

Sept. 18, 1951

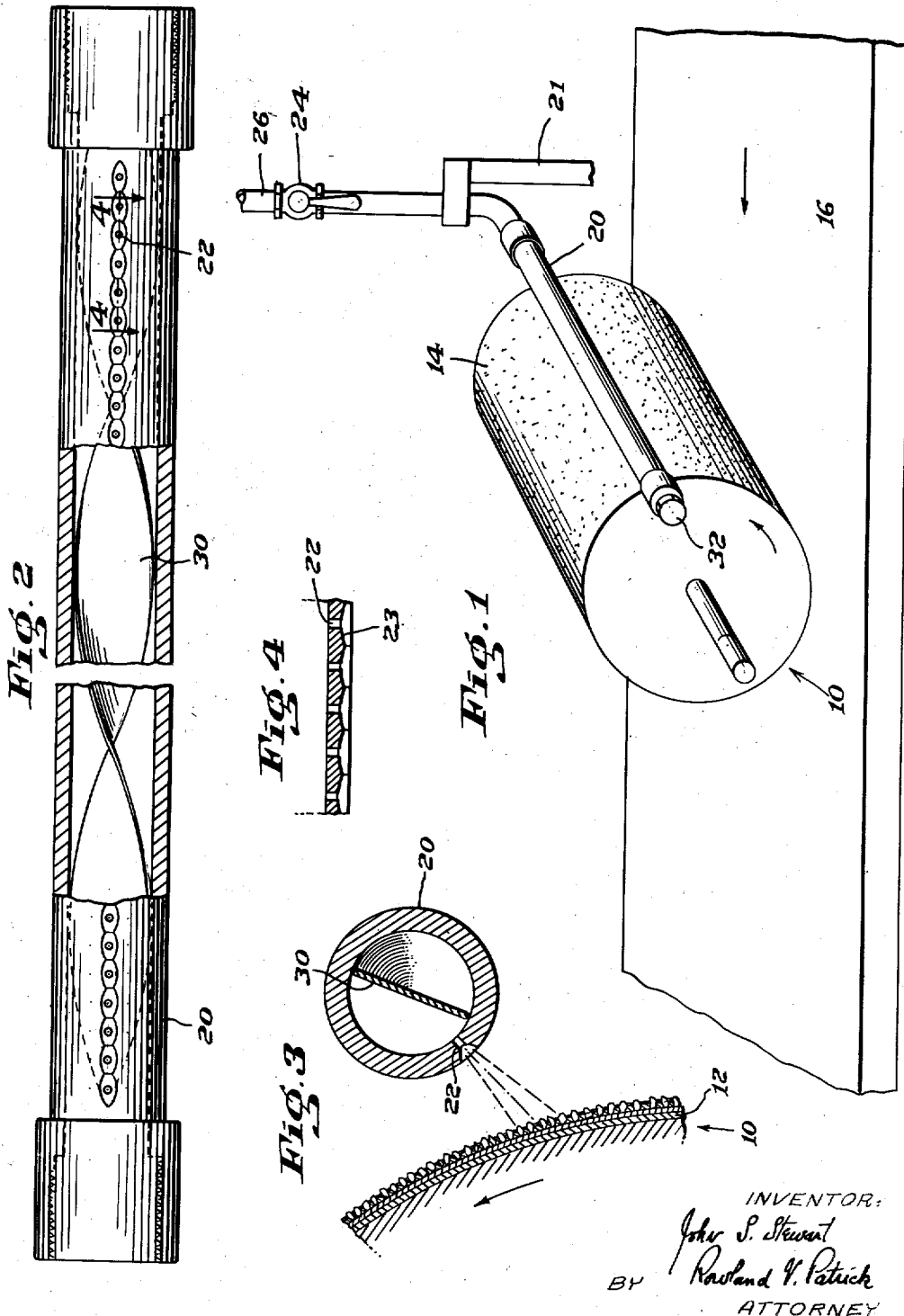
J. S. STEWART

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ABRADING OPERATIONS AND APPARATUS USEFUL THEREIN

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2 Sheets-Sheet 1



