

1,056,066.

O. A. SMITH.
METAL WORKING MACHINE.
APPLICATION FILED JUNE 26, 1911.

Patented Mar. 18, 1913.

4 SHEETS—SHEET 1.

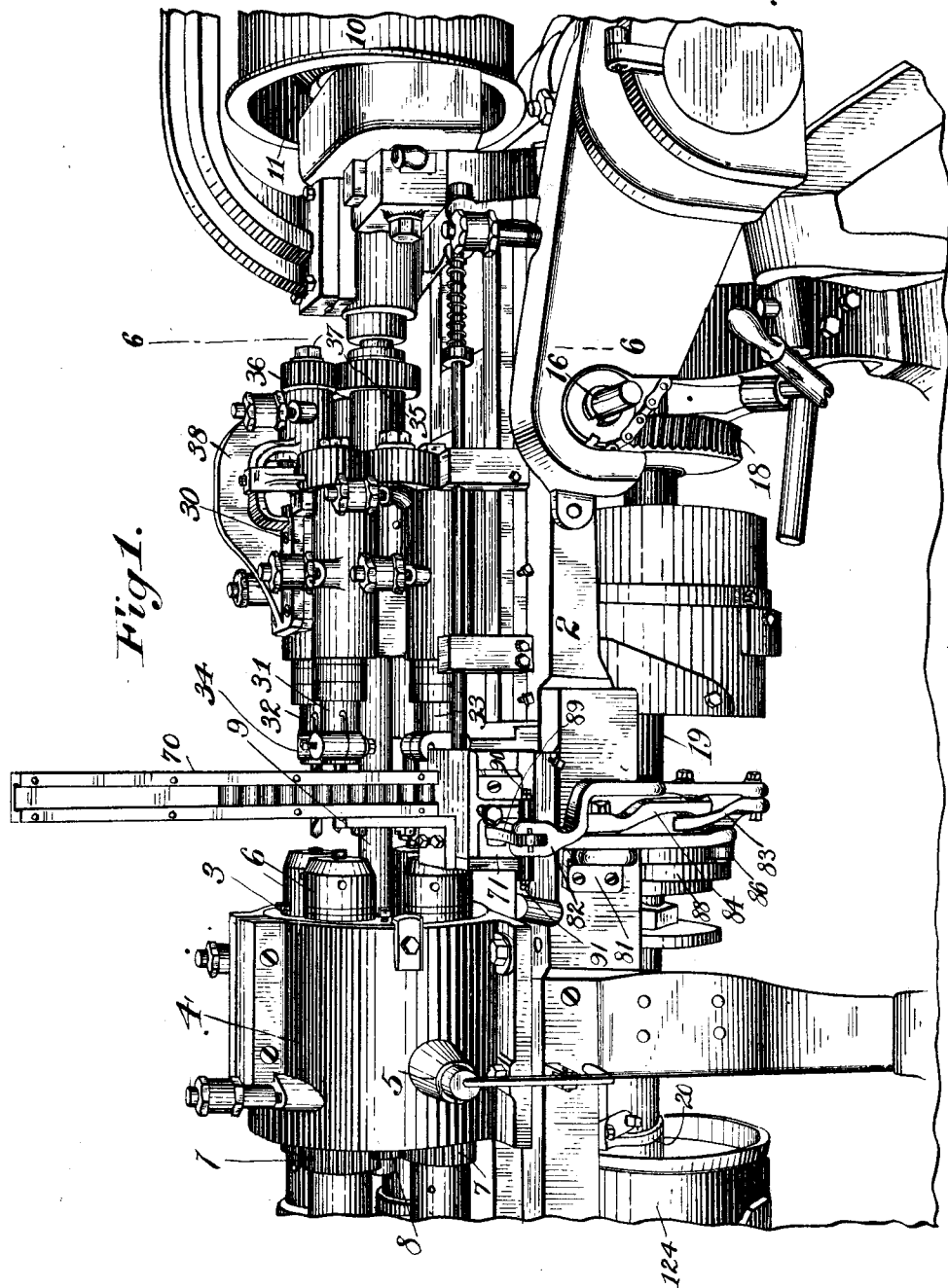


Fig. 1.

Witnesses:
R. M. Pittman
F. E. Royce

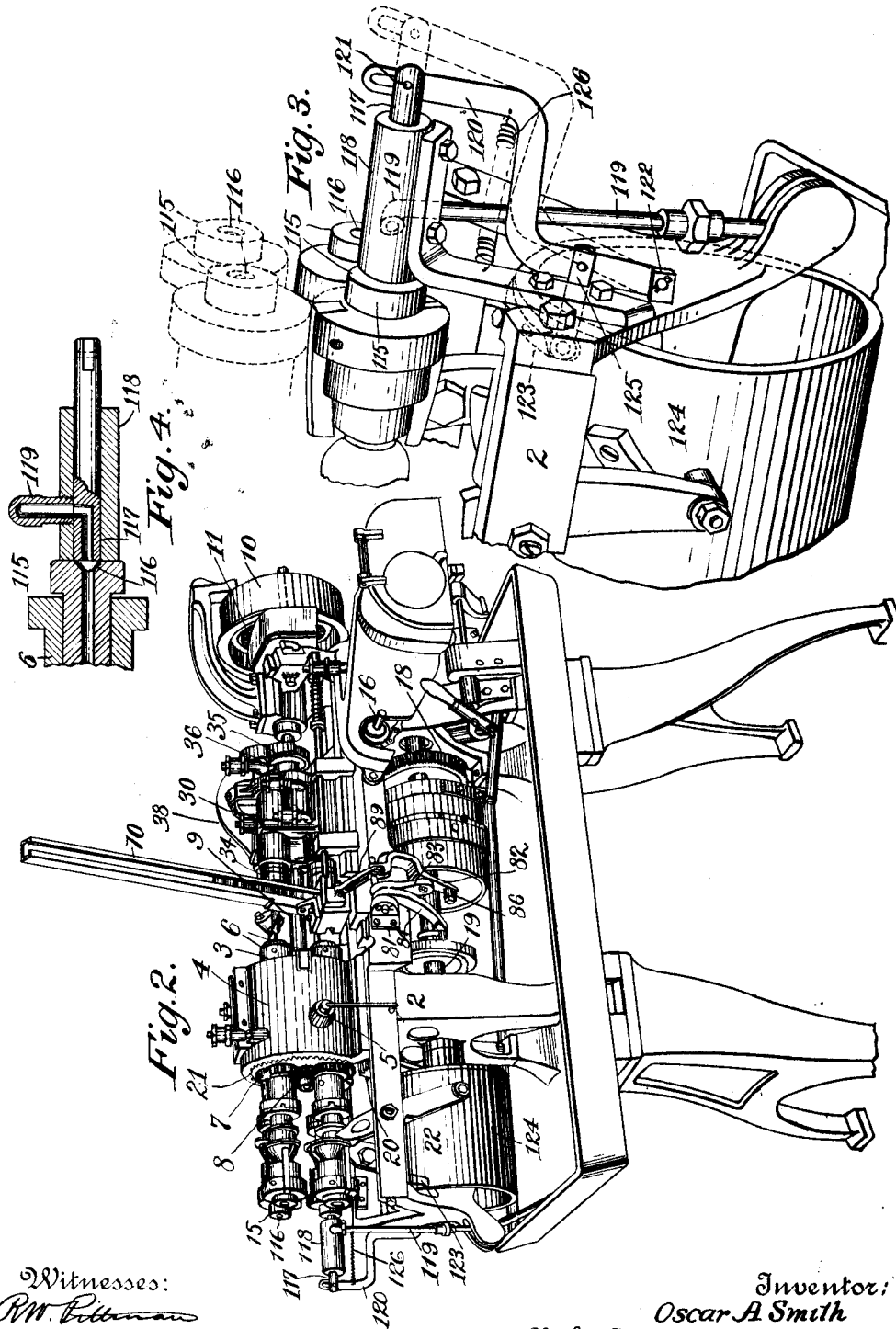
Inventor:
Oscar A. Smith
By his Attorney
C. A. Reed

1,056,066.

