

[54] **IMPELLING WHEEL FOR PARTICULATE MATERIAL**

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[51] Int. Cl. **B24c 5/06**

[58] Field of Search **51/9; 241/275**

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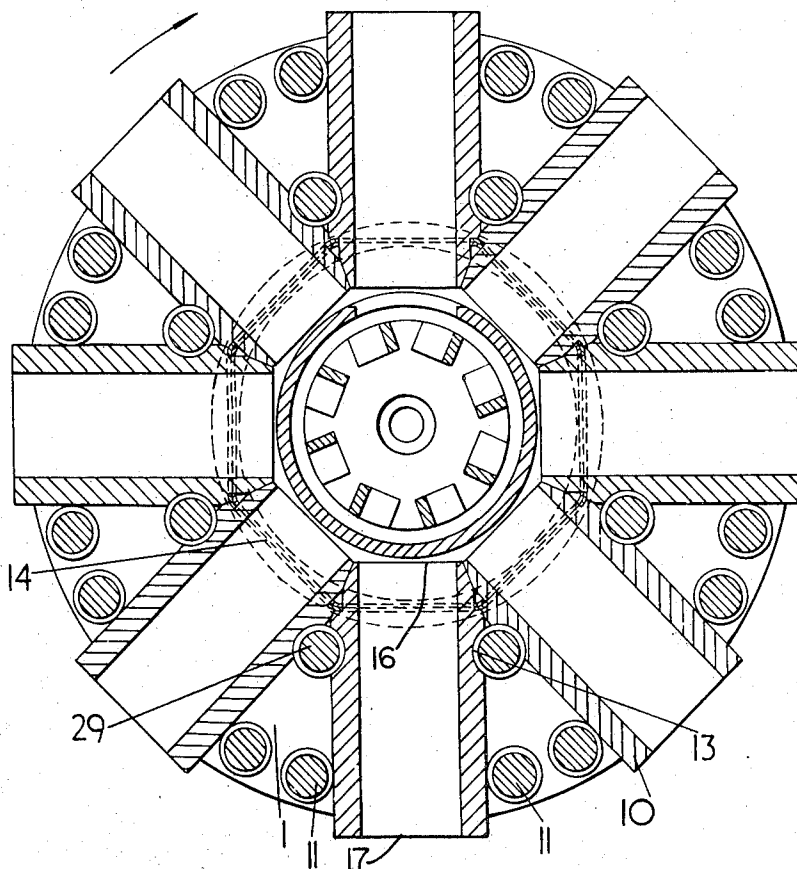
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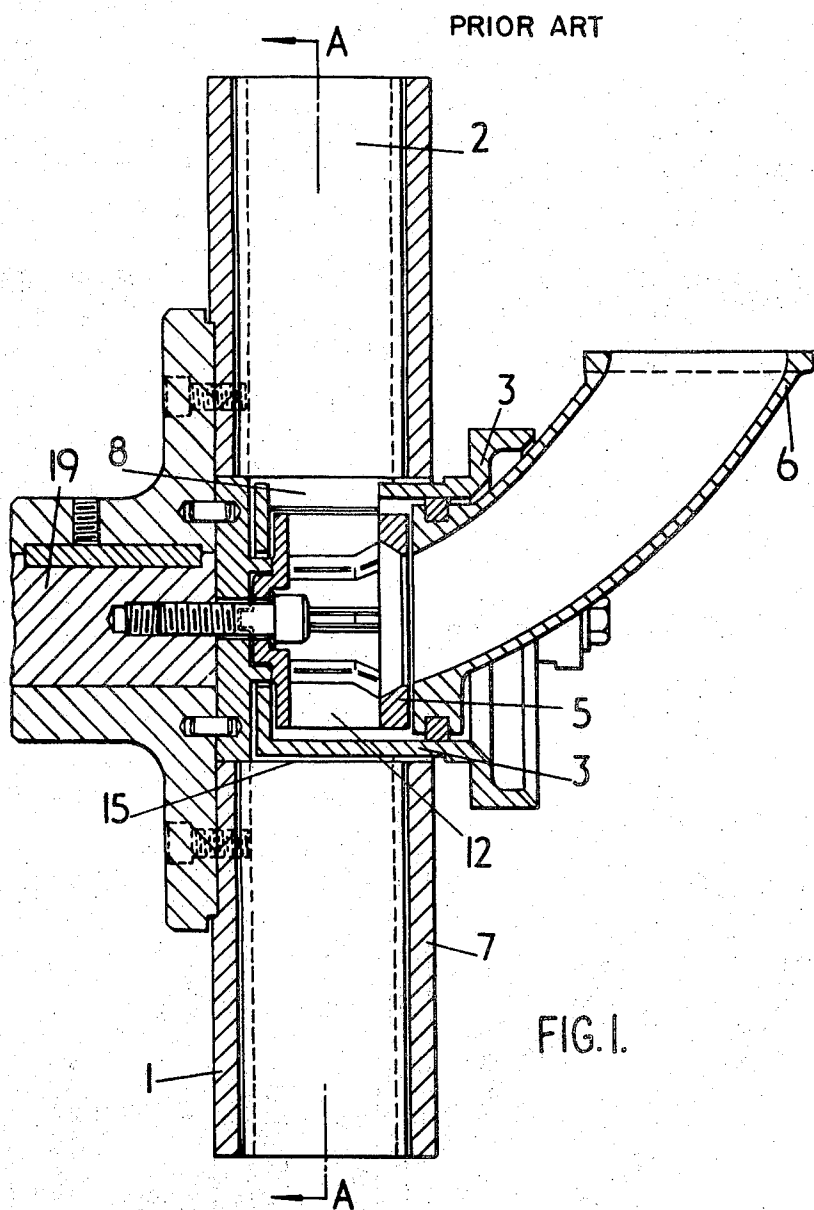
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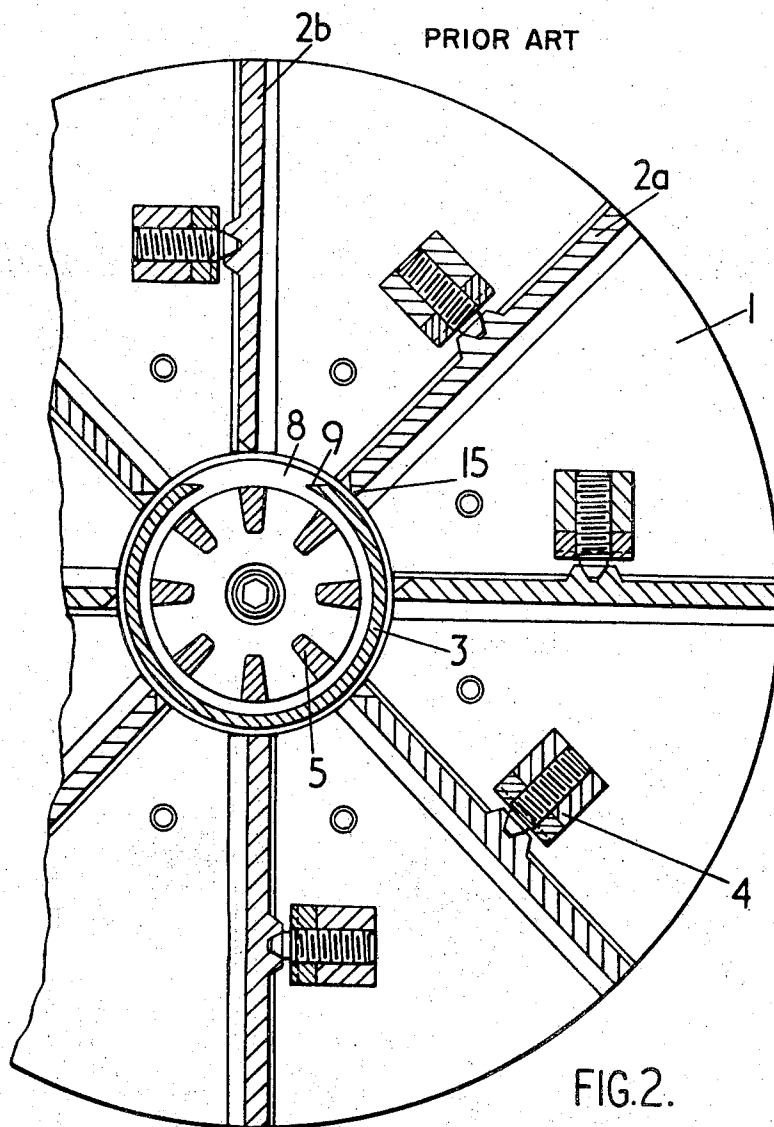
[57] **ABSTRACT**

