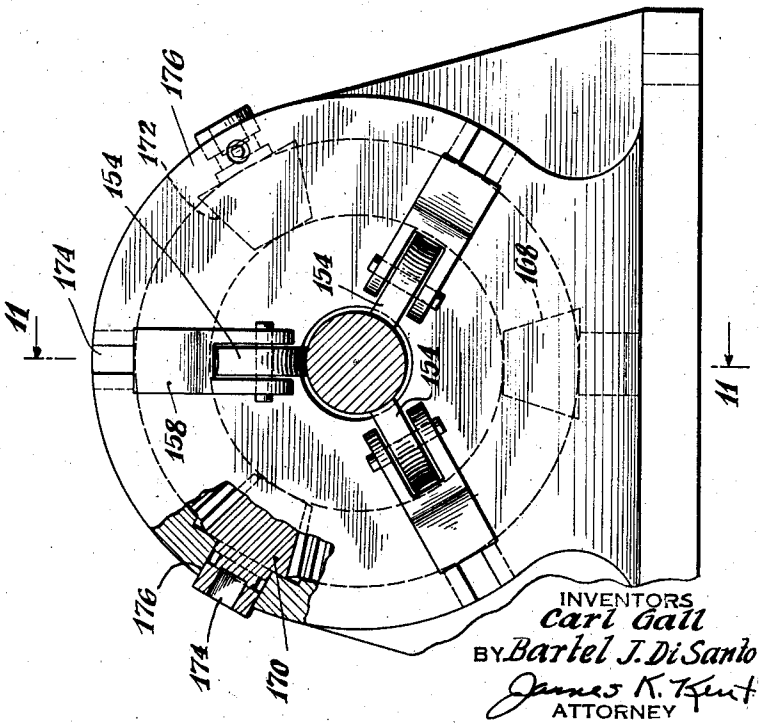


Fig. 10



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METALWORKING MACHINE

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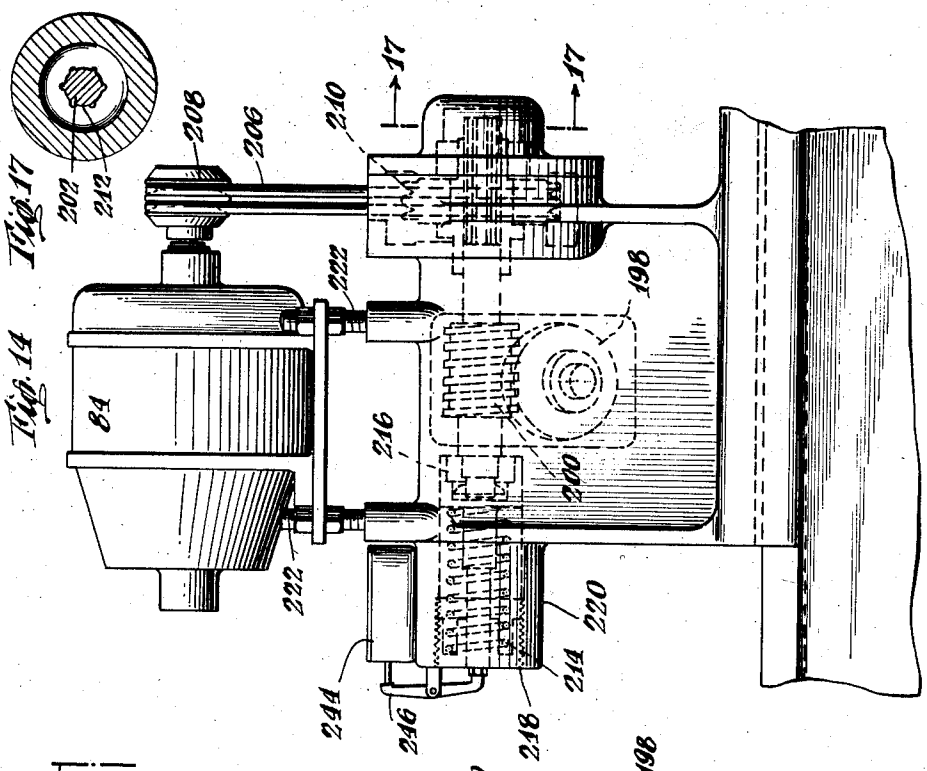


