Jan. 25, 1949. R. E. VANDERHIDE 2,460,156

AUTOMATIC DRILLING MACHINE

Filed April 4, 1945 3 Sheets-Sheet 1

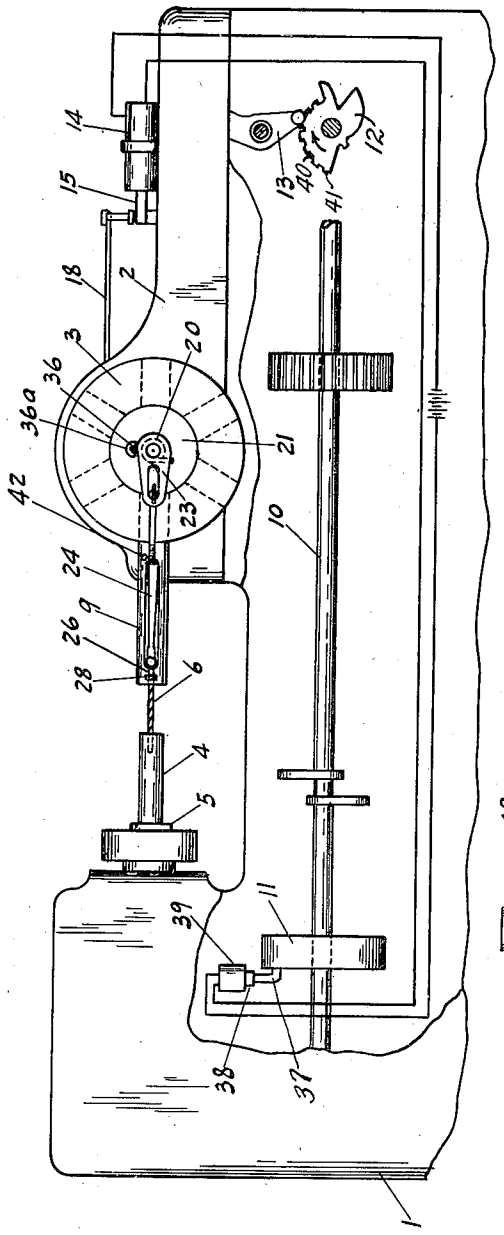


Fig. 1.



Fig. 10.

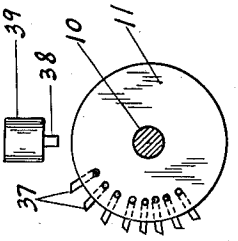


Fig. 8.

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3 Sheets-Sheet 2

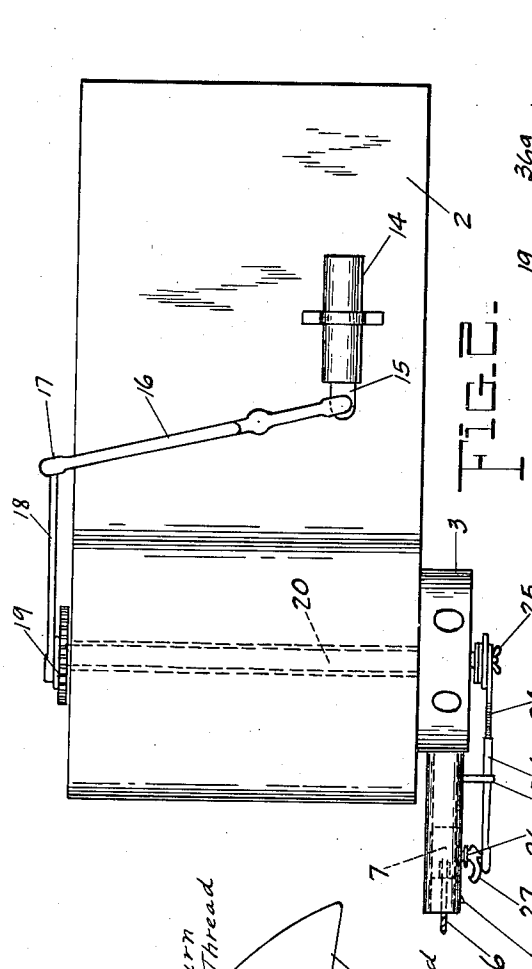


FIG. 2.

