Nov. 2, 1971 R. W. JOHNSON ET AL 3,616,581

POLISHING AND GRINDING ROTARY FINISHING TOOL

Filed Oct. 8, 1969

GRINDING

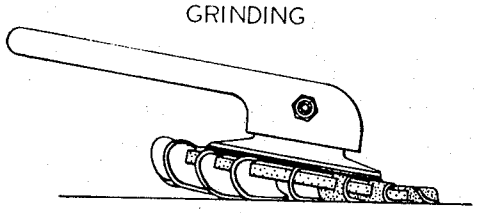

Fig. 1

POLISHING

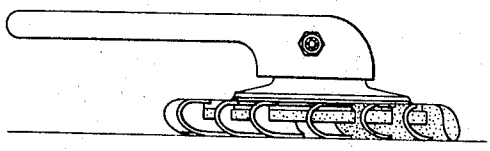

Fig. 2

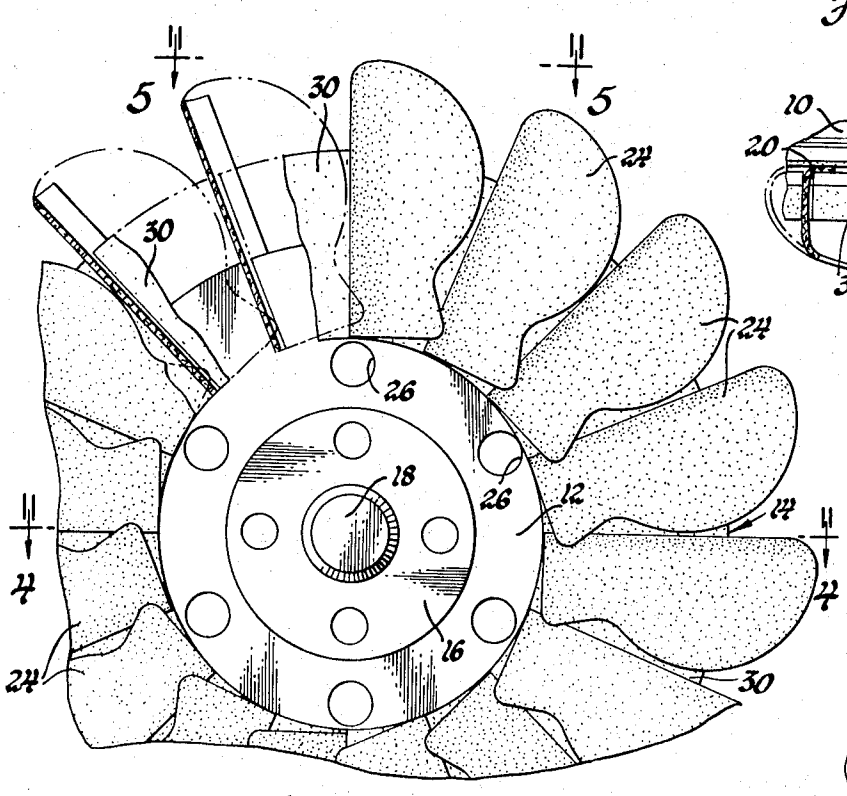

Fig. 3

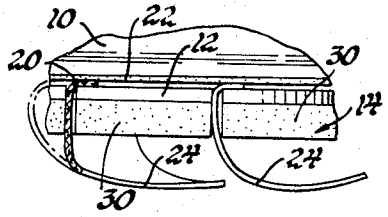

Fig. 5

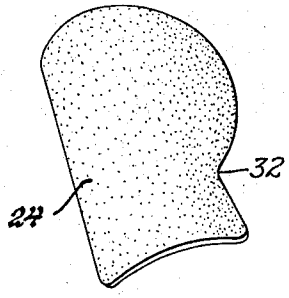

Fig. 6

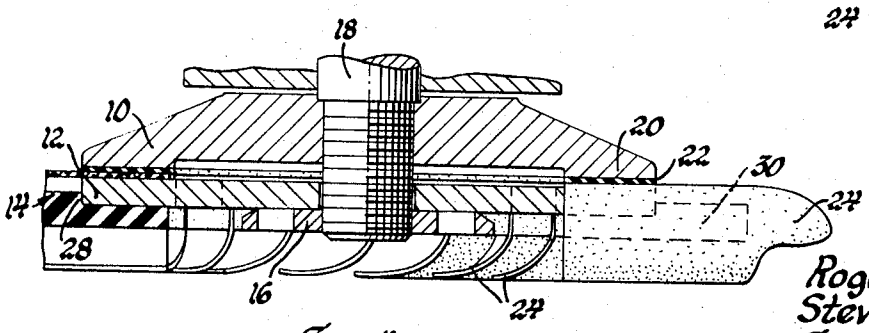

Fig. 4

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3,616,581

POLISHING AND GRINDING ROTARY FINISHING TOOL

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Int. Cl. B24d 9/08
U.S. Cl. 51—337 4 Claims

ABSTRACT OF THE DISCLOSURE

A nonloading, self-cleaning rotary surface finishing assembly for both grinding and polishing operations using the same abrasive grit. The assembly includes a rigid backup pad and a composite front plate having integral flexible fingers extending radially beyond the backup pad. A plurality of radially arrayed, overlapping, generally tapered flaps, extending out from the fingers, are clamped in place between the backup plate and a rigid central portion on the front plate. The outer periphery and trailing edge of each flap is arcuate, and the trailing edge preferably has a notch near its innermost end for improved wear life.

BACKGROUND OF THE INVENTION

This invention relates to rotary surface finishing tools and more particularly to a rotary finishing assembly particularly useful for the finishing of automobile bodies.

The finishing of metal surfaces for painting, particularly automobile bodies, requires a diversity of tools and a high degree of skill in the operation of these tools. The satisfactory blending of a solder-filled body joint, for example, is difficult for even an experienced tool operator to rapidly finish, particularly in or near crevices and character lines of a sculptured surface. As a result, particular types of surface finishing tools have been developed to minimize the effort and skill required. The larger surfaces are typically finished with a plain, rosette, or serrated circular abrasive disk, along with rigid, flexible or rubber backup pads, depending on the particular surface contour being finished. Elastomeric backup pads are also frequently used, having plain, stepped, and grooved edge configurations. All of these disks and pads are used in various combinations for selected surface areas, using particular abrasive grits, depending on whether the surface is being ground or polished.

