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POWER HAND TOOL FOR DIE FINISHING AND THE LIKE

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Fig. 2

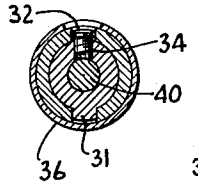

Fig. 1

Fig. 3

MAX. STROKE

Fig. 4

MIN. (ZERO) STROKE

Fig. 5

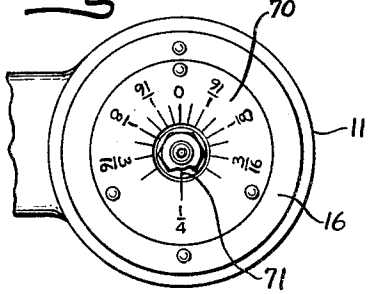

Fig. 6

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POWER HAND TOOL FOR DIE FINISHING AND THE LIKE

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The present invention relates to power hand tools and more particularly to a filing tool for smoothing and polishing surfaces of dies and the like.

In making dies for molding plastic and metal, the finish of the final product depends upon the finish imparted to the surface of the die itself. This finish is commonly achieved by skilled operators employing a tool for reciprocating small blocks of abrasive of various grades. Die finishing is a tedious and exacting procedure requiring a tool which meets a number of specialized requirements.

It is an object of the invention to provide a filing tool of the reciprocating type which is variable in stroke over wide limits but which is nevertheless dynamically balanced for all stroke adjustments so as to produce a minimum amount of vibration. In this connection it is an object to provide a tool which may be employed universally regardless of the grade of abrasive or length of stroke required and which may be used for hours at a time, for example, over an entire shift, without operator fatigue. It is a more specific object to provide a filing tool in which the balancing counterweights are automatically adjusted incident to setting the stroke adjustment so that both the adjustment and operation of the tool are simple and foolproof.

With regard to setting the stroke, it is an object to provide a filing tool which includes a novel and convenient adjusting arrangement having a calibrated scale and in which the tool is automatically placed in a reference condition incident to inserting an adjusting tool thereby insuring a correct scale reading.

It is another object of the invention to provide a novel filing tool which is safe to use and which does not provide any hazard to the operator or the workpiece even when carelessly handled. More specifically, it is an object to provide a tool in which all of the vibrating parts are enclosed and in which the only exposed vibrating element is the file itself at the tip of the tool. In this connection it is an object to provide a filing tool which, although it provides positive driving of the filing element, nevertheless includes a novel yielding connection which "gives" in the event that the file strikes a shoulder or other portion of the workpiece on its forward power stroke. Thus it is an object of the present invention to provide a tool of the above type which is self protecting and in which parts cannot be bent or overloaded.

It is still another object of the present invention to provide a filing tool which is extremely durable and which may be operated for long periods of time at a greater loading than conventional tools of comparable size and weight. More specifically, it is an object to provide a tool which avoids the points of inherent weakness of the tools which have been used for this purpose in the past. It is accordingly an object to provide a filing tool which has a longer useful life, with a minimum of maintenance, than conventional tools.

It is still another object of the present invention to provide a filing tool which is easily disassembled for periodic cleaning and inspection and which has a novel and effective lubrication arrangement. Finally it is an object to provide a filing tool which has a small number of moving parts and which does not require any critical machining operations. Consequently, it is an object to provide a tool which may be inexpensively constructed and capable

of use with flexible shafts or any other conveniently available driving means.

Other objects and advantages of the invention will become apparent from the attached detailed description and upon reference to the drawings in which:

FIGURE 1 is a longitudinal section taken along the axis of the tool.

FIG. 2 is a transverse section taken along the line 2—2 in FIG. 1.

FIG. 3 is a fragmentary cross section taken along the line 3—3 in FIG. 1 showing the tool adjusted for the maximum stroke condition.

FIG. 4 is a cross section similar to FIG. 3 but showing the minimum (zero) stroke condition.

FIG. 5 is a fragmentary top view of the tool with the cap removed showing the scale and setting used for the maximum stroke condition of FIG. 3.

FIG. 6 is a fragmentary section showing the lubricating arrangement.

While the invention has been described in connection with a preferred embodiment, it will be understood that I do not intend to be limited to the particular embodiment shown but intend to cover the other equivalent and alternative constructions included within the spirit and scope of the appended claims.