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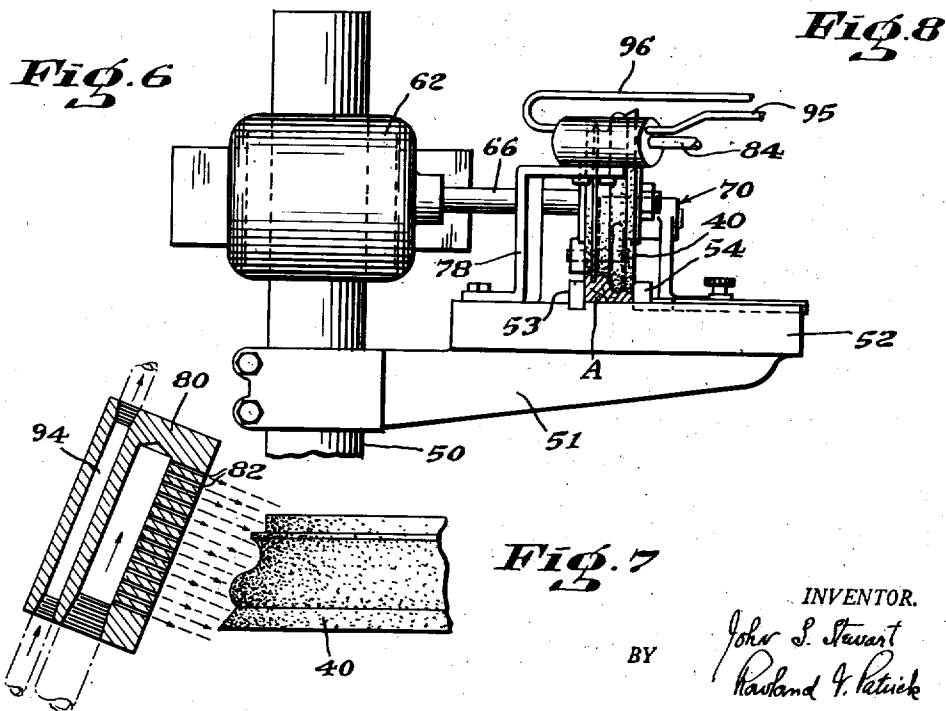
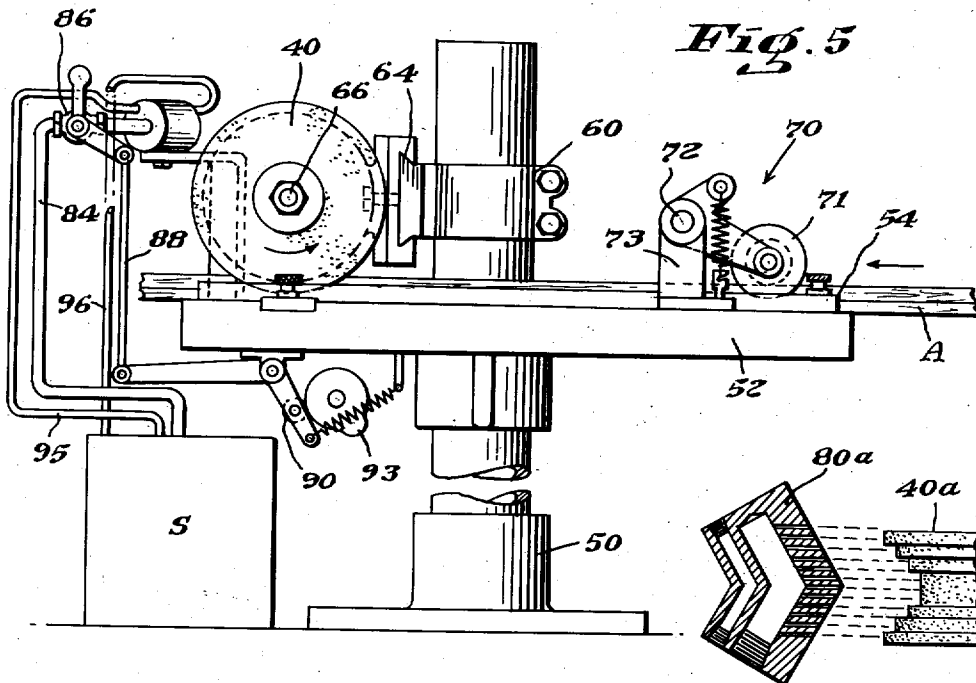
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2 Sheets-Sheet 2



