United States Patent

Boyd

[15] **3,678,532**

[45] **July 25, 1972**

[54] ROTATING DISC SCRAPER

[72] Inventor: **Reed L. Boyd,** c/o John E. Wagner, Attorney at Law, 1041 E. Green St., Suite 202, Pasadena, Calif. 91101

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[52] **U.S. Cl.** **15/236,** 90/17

[51] **Int. Cl.** **B23c 7/00,** B23c 5/20

[58] **Field of Search** ..... 15/236, 93 R, 104.13, 104.14; 29/81 J, 105; 125/1, 3, 4, 5; 114/222; 241/293; 299/89, 90, 80; 90/17; 175/342

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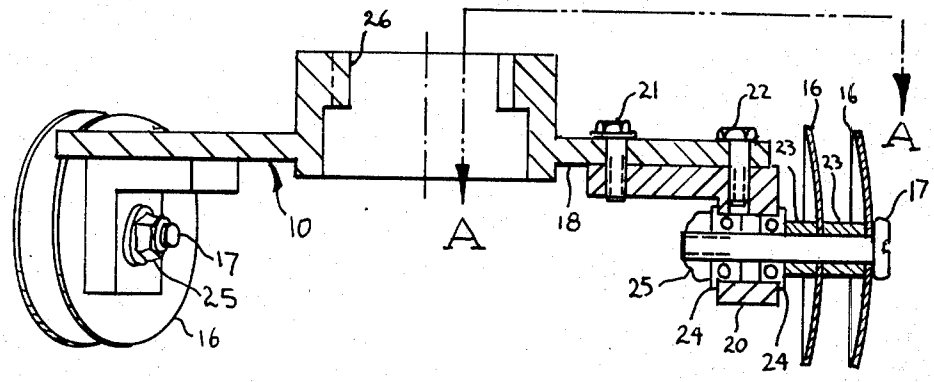
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Primary Examiner—Leon G. Machlin
Attorney—John E. Wagner

[57] **ABSTRACT**

This disclosure involves a scraper having freely rotating disc-shaped cutters with their axes of rotation in the plane of a flat, circular common holder; each cutter's axis of rotation being at an angle from radial lines extending from the center of the holder, about which the holder is rotationally driven. The disc-shaped cutters are of thin cross section so that the disc edges easily cut into tough or gummy surfaces as they are driven in circular patterns by the holder.

7 Claims, 12 Drawing Figures



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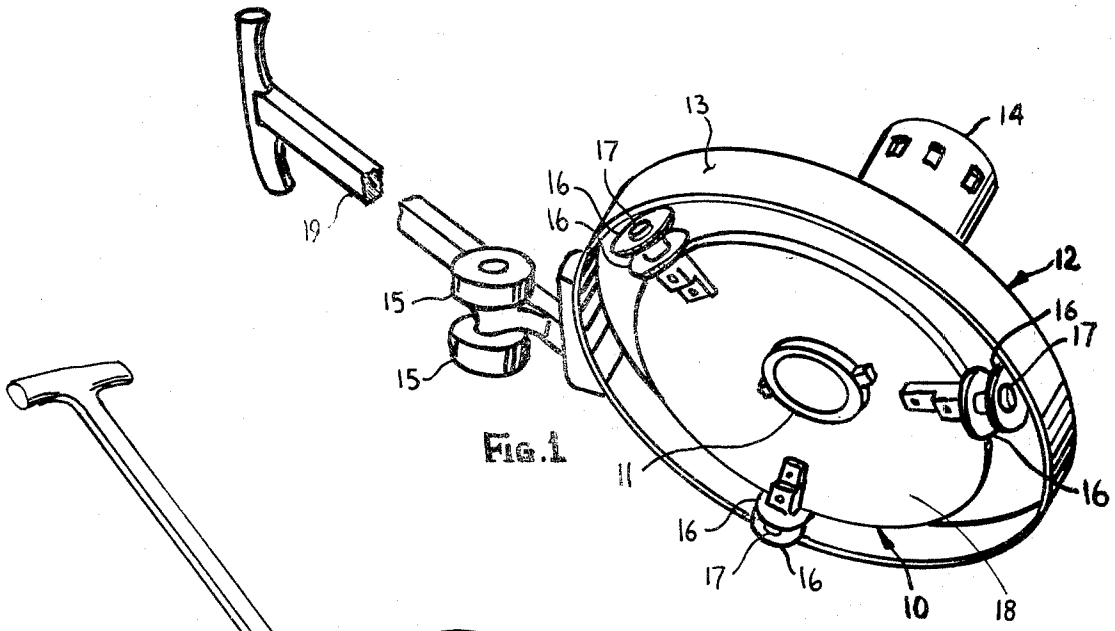


FIG. 1

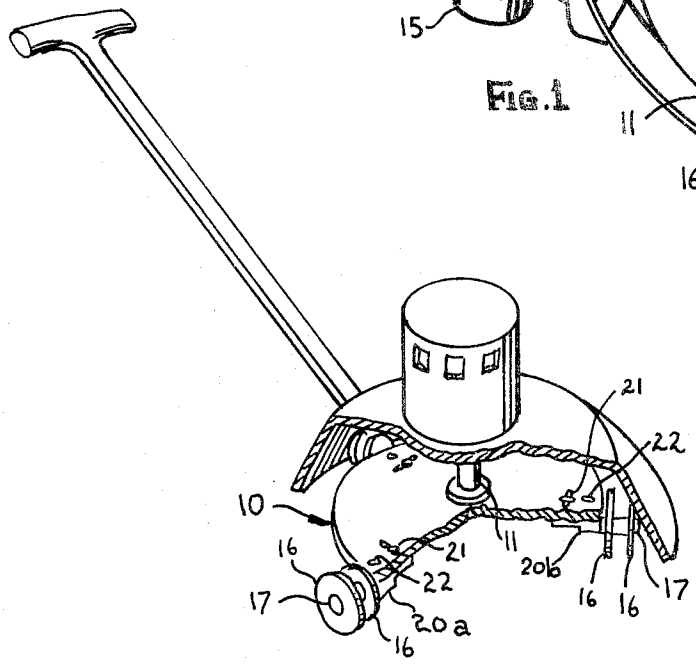


FIG. 2

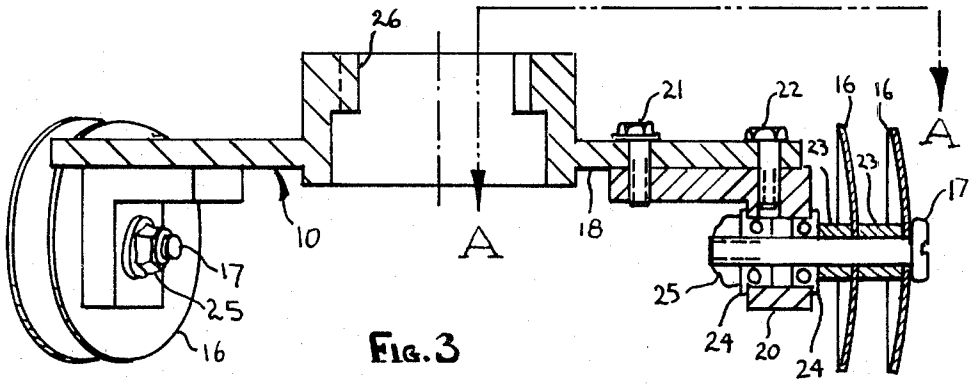


FIG. 3

INVENTOR.
REED L. BOYD
BY
John E. Wagner

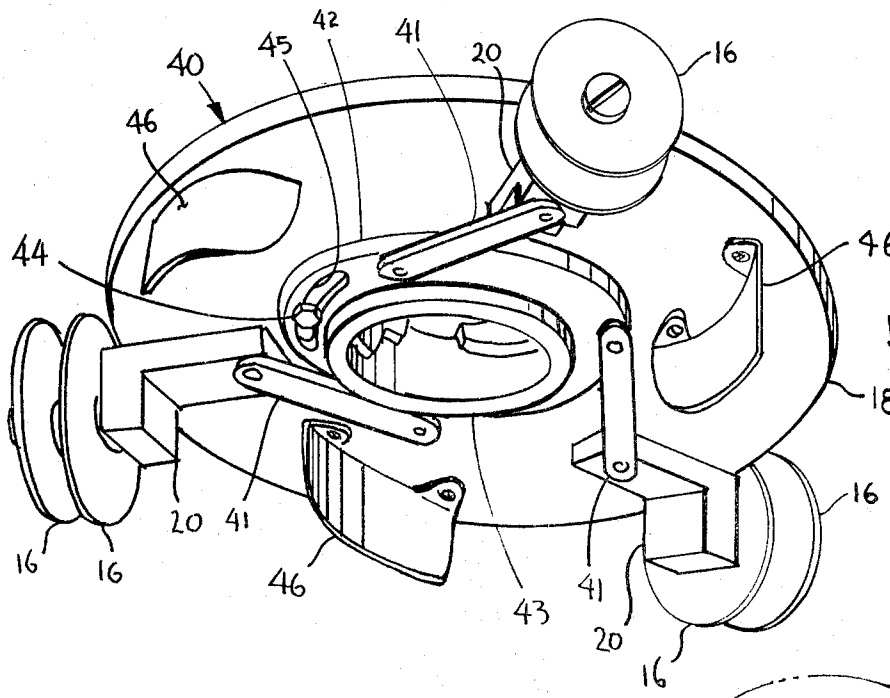


FIG. 6

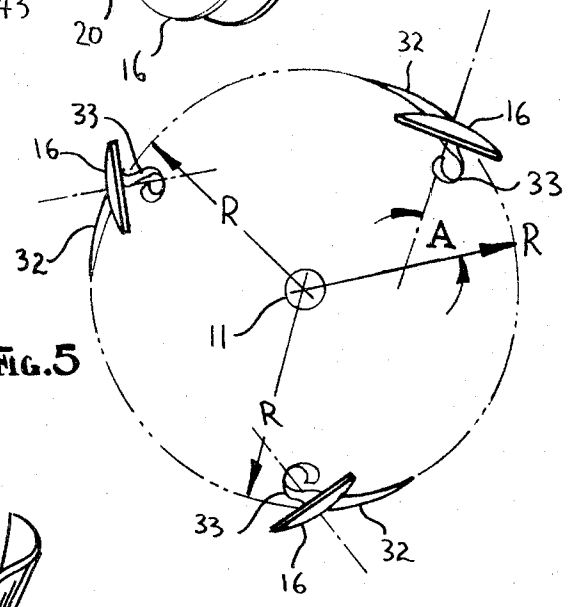


FIG. 5

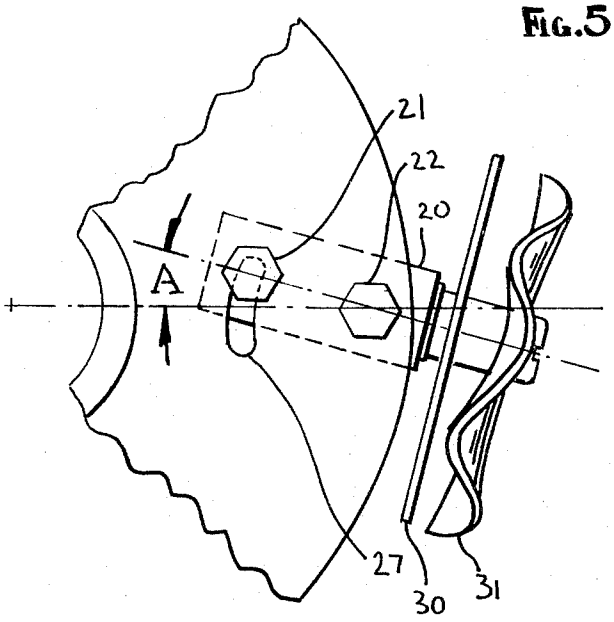


FIG. 4

INVENTOR.
REED L. BOYD

BY John E. Wagner

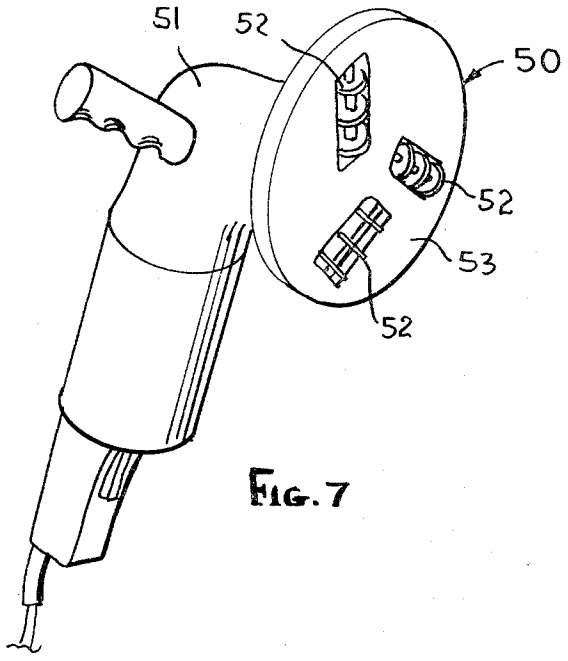


FIG. 7

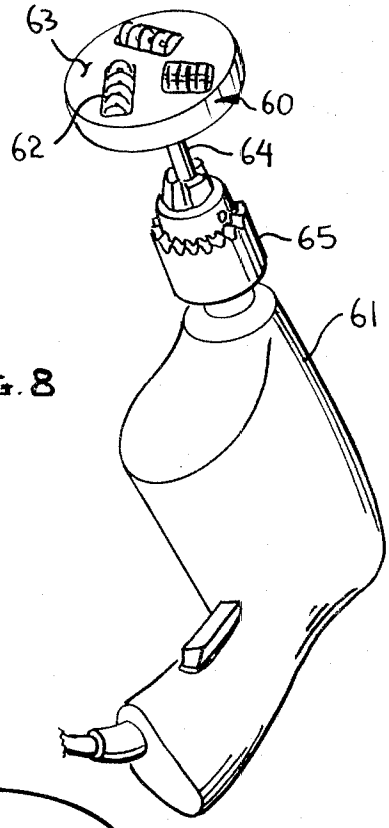


FIG. 8

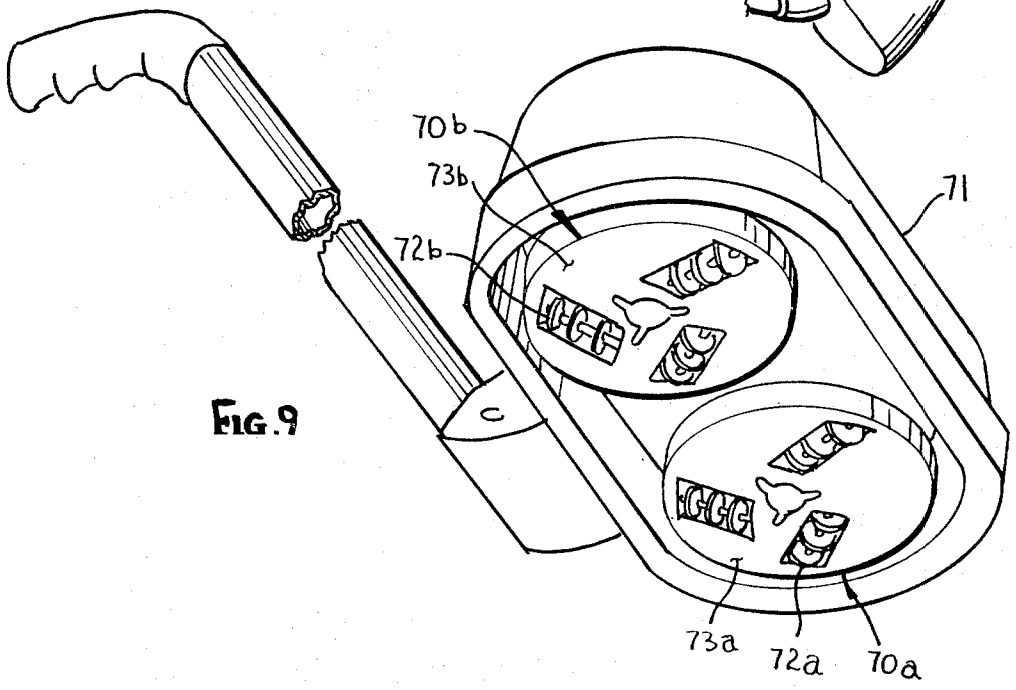


FIG. 9

INVENTOR.
REED L. BOYD
BY John E. Wagner

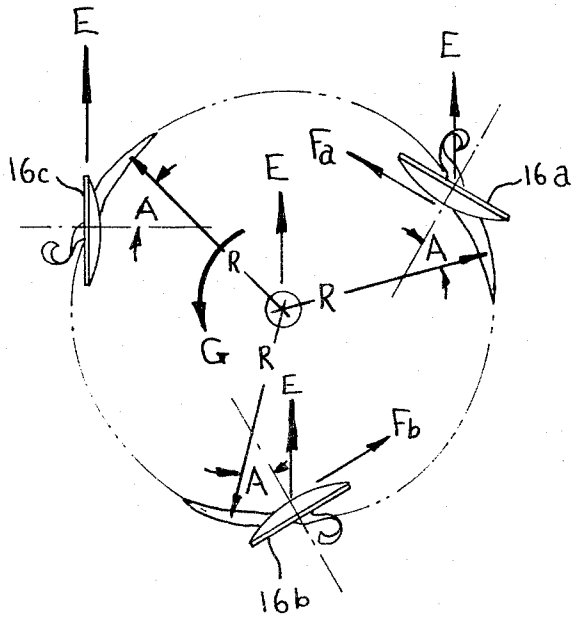


FIG. 10

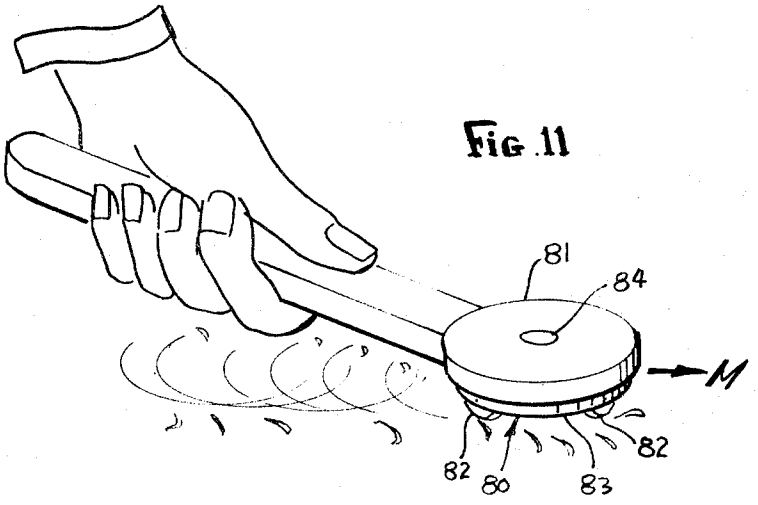


FIG. 11

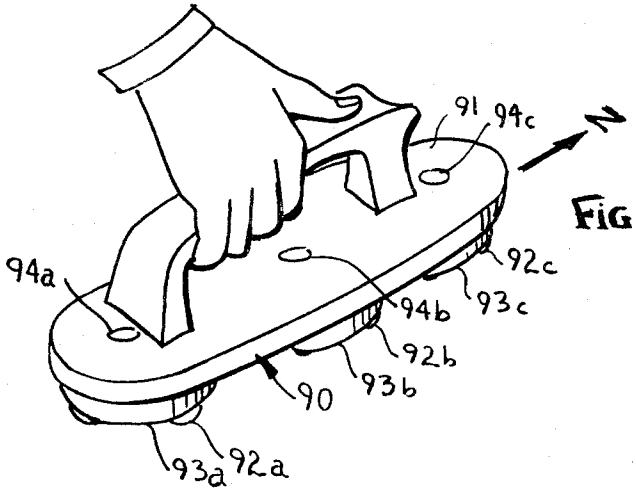


FIG 12

INVENTOR.
REED L. BOYD
BY John E. Wagner

ROTATING DISC SCRAPER

BACKGROUND OF THE INVENTION

Cutting or scraping of tough and gummy surfaces has been a continuing problem for both home and industry. There are a large number of materials, including many paints, plastic resins and petroleum deposits which are too tough to cut with a simple blade cutter, and at the same time are too gummy to cut with abrasive means. One typical example of such a problem surface is a painted concrete floor. Removal of old paint is virtually impossible with a scraping blade, and even the coarser power sanding discs and belts become almost instantly clogged with paint. Another example relates to automobile refinishing. Old wax and paint are extremely tough, and tend to fill the cutting surfaces of even relatively coarse files and sanding machines. As a result, extremely coarse cutting surfaces are used which abrade the underlying metal to the extent that considerable time must be spent in filling and priming to cover up the damaged surface. Still another example exists in the laminated resin bonded glass fiber material industry. Laminating resins are intentionally manufactured to retain a sticky surface after fully curing, to insure the integrity of the bond to the next layer of the laminate. Therefore, smoothing or trimming a resin bonded glass fiber material part is extremely troublesome. Power sanders become instantly clogged, and even hand files become tightly clogged within a few minutes of use on the always sticky surfaces. There are many more similar problems in various industries, where it is necessary to clean floors and other surfaces of grease deposits, plastics, food residues, etc., and where these substances are usually scraped by hand because of the lack of suitable power equipment to do the job faster and more efficiently.

Previous attempts to solve this type of problem have resulted in the development of metallic "sandpapers", as well as the development of both hand and power-driven versions of relatively open-surfaced stamped sheet metal files. Each of these solutions has resorted to a very rough cutting surface which tends to score and abrade the work surfaces. Further, although the new cutting surfaces cut soft materials readily, they tend to dull rather quickly on abrasive workpieces, such as resin bonded glass fiber material, or on an underlying substrate like concrete.

The object of this invention is to provide a tool for scraping and cutting tough and gummy materials which is completely non-clogging, which is well adapted to both manual and power operation, which has self-renewing or self-sharpening cutting edges and which does not have irregular, jagged cutting surfaces to undesirably abrade the work surfaces or underlying substrates.

SUMMARY OF THE INVENTION

The object of the invention is achieved by a rotary scraper or cutter having a number of thin-walled, circular cutting discs in which the discs essentially stand on edge on the work surface so the axes of the discs are generally parallel to the work surface. The discs are free to rotate about their axes, and are held and driven about a circular pattern by one or more rotating holders. Each holder rotates about an axis generally normal to the work surface, and holds a number of cutting discs on several axes which are generally in the common plane of the holder, and are at an angle with respect to radial lines passing through the axis of rotation of the holder. As the holder is driven about its axis, each of the cutting discs is free to roll in a generally circular pattern on the work surface.

The angle of each cutting disc axis with respect to the holder's axis of rotation causes each cutting disc to be at some angle across the tangent line of the circular path the cutting disc is inscribing on the work surface, thereby creating a combined rolling and scraping action of the edge of the cutting disc against the surface.

In a typical rotary scraper embodiment in its simplest form, three cutting discs are equally spaced about the periphery of a circular holder, so that all three cutting discs are in contact with even a compound-curved work surface. As the holder is rotated, the discs cut a circular pattern, and as the rotary scraper is translated along the work surface, a cutting path is produced having a width equal to the diameter of the circular pattern. More complex embodiments include additional cutting discs on each disc axis, additional disc axes within the holder, and multiple holders in a more complex rotary scraper.

Several means are usable to drive the holders in their rotary motion, such as, combustion engines or electric motors. The angle of the individual cutters with respect to the tangent line of their circular paths can be established to cause the rotary scraper to autorotate during translation along the work surface. This negates the need for external power to drive the holders in rotation, since some of the translation work is converted into rotary motion, and makes the rotary scraper particularly well adapted to small, manually operated devices.

Although the cross sectional configurations of the cutting discs are varied for optimum cutting efficiency depending on the workpiece material properties, operating experience with this type of cutter has shown that each disc must be quite thin with respect to its diameter to cut effectively under reasonably low cutting pressures, and to maintain a sharp cutting edge as the diameter of the cutter is reduced by wear.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of the underside of a rotary scraper illustrated as a cutting and scraping attachment to a floor treating machine.

FIG. **2** is a perspective view of the upper side of the machine in FIG. **1**, having portions of the machine housing and the rotary scraper cut away for clarity.

FIG. **3** is a cross sectional view of the rotary scraper showing the structure of the cutting discs and holder.

FIG. **4** is a partial top elevation view of the scraper showing a means of attachment and adjustment of the cutting discs.

FIG. **5** is a diagram of the cutting geometry of the cutting discs in a power driven machine.

FIG. **6** is a perspective view of the underside of a rotary scraper having interlocked cutter angle adjustment.

FIG. **7** is a perspective view of the invention as adapted for use in a power sanding machine.

FIG. **8** is a perspective view of the invention as adapter for use in a portable electric drill.

FIG. **9** is a perspective view of the invention as adapter for use in a home-type floor polishing machine.

FIG. **10** is a diagram of the cutting geometry of the cutting discs in a non-powered autorotation operation.

FIG. **11** is a perspective view of the invention as adapted for use as a hand scraper.

FIG. **12** is a perspective view of the invention as adapted for use in a plane-surface hand scraper.

Now refer to FIG. **1** in which the scraper **10** may be seen mounted on the shaft **11** of a commercial floor treating machine **12** including a housing **13**, motor **14**, transporting wheels **15**, and handle **19**. A number of cutting discs **16** are shown rotatably supported on three shafts **17** which are equally spaced about a generally circular holder **18**. The wheels **15** clear the floor in operation, and may be engaged to transport the machine by moving the handle **16** downwards. Energizing motor **14** causes shaft **11** to rotate, thereby moving discs **16** about the axis of rotation of holder **18**.

Now refer to FIG. **2** wherein the scraper **10** may be seen mounted on motor shaft **11** within the partially cut away machine housing **13**. Cutting discs **16** are shown supported on shafts **17**, which are attached to the partially cut away holder **18** through bearing blocks **20***a*&*b*, and fasteners **21** and **22**.

Now refer to FIG. **3** in which the cross sectional view of the rotary scraper **10** is shown with discs **16** located on shaft **17** by spacers **23**. Shaft **17** is in turn supported by bearings **24** retained by nut **25**. The bearing block **20** is attached to holder **18** by fasteners **21** and **22**. Holder **18** is provided with a hub **26**

suitable for motor shaft attachment. In this view, the discs **16** are shown to have a preferred shape as a portion of a sphere. This is a relatively low-cost configuration presenting a cutting edge having a rake angle, and having high stiffness even with a very thin wall as would be possible in a hard material, preferably steel. The use of the illustrated shape for steel cutters has proven most effective in models tested in applications such as the removal of old paint and grease deposits from concrete floors. In these applications, it has been found that the thin steel edges, approximately 0.032 inches thick for a 4 inch diameter cutter, in an arrangement almost precisely as illustrated in FIG. **3**, were very effective in cutting off paint and grease with no perceptible damage to the floor.

Now refer to FIG. **4** which is a partial top elevation view of the scraper as indicated by the viewing plane AA in FIG. **3**, and showing bearing block **20** pivotally attached by fastener **22**, with the cutter angle adjustably retained by fastener **21**; fastener **21** being threaded into block **20** and having side clearance for adjustment in slot **27** of holder **18**. Experience with prototype models has shown an adjustment range between 0° and 15° for angle A to be adequate to cut a wide variety of surface materials, there being an optimum cutter thickness and shape, diameter, working circle, cutting speed and cutter angle A for each material to be cut. Two additional configurations for the cutting discs are shown as a flat disc **30** and a serpentine-edged disc **31**. The use of the flat disc **30** is indicated where cost of the unit is a critical factor, since flat steel discs are some of the lowest possible cost cutters. The serpentine-edged cutting disc **31**, as in the case of the previously described spherical form, is a means of providing increased cutter stiffness and still maintaining a thin cutting edge. There are some scraping applications where this is very desirable, particularly where the disc material must be somewhat soft. One such case is in the cleaning of deposits such as bakery dough or food residue from vinyl-surfaced floors. It is imperative that the cutter be of a material harder than the residue being scrapped off, but still softer than the vinyl and perhaps even the wax finish on the floor, and this becomes possible by using materials such as polyethylene plastics for the discs.

Now refer to FIG. **5** wherein a diagram of the cutting geometry of the scraper, which is a simplification of a typical unit such as the floor treating machine shown in FIG. **1**. The diagram shows cutting discs **16** equally spaced on a radius R and rotated in direction D. Angle A is the angle of the cutter axis with respect to a radial line from the center of rotation of shaft **11**. If angle A were zero ° and the cutting discs have true point contact with the work surface, which is only theoretically possible, the cutting discs **16** would merely roll freely about radius R without cutting. The actual existence of line contact as opposed to point contact means that some translational movement, and hence some cutting, will occur. Increasing angle A increases the magnitude of the translational movement or scraping action of the cutting disc, cutting grooves **32** and producing chips **33**.

Now refer to FIG. **6** showing a perspective view of the underside of another embodiment of the scraper **40** including a means for simultaneously changing the cutting angle of all of the discs **16**. A toggle link **41** is pivotally attached to the inner end of block **20**, and the other end of each toggle link **41** is pivotally attached to a rotatable ring **42** around hub extension **43**, whereby rotation of the ring **42** will simultaneously move all of the blocks **20** through a change of cutting angle. A locking fastener **44** is positioned in an arcuate slot **45** to lock the adjustment during operation. A form of fluid-moving blade **46** is shown attached to the underside of holder **18**, so formed as to sweep cut material from under the machine during rotation of the scraper.

Now refer to FIG. **7** wherein a scraper **50** is particularly adapted for use on a commercial power sanding disc machine **51**. A plurality of small diameter cutting discs **52** are positioned to partially extend from the surface of holder **53** in a manner convenient for use in operations such as removing paint from an automobile body.

Now refer to FIG. **8** wherein a scraper **60** is particularly adapted for use in a portable electric drill **61**. A plurality of small diameter cutting discs **62** are positioned to partially extend from the surface of holder **63** to engage a work surface. A shaft **64** is provided on holder **63** to adapt the scraper for rotating and support by a drill chuck **65**.

Now refer to FIG. **9** wherein two scrapers **70*a*** and **70*b*** are adapted for us in a typical home floor polishing machine **71**. A plurality of small diameter cutting discs **72*a*** and **72*b*** are positioned to partially extend from the respective surfaces of holders **73*a*** and **73*b*** in a manner convenient for use in operations such as removing paint from a floor.

Now refer to FIG. **10** wherein a diagram of the cutting geometry is shown for a scraper that is not powered in rotation, but instead autorotates during translational movement along the work surface. In this diagram, three cutting discs **16*a***, **16*b*** and **16*c*** are equally spaced about the periphery of a holder on radius R, each disc being set at a cutting angle A with respect to the radial line extending from the center of rotation of shaft **11**. The scraper is moved in translation in direction E. Disc **16** *a* when moved in direction E will attempt to roll in the direction normal to its axis of rotation, and thereby produces a force F*a*, producing additional torque in direction G. Similarly, disc **16*b*** when moved in direction E will also attempt to roll in a direction normal to its axis of rotation, and thereby produces a force F*b*, producing additional torque in direction G. Disc **16*c*** when moved in direction E will simply attempt to roll normal to its axis of rotation, which is in the direction E and imparts no instantaneous torque. Any accumulative torques applied by the discs in all locations are all in the same direction to produce autorotation from translational movement.

Now refer to FIG. **11** wherein a scraper **80** is particularly adapted for use in a handle **81**. A plurality of small diameter cutting discs **82** are positioned to partially extend from the surface of a holder **83** which is free to rotate on shaft **84**, so that motion in direction M causes autorotation of the discs and holders.

Now refer to FIG. **12** wherein a scraper **90** is shown having a planar body **91**. A plurality of small diameter cutting discs **92*a***, **92*b*** and **92*c*** are positioned to partially extend from the respective surfaces of each of three holders **93*a***, **93*b*** and **93*c*** which are free to rotate on respective shafts **94*a***, **94*b*** and **94*c***, so that motion in direction N imparted through handle **95** causes autorotation of the discs and holders.

The foregoing descriptions have included components and geometries to most clearly illustrate the concept of the invention. Operating experience has shown that each combination of surface material to be removed, hardness of the underlying substrate and speed and weight of the driving machine calls for a specific cutting disc shape, thickness, distribution and angle in the holder or holders, as well as a preferred cutter spacing to preclude clogging.

In some applications where more severe scraping action is desired, it is desirable to lock the rotation of the individual cutting discs so a single cutting edge on each disc is presented to the work surface, but the discs may be unlocked and manually turned when a new cutting surface is desired by the operator.

The above described embodiments of this invention are merely descriptive of its principles and are not to be considered limiting. The scope of this invention instead shall be determined from the scope of the following claims including their equivalents.

I claim:

1. A rotary cutter comprising a frame including central connecting means for securing said frame to a drive shaft of a motor,

a plurality of axles secured to said frame and extending generally radially from said central connecting means,

at least one cutter journaled on to each axle for rotation by engagement with a surface to be cut, said cutters comprising thin discs with continuous edges in contact with the surface to be cut defining a planar cutting surface and

said discs constituting the support for said rotary cutter and driving motor, and means for changing the angle of axles with respect to lines passing through the axis of rotation of the frame.

2. A rotary cutter in accordance with claim 1 wherein said angle changing means is capable of changing the angle of the axles between 0° and 15°.

3. The combination in accordance with claim 1 wherein said cutters comprise cupped discs.

4. The combination in accordance with claim 1 including common means connected to each of said axles whereby said axles may be simultaneously adjusted in angle with respect to the radius.

5. A rotary cutter comprising a frame including central connecting means for securing a frame to a drive shaft of a motor, a plurality of axles securing to the frame and extending generally radially from the central attachment means, at least one disc journaled on to each axle for rotation by engagement with a surface to be cut, said cutters comprising discs with continuous edges in contact with the surface to be cut, and common means connected to each of said axles for changing the angle of axles with respect to lines passing through the axis of rotation of the frame, said common means comprise a ring secured to the frame and individual toggles coupled to respective axles whereby rotary movement of the ring about the axis of rotation of the frame produces a similar change in angle to the axles.

6. The combination in accordance with claim 5 wherein each axle is mounted on a pivoted bearing block and each toggle engages an inner portion of the respective bearing block.

7. The combination in accordance with claim 1 wherein said frame is circular and includes a plurality of blade members extending downward into the regions between said cutters for ejecting cut debris from under the frame on rotation of said frame.

* * * * *