Fig. 17

Fig. 14

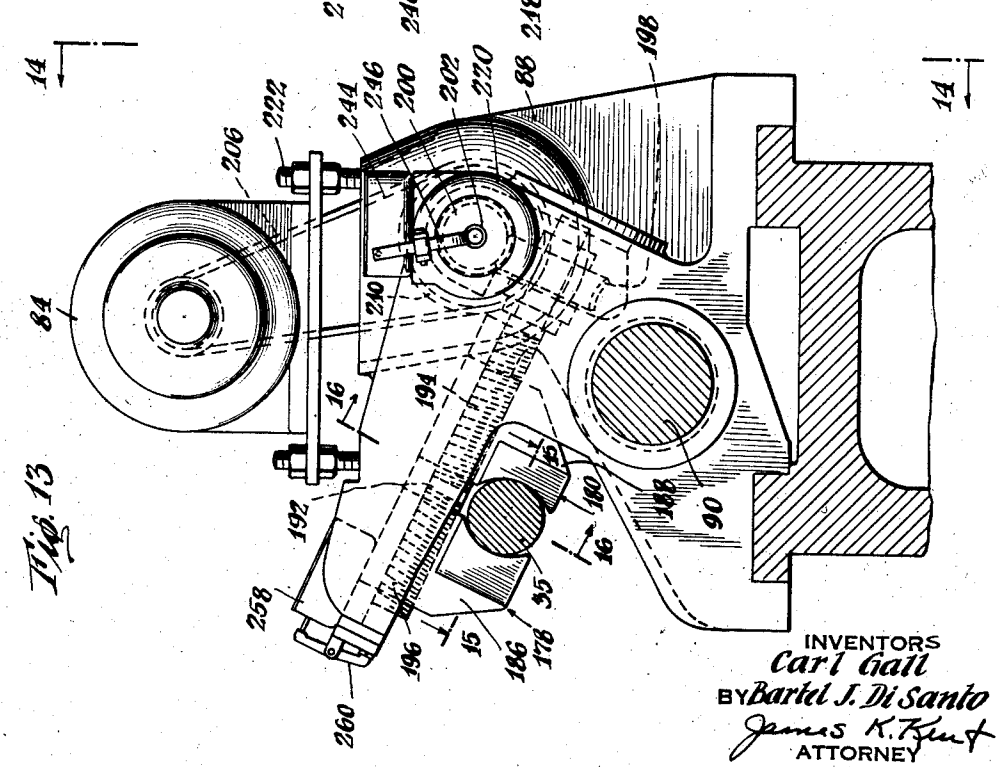


Fig. 13

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Patented Aug. 31, 1943 2,328,002

UNITED STATES PATENT OFFICE

2,328,002

METALWORKING MACHINE

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Application September 7, 1939, Serial No. 293,679

5 Claims. (Cl. 29—27)

It is well known that in the production of billets such as copper and brass billets to be fabricated into seamless tubing by the piercing process, the trade desires billets which have a smooth and bright surface. In order to fulfill such requirements of the trade, machines have been devised which will remove the outmost layers of the billets, that is to say will "scalp" the billets.

It is well known that the trade requirements as to perfection of the surface of the billets are very rigid, and that billets the machined surface of which show only very slight defects under minute inspection, or which may be only slightly bent or distorted, are not acceptable to the trade.

It is well known also that operating conditions which will produce a perfect scalped brass billet will not fulfill requirements for scalping copper billets, as this has been established repeatedly. Thus a machine which produces wholly satisfactory scalped brass billets at a satisfactory commercial capacity will not be satisfactory for copper billets at the same operating capacity, it being found in practice that in order to produce a scalped surface on copper billets which is comparable to that on the brass billets, it is necessary to reduce very materially both the speed of cutting and the speed at which the billets are fed through the machine, thus destroying the commercial practicability of the operation.

It is true that machines have been designed for the machining or "scalping" of copper billets, and such machines have been put into operation. However, owing to the softness and toughness of copper, special problems are present for such undertaking, and it is found in practice that the output of such machines may be faulty as to surface to a greatly preponderating extent.

A principal defect of the surface of a "scalped" copper billet lies in an irregular machined surface which is termed "off-set," and which manifests itself principally in sharp-shouldered ridges in the machined surface of the billet, the effect of which is to tear the metal during working and consequent deformation of the copper stock being worked.

The cause of such defectiveness has been the subject of much study, and costly machine building has been resorted to without satisfactory results, up to the development of the machine of the present invention. These studies have shown that the said defectiveness can be obviated by running the cutting tools at slow speed, and by slowing the speed of feed of the billet through the machine. Consequently it has been found that the cause of this "off-set" is due to a considerable extent to two factors, namely, insufficient support of the billet as it goes through the machine to hold the billet absolutely rigidly during machining, so that the billet wobbles to some extent; and secondly a contributing factor in producing the off-set is the amount of copper which is present at the machining cutters at one time.

These factors are of no great consequence in machining brass or other comparatively brittle metal, but when the metal is tough and tenacious as is the case with copper, they become of great importance.

The present invention provides, therefore, an improved means of conditioning certain types of work-pieces for the performance of metal-removing operations thereon, wherein these are performed on a metal shape such as, for example, a substantially round copper billet, whereby there is imparted to the billet a smoothly machined, highly polished surface with the minimum of tool-cuts, and free from the above described "off-set" defects.

One object of the present invention, therefore, is to provide an improved "scalping" machine for metal billets such as, for example, copper billets, for removing surface metal therefrom.

A further object of the invention is to provide a machine of this indicated character wherein the billet is held rigidly steady always, as it passes through the machine, so that there is no tendency of the billet to wobble during machining, thereby minimizing objectionable "off-set" in the machined surface of the billet, while maintaining the output of the machine well within commercial limits.

