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Bass

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[54] WORK HOLDER FOR ELECTROCHEMICAL ABRADING MACHINE

[72] Inventor: **Miles M. Bass,** Kalamazoo, Mich.

[73] Assignee: **Hammond Machinery Builders, Inc.,** Kalamazoo, Mich.

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[52] **U.S. Cl.**.....**204/297 R,** 204/143 M, 204/143 G, 204/224, 204/286

[51] **Int. Cl.**.....**C23b 5/70,** B23p 1/00

[58] **Field of Search**.....204/286, 297 R, 143 M, 143 G, 204/225, 212, 217, 224; 74/813; 29/38 C, 49

[56] **References Cited**

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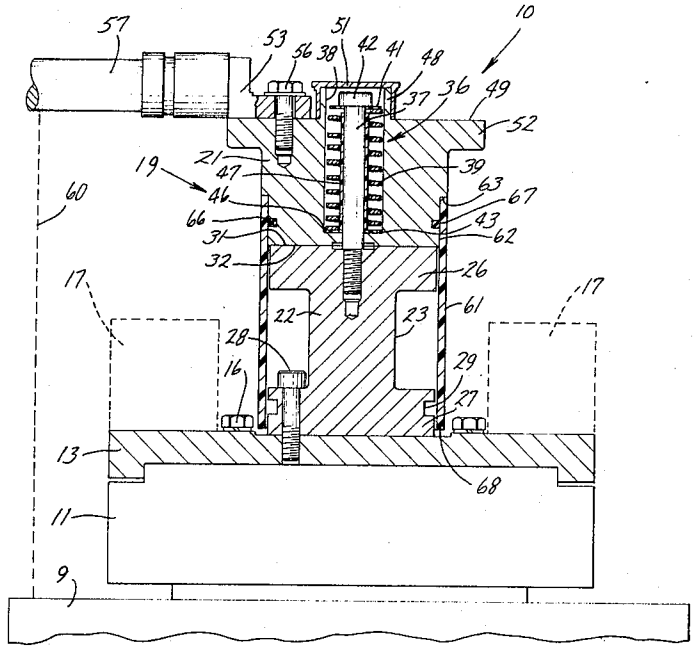
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Primary Examiner—John H. Mack
Assistant Examiner—Regan J. Fay
Attorney—Woodhams, Blanchard and Flynn

[57] **ABSTRACT**

A work holder, particularly for an electro-chemical grinding machine, including an electrically conductive plate secured to an indexable rotatable table and having a plurality of work-holding fixtures thereon. A post extends upwardly from the conductive plate for permitting electrical potential to be applied to the device at a location spaced above the work fixtures. The post includes an electrically conductive lower brush portion secured to the conductive plate and an electrically conductive upper brush portion in rotatable sliding contact with the lower brush portion. The upper brush portion is stationarily secured and fixedly connected to a current-conducting cable. A protective sleeve extends between and surrounds the upper and lower brush portions for preventing electrolyte from contacting the sliding contact surfaces therebetween.

