

Jan. 3, 1950

K. H. BARNES

2,493,215

SURFACE TREATING DEVICE

Filed March 6, 1947

4 Sheets-Sheet 1

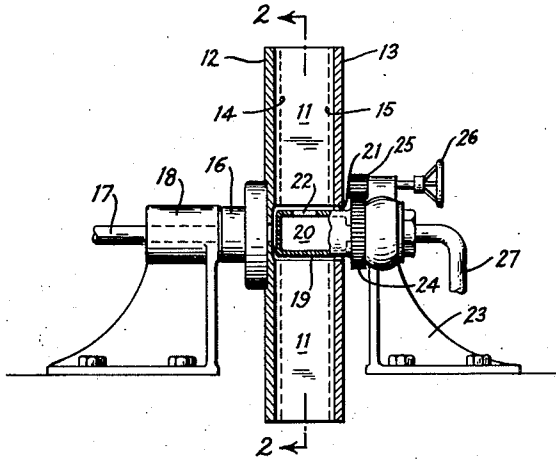


Fig. 1

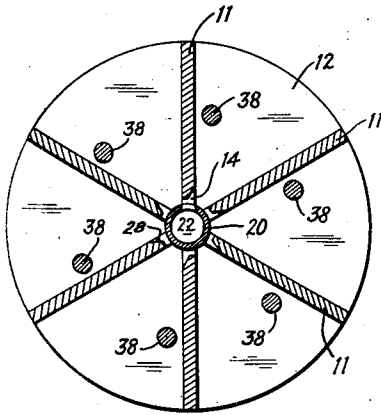


Fig. 2

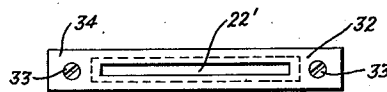


Fig. 4

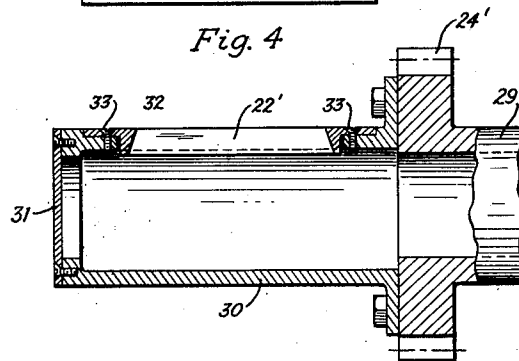


Fig. 3

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4 Sheets-Sheet 2

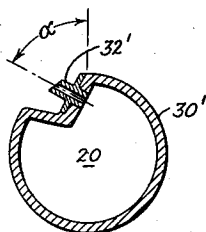


Fig. 5

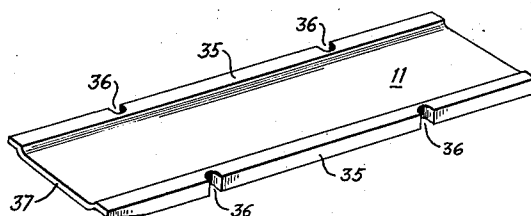


Fig. 6

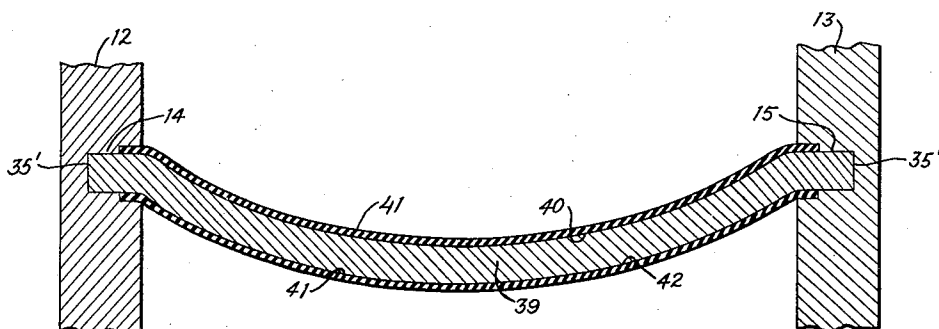


Fig. 7

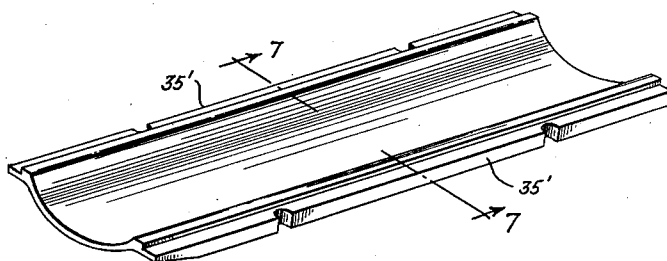


Fig. 8

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4 Sheets-Sheet 3

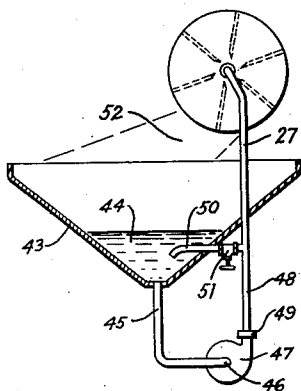


Fig. 9

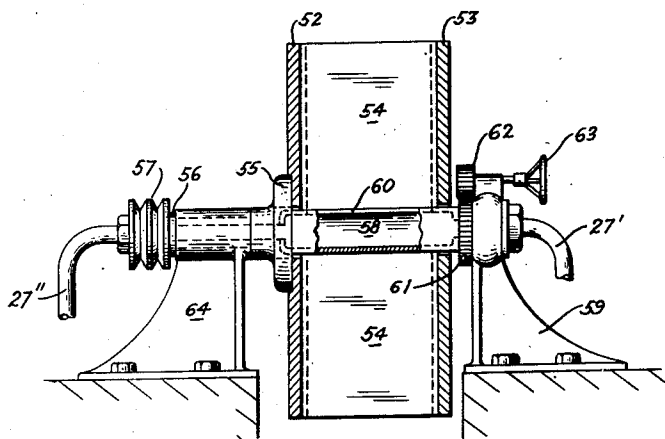


Fig. 10

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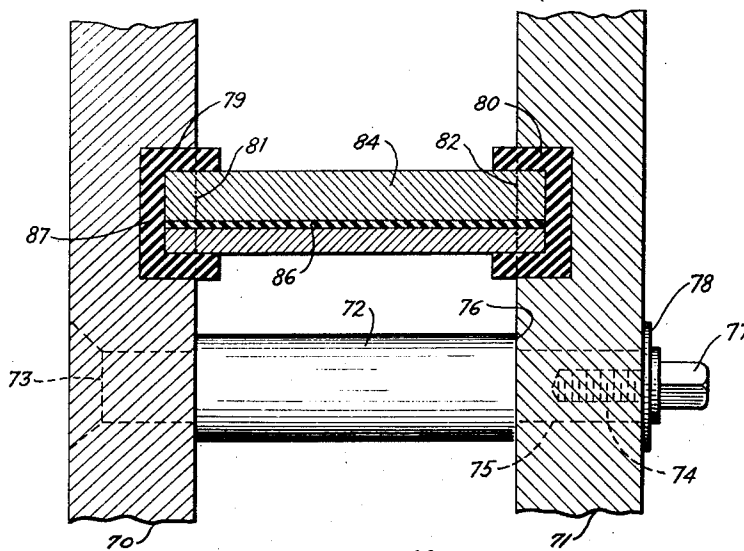
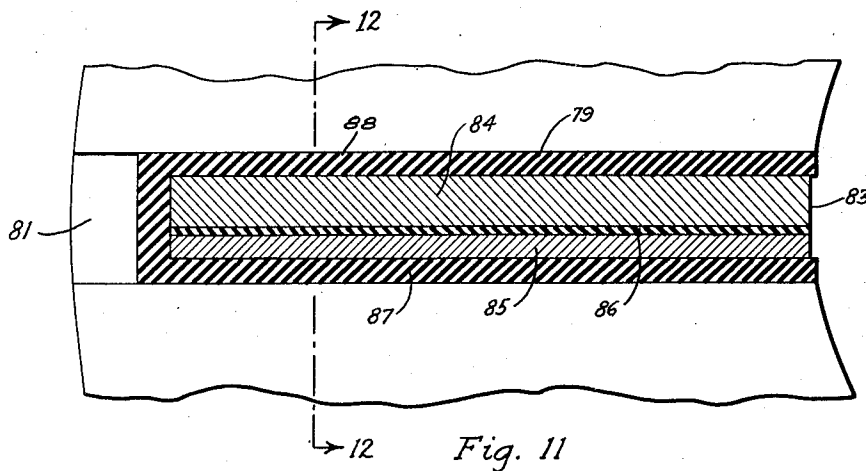
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SURFACE TREATING DEVICE

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4 Sheets-Sheet 4



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SURFACE TREATING DEVICE

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Application March 6, 1947, Serial No. 732,727

7 Claims. (Cl. 51—9)

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This invention relates to the surface treating of materials, particularly to the surface treating of semi-finished or finished work pieces by wet abrasion and provides a device for the projection of liquid abrasive in a particularly advantageous and economical manner.

According to conventional practice, liquid abrasive is projected against work pieces from nozzles to which the abrasive is fed under extremely high pressure of the order of 500 to 1500 pounds per square inch. It has been found by experience that projection of liquid abrasive from nozzles at lower pressures is not practicable.

A jet of abrasive liquid projected from a nozzle at high pressure is necessarily relatively harsh and for many purposes too severe since it causes a rate of abrasion too high for a great many jobs, for example for cleaning the surfaces of work pieces machined to close tolerances which must not be changed materially by the abrading treatment.

A further disadvantage of nozzle projected liquid abrasive is that its impact area is relatively limited. It is impracticable to increase the impact area of the abrasive jet by increasing the size of the nozzle since such an increase leads to power requirements for the supply of the liquid under pressure which is uneconomical.

This invention provides a centrifugal throwing device for projecting liquid abrasive. The liquid abrasive, according to the invention, is fed under relatively low pressure into a central chamber located within the central portion of a centrifugal throwing wheel. The central chamber has an elongated discharge opening in its peripheral wall adjacent to the inner ends of centrifugal throwing blades in the wheel. Abrasive discharged against the blades travels over the leading surface of the blades, is centrifugally accelerated and finally thrown off the outer ends of the blades at a high velocity which may be of the order of 50 to 300 feet per second.

The throwing wheel produces a discharged jet or blast which differs from a nozzle projected blast in various important particulars. The wheel projected jet or blast is substantially fan-shaped and covers a relatively large area, large enough to accommodate several small work pieces or a considerable portion of a large work piece.

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The jet of liquid abrasive projected by the wheel is not a solid mass of liquid travelling or flowing at a high rate, but is a dispersed mass of liquid and abrasive particles each travelling at a high rate of speed depending on the peripheral speed of the wheel and comparable in action to a great number of individual small jets of liquid abrasive evenly distributed over a large area.

The mass of liquid abrasive projected by each individual blade of the wheel forms an individual blast of very short duration as distinguished from the continuous blast of a nozzle projected abrasive liquid, and each individual blast sweeps across the surface of the work piece in a wiping action which is particularly advantageous for an even treatment of the work pieces. In sweeping the surface of the workpiece, each blast also changes its angle of impact which considerably enhances the abrading action particularly for surfaces having an uneven contour which would cause a shadow pattern to be formed on the work piece, if the impact angle of the blast were constant.

These and various other features and advantages of this invention will appear more fully from the detailed description which follows accompanied by drawings showing, for the purpose of illustration, preferred devices embodying the invention.

The invention also consists in certain new and original features of construction and combination of parts herein set forth and claimed.

Although the characteristic features of the invention which are believed to be novel will be particularly pointed out in the claims, the invention itself, its objects and advantages and the manner in which it may be carried out may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part of it, in which preferred forms of the invention are illustrated.

In the following description and in the claims various details will be identified by specific names for convenience. The names, however, are intended to be as generic in their application as the art will permit.

In the drawings accompanying, and forming part of, this specification, certain specific disclosure of the invention is made for the purpose of explanation of broader aspects of the inven-

tion, but it is understood that the details may be modified in various respects without departure from the principles of the invention and that the invention may be applied to other structures than the ones shown.

Referring to the drawings:

Fig. 1 is an elevational view partly in section of a centrifugal throwing wheel according to the invention;

Fig. 2 is an elevational side view, a section 10 being taken on line 2—2 of Fig. 1;

Fig. 3 is a sectional view on an enlarged scale of an element of the wheel in Fig. 1;

Fig. 4 is a plan view of the discharge nozzle forming a part of the assembly shown in Fig. 3; 15

Fig. 5 is a sectional view of a modified form of discharge nozzle;

Fig. 6 is a perspective view of a preferred form of throwing blade;

Fig. 7 is a sectional view of a coated blade, a 20 section being taken on line 7—7 of Fig. 8;

Fig. 8 is a perspective view of a coated throwing blade;

Fig. 9 is a simplified diagrammatic illustration of an installation in which a throwing wheel 25 of the character shown in Fig. 1 forms a part;

Fig. 10 is a modified form of throwing wheel for projecting a liquid blast of considerable width and volume;

Fig. 11 is a sectional view of a portion of a 30 centrifugal throwing wheel of modified construction mounting a blade of special composition and construction; and

Fig. 12 is a sectional view of the elements shown 35 in Fig. 11, a section being taken on line 12—12.

The centrifugal throwing wheel shown in Figs. 1 and 2 comprises throwing blades 11 mounted between face disks 12 and 13. The face disks have substantially radially extending grooves 14 and 15 in them into which the side portions of the blades fit. The face disk 12 is secured to a flange 16 on the end of a drive shaft 17 mounted in a bearing 18.

The blades 11 extend from the periphery of the wheel to points short of the wheel axis thereby leaving a central space 19 in the wheel into which 45 a central chamber 20 extends through an aperture 21 in the face disk 13.

The central chamber 20 is a hollow body having a discharge port 22 therein which is preferably relatively narrow and somewhat shorter in length than the width of the blades, a typical port dimension for a wheel having blades of two and one-half inch width being one and seven-eighths inches by five-eighths of an inch. The clock dial position of the discharge port 22 is adjustable by rotation of the central chamber 20 about its axis with respect to a bearing or support 23 in which the central chamber is mounted. The chamber 20 is, for this purpose, provided with a gear portion 24 engaged by a pinion 25 rotatable by a hand wheel 26. 50

The bearing or support 23 is hollow and permits passage of abrasive slurry from a supply duct 27 into the interior of the chamber 20 so that abrasive slurry supplied under pressure through the duct 27 is discharged in a predetermined direction through the port 22 into the path of the blades 11. 55

The inner ends of the blades against which the discharge of slurry from the port 22 is directed may be tapered in knife edge fashion as shown at 28 in order to reduce to a minimum the obstruction which the blade edges present to the flow of abrasive slurry. 60

The size and shape of the discharge port 22 of the central chamber 20 may conveniently be altered according to the requirements of particular jobs by making the port exchangeable. A 5 construction offering this feature is shown in Figs. 3 and 4. A hollow hub portion 29 for mounting in the bearing or support 23 is provided with a gear 24' for clock dial adjustment. A substantially tubular housing 30 is secured to the hub portion 29 and is closed at the far end by a cover 31. A nozzle member 32 is inserted in an appropriate radial aperture of the housing 30 and is held in place by screws 33 extending through a flange portion 34 of the nozzle member 32. The nozzle member 32 has a discharge port 22' through which the liquid abrasive is discharged. Besides permitting convenient variation in the size of the discharge port, the construction offers the advantage of easy replacement of worn nozzles.

Liquid abrasive particles are discharged by the nozzles illustrated in Figs. 1 to 4 in a substantially radial direction into the path of the centrifugal throwing blades 11 of the wheel. The blades accelerate the particles both radially and tangentially resulting in the discharge of the liquid abrasive from the wheel as a fan-shaped blast having both a radial and a tangential component of velocity.

In order to lessen the initial impact on the 30 blades by the liquid abrasive particles discharged through the port 22, the port axis may be set at an angle with respect to the blades as illustrated in Fig. 5. The tubular housing 30' which forms the central chamber 20' has a discharge nozzle member 32' attached to it whose axis 35 forms an angle with respect to the radius of the wheel. Liquid abrasive discharged from the port of the nozzle member has a tangential component of velocity which greatly lessens the impact on the inner ends of the centrifugal throwing blades. 40

A blade of typical form is illustrated in Fig. 6. The blade 11 is a substantially trough-shaped member having side portions 35 fitting the grooves 14 and 15 of the face disks. Suitable recesses 36 45 are provided for the ends of set screws which hold the blades in place between the face disks and insure the proper spacing of the inner tapered ends of the blades 37 from the wheel axis. The face disks 12 and 13 proper are spaced from each other and secured together by posts 38. 50

The wear of the liquid abrasive on the blades may be greatly reduced and the life of the blades be correspondingly extended by coating the blades with a material which has the property of becoming slippery when wet. Rubber, for example, has this property. Tests have shown that a rubber coating, although very much softer in itself than the tough steel alloy from which the blades are made, resists abrasion by liquid abrasive to a higher degree than the tough steel blades and is, for this reason, admirably suited as coating material.

A representative form of coated blade is illustrated in Figs. 7 and 8. The body 39 of the blade is preferably made of a tough wear-resistant steel. The surfaces of the blade are coated with a non-metallic material having the property of becoming slippery when wet, for example rubber firmly adhered to the blade surface. It is usually 65 sufficient to coat the leading trough-shaped surface 40 of the blade with a layer of coating material 41, but the trailing surface 42 may likewise be coated, particularly if the blade is to be used in a wheel for the discharge of relatively 70 great volumes of liquid abrasive. The edge por-

tions 35' of the blades are preferably left uncoated, or the coating is removed from the edge portions to insure an accurate metal-to-metal fit in the grooves 14 and 15 of the face disks 12 and 13.

As clearly apparent from the drawings, the blades are formed in the shape of a trough, the curvature of the trough being so selected that a film of liquid abrasive of substantially constant thickness is formed on the blades throughout their width to insure a constant blast intensity across the entire blast pattern formed by the centrifugally discharged abrasive particles on an impact surface. The edges of the trough near the face disks are so shaped that an accumulation of abrasive at, and a flow of abrasive along, the face disks is prevented.

Fig. 9 illustrates in the form of a simplified diagram an installation employing a wheel for centrifugally projecting liquid abrasive. A tank 43 is filled with a charge 44 of liquid in which finely divided particles of abrasive are suspended. Proper mixing of the liquid with the abrasive is insured by suitable agitating means, a circulating system being shown in Fig. 9 for the sake of simplicity. The circulating system comprises a suction duct 45 leading to the intake 46 of a pump 47. A pressure duct 48 is connected to the discharge end 49 of the pump. A by-pass duct 50 having a valve 51 therein returns a portion of the liquid abrasive mixture to the tank 43 causing thorough agitation of the liquid in the tank. Liquid abrasive mixture fed by the pump flows through the supply duct 27 to the wheel whence it is discharged as a fan-shaped jet or blast 52. Work pieces are supported in, or moved through, the blast of finely divided abrasive and liquid mixture in any suitable manner.

A modified form of centrifugal throwing wheel for projecting liquid abrasive mixture in a particularly wide blast pattern is shown in Fig. 10. The machine comprises face disks 52 and 53 between which wide throwing blades 54 are mounted. The face disk 52 is secured to a flange 55 on the end of a hollow drive shaft 56 carrying a multiple pulley 57 for connection to a suitable prime mover. The drive shaft 56 is mounted in a bearing 64.

A tubular housing 58 forming a central chamber is mounted with one end in a support or bearing 59. The tubular housing has an elongated discharge port 60 in it whose clock dial position with respect to the wheel is adjustable by means of a gear 61 on the housing, a pinion 62 and a hand wheel 63.

A pressure duct 27' extends through the support 59 for supplying liquid abrasive to the inside of the housing 58. A further supply duct 27'' leads through the hollow drive shaft 56 and supplies liquid abrasive under pressure to the opposite end of the housing 58.

The supply of liquid and abrasive mixture to either end of the central chamber 58 compensates for the drop in pressure which would otherwise occur in the chamber with increased distance from the supply duct 27' if only one duct were provided. It also permits discharge of far greater volumes of liquid abrasive fed at relatively lower pressure than would be possible if only one supply duct were provided. Thus the centrifugal throwing wheel of the type shown in Fig. 10 is particularly suited for the discharge of relatively great volumes of liquid abrasive and is capable of covering an exceptionally large area by producing a very large blast pattern. The

blast pattern is of uniform intensity through its width and could not be produced with comparable evenness by a plurality of superimposed small high-pressure jets discharged from nozzles.

A modified form of wheel and blade construction is shown in Figs. 11 and 12. The face disks 70 and 71 of the wheel are secured together by posts 72. The posts are fixedly secured to the disk 70 at 73 and have an end portion of reduced diameter 74 fitting corresponding holes 75 in the face disk 71. The face disk 71 rests against a shoulder 76 of the posts 72 and is held in place by bolts 77 and washers 78.

Channels 79 and 80 are machined in the face disks 70 and 71 and closed at the outer periphery of the disk by plugs 81 and 82. The plugs 81 are welded in place and provide abutments against which the blade proper and its respective mounting rests.

The blade 83 is laminated and consists of an outer wear resistant lamination 84 of a hard, wear resistant material such as boron carbide, aluminum oxide, or other suitable materials having comparable characteristics. The hard surface lamination 84 is backed by a carbon steel lamination 85 and cemented thereto by a thin sheet of rubber or plastic 86 compensating for slight irregularities in the flatness of the back surface of the lamination 84.

The laminated blade 84, 85, 86 is held in rubber channels 87 and 88 providing a tight fit of the blade in the channels of the face disks.

The assembly of the blades and wheel disks proceeds by inserting the laminated blades with their rubber channel into face disk 70 whereafter the face disk 71 is placed thereover and tightened by the bolts 77 causing tight frictional engagement of the blades in the respective channels.

During operation, the outer end of the blades bear against the respective plugs 81 which hold the blades in the channel.

The invention thus provides a highly efficient and advantageous device for projecting liquids, particularly liquid abrasives. The rate at which the liquid is projected may be controlled within wide ranges by varying the speed of the wheel.

Compared with liquid abrasive projecting devices of the nozzle type, the centrifugal projecting wheel has the advantage of requiring less power due to the absence of losses in the ducts and nozzle of a high pressure nozzle system.

The maintenance costs of the centrifugal blasting device are lower than those of a device employing multiple nozzles since there is no appreciable wear of the liquid carrying ducts and the central chamber due to the relatively low pressures employed, the velocity of the blast being mainly produced by centrifugal acceleration of the liquid.

The sweeping action of individual blasts sweeping over the work pieces from end to end produces a thorough and even abrading action and a superior finish on the work piece not obtainable with conventional nozzle operated equipment.

The impact area covered by the machine is a rectangle at all points of which the blast intensity is substantially the same and remains the same over long periods of operating time. Evenness of blast intensity over a large area and over extended periods of time is a particular advantage of the centrifugal throwing wheel over devices operating with nozzle projected jets, which, by reason of the limitation to nozzle size, must employ a plurality of nozzles in order to

cover a comparable area. The difficulties encountered with such nozzle equipment are chiefly the impossibility of obtaining constant blast intensity at all points of the operating area and the impossibility of maintaining a constant blast intensity over extended periods of operating time. Constant blast intensity at all points of the impact area is practically impossible to attain due to overlap of, or space between, individual jets. The blast intensity of a nozzle at any given point of the impact area changes with operation time due to inevitable wear, and resulting enlargement of, the nozzles. Both of these disadvantages are effectively overcome by the invention which provides constant blast intensity over extended areas and periods of time.

Wear on the blades is greatly reduced by coated blades. The coating of rubber or other comparable material having the property of becoming slippery when wet reduces the friction between the liquid and the blade materially thereby reducing the required power for driving the wheel and increasing the life of the blades. After the coating of a blade has worn through, the blade need not be thrown away, but may be reconditioned simply by replacing the coating of rubber or other comparable material thereon. It is evident that a similar coating may be employed with equal benefit for the inner surfaces of the wheel disks but experience has shown that this is unnecessary unless the wheel is put to particularly hard use.

Where particularly severe operating conditions are encountered, laminated blades having a wear resistant surface of boron carbide, aluminum oxide, and other wear resistant materials of a metallic or non-metallic base may be employed to great advantage.

Obviously the present invention is not restricted to the particular embodiments herein shown or described. Manifestly many changes, additions, omissions, substitutions and modifications may be made without departing from the spirit and intent of this invention and without sacrificing its major features and advantages.

What is claimed is:

1. A centrifugal throwing wheel for projecting liquid comprising, a central portion; a hollow shaft supporting said central portion for rotation of the wheel about the shaft axis; a plurality of blades extending from said central portion to the outer periphery of the wheel; a central chamber within said central portion, said chamber having a radially directed elongated discharge opening in its peripheral wall adjacent to the inner ends of the blades adapted to discharge liquid therethrough in substantially radial direction; and a pair of pressure ducts for supplying liquid under pressure into said chamber from both ends, one of said ducts extending through said hollow shaft, the chamber being liquid tightly closed except for said discharge opening, and the interior of the chamber being free from obstructions, whereby flow of liquid from said duct to said discharge opening is unimpaired.

2. A centrifugal throwing wheel for projecting liquid comprising, a central portion; a drive shaft on said central portion; a first bearing supporting said shaft for rotation of the wheel about the shaft axis, a plurality of blades extending from said central portion to the outer periphery of the wheel; a central chamber within said central portion, said chamber having a radially directed elongated discharge opening in its peripheral wall adjacent to the inner ends of the blades adapted

to discharge liquid therethrough in substantially radial direction; a pressure duct terminating in said chamber for supplying liquid under pressure into said chamber, the chamber being liquid tightly closed except for said discharge opening, and the interior of the chamber being free from obstructions, whereby flow of liquid from said duct to said discharge opening is unimpaired; a second bearing supporting said central chamber for rotation coaxial with said shaft; and means for rotating said central chamber relatively to said second bearing, whereby the clock dial position of the discharge opening of said chamber may be adjusted.

3. A centrifugal throwing wheel for projecting liquid comprising, two parallel disks; a drive shaft mounting said disks for rotation about an axis; a plurality of substantially radial blades mounted between said disks, the inner ends of said blades terminating short of said axis thereby defining a central wheel space, the leading surfaces of the blades being coated with a non-metallic rubbery material having the property of becoming slippery when wet; a central chamber within said central wheel space, said chamber having a radially directed elongated discharge opening in its peripheral wall adjacent to the inner ends of the blades adapted to discharge liquid therethrough in substantially radial direction; a pressure duct terminating in said chamber for supplying liquid under pressure into said chamber, the chamber being liquid tightly closed except for said discharge opening, and the interior of the chamber being free from obstructions whereby flow of liquid from said duct to said discharge opening is unimpaired.

4. A centrifugal throwing wheel for projecting liquid comprising, a central portion, means for journaling said central portion for rotation of the wheel about an axis; a plurality of blades extending from said central portion to the outer periphery of the wheel; a central chamber within said central portion, said chamber having an elongated discharge opening in its peripheral wall adjacent to the inner ends of the blades adapted to discharge liquid therethrough, the axis of the discharge opening being at an angle with respect to the radius of the wheel to discharge liquid in the direction of rotation of the blades; and a pressure duct terminating in said chamber for supplying liquid under pressure into said chamber, the chamber being liquid tightly closed except for said discharge opening, and the interior of the chamber being free from obstruction, whereby flow of liquid from said duct to said discharge opening is unimpaired.

5. A blade for a centrifugal throwing wheel comprising, a bottom lamination of metal; a top lamination of a wear resistant carbide; and a center lamination of a plastic material cemented to said bottom and top laminations.

6. A blade for a centrifugal throwing wheel comprising, a base lamination of steel; a top lamination of a wear resistant material having a carbide base; and a center lamination of rubber cemented to said bottom and top laminations.

7. In a device for centrifugally projecting material including two parallel disks; a drive shaft mounting said disks for rotation about an axis; a plurality of substantially radial blades mounted between said disks in channels in said disks, the inner ends of said blades terminating short of said axis defining a central wheel space; and means for discharging into said central wheel space material to be centrifugally projected from

said wheel, the improvement which comprises, channel shaped members of a resilient material providing a cushioning mounting for the edges of said blades in said disk channels.

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