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ABRADING OPERATION AND APPARATUS
USEFUL THEREIN

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This invention relates to abrading and more specifically to methods for improving the quality of work, efficiency of cutting and specifically the useful life of abrasive materials used in power driven machines. One use for the invention is in connection with so-called "sanders" commonly used in wood finishing plants wherein the abrasive surfaced materials are flexible "sandpaper," but, as hereafter described, and for the reasons given, the invention also permits the use of solid inflexible abrasive material, i. e., wheels, in finishing operations where they were heretofore entirely uneconomical due to the high cost of the wheels as compared with the amount of finishing that they could perform before replacement.

In the wood finishing industry, tons of flexible "sandpaper" are now used annually in the finishing of flat wood structures, for example, doors, door frames, window frame and sashes, on power operated machines, wherein the sandpaper is clamped about a drum or series of drums and a composite generally flat wood structure is tabled beneath or across the drums which rotate at high speed, for example, anywhere from 4,000 to 10,000 surface feet per minute.

"Sandpaper" has always had a limited life. Present day operation of a plant finishing flat wood structures is a constant compromise between running the abrasive material for as long a period as possible to minimize the number of shutdowns required for replacement, but not beyond the period wherein it performs respectable finishing without burning of the wood.

Today the quality of backings, bonds and grits in first class abrasive sheet material is such that, for example, in a drum type sander, the primary cause of sandpaper discard is not disintegration, but "loading," i. e., its grit surface becomes so filled with abraded dust and rosin that the abrading surface becomes smooth, with the cutting edges buried. Cutting decreases and even ceases; friction increases and, in the case of operation on wood, surface burns appear. In finishing softwoods such as ponderosa pine and southern pine, loading is very rapid and particularly troublesome because of the high rosin content of these softwoods. In these operations on modern machines having six drums a typical shutdown for replacement of the abrasive material may last fifty minutes and consume at least three man-hours of labor in completing the replacement. An average of present day replacement practice may be between one and two a day.

Such production interruptions caused by constant replacement have been so costly to the in-

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dustry that attempts have been made to renew the cutting surfaces. Organic liquids of the nature of carbon tetrachloride have been tried, but such organic liquids are expensive, the operation is a hand-scour with the machine stopped and, because of the inaccessibility of the surfaces, it is a tedious dirty job. In the end it requires almost as much time and production interruption as replacement and its proposed use has not proved sufficiently successful or economical as to have met with more than isolated instances of adoption.

According to this invention, certain types of abrasive material operating on machines of the above type may be maintained in continuous top flight cutting condition by periodic, practically instantaneous removal of accumulated fill while the machine is being driven. The cleaning operation may be performed even while the machine is cutting, though preferably it is done between work feeds, the time of the operation being so short that it does not affect production schedules.

The cleaning material used is inexpensive and available in every plant; the apparatus is simple and readily installed as an attachment on conventional equipment.

