Nov. 30, 1971

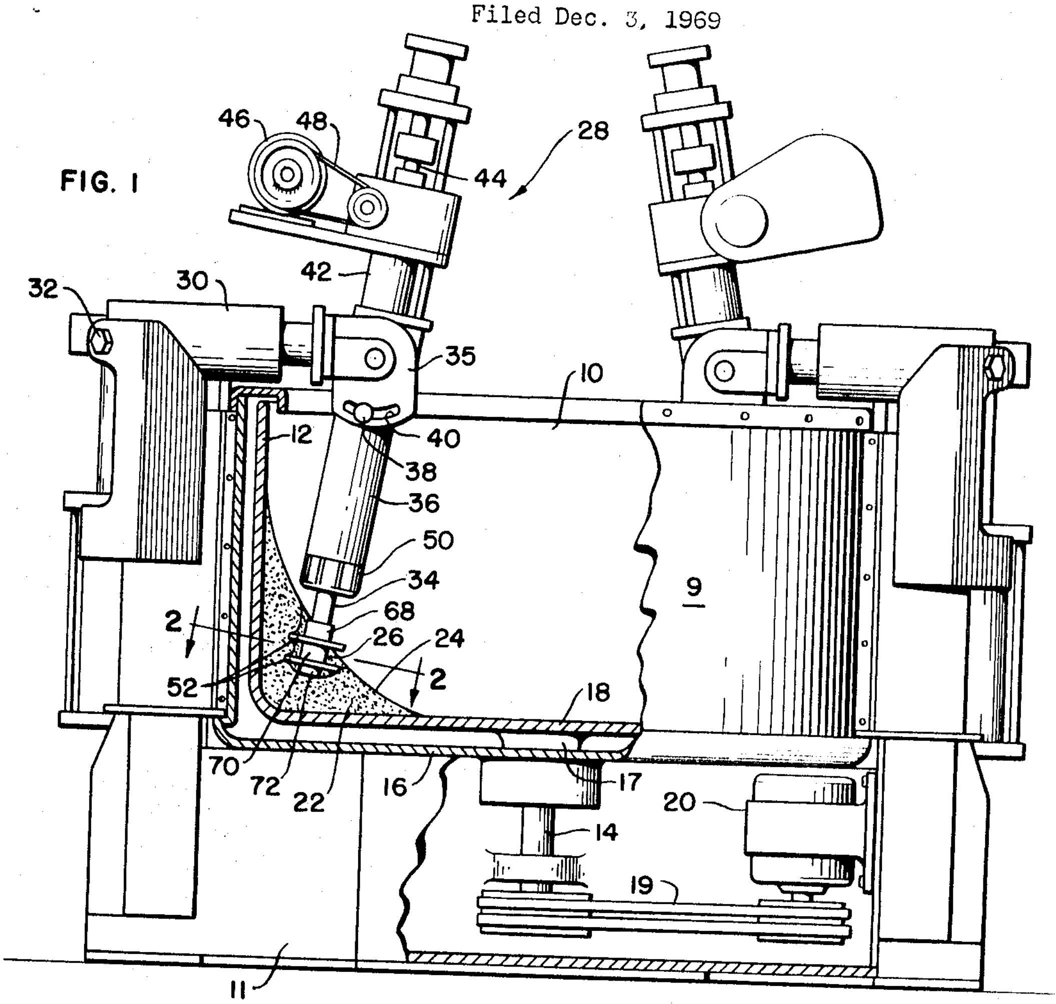
H. J. SCHWARTZ

3,623,278

DEBURRING PROCESS

Filed Dec. 3, 1969

FIG. I



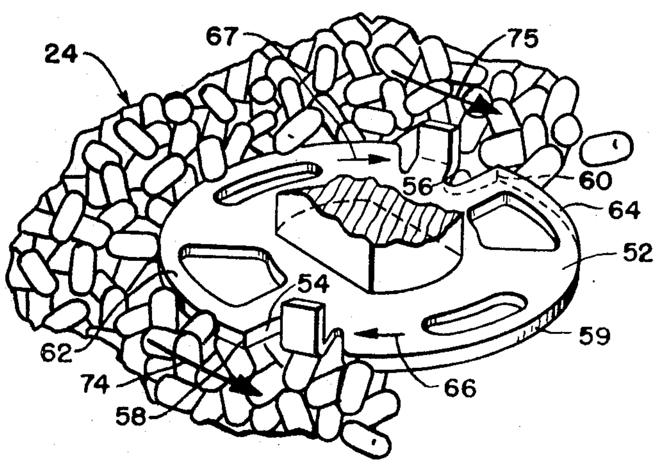


FIG. 2

INVENTOR
HERMAN J. SCHWARTZ
BY Sherman P. Appel
ATTORNEY

United States Patent Office

3,623,278
Patented Nov. 30, 1971

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3,623,278
DEBURRING PROCESS
Herman J. Schwartz, Chicago, Ill., assignor to Teletype Corporation, Skokie, Ill.
Filed Dec. 3, 1969, Ser. No. 881,799
Int. Cl. B24b *1/00*
U.S. Cl. 51—317 **6 Claims**

ABSTRACT OF THE DISCLOSURE

In a mass deburring process, the integrity of a corner of a workpiece is maintained by rotating a centrifugally maintained gritty abrasive wall in a first angular direction about the workpiece and rotating the workpiece in the wall such that the velocity of the corner is about at least as great as the velocity of the abrasive and in a second angular direction substantially opposite to said first angular direction.

BACKGROUND OF THE INVENTION

The present invention relates to surface finishing. Particularly it relates to deburring piece parts in a mass production process.

It has been known to tumble, agitate or otherwise move metallic workpieces, such as small piece parts, in drum or barrel in the presence of a gritty abrasive to remove surface irregularities such as burrs and other projections. However, the heretofore known procedures are unsuitable for finishing a workpiece if there is a requirement to retain the integrity of a specific surface thereon because there is no known economical practice for protecting a selected surface from abrasion.

For example, in a known process for making a clutch, a metallic disc is stamped from a blank. Incident thereto burrs are raised on the surface of the disc which then is formed; and a corner is milled in the formed member. The sharpness of the corner is critical to clutch operation. Accordingly, no heretofore known mass abrading techniques can be used for deburring the discs. In consequence, a highly costly manual technique in which each disc is separately finished is required for burr removal and to insure retention of corner integrity.

It is an object of this invention to provide an improved finishing process.

It is another object of the invention to minimize the cost of finishing the surface of a workpiece having a region required to be unaffected by the finishing operation.