Referring now to the drawing, a tool constructed in accordance with the present invention is indicated in axial cross section at **10**. It includes a hollow cylindrical frame or shell **11** having a cap **11***a* and defining a central space **12**. Extending centrally within the tool is a shaft **13** mounted in ball bearings **14**, **15** which are spaced from one another at opposite ends of the chamber **12**. To permit access, the upper ball bearing **15** is mounted in a threaded annular bushing **16** which is screwed into the upper end of the frame.

For the purpose of driving the shaft **13**, a flexible shaft **20** is used having a central rotatable cable **21** connected to an electric motor or the like. Preferably the flexible shaft **20** is coupled to the tool by a coupling having a sleeve portion **22** and an insert portion **23**. The sleeve portion **22** may be integral with the frame **11**, or it may be, as shown, a separate tubular piece which surrounds the shaft **13** and which is screwed onto the lower end of the frame. To maintain the inserted portion of the coupling in place, a ball detent **25** is used which is seated in an aperture in the sleeve **22** and which is held therein by means of an encircling C spring **26**. A bayonet connection **28** is provided between the central drive cable **21** and the lower tip of the shaft **13**. Simply stated, when the insert **23** is slipped into its detented position, a driving connection is made with the power source permitting the tool to be freely manipulated.

Extending at right angles away from the frame **11** is a tubular offset **30**. Such offset is preferably screwed into the side of the frame **11** as shown. Slidably mounted in the offset **30** is a slide **31** which includes a chuck **32** and a shank portion **33**. For clamping a tool in the chuck, a setscrew **34** is provided, access being had through an aperture **35** normally covered by an encircling C spring **36**.

Received in the chuck **32** is a filing tool **40** having an offset shank mounting a file in the form of abrasive block **41**. The latter is brought to bear against the surface of the workpiece fragmentarily indicated at **42**. In the illustration, the file is shown seated on the bottom of a cavity; in normal use, the file reciprocates back and forth in the direction of the arrows, finishing and polishing the surface to mirror-like appearance.

For counteracting the unbalance of the slide, a counterweight **45** is fixed to the shaft by a setscrew **46**.

In accordance with the present invention a novel eccentric and pitman arrangement is employed between the drive shaft **13** and the slide **31** for varying the length of

the stroke of the slide and for simultaneously varying the amount of counterweighting so that the effective counterweight is at all times proportioned to the length of the stroke. This is accomplished in the present instance by providing on the shaft 13 an eccentric 50 which is surrounded by a pitman 51. This pitman is preferably of two piece construction as shown having a pitman rod 52 which is screwed into the pitman at its inner end and which engages the slide 31 at its outer end. Interposed between the eccentric 50 and the ring of the pitman 51 is an eccentric sleeve 55. The latter is so constructed that its eccentricity adds to the eccentricity of the eccentric 50 to provide a maximum throw in one phase position and subtracts from, or neutralizes, the eccentricity of the eccentric 50 to provide a condition of minimum or zero throw when twisted around the shaft through 180°.

In order to adjust the phase position of the eccentric sleeve 55 and at the same time change the degree of counterweighting, an adjustable counterweight 60 is provided having a keyed connection with the eccentric sleeve 55. This keyed connection is, in the present instance, brought about by machining on the sleeve 55 an axial projection 56 and by notching the counterweight 60 to form a notch 61 which snugly embraces the key 56. Being thus keyed together, it will be apparent that the eccentric sleeve 55 and the counterweight 60 always have the same phase relationship to one another so that when one of the elements is moved to a new phase position with respect to the drive shaft 13, the other will be correspondingly moved.

In accordance with one of the aspects of the invention means are provided for adjusting the shaft 13 with respect to the sleeve 55 and counterweight 60 with the latter maintained at a reference position with respect to the frame of the tool, and means are further provided on the shaft and frame for indicating the phase position of the shaft with respect to the frame which exists at the time that the adjusting means is tightened. In the present instance the counterweight 60 is clamped in a desired phase position on the shaft by means of a setscrew 62, and a narrow opening 65 is formed in the wall of the hollow frame through which an appropriate tool such as an Allen wrench or the like 66 may be inserted. Thus, insertion of the tool through the aperture 65 and into the setscrew insures that the eccentric collar 55 and counterweight 60 occupy a predetermined reference position so that the degree of eccentricity and hence the stroke of the tool is indicated by the then existing phase position of the shaft with reference to the frame of the tool.

In order to provide direct reading of the throw, a scale 70 is provided at the top of the tool mounted upon the annular bushing 16. Cooperating with this scale 70 is a pointer 71 which may simply be a line inscribed on the side of the shaft. The scale 70 as noted in FIG. 5 is marked off directly in terms of throw, from zero to ¼".

