MACHINE FOR DRILLING, SHAPING, AND POLISHING DIAMOND DIES

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This invention relates to machines for polishing and cutting drawing dies; that is to say, machines for performing what might be termed the finished cutting or shaping of the passages through the dies, and to give predetermined contour to such passages. The object of the invention is to provide a machine employing a series of oscillating die holders having means for automatically oscillating the holders with means adaptably supporting, cutting and polishing tools axially above the die holders or dies supported therein, and further to the provision of a common drive means between the die holder and tool for rotating the die and tool in opposite directions with respect to each other; a further object being to provide a machine of the character described wherein the die holders are swung about a pivot disposed at one side of the tool thereby moving the holders and the dies supported thereon in an arcuate path with respect to the axis of the tools, thereby producing in the resulting die a substantially arcuate or toric curvature to the wall of the passage therethrough; a further object being to provide means tensionally supporting the tool against one wall of the die passage to provide a constant bearing thereon, which together with the reciprocation of the die holder and rotation of the holder and tool, maintains the pointed end of the tool sharp at all times; and with these and other objects in view, the invention consists in a novel method of polishing and cutting dies as more fully hereinafter described.

The invention is fully disclosed in the following specification, of which the accompanying drawings form a part, in which the separate parts of my invention are designated by suitable reference characters in each of the views; and in which:

Fig. 1 is a side and sectional view of a machine made according to my invention with parts of the construction broken away.

Fig. 2 is a plan view of the machine as seen in Fig. 1 showing the central portion of the machine broken away.

Fig. 3 is a front and sectional view of one end portion of the machine.

Fig. 4 is an enlarged perspective and sectional view showing one of a number of tool holders employed and illustrating the method of mounting the same.

Fig. 5 is an enlarged sectional view of a part of the structure as seen in Fig. 3.

Fig. 6 is a plan view of the structure as seen in Fig. 5 with part broken away.

Fig. 7 is a sectional view through a drilled diamond die used as a workpiece in the machine.

Fig. 8 is a view similar to Fig. 7, showing the result of the shaping and polishing of the die; and,

Fig. 9 is a diagrammatic view illustrating two extreme positions of travel of the workpiece with respect to the tool.

It is the purpose of my invention to provide a machine for performing the finished drilling operations on drawing dies; that is to say, in opening the passage through the dies so as to more positively control and regulate the accurate formation of the size of this passage and also producing the desired shape or contour of the admission or entrance passage of the die, while at the same time polishing the surfaces of the die to produce highly efficient drawing dies for the purpose of drawing wire and other strand material.

In the accompanying drawings, I have shown one adaptation of the invention, and these drawings represents the frame of the machine, the frame having end plates 11 at the rear of which is supported a drive shaft 12 driven from an electric motor 13 disposed within the frame through a belt or similar drive 14. Passing around a pulley 15 on the motor shaft is a pulley 16 on the drive shaft.

Arranged forwardly of the shaft 12 is a supplemental drive shaft 17 driven from the shaft 12 by a gear 18 thereon meshing with a corresponding gear 19 on the shaft 17, so that both shafts are rotated at the same speed. Arranged at the front of the machine beneath an elongated and forwardly projecting table 20 is a cam shaft 21 driven from the shaft 17 by a belt 22 engaging a variable size pulley 23 on the shaft 17 and a corresponding but reversely arranged pulley 24 on the shaft 21, so that the speed of drive of the cam shaft may be increased or decreased at will.