Use of these attachments insures more uniform, better quality finish, obviates burning of the work from loss of cutting surface and so prolongs the effective life of the abrading material that the operation interval between replacement shutdowns is increased in the case of an ordinary drum type sander by a time factor which may run as high as ten, or even more with some grits and on some work and making the effective life of the material more nearly a function of its integrity and no longer a function of its "loading" time.

Where the finishing plant is concerned with the manufacture of other than flat wood structures, for example, mouldings which have complicated surface contours, the use of drum sanders is impossible. Accordingly, when moulding is polished at the plant, it is done as a separate operation on a so-called slash roll sander of the type manufactured by Vonnegut or on pneumatic drum sanders, both of which utilize flexible sandpaper. Because of the expense and slowness of polishing operations on such machines, it has become the practice for trim manufacturers to omit the sanding of interior trim having multiple contour surfaces. Unsanded trim is apt, however, to show a ripple from the knife-head action.

Practice of this invention permits the use of solid inflexible abrasive surfaced finishing wheels which are dressed to the contour of the moulding or other trim, whereby the manufacture is now, for the first time, enabled, with the same feed, to cut and polish in tandem to produce a satisfactorily polished moulding without expensive adjuncts to conventional moulding machines, and to double the work feed and produce a better finish than that produced in the absence of the grinding wheel at half the work feed speed.

The use of such a grinding wheel on a wood moulder would, however, be wholly impracticable in the absence of the cleaning attachment of my invention, because the grinding wheel would otherwise fill so rapidly and require replacement so often that the grinding wheel operation would be economically unsound.

Objects of the invention thus include a substantial reduction in the cost of wood finishing operations by prolongation of the effective cutting life of abrasive materials thereby reducing both the number of necessary replacements over a given period of operation and the ratio of abrading material cost to work finished; to provide improved quality of finishing by reason of maintenance of more uniform cutting surfaces throughout the useful life of the material; and to secure higher production rates by reason of faster feed permitted by maintenance of better cutting power and less friction throughout the useful life of the material. Coincidentally, the invention has for a further object, the provision of suitable apparatus for performing the method of the invention in conventional or other wood finishing machines.

For example, in one plant the rate of the work table feed in a drum type sander has been increased from 18 to 25 feet per minute or by 36%. In another plant, where abrading material replacements on a check rail sander were averaging two a day, the apparatus was operated with the same abrading material over a period of three weeks on a 45-hour week without replacement and with excellent quality of work throughout the entire period. By reducing friction, the load factor on the electric motors has been reduced by as much as 60%.

Such important increase in production, astoundingly increased periods of effectively useful life and saving in power consumption are accomplished in accordance with this invention by the provision in the apparatus of means for periodically restoring the original cutting characteristics (wear excepted) of the surface of the abrasive material by displacing in a new and novel manner the abraded wood dust which loads in the material.

I have found that the fill of wood dust and rosin can be successfully displaced from certain types of abrasive material, for example, sandpaper on a drum type wood finishing machine or an abrasive wheel associated with a moulder, by applying to the material, while it is being driven, a controlled quantity of moisture in vapor form at elevated temperature accompanied with or followed by a forcible vaporous or gaseous impact.

The function of the moisture according to my theory of the operation is to swell and loosen the absorbent fill while the forceful impact displaces it. The vapor form is instrumental in securing rapid absorption of the moisture, but more important, insures its distribution in such manner as to prevent liquid accumulations.

Presence of liquid cannot be tolerated. In the case of flexible sandpaper, wetting of the blanket which underlies the abrasive material will cause it to stretch and loosen. Also, the conventional manner of attaching blankets to drum type sanders is by glue; any excessive moisture will loosen the anchorage of the blanket and soon cause surface wrinkles, ripping of the abrasive cover and blanket and finally shutdown. And, in the case of both flexible and solid abrasive finishing machines, the construction of the machines is incompatible with the presence of water which will rust and deteriorate the machines, as well as adversely affect the kiln-dried work.

It should be understood that in order to withstand even the amount of moisture contemplated by the method of this invention, the abrasive material must be of the type which has a moisture-resistant surface. Such is generally the case with solid molded wheels. In the case of flexible material, the moisture-resistance may be provided by a sizing coat of any suitable waterproofing material of the synthetic resin type, in which case the making coat can withstand the cleaning operation even though it consists of conventional animal glue. The base sheet, however, in drum-covered sanders should not be subject to stretching when moistened and accordingly I have found that the most desirable combination is a sheet material having a non-stretching vulcanized fibre backing, an animal glue making coat and a urea-formaldehyde resin size coat.

Results such as those heretofore described have been obtained in commercial operations by the use of apparatus as shown in the accompanying drawings wherein:

Fig. 1 is a diagrammatic representation of one drum of a multiple drum type conventional wood finishing sander, having an attachment of this invention;

Fig. 2 is an elevation broken into a cross-sectional view centrally and broken away to show extent of one part of the attachment shown in Fig. 1;

Fig. 3 is an enlarged cross-sectional view of a detail of the apparatus shown in Fig. 1;

Fig. 4 is an enlarged cross-sectional view taken along line of 4-4 of Fig. 1;

Fig. 5 is a side view of a modified form of apparatus adapted for use in polishing mouldings in tandem with and after their formation on a conventional moulding machine;

Fig. 6 is a rear elevational view of the apparatus shown in Fig. 5, with parts broken away;

Fig. 7 is an enlarged detail of certain of the parts shown in Figs. 5 and 6; and

Fig. 8 is a detail of a modified form of construction of the parts of the apparatus shown in Fig. 7.

Fig. 1 shows diagrammatically a conventional drum 10 of a drum type sander, for example, of 36" in circumference, over which is glued a blanket 12 which may be either of wool felt, canvas or other suitable cushioning material and over which is clamped a sheet 14 of the above described vulcanized fibre garnet-grit sheet material. These sanders are commercially well-known, being products of Yates-American Machine Company, Salem Machine Company and H. B. Smith Company.

A machine of this type is ordinarily operated at about 1800 R. P. M. to produce a surface speed of 5400 surface feet per minute. In addition the drums are oscillated through a path of $\frac{1}{8}$ " or more. The feed table is indicated diagrammati-

cally at 16, feeding work in the direction of the arrow.

The attachment of this invention comprises, in the form shown, a $\frac{3}{4}$ " pipe 20, supported by a suitable bracket 21 transversely of the drum and spaced therefrom a distance of about $\frac{1}{2}$ ", and provided with an axially extending line of minute perforations 22, spaced on $\frac{1}{4}$ " centers and being about .050" in diameter and cut away in flared curvature at their outlets as shown at 23. The pipe 20 is adapted for connection to a source of steam supply 26 through a quick opening hand valve 24. As shown, the series of apertures is adapted to direct the steam in the form of a long, thin jet at an angle of about 110° to the tangent of the drum at the point of impact, being downwardly directed against the direction of movement of the drum surface, indicated by the arrow.

In order to revaporize condensate accumulating in the pipe 20, it may be provided internally with a spiral baffle 30. Turbulence in the steam stream caused by the baffle will prevent liquid accumulation and prevent dripping. While the pipe 20 is shown in Figs. 1 and 2 as being provided with threaded taps at both ends, it will be understood that the steam supply may, as shown in Fig. 1, be connected at only one end of the pipe 20 and the other end plugged as shown in Fig. 1 by plug 32.

A typical operation involves the use of a source of steam at 100 lbs./sq. in. pressure and the time of impact is controlled with respect to the R. P. M. of the drum to subject each surface point to at least ten and not more than fifteen impacts per each cleaning operation. In the case thus of a drum of 36" circumference operating at 1800 R. P. M. a jet of one-half second duration and an impact width of about $\frac{1}{8}$ " will operate 15 times on each $\frac{1}{8}$ " width of the surface. A steam blast of such form from such a pressure source will restore the abrasive material to substantially its original cutting condition. The operation can be repeated whenever the loading justifies. Care should be taken not to apply continuously the steam to the extent that condensation will form liquid pools on the machine.

