PORTABLE MILLING MACHINE

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ABSTRACT OF THE DISCLOSURE

Machine consists of a milling head and its power source pivotally mounted on a frame that is slidable on ways in the top of the base of the machine. The base is adapted to be attached to a workpiece such as a length of pipe for cutting a notch or contoured defect in the pipe to produce a reference standard for use in conjunction with inspection equipment for testing for internal discontinuities.

The present invention relates generally to metal working and more particularly has as its primary object the provision of a portable milling machine especially suitable for producing notches or contoured defects in reference workpiece standards to be used in conjunction with inspection of metal products for internal discontinuities. Inspection of metal products for internal discontinuities by ultrasonic, eddy-current, or fringe-flux systems requires adjustment of the test equipment to the desired sensitivity levels by using as reference standards specimens containing simulated defects. These reference standards must be made to accurate dimensions because they represent the required tolerance range of defect detection.

The most commonly used methods for producing contoured or simulated defects in reference standards are mechanical metal removal, jet abrasive cutting, and electrical-discharge machining. The metal removal system is the one that is most used because it can be performed with a milling machine or manually with conventional tools such as hammer and cold chisel, file, etc., directly at the production line. When the operation is performed manually, the dimensions are controlled by making successive cuts and measurements until the desired depth has been attained. While electrical-discharge machining, jet abrasive cutting, or machine-tool metal-removal cutting are more accurate, it is necessary to perform these operations in a laboratory or machine-shop area remote from the production line. Transportation of large samples from a production line to a laboratory or remote testing area can be difficult, time consuming, or in many cases impossible. It is, therefore, desirable to provide means for making suitable reference standards in the vicinity of the production line.

The necessary means, performed with hammer and cold chisel or with a file, in addition to being hard to control for accuracy, are limited in application. For example, files notches can be made only transversely on pipe or round bars and not at all on flat surfaces. Since most defects are longitudinal, adequate reference standard defects should be placed correspondingly. An example of a file-type notching apparatus is disclosed by Patent No. 2,682,699. But this patented apparatus can only be used for creating transverse notches on the outside of pipe or other cylindrical product.

It is, accordingly, the primary object of my invention to provide a portable milling machine which can quickly and accurately produce simulated defects of desired dimensions in any size or shape reference standard.

It is a further object of my invention to provide a portable milling machine as set forth by the object above which can be used in the immediate vicinity of the production line of a mill or in any other area desired. These and other objects will become more apparent after referring to the following specification and attached drawings, in which:

FIGURE 1 is a side elevational view illustrating the apparatus of the invention clamped to a pipe workpiece for the purpose of producing a simulated defect in the workpiece;

FIGURE 2 is an end view looking at the right end of FIGURE 1;

FIGURE 3 is an enlarged side elevation view of the micrometer feed mechanism of the invention;

FIGURE 4 is an elevational view taken substantially along the line IV—IV of FIGURE 3;

FIGURE 5 is a view similar to FIGURE 3 but showing the micrometer feed mechanism of the invention locked in operating position; and

FIGURE 6 is a view taken substantially along the line VI—VI of FIGURE 5.

In general, the machine of the invention is a milling apparatus which can be readily attached to a reference standard such as a pipe length with clamps. The machine of the invention includes a motor-driven milling cutter which is fed into the workpiece with a micrometer feed screw to a measured depth and then is moved longitudinally by another feed-screw means for a measured distance. The micrometer depth-feed-screw arrangement is adapted to accommodate rough, irregular surfaces encountered on hot-rolled metals and yet provide accuracy for notch depth and length.

Since the machine of the invention is portable, it can be and is used to notch product that is still on the production line. This feature of portability is useful because it is frequently advantageous not to lift an inspection transducer off the production line and move it to the reference standard to make a calibration.

Another advantage of the machine of the invention is that a measurement can be made of the depth of the notch at any time during the process without altering the feed-depth setting because play and lost motion are kept to a minimum by the simplicity of the feeding arrangement, as will become apparent hereinafter.

Reference numeral 2 designates the frame of the invention which is provided with V-shaped slots 4 in opposite ends thereof. A pair of toggle clamps 6 is provided on the bottom of the frame for holding it onto a pipe workpiece 8 as seen in FIGURES 1 and 2. A way is formed in the upper part of the frame by two parallel rods 8 which extend from one end of the frame to the other in spaced relation to each other. A carriage 10 is mounted for traverse longitudinally of the rods 8 by means of a screw feed 12 which is mounted on one end of the frame. A platen 14 is pivotally mounted on the carriage for movement toward and away from the pipe workpiece 8 to which the frame is clamped. A milling cutter 16 is journaled on the underside of the platen 14 and is driven by a motor 18 through a right-angle drive 20 and a flexible coupling 22. A micrometer feed means whereby the platen 14 may be moved toward the pipe P and the cutter 16 fed into the pipe wall is designated generally by reference numeral 24 and is disposed on the end of the platen remote from its pivoted end. The micrometer feed means includes a feed screw shaft 26 having a longitudinal slot 28 extending along the length thereof. The bottom of shaft 26 projects downwardly from the underside of the platen and is formed with a ball projection 30 thereon. The upper portion of shaft 26 passes through a thimble yoke 32 which is rigidly mounted on the upper surface of the platen. A pin 34 extends through the bottom por-
tion of the yoke 32 normal to the shaft with its inner end fitting into the slot 28 to thereby lock the shaft from rotation.

A thimble 36 having a hub 38 inscribed with properly spaced indicia graduated is threadingly mounted on the shaft 26 circumferentially therein within the yoke 32. A pointer mark 40 is inscribed on the yoke adjacent to the hub 38 and serves as a zero reference mark for the hub. Manual rotation of the thimble 36 causes the platen 14 and cutter 16 journaled thereon to move toward or away from the pipe P, depending upon the direction of rotation of the thimble.

A lock nut 44 is circumferentially and threadingly mounted on the screw shaft 26 above the yoke 32 for a purpose which will become apparent.

A spring-loaded ball lock 46, having a leading end 48 formed with a longitudinal trough 50 adapted to receive the ball projection 30 on the bottom of screw shaft 26, is mounted on the end of carriage 10 in the path of the projecting end of screw shaft 26. A portion 52 of ball lock 46 immediately adjacent leading end portion 48 is formed with a continuation 50' of trough 50. However, the walls of trough continuation 50' are extended radially so as to form an enclosure having a slotted opening 54 extending longitudinally along the top thereof. As will become apparent, the slot 54 is adapted to receive the neck portion 56 of the ball projection 30. A circumferential collar 58 is formed on the ball lock adjacent the body portion 52 and serves as a bearing for one end of a helical compression spring 60 which surrounds the ball lock between the collar 58 and a transverse end member 62 of the carriage 10 and constantly urges the ball lock inwardly of the carriage 10 toward the path of the screw shaft 26.

A handle 64 is provided on the end of a reduced diameter shaft portion 66 of ball lock 46 to facilitate manipulation of the ball lock. The shaft portion 66 passes through a boss 68 welded on the outer surface of the end member 62 of carriage 10 and has a longitudinal slot 70 along its length for receiving a pin 72 to prevent rotation of the ball lock.

In operation, to produce a simulated defect on the surface of the pipe P, the frame 2 is attached to the pipe by means of the toggle clamps 6. If necessary, the thimble 36 is turned to adjust the length of the screw shaft 26 to insure that the ball projection 30 will engage the ball lock 46 before the milling cutter 16 engages the pipe surface when the platen is moved downward about its pivotal end. The handle 64 of ball lock 46 is pulled outwardly as the platen 14 is pivoted downwardly until the ball projection 30 is received in the trough 50 at which point the handle 64 is released to permit the ball lock to be urged inwardly of the carriage end wall 62 by action of spring 60, and the ball projection to be locked in the slotted portion 52 of the ball lock.

The motor 18 is then energized to drive the milling cutter 16, and rotation of thimble 36 is continued. When the periphery of the milling cutter makes initial contact with the surface of the pipe P, the setting of the hub 38 is noted to establish the zero point or starting position of the cutter, and then rotation of thimble 36 is continued to feed the milling cutter into the surface of the pipe to make a plunge cut of the desired depth. The thimble hub is observed during the plunge cut so that vertical feeding of the cutter can be halted when the position of the hub relative to the pointer mark 40 indicates that the desired depth has been reached. It will be noted that the measurement indicated on the hub are originally transcribed in numerals for the difference in positions, relative to the pivotal edge of the platen 14, of the milling cutter and the micrometer feed mechanism elements.

After the desired depth of cut has been reached, the lock nut 44 is threaded into engagement with the thimble yoke 32 so as to lock the platen from further downward movement and stop further plunge feeding of the milling cutter which continues to rotate. After the micrometer feed mechanism has been thus locked with the cutter revolving at the desired depth, the crank 74 of the longitudinal screw feed 12 is rotated to advance the carriage 10 along the rods 8 a distance equal to the length of notch desired. During longitudinal movement of the carriage, ball projection 30 of screw shaft 26 rests in the slot 54 of the ball lock 46.

After the contrived notch has been thus formed, the ball lock 46 is retracted to free ball projection 30 from the confines of the slotted portion 52 of the ball lock, and the platen is lifted to pivot it and the milling cutter away from the pipe P. The toggle clamps 6 are then loosened and the machine of the invention is removed from the pipe. The pipe P with the contrived notch therein is then ready for use as a reference standard for calibrating inspection equipment of the ultrasonic, eddy-current, or fringe-flux type for checking metal products for internal discontinuities in the well known manner.

Although I have shown and described the machine of my invention as used to cut a notch in the outer surface of a pipe, it will be noted that it can, with minor modifications, be used for cutting notches in the inner surface of a pipe. Such modifications would include the substitution of suction cups for the toggle clamps 6, and the addition of remote controls for the motor 18, longitudinal screw feed 12 and micrometer feed screw mechanism 24.

While I have shown but one embodiment of my invention, it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claim.

I claim:

A portable milling machine comprising a frame adapted to be clamped on a workpiece column, a way on said frame, a carriage adapted to traverse said way, means for moving said carriage along said way, a platen pivoted on said carriage for movement toward and away from a workpiece to which said frame is clamped, a milling cutter journaled on said platen adapted to engage said workpiece and cutting notch therein when said platen is moved toward it, means for driving said milling cutter, a micrometer feeding mechanism mounted on and projecting through said platen adjacent said milling cutter adapted to effect pivotal movement of said platen, said micrometer feeding mechanism including a thimble yoke rigidly mounted on said platen, a feed screw shaft extending through said thimble yoke and said platen with a portion thereof projecting from said platen adjacent said cutter, means engaging said screw for preventing rotation thereof relative to said yoke and said platen, a thimble circumferentially and threadingly mounted on said screw shaft within the confines of said yoke to effect pivotal movement of said platen, and a locking means on said carriage for releasably engaging the projecting end of said screw shaft.

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