8 Claims, 2 Drawing Figures



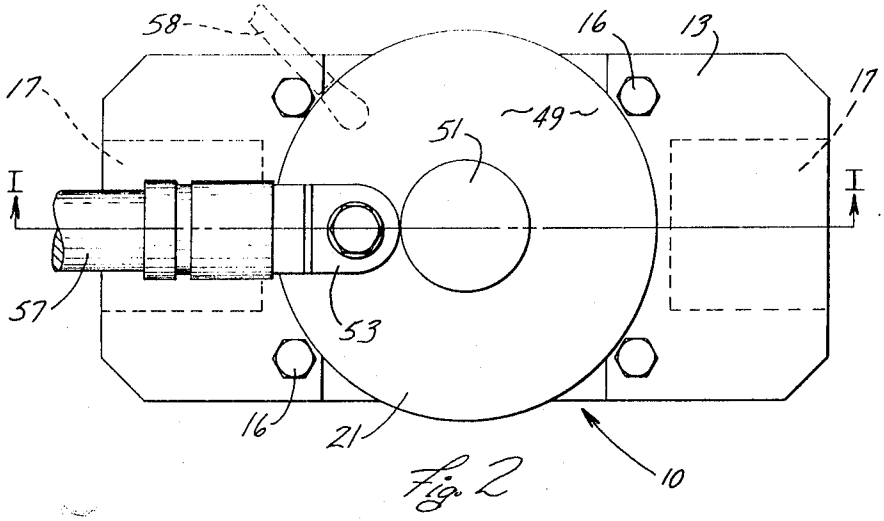


Fig. 2

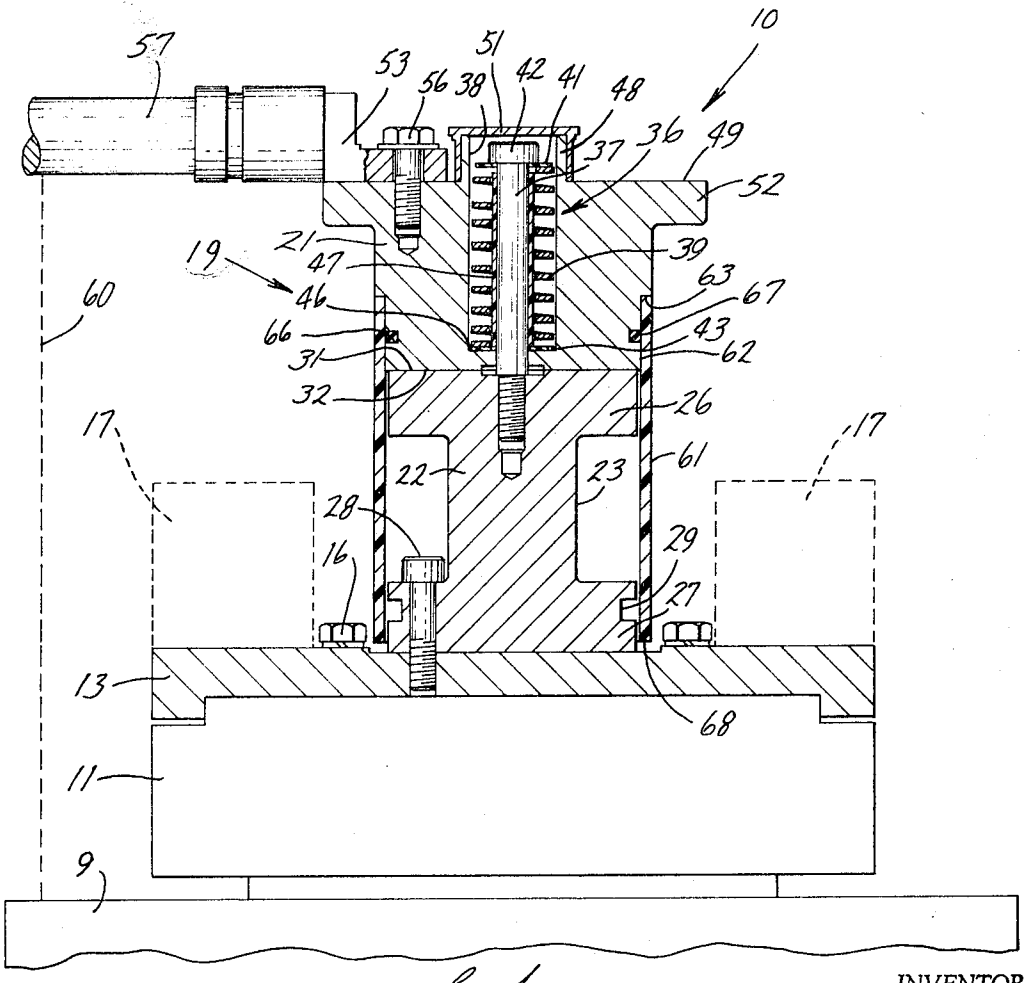


Fig. 1

INVENTOR.
MILES M. BASS
BY
Woodhams, Blanchard & Flynn
ATTORNEYS

WORK HOLDER FOR ELECTROCHEMICAL ABRADING MACHINE

FIELD OF THE INVENTION

This invention relates to a work-holder device and, in particular, relates to an indexable rotary device adapted for the positioning of a workpiece with respect to an electro-chemical grinding machine.