An impeller wheel for particulate material having a plurality of tubes radially positioned for impelling the material under the action of centrifugal force. The impeller wheel has a distributing rotor for the material at the axis of rotation of the wheel, the rotor having blades which are shaped to induce the material to be fed to the inner ends of the tubes in the stream of restricted width while the tubes are each rotatable about their longitudinal axis to bring different parts of the tubes into line with the stream so as to be subject to wear selectively.

12 Claims, 16 Drawing Figures







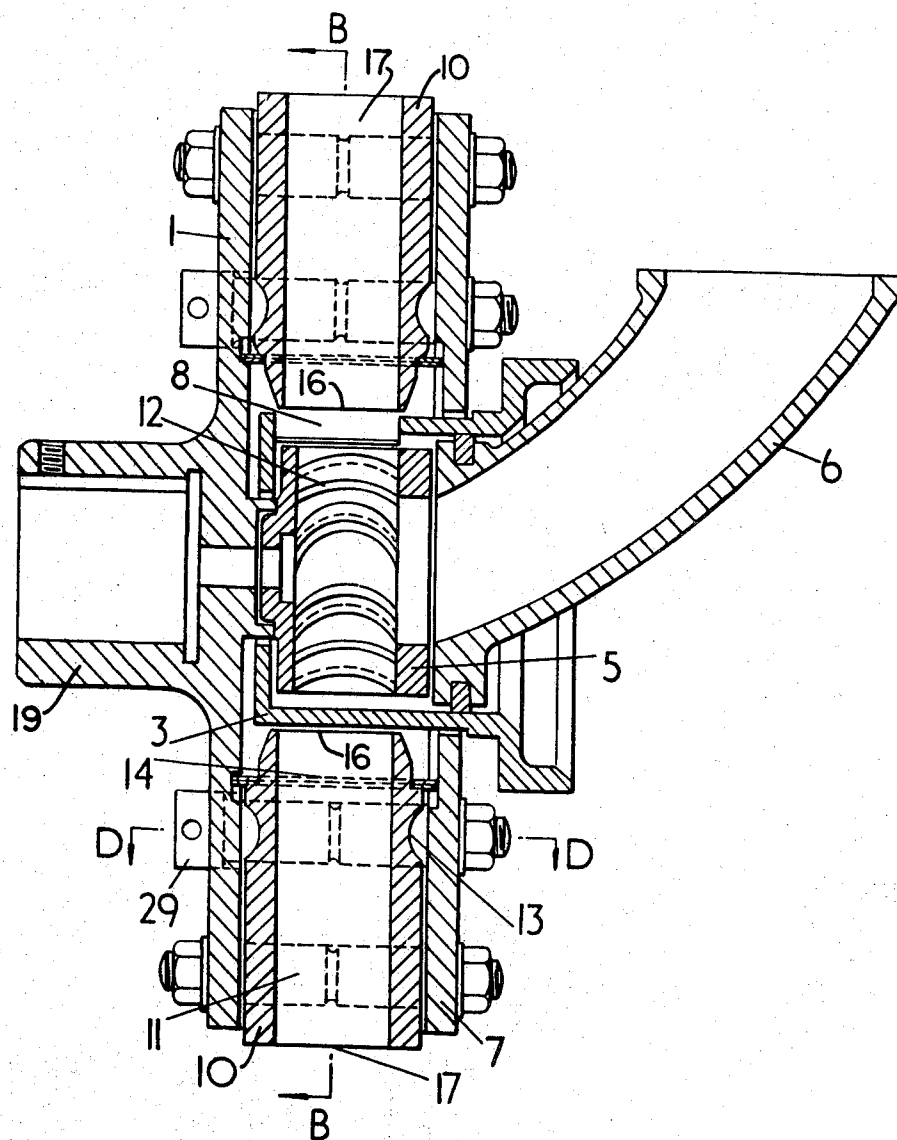
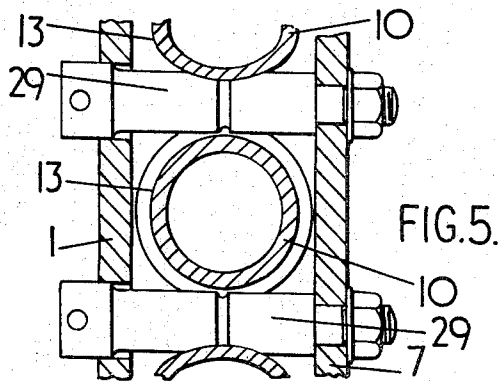
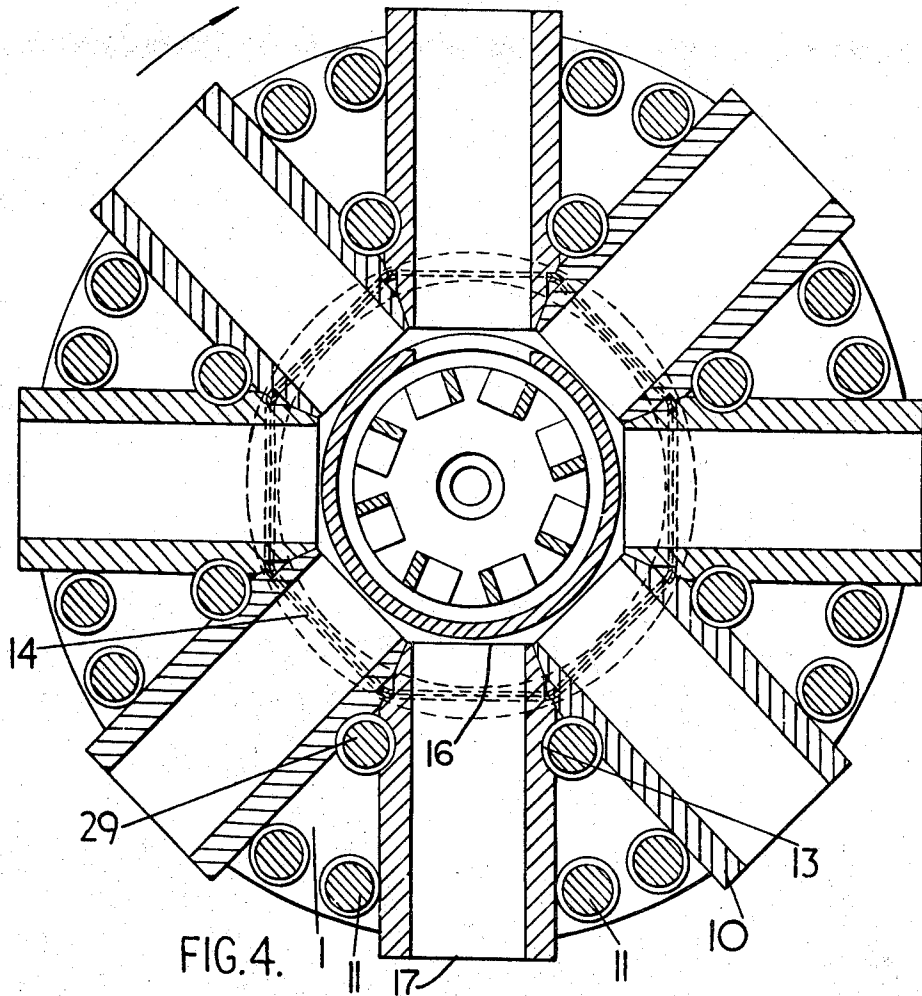