At the rear of the table 12 and extending longitudinally of the front of the machine is arranged a pair of spaced parallel frame rails 25 within and between which are swingably supported a plurality of longitudinally spaced brackets 26 pivoted as seen at 27. As each bracket is of the same construction, the brief description of one will apply to all. In the accompanying drawings, part of these brackets is shown in Figs. 2 and 3, but both of these figures are broken away to eliminate unnecessary duplication of the parts in the present illustration. These brackets are shown in detail in Figs. 5 and 6 of the drawings. Each bracket has a channel por-
tion 28 projecting at one side thereof forming bearings for the shaft or spindle 29 of a die support plate or disc 30 and below the channel portion 28 is a correspondingly projecting flange 31 supporting an adjustable screw 32 regulating the tension of a spring 33 bearing upon a seat 34 which engages the lower rounded end of the spindle 28. It will thus be seen that a die 35 supported upon the upper surface of the disc 30 can yield downwardly against the tension of the spring 33 in the operation of a drilling and polishing tool 36 upon a diamond 37 supported within-in the die structure 39, or either of the spindles or spindles 28 within the channel, 28 is a pulley 38 driven by a belt 39 so as to rotate the die support 30, including the die, the belt 39 passing around a large pulley 40 on the drive shaft 12, also around a pulley 41 of the same diameter as the pulley 38 and secured to a tool supporting spindle 42. This belt also then passes around another large pulley 43 similar in diameter to the pulley 40 secured to the shaft 17, from which it returns to the pulley 38. In other words, one continuous belt passes around each unit area of pulleys 40-43, and 38-41, as will clearly appear from the reproduction of Fig. 2 of the drawings. With this construction the drilling and polishing tool 36 will be rotated at the same speed as the speed of rotation of the die, but in a direction opposite to that of the rotation of the die. This arrangement is advantageous first from the standpoint that the resulting action of the tool upon the diamond is equal to twice the speed of the initial drive, and further, compounds as used in the drilling and polishing of the diamond 37 will be retained against displacement from the diamond, particularly so prior to the time at which the diamond passage is fully open.

Joining the plates or rails 25 intermediate the brackets 26 are cross bars 44 which serve to reinforce and space the said rails; and to these cross bars are secured at one end coil springs 45 which are also coupled to lower end portions of the bracket 26 as seen at 46 to support the bearing pins or buttons 47 at the lower ends of the brackets in constant engagement with adjustable ring cams 48 pivoted to supports 49 arranged on the cam shaft 21, the points being seen at 50. These supports 49 having portions of adjustable screws 52 and 53 are arranged, on opposed sides of the support, as clearly seen in Fig. 1, and in positions to engage the ring cams 48 at right angles to the pivots of these cams on the support. The purpose of the screws 52 is to adjust the angularity of the cams 48 in controlling oscillating or reciprocating movement imparted to the brackets 26 as they swing upon the pivots 27 in correspondingly reciprocating the dies 35 through an arc-shaped path. By virtue of this adjustment, the degree and control of the curvature in the resulting passage 31a, formed in the diamond 37, which defined by the die 37, with respect to the tool 36, will be determined.

Arranged directly above the pair of rails 25 is another pair of rails 54, in which are supported, directly above the die supporting plates or discs 30, the blocks 55 pivoted to the rails 54 as seen at 56, note Fig. 4 of the drawings. The blocks 55 are rectangular in form and thus keyed against rotation between the rails 54, and in these blocks are vertically adjustable bearing sleeves 57 having as their upper ends milled heads 58 by means of which the position of the tools 36 with respect to the diamond 37 of the dies must be adjusted from time to time. In other words, in originally drilling and polishing a diamond, the sleeves will be raised in the blocks 55 and as the diamond is drilled and as the polishing continues, these sleeves 51 are gradually lowered bringing the pointed ends 56 of the tools in closer relationship with the diamond operated upon.

The spindles 41 which are arranged at the upper ends of the tool supporting spindles rest by gravity upon upper surfaces of the milled heads 48, so that it is simply the weight of the tool plus the spindle and the pulley which operates upon the diamond, or which resist the upward thrust of the diamond in its rotary reciprocating or oscillating movement.

It will also be apparent that this construction provides a very simple means for removing and reinserting a tool. Between the rails 55 are disposed a series of supporting plates or members 59, each supporting at its lower end an adjustable screw 60 adapted to bear against the lower and flared end of a flat spring 61, secured to one side of each block 55, the purpose of which is to tensionally maintain the tool 36 in constant engagement with the die while at the same time compensating for a degree for the rotary oscillating or reciprocating movement which is imparted to the die.

An adjustable stop screw 62 is also provided to limit swinging movement of the block 55 in one direction. In the preferred operation of the machine it is so regulated and adjusted as to limit the upward swinging movement of the die to a position slightly above horizontal. For illustrative purposes three different positions of the dies and their supporting and operating brackets are shown in Fig. 3 of the drawings, the one to the left being shown in the horizontal position, the one to the right at the extreme of its downward swinging position, and the intermediate unit being shown at 90° to both of the other named positions. At this time it is also well to mention that each unit operates independently of the other, and from this standpoint the position of the tool 36 or its supporting sleeve 57 may vary with that of other units.

The rails 25 are apertured as seen at 63 in alignment with the pulleys 38 to allow for the passage of the upper and lower portions of the cutters 28 and 29 to provide for the free action of the pulleys, sufficient clearance being also provided to compensate for the slight vertical reciprocating motion that is imparted to the die in engaging the tool.

In Fig. 7 of the drawings I have indicated at 37b the partially drilled or unfinished diamond where the passage through the diamond is still closed as seen at 64. It is preferred that in originally producing finished diamond dies that this type of partially drilled or rough cut die be used in the machine in order that the passage at the closed point or section 64 may be properly and accurately opened, and at the same time the finished contour given to the die passage 31a can be produced and the walls of the passage polished to produce a finished surface thereon, in which latter instance, the size of the restricted passages 28 and 29 at the opposite ends of the die may be increased in width to facilitate the use of the different uses of the machine, the cams 48 will be adjusted to give the desired throw or size of the chamfer 25 and the die 37. Diameters of the die 37 are thus adjustable.
swing to the dies, and other adjustments made accordingly in the machine, but in all instances, the contour of the passage in the finished die will be of substantially toric or arcuate curvature.

In Fig. 9 of the drawings is diagrammatically illustrated two extreme positions of travel of the die 37 including the holder 35 with respect to the tool 36 in the swinging of the holder 35 upon the axis 27. This axis is arranged normally in substantially a common horizontal position with the center of the diamond 37, when the holder 35 is in horizontal position. Thus it will be seen that the holder including the diamond 37 swings on the axis 27 in an arcuate path; whereas the tool 36 maintains a perpendicular position bearing always against one wall of the passage 31 through the die. This arrangement and mode of operation forms on the lower end 36a of the tool a curved workpiece engaging end having a sharp point; and this point is constantly maintained sharp by the action of the tool thereon. In other words, the curved end of the tool will move or less conform to the resulting curvature formed in the wall structure of the resulting die, particularly at the entrance side of the die. This curvature will extend slightly beyond the center of the die by reason of the fact that the die in its upward movement passes slightly beyond the horizontal plane. As has been stated, the degree of accurate movement of the workpiece with respect to the tool can be controlled and regulated by adjustment of the actuating cam.

One feature of my present machine resides in the fact that the dulling or balling of the pointed end 36a of the tool 36 is obviated in that this tool is constantly being resharpened due to the cooperative action between the swinging oscillatory movement of the die and the tiltable movement of the tool, which has a tendency to constantly and tensionally bear upon the wall of the die passage thus producing a resharpening operation upon the pointed end of the tool. It will, of course, be apparent that my improved machine may operate upon workpieces of any type in performing drilling, shaping and polishing operations, and particularly in the production of and polishing of curved surfaces within a body of any type or kind. It will also be apparent that the size and characteristics of the tools may be varied to suit different types and sizes of workpieces in caring for the different uses of the machine.

It will appear from the consideration of the general machine structure that a very simple and economical type of machine is employed, and one wherein all of the operating parts are compactly disposed substantially within the boundary limits of the frame. The fact that many of the parts are duplicated simplifies and economizes greatly in the cost of producing the entire machine.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A machine for forming and polishing dies comprising a die supporting unit, a tool supporting unit disposed in axial alignment with said die unit, means imparting rotary reciprocating movement to the tool supporting unit toward and from the tool supporting unit, and means yieldably mounting the tool supporting unit to compensate for the rotary reciprocating movement of the die unit in the operative engagement of a tool with a die.