The particular disk, pad and grit used are important if one is to obtain rapid metal removal without edge cutting, undercutting, scalping and the like. Even then the skilled operator must still employ one particular tool combination for grinding and another for polishing. Moreover, these tools will still fairly readily produce surface damage in the hands of an inexperienced operator. In addition, it should also be noted that abrasive disks are susceptible to loading with the solder being abraded, particularly when improperly used.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a single rotary finishing assembly which is useful for both grinding and polishing operations, particularly on automobile bodies.

Another object of the invention is to provide a rotary finishing assembly capable of finishing a wider variety of surface contours, particularly those involving character lines on sculptured surfaces.

A further object of this invention is to provide a rotary finishing assembly which is less susceptible to edge cutting, scalping and undercutting, particularly in the hands of an inexperienced operator.

A still further object of the invention is to provide a finishing assembly that is resistant to loading.

These and other objects of the invention are attained with a rotary finishing assembly having a plurality of radially arrayed, partially overlapping flaps of abrasive material backed by resilient elastomeric fingers of about 60–70 A. durometer hardness. The assembly includes a rigid backup plate and a composite circular front plate having a rigid central portion and an integral elastomeric rim portion overlapping the rigid central portion. The elastomeric rim forms a plurality of radially extending fingers supporting the inner end of the abrasive flaps. The flaps are clamped between the backup plate and the rigid central portion of the front plate. They extend through slots in the front plate to the working face thereof and flex over the fingers of the elastomeric rim.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features and advantages of the invention will become more apparent from the following description of preferred examples thereof and from the drawings, in which:

FIG. 1 shows an elevational view of a rotary hand tool with the rotary finishing assembly of this invention being used in the grinding mode;

FIG. 2 shows an elevational view of the apparatus shown in FIG. 1 when it is being used in the polishing mode;

FIG. 3 shows a fragmentary elevational view, in partial section, of the working face of the finishing assembly of this invention;

FIG. 4 shows a sectional view along the line 4—4 of FIG. 3;