FIG. 3.



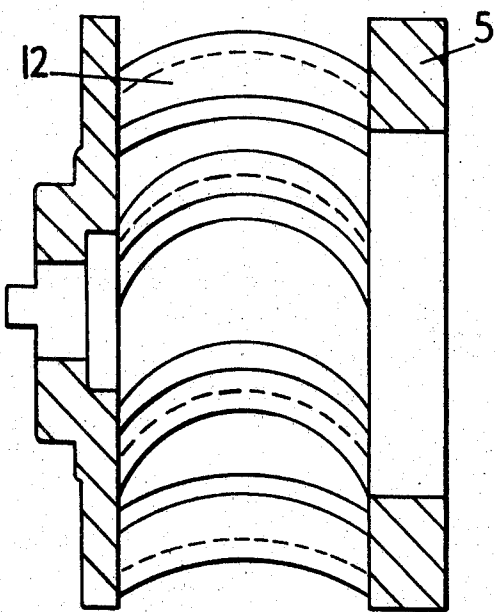


FIG. 6.

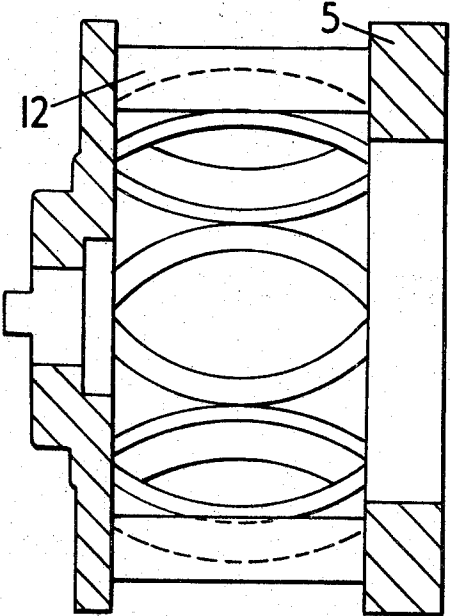


FIG. 7.

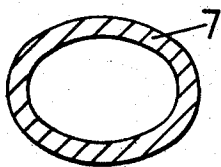


FIG. 8.

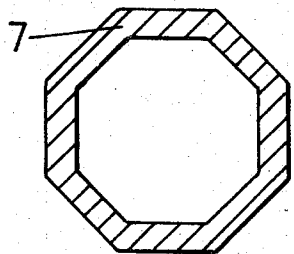


FIG. 9.