A further object of the invention is to provide improved machining tools which produce a broad-nosed finishing cut on the billet surface with the minimum of tool markings.

A further object of the invention is to provide a machine of the above-indicated character wherein there is maintained a predetermined relationship between the speed of the cutting tools and the rate of feed of the billet to the cutting tools.

A further object of the invention is to provide a novel apparatus for preparing deformable metal bars, such as round copper billets or other metal work pieces, for the performance of piercing operations thereon, while guarding the work-piece against deformation and surface unevenness during the preparation thereof.

A still further object of the invention is to provide a fully automatic machine for perform-

ing the above-indicated machining of a metal work-piece.

The invention also comprises the novel character of certain of the mechanism used in carrying out the foregoing objects.

Further objects and advantages of the present invention will become apparent as the description proceeds, and the features of novelty will be pointed out in particularity in the appended claims; and the invention accordingly comprises the features of construction, combination of elements, and arrangement of parts, which will be exemplified in the construction hereinafter set forth, and the scope of the application of which will be indicated in the claims.

While the present invention may be applicable to various industries, it will be described herein in connection with the operations required for preparing a billet for the production of seamless tubes and pipes by the piercing process.

Metal which is intended to be converted into seamless pipes or tubes is cast usually in billet molds, or more particularly in connection with the present invention, the metal may be cast continuously as a rod of indeterminate length and of requisite diameter for billets when the continuously moving rod from the continuous casting apparatus which is producing the rod, is cut to produce the billets. While the rod thus produced is usually substantially circular in cross-section, the surface of the rod may be somewhat oxidized and a little rough, and the trade prefers a billet which has a smooth bright surface, finished to a substantially mirror luster.

Accordingly, the general object of the machine illustrated in the present drawings is to prepare a billet which is favored by the trade for conversion into seamless tube or pipe by the piercing process. In the case of copper billets for tube production, such preparation includes the removal of the outer layers of the metal by the use of a broad-nosed finishing cut, which the present machine is designed to produce. The machine is largely automatic in its operation. The billets are supplied manually to a loading rack from which they are fed to the machine one at a time while the machine is in operation. The operator closes an electric circuit, which causes the machine to go through a fixed cycle of operation during which time each billet is charged to the machine at the loading, fed through the scalping cutters and brought to an unloading station where the scalped billet is discharged from the machine upon actuation of releasing mechanism.

In general, this is accomplished in the following manner:

A power-actuated cam receives a billet from the loading rack, and transfers it to a carriage which includes pushing means for pushing the billet through a cutting head, wherein the milling cutters are rotatably mounted.

As the billet rolls by gravity upon this carriage, it passes over a switch which starts the carriage in motion, and stops the loading cam, this carriage comprising a motor driven screw shaft upon which rides a head carrying a pushing bar which pushes the billet through the cutter head. A short time prior to the billet entering the cutting head, the carriage head engages a retarding switch which decreases the speed of feed of the billet to the cutting head.

As the billet passes through the cutting head, the feed carriage head engages a switch which stops the feed carriage and actuates a discharge carriage which includes a head which comprises a power-actuated clamp, the head being mounted also on a power-driven screw shaft, along which the clamping head rides. As the discharge carriage is actuated by the stopping of the feed carriage, the clamp is put into operation and grips the bar, which then is pulled through the cutting head as the clamp head is retarded on its screw shaft until at the end of its travel, the clamp head actuates a switch which stops the carriage and releases the clamp, which drops the bar onto suitable conveying mechanism for transport to a storage or distribution station. The movement of the clamping jaws closes a switch which reverses the screw shaft which carries the clamp head and causes it to move into billet-receiving position for repetition of the cycle.

As the pushing head of the billet-feeding carriage starts to push the billet towards the cutting head, it throws a switch which stops the operation of the loading cam, and by the time the billet has been released from the clamp after completion of the scalping operation the pushing head has returned to its starting position and has operated a switch which stops it and causes rotation of the loading cam to load a billet on the machine, when the cycle of operations is repeated.

The present machine embodies also structural details of the cutting head, the design being such as to eliminate possibility of the billet becoming bent during the scalping operations thereon; and it embodies also means for enabling the machining of billets over a range of diameters.

Further objects and advantages of the present improved construction will become apparent as the description proceeds and the features of novelty will be pointed out in particularity in the appended claims; and the invention accordingly comprises the features of construction, combination of elements and arrangements of parts which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the claims.

The invention will be understood more clearly from a consideration of the following detailed description, taken in conjunction with the accompanying drawings, in which

Fig. 1 is a plan view of the improved machine.

Fig. 2 is a side elevation thereof.

Fig. 3 is a sectional elevation taken on the line 3—3 of Figs. 1 and 2, looking in the direction of the arrows.

Fig. 4 is a sectional elevation on the line 4—4 of Fig. 2, looking in the direction of the arrows.

Fig. 5 is a sectional elevation taken on the line 5—5 of Fig. 2, looking in the direction of the arrows.