It is an additional object of the invention to provide a mass process for deburring metallic workpieces while maintaining the integrity of a sharp edge on each thereof.

It is a further object of the invention to eliminate the requirement for manual deburring of a workpiece in a finishing process in order to maintain the integrity of a sharp edge thereon.

SUMMARY OF THE INVENTION

In accordance with the present invention, the foregoing objects are effected by rotating a workpiece relative a mass of an abrasive and arranging the workpiece in the mass such that during each rotational cycle a part of the workpiece sought to be protected is masked from abrasive impact by the bulk on the workpiece and will move away from an impacting course with the abrasive mass.

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Considered from another aspect, the objects of the invention are achieved by coupling a wall of a gritty abrasive to a rotating container to rotate the abrasive. A workpiece is engaged and held at a fixed station in the wall as the abrasive rotates. A surface of the workpiece is rotated at a linear velocity at least about equal to the linear velocity of the abrasive in which the workpiece is engaged.

BRIEF DESCRIPTION OF THE DRAWINGS

In the ensuing description reference is had to the accompanying drawings in which:

FIG. 1 is a side elevational view of apparatus for practicing a process embodying the present invention and

FIG. 2 is a perspective view enlarged from, and taken in a plane along line 2—2 of FIG. 1.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

Referring now to FIG. 1, shown is a housing **9** which may be circular in cross section and has an upper opening **10**. A sheet metal skirt serves as a base **11** adapted for rigidly supporting the housing above suitable flooring (not shown). An upwardly opening container, drum or barrel **12** concentric with the housing is arranged therein by any suitable means enabling rotation about a vertical axis. A vertically oriented drive shaft **14**, which is journalled through the lower wall **16** of the housing **9**, has an upper enlarged supporting end portion **17** centrally secured to the lower wall **18** of the drum. A pulley system **19** operably couples shaft **14** to the output shaft of a motor **20** which comprises prime mover means for rotating the drum.