The function of the mechanism and indicia described thus far will be apparent upon reviewing a typical adjustment of the tool. Suppose it is desired to set up the condition of maximum throw. The cap 11*a* of the tool is removed exposing the end of the shaft 13 as wel as the scale 70. The end of the shaft is machined to be hexagonal as indicated at 73 so that it may be engaged by an open end wrench of the like. The Allen wrench or other adjusting tool 66 is then inserted into the opening 65, and the shaft 13 is rotated either manually or by the shaft wrench until the tool 66 falls into seated position in the set screw 62. The tool 66 is then turned to unscrew the set screw and hence to release the eccentric sleeve 55 and its associated counterweight 60 from the shaft. The shaft wrench is next turned so that the pointer 71 thereon is rotated around into the position shown in FIG. 5, i.e., the position for ¼" throw. The tool 66 is then turned to screw the setscrew tight onto the shaft thereby to lock the eccentric sleeve 55 in its position of maximum throw, i.e., the position where its throw is additive with respect to the throw of the eccentric 50 on the shaft. It will be noted that under such conditions the counterweight 60 and the counterweight 45 are alined with one another so that their effects are additive. Thus the condition of maximum throw is accompanied by maximum effective counterweighting.

It will next be assumed that the tool is to be adjusted for a very small throw of say, only 1/32 of an inch. The adjusting operation is then repeated as follows: The tool 66 is inserted and the shaft 13 is rotated until the tool is seated in position in the set screw 62, thereby establishing the reference position of the essentric sleeve and the associated counterweight with respect to the frame. The set screw is loosened and, keeping the tool 66 in place, the shaft 13 is turned until the mark 71 thereon is opposite the 1/32 inch position of the scale 70. Either one of the two available positions may be employed. The set screw is then tightened, following which the tool 66 may be withdrawn. Under such conditions the eccentric sleeve will be rotated around to nearly the position shown in FIG. 4 where the eccentricity of the eccentric 50 and the sleeve 53 almost cancel out thereby producing a nearly zero stroke. Also under such conditions, the counterweight 60 is rotated with respect to the counterweight 45 so that the two are opposite one another, providing a condition of minimum counterweighting corresponding to the minimum stroke. It will be apparent to one skilled in the art that intermediate conditions of adjustment are possible and that the "half-way" condition of the eccentric sleeve will be accompanied by a "half-way" condition of the counterweight.

It is of interest to note that rotation of the counterweight 60 relative to the shaft not only changes the stroke and the amount of effective counterweighting but also maintains the direction of the counterweight vector in a direction opposite to the direction of unbalance. This is due to the fact that rotation of the sleeve 55 changes the effective angle of the cam 50.

In accordance with one of the more detailed features of the construction a yieldable connection is provided between the pitman and the slide so that in the event the file is obstructed in its forward stroke, as will occur when the tool advances too closely to a shoulder on the workpiece, yielding will take place thereby protecting the workpiece and preventing the tool from damaging itself. In the present instance this is accomplished by providing a ball and socket connection between the pitman rod 52 and the slide and by seating the ball in its socket with a yieldable coil spring. Referring to FIG. 1, the shank 33 of the slide is made hollow but is necked down as indicated at 81 to provide a seat for the ball 82 at the outer end of the pitman rod 52. Pressing against the ball 82 is a coil spring 83 which is prestressed to provide a substantial normal force against the pitman rod so that, under normal operating conditions, the pitman rod and slide reciprocate back and forth as a unit. However, if the tool is obstructed, the pitman rod 52 will simply telescope into the shank of the slide, overcoming the force of the spring 83 thus preventing the buildup of a force greater than that for which the spring has been set. It is one of the features of the present tool that the encountering of large forces either intentionally or accidentally may be tolerated by the tool without any danger of bending the shaft 13. Thus it is one of the features of the construction that in addition to the bearing 14 there is provided what might be termed an outboard bearing 15. Thus the shaft 15 is not subjected to any cantilever forces. Or, stated another way, the eccentric drive mechanism is straddled by anti-friction bearings on each side so that large forces may be developed in the drive mechanism without any tendency to bend or otherwise damage the drive shaft.

It is a further detailed feature of the construction that adequate lubrication is provided for the relatively in-

accessible drive assembly, lubricant being fed downwardly from the end of the drive shaft through lubricant passageways leading directly to the frictional surfaces. Thus referring to FIG. 6 it will be noted that a grease fitting 90 is provided at the upper end of the shaft 13 which fitting communicates with a central bore 91 which is connected to a transverse bore 92 which leads to the inside of the eccentric sleeve 55. The sleeve is internally grooved and provided with radial parts 93 so that lubricant passes through to the outside of the sleeve. It is found in practice that occasional application of a grease gun to the fitting 90 is adequate to produce lubrication for several hours of continuous use. For the purpose of lubricating the slide 31, an oil hole 95 is provided in the wall of the offset and into which a few drops of oil may be added from time to time. In order to prevent the entry of grit or other foreign material, the oil hole 95 is normally covered by means of an embracing C spring 96. The ball bearings are of the permanently lubricated type.

Having understood the above construction, it will be apparent to one skilled in the art that a minimum vibration condition is achieved regardless of the stroke adjustment. Consequently the tool may be operated for several hours at a stretch or even over an entire shift without the vibration producing any fatigue on the part of the operator. Because of the wide range of stroke adjustment, it has been found that tools of the present design may be used universally in all filing and die sinking operations, all the way from coarse filing operations to the finest degree of polishing. Adjustment of the tool is simple and foolproof since only one adjustment is required to bring about a change in the throw and counterweighting suitable for such throw. The tool is safe since all of the vibrating elements with the exception of the file itself are completely enclosed and since the tool includes provision for automatically relieving any overload condition caused by the file striking an obstruction as it is guided over the work. Finally it will be apparent that the tool consists of only a small number of moving parts and may be inexpensively constructed while nevertheless of inherently durable long lasting design.

The tool may be easily disassembled when maintenance or inspection become necessary. Upon removing the shank 40 of the file, the setscrew which retains the spring 83 is exposed when the screw is removed, the spring 83 slips out following which a screwdriver may be inserted into the slotted end of the pitman rod 52. The pitman rod is then unscrewed, following which the entire tubular offset 30 may be unscrewed. The annular bushing 16 surrounding the upper bearing is next unscrewed, following which the drive shaft 13 and eccentric drive assembly may be withdrawn from the frame. Assembly following maintenance is equally simple.

While the tool has been described in connection with the reciprocating of a file in the form of a block of abrasive, it will be understood that the tool is not limited to use with a file and may, if desired, be used with a saw tip, a lap charged with abrasive, a felt polishing pad, a brush, or the like.

I claim as my invention:

1. In a power tool or the like the combination comprising a hollow frame, a drive shaft extending longitudinally in said frame, an eccentric on said drive shaft, a slide having chuck means and mounted in said frame for reciprocating movement at right angles to the shaft, a pitman coupled to said slide and having a ring at one end thereof, an eccentric sleeve snugly interposed between the eccentric and the ring on the pitman and so arranged that rotating the sleeve 180° causes the throw of the ring with respect to the shaft to vary from maximum to substantially zero, a counterweight fixed to said shaft, a second counterweight keyed to the sleeve for movement with the sleeve and having means for fixing the same in an adjusted phase position on said shaft, said counterweights being so phased with respect to their respectively associated shaft and sleeve so that the counterweights are alined for additive effect when the sleeve is in its position for maximum throw and diametrically opposed when the sleeve is in its position of substantially zero throw with the degree of counterweighting varying in unison with the throw in the intermediate positions of adjustment.

2. In a power tool or the like the combination comprising a hollow frame, a drive shaft extending longitudinally in said frame, an eccentric on said drive shaft, a slide having chuck means and mounted in said frame for reciprocating movement at right angles to the shaft, a pitman coupled to said slide and having a ring at one end thereof, an eccentric sleeve snugly interposed between the eccentric and the ring on the pitman and so arranged that rotating the sleeve 180° causes the throw of the ring with respect to the shaft to vary from maximum to substantially zero, a counterweight fixed to said shaft, a second counterweight keyed to the sleeve for movement with the sleeve and having means for fixing the same in an adjusted phase position on said shaft, said counterweights being so phased with respect to their respectively associated shaft and sleeve so that the counterweights are alined for additive effect when the sleeve is in its position for maximum throw and diametrically opposed when the sleeve is in its position of substantially zero throw with the degree of counterweighting varying in unison with the throw in the intermediate positions of adjustment, the fixing means of said second counterweight comprising a set screw, and said hollow frame having an aperture on one side thereof for receiving a tool so that the set screw can be operated only when the second counterweight and sleeve are in a particular registered phase position with respect to the frame, and cooperating indicia on the shaft and frame for reading when the tool is inserted into engagement with the set screw for indicating the degree of throw.

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