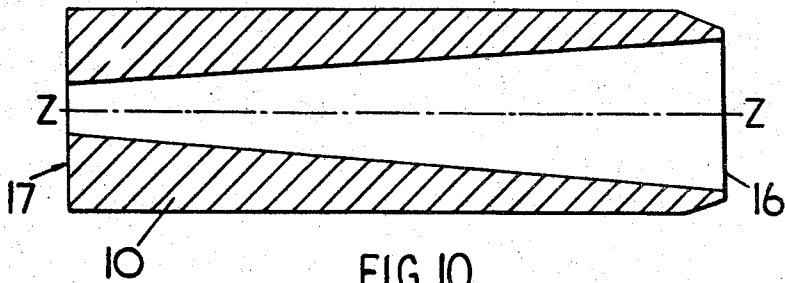
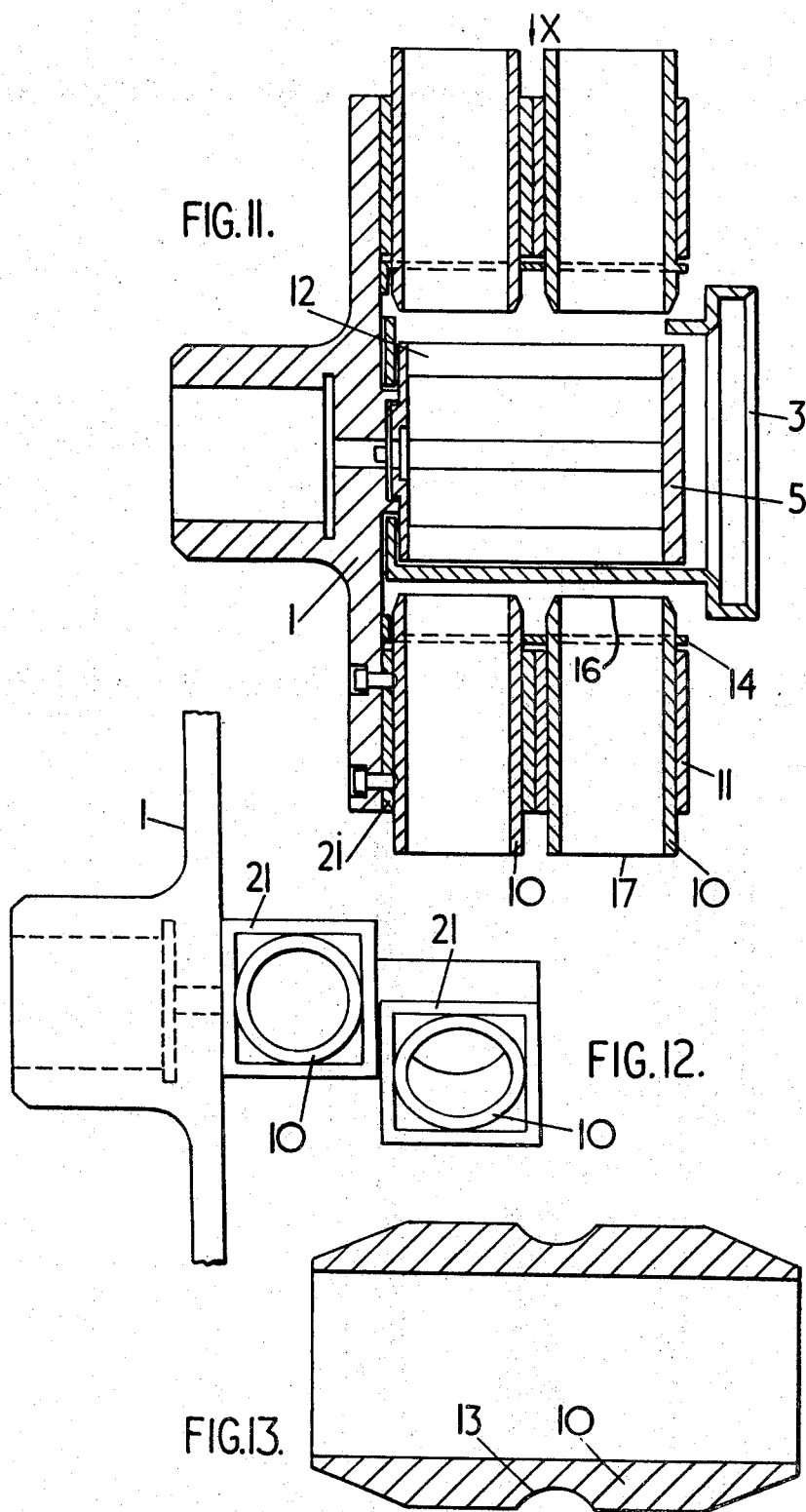
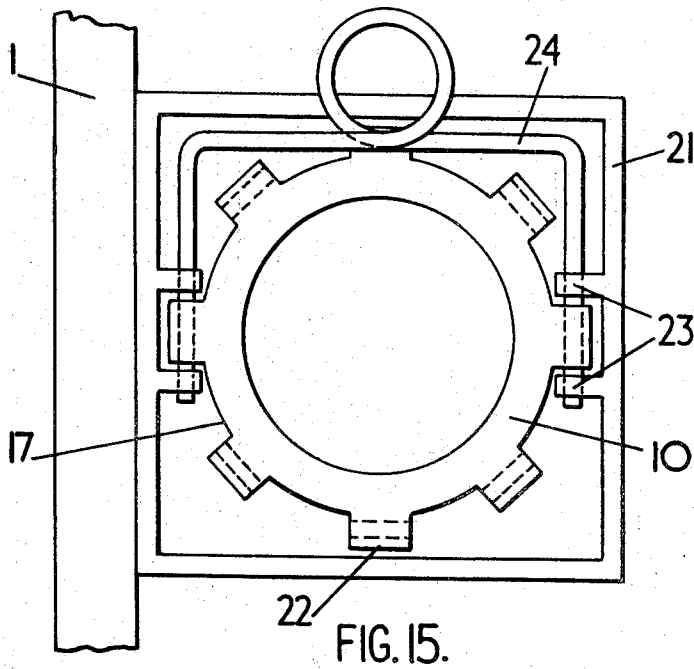
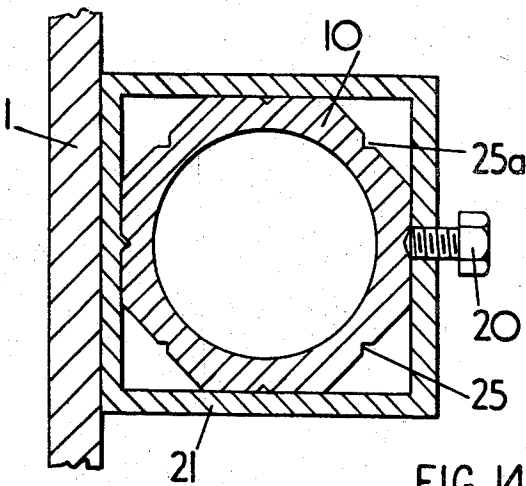


FIG. 10.