2. A die shaping and polishing machine comprising a die supporting member, means reciprocating said member in an arcuate path, a tool supporting part arranged in line with said member to support a tool axially of a die supported on said member, means yieldably supporting the tool with respect to said member, and means yieldably supporting a die in said member to yield to the pressure engagement of the tool with said die, and said last named means being adjustable.

3. A die shaping and polishing machine comprising a die supporting member, means reciprocating said member in an arcuate path, a tool supporting part arranged in alignment with said member to support a tool axially of a die supported on said member, means yieldably and yieldably supporting the tool with respect to said member, means yieldably supporting a die in said member to yield to the pressure engagement of the tool with said die, and said first named means being adjustable to vary the extent of reciprocatory movement imparted to said member.

4. A die shaping and polishing machine comprising a die supporting member, means reciprocating said member in an arcuate path, a tool supporting part arranged in alignment with said member to support a tool axially of a die supported on said member, means yieldably and yieldably supporting the tool with respect to said member, means yieldably supporting a die in said member to yield to the pressure engagement of the tool with said die, and said first named means being adjustable to vary the extent of reciprocatory movement imparted to said member.

5. A die shaping and polishing machine comprising a die supporting member, means reciprocating said member in an arcuate path, a tool supporting part arranged in alignment with said member to support a tool axially of a die supported on said member, means yieldably and yieldably supporting the tool with respect to said member, means yieldably supporting a die in said member to yield to the pressure engagement of the tool with said die, and means rotating the die supporting member and tool supporting part in opposite directions to each other.

6. A die shaping and polishing machine comprising a die supporting member, means reciprocating said member in an arcuate path, a tool supporting part arranged in alignment with said member to support a tool axially of a die supported on said member, means yieldably and yieldably supporting the tool with respect to said member, means yieldably supporting a die in said member to yield to the pressure engagement of the tool with said die, means rotating the die supporting member and tool supporting part in opposite directions to each other, and at the same speed.

7. A machine of the character described comprising a swinging workpiece supporting member, a tool supporting part adjustable toward and from said member in controlling engagement of a tool arranged in said part with a workpiece supported on said member, means imparting reciprocating movement to said member in moving the workpiece toward and from said tool in an arcuate path, and means for rotating the workpiece and the tool at the same speeds in opposite directions to each other.

8. A machine of the character described comprising a swinging workpiece supporting member, a tool supporting part adjustable toward and from said member in controlling engagement of
a tool arranged in said part with a workpiece supported on said member, means imparting reciprocating movement to said member in moving the workpiece toward and from said tool in an arcuate path, means for rotating the workpiece and the tool at the same speeds in opposite directions to each other, and means providing yielding movement of the workpiece with respect to said tool.

9. A machine of the character described comprising a swinging workpiece supporting member, a tool supporting part adjustable toward and from said member in controlling engagement of a tool arranged in said part with a workpiece supported on said member, means imparting reciprocating movement to said member in moving the workpiece toward and from said tool in an arcuate path, means for rotating the workpiece and the tool at the same speeds in opposite directions to each other, and means providing yielding movement of the workpiece with respect to said tool, and means providing swinging movement of the tool in its support to compensate for reciprocating movement of the workpiece.

10. A machine of the character described comprising a swinging workpiece supporting member, a tool supporting part adjustable toward and from said member in controlling engagement of a tool arranged in said part with a workpiece supported on said member, means imparting reciprocating movement to said member in moving the workpiece toward and from said tool in an arcuate path, means for rotating the workpiece and the tool at the same speeds in opposite directions to each other, means providing yielding movement of the workpiece with respect to said tool, and means providing swinging movement of the tool in its support to compensate for reciprocating movement of the workpiece, and means yieldably supporting the tool in engagement with the workpiece.

11. A machine of the character described a tool supporting member, means pivotally mounting said member, a sleeve adjustable longitudinally of the member, a tool element rotatable in said sleeve and freely movable longitudinally thereof, means limiting the movement of said element in one direction in said sleeve, and means limiting swinging movement of said member in one direction.

12. In a machine of the character described a tool supporting member, means pivotally mounting said member, a sleeve adjustable longitudinally of the member, a tool element rotatable in said sleeve and freely movable longitudinally thereof, means limiting the movement of said element in one direction in said sleeve, and means limiting swinging movement of said member in one direction, and means controlling swinging movement of said member in the opposite direction, and adjustable means controlling said last named means.

13. A machine of the character described a workpiece supporting and operating unit, means pivotally mounting said unit, an adjustable cam engaging said unit to reciprocate the same on said pivot, a workpiece supporting part rotatably mounted in said unit, and means yieldably supporting said part in said unit.

14. A machine of the character described the combination with a reciprocating workpiece supporting and operating member, said member having a tool supporting part adapted to support a tool in the path of reciprocating movement imparted to said workpiece supporting element to engage a workpiece supported thereby, means for rotating said part in said member, means adjustable in said member and cooperating with said part to limit the movement thereof in the direction of said unit, and means yieldably supporting said member to control the movement of said workpiece supporting unit.

15. In a machine of the character described the combination with a rotatable and yieldable tool supporting part, of a reciprocating workpiece supporting unit, means involving an adjustable cam for reciprocating said unit, and a workpiece supporting element rotatably and yieldably mounted in said unit in the reciprocating movement of a workpiece supported on said element toward and from a tool on said tool supporting part.

16. A machine of the character described comprising a plurality of pivotable workpiece supporting units arranged and spaced longitudinally of the machine, a corresponding number of tool supporting units arranged in alignment with said first named units, the first units each having a workpiece supporting part and the second units each having a tool supporting part, a common drive for both parts of each pair of units to rotate said parts at the same speed in opposite directions to each other, a cam shaft extending longitudinally of the first named unit, a plurality of individually adjustable cams on said shaft cooperating with the first named units to reciprocate the units on their pivots, and means yieldably and adjustably mounting the tool supporting parts of the second named units in controlling engagement of tools arranged in said parts with workpieces on the workpiece supporting parts.

17. A machine of the character described comprising a plurality of pivotable workpiece supporting units arranged and spaced longitudinally of the machine, a corresponding number of tool supporting units arranged in alignment with said first named unit, the first units each having a workpiece supporting part and the second units each having a tool supporting part, a common drive for both parts of each pair of units to rotate said parts at the same speed in opposite directions to each other, a cam shaft extending longitudinally of the first named unit, a plurality of individually adjustable cams on said shaft cooperating with the first named units to reciprocate the units on their pivots, and means yieldably and adjustably mounting the tool supporting parts of the second named units in controlling engagement of tools arranged in said parts with workpieces on the workpiece supporting parts, and means providing variable drive of the cam shaft in regulating the speed of reciprocation of said workpiece supporting units.

18. A machine for drilling and polishing bores or passages of predetermined workpieces comprising means supporting the workpiece to reciprocate at a predetermined speed in the machine, means adjusting a tool in the path of movement of said workpiece on a first named means, means providing yielding movement between the tool and workpiece in the movement thereof toward and from each other, and means providing lateral tilting movement of the tool in compensating for the reciprocating movement of said workpiece.

19. A machine for drilling and polishing bores or passages of predetermined workpieces comprising means supporting the workpiece to reciprocate at a predetermined speed in the machine,
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means adjustably supporting a tool in the path of movement of a workpiece supported on said first named means, means providing yielding movement between the tool and workpiece in the movement thereof toward and from each other, means providing lateral tilting movement of the tool in compensating for the reciprocating movement of said workpiece, and a common means for rotating the tool and workpiece in opposite directions to each other at the same speed.

20. In a diamond drilling machine, a workpiece supporting part, a tool supporting element, means for rotating said part and element at one predetermined speed in opposite directions to each other while providing yielding movement between said part and element, and means swinging said part through a predetermined adjustable arc and at predetermined speed.

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