BACKGROUND OF THE INVENTION

While electro-chemical grinding equipment has been known for several years, the design of fixturing for same has continued to present difficulties. Among these have been the design of fixturing which would handle rates of production as high as those of which the machine is capable. This requires that the unloading and reloading of one workpiece position takes place while the workpiece in another position is being ground with said operation being performed without sacrifice of operator convenience or safety. While turret-type fixtures have been previously utilized to obtain high production rates, both in conventional grinding and in electro-chemical grinding, there has remained a considerable area for improvement, particularly in view of the space limitations which must be met to fit the fixture into the relatively small and restricted area in the electrolyte pan in front of the grinding wheel. Further, the fixture or work-holder device must operate effectively under several severe conditions which are essential for efficient electro-chemical grinding. First, the device must be able to apply a low voltage to the workpiece since the workpiece voltage will seldom, if ever, exceed 15 volts, and is preferably less. Second, the device must be able to apply high amperage through the workpiece, which amperages often are as high as 500 to 3,000 amperes. Third, the device must be designed so as to be usable with the corrosive electrolytes which are used during the electro-chemical grinding process. Also, since the workpieces are mounted on a rotatable table, it is necessary for the electrical potential to be applied to the workpiece through relatively moving parts and, if the corrosive electrolyte is permitted to enter between the relatively moving parts so as to effect corrosion thereof, then said parts will be unable to conduct to the workpieces the necessary high amperes at the low voltage levels utilized.

In most of the prior known work-holder devices, the rotatable workpiece table is rotatably supported on and above a stationary part, which part is provided with electrically conductive brush members thereon in rotatable sliding engagement with a portion of the rotatable table. The brush members in turn are connected to a current-conducting cable for permitting electrical current to be supplied through the brush members to the rotatable table so as to create an electrical potential between the workpiece and the grinding wheel. This arrangement results in the brush members being positioned at an elevation below the workpiece. Accordingly, during the electro-chemical grinding operation, the electrolyte flows downwardly from the workpiece and around the rotatable table and often comes into contact with the brush members, resulting in corrosion between the brush members and the sliding contact surfaces formed on the table. This corrosion thus causes the resistance of the electrical flow path to be substantially increased, thereby resulting in a decrease in the amperage applied to the workpiece. This corrosion also causes electrical arcing between the brush members which in turn causes pitting of the brush surfaces and additional electrical resistance to the point of electro-chemical grinding failure.

Accordingly, it is an object of this invention to provide:

1. An indexable work-holder device for use with an electro-chemical grinding machine, which device will fit into the limited available space in the pan of an electro-chemical grinding machine and yet will provide ample protection for the current-conducting surfaces against corrosive attacks by the electrolyte.

2. A device, as aforesaid, which will be particularly adaptable for use in low voltage electro-chemical grinding operations, such as voltages not over 10 or 15 volts, but which will successfully transmit to the workpieces amperages of the order of 500 to 3,000 amperes.

3. A device, as aforesaid, wherein the electrical supply cable is connected to the device at a position above the work-holding fixture.

4. A device, as aforesaid, wherein the current-conducting surfaces of the relatively rotatable brush members are positioned at an elevation above the upper surface of the table and preferably above the work-holding fixtures.

5. A device, as aforesaid, wherein the electrically conductive brush surfaces are surrounded by a protective enclosure for preventing corrosive electrolyte from gaining access to said surfaces.

6. A device, as aforesaid, which is of sufficient mechanical simplicity as to be capable of relatively economical manufacture.

7. A device, as aforesaid, which is of sufficient mechanical simplicity as to be capable of easy and convenient cleaning and maintenance.

Other objects and purposes of the invention will be apparent to persons acquainted with apparatus of this general type upon reading the following description and inspecting the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional elevational view of a device embodying the invention as taken along the line I—I of FIG. 2.

FIG. 2 is a top plan view of the device illustrated in FIG. 1.

Certain terminology will be used in the following description for convenience in reference only and will not be limiting. The words "upwardly", "downwardly", "rightwardly" and "leftwardly" will designate directions in the drawings to which reference is made. The words "inwardly" and "outwardly" will refer to directions toward and away from, respectively, the geometric center of the device and designated parts thereof. Said terminology will include the words above specifically mentioned, derivatives thereof and words of similar import.