FIG. 5 shows an elevational view along the line 5—5 of FIG. 3; and

FIG. 6 shows an isometric view of an abrasive flap for the rotary finishing assembly of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As can be seen in connection with FIGS. 1 and 2, the rotary finishing assembly of this invention can be used for both grinding and polishing operations without changing the backup pad or the abrasive grit. It is conventional to use a coarse grit abrasive for grinding and to use a fine abrasive grit for polishing out the grinding marks. Hence, two separate tools are conventionally necessary in order to finish a metal surface for painting to a specular appearance. As shown in FIG. 1, the assembly is canted somewhat, at least 5° and preferably at least 10–15° from the surface being abraded when the assembly is used for grinding. In addition, a slight hand pressure is applied sufficient to flex the rubber fingers of the supporting front plate. In such instance the surface can be readily ground, by even an inexperienced operator, without surface damage, even over gentle surface contours and in crevices.

After grinding, the whole working face of the same assembly is simply placed flat on the surface to be polished, with only sufficient pressure to guide the tool being needed. The working face is then allowed to effectively flow over the previously ground surface as shown in FIG. 2. By simply oscillating the tool over the ground area, the grinding marks are polished away. Hence, the same abrasive flap is used for both grinding and polishing.

As can be seen in connection with FIGS. 3–5, the finishing assembly comprises a back plate **10** and a composite front plate having a rigid central portion **12** and an outer rubber rim portion **14**. A spanner nut **16** locks the back plate to the front plate, and holds the assembly on rotatable shaft **18** of an appropriate rotary hand tool.

The back plate **10** has an annular land portion **20**, and an annular rubber facing **22** on the land, for clamping the abrasive flaps **24** betwen the back plate and the rigid central portion **12** of the front plate. The rigid central portion has a plurality of apertures **26** therein which lighten the weight of the front plate and which can be used to facilitate mounting and locking the assembly together.

This apparatus is particularly adapted for use in finishing large area surfaces of gentle curvature, as well as smaller area surfaces of complex, compound curvature, such as is associated with automobile body sculpturing. We have found that the utility of this tool in such an application is directly related to its size. If the assembly is of a larger size its ability to closely follow surface contour, and finish more abruptly changing surfaces is severely curtailed. On the other hand, if the size of this assembly is smaller, the time required to finish a given surface area is extended and the assembly requires a greater degree of skill to satisfactorily grind and polish with it. The particular size assembly described herein has been found to provide highly satisfactory results even in the hands of an inexperienced operator.

The back plate is of cast aluminum and is approximately 4 inches in diameter. The land area **20** on the backup plate is about ½ inch wide and is tapered inwardly about 1° to compensate for the slight deformation which occurs when the back plate is clamped to the rigid central portion **12** of the front plate by the spanner nut **16**. Rubber facing **22** on the land region **20** is about ⅛ inch thick, and may be included to enhance the clamping action on the abrasive flaps **24** and reduce land wear on the backup plate.

The central portion **12** of the front plate is of approximately 0.2 inch thick aluminum, and is about 4 inches in diameter.

The rim portion **14** of the composite front plate is of a nitrile rubber, such as Hycar 1072, having a durometer of approximately 60–70 A. hardness. A higher durometer elastomer rim promotes edge cutting and ditching, and is more susceptible to fracture at the outer edge **28** of the rigid central portion **12**. Lower durometer elastomer rims make it difficult to grind out file marks. Further, it tends to rapidly wear and widen the slot between the fingers **30**, particularly at their outer periphery. In addition the fingers lose tear strength.

The rubber rim portion is molded in place, so that it is integral with central portion **12**. The rim must be molded in place in order to withstand the flexing rigors it is exposed to. It is an annulus approximately 2½ inches wide, with an outer diameter of approximately 5¼ inches. Hence, about one-half of its width overlaps the outer periphery of rigid central portion **12** and the outer one-half is unsupported. The rubber rim is approximately ¼ inch in thickness in the unsupported region with about ⅓ of this thickness abutting the edge **28** of the rigid central portion. Thus, the rigid central portion can be considered as partially embedded within the rubber annulus forming the outer rim portion. The partial embedding has been found to be especially important in preventing fracture of the rubber rim at the periphery of the rigid central portion, due to a continuous flexing action during grinding.