Fig. 6 is a fragmentary end elevation of the improved cutter head of the improved machine, the view being taken on the plane of the line 6—6 of Fig. 2, looking in the direction of the arrows.

Fig. 7 is a sectional elevation on the line 7—7 of Fig. 6, looking in the direction of the arrows.

Fig. 8 is a sectional plan view on the line 8—8 of Fig. 7, looking in the direction of the arrows.

Fig. 9 is a sectional elevation on the line 9—9 of Fig. 7, looking in the direction of the arrows.

Fig. 10 is an end elevation of the roller guide head of the machine, the view being taken on the plane of the line 10—10 of Fig. 2.

Fig. 11 is a sectional elevation taken on the line 11—11 of Fig. 10.

Fig. 12 is a fragmentary plan view of the structure of Fig. 11.

Fig. 13 is a sectional elevation showing one end of the clamp head, taken on the line 13—13 of Fig. 2.

Fig. 14 is a side elevation of the clamp head, taken on the plane of the line 14—14 of Fig. 13.

Fig. 15 is a sectional elevation, taken on the line 15—15 of Fig. 13.

Fig. 16 is a sectional elevation taken on the line 16—16 of Fig. 13, looking in the direction of the arrows.

Fig. 17 is a section taken on the line 17—17 of Fig. 14.

Fig. 18 is a sectional elevation taken on the line 18—18 of Fig. 2, looking in the direction of the arrows.

Fig. 19 is a fragmentary side elevation of Fig. 18.

Fig. 20 is a fragmentary sectional elevation taken on the line 20—20 of Fig. 2, looking in the direction of the arrows.

Fig. 21 is a fragmentary side elevation of Fig. 20.

Fig. 22 is a fragmentary sectional elevation taken on the line 22—22 of Fig. 2 looking in the direction of the arrows.

Fig. 23 is a fragmentary side elevation of Fig. 22.

In the drawings, the electrical connections have been omitted for clarity.

On the illustrative embodiment of the invention shown in the drawings, reference number 40 indicates an elongated bed. Towards the right hand end of the machine as viewed in Figs. 1 and 2, is a loading station, at the opposite end is an unloading station, and between these two stations there is arranged a set of milling cutters which revolve around the billet for machining the surface thereof. The billet is conveyed from the loading to the unloading station through the revolving cutters by suitable carriage instrumentalities which will be described hereinafter in detail.

The loading station includes a loading rack 32 which receives billets 34 to be "scalped," this rack 32 being suitably supported on brackets 36, 36 which are in turn secured to brackets 38, 38 mounted on the frame 40 on one side of the machine.

The billets 34 are placed lengthways on the rack 32, so that they may be picked up from the rack by loading cams 42, 42, which are mounted on a shaft 44, so that corresponding billet-receiving pockets 46 on the cams are in register. These pockets are positioned 120° apart. Therefore as corresponding pockets 46 come into register with a billet, it rolls by gravity into these pockets, and as the cams rotate on the shaft 44, the billet is deposited in position on rack 41 to be conveyed through the milling cutters. These cams 42 are actuated by a motor 48, which, through a suitable coupling 50, drives a gear 52 on a vertical shaft 54, a pinion 56 on the motor shaft engaging this gear 52. The upper end of shaft 54 is provided with a beveled pinion 58 which meshes with a gear 59 on the end of the shaft 44.

As the billets are picked up one at a time by the loading cams 42, 42, each one is laid in position on the machine to be conveyed through the cutters. The carriage instrumentalities for this purpose include a pusher carriage 62 which is mounted on a screw shaft 64 and carries a pusher rod 66, the carriage 62 traveling along the screw shaft 64 responsive to the latter being rotated by a motor 68 which acts through a suitable speed reducer 70 to drive a gear 72 on shaft 64 to rotate the shaft 64, as will be clear from the drawings.

It will be understood that at the start of the operation, the pusher carriage 62 is at the extreme right hand end of the machine, as is shown in Figs. 1 and 2. As the billet being machined rolls onto the loading cams 44, it passes over a switch 226 to close this switch, and consequently to close a circuit which includes the motor 68 to operate this motor for turning this shaft 64 in clockwise direction. As the shaft 64 rotates, the pusher carriage 62 is moved along it towards the cutters which are mounted in a rotary cutting head 76, which is rotated by motor 78 through V-belt drives 80. The construction of this cutting head will be described hereinafter.

As the pusher carriage 62 moves forward, the loading mechanism having stopped, the pusher carriage brings the pusher bar 66 into engagement with the billet, indicated at 35 on Fig. 5, which billet is then pushed by the bar 66 first through a guide head 82 (to be referred to hereinafter) and then through the cutter head 76.

By the time the front end of the billet 35 has been pushed through the cutters and emerges from the cutting head 76, the pusher carriage 62 has reached its forward limit of travel and has closed a circuit which includes a motor 84 which actuates a clamp 86 to grip the end of the billet protruding from the cutter head 76.