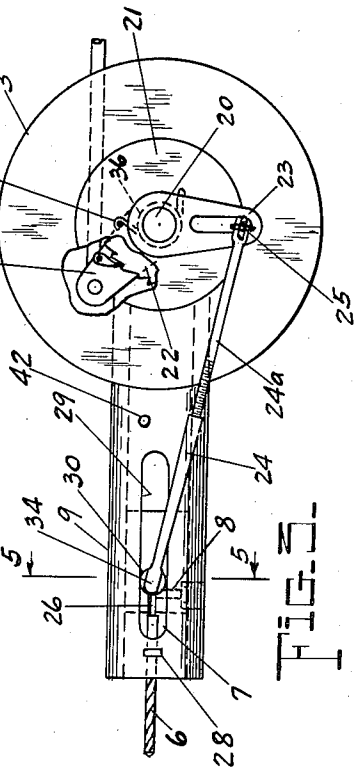


FIG. 3.

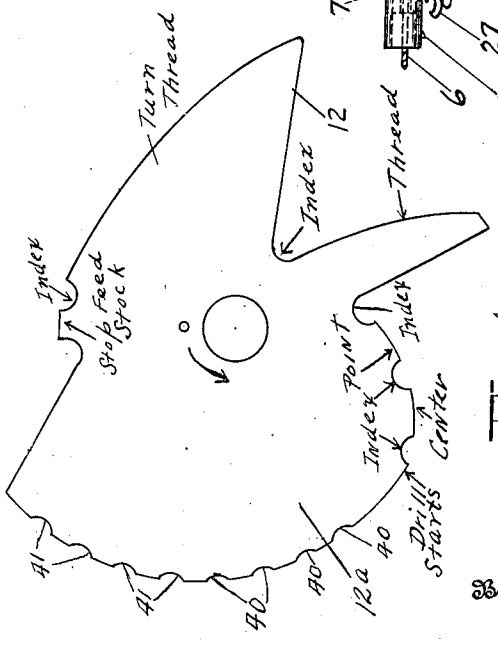


FIG. 4.

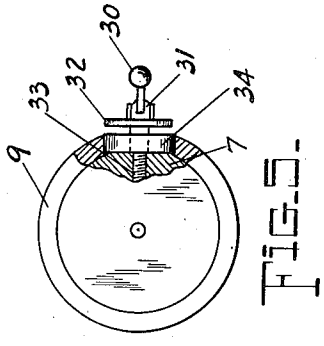


FIG. 5.

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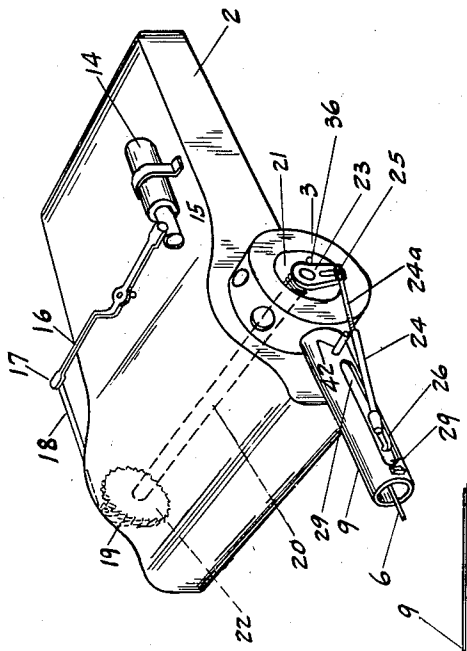


Fig. 6.

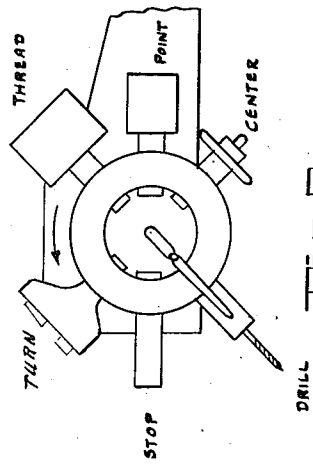


Fig. 5.

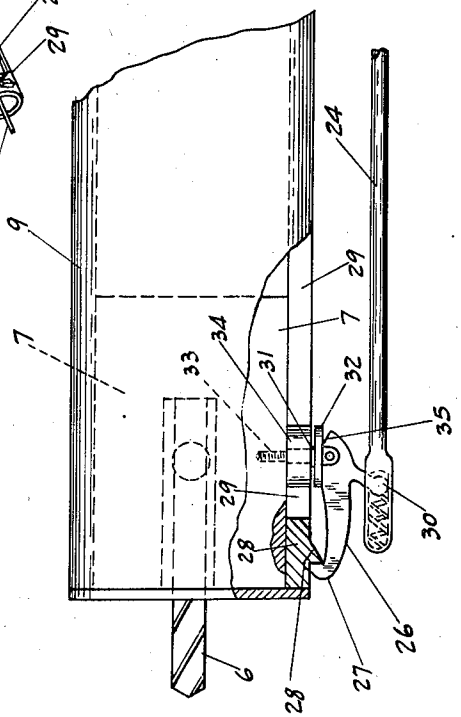


Fig. 7.

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2,460,156

UNITED STATES PATENT OFFICE

2,460,156

AUTOMATIC DRILLING MACHINE

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Application April 4, 1945, Serial No. 586,475

16 Claims. (Cl. 77—32)

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My present invention embodies certain novel improvements in drilling machines.

In one of the preferred embodiments of my invention the same is adapted particularly for use in conjunction with Brown & Sharpe automatic screw machines of the turret type, such machines being commonly used for performing additional operations than drilling upon the work by equipping the turret with the appropriate tools which may perform threading, turning, tapping, knurling, or other operations.

In the operation of automatic screw machines of the class above referred to, the use of the drill requires that it be pulled out from the work periodically for cleaning, as by wiping off the chips or metal particles therefrom, and oiling the same. The pull-out operations in the turret type machine are effected by the customary operation of movement of the turret slide and turret under the control of the lead cam, such movement effecting the withdrawal of the drill from the work during certain periods of the rotation of the lead cam. This method of withdrawal of the drill slows down the drilling operations materially because of the requirement to bodily shift the turret slide and the turret sufficiently to pull the drill out of the work, causing a wastage of time due to the relatively slow movement of the lead cam in effecting the drill pull-out action or actions. A simple example explanatory of the foregoing may be given, applicable to a job requiring 100 seconds to complete, which job would involve a time factor of substantially 10 seconds per piece for the pull-out operations by movement of the turret slide and the turret. It is obvious that where the job involves a lot of 5,000 pieces to be run, with the foregoing allowance of approximately 10 seconds per piece for withdrawal or pull-out action of the drill, wasted time in the aggregate of approximately 14 hours is incident to the handling of the job mentioned.

It has therefore been a primary object of my invention, by the addition of attachment parts and controlling operating devices to the ordinary Brown & Sharpe automatic screw machine, to effect the pull-out actions of the drill entirely independently of the movement of the turret with the turret slide, the turret of course supporting the drill, as usual.

U. S. Patent of Rich 2,039,347 in the prior art exemplifies a known type of machine such as above referred to as an ordinary automatic screw machine.

By my improved attachment and operating features referred to, together with a redesigning of the lead cam, I place the pull-out operations of the drill under an operating control of mechanism which will perform the pull-out action or actions, as the case may be, and the number of which will depend upon the depth of the hole to

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be drilled, substantially instantaneously or approximately in a second's time, and only involving a fraction of the movement of the turret and slide utilized today. Therefore, I am enabled to save a tremendous amount of time by the use of my improved instrumentalities, so far as the pull-out operations are concerned, providing a great economy in production time for finishing the drilling operations on the work, with obvious resultant advantages.