O. A. SMITH.
METAL WORKING MACHINE.
APPLICATION FILED JUNE 26, 1911.

Patented Mar. 18, 1913.

4 SHEETS—SHEET 2.



Witnesses:
R. W. Pittman
F. E. Royce.

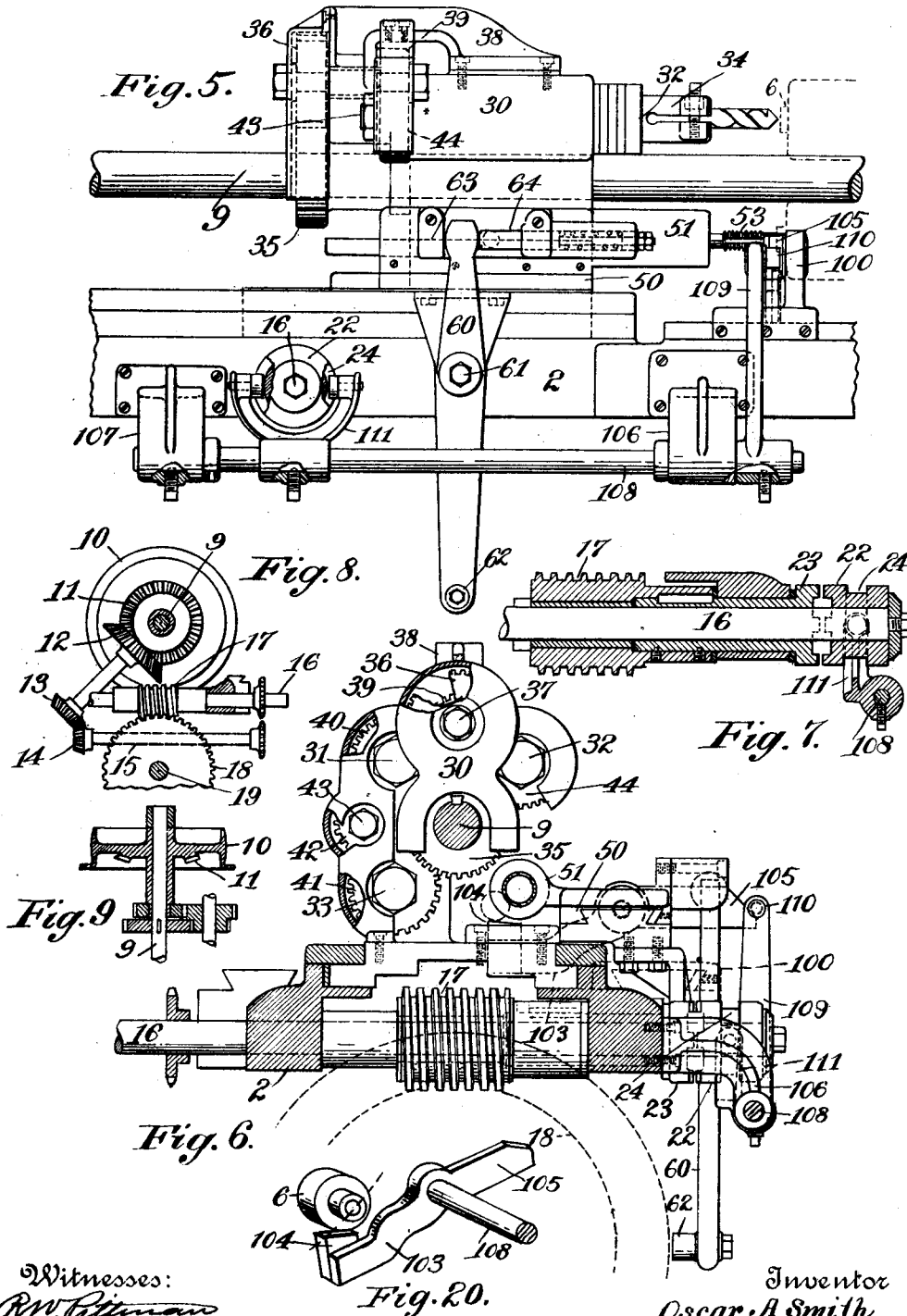
Inventor:
Oscar A. Smith
By his Attorney
G. H. Green

O. A. SMITH.
METAL WORKING MACHINE.
APPLICATION FILED JUNE 26, 1911.

1,056,066.

Patented Mar. 18, 1913.

4 SHEETS—SHEET 3.



Witnesses:
R. W. Pittman
F. E. Boyce

Inventor
Oscar A. Smith
By his Attorney
G. H. Ward

1,056,066.

4 SHEETS- SHEET 4.

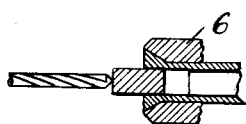
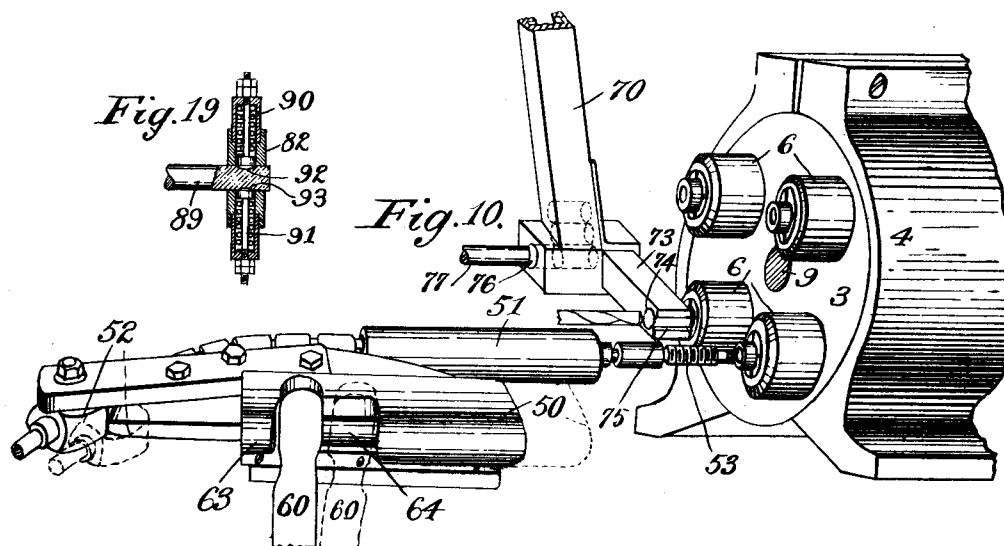


Fig. 11.

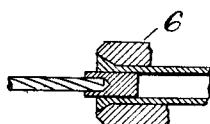


Fig.12.

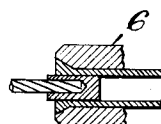
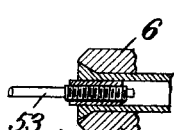


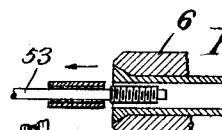
Fig. 13.