The clamp 86 is mounted in a clamping carriage 88 which rides on a screw shaft 90 which is driven by a motor 92 through a speed reducer 94 and gear 96 on shaft 90 to rotate this shaft in clockwise direction, thereby causing the clamp carriage 88 to travel away from the cutting head 76, thereby pulling the billet completely through guide head 82 and cutting head 76. As the clamp carriage 88 reaches the end of its travel, the clamp 86 opens to release the billet which drops onto a suitable conveyor, not shown, for conveying to a storage or shipping station.

It will be obvious that the carriages 62 and 88 are guided in their travel by suitable guide tracks 98, 98 and 100, 100 respectively.

The full automatic operation of the machine will be described in fuller detail hereinafter.

Reference has been made above to the cutting head employed on this machine. The details of the construction of the cutting head are shown in Figs. 6 to 9 inclusive. It will be seen that this cutting head comprises the sheave 77, which is driven from the motor 78 by suitable driving means such as V-belts 80. A housing 102 encloses the sheave and associated parts, this housing of course having a lateral opening for the driving belts.

The sheave operates on suitable bearings, designated at 104 and 106, lubrication being provided through the annular cavity 108 supplied with a pressure lubricating intake 110, the lubricant being fed through annular passages 112, 114, 116 to the bearings and between moving and fixed parts.

Secured to the sheave 77 by screws 118 is a cap 120, which is the cutting head proper, in which are contained the milling cutters 122, which are arranged to mill off the surface of the billet 35 with the broad-nosed finishing cut referred to above. The cutting head is adapted to operate upon billets of different sizes within a specified range of diameters, and accordingly the cutters

122 are adapted to be adjusted relative to the billet 35. Consequently, adjusting means for the cutters must be provided, there being adjusting screws 124 provided for this purpose in cooperation with clamping screws 126, 126, which are adapted to clamp the cutters 122 in adjusted position. This construction is repeated for each cutter 122, three of which are shown, equi-spaced around the billet 35.

Sealing means are provided also for the interior of the cutting head, such means being indicated by a flanged sealing plate 128 which is held in place by a retaining casting 130, which in turn is held in position by means of screws 132, the cutting head 120 contacting with a casting 133, which is held in place by screws 134. Air vent 136 serves to ventilate the cutters 122 and prevents the same from overheating during machining of the billet, and also as exit means for fine metal chips, the cut on which is represented at 138.

Guide means 140 are provided for maintaining the billet in alignment while it passes through the cutting head. Such means include levers 142 equi-spaced around the billet, the levers 142 being adjustable as to their position by being pivotally mounted on a pivot pin 144 and each of the levers carries a roller 146 which rides on the billet as the billet passes through the cutting head. These rollers are positioned in a bifurcated end of the levers 142 and rotate upon shaft 148 which is integral with the rollers and which is held between the bifurcated end of the levers 142 and a demountable cap 150, which is secured by cap screws 152.

The levers 142 are held in position by cooperating annular clamping nuts 155, 156 which are threaded together for independent adjustment, the outer nut 156 being also threaded into the housing 102. A cam-shaped annular recess 158 is provided between the inner ends of the nuts, into which fits the end 160 of the lever 142, which end is tapered to be received in this recess and clamped therein between the nuts 155 and 156, thereby holding the lever in desired position of adjustment dependent upon the diameter of the billet being machined.

When it is desired to shift the adjustment of the lever 142, for example to lift the roller 146 in order to receive billets of larger diameter than that shown in Fig. 7, the clamping nuts are unscrewed sufficiently far to enable the end 160 to slide down the slope of the curve of the recess 158 towards the foot of the curve; and when proper adjustment of the lever 142 is effected, the nut 156 is tightened up on the handle 160, thus clamping the lever in its newly-adjusted position. Adjustment and locking of the levers are effected simultaneously.

The pins 144 upon which pivot the levers 142 are mounted in the housing 76 which is recessed as is shown in Fig. 9 in order to receive these guide levers, the rollers 146 of which are turnable under the movement of the billet through the cutting head. The fact that these levers 142 are clamped rigidly in adjusted position affords rigid support and guidance for the billet as it moves through the cutting head. The adjustment of the levers 142 in practice allows for a range of about one inch in the diameter of the billets being machined, but obviously such a range is not limiting as to the amount of adjustment that may be effected.

It has been said above that prior to the billet entering the cutting head, it passes through a roller guide 82, which comprises guide rollers 154 at each end of the guide head, three of which rollers are shown, each of which is mounted in similar brackets, such as that designated at 158. These rollers guide the billet through the guide head 82, in which there is a chuck comprising beveled chuck gears 160, which are joined to adjustable brackets 162 through the spiral connection 164, the chuck gears 160 being similarly connected to the chuck housing 163 by spiral connection 166.

Actuation of these chuck gears is accomplished by the provision of beveled pinions 168, 170, 172, three of which are shown, these meshing with the chuck gears.

The pinions 170, 172 are turnable manually by a proper wrench inserted in sockets 174 in hubs 176 of the pinions. Movement of any one of these pinions operates all, so that the roller wheels 154 are moved towards or away from the billet 35 being machined, the adjustment depending upon the diameter of the billet being machined, thereby allowing a range of diameters of billets, say, for example, from 2½ inches to 3½ inches in diameters. When adjustment has been made for the accommodation of given billets of the same diameter, the mechanism being self locking, the adjustment holds until it is shifted for the reception of other billets having different diameters.

The adjustment is effected by the movement of the brackets 162 along T-shaped guides 174 which extend through the housing 163.

Since the roller-wheels 154 have concave surfaces, they, in conjunction with roller wheels 146 of the levers 142 in the casting 76, hold the billet 35 against turning during the machining thereof, the wheels 154 exerting a clamping action on the billet in view of the adjustment of the chuck gears 160.

It has been mentioned above that the billet is gripped by a clamping device as the pushing mechanism pushes the billet through the cutting head, the clamping device pulling the billet all the way through the cutting head and taking it to the discharging station as the pushing instrumentalities return to starting position for the next billet.

Details of this clamping mechanism are shown in Figs. 13 to 17 inclusive. It has been mentioned previously that the clamping carriage 88 rides on screw shaft 90, reciprocating between the casting 76 and the discharge station which is located at the left-hand end of the shaft 90.

The clamp itself comprises clamping jaws 178, 180, which are adapted to grip the billet 35. The jaws 178, 180 are shown as being made up of brass parts 182, 184 bolted to steel or cast iron backings 186, 188, by countersunk bolts, not shown.

The jaws 178, 180, move in and out on a guide 190 responsively to the direction of rotation of a shaft 192 which has right hand threads 194 extending through clamp jaw 188 and left hand threads 196 extending through clamp jaw 186, the jaws being of course correspondingly internally threaded.

The shaft 192 has a worm wheel 198 secured to it, the wheel and shaft being rotated by a worm 200 on shaft 202, which in turn is driven from a motor 84 through belts 206, passing around sheaves 208 and 210 on the motor 84 and shaft 202, respectively. Shaft 202 is a splined shaft as is indicated at 212 on Fig. 17 to allow for some longitudinal movement of the shaft, a spring 214 positioned between abutment 216 on the shaft and

abutment 218 on the housing 220 resiliently cushioning the shaft in its longitudinal movements.

The motor is adjustable as to height as is indicated at 222.

The operation of the machine may be described more fully as follows:

First, the cutter motor 78 rotates continuously and must be on the line before the cycle is started.

The machine loads and unloads billets automatically. The billets to be scalped are loaded onto rack 32 where they travel into the feeding cams 42, 42, which pick up each successive billet in predetermined timed intervals. As each billet rolls into the feeding cams 42, 42, the finger 224 of limit switch 226 is depressed. This limit switch 226 is interconnected electrically with the push motor 68 so that when the push motor 68 has the pusher bar 66 in returned position, the motor 48 is started, which rotates the feeding cams 42, 42 through gears 56, 52, shaft 54, gears 58, 59 and shaft 44 which carries the cams 42, 42.

The cams 42, 42 rotate the billet through an arc of 120°, the billet then rolling from the cam onto the rack 41 for feeding to the cutters. After the cams 42, 42 rotate through 120°, a contact cam 228 mounted on the cam shaft 44 engages a limit switch 230, which stops the motor 48. The limit switch 230 is of the conventional type construction wherein circuit opening and closing contact members are operated by cam means.

As a billet 35 comes to rest on rack 41, it depresses finger 232 of limit switch 234, which is interconnected electrically with motor 68, so that the motor 68 is started, thus rotating screw shaft 64 by means of the gear train 70, 72, thereby driving the pusher carriage 62 and pusher bar 66 forward against the end of the billet, indicated at 35, thus pushing the billet towards the guide head 82 until a cam 236 on the pusher carriage 62 trips a limit switch 238, positioned on the frame of the machine, which slows down the motor 68, so that the billet travels through the guide head 82 and cutter head casting 76 at slow speed. The pusher carriage 62 moves to the left as viewed in Figs. 1 and 2, pushing the billet through the roller guide head 82 and cutter head casting 76, where the cutters 122 machine off the surface of the billet as it passes through the cutter head.

The pusher carriage 62 continues to move to the left until the forward part of cam 240 on the carriage 62 contacts limit switch 242 on the frame of the machine at substantially the left hand end of the travel of the carriage 62 as viewed in Figs. 1 and 2.

This contact with switch 242 starts the clamp motor 84 and pull motor 92.

The clamp motor 84 is connected through belts 206 (Fig. 13) and worm gear connections 200, 188, for operating the shaft 192, so that the clamp jaws 178, 180 come together and clamp the billet. When the jaws are tight, limit switch 244 is contacted through arm 246 to stop the motor 84 and lock the jaws 178, 180 in closed position.

Now the pull motor 92 is connected through gearing 94, 96 to the screw shaft 90, thus rotating this shaft so as to move the carriage 88 on which the clamp is mounted. This carriage 88 is adjacent to the casting 76 as the billet is pushed through the latter, and the clamp jaws grip the billet.

As the clamp jaws engage the billet, the carriage 88 moves to the left, as viewed in Figs. 1 and 2, thus pulling the billet through the cutter head. The pusher carriage 62 meanwhile continues to move towards the left as viewed in Figs. 1 and 2, until the back portion of cam 240 contacts a limit switch 248, which stops the motor 68.

Now, the billet being clamped, the carriage 88 moves to the left, as viewed in Figs. 1 and 2, at slow speed until cam 250 on the carriage 88 contacts a limit switch 252, which increases the speed of the motor 92 to give a rapid traverse. This limit switch 252 is situated so that the cam 250 does not engage it until the billet has been drawn by the carriage 88 completely through the cutting head.

The carriage 88 continues to the left until cam 250 on the carriage 88 engages a limit switch 256 positioned close to the left hand end of the machine as viewed in Figs. 1 and 2. This stops motor 92 and starts motor 84 so that the clamps release the billet and it drops out of the machine onto a conveyor (not shown). As soon as the upper clamp jaw 178 opens, it contacts a limit switch 258 through actuation of a switch arm 260 (see Fig. 13), which action reverses the pull motor 92, thereby rotating shaft 90 in reverse direction, thereby causing the carriage 88 to return to clamping position at the cutting head. As soon as the cam 250 contacts limit switch 262 which is positioned on the machine frame at right-hand end of travel of the carriage 88, the motor 92 stops and the carriage 88 is in position to receive the next billet.

It will be clear that when the jaws 178, 180 in the previous cycle are tight on the bar, limit switch 244 is contacted. This stops motor 84 and starts the motor 68 in reverse, thus returning pusher carriage 62 to its starting position. As soon as cam 268 on the pusher carriage 62 contacts limit switch 270, positioned near the right hand end of the machine frame, the motor 48 of the billet-charging mechanism is started and another billet is fed into the machine.

The timing and placement of cams and limit switches is arranged to give a smooth and uninterrupted sequence. That is, more than one action is taking place at one time but in good sequence, so that the shortest possible cycle may be maintained.

All of the cams on the carriages 62 and 88 are movable to allow for handling of billets of different lengths.

It may be mentioned in this connection that one of the difficulties which has been encountered is the production of what may be called "off-set" in the billet, that is to say the production of a faultily machined surface due to misalignment of billet-handling instrumentalities through which the billet passes on its way to the unloading station.

This "off-set" is due to the billet entering the cutter-head at a slight angle to the horizontal, instead of on a perfectly straight or level position. It will be noted that the billets are rather long, and as each one travels through the holding and guiding devices, it may or may not go through the cutters at a slight angle to the horizontal. Now as the billet continues through the cutters it is gripped by the rollers 146 and deflected to meet the center line of the said rollers. This leaves a distinct mark on the billet, and the billet may become bent or bowed.

It is very difficult in practice to obtain this exact centering of the parts; but the formation of this objectionable off-set is due at least partially to insufficient support of the billet as it

passes through the gripping means. Consequently not only are the gripping rollers 154 arranged so as to provide substantial support for the billet all around it, but they are moved close to the cutting head 120 as are also the rollers 146, so that at no time will the billet be subjected to distortional deformation stresses over any considerable length of the billets. By minimizing the distance between rollers 154, cutters 122 and rollers 146, any substantial leverage on the billet is avoided. Also the cutters 122, being broad and rotating at rather slow speed, afford additional support to the billet as it passes from the gripping rollers 154 to the gripping rollers 146, thereby minimizing any tendency to distort the billet.

The rollers 154 of the guide and holding mechanism are adjusted by manual operation of the pinions 170 or 172, which are accessible readily from the outside of the chuck housing 82. These holding rollers 154, together with the rollers 146 and the support afforded by the cutters 122 provide a substantially continuous support for the billets as they pass from the carriage 68 through the holding means and the cutting head and associated parts, until it is gripped by the clamp jaws 178 and 180, these jaws being sufficiently wide to hold the billet rigidly and perfectly straight as it passes from the machining mechanism, the rollers 146 holding the billet against turning or becoming off-center until it is withdrawn entirely clear of the cutters 122 and sheave 77. The clamping carriage 68 also is closely adjacent to the sheave 77 as the end of the billet comes through the sheave to be engaged by the clamp. It will be understood of course that the billet is supported also on the rack along which it travels until it is pulled off therefrom by the return of the clamp carriage to the unloading station. The closely adjacent supporting and holding instrumentalities provided in this machine obviate any long unsupported lengths of the billet and hold it steadily without wobbling at any time during its machining.

It has been mentioned previously herein that the amount of metal at the cutters at one time has a bearing on the production of the objectionable off-set, and it has been found that a predetermined relation should be maintained between the speed of the cutters and the speed of longitudinal movement of the billet. Thus, in practice it is found that for copper billets 4 ft. long and 3 inches in diameter, the cutters should revolve at about 600 R. P. M. where the forward movement of the billet past the cutters is 120 inches/minute.

What is claimed is:

1. A machine for scalping metal billets comprising an elongated bed, a metal scalping tool means positioned intermediate the ends of said bed, a billet clamping and guiding means disposed adjacent said scalping tool, said billet clamping and guiding means comprising rigidly supported roller clamping means with said rollers being arranged in the same plane for unyieldingly holding and guiding the billet so that the longitudinal axis of the billet throughout its entire length is maintained in accurate alignment with the longitudinal axis of said scalping tool during the scalping operation, reciprocable carriage means arranged on one side of said scalping tool for receiving and feeding said billet lengthwise along said bed through said clamping and guiding means and to said scalping tool, additional reciprocable carriage means located on opposite side of said scalping tool for receiving and guiding said billet away from said tool, said last mentioned carriage having a clamping means mounted thereon for gripping the advancing end portion of said billet as it emerges from said scalping tool whereby upon movement of the carriage away from said tool said billet is pulled forward while the remainder of the billet is being scalped.

2. A machine for scalping metal billets comprising an elongated machine bed, a metal scalping tool positioned intermediate the ends of said machine bed, a billet guide head member fixedly mounted adjacent said scalping tool for firmly holding and uniformly guiding the billet in position to be accurately machined, said billet guide head member comprising an adjustable chuck which includes a set of cooperating rollers arranged in the same plane, a set of rollers being disposed at opposite ends of said head member for exerting an unyielding clamping action on said billet as it is moved therealong, said guide head member holding said billet rigidly so that the billet is free to move lengthwise only, reciprocable carriage means arranged on one side of said scalping tool for receiving and feeding said billet endwise through said billet guide head member and in position to be machined by said tool, additional reciprocable carriage means disposed adjacent the opposite side of said scalping tool to receive and advance the scalped portion of said billet therealong while the remainder of said billet is being scalped by said tool, said last mentioned carriage having clamping means carried thereby for gripping the leading end portion of said billet which has passed said scalping tool for rigidly holding the billet as it is conveyed lengthwise therealong.

3. A machine for scalping metal billets comprising an elongated machine bed, a metal scalping tool positioned intermediate the ends of said machine bed, a billet guide head member fixedly mounted adjacent said scalping tool for firmly holding and uniformly guiding the billet in position to be accurately machined, said billet guide head member comprising an adjustable chuck having cooperating rollers arranged in the same plane for exerting an unyielding clamping action on said billet as it is moved therealong and maintaining the longitudinal axis of the billet throughout its length in substantial alignment during said movement, said guide head member holding said billet rigidly so that the billet is free to move lengthwise only, reciprocable carriage means arranged on one side of said scalping tool for receiving and feeding said billet endwise through said billet guide head member and in position to be machined by said tool, additional reciprocable carriage means disposed adjacent the opposite side of said scalping tool to receive and advance the scalped portion of said billet therealong while the remainder of said billet is being scalped by said tool, said last mentioned carriage having clamping means carried thereby for gripping the leading end portion of said billet which has passed said scalping tool for rigidly holding the billet as it is conveyed lengthwise therealong, said chuck comprising spiral meshing gears and being manually adjustable for allowing the machine to accommodate billets having a diameter range of between 2½ to 3½ inches.

4. A machine for scalping metal billets comprising a metal removing tool means positioned intermediate the ends of said machine, means comprising an adjustable chuck having angu-

larly spaced rollers member disposed in a common plane for rigidly clamping and guiding a billet axially therealong without flexing and in position to be scalped by said tool, reciprocable carriage means positioned at one end of said machine for receiving and pushing a billet lengthwise through said billet clamping and guiding means and in position to be scalped by said tool, a second reciprocable carriage means disposed at the opposite end of said machine for receiving the scalped billet, said last mentioned carriage means comprising an adjustable clamping device for gripping the advancing scalped end portion of said billet, said second carriage being arranged to pull said billet endwise therealong while the remainder of the said billet is being scalped, said metal removing tool comprising a rotary cutting tool means and associated roller guide means for maintaining the longitudinal axis of said billet in accurate alignment with the axis of said rotary cutting tool means while it passes therethrough and is scalped, said roller guide means being mounted on pivoted lever means providing adjustment means whereby billets of different size diameter can be machined without requiring the dismantling or substitution of parts in said machine.

5. A machine for scalping metal billets comprising a metal scalping tool means positioned intermediate the ends of said machine, reciprocable means arranged on one side of said scalping tool for receiving and feeding said billet endwise towards said tool means, a billet clamping and guiding mechanism for rigidly maintaining said billet in position to be advanced endwise into said scalping tool, said last mentioned means comprising a universal chuck having cooperating spaced roller members disposed in a common plane for engaging the billet and maintaining the longitudinal axis of said billet in accurate alignment with the axis of said scalping tool means as the billet is passed therealong from one end of the machine through said scalping means, reciprocable carriage means located adjacent the opposite end of said machine for receiving the scaped billet and conveying it therealong, said last mentioned reciprocable carriage means having a billet clamping member mounted thereon for gripping the end portion of said billet as it advances from said tool to continue said movement while the remainder of the billet is being scalped whereby a completely scalped billet is provided, said billet guiding mechanism, scalping tool, and clamping means being adjustable for accommodating billets of different size diameter.

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