SUMMARY OF THE INVENTION

In general, the objects and purposes of the invention are met by providing a rotatable table having an electrically conductive plate secured thereto, which plate has one or more work-holding fixtures mounted thereon. A post assembly is centrally secure to and extends upwardly from the conductive plate and includes a lower brush member secured to and rotatable with the conductive plate. The lower brush member is in rotatable sliding engagement with an upper brush member which is stationarily secured and suitably connected to an electrical cable. A protective sleeve encircles and encloses both the upper and lower brush members to prevent electrolyte from contacting the rotatable sliding contact surfaces of the brush members. The sliding contact surfaces of the brush members are thus positively protected and the electrical cable is positioned above the table, preferably at or above the elevation of the work-holding fixtures.

DETAILED DESCRIPTION

Referring to the drawings, there is shown a work-holding device **10** mounted on a horizontal rotatable base **11** which is rotatably supported in any conventional manner in working relationship with respect to an electro-chemical tool (not shown) of any known type. Same is supported on any conventional base **9**, such as the table shown in U.S. Pat. No. 2,922,258. The base **11** has a current-conductive mounting plate **13** secured thereto by a plurality of screws **16**. The conductive mounting plate **13** is provided with a plurality of conventional work-holding fixtures **17** thereon, with fixtures may be similar to the fixtures shown in U.S. Pat. No. 3,272,732 and are adapted to have a workpiece fixedly secured to each thereof. The base **11** is indexable by any conventional inter-

mittent driving mechanism for permitting an operator to install or remove a workpiece from one work-holding fixture while permitting an electro-chemical grinding operation to be performed on a workpiece mounted in a different work-holding fixture.

To permit the supply of electrical current to the work fixtures **17**, the mounting plate **13** is provided with a post-like brush assembly **19** centrally secured thereto and extending upwardly therefrom. The brush assembly **19** includes upper and lower post portions **21** and **22** which function as upper and lower brush members, respectively. The lower brush member **22** is provided with upper and lower annular flanges **26** and **27**, respectively which flanges are axially spaced and define an annular recess **23** therebetween. The lower brush member **22** is fixedly secured to the mounting plate **13** by a plurality of screws **28** (only one shown) which extend through the lower flange **27**. The lower flange **27** is further provided with a small annular groove **29** formed in the periphery thereof for a purpose to be explained hereinafter.

The upper end of the lower brush member **22** is provided with a substantially planar contact surface **31**, which contact surface **31** is in rotatable bearing engagement with a further planar contact surface **32** formed on the lower end of the upper brush member **21**. Said surfaces are symmetrical about the axis of the rotatable table means and are both here shown as being planar and perpendicular to such axis. However, other configurations for said surfaces, as conical or comprising portions of a sphere, are possible. The surfaces **31** and **32** are maintained in snug bearing engagement by means of a fastening device **36**, which device **36** includes a screw **37** threadably secured to the lower brush member **22** and extending upwardly therefrom so as to be received within a central bore **38** formed in the upper brush member **21**. A compression spring **39** is positioned within the bore **38** in surrounding relationship to the screw **37**. The upper end of the spring **39** bears against a nonconductive washer **41**, preferably of fiber glass, which washer in turn bears against the head **42** of the screw **37**. The lower end of the spring **39** bears against a similar nonconductive washer **43**, also preferably of fiber glass, which washer **43** in turn bears against the end wall **46** of the bore **38**. A nonconductive sleeve **47**, preferably of nylon, is positioned within the spring **39** and surrounds the screw **37**.

The upper brush member **21** is further provided with a central annular hub portion **48** which extends upwardly beyond the upper surface **49**, the bore **38** extending centrally through the hub portion **48**. The open end of the hub portion **48** is closed by a cup-shaped cap **51** positioned to surround the hub portion **48**, the cap preferably being of plastic or similar material.

The upper brush member **21** is preferably provided with an annular outwardly extending flange **52** adjacent the upper end thereof, which flange **52** is electrically and mechanically connected to a fitting **53** by means of a screw **56**. The fitting **53** is fixedly interconnected to one end of a D.C. electrical supply cable **57**, the other end of the supply cable **57** being stationarily secured. Since the cable **57** is relatively stiff, it maintains the upper brush member **21** substantially stationary, or if necessary, said cable may be clamped to the frame of the electrochemical machine in question or to any other relatively fixed base as indicated by the broken line **60**. Further, if desired, a feedback control cable **58** can be suitably connected to the upper brush member **21**.

To protect the contact surfaces **31** and **32** from electrolyte, a protective sleeve **61** extends over and surrounds at least the mutually adjacent ends of the upper and lower brush members **21** and **22**. The upper end of the protective sleeve **61** surrounds and is in snug engagement with a reduced diameter portion **62** formed on the lower end of the upper brush member **21**, the upper axial end of the sleeve **61** being in abutting engagement with a shoulder **63** formed on the upper brush member **21**. The reduced diameter portion **62** is provided with a small annular groove **66** therearound, in which is received a resilient seal **67**, such as an O-ring, which O-ring engages the inner surface of the protective sleeve **61** to create a fluid tight seal therebetween. The lower portion of the sleeve **61** surrounds the lower brush member **21** and has its inner surface positioned closely adjacent to but slightly spaced from the peripheral surfaces of the upper and lower flanges **26** and **27** so as to permit free rotation of the lower brush member **22** relative to the sleeve **61**. The lower axial end **68** of the sleeve **61** preferably extends to a point closely adjacent to but slightly spaced upwardly from the upper surface of the mounting plate **13** so as to not interfere with the rotation thereof.

The mounting plate **13** and the upper and lower brush members **21** and **22** are all constructed of an electrically conductive material, preferably phosphor bronze. On the other hand, the protective sleeve **61** is preferably constructed of a nonconductive, nonmoisture absorbing, material which is able to withstand the corrosive and chemical effects of the electrolyte. In a preferred embodiment of the invention, the protective sleeve **61** is constructed of a noncorrosive plastic, such as acrylic resin tubing. However, sleeve **61** could also be constructed of a linen base phenolic or of fiber glass.

OPERATION

The operation of the device embodying the invention will be described in detail hereinbelow for a better understanding thereof.

The work-holder device **10** as illustrated in the drawings will be mounted on the feed table **9** of an electro-chemical grinding machine in any convenient manner. Suitable workpieces will be mounted on the rotatable base **11** by means of the work-holding fixtures **17** for presentation in the desired attitude to the grinding wheel. Suitable electrical potential will be supplied to the cable **57** in a manner already well known in electro-chemical grinding apparatus.

As the grinding operation proceeds, electrical current is supplied from the cable **57** through the fitting **53** to the upper annular brush member **21**, which brush member remains stationary. Current then flows from upper brush member **21** through contact surfaces **31** and **32** to the lower annular brush members **22**. The current then flows from the lower brush member **22** through the electrically conductive mounting plate **13** to the work-holding fixtures **17** and then therethrough to the workpiece. The electrolytic fluid which is supplied in the required amount to the workpiece flows around the fixture **17** and across the upper surface of the mounting plate **13**, whereupon the electrolyte then flows downwardly past the mounting plate **13** and the base **11** so as to be collected in a suitable pan (not shown).

Due to the contact surfaces **31** and **32** being positioned at an elevation above the fixtures **17**, the contact surfaces **31** and **32** are displaced from the normal downward flow path of the electrolyte and thus the surfaces **31** and **32** are not in a position to be contacted by the electrolyte. Further, while the grinding operation normally results in some of the electrolyte being splashed on the surrounding portions of the apparatus, the protective sleeve **61** surrounding the surfaces **31** and **32** effectively prevents the splashed electrolyte from coming into contact with the contact surfaces. For example, any fluid which contacts the external periphery of the upper brush member **21** is prevented from contacting the surfaces **31** and **32** due to the upper end of the sleeve **61** being in abutting contact with the shoulder **63**. Further, the resilient seal **67** prevents electrolyte from flowing downwardly therepast so as to contact the surfaces **31** and **32**.

Upward flow of electrolyte within the protective sleeve **61** is also normally prevented since the protective sleeve **61** is positioned in close surrounding relationship to the annular periphery of the upper and lower flanges **26** and **27** formed on the lower brush member **22**. Further, any tendency for the fluid to flow upwardly along the periphery of the sleeve **61** is additionally inhibited by the presence of the annular groove **29**, which annular groove collects electrolyte which tends to flow upwardly along the periphery of the sleeve **61**.

Electrolyte is additionally prevented from gaining access to the region of the contact surfaces **31** and **32** by the presence of the cup-shaped cap **51**, which cap extends around the upwardly extending hub **48**, being positioned on the external periphery thereof so as to prevent electrolyte from entering into the bore **38**.

Although a particular embodiment of the invention has been disclosed above in detail for illustrative purposes, it will be recognized that obvious or equivalent variations or modifications thereof are fully contemplated and lie within the scope of the invention.

The embodiments of the invention in which I claim an exclusive property or privilege are defined as follows:

1. A work-holder device for use with an electro-chemical apparatus comprising:

rotatable base means including a plate-like mounting portion of electrically conductive material, said mounting portion having a substantially horizontal and upwardly directed support surface thereon adapted to have at least one work-holding fixture mounted thereon for permitting the mounting of a workpiece on said base means;

post means fixedly connected to and extending vertically upwardly from the central portion of said base means for conducting current thereto, said post means including a first annular member fixedly secured to said electrically conductive mounting portion and extending upwardly from said support surface, said first member having a first contact surface positioned adjacent the upper end thereof and facing upwardly, said first contact surface being positioned a substantial vertical distance above said support surface;

said post means also including a second member, at least a lower portion of which is cylindrical, positioned above said first member and having a downwardly directed second contact surface adjacent the lower end thereof and disposed in rotatable slidable bearing engagement with said first contact surface, said first and second members being of electrically conductive material whereby electrical current supplied to said second member is conducted therefrom through said first member to said electrically conductive mounting portion;

resilient holding means coacting between said first and second members for axially securing said first and second members together while permitting relative rotation therebetween, said resilient holding means normally maintaining said first and second contact surfaces in snug slidable engagement with one another; and

protective sleeve means surrounding at least the mutually adjacent ends of said first and second members for preventing electrolyte used in the electro-chemical operation from contacting the first and second contact surfaces, said protective sleeve means including an elongated thin-walled hollow sleeve constructed of nonmetallic material which is substantially chemically inert and nonconductive, an upper portion of said hollow sleeve being snugly and sealingly received in surrounding relationship on said cylindrical portion of said second member, the remaining portion of said hollow sleeve being positioned in surrounding relationship to said first member for permitting said first member to freely rotate within said sleeve, the lower end of said sleeve being disposed closely adjacent the upper surface of said plate-like mounting portion.

2. A device according to claim **1**, wherein said contact surfaces are planar and both are positioned perpendicularly to the axis of the rotatable base means.

3. A device according to claim **1**, wherein resilient seal means is positioned between the cylindrical portion of said second member and the internal surface of said sleeve for preventing flow of electrolyte therebetween.

4. A device according to claim **1**, wherein said first member includes upper and lower annular flange portions axially separated by an annular recess, and fastening means extending through said lower flange portion for fixedly securing said first member to said base means.

5. A device according to claim **1**, further including supply means secured to said second member for supplying electrical current thereto and for maintaining said second member stationary, the point of connection of said supply means to said second member being disposed substantially adjacent the upper end thereof.

6. A device according to claim **1**, wherein said second member has an opening formed therein, and said holding means including an elongated screw member positioned at least partially within said opening and having one end thereof fixedly secured to said first member and spring means coacting between said screw member and said second member for resiliently urging said second member toward said first member for causing said first and second contact surfaces to be resilient maintained in slidable bearing engagement.

7. A device according to claim **6**, wherein said holding means further includes nonconductive means coacting between said screw member and said second member, said nonconductive means including a nonconductive sleeve positioned within said opening and disposed in surrounding relationship to said screw member, and said spring means being positioned in said opening and disposed in surrounding relationship to said nonconductive sleeve.

8. A device according to claim **1**, wherein said first and second members are constructed of bronze.

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