Fig. 14. ⁶



6



53  *Fig. 16.*

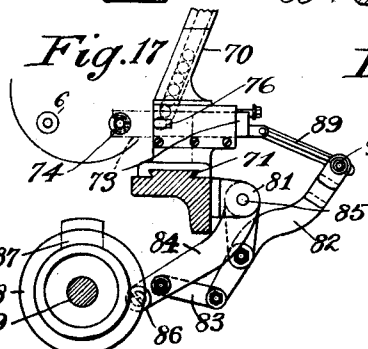


Fig. 17  70

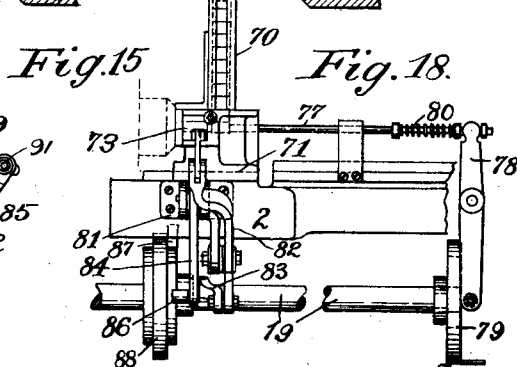


Fig. 15

Fig. 18

Witnesses:
R. W. Pittman
F. E. Boyce

Inventor
Oscar A. Smith.
By his Attorney
C. A. Mear

UNITED STATES PATENT OFFICE.

OSCAR A. SMITH, OF CLEVELAND, OHIO, ASSIGNOR TO THE NATIONAL-ACME MANUFACTURING COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

METAL-WORKING MACHINE.

1,056,066.

Specification of Letters Patent.

Patented Mar. 18, 1913.

Application filed June 26, 1911. Serial No. 635,521.

To all whom it may concern:

Be it known that I, OSCAR A. SMITH, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Metal-Working Machines, of which the following is a specification.

This invention relates to metal working machines, and more particularly to automatic multiple spindle machines, the present improvement particularly comprising a combined automatic multiple spindle drilling and tapping machine especially well adapted for the making of pipe couplings, the object of the invention being to provide an improved machine of this character in which the couplings are supplied to the machine by a suitable magazine and fed to the rotary turret by one of the drills itself and partially drilled, the companion drills successively drilling the blank or coupling from the point where the immediately preceding drill stopped, and in which, after the complete drilling of the coupling the same is automatically tapped, the tap forming the means for removing the completed blank from the turret, and in which also the blank or work carrying spindles will be rotated at the required slow speed to permit the proper tapping operation while at the same time the work spindles and drills are so rotated relatively to each other that the drilling operations will be rapidly effected and the loss of time which would result by rotating the work spindles slowly to permit the tapping operation is avoided, and in which improved machine safety mechanisms are also provided which will permit the combined operations of drilling and tapping to be carried out in the same machine so that injury and damage to the machine will be avoided should there be any imperfect feeding of the blanks or should the tap be unable to perform its proper work by the breaking of a drill, and in which also oil will be automatically fed during the tapping operation and automatically cut off during the drilling operation.

In the drawings accompanying and forming part of this specification, Figure 1 illustrates a side view of this improved machine on the magazine side thereof, portions at

each end being broken away; Fig. 2 illustrates a similar view of the complete machine; Fig. 3 is a perspective view illustrating the rear end of the machine and the oiling mechanism for the tap; Fig. 4 is a cross-sectional detail view of a portion of the mechanism shown in Fig. 3; Fig. 5 is a side view opposite to that shown in Figs. 1 and 2, illustrating a portion of the machine; Fig. 6 is a cross-sectional view taken in line 6—6, Fig. 1; Fig. 7 is a detail view of a portion of the clutch mechanism shown in Fig. 6; Figs. 8 and 9 are detail views, partly in section, illustrating the driving means for the cam shaft; Fig. 10 is a detail view illustrating the tap mechanism; Figs. 11, 12, 13, 14, 15 and 16 are sectional views illustrating the different positions of the drills and tap; Fig. 17 is a partly cross-sectional view and Fig. 18 a side view illustrating in part the means for supplying a blank to the turret chucks; Fig. 19 is a detail view of a part of such mechanism; and Fig. 20 is a detail perspective view of a part of the mechanism shown in Figs. 5 and 6.

Similar characters of reference indicate corresponding parts throughout the figures of the drawings.

In a machine of the character referred to it is necessary, in order to use a non-rotatable tap, that the work spindles carrying the blanks shall rotate at a relatively slow speed to permit the proper tapping operation. This slow speed of the work spindles, however, would result in considerable loss of time during the drilling operation, and therefore, in order to avoid this loss of time it is essential that the machine be so organized that notwithstanding the relatively slow speed of the blank or work spindles the product of the machine will not be reduced by reason of this fact, and it is also essential in an organization of this character, that damage and injury to the machine will not result should the blanks not be fed properly or the drills break off during the drilling operation. To provide such a machine is therefore the gist of the present improvement.

In the embodiment shown the operating mechanisms are carried upon a suitable bed or base 2. The rotary turret or work spindle indexing mechanism comprises a rotary

turret or cylinder 3 carried by a casing 4 fixed to the bed and having the usual locking bolt mechanism 5 for holding the turret or cylinder stationary on each indexing thereof. Carried by this turret or cylinder are a plurality of work spindles 6, shown as four in number, rotated by means of gears 7, one carried by each of the spindles and in mesh with a gear 8 carried on the spindle shaft 9, which extends through the drill slide and to the opposite end of the machine, having fixed thereto at this point a suitable driving pulley 10 carrying a bevel gear 11, which bevel gear is in mesh with a bevel gear 12 mounted on a shaft having a bevel gear 13 at its opposite end and in mesh with a bevel pinion 14 mounted on a shaft 15 supported transversely in the bed of the machine, and which shaft, by means of a suitable sprocket chain and change gearing, (not shown) imparts motion to a worm shaft 16, the worm 17 of which is loosely mounted thereon for the purpose hereinafter explained, and which worm is in mesh with a worm wheel 18 fixed to the cam shaft 19.

The turret or cylinder is rotated or indexed from the cam shaft 19 by means of a fan gear 20 fixed to the shaft and the teeth of which gear are in mesh with teeth 21 carried by the cylinder or turret, whereby the turret is indexed at predetermined intervals. Each of the work spindles is provided with a blank receiving chuck opened and closed by suitable cam mechanism 22 carried by the cam shaft 19 in the usual manner. On the worm shaft 16, upon which the worm 17 is loosely mounted, is located a pair of clutch members 22 and 23, the clutch member 22 being keyed to the shaft 16 and sliding thereon and having the usual groove 24 for the purpose hereinafter specified, while the clutch member 23 is fastened to the loosely mounted worm 17, it having a suitable bearing in the bed of the machine. From this it follows that when the clutch members are in engagement the worm will be rotated and thereby the worm wheel, to impart motion to the cam shaft, but when out of engagement the worm will be idle and therefore the rotation of the cam shaft ceases. The purpose of this organization will be explained hereinafter.

Mounted upon the bed of the machine is a sliding tool carrier 30 bored to receive three tool spindles 31, 32 and 33 located in line with three of the work spindles 6 when in their working position. In these tool spindles are secured drill holders 34. For rotating these drill holders 34, located in step formation, that is to say so arranged that one drill will project beyond a companion drill, there is housed on the spindle shaft 9 a sliding gear 35 in mesh with a spur gear 36, which is keyed to a shaft 37 having a bearing in a bracket 38 secured to the

sliding tool carrier. On the opposite end of this shaft 37 is keyed another spur gear 39 in mesh with a gear 40 keyed to drill spindle 31. A gear 41 is keyed to spindle 33 and a gear 42, carried by a stud 43, is in position to mesh with gears 40 and 41, and a gear 44 is keyed to spindle 32 and is in mesh with gear 39. This method of gearing drives all three drill spindles right handed from the spindle shaft 9, which runs through and has its bearing, as hereinbefore stated, in the turret or cylinder 3 and carries the gear 8 in mesh with the spur gears 7 carried by the work spindles 6, thus driving the work spindles in the opposite direction from the drill spindles, so that the work spindles can be rotated at a speed to suit the tap hereinafter referred to, while the drill spindles can be rotated at a greater speed to suit the drills, this being effected by changing the gears carried by the tool slide. In other words, the work spindles must be rotated at a sufficiently slow speed to permit the tap to run easily and cut through the blank, as a steel tap cannot be run in at a high speed, there being a fixed standard at which the work spindles can be rotated to permit the proper tapping operations, and therefore, as stated, the work spindles must be run slowly in order to permit the tapping operation to be effected; but in order to drill at a high speed and thus turn out the product quickly, the drills are run in the opposite direction and faster than the work spindles are run, thus giving a much greater speed than could otherwise be obtained.

On the tool slide or sliding tool carrier 30, under the drill spindle 32, a slide 50 is gibbed in the usual way. On this slide 50 is a long bearing 51 bored in line with one of the work spindles when the cylinder is in its working position. This bore is bushed to suit the diameter of the work blanks to be tapped. At the rear end of this slide is pivoted a swinging bearing 52 also bored to the size of the work blanks. These two bearings 51 and 52 hold the curved tap 53. This swinging bearing 52 is essential in order to relieve the strain on the tap when the completed work blanks are passing over the shank of the tap. The action of this bearing can be plainly observed in Fig. 10. In other words, when a blank is passing over the threaded portion of the tap it comes into contact with a blank that has previously been threaded and passed over the threaded portion of the tap, so that eventually the shank of the tap will be completely inclosed with completed or tapped blanks. Each blank passing over the threaded portion of the tap and coming into contact with a blank that has just previously passed over the tap, has to make room for itself on the shank of the tap by forcing the blanks ahead of it the length of a blank. If the tap remained

in its neutral position during the tapping operation in the bearings 51 and 52, which neutral position is central with the bores of such bearings, there would be no advantage in having the bearing 52 swing, but as the tap passes through the blank it causes the curved end thereof to advance laterally the length of the threaded portion of the tap, which would cause it to cramp in the bearing 52 so that the blank would not be allowed to freely pass over the shank of the tap; but by having this bearing 52 swing it automatically changes its position of alignment with the travel of the tap, thus relieving the cramping of the blanks when they are passing over the shank of the tap. The tap slide 50 is operated toward and from the turret by means of a lever 60 and a suitable stud 61 and roller 62 engaged by a cam on the cam drum mounted on the cam shaft 19 hereinbefore referred to. The end of this lever 60 is located between an extension 63 on the slide 50 and a spring plunger 64 carried by the slide, so that when starting the tap into the blank the slide 50 pushes against the plunger 64 and avoids all danger of spoiling the threads in the work blank.

From the foregoing it will be observed that although the tap slide is carried by the tool carrier or slide it also has a movement independently thereof at the proper time to permit the tapping operation, and that by means of the swinging or swiveled bearing 52 the tapped blanks can be properly fed from the curved shank of the tap without any cramping thereof, the tap thus operating not only to tap the blanks, but to feed the same from the chuck of the work spindle when such chuck is opened at the proper time by the mechanism provided for that purpose, thus obviating the use of any ejecting mechanism for ejecting the completed blank.

The feeding mechanism for feeding the blanks successively to the chucks of the work spindles comprises a magazine 70 carrying the cut off blanks. The lower end of this magazine is secured to a housing 71 dovetailed to the main bed of the machine for movement toward and from the turret. In this housing, and supported to slide easily at right angles to the axis of the work spindles, is a slide 73. At a suitable distance from the inner end of this slide 73 is bored a hole 74 having the same diameter as the work blanks, which hole is located in exact alignment with one of the work spindles when the turret is in its stopped position and with a drill in the drill spindle 32. A slot 75 is machined in the end of this slide to communicate with the hole, and which slot is slightly larger in diameter than the drill to allow it to pass over the drill when the drill is operating on the work or

blank in the work spindle. In the housing 71, at the required distance from the front end thereof and at right angles to the slide 73, is bored a hole 76 of the same diameter as the work blanks, which hole will be in alignment with the hole 74 in the slide 73 when the latter is retracted, and over this hole 76 the blank carrier or magazine 70 is belted so that the work blanks will successively drop into this hole 76 of the housing 71 and not interfere with the working of the slide 73. For pushing the blanks from the hole or opening 76 in the housing into the hole or opening of the slide 73 a suitable plunger 77 is supported on the bed in alignment with this hole 76. To the outer end of this plunger is fastened a lever 78 pivotally supported on the bed of the machine, and which lever is operated by a cam 79 on a cam drum carried by the cam shaft, by means of which the plunger will be operated at the proper time to push a blank into the slide 73, a suitable spring 80 being provided on the plunger for returning the plunger or rod to its normal position.

For operating the slide 73 a slotted bracket 81 is bolted to the bed of the machine. One end of this bracket is extended downward and carries a pivoted lever 82 on the lower end of which is fastened a short lever 83, the opposite end of which is secured to a master lever 84, which lever 84 is pivotally supported at its upper end by a bracket 85 secured to the bed of the machine, while its lower end carries a roller 86 in position to contact with a suitable cam 87 carried by a cam drum 88 on the cam shaft 19, see Fig. 17. The upper end of the lever 82 is crotched to receive a slotted link 89, the opposite end of which link 89 is pivotally secured to the slide 73 at the outer end thereof. Housed in the crotched end of the lever 82, see Fig. 19, are two spring plungers 90 and 91, the inner ends of which are adapted to engage depressions 92 and 93, one on each side, in the end of the slotted link 89, and thus form the connecting means between the lever 82 and the slotted link. The springs of these plungers are strong enough to withstand the strain of feeding the slide 73 to its proper position. Should the slide 73 clog the plungers will be forced out of the depressions so that the lever 82 can move forward in the slot of the link and thus allow the plungers to slide freely in the slot without operating the slide 73. On the return of the lever 82 the plungers will automatically project into the depressions in the sides of the slotted link, thereby again forming a proper connection. This mechanism thus avoids the breaking of the parts due to any imperfect feeding of the blanks into the bore or opening of the slide 73.

To the bed of the machine, on the tap side thereof, is dovetailed a bracket 100, to which

bracket is pivoted a lever 103, to the front end of which is fastened a plate 104 directly in front of the work spindle. On the other end of this lever 103 is fastened a tapered steel inclined shoe 105. Secured to the bed of the machine are brackets 106 and 107, in which is housed a shaft 108, on one end of which is fastened a lever 109 having a roller 110 in contact with the inclined steel shoe 105. A clutch lever 111 is fastened to the shaft 108 and engages in the groove 24 of the sliding clutch member 22 keyed to the worm shaft 16.

From the foregoing it will be observed that should a piece of work not be removed from the work spindle by the tap, as for instance should the tap be prevented from passing through the blank by the breaking of the drill so that the tap cannot remove the blank from the chuck upon the indexing of the cylinder, this imperfect work blank will come into contact with the lever 103, which will thus operate the shaft 108 and disconnect the clutch members 22 and 23 and thus prevent the cam shaft from turning and so prevent further rotation of the turret or cylinder, and consequently prevent breakage of the several parts, for instance the feeding mechanism and any of the drills. In other words, on the stoppage of the cam shaft the operation of all the mechanisms depending upon it are also stopped.

For supplying the proper quantity of oil to each of the work spindles as they are successively brought into tapping position each of the four spindles is provided with a housed bronze bushing 115 drilled with a suitable countersunk hole 116 to receive the tapered end of a plunger 117 carried by a suitable bearing 118 supported at the rear end of the bed. Into the bearing 118 is tapped an oil-conveying pipe 119. The plunger 117 is provided with an axial opening from the front end thereof and with a cross hole communicating therewith, which cross hole, when the plunger projects into the bronze bushing of a work spindle, is in communication with the end of the oil-supply pipe 119, so that oil will then be allowed to flow from pipe 119 through the plunger 117 into the spindle. To the outer end of the plunger 117 is fastened a slotted lever 120 by means of a pin 121. The lower end of this lever 120 is pivoted to a bracket 122 on the bed of the machine, and by means of a cam 123 on a cam drum 124 and a connecting member 125 and spring 126 the plunger 117 is drawn into and out of the connection with the work spindle at the required time, so that when each work spindle is brought into position for the tapping operation oil is allowed to freely flow into the same. Just before the cylinder indexes to a new position the plunger 117 is withdrawn and held in such position until the

cylinder has been indexed, when it enters the next succeeding spindle, the oil being shut off automatically during the interval by reason of the fact that the plunger is moved away from the oil-supply pipe tapped into the bearing 118. As the blank has been completely drilled or bored when it is carried by the turret to the tapping position, it follows that the oil supplied at the rear end of the spindle, when the blank is in its tapping position can flow through such spindle and the blank and so flush the latter and clear it of chips and pieces of metal and also act upon the threaded end of the tap as it penetrates the blank, and so maintain the same thoroughly lubricated at the point where most needed, namely at the end of the tap within the blank.

In operation, the rod or plunger 77 having pushed a blank from the opening or hole in the housing 71 into the opening or hole of the slide 73, the slide 73 is caused to advance through the medium of the levers 82, 83 and 84 and the cam mechanism provided for operating these levers, until the blank is in alinement with the lower work spindle at one side of the turret. The tool slide is then rapidly advanced by the usual cam mechanism provided on the cam shaft for that purpose, whereupon the drill in the drill spindle pushes the work blank from the slide 73 into the chuck of the work spindle, which chuck has of course been opened or released by means of the usual cam provided for this purpose, whereupon the chuck is closed to grip the work blank. When the blank has been properly gripped by its chuck the continued rapid advance of the tool slide is retarded to the speed possible to enable the drill to drill the work blank. These two speeds are regulated by means of cams on the cam drum on the cam shaft. In the meantime the slide 73, through the levers hereinbefore referred to, is withdrawn to its loading position. The cam on the cam drum for operating the tool slide has a lead that will carry the drill one-third way through the work blank. When the tool slide has advanced to the extreme length of travel it is returned rapidly by means of the cams on the cam drum to its initial position and the cylinder is indexed in the usual way, thus bringing this same work blank which has been drilled one-third the distance thereof into line with spindle 31, whereupon the tool slide is again advanced in the manner hereinbefore explained, while the drill in spindle 31 starts to drill where the drill in spindle 33 left off, thus drilling a blank two-thirds of the way therethrough. When this drilling operation is completed the tool slide is again retracted and the cylinder indexed, thus bringing the same blank into alinement with the drill of drill spindle 32, whereupon as the slide again ad-

vances the drill in this spindle 32 starts drilling where the last drill left off and drills the last third or through the entire blank, whereupon the tool slide returns to its neutral position. The cylinder is again indexed to the last or fourth position, bringing the completely drilled blank into line with the tap, whereupon the tap is advanced into the blank by the means provided for that purpose, and when the threaded portion of the tap has passed through the work blank the chuck of the work spindle is opened in the usual manner, thus allowing the work slide to recede to its initial position, the tap removing the blank from the work spindle. Thus the complete indexing of the spindle and the succeeding advancing and retracting of the tool slide with its plurality of drills, one projecting beyond another, results in one complete drilled and tapped blank at each complete indexing of the cylinder, while the successively tapped blanks are withdrawn from the work spindles and discharged from the free end of the curved tap shank.

Of course it will be understood that while one drill is drilling a third of the way into a blank a companion drill is drilling a previously drilled blank from the point where the first drill left off, while another drill is drilling another blank from the point where the second drill left off, and that while these drilling operations are going on at a relatively rapid speed by reason of the fact that the drills are rapidly rotated in one direction while the work blanks are rotated in another, the tapping operation in the fourth work spindle is also proceeding, the work spindles, however, being rotated sufficiently slow to permit the proper effective operations of the tap, the successive drilling operations occurring, the first at the bottom of the turret at the same side as that on which the magazine is located, the second at the top of the turret at the same side as the magazine, the third on the opposite side of the magazine at the top, while the tapping operation takes place at the bottom of the turret on the side opposite to the magazine. Thus it will be observed that the first drill not only drills the blank through one-third thereof, but that this drill also acts to feed the blank into the chuck, pushing the blank from the slide 73 into the chuck to permit the same to be gripped and then continuing to drill the blank through one-third thereof.

By the present improvement I am enabled materially to increase the quantity of the product of the machine.

In operation, as soon as the tap has completed the tapping operation it starts back and pulls the blank from the chuck, which is opened to permit this to be done, this retracting movement of the tap being inde-

pendent of the retracting movement of the tool slide. By using one of the drills as the means for feeding or pushing the blanks into the chuck it makes it possible to do away with an independent plunger to push the blanks into the chuck, and thus enables another drill to be used in the machine, for the reason that when a plunger is used no work can be done upon the blank until the blank is indexed to a succeeding position. By having the tap formed with a curved shank it will be understood that the tapped blanks form the means for supporting the tap in its bearings.

I claim as my invention:

1. In a machine of the class described, the combination of a turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, means for rotating the work spindles in one direction at a relatively slow speed, a sliding tool carrier carrying a plurality of tools, means for reciprocating said tool carrier, means for rotating the tools in a direction opposite to the direction of rotation of the work spindles and at a relatively rapid speed as compared with the speed of the work spindles, whereby the cutting speed of the tools is increased notwithstanding the decreased rotation of the work spindles, and means for threading each successive blank at the speed at which said blank is rotated.

2. In a machine of the class described, the combination of a turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, means for rotating the work spindles in one direction at a relatively slow speed, a sliding tool carrier carrying a plurality of tools, means for reciprocating the tool carrier, means for rotating the tools in a direction opposite to the direction of rotation of the work spindles and at a relatively rapid speed as compared with the speed of the work spindles, whereby the cutting speed of the tools is increased notwithstanding the decreased rotation of the work spindles, and means for tapping each successive blank at the speed at which said blank is rotated and comprising a tap and means for operating the same, the tap being effective to withdraw the tapped blank from its work spindle and for discharging the same from the free end thereof.

3. In a machine of the class described, the combination of a turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, means for rotating the work spindles in one direction at a relatively slow speed, a sliding tool carrier carrying a plurality of tools, means for reciprocating the tool carrier, means for rotating the tools in a direction opposite to the direction of rotation of the work

spindles and at a relatively rapid speed as compared with the speed of the work spindles, whereby the cutting speed of the tools is increased notwithstanding the decreased rotation of the work spindles, and means for tapping each successive blank at the speed at which said blank is rotated and comprising a curved ended tap, means for operating the same, the tap being effective to withdraw the tapped blank from its work spindle and for discharging the same from the free end thereof, and swinging means for supporting the curved end of the tap thereby to prevent the cramping of the blanks as they pass along the tap.

4. In a machine of the class described, the combination of a turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, means for rotating the work spindles, a sliding tool carrier carrying a plurality of tools set one in advance of another, means for locating a blank in position relatively to each of the work spindles, means for reciprocating said tool carrier so that the most advanced tool will feed a blank to the work spindle, and means for rotating the tools.

5. In a machine of the class described, the combination of a turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, means for rotating the work spindles, a sliding tool carrier carrying a plurality of drills set one in advance of another, means for reciprocating said tool carrier, means for rotating the drills, and means for tapping each successive blank and comprising a curved ended tap, means for operating the same, the tap being effective to withdraw the tapped blank from its work spindle and for discharging the same from the free end of the tap, and swinging means for supporting the curved end of the tap thereby to prevent the cramping of the blanks as they pass along the tap.

6. In a machine of the class described, the combination of a rotary turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, means for rotating the work spindles, a sliding tool carrier carrying a plurality of drills set one in advance of another, means for locating a blank in alinement with a work spindle and with one of the drills, and means for operating the tool carrier whereby one of the drills will feed a blank to a work spindle and drill the blank part way therethrough, the companion drills operating from points where the preceding drills left off.

7. In a machine of the class described, the combination of a rotary turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, means for rotating the work spindles, a slid-

ing tool carrier carrying a plurality of drills set one in advance of another, means for locating a blank in alinement with a work spindle and with one of the drills, means for operating the tool carrier whereby one of the drills will feed a blank to a work spindle and drill the blank part way therethrough, the companion drills operating from points where the preceding drills left off, and means for tapping each successive blank.

8. In a machine of the class described, the combination of a rotary turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, means for rotating the work spindles, a sliding tool carrier carrying a plurality of drills set one in advance of another, means for locating a blank in alinement with a work spindle and with one of the drills, means for operating the tool carrier whereby one of the drills will feed a blank to a work spindle and drill the blank part way therethrough, the companion drills operating from points where the preceding drills left off, and means for tapping each successive blank and comprising a curved ended tap, means for operating the same, the tap being effective to withdraw the tapped blank from its work spindle and for discharging the same from the free end of the tap, and swinging means for supporting the curved end of the tap thereby to prevent the cramping of the blanks as they pass along the tap.

9. In a machine of the class described, the combination of a turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, means for rotating the work spindles in one direction at a relatively slow speed, a sliding tool carrier carrying a plurality of tools set one in advance of another, means for reciprocating said tool carrier, means for rotating the tools in a direction opposite to the direction of rotation of the work spindles and at a relatively rapid speed as compared with the speed of the work spindles, whereby the cutting speed of the tools is increased notwithstanding the decreased rotation of the work spindles, and means for threading each successive blank at the speed at which said blank is rotated.

10. In a machine of the class described, the combination of a turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, means for rotating the work spindles in one direction at a relatively slow speed, a sliding tool carrier carrying a plurality of tools set one in advance of another, means for reciprocating said tool carrier, means for rotating the tools in a direction opposite to the direction of rotation of the work spindles and at a relatively rapid speed as

compared with the speed of the work spindles, whereby the cutting speed of the tools is increased notwithstanding the decreased rotation of the work spindles, and means for tapping each successive blank at the speed at which said blank is rotated.

11. In a machine of the class described, the combination of a turret having a plurality of work spindles adapted to carry blank, means for indexing the turret, means for rotating the work spindles in one direction at a relatively slow speed, a sliding tool carrier carrying a plurality of tools set one in advance of another, means for reciprocating said tool carrier, means for rotating the tools in a direction opposite to the direction of rotation of the work spindles and at a relatively rapid speed as compared with the speed of the work spindles, whereby the cutting speed of the tools is increased notwithstanding the decreased rotation of the work spindles, and means for tapping each successive blank at the speed at which said blank is rotated and comprising a tap and means for operating the same, the tap being effective to withdraw the tapped blank from its work spindle and for discharging the same from the free end thereof.

12. In a machine of the class described, the combination of a turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, means for rotating the work spindles in one direction at a relatively slow speed, a sliding tool carrier carrying a plurality of tools set one in advance of another, means for reciprocating said tool carrier, means for rotating the tools in a direction opposite to the direction of rotation of the work spindles and at a relatively rapid speed as compared with the speed of the work spindles, whereby the cutting speed of the tools is increased notwithstanding the decreased rotation of the work spindles, and means for tapping each successive blank at the speed at which said blank is rotated and comprising a curved ended tap, means for operating the same, the tap being effective to withdraw the tapped blank from its work spindle and for discharging the same from the free end thereof, and swinging means for supporting the curved end of the tap thereby to prevent the cramping of the blanks as they pass along the tap.

13. In a machine of the class described, the combination of a turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, means for rotating the work spindles in one direction at a relatively slow speed, a sliding tool carrier carrying a plurality of tools set one in advance of another, means for reciprocating the tool carrier, means for rotating the tools in a direction opposite to the di-

rection of rotation of the work spindles and at a relatively rapid speed as compared with the speed of the work spindles, whereby the cutting speed of the tools is increased notwithstanding the decreased rotation of the work spindles, means for locating a blank in alinement with a work spindle and with one of the tools whereby on the forward movement of the sliding tool carrier the tool will feed the blank to the work spindle, and means for tapping each successive blank at the speed at which said blank is rotated.

14. In a machine of the class described, the combination of a turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, means for rotating the work spindles in one direction at a relatively slow speed, a sliding tool carrier carrying a plurality of drills set one in advance of another, means for reciprocating the tool carrier, means for rotating the drills in a direction opposite to the direction of rotation of the work spindles and at a relatively rapid speed as compared with the speed of the work spindles; whereby the cutting speed of the tools is increased notwithstanding the decreased rotation of the work spindles, means for locating a blank in alinement with a work spindle and with one of said drills whereby said drill will feed the blank to the work spindle and drill the blank part way there-through, the companion drills operating from points where preceding drills left off, and means for tapping each successive blank at the speed at which said blank is rotated and comprising a curved ended tap, means for operating the same, the tap being effective to withdraw the tapped blank from its work spindle and for discharging the same from the free end thereof, and swinging means for supporting the curved end of the tap thereby to prevent cramping of the blanks as they pass along the tap.

15. In a machine of the class described, the combination of a turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, means for rotating the work spindles in one direction at a relatively slow speed, a sliding tool carrier carrying a plurality of drills set one in advance of another, means for reciprocating the tool carrier, means for rotating the drills in a direction opposite to the direction of rotation of the work spindles and at a relatively rapid speed as compared with the speed of the work spindles, whereby the cutting speed of the tools is increased notwithstanding the decreased rotation of the work spindles, means for locating a blank in alinement with a work spindle and with one of said drills whereby said drill will feed the blank to the work spindle and drill the blank part way there-through, the companion drills operating from points

where preceding drills left off, means for tapping each successive blank at the speed at which said blank is rotated and comprising a curved ended tap, means for operating the same, the tap being effective to withdraw the tapped blank from its work spindle and for discharging the same from the free end thereof, swinging means for supporting the curved end of the tap thereby to prevent cramping of the blanks as they pass along the tap, and means operated by an unextracted piece of work for throwing a part of the driving mechanism out of operation on the failure of the tap to extract such piece of work.

16. In a machine of the class described, the combination of a turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, means for rotating the work spindles in one direction at a relatively slow speed, a sliding tool carrier carrying a plurality of drills set one in advance of another, means for reciprocating the tool carrier, means for rotating the drills in a direction opposite to the direction of rotation of the work spindles and at a relatively rapid speed as compared with the speed of the work spindles, whereby the cutting speed of the tools is increased notwithstanding the decreased rotation of the work spindles, means for locating a blank in alinement with a work spindle and with one of said drills whereby said drill will feed the blank to the work spindle and drill the blank part way therethrough, the companion drills operating from points where preceding drills left off, means for tapping each successive blank at the speed at which said blank is rotated and comprising a curved ended tap, means for operating the same, the tap being effective to withdraw the tapped blank from its work spindle and for discharging the same from the free end thereof, swinging means for supporting the curved end of the tap thereby to prevent cramping of the blanks as they pass along the tap, means operated by an unextracted piece of work for throwing a part of the driving mechanism out of operation on the failure of the tap to extract such piece of work, and means for preventing the feeding of a blank should the feeding mechanism become clogged.

17. In a machine of the class described, the combination of a rotary turret having a plurality of work spindles, means for indexing the turret, means for rotating the spindles, a sliding tool carrier carrying a plurality of tools set one in advance of another, means for locating a blank in alinement with a work spindle and with one of the tools and including driving means therefor, means for operating the tool carrier so that the most advanced tool will feed a blank to a work spindle and operate there-

on, the companion tools operating from points where the preceding tools left off, and means permitting the blank locating means to be ineffective and to remain stationary should the same become clogged, without interfering with the operation of such driving means.

18. In a machine of the class described, the combination of a rotary turret having a plurality of work spindles, means for indexing the turret, means for rotating the spindles, a sliding tool carrier carrying a plurality of drills set one in advance of another, a magazine for carrying blanks, sliding means for feeding blanks successively in alinement with one of the work spindles and with one of the drills and including driving means therefor, means for operating the tool carrier whereby one of the drills will feed a blank to a work spindle and drill the blank part way therethrough, the companion drills operating from points where the preceding drills left off, and means for permitting the sliding blank feeding means to be ineffective and to remain stationary should the same become clogged, without interfering with the operation of such driving means.

19. In a machine of the class described, the combination of a rotary turret having a plurality of work spindles, means for indexing the turret, a sliding tool carrier carrying a plurality of drills set one in advance of another, means for locating a blank in alinement with a work spindle, means for operating the tool carrier whereby one of the drills will feed a blank to a work spindle and drill the blank part way therethrough, the companion drills operating from points where the preceding drills left off, a tap for tapping each successive blank and extracting the same, and means operated by an unextracted piece of work for throwing a part of the driving mechanism out of operation on the failure of the tap to extract such piece of work.

20. In a machine of the class described, the combination of a turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, a sliding tool carrier carrying a plurality of tools set one in advance of another, means for reciprocating the tool carrier, means for locating a blank in alinement with the work spindle and with one of the tools whereby said tool will feed a blank to the work spindle and operate upon the same part way therethrough, the companion tools operating from points where the preceding tools left off, means operated by an unextracted piece of work for throwing a part of the driving mechanism out of operation on the failure of the tap to extract such piece of work, and means for tapping each successive blank and comprising a tap effective to

withdraw the tapped blank from its work spindle and for discharging the same from the free end thereof.

21. In a machine of the class described, the combination of a turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, a sliding tool carrier carrying a plurality of tools, means for reciprocating the tool carrier, means for rotating the spindles or tools, whereby one or more of the blanks will be completely penetrated during each revolution of the turret, each of said spindles having an opening entirely therethrough, and oil supply mechanism for automatically supplying oil to the rear end of each work spindle.

22. In a machine of the class described, the combination of a turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, a sliding tool carrier carrying a plurality of tools, means for reciprocating the tool carrier, means for rotating the tools, means for tapping each successive blank and comprising a tap, means for operating the same, and means for automatically supplying oil to each work spindle from the rear end of such spindle during the tapping operation.

23. In a machine of the class described, the combination of a turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, a sliding tool carrier carrying a plurality of tools, means for reciprocating the tool carrier, means for rotating the work spindles or the tools, means for tapping each successive blank and comprising a tap and means for operating the same, and means for automatically supplying oil at the rear end of each work spindle during the tapping operation and for cutting off the same during the indexing of the turret.

24. In a machine of the class described, the combination of a turret having a plurality of work spindles, each provided with an opening therethrough and adapted to carry a blank, means for indexing the turret, a sliding tool carrier carrying a plurality of tools, one or more effective to penetrate entirely through a blank, means for reciprocating the tool carrier, means for rotating the work spindles or the tools, and means for automatically supplying oil to each work spindle at the rear end thereof and for cutting off such supply during the indexing of the turret.

25. In a machine of the class described, the combination of a rotary turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, a sliding tool carrier carrying a plurality of tool spindles, means for reciprocating the tool carrier, means for rotating certain spindles, means for tapping each successive

blank and comprising a slide and a tap carried by the tool carrier, and means for automatically advancing the tap slide and tap independently of the tool carrier to start the same into the work.

26. In a machine of the class described, the combination of a rotary turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, a sliding tool carrier carrying a plurality of tool spindles, means for reciprocating the tool carrier, means for rotating some of the spindles, means for tapping each successive blank and comprising a slide and a tap carried by the tool carrier, and means for advancing the tap slide and tap independently of the tool carrier, the tap being effective to withdraw the tapped blank from its work spindle and for discharging the same from the free end thereof.

27. In a machine of the class described, the combination of a rotary turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, a sliding tool carrier carrying a plurality of tool spindles, means for reciprocating the tool carrier, means for rotating some of the spindles, means for tapping each successive blank and comprising a tap carried by the tool carrier, means for advancing the tap independently of the tool carrier, the tap being effective to withdraw the tapped blank from its work spindle and for discharging the same from the free end thereof, said tap having a curved ended shank, and swinging means for supporting the shank of the tap thereby to prevent the cramping of the blanks as they pass along the tap.

28. In a machine of the class described, the combination of a rotary turret having a plurality of work spindles adapted to carry blanks, means for indexing the turret, a sliding tool carrier carrying a plurality of tool spindles, means for reciprocating the tool carrier, means for rotating some of the spindles, means for tapping each successive blank and comprising a tap carried by the tool carrier, means for advancing the tap independently of the tool carrier, and means for automatically supplying oil to each of the work spindles from the rear end thereof during the tapping operation and for cutting off such supply during the indexing operation.