A mass of a grinding medium such as a gritty abrasive **22** is disposed in drum **12**. Motor **20** is adapted to rotate at a rate sufficient to generate a centrifugally maintained wall **24** of abrasive against the inner surface of the drum. In the illustrated embodiment the particles of abrasive **22** are vitrified molded angle cylinders or pellets of aluminum oxide $\frac{3}{16}''$ by $\frac{11}{32}''$. However, neither the specific composition nor the specific size of the pellets is critical in the invention. A load of abrasive sufficient to effect the process in the exemplary drum comprises about 400 lbs.

In the illustrated process, the drum **12** has a diameter of 4 feet and is rotated at about 60 r.p.m. The mass of the abrasive **22** is such that when rotated at said rate, the velocity of the abrasive at a circular grinding, abrading or finishing station **26**, the character of which will be further clarified in ensuing description, is about 650 feet per minute.

A work holder **28** may, as illustrated, be one of a plurality of like members spaced about drum **12**. It comprises an arm **30** which is rockably mounted above a pivot **32** to lower and raise a spindle **34** toward and away from station **26**. The agency (not shown) for rocking said arm may be any well-known means and is not limiting on the invention. A bracket **35** which is carried from the work proximate end of arm **30** adjustably carries a mounting cylinder **36**. When operatively conditioned, the cylinder is secured by fastening means **38** at a generally vertical, though slightly tipped, orientation which can be selectively adjusted within the limits of a slot **40** in bracket **35**. A journalling sleeve **42**, carried in cylinder **36**, provides a bearing for a driveable shaft **44**. Driving means comprising a motor **46** is drivingly coupled to shaft **44** through a drive transmission, which may be of known construction and include pulley belt 48. A chuck 50 is connected to the work proximate end of shaft 44 for rotation at the lower end portion of cylinder 36.

Spindle 34 is releasably secured in the chuck 50 by usual means for rotation with shaft 44 from which the spindle projects axially. The spindle is proportioned such that when in operable position, its lower end portion will engage in wall 24 and therein define an annulus comprising station 26 as abrasive is displaced. The exemplary spindle when operatively disposed is 1.75 feet from the center of rotation of drum 12.

According to the present invention, the surface of a plurality of workpieces 52 can be simultaneously abrasively finished by rotating them in wall 24 relative abrasive 22 at station 26. Abrasive dislodged or displaced by interaction therewith and any workpiece is returned to and reforms the wall by centrifugal force as drum 12 rotates and thereby prevents cavitation. Each exemplary workpiece is a clutch disc fabricated of a chrome nickel alloy having an AISI designation of 4130 and is formed by stamping from a blank in consequence of which burrs, which will be removed during finishing, are raised on its surface. Following stamping, each disc is further formed to generate a pair of opposed outwardly opening recesses 54 and 56 and a pair of opposed corners 58 and 60; and then it is perimetrically ground to an outside diameter of about 2".

Thereafter, the corners 58 and 60 are contoured in a mill. Subsequently, each disc is hardened by carburizing to a depth of about .003 inch. Each of the corners comprises a part or portion, the integrity of which it is desired to maintain during finishing. In accordance with the invention abrading association of the corners practically is prevented during finishing.

Each of the corners of a disc is defined by the junction of the disc perimeter 59 and a respective wall of recesses 54 and 56. They are disposed in trailing association with disc bulks 62 and 64 in terms of angular disc direction (arrows 66 and 67) during finishing.

To the latter end a pair of discs 52 is fixed on spindle 34 in parallel planes normal to the spindle axis. The innermost disc is held against a fixed collar 68 and separated from an adjoining disc by a spacer 70. The assembly is secured by a nut mounted on the outer end portion of said spindle and forcing the proximate disc against said spacer.

In the illustrated embodiment, spindle 34 is driven at 1250 r.p.m. This rate imparts a linear velocity to the perimeter 59 of about 650 feet per minute, said velocity being about 25 feet per minute greater than the velocity of the abrasive at station 26. Moreover, the angular direction (66 and 67) of rotation of the spindle and the workpieces mounted thereon is substantially opposite to the angular direction (according to arrows 74 and 75 of rotation) of the abrading material which is disposed about station 26.

Ideally, the workpieces 52 are mounted such that corners 58 and 60 are parallel to the axis of rotation of wall 24. Practically, in the exemplary equipment, this cannot be done economically; and an angle of between 10° and 15° from the vertical is imparted to spindle 44 to enable cylinder 36 to clear the abrasive in wall 24 during the process.

The achievement of the process can be readily understood by referring to FIG. 2. There it is seen that during each cycle of disc 52 each corner thereof, while moving in an opposite angular direction to the abrasive, will have: (1) a linear component of motion (according to arrow 66) which is opposite the linear component of motion (according to arrow 74) of the abrasive and (2) a linear component of motion (according to arrow 67) which is roughly the same as the linear component of motion (according to arrow 75) of the abrasive.

The concept clarifies by considering, for the moment, corner 58. In the phase (herein called the first phase) of the cycle shown in FIG. 2, the linear component of motion of said corner 58 is in a direction (arrow 66) which is substantially opposite to the direction (arrow 74) of the linear component of motion of the abrasive at station 26. Therefore, if it were not for the masking effect of bulk 62, corner 58 would come into abrasive impact with the particles of abrasive 22 comprising wall 24. However, because it is masked during the first phase of each cycle, abrasion of corner 58 is prevented. On the other hand, when corner 58 is in the second phase of each cycle, that is, for example, when it occupies the position of corner 60 shown in FIG. 2, then the direction (arrow 67) of its linear component of motion is substantially the same as the direction (arrow 75) of the linear component of motion of abrasive 22. In the second phase of the cycle corner 58 is exposed without protection of the masking mass to the abrasive. However, because corner 58 is moving faster than wall 24, it moves away from the abrasive 22 to which it is exposed; and in consequence, though exposed, it does not become abraded.

During a short portion of each cycle, a corner sought to be protected will be neither masked nor have a linear component of velocity which is parallel and at least equal to the linear component of velocity of the abrasive. Accordingly, an abrasive effect on such corner is manifest. Integrity retention of the corner in this condition is proportional to the differential of the linear velocities of the abrasive and such corner. Practically, under exemplary conditions, the undesired abrasion is inconsequential as the extent thereof falls within tolerable limits.

Though ideally, the relative rates of spindle 44 and shaft 14 are such that a workpiec 52 will move at least as fast as the abrasive 22 to avoid abrasive collision of a corner while in the second phase of each cycle, a suitable finishing result can be obtained if the velocity of the corner is less than or negative relative the velocity of the abrasive, provided total corner exposure is brief and abrasive impact is of low level. The limit of the range of tolerable negative velocity will, of course, vary according to many factors, for example, duration of exposure and grittiness of abrasive. However, it is intended that such negative speed of a workpiece within a tolerable limit at which integrity of an area or portion of the workpiece will be maintained following impact with the abrasive falls within the scope of a definition for velocity of about equal to the velocity of abrasive in which the workpiece is engaged.

Prior to the present invention one operator was required to work one hour to finish 50 exemplary workpieces. Employing the invention, the productivity of the like worker has been increased to 300 workpieces per hour.

As many changes could be conceived in the foregoing process, and as many changes could be made therein without departing from the spirit and scope of the claims, it is intended that all matter contained in the accompanying specification shall be considered as illustrative only and not in a limiting sense.

I claim:

1. A process for abrasively finishing a workpiece having a bulk part while maintaining a surface part of the workpiece in an unabraded condition and comprising the steps of:

rotating the workpiece including the bulk part and the surface part through a mass of abrasive;

rotating the abrasive mass about the workpiece while the workpiece is rotated; and

arranging the workpiece in the mass such that the surface part is masked from impact with the abrasive mass by said bulk part during only a portion of each rotational cycle and moves away from contact with the abrasive mass only during the remainder of such cycle.

2. A process according to claim 1 characterized in that the velocity of the surface part is greater than the velocity of the abrasive mass.

3. A process according to claim 2 characterized in that

the angular directions of rotation of the workpiece and the abrasive mass are substantially opposite.

4. A process according to claim **1** wherein the surface part is a corner and is mounted in trailing relationship with said bulk part.

5. A deburring process comprising the steps of:

coupling a wall of a gritty abrasive against a rotating container for rotating the abrasive wall;

engaging and holding a workpiece at a fixed station in the wall as the container rotates; and

rotating a surface of the workpiece relative to a holder for the workpiece and at a linear velocity at least about equal to the linear velocity of the abrasive in which the workpiece is engaged and in an angular direction substantially opposite to the direction of rotation of said wall.

6. A process according to claim **5** in which the linear velocity of the surface of the workpiece is greater than the linear velocity of the abrasive in the wall.

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U.S. Cl. X.R.

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