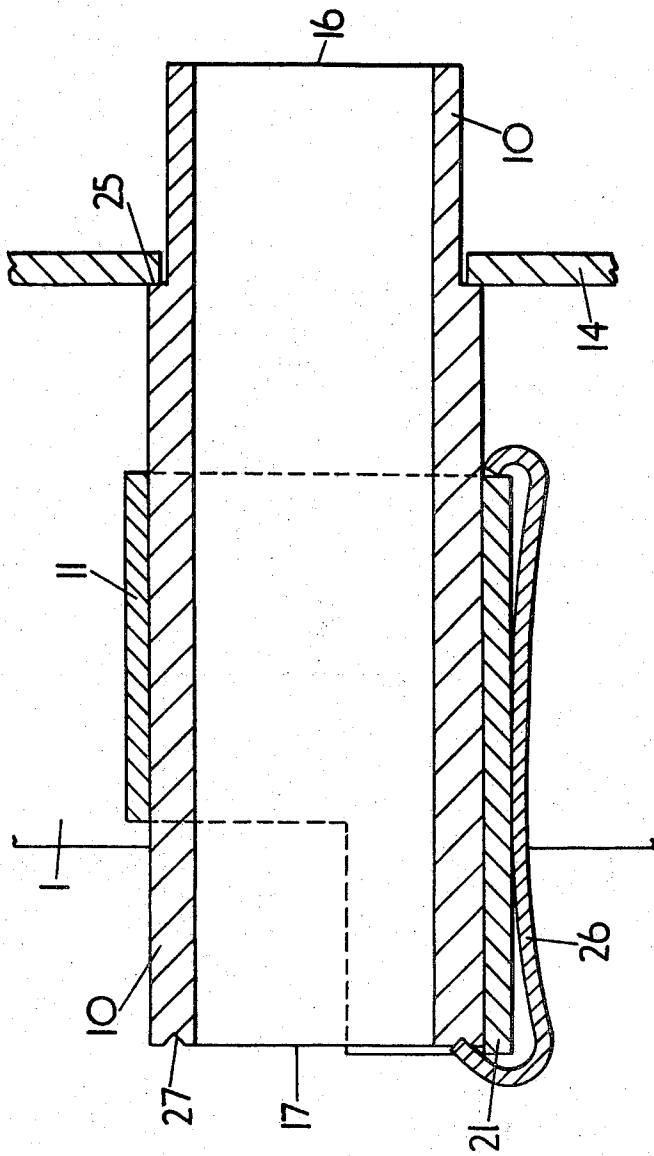


FIG. 16.

IMPELLER WHEEL FOR PARTICULATE MATERIAL

This invention relates to impact finishing machines and, in particular to machines in which particulate material is impelled or thrown in the direction of the workpiece by the action of a wheel.

The object of the invention is firstly to improve the operation of abrasive throwing wheels in respect of wear that is inherent in prior art abrasive throwing wheels. This wear is caused mainly by the action of abrasive particles as they are accelerated along blades after being fed into the centre of the wheel and before being impelled at high speed from the tips of the blades. As a result of such wear the blades must be replaced as soon as the extent of said wear in any one area renders the blade unusable. In particular, excessive wear is experienced at the root of the blade due to crushing of abrasive particles, and at the tip due to impact of said particles. An additional object is to reduce the battering effect of abrasive on the abrasive throwing blades. Instead of said abrasive following a generally sliding action along the blade surface it impacts the blade at an angle to its surface causing accelerated wear. This is caused by particles leaving the abrasive feeding orifice ahead of the blade root, but behind the preceding blade, and is largely the result of the divergent nature of the volume space between adjacent blades. A further object is to concentrate the flow width of the abrasive stream on the blade surface compared with that of abrasive throwing blades of known form.

A further object is to discharge the abrasive particles in a more controllable stream on to the workpiece.

A still further object is to reduce the noise level associated with the operation of impact finishing machines in which the abrasive particles are impelled by the action of a wheel.

Yet a further object is to eliminate the tendency in bladed wheels operated with the axis vertical, for the abrasive to discharge from the lower edge of the blade.

The invention consists in an impeller wheel for particulate material having a plurality of radially disposed passages for directing the material under the action of centrifugal force onto a workpiece, characterised in that each passage is in the form of a tube and there is a distributing rotor for the material at the axis of rotation of the wheel having radial blades which are so shaped as to induce the material to be fed in turn into the tubes in a stream of restricted width, while the tubes are each rotatable about their longitudinal axis to bring different parts into line with the said stream as they become subjected to wear.

The invention further consists in an impeller wheel as set forth in the preceding paragraph in which the material rotor is provided with an adjustable apertured sleeve therearound which feeds the material in turn into the tubes.

The invention still further consists in an impeller wheel as set forth above in which the cross-sectional shape of the radial blades corresponds to part of the inner surface of the tubes.

The invention still further consists in an impeller wheel as set forth above in which the aperture sleeve is normally stationary, but is adjustable as to position relative to the base of the machine to vary the direction in the material is directed by the tubes.

The invention still further consists in an impeller wheel as set forth above in which the tubes are of constant cross-section throughout their length.

The invention still further consists in an impeller wheel as set forth above in which the tubes are of varying cross-sectional shape throughout their length.

The invention still further consists in an impeller wheel as set forth above in which the tubes are held between an inner and outer support plate, and means are provided for securely locating each tube in each of the plurality of rotated positions to bring the different parts of the inner surface into different working positions.

The accompanying drawings show by way of example only some known systems together with embodiments of the invention in which:

FIG. 1 shows a longitudinal cross-section through a known system in which the particulate material is fed into the centre of a wheel containing a plurality of throwing blades.

FIG. 2 shows a section on the line A—A of the system shown in FIG. 1.

FIG. 3 shows a longitudinal cross section through one embodiment of the invention.

FIG. 4 shows a section on the line B—B of the embodiment illustrated in FIG. 3.

FIG. 5 shows a part section on the line D—D of the of the embodiment illustrated in FIG. 3.

FIG. 6 shows in cross-section a further embodiment of the invention in which the rotor has vanes conforming to the shape of the tube.

FIG. 7 shows in cross-section a modification of the invention as shown in FIG. 6 with two sets of rotor vanes such that a radial line to the centre between any two consecutive vanes around the circumference of the rotor, forms an axis of symmetry between these consecutive vanes.

FIG. 8 shows in cross-section a further embodiment of the invention wherein the abrasive throwing tubes have a cross section comprising a closed loop.

FIG. 9 shows in cross-section a further modification of FIG. 6 wherein the abrasive throwing tubes have a cross-section comprising a polygon.

FIG. 10 shows in longitudinal section a further embodiment of the invention wherein the abrasive throwing tubes have a varying cross-section along their length which may increase in either direction.