A plurality of narrow slots extend inwardly to the center of the front plate forming a plurality of radially arrayed rubber fingers **30** in the rubber rim. At least 10 such fingers are needed, and preferably about 15 to 20, for the assembly to function most effectively.

Abrasive flaps **24** disposed within each slot, with their inner ends clamped in place between the rigid central portion of the front plate and the annular land area of the back plate, extend to the work face of the assembly. Flaps **24** are formed of a cloth backed single flex abrasive material and mounted in place so that they flex in a direction opposite to the direction of rotation of the tool when in use. About one-half of the length of flaps **24** projects radially outwardly beyond rim **14**, approximately ⅝–⅞ of an inch. This outer end and adjacent trailing edge is arcuate, as can be seen most clearly in FIG. 6. The radius of the curvature on the outer periphery and connected trailing edge is approximately ¾ of an inch. Since only about ½ of the flap is supported by fingers **30**, the flap can more readily flow over and against abrupt surface contours without edge cutting, ditching, undercutting, etc.

The flaps **24** can be considered as generally tapered inwardly along their trailing edge, so as to produce a generally uniform overlap along the trailing edge. An overlap of approximately 1/16 to 3/16 inch is preferred. In addition, it has been found that if the trailing edge of the flap has been notched along the inner one-half of its length, wear life of the flap can be significantly increased. Accordingly, FIG. 6 shows the flap having a notch **32** near its inward end for producing a two-point contact of overlap.

While it is conventional to use a 50 grit abrasive for grinding automotive bodies and an 80 grit abrasive for polishing the ground surface, this tool can perform both functions as satisfactorily using a 60 grit abrasive. Of course, for applications where it may be preferred to use this tool solely for grinding, a coarser grit may be preferred. On the other hand, if it is to be used primarily for polishing functions it may be preferred to use a finer grit.

In addition, abrasive disks will fairly readily load with paint and solder, especially if used improperly. The inherent air pumping action of our assembly and the continuous flexure of the abrasive flaps apparent by make this assembly quite resistant to loading, even when used by an inexperienced operator.

We claim:

1. A nonloading, self-cleaning rotary surface finishing assembly for both grinding and polishing operations using the same abrasive grit, said assembly comprising a circular rigid backup plate about 4 inches in diameter, a composite circular front plate about 5¼ inches in diameter, a rigid central portion in said front plate about 4 inches in diameter, an integral elastomeric circumferential outer rim portion of about 60–70 A. durometer overlapping the outer periphery of said central portion and forming a working face for said assembly, at least 10 slots extending from said rim into said rigid central portion and producing a plurality of radially arrayed integral flexible fingers on the front plate, flexible cloth-backed abrasive flaps in said slots having portions extending axially from said front plate and radially outwardly from said fingers about ¾ inch, the axially extending portions providing trailing edges for said flaps, said flaps flexing in a direction opposite to the direction of rotation of said rotary finishing assembly, said flaps being generally tapered inwardly and projecting axially sufficiently to overlap one another less than about ¼ inch when flexed against the working face of said front plate, an arcuate periphery on the axially and radially extending portions of said flaps, and means for clamping the portions of said flaps in said slots in place against said rigid central portion of said front plate.

2. The rotary surface finishing assembly defined in claim **1** wherein the trailing edge of each abrasive flap has a notch therein adjacent its inner end to increase flap wear life.

3. The rotary surface finishing assembly defined in claim **1** wherein the composite front plate has a metal

central portion and an outer rim portion of nitrile rubber molded in place forming 15–20 flexible fingers backing up the abrasive flaps, the abrasive flaps are of a single flex cloth-backed material, and the training edge of each flap has a notch therein about midway along its length to increase flap wear life.

4. The rotary surface finishing assembly as defined in claim 3 wherein the rigid central portion is embedded in said rubber rim portion to enhance the life of the flexible fingers formed in the rubber rim.

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LESTER M. SWINGLE, Primary Examiner

U.S. Cl. X.R.

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PO-1050
(5/69)

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,616,581 Dated November 2, 1971

Inventor(s) Roger W. Johnson, Steve M. Senko and Frank J. Sienkiewicz

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, bridging lines 5 and 6, "assignors to General Electric Corporation, Detroit, Mich." should read -- assignors to General Motors Corporation, Detroit, Mich. --.

Signed and sealed this 2nd day of May 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents