July 11, 1939. E. T. MEAKIN 2,165,566

APPARATUS AND METHOD FOR GRINDING AND POLISHING BORE HOLES

Filed July 13, 1935

FIG. 1

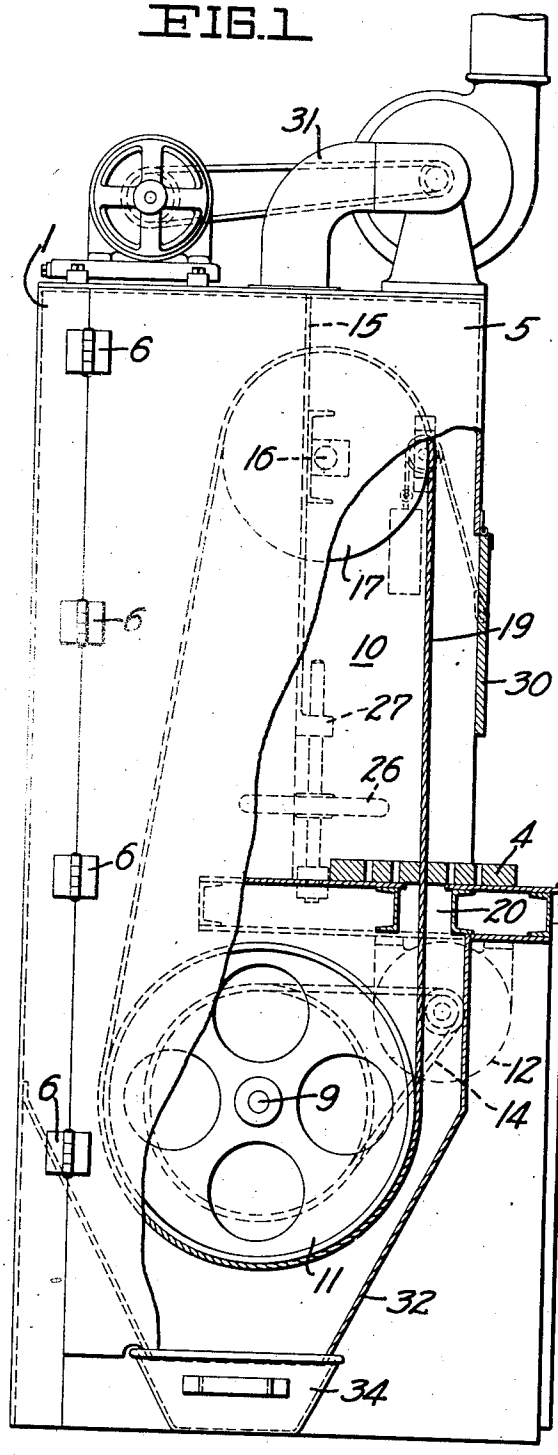


FIG. 6

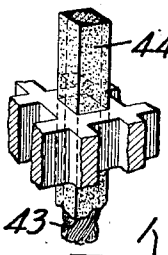


FIG. 3

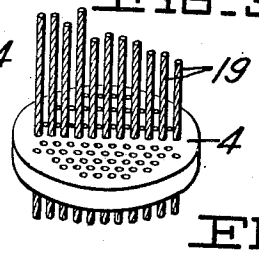


FIG. 2

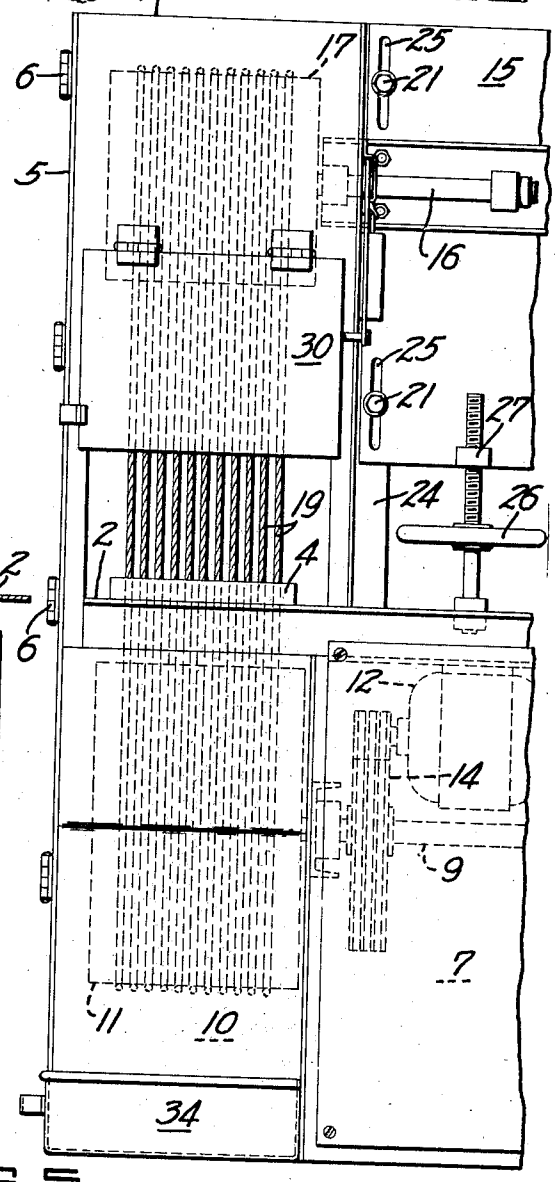


FIG. 4

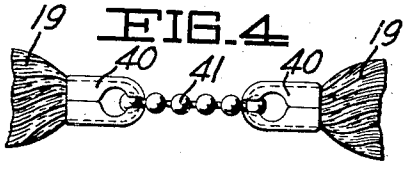
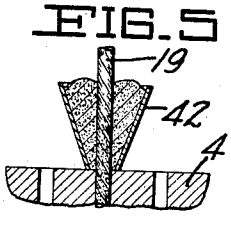


FIG. 5



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2,165,566

APPARATUS AND METHOD FOR GRINDING AND POLISHING BORE HOLES

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Application July 13, 1935, Serial No. 31,241
In Great Britain November 27, 1934

7 Claims. (Cl. 51—135)

My invention relates to the manufacture of dies, and is directed more particularly to an apparatus and method for grinding and polishing bore holes.

Among the objects of my invention are: To provide a means and method of grinding and polishing a bore hole; to provide a means and method for smoothing a plurality of bore holes simultaneously; to provide an apparatus which can be used for the simultaneous grinding or polishing of a plurality of bore holes in a die plate; to provide a means and method of accurately sizing bore holes; to provide a means and method of forming polished bore holes; to provide a means and method of manufacturing die plates for use in extrusion presses; to provide a means and method for insuring uniform polishing or grinding of bore holes; and to provide a more efficient method and apparatus for manufacturing dies.

My invention possesses numerous other objects and features of advantage, some of which, together with the foregoing, will be set forth in the following description of specific apparatus embodying and utilizing my novel method. It is therefore to be understood that my method is applicable to other apparatus, and that I do not limit myself, in any way, to the apparatus of the present application, as I may adopt various other apparatus embodiments, utilizing the method, within the scope of the appended claims.

Referring to the drawing:

Figure 1 is a side view, partly in section and partly in elevation, of a preferred form of bore hole polishing machine.

Figure 2 is a front view of the same machine.

Figure 3 is a perspective view of a die plate, showing how the polishing ropes pass through the die plate.

Figure 4 is a view in elevation of one preferred form of coupling.

Fig. 5 is a sectional detailed view indicating how abrasives are fed to the polishing means in order to insure a uniform polish.

Figure 6 is a detailed view in perspective indicating the built-up structure of a polishing element of square cross-section.

It should be understood in the following description that for the purposes of the present patent application "grinding" and "polishing" are synonymous and differ only in the type of abrasives used; "grinding" including the use of the coarser abrasives, and "polishing" including the use of finer abrasives and rubbing materials commonly used in the art to obtain a high polish on metal.

While my invention is particularly adapted for use in the making of die plates, later to be utilized in extrusion presses such as pellet mills, for example, it should be understood that the invention may be applied within the scope of the claims to any structure within bore holes are to be ground or polished.

In the making of dies for use in extrusion presses, the die plate itself is usually a flat disc of metal produced by forging. These dies are made of a selected grade of alloy steel, and after forging they are annealed in an oven to remove any internal strains which might be set up during the forging process. The die blank is then roughened into shape by machining, leaving of course proper clearance for future operations.

The rough blank is next drilled, preferably on a multiple drill press equipped with an indexing device so that a plurality of holes of the size desired are bored through the die in the desired pattern. In many cases the entrance to each hole is counter-sunk.

If the holes through the die are to be finished in circular cross section, the die is ready for hardening at this point. If, however, square, hexagonal, triangular or other special shape bore sections are desired, the holes are broached on a broaching press with a broaching tool, as is well known in the art. In any case, the holes are, up to this point, slightly smaller in diameter than in the finished product. The die is then hardened, utilizing any of the processes well known in the art, such as carburization, for example, after which the die is sand-blasted and cleaned to remove all traces of the hardening process from the surface of the die and from the holes themselves.

Up to this point I have simply described the usual procedure for making a die of this type. I have found, however, particularly in machines which extrude relatively hard and incompressible material, that the surface conditions of the bore holes exert a very strong effect upon the amount of power consumed during extrusion; and I have also found that it takes only a minor roughness of the interior of the bore holes to greatly increase the amount of power necessary to push the material through the holes.

Upon examination, I have also found that the bore surfaces are relatively rough, due to the fact that they show spiral drill ridges in the case of a bored hole, and show ridges, due to small edge imperfections in broaching tools, in the case of a broached hole. In fact, such minute and multiple variations from level on the bore hole surface may increase pressure by cumulative effect to such a point that die breakage will take place.

I have therefore provided an apparatus and method of polishing the surface of the bore holes in such a manner that the final holes are not only given a high polish but are uniformly polished over their entire surface.

Broadly as to method, my invention comprises rough-finishing a bore hole and thereafter passing an endless resilient member through the hole,

preferably in the direction of travel of the material to be extruded, and coating the resilient member with abrasives or polishing materials in such a manner that the abrasives are uniformly distributed over the resilient member.

In broad terms as to apparatus, I provide a series of endless polishing members, each passing through a die hole, and drive these members at a relatively high rate of speed while maintaining an abrasive surface thereon.

I prefer to construct the main body of my polishing members in the form of ropes, twine, string or other relatively resilient material, in accordance with the size and shape of the hole it is desired to polish, maintaining such members of a slightly greater diameter than the hole to be polished, thereby exerting considerable pressure on the bore surface during travel therethrough. I also provide couplings for the individual polishing members so that they may be readily replaced.

Other broad aspects of my invention may be more readily understood by direct reference to the drawing which shows a specific embodiment of my invention as applied to the polishing of bore holes in die plates for use in an extrusion press.

In the embodiment illustrated, an upright case 1, preferably of heavy construction, is provided with an operating platform 2 upon which a die 4 may be placed, and if desired locked in place by any means well known in the art but not shown in the drawing.

I prefer to completely enclose the grinding mechanism and to provide one side of the device at least with a full-length door 5 and support the door on hinges 6.

Extending from one side of the cabinet at the bottom is a motor compartment 7 in which is mounted a main pulley shaft 9 which extends through into the main polishing chamber 10 and supports a driving pulley 11. The main pulley shaft 9 is driven in any convenient manner but preferably by an electric motor 12 by means of a belt drive 14.

The upper portion of the cabinet is provided with a lateral extension 15 upon which is mounted a driven pulley shaft 16 having one end projecting into the chamber 10 and carrying a driven pulley 17 in line with the driving pulley 11, these pulleys being so positioned with respect to each other that polishing ropes or members 19 mounted thereon will pass through a polishing aperture 20 in the platform 2.

The lateral extension 15 is supported by bolts 21—21 passing through an upright angle bar 24, vertical motion of the extension plate being made possible by vertical slots 25—25. Vertical motion is accomplished by means of hand wheel and screw 26 fastened to the motor cabinet at the lower end, and the screw engaging a screw block 27 fastened to the lateral extension 15. Rotation of the hand wheel will cause the lateral extension to be raised or lowered, thus adjusting the tensioning on the polishing ropes 19.

In this respect the term "polishing ropes" is deemed to include as equivalents cotton, flax or hemp rope, hard laid seine twine, rubber, insulated copper wire or ropes of special section corresponding to the particular cross sectional shape of the hole to be polished. I also wish to include under the term "polishing rope" the use of a polishing member formed of individual filaments laid side by side but without interweaving and of sufficient quantity to slightly more than fill the hole it is desired to operate on; and which will, become of the lack interweave, take the form of irregularly shaped bore hole cross sections. Such ropes may also include a resilient foundation and a built-up surface layer.

In order to provide easy access to the die plate, I prefer to provide the front of the device with a hinged door 30, and in order to prevent abrasives from entering the room in which the machine is operated, I prefer to utilize an exhaust fan assembly 31 at the top of the device and an abrasive collecting cone 32 open at the bottom but ending in a collecting container 34.

In operation, the die plate 4 is placed on the platform 2 and the endless ropes uncoupled and passed through a series of holes in the die plate, as shown in Figure 3.

In order to facilitate coupling and uncoupling, I prefer to utilize a quickly detachable coupling, one preferred form of which is shown in Figure 4, where the ends of the ropes 19 are provided with chain sockets 40 firmly attached thereto and a small length of ball chain 41 connecting them. In other cases, as for example when square holes are being polished and square polishing ropes used, I may use ordinary belt lacing to make the coupling, and in the case of small twine I may desire to utilize a small hook and eye coupling similar to that which would be used on belts, the main feature being that the coupling be no larger than the polishing element itself and be able to pass through the holes without obstruction.

After all the polishing ropes have been pushed through a plurality of holes, they are tightened by means of the hand wheel 26 and the pulleys rotated to cause the polishing ropes to pass through the die in the direction that the materials are eventually to be extruded. I have found that a very satisfactory speed of passage for the polishing elements is about 1875 to 2000 feet per minute, and I have found that under these circumstances holes can be completely polished in about 1½ minutes.

In order that abrasives may be efficiently passed into the holes for polishing purposes, I prefer to treat the polishing ropes in such a manner that they will carry the abrasives, and I prefer to impregnate the ropes with a receptive matrix material to which abrasives will easily adhere or will embed themselves therein. There is a large number of matrix materials which may be used to impregnate the ropes, and I do not wish to be limited to any particular material. Some of the materials, for example, are molasses, wax, emery brick, tar, belt dressing, glue, etc.

I have found, however, that it is not efficient to rely upon the abrasive material being carried around the entire length of the rope, and therefore I have provided means for continuously supplying abrasives to the top of the die. This I accomplish as shown in Figure 5 by the use of retaining means 42 positioned around each rope immediately above the holes and preferably smaller in diameter next to the hole. The abrasive is put in this container and the passage of the ropes therethrough continually pulls the abrasive into the holes. In case a large number of polishing ropes are used as in Figure 3, where it would not be practical to place an individual container around each rope, I prefer to position a pair of flat strips adjacent the ropes, one in front of the ropes and one behind them, to form a sort of trough which may be filled with abrasive material. In either case the abrasive material will completely surround the traveling

polishing elements and cause the abrasive to be pulled into the hole around the entire periphery of the elements, thus giving a uniform polish to the entire inner wall of the bore holes.

I have found that certain very definite advantages are obtained by passing the polishing elements through the bore holes in the same direction as the material is to be extruded. In the first place, there is some vibration to the ropes 19 above the die plate during polishing. This creates what is known as an "easy inlet" to the hole, a small polished counter-sink as it may be termed, and assures that there will be no sharp edges to obstruct the extruded material. In the second place, the effect is exactly opposite as far as the outlet of the bore hole is concerned, as the rope is stabilized in passing through the die and produces an extremely sharp edge on the outlet. This type of edge is desirable, particularly when the material extruded through the holes is to be cut into pellets, for example, by the passage of a blade over the bottom face of the die. The production of a sharp edge on the bottom of each hole greatly facilitates the cutting of the extruded material, particularly when it is refractory. Furthermore, it may be that some of the drill ridges within a hole are too large to be completely polished out. Polishing in the direction of extrusion, however, rounds the upper edges of these ridges with an easy curve and leaves the lower edges sharp so that a condition obtains where the extruded material can pass over them with a minimum expenditure of power.