FIG. 11 shows in longitudinal section a further embodiment of the invention wherein a plurality of abrasive throwing tubes are mounted at each station of the wheel to produce a wider track of impelled abrasive.

FIG. 12 shows in elevation a modification of the embodiment of the invention shown in FIG. 11 wherein the plurality of abrasive throwing tubes are staggered at each station on the wheel to ensure that abrasive leaving the tip of each tube does not interfere with that leaving any adjacent tube mounted at that station on the wheel.

FIG. 13 shows in cross-section a further embodiment of the invention wherein the abrasive throwing tubes are reversible being symmetric about a cross-section taken half-way along their axis.

FIG. 14 shows in cross-section a further embodiment of the invention pertaining to the locating of the abrasive throwing tubes to facilitate ease of rotary adjustment and removal.

FIG. 15 shows in end elevation a further variation pertaining to the location of the abrasive throwing tubes to facilitate ease of adjustment.

FIG. 16 shows in longitudinal section a further variation pertaining to the location of the abrasive throwing tubes to facilitate ease of adjustment.

DESCRIPTION OF THE PRIOR ART

Referring to FIG. 1, this represents a typical known system for propelling particles of an abrasive nature by the action of a wheel. In this system particles are fed through a funnel 6 into a rotor 5. They are centrifugally impelled along the vanes 12, of the rotor 5, through the feed orifice 8, in the stationary control sleeve 3. Said particles leave the abrasive feed orifice 8, and are picked up by the blades 2, which are rotating. This provides an accelerating means and the particles are accelerated along the blades 2, leaving the tips at high speed to act on a suitably situated workpiece. The blades 2, are mounted between the backplate 1, and the faceplate 7, and the wheel is driven by a shaft 19, attached to the backplate 1. The rotor 5, is also attached to the shaft 19, so that the rotor and backplate with blades rotate in a constant relative position. FIG. 2 is a section view of FIG. 1 on the line A—A. This clearly illustrates the feed orifice 8, in the stationary control sleeve 3, and the rotor 5, mounted within it. The backplate 1, and blades 2, are clearly illustrated as is the blade clamp 4.

The disadvantage of such a system is that wear by the abrasive action of particles on the surface of the blades 2, causes said blades to require replacement as soon as said wear in any one area renders the blades 2, unusable. This wear is normally at the blade root 15, of blades 2, or at the outer tip of the blades 2.

A further disadvantage in the system is that the blade root 15, being parallel to the edges of the feed orifice 8, results in particles being crushed by the instantaneous shearing action between an advancing blade 2b, and the terminating edge 9 of the feed orifice 8. This crushing action results in accelerating wear on the root of the blade 2b, and on the terminating edge 9, of the feed orifice 8. A further disadvantage is that particles continually leaving the feed orifice 8, enter the space between the back of a receding blade 2a, and the face of an advancing blade 2b. Thus, some particles having entered said space between two blades 2a, and 2b, are struck by the advancing blade 2b, incurring greater wear on the blade 2b surface than would have been the case had all the particles been fed along blade 2b, surface from the rotor vane, in a smooth manner. The divergent nature of the volume space between adjacent blades 2, aggravates this situation.

Yet a further disadvantage is that the spread of abrasive particles across the whole width of blades 2, results in a wide spread of particles across the workpiece in a direction parallel to the shaft 19. The desired effect on the workpiece is less than if all the particles were confined to a smaller area of the workpiece.

Yet a further disadvantage is that, whilst rotating, the blades 2 travel through the atmosphere at high speed and in an enclosure, and shed a vortex at their tips with a consequent emission of a high level of noise.

THE INVENTION

The apparatus constructed in accordance with the present invention provides a means whereby excessive wear in any one area on the accelerating means does

not render said item unusable and subject to replacement. It provides the advantage of reducing the width of the particles stream travelling along the surface of the accelerating means and hence reducing the extent of wear accordingly. It eliminates the divergent nature to the volume space into which the particles flow from the feed orifice, thus reducing the wear on the accelerating means.

It also provides for a feed of particles into an accelerating means whereby a stream of abrasive particles is produced which is relatively narrow across its width parallel to the axis of the shaft; said stream of abrasive particles producing a track on the workpiece of controllable length. By virtue of modifying the nature of the feed of particles into the accelerating means, combined with a novel form of rotor, the desired effect of the accelerated particles on the workpiece is increased. Wear caused by the particles impinging on the accelerating means is reduced, as is wear due to the crushing of particles between the terminating edge of the feed orifice and the root of the accelerating means. The noise level emitted is also reduced.

In addition several advantages accrue relating to the operation and maintenance of impact finishing machines wherein the particles are impelled by the action of a wheel.

Referring to FIGS. 3, 4 and 5, these show one form of the invention in which blades 2, in the previously described known form are substituted by tubes 10, also of known form, mounted on a wheel comprising a backplate 1, and a front plate 7, between which tubes 10, are retained. Particles of abrasive are fed through the funnel 6, into the rotor 5, then centrifugally impelled along the vanes 12, of the rotor 5, through the feed orifice 8, in the control sleeve 3. Particles are then picked up by the tubes 10, and accelerating along their advancing inner walls as they rotate to leave the tips 17, of the tube 10, at high speed.

The combination of air flow being centrifugally induced down the centre of the tubes 10, and the curved wall of said tubes results in a reduced width of the stream of particles travelling within the tubes on their advancing inner walls.

The use of tubes 10, as the accelerating means coupled with a system to feed abrasive particles through the feed orifice 8, of an adjustable control sleeve 3, by means of a rotor 5, has the advantage of producing a track of particles at the workpiece which is narrow across its width, parallel to the axis of shaft 19, and of controllable length.

Additionally, referring also to FIG. 6, in which the vanes 12, of the rotor 5, are designed such that they have the same shape or curvature as the advancing inner walls of tubes 10, a reduction in wear on tubes 10, results due to smooth transition of the particles from the vanes 12, of the rotor 5, into tubes 10,

The rotor 5, may have as many vanes 12, as there are tubes means, but this need not be the case. Generally, but not specifically, the rotor 5, would have a plurality of vanes 12. If the rotor 5, does have an equal number of vanes 12 as there are tubes 10, and these vanes 12, are of like section as the tubes 10, the vanes may or may not be in line with said tubes 10, being in advance or behind tubes 10, relative to their direction of rotation, whichever provides the most benefit in any particular embodiment of the invention.

It is essential with this embodiment of the invention that a collar 14, formed as a perforated tube, or some other means is utilised to prevent particles from the feed orifice 8, passing between adjacent tubes 10, and creating wear on the outer wall of the tubes.