One of the special advantages of my improvements lies in the fact that they may very readily be adapted for application to the common construction of the Brown & Sharpe automatic screw machines without material change in the latter, indeed, practically with no special changes except a slight alteration in the design or form of the lead cam.

While my invention is particularly adapted to the class of screw machines to which I have referred above, it is not necessarily limited thereto since the general principle of construction of which I avail may be employed in conjunction with rotating drill spindle types of machines (Wickman Swiss type, for instance) and may be likewise incorporated for use in drill presses and similar machines.

A full understanding of my invention may be had upon reference to the following detail description and attached drawings, in which—

Figure 1 is a side elevational view showing in a general manner a Brown & Sharpe automatic screw machine with my improvements adapted thereto, the view being largely diagrammatic.

Figure 2 is a plan view showing primarily the turret slide and turret with the motor operated instrumentalities mounted thereon for performing the pull-out operations for the drill illustrated as carried by the turret.

Figure 3 is a side view of the turret alone, the same broken away to bring out more clearly the mounting of the ratchet lever and ratchet wheel on the shaft that passes through the turret spindle; also showing the connection of the pull-out arm and drill holder more fully.

Figure 4 is a side elevation showing in full lines the construction of the lead cam when designed for the purposes of my invention, dotted lines illustrating the ordinary construction of such a lead cam by way of distinguishing it from my redesigned form.

Figure 5 is a transverse sectional view taken about on the line 5—5 of Figure 3.

Figure 6 is a perspective view generally showing the turret slide, turret, and the operating instrumentalities illustrated in Figure 2, the drill being in withdrawn position as distinguished from its operating position shown in Figure 7.

Figure 7 is an enlarged fragmentary view looking down upon the drill supporting means and

associated pull-out instrumentalities, the cylinder supporting the drill holder being broken away to show the stop lug on the drill holder.

Figure 8 is a side view of the timing drum and micro-switch, and interacting parts.

Figure 9 is a diagrammatic view of a turret equipped with tools as may be used with my invention.

Figure 10 is a view of a piece of work made by the turret tools of Figure 9.

Referring to the drawings, and particularly to Figure 1, it is noted that the frame of the automatic screw machine illustrated is designated 1, and on this frame is mounted in the customary manner the turret slide 2 supporting the turret 3. In this view the work is designated 4 and is supported by a suitable collet or work chuck of any conventional type designated 5. The drill 6 is mounted in the holder 7 in any customary manner and is fastened by means of the usual screw seen in dotted lines in Figure 3 and indicated 8. The drill holder 7 is carried in a tubular drill carrier comprising the cylinder 9, and the holder 7 is adapted to slide longitudinally within said carrier 9, the latter being mounted detachably on the turret. The screw machine comprises the usual drum and cam shaft 10, see Figure 1, said shaft supporting the timing drum 11, the movement of which is synchronized with the movement of the lead cam 12 by which the slide actuating lever 13 is operated. The foregoing parts are generally the conventional parts employed in a screw machine of the general type referred to as incorporating my improvements, and the improvement features of my invention will now be set forth.

On the slide 2 is supported a motor in the form of the solenoid 14, the core member 15 of which is connected pivotally with one end of a lever 16, the opposite end of which is attached pivotally also by a universal joint member 17 to a link 18. The end of the link 18 opposite that attached to the lever 16 is detachably secured to the upper end of a ratchet lever 19. The lever 19 is pivotally mounted loosely on the adjacent end of a shaft 20 which passes through the supporting spindle or shaft 21 for the turret 3. On the end of the shaft 20 adjacent to the lever 19 is keyed or otherwise fixed the ratchet wheel 22 and at the opposite end of the shaft 20, where said shaft terminates externally at the turret 3 there is secured the pull-out arm 23 which may be keyed or otherwise fastened to the shaft 20 to turn therewith as the shaft 20 is rotated by the action of the ratchet wheel 22. The outer portion of the arm 23 is slotted, and adjustably fixed to the arm is the pull-out rod 24, a screw and wing nut connection being provided between one end of the rod 24 and the arm 23 so that these parts are detachable, and additionally the amount of throw of the rod 24 by movement of the arm 23 may be adjusted by varying the position of the wing nut and screw connection at 25 in relation to the slotted portion of the arm 23. The rod 24 is an adjustable rod in that it is made of a sleeve section into which the threaded section 24a may be screwed.

The pull-out rod 24 is attached at the end opposite that secured to the arm 23 to the drill-holder 7, and the attachment means is somewhat peculiar in construction. Said means comprises the bell crank latch member 26 having the catch 27 at one end for engaging over a stop lug 28 projecting laterally from the carrier or support 9. The latch member 26 has its outer arm connected by a ball and spring joint 30 with the rod 24, and the latch member 26 is, furthermore, pivoted at 31 to the outer head 32 of a spindle 33 which is attached to the drill holder 7 by screw thread connection with the latter. The spindle 33 supports a guide roller 34 which operates in the slot 29 in the side of the holder supporting member 9. Looking at the parts as seen in Figure 7, a pull to the right on the pull-out rod 24 will rock the lever 26 until the tail portion 35 of said lever abuts with the head 32. This initially disengages the catch 27 of the lever from the stop lug 28, and further movement of the rod 24 rightwardly causes the same, through the lever 26, to pull the drill holder 7 in the same direction, the roller 34 rolling in the slot 29 in the above operation.

As seen best in Figure 3, the arm 23 is subjected to the action of a spring 36 which is coiled about the shaft 20 at the point where said shaft projects slightly from the side of the turret 3, one end of the spring 36 being attached in a stationary manner as at 36a to turn with the turret 3 as the latter rotates, the other end of the spring 36 being bent outwardly against the right hand edge portion of the lever 23, whereby to normally tend to shift said lever 23 in the direction of the drill 6 for holding the parts in substantially the normal positions illustrated in Figure 1.

As previously suggested, the timing drum 11 carried by the drum shaft 10 is synchronized in its operation or rotation with the movement of the lead cam 12, and the said drum 11 carries one or more contact dogs 37 attachable thereto and engageable incident to the rotation of the drum 11 with the member 38 of the micro-switch 39 supported in any suitable manner on the frame 1 of the machine. The micro-switch 39 is connected by suitable wiring to the solenoid or motor 14 and the contact dogs 37 are arranged to engage and move the member 38 of the switch 39 for closing the latter to thereby close the circuit including the solenoid 14 at predetermined timed intervals related to the movement of the cams of the lead cam 12.

I now particularly refer to Figure 4 in order that the construction of my lead cam as redesigned by me for the purposes of my invention may be understood. The cam 12 will be of the general form customarily employed for controlling different operations of tools carried by the turret 3, including the drill 6. Customarily, there may be as many as six of these tools for performing different operations on the work. It will be noted in the illustration given in Figure 4 that the cam of the lead cam 12 intended for controlling the drilling operation of drill 6 is designated 12a. This cam would ordinarily be constructed with the deep dwells for enabling the lead cam 12 to cause a movement of the turret slide 2 and turret 3 for pull-out actions of the drill.

Since, according to the operation of my improved invention, the pull-out operations for the drill are intended to be performed independently of the lead cam 12, my design of the lead cam 12 as shown by the full lines in Figure 4 contemplates only the provision of the slight recessing or dwells 40 and 41. The purpose of these dwells 40 and 41 is to effect a drop-back action of the turret slide and turret substantially instantaneously with the pull-out action of the drill 6, so that the turret may drop back approximately .015" at the time the drill pull-out operation is performed, the latter taking place almost in-

stantly, as later to be described. By such drop-back action of the turret slide and turret, when the drill is released to re-enter the hole after its pull-out operation, the point of the drill will not hit the bottom of the hole and become damaged. The advantage of the foregoing will be more fully appreciated after a description of the complete operation of my improved invention now to be given.

The operation of a machine embodying the improvements of my invention, as disclosed in the drawings, contemplates the customary operation of the turret 3 and slide 2 which are indexed in the usual manner for the presentation of the particular tools carried in the openings of the turret 3, to the work. As previously indicated, the only tool illustrated in Figure 1 is the drilling means with which my invention has to do. In the machine illustrated, furthermore, the work 4 is rotated in the drilling operation while held by the collet 5 and the drill 6 is stationary against rotation. However, automatic screw machines of the type to which my invention may be adapted, by provision of certain additional parts, to be converted into constructions utilizing a rotating drill holder, and, by mechanical modification of certain parts of my invention, the latter may be adapted to such machines.

Referring to Figure 1 particularly, the parts of my invention are illustrated in the normal positions assumed thereby when the drill 6 is being fed to the work 4 as the latter is rotating, and during this period the drill is being moved to the work by the slide movement of the slide 2 and turret 3 under the influence, we will say, of the feed cam 12*a* of the lead cam 12. This cam, of course, has a slight pitch eccentric to the axis of the cam 12 because the hole is usually drilled to a certain slight depth first and then subsequently drilled to a secondary slight depth and so on, dependent upon the ultimate required depth of the hole to be produced. During the feeding of the drill under the action of the cam surface 12*a*, drill pull-out and return operations are almost simultaneously produced along the lines previously described. However, it is contemplated in the normal position of the drill when feeding to the work that the drill holder 7 shall be locked in its forward position, as seen in Figures 1 and 7, by the locking engagement between the lock member or catch 27 and the lug 28. This engagement maintains the drill rigidly against movement away from the work as the turret is fed forward for the drilling operations.

When the cam 12 has turned to the point of the first dwell or recess 40 thereof, as previously stated, the slight depth of the dwell will permit of drop-back movement of the turret with the drill holding means thereon to an extent of approximately .015". It is at this time that the drum 11, the movement of which is synchronized with that of the cam 12, has one of its dogs, we will say the upper dog 37 shown in Figure 8, brought into engagement with the member 38 of the micro-switch 39 so that substantially simultaneously with the drop-back movement of the turret 3, mentioned above, the solenoid 14 is energized to shift the lever 16, ratchet lever 19, ratchet wheel 22, arm 23, and pull-out rod 24. The energizing of the solenoid 14 is momentary and effects the almost instantaneous pull-out action of the drill 6 and return action of said drill into the hole while the turret 3 is in its drop-back position. This prevents the drill 6 from hitting the bottom of the hole on the return movement thereof established by the breaking of the circuit between the micro-switch 39 and the solenoid 14 which releases the pull-out rod to cause the drill and drill holder to be restored to their normal positions of Figure 1 from the operated or pull-out positions shown in Figures 3, 2, and 6.

It must be understood that the initial pull on the rod 24 when the solenoid 14 is energized rocks the catch lever 26, disengaging the catch or lock 27 from the lug 28 on the cylinder 9, rendering the holder 7 under such conditions movable in a direction away from the work for the pull-out action. In its normal position as seen in Figure 1, the pull-out rod 24 is shown as limited in its return movement under the influence of the crank or arm 23 by a stop pin 42 projecting laterally from the cylinder or support 9 for the holder 7. The engagement between the parts 24 and 42 is maintained by the action of the spring 36, which, of course, normally tends to shift the pull-out rod to its advanced drilling position relative to the support 9 and the holder 7 in a corresponding position locked against retreat from the work by the cooperation of the parts 27 and 28.

It is to be understood, of course, that the number of pull-out operations for a particular job of drilling a hole of a certain depth will depend upon the depth dimension of the hole, and each time the drill 6 is pulled out from the hole in the work 4, oil from an oil supply nozzle and conduit will feed on to the drill for cooling and lubricating the same, and a wiping brush will wipe the drill for cleaning metal particles or chips therefrom.

When the drilling operations are performed by the pull-out controlled drilling means described by me as my invention, the turret 3 may be indexed for further operation on the work by a different tool carried thereby, and this operation performed a number of times, dependent upon the number of tools intended to be used for making the particular part constituting the work.

I contemplate that a common form of electric motor may be used in substitution for the solenoid 14 for operating a drive shaft, and the movement of the lever 16 may be communicated thereto by any automatic type of reverse clutching means, should such electric motor last mentioned be employed.

The lead cam 12, as shown in Figure 4, has its cam 12*a* recessed at 40—41 for eight turret drop-back operations to drill a single hole such as seen for example in the work piece shown in Figure 10. The drill pull-outs take place simultaneously with the turret drop-back actions, as governed by the eight dogs 37 (see Figure 8). The piece of work (Figure 10) will be completely finished by operations of the five other tools on the turret. The six tools of the turret including my drill controlled means, are diagrammatically shown in Figure 9. Obviously, many other kinds of tools may be availed of for those selected depend on the particular character of operations to be performed on the work. In Figure 4 the dotted line dwells 12*c*, 12*d* indicate how the cam 12 would be made for operating to give pull-out operations by moving turret 3, and discloses the long time factor involved in the known practice as compared with that of my invention. The various turret movement and tool control operations are designed on Figure 4, for clearness of understanding of my invention.

Having thus described my invention, what I

claim as new and desire to secure by Letters Patent of the United States is:

1. In a drilling machine, in combination, a drill holder, a drill carried thereby, a support in which the drill holder is movably mounted, a work holder for supporting work engageable by said drill, a feeding device for advancing the drill into the work, means for periodically moving the holder relatively to its support for pulling the drill out of the work during the feeding movement of the drill to the work, the said pulling out means comprising a releasable latch member to limit the movement of the holder on its support while the drill is being advanced into the work.

2. A machine as claimed in claim 1, in which a relatively fixed catch on the holder support coacts with the latch means mentioned to fix the position of the holder relative to its support for drilling operation of the drill, and supporting means movably connecting the catch to the holder for initial disengagement from the support thereof on actuation of the pull-out means for drill pull-out movement.

3. In a drilling machine, in combination, a drill holder, a drill carried thereby, a support in which the drill holder is movably mounted, a work holder for supporting work engageable by said drill, a feeding device for advancing the drill into the work, pull-out means for the drill connected to the holder, means to actuate the pull-out means to shift the holder on its support independently of said feeding means to momentarily disengage the drill from the work, and spring means coacting with the pull-out means to return the drill into the work after such momentary disengagement.

4. In a drilling machine, in combination, a drill holder, a drill carried thereby, a support in which the driller holder is movably mounted, a work holder for supporting work engageable by said drill, a feeding device for advancing the drill into the work, means for periodically moving the holder relatively to its support for pulling the drill out of the work during the feeding movement of the drill to the work, and means for causing a drop-back movement of the support for the drill holder away from the work during return movement of the drill to the work.

5. In a drilling machine, in combination, a drill holder, a drill carried thereby, a support in which the drill holder is movably mounted, a work holder for supporting work engageable by said drill, a feeding device for advancing the drill into the work, means for periodically moving the holder relatively to its support for pulling the drill out of the work during the feeding movement of the drill to the work and means for causing a drop-back movement of the support for the drill holder away from the work simultaneously with the drill pull-out and return movements.

6. In a drilling machine, in combination, a drill holder, a drill carried thereby, a support in which the drill holder is movably mounted, a work holder for supporting work engageable by said drill, a feeding device for actuating the support for advancing the drill into the work, a motor, pull-out connections between the motor and the drill holder, means to periodically cause actuation of the said connections for pull-out and return operations of the drill during operation of the feed device and said support, and instrumentalities to effect a drop-back action of the support simultaneously with the drill return movement to prevent impinging of the drill point with the bottom of the hole being drilled.