By continually feeding the abrasive material to the matrix present on the rope, I have been able to completely polish a series of holes without the necessity of changing ropes or breaking the couplings, until a new set of holes is to be polished. The use of abrasive impregnated rope alone, without further feeding of material thereto, while feasible, is not wholly satisfactory because in many cases it is not possible to completely polish a hole or set of holes without changing the ropes or re-impregnating the same with abrasive.

The description of my polishing process so far has been limited to holes which are round and which therefore may be fitted with a polishing element completely filling its diameter. When square, triangular, polygonal or other odd shaped holes are to be polished, the polishing ropes themselves may be made to have similar cross sectional shape, but in some cases this is not practical. I prefer in these latter cases (see Figure 6) to utilize a round core element 43 of a size which will most nearly fit the hole and pass easily therethrough, and then build up upon the element a matrix layer 44 of substantial thickness until the complete polishing element is formed by the die itself to have a cross section which will almost identically coincide with the cross section of the hole through which it passes. In this case of course the ropes must be mounted and passed through the die before the complete formation of the polishing element occurs, and in other cases it may be desirable to continually supply the matrix material to the rope above the die entrance and thereafter apply the abrasives in the manner previously described.

My invention as outlined above not only polishes a multi-hole die in much less time than it could be polished by the other means, but it also produces an improved bore hole and one which is adapted to pass extruded materials with the minimum effort consistent with the material being handled.

I claim:

1. The method of polishing a bore hole, which comprises continuously passing a cord through said hole while building up on said passing cord an adhesive coating until the periphery thereof conforms to that of the hole, and feeding an abrasive to the periphery of the built-up cord as it passes through said hole.

2. The method of polishing a bore hole, which comprises continuously passing a resilient cord through said hole while building up on said passing cord an adhesive coating until the periphery thereof conforms to that of the hole, and feeding an abrasive to the periphery of the built-up cord as it passes through said hole.

3. Apparatus for polishing a plurality of closely spaced bore holes, comprising a plurality of looped cords adapted to pass through said holes, a pair of spaced pulleys forming a common support for the opposed portions of said looped cords, means for varying the distance between said pulleys to simultaneously adjust the tension on said cords, means for driving one of said pulleys to simultaneously pass said cords through said holes, and means common to all of said cords for applying abrasive material thereto in advance of the passage of said cords through said holes.

4. Apparatus for polishing a plurality of closely spaced bore holes, comprising a plurality of looped cords adapted to pass through and be spaced by said holes, a pair of spaced pulleys forming a common support for the opposed portions of said looped cords, said cords being slidable axially on said pulleys to vary the spacing therebetween, means for varying the distance between said pulleys to simultaneously adjust the tension on said cords, means for driving one of said pulleys to simultaneously pass said cords through said holes, and means common to all of said cords for applying abrasive material thereto in advance of the passage of said cords through said holes.

5. The method of polishing a bore hole, which comprises continuously passing a cord through said hole, applying an adhesive matrix to said cord while it is passing through said hole until the cross-section thereof conforms to that of the hole, adding abrasive material to said matrix to abrade and enlarge said hole while the same is passing therethrough, and thereafter while the cord is passing through said hole adding additional abrasive to said matrix as the bore enlarges to increase the cross-sectional size of said matrix to correspond to that of said hole.

6. The method of polishing a bore hole of irregular cross-section, which comprises continuously passing through said hole a resilient cord having a basic cross-sectional shape differing from and less than that of said hole, applying to said cord while the same is passing through said hole an adhesive matrix until the periphery thereof is built up to correspond to that of said hole, and feeding an abrasive to the periphery of said built up cord as it passes through said hole.

7. The method of polishing a bore hole, which comprises continuously passing a polishing element through said hole while applying an adhesive matrix to said element until the cross-section thereof conforms to that of said hole.

EDGAR T. MEAKIN.