Ultimately the wear at one area on the inner walls of the tubes 10, resulting from the passage of the particles renders the tubes 10, unusable as efficient accelerating means. The tubes 10, may then be manually reoriented by turning them about their longitudinal axis to present an unworn inner wall along which efficient acceleration of the particles from the feed orifice 8, can again take place. Means is also illustrated whereby tubes 10, are retained by a pin 29, engaging groove 13, in tubes 10. The pin can be large enough for a single pin 29, to retain two tubes 10, as specifically illustrated, or alternatively two separate pins 29, can be utilised to retain each tube 10. This retention means enables tubes 10, to be readily rotated whilst remaining firmly retained. In the embodiment shown, groove 13, is in a specific position, but this could be in any position along tube 10, and of any size, whichever gives the most benefit in any particular embodiment of the invention. The pins 29, are preferably located outside the collar 14, to eliminate any effect from abrasive particles retained inside the collar 14.

When destructive wear is again apparent the tubes 10, can be rotated again to present a further fresh inner wall for particle acceleration. The tubes 10, may thus be indexed a number of times equal to the next lowest integer of the value obtained when the inner circumference of a tube 10, is divided by the particle wear track width on the inner wall of said tube. Typically tube 10, of 50 mm internal diameter can be turned to present eight separate positions with a particle stream of 20 mm width.

Having provided tubes 10, as the particle accelerating means, particles now leaving the feed orifice 8, no longer enter a divergent volume space. The wear resulting is thus reduced. The use of tubes 10, as the particle accelerating means together with control sleeve 3, and a suitably designed rotor 5, to guide particles smoothly into tube 10, results in reduced wear on the terminating edge 9, of the feed orifice 8, from the crushing of particles between the tube root 16, and said terminating edge. This beneficial effect is obtained because the tube root 16, is not parallel to the terminating edge 9, of the feed orifice 8, thus the cutting action of the tube passing over the feed orifice 8, is gradual and not instantaneous. The use of tubes 10, as the particle accelerating means has the additional beneficial effect of modifying the flow of air centrifugally induced within the tubes 10, to provide a more concentrated flow of air with the particles impelled from the tip 17, of the tubes 10.

In addition, the use of tubes 10, as the particle accelerating means modifies the air vortex leaving the tip 17, of the tubes 10, caused by their high speed rotation in the atmosphere within an enclosure. The modified nature of this vortex results in the emission of noise of a reduced level compared with like devices of known form.

Referring to FIG. 7, this shows the form of rotor 5, in which two sets of vanes 12, are present to enable rotation in either direction. When said rotor is used in conjunction with tubes 10, particles are accelerated smoothly from the vanes 12, of rotor 5, into tubes 10,

irrespective of the direction of rotation of shaft 19. Two sets of vanes may of course be replaced with a single set of vanes having a concave profile on each side.

Referring to FIGS. 8 and 9, these show an additional form of the invention in which the tubes 10, have a cross-section forming any closed loop or polygon. Preferably these should be of a symmetrical form to allow maximum flexibility in rotation to expose the maximum number of different wearing areas. For tubes 10, of various shapes of cross-section it is of particular benefit that the vanes 12, of the rotor 5, should conform to that cross-section to enable a smooth flow of particles from the rotor 5, into the tubes 10.

Referring to FIG. 10, this shows an additional form of the invention in which the tubes 10, have a varying cross-section along their length, the variation in cross-section being of any form along the length of the tube 10. In this instance the vanes 12, of rotor 5, would conform to the shape of internal cross-section of tubes 10, at the tube root 16, which could be the narrowest end of tube 10, or the widest, whichever gives the most benefit in any particular application.

Specifically FIG. 10 shows a tube 10, where the internal area of cross-section decreases along axis Z—Z of the tube 10, from the tube root 16. This has the advantageous effect in specific instances of concentrating the flow of particles and air leaving the tips 17, of tubes 10.

A further advantage of the form of the invention specifically illustrated in FIG. 10, is that the tube 10, wall thickness is greater at the tip 17, wherein the greatest wear resulting from the accelerated passage of particles is generally to be found. This increase of wall thickness results in a greater passage of time before the wear in any one area renders the tube 10, liable to be rotated to offer a fresh face on which particles are accelerated.

Conversely, the internal area of cross section of tubes 10, could increase along the length of said tubes. This will have the advantageous effect in specific instances of diffusing particles of air leaving tips 17, of tubes 10. Many combinations of shapes of cross-section and variability of cross-section area along the lengths of tubes 10, are possible (such as a converging/diverging cross-section) in combination with a rotor 5, of appropriate type of vane 12. Those described are by way of illustration only.

FIG. 11 illustrates a further form of the invention in which a multiplicity of tubes 10, are mounted at each station of the backplate 1, where a single tube 10, was previously situated. Particles of an abrasive nature enter the control sleeve 3, into a rotor 5, both items having been modified to accommodate the appropriate tubes 10, now mounted at each station on the backplate 1. The particles are then centrifugally impelled along vanes 12, of the rotor 5, through the appropriately modified feed orifice 8, in the control sleeve 3. The particles are then picked up by the tubes 10, and accelerated along their advancing inner walls, as they rotate to leave the tips 17 of tubes 10, at high speed. This form of the invention has the advantage of simply providing a greater quantity and width of track parallel to the rotational axis, of particles of an abrasive nature impelled on to a workpiece. This particular example of this form of the invention may have the disadvantage that the particle streams leaving the tips 17, of tube 10, may interfere and adversely modify the nature of the ultimate track of the particles on a workpiece.

FIG. 12 illustrates a further variation of FIG. 11, viewed in direction X. In this variation tubes 10, at any one station on the backplate 1, are staggered circumferentially about that station so that the particle streams leaving the tips 17, of tubes 10, do not interfere one with the other. The vanes 12, in the rotor 5, will of course be offset longitudinally to maintain the necessary relative portions with respect to the rings of staggered tubes.

FIG. 13 illustrates one tube 10, the function of which was explained in reference to FIGS. 3, 4 and 5. The said tube described herein has a shape which is symmetric about the cross section taken half-way along its length. The use of a tube 10, of this nature has the advantage that it can be retained by pin 29, engaging in the groove 13 of tube 10, so as to present either end as the tube root or tip. When said tube has been in use having been rotated an appropriate number of times, such that no fresh inner faces are available for use, the greatest wear may be apparent at the tip, with negligible wear occurring at the tube root. The tube 10, being symmetric as described may now be mounted so as to present the comparatively unworn tube root 17, as the tip and its former worn tip 17, as the root. Said tube 10, may now be used further until rendered unusable by extensive wear.

FIG. 14 illustrates a means by which the tube 10, may be clamped in position and readily rotated. Tube 10, consists of an octagonal prism, within which is bored a circular hole along its principal axis. On each flat external face of tube 10, are situated small locators 25. The tubes 10, are clamped by means of the clamp screw 20, which screws into the tube holder 21, engaging in the locators 25, and thereby locking tube 10, into position.

It is a simple matter to release the locking screw 20, remove tube 10, and rotate it by one eighth of a turn and replace the tube in the tube holder 31, the clamp screw 20, then engaging in a different locator 25a. This particular means of locating tube 10, has the advantage that the tube 10, wall has an added thickness for additional wear to take place.

FIG. 15 illustrates a further means by which tube 10, may be clamped in position and readily rotated. In this form of construction tube 10, has lugs 22, protruding at its tip 17, through which a hole is bored with its axis at right angles to that of tube 10. The tube holder 21, has locating lugs 23, so positioned that lugs 22, fit between them. Holes are bored in locating lugs 23, of the same size and on the same axis. When the tube 10, is inserted in the tube holder 21, the axis of the hole in lugs 22, is coincident to that of the holes in locating lugs 23. By the insertion of spring clip 24, the tube 10, is locked in the tube holder 21. The tube 10, has a plurality of lugs 22, located around its circumference. It is a simple matter to release the tube 10, from the tube holder 21, by removing the spring clip 24. Tube 10, may then be rotated so that different lugs 22, engage the locating lugs 23.

Referring to FIG. 16, this illustrates yet a further means by which the tube 10, may be clamped in position and readily rotated. The figure shows tube 10, mounted in a tube holder 21, which may be of any shape suitably enclosing tube 10. Tube holder 21, is attached to the backplate 1. The tube has a flange which locates on the collar 14, near its root end 16. The tube is located in position by means of a suitably shaped spring clamp 26, one end of which locates on the tube

holder 21, and the other end of which locates on the tube tip 17, in a recess 27. The spring face of the clamp 26, forces the flange of tube 10, against the collar 14, thus locking the tube in position. The tube 10, may readily be removed or rotated by removing clamp 26. This system has the advantage of simplicity, and that there are no accurately mating parts required. There are, of course, many alternate means by which tubes 10, can be clamped and readily rotated without modifying the nature of the invention. Those described are by way of illustration only.

From the foregoing descriptions it will be seen that as a further modification it would be a simple matter to incorporate a row of dimples around the outside diameter of the tubes 10, approximately mid-way along their length; and by arranging a spring loaded pawl to pass through the backplate 1, or front plate 7, in line with the ring of dimples, the tube can be held against any tendency to twist during rotation of the wheel assembly. The advantage of such an arrangement is that the spacing between the dimples can be such that the maximum number of new wearing faces of the tube are exposed before the tube becomes completely unusable.

As a further refinement the ends of the tubes can be toothed or similarly modified such that the operation of a toothed ring around the outside of the wheel assembly will cause all tubes to turn to a similar degree by one adjustment. Other known means can be readily adapted to provide a single control for the rotation of the tubes in order to expose new wearing areas.

Finally, without departing from the scope of the invention, means whereby the tubes are generally rotated during the operation of the wheel assembly would ensure that a gradual erosion of the tube wall takes place so that the maximum life is obtained before the tubes may be replaced.

We claim:

1. An impeller wheel for particulate material comprising a back plate and a front plate secured parallel to and spaced away from the back plate, a driving shaft attached at right angles to the back plate for rotating the front plate and the back plate together around the axis of the driving shaft, an axial aperture in the front plate for the entrance of particulate material into the space between the front plate and the back plate, a rotor positioned axially between the front plate and the back plate and driven by said driving shaft and opposite said aperture for receiving the particulate material entering into said aperture in the front plate, radially disposed vanes in said rotor which induce radial motion of the particulate material under centrifugal action, a manually adjustable cylindrical control sleeve around the rotor and having a feed orifice in the outer periphery thereof to control the radial direction in which the particulate material is permitted to emerge as a stream from the rotor, and a plurality of equally spaced radially disposed tubes between the front plate and the back plate and adjustably fastened thereto with their inner ends positioned close to the cylindrical control sleeve, the particulate material entering each tube in turn as it passes the feed orifice of the control sleeve and following a narrow path along each tube in turn to the other end of each tube, each tube being rotatable about its longitudinal axis to bring different parts thereof into line with the stream of particulate material as the tube is subjected to wear.

2. An impeller wheel as claimed in claim 1 in which the cross-sectional shape of the radial vanes in said rotor correspond in part to the inner surface of the tubes.

3. An impeller wheel as claimed in claim 2 in which the blades of the distributing rotor are of the same cross-sectional shape on both sides so that distribution of the particulate material is similar for either direction of rotation of the impeller wheel.

4. An impeller wheel as claimed in claim 1 in which the control sleeve is normally stationary, but is angularly adjustable about the axis of the driving shaft to vary the direction in which the particulate material is directed by the tubes.

5. An impeller wheel as claimed in claim 1 in which the cross-sectional shape of the radial vanes in said rotor corresponds to the inner surface of the tubes when the tubes rotate in either direction.

6. An impeller wheel as claimed in claim 1 in which the cross-sectional area of each tube varies along the length of the tube.

7. An impeller wheel as claimed in claim 6 in which the cross-sectional area of each tube increases progressively from the tip to the root of the tube.

8. An impeller wheel as claimed in claim 1 in which

the tubes are arranged in pairs at equally spaced intervals around the wheel, while the orifice of the control sleeve is formed to provide two outlets for abrasive, one for each tube of the pair.

9. An impeller wheel as claimed in claim 1 in which each tube is symmetrical about the cross-section taken half way along its length.

10. An impeller wheel as claimed in claim 1 in which fastening means are provided for securely locating each tube in each of a plurality of rotational positions to bring the different parts of the inner surface into different abrasive contacting positions.

11. An impeller wheel as claimed in claim 10 in which the means for locating each tube in each of a plurality of rotational positions are circumferential grooves in said tubes and retaining pins mounted in said back and front plate to engage said grooves.

12. An impeller wheel as claimed in claim 1 in which fastening means are provided for securely locating each tube in each of a plurality of rotational positions said means comprising a spring clip engaging the tip of a tube, and a seat formed in said wheel adjacent the root of each tube against which the tube is axially pressed by said spring clip.

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