7. In a turret type automatic screw machine, a turret slide, a tool holding turret mounted thereon and comprising a drill holder support, a drill holder mounted movably on said support, a lead cam for causing drill feeding movement of the slide and holder support, a timing drum operating in synchronism with the lead cam, said lead cam being formed with members to cause a periodic drop-back action of the slide and turret with the drill holder, and means operated from the timing drum substantially simultaneously with the effective operation of the drop-back members aforesaid, to impart drill pull-out and return movements to the drill holder during the continuing feed action of the slide and turret.

8. A machine as claimed in claim 7, in which the last means comprises a pull-back rod connected to the drill holder, a motor unit to actuate said rod, and means on the timing drum to energize the motor unit for quick movements of said rod.

9. A machine as claimed in claim 7, in which the last means comprises a pull-back rod, a catch member connecting the rod and drill holder, a part on the drill holder support to interlock with said catch member and releasable therefrom on actuation of the rod, a solenoid connected to impart quick movement to the pull rod, and electric circuit closing means on the timing drum to energize the solenoid for operating the pull rod.

10. In a drilling machine, in combination, a drill holder, a drill carried thereby, a support in which the drill holder is movably mounted, a work holder for supporting work engageable by said drill, means to rotate the work holder a feeding device for advancing the drill into the work, and electrical means independent of said work holder rotating means to effect quick pull-out and return movements of the drill relatively to the work independently of the operation of the feeding device.

11. In a drilling machine, in combination, a drill holder, a supporting member therefor, work holding means, mechanism for feeding the drill to the work for operating thereon, and instrumentalities for periodically withdrawing the drill from the work for pull-out action during the feeding operation including a pull-out device for actuating the drill holder, and means operable by the pull-out device to lock and unlock the drill holder relatively to its supporting member.

12. A machine as claimed in claim 1 in which the pullout latch member is combined with a fixed catch upon the holder support with which the latch member releasably coacts to fix the position of the drill holder relative to its support during the drilling operation of the drill.

13. In a drilling machine, in combination, a movable support, a drill holder thereon, a work holder for supporting work engageable by a drill on said holder, feed mechanism for feeding the support and its drill holder to work carried by the work holder, and including a lead cam and a member operated by the said cam and connected with the support to cause the feeding movement of said support and drill holder, the lead cam having a pull out section to coact with the said member to control a drop back movement of the support and holder at a predetermined time during the feeding movement of the support by said cam, and mechanism timed to operate when the pull out section of the lead

cam coacts with said member, for actuating the drill holder to effect a drill pull out and return movement of the drill holder.

14. A machine as claimed in claim 13 in which the pull out section of the lead cam consists of a recess arranged to receive an adjacent operating portion of the said member for enabling the drop back movement of the feed support to take place during the feeding movement of the support.

15. In a drilling machine, in combination, a movable support, a drill holder thereon, a work holder for supporting work engageable by a drill on said holder, feed mechanism for feeding the support and its drill holder to work carried by the work holder, and including a lead cam and a member operated by the said cam and connected with the support to cause the feeding movement of said support and drill holder, the lead cam having a pull out section to coact with the said member to control a drop back movement of the support and holder at a predetermined time during the feeding movement of the support by said cam, and mechanism timed to operate when the pull out section of the lead cam coacts with said member, for actuating the drill holder to effect a drill pull out and return movement of the drill holder, and in which the timed mechanism includes a drum operated in synchronism with the

movement of the lead cam, and instrumentalities controlled from said drum for causing the pull out and return movement of the drill holder at a relatively high speed as compared with the speed of the feeding movement.

16. A tool slide feed unit for automatic screw machines comprising a lead cam having a body formed with feed lobes thereon for moving a tool slide, and also formed with at least one drop back recess in the said lobe for controlling a drop back movement of the tool slide in a direction opposite its tool feed movement, and a slide actuating lever having a follower portion with which the lobe and recess portions of the lead cam may engage.

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The following references are of record in the file of this patent:

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