29. In a machine of the class described, the combination of a rotary turret having a plurality of rotating work spindles adapted to carry blanks, means for indexing the turret, means for rotating the work spindles in one direction, a sliding tool carrier carrying a plurality of drills set one in advance of another, means for reciprocating the tool carrier, means for rotating the drills in a direction opposite to the direction of rotation of the work spindles, means for tapping

each successive blank and comprising a tap supported for movement with and independently of the tool carrier, means for operating the tap, means for automatically supplying oil to the rear end of the work spindles successively as each is brought into the tapping position, a magazine for holding blanks, blank locating means for locating a blank in alinement with a work spindle and with one of the drills, and means for pushing the blanks into the blank locating means whereby the drill on the forward movement of the tool carrier will feed a blank to one of the spindles and drill part way therethrough, each companion drill commencing operation where the preceding drill left off.

30. In a machine of the class described, the combination of a rotary turret having a plurality of work spindles, a cam shaft, means carried thereby for indexing the turret, a sliding tool carrier carrying a plurality of tools, means carried by the cam shaft for reciprocating the sliding tool carrier, a worm wheel on said shaft, a worm shaft, a worm loosely mounted thereon and in mesh with said worm wheel on the cam shaft, a pair of clutch members mounted on said worm shaft and one fastened to the worm thereof, and means for disconnecting the clutch members thereby to stop the rotation of the cam shaft on the breakage of a tool or part.

31. In a machine of the class described, the combination of a rotary turret having a plurality of work spindles, a cam shaft, means carried thereby for indexing the turret, a sliding tool carrier carrying a plurality of tools, means carried by the cam shaft for reciprocating the sliding tool carrier, a worm wheel on said shaft, a worm shaft, a worm loosely mounted thereon and in mesh with said worm wheel on the cam shaft, a pair of clutch members mounted on said worm shaft and one fastened to the worm thereof, and means for disconnecting the clutch members thereby to stop the rotation of the cam shaft on the breakage of a tool or part, said means comprising a member in position to be operated on the indexing of the turret.

32. In a machine of the class described, the combination of a rotary turret having a plurality of work carrying spindles, means for indexing the turret, a sliding tool carrier, a plurality of tools carried thereby, means for reciprocating the tool carrier, tapping mechanism carried by said tool carrier and having a movement independently thereof and comprising a curved ended tap, and swinging means for supporting the curved end of said tap thereby to prevent the cramping of the tapped blanks as they pass along the tap.

33. In a machine of the class described, the combination of a rotary turret having a

plurality of work carrying spindles, means for indexing the turret, a sliding tool carrier, a plurality of tools carried thereby, means for reciprocating said tool carrier, tapping mechanism comprising a curved ended tap supported in position to operate on the work carried by one of the work carrying spindles, and swinging means for supporting the curved end of the tap whereby to prevent cramping of the tapped blanks as they pass along the tap.

34. In a machine of the class described, the combination of a rotary turret having a plurality of work carrying spindles, means for indexing the turret, a sliding tool carrier carrying a plurality of tools, means for reciprocating the tool carrier, tapping mechanism comprising a curved ended tap supported in position to successively work upon blanks carried by the work carrying spindles, and movable means for supporting the curved end of the tap thereby to prevent the cramping of the tapped blanks as they pass along the tap.

35. In a machine of the class described, the combination of a rotary turret having a plurality of work carrying spindles, means for indexing the turret, a sliding tool carrier carrying a plurality of tools, means for reciprocating the tool carrier, tapping mechanism comprising a curved ended tap supported in position to successively work upon blanks carried by the work carrying spindles, movable means for supporting the curved end of the tap thereby to prevent the cramping of the tapped blanks as they pass along the tap, and means for advancing the tap independently of the tool carrier.

36. In a machine of the class described, the combination of a rotary turret having a plurality of work carrying spindles, means for indexing the turret, a sliding tool carrier carrying a plurality of tools, means for reciprocating the tool carrier, tapping mechanism comprising a curved ended tap supported in position to successively work upon blanks carried by the work carrying spindles, movable means for supporting the curved end of the tap thereby to prevent the cramping of the tapped blanks as they pass along the tap, and means for advancing the tap independently of the tool carrier, said tap being supported by and having a forward and backward movement with the tool carrier.

37. In a machine of the class described, the combination of blank supporting means and tap supporting means, a curved ended tap, swinging means for supporting the curved end of said tap thereby to prevent the cramping of the tapped blanks as they pass along the tap, means for operating one of said means toward and from the other, and means for imparting relative rotation between the blank and tap.

38. In a machine of the class described, the combination of blank supporting means and tap supporting means, a curved ended tap, swinging means for supporting the curved end of said tap thereby to prevent the cramping of the tapped blanks as they pass along the tap, means for operating the tap toward and from the blank, and means for imparting relative rotation between the blank and tap.

39. In a machine of the class described, the combination of a bed, blank supporting means carried thereby, tap supporting means carried thereby, a curved ended tap carried by said tap supporting means, movable means for supporting the curved end of the tap thereby to prevent the cramping of the tapped blanks as they pass along the tap, and means for imparting relative rotation between the blank and tap.

40. In a machine of the class described, the combination of a bed, blank supporting means carried thereby, tap supporting means carried thereby, a curved ended tap carried by said tap supporting means, movable means for supporting the curved end of the tap thereby to prevent the cramping of the tapped blanks as they pass along the tap, means for advancing the tap to the work, and means for imparting relative rotation between the blank and tap.

41. In a machine of the class described, the combination with a bed, of blank supporting means carried thereby, tap supporting means carried thereby and having a bore for the passage of the blanks, a curved ended tap carried at one part by the blanks passing through the bore of said tap supporting means, movable means for supporting the curved end of the tap thereby to prevent the cramping of the blanks as they pass along the tap, means for shifting one of said supporting means to effect the tapping of the blank, and means for imparting relative rotation to the blank and tap.

42. In a machine of the class described, the combination of blank supporting means, tap supporting means, a curved ended tap carried thereby, swinging means for supporting the curved end of said tap thereby to prevent the cramping of the tapped blanks as they pass along the tap, means for imparting to the tap a movement independent

ent of a part of its supporting means, and means for imparting relative rotation between the blank and tap.

43. In a machine of the class described, the combination with a bed, of blank supporting means carried thereby, tap supporting means carried thereby and comprising a compound slide consisting of a pair of slides, a curved ended tap carried by said compound slide, movable means for supporting the curved end of the tap thereby to prevent the cramping of the blanks as they pass along the tap, means for shifting the compound slide and thereby the tap, means for advancing one slide of said compound slide and the tap carried thereby independently of the other slide of such compound slide, and means for imparting relative rotation between the blank and tap.

44. In a machine of the class described, the combination with a bed, of blank supporting means carried thereby, tap supporting means carried thereby and having a bore for the passage of the blanks, a curved ended tap carried at one part by the blanks passing through the bore of said tap supporting means, movable means also having a bore for the passage of the blanks for supporting the curved end of the tap thereby to prevent the cramping of the blanks as they pass along the tap, means for shifting one of said supporting means to effect the tapping of a blank, and means for imparting relative rotation between the blank and tap.

45. In a machine of the class described, the combination with a bed, of a blank supporting member carried thereon, a tap supporting member carried thereon, a curved ended tap carried by said tap supporting member, movable means for supporting the curved end of said tap thereby to prevent the cramping of the tapped blanks as they pass along the tap, means for moving one of said members toward and from the other, and means for imparting relative rotation between the blank and tap.

Signed at Cleveland, Ohio, this 21st day of June, 1911.

OSCAR A. SMITH.

Witnesses:

A. W. HOPKINS,
W. R. MITCHELL.