Because of losses in jet pipe 20 and elsewhere, the source pressure must be chosen to compensate for the losses in a specific installation, depending upon the length of pipe 20 and the capacity of the steam source to supply sufficient volume to the jet pipe when open. In general, the source pressure should be such as to maintain a pressure of something above 10 lbs./sq. in. and preferably 20-50 lbs./sq. in., at the plug opening 32, or other location of minimum releasing pressure, with the jets open. The lower limit will vary somewhat depending upon the spacing of pipe 20 from the surface, though close spacing is to be preferred to more distant spacing and greater pressure at the point of release. In some installations, the source pressure has run as high as 250 lbs./sq. in., the maximum limit being dependent only upon safety and costs of installation.

In so far as the pressure is less than 10 lbs. at the plug end 32 the duration is desirably prolonged, the rate of moisture application lessening with decrease in pressure and velocity and hence requiring longer duration. In any event, it has been found that if the steam pressure at the plug end 32 is below 10 lbs./sq. in., the moisture application must be supplemented by a subsequent more forceful impact operation such as can be supplied from a source of compressed air which

will produce a minimum pressure in the jet pipe of about 20 lbs./sq. in.

Where compressed air is necessary because of inadequate steam pressure, a source of compressed air can be connected to the pipe 20 at the plugged end 32.

The attachment and the method of the invention are equally adapted for application to other types of sanders. The representation of Fig. 1 is therefore intended to include a type of machine wherein the drum 10 comprises one pulley of a belt type sander. However, because in belt type sanders, oscillation is not present, closer spacing of the apertures 22 is desirable to insure the necessary uniformity of velocity and moisture application over the entire surface to effect proper cleaning. In the case of belt type sanders, because of the adjustability of the tension on the belt, it is not so essential that the base sheet of the abrading material be non-stretchable when moistened, as the slack can be taken up by the adjustment of the pulleys.

In Fig. 5 there is shown an apparatus on which is mounted a solid abrasive wheel 40 for polishing a moulding as it emerges from a conventional wood trim moulding machine. For this purpose, a frame 50 in the form of a vertical post is provided having slidably mounted thereon for vertical adjustment thereof a worktable 52 carried by an arm 51. This table 52 is provided on its top surface with guides 53 and 54, one of which, as 54, may be adjustable, as shown, laterally of the table 52 to vary the width of the space between the guides. Depending upon the type of trim being produced, the table 52 and guide 54 may thus be adjusted to proper height and to proper guideway width to permit the apparatus to receive and operate upon moulding as it emerges from the moulding machine, the work being fed through the present apparatus by the same work-feed which carries it through the moulding machine.

Also mounted on the post 50 is a second bracket 60 adapted for adjustable vertical movement relative to the post and carrying a motor 62 which is additionally adjustable horizontally by reason of the dovetail guides 64.

The abrasive wheel 40 is carried on the spindle 66 of the motor 62, and with the vertical and horizontal adjustability of the position of the motor, the wheel 40 may be positioned relative to the table 52 in such manner as to perform its polishing operation on mouldings fed across the table 52.

As shown in Fig. 7, the peripheral surface of the wheel 40 is dressed to the contour of the surface of the moulding. The work A shown has a typical trim contour.

Thus, with the wheel 40 in proper position relative to the table 52, dependent upon the thickness of the work A, and with the abrasive wheel operating in a counter-clockwise direction as viewed in Fig. 5 at 3600 R. P. M., a piece of work A is quickly polished and knife ripples are readily removed by feeding it beneath and past the wheel 40.

At 70 is a hold-down device which comprises a wheel 71 pivotally mounted at 72 on a bracket 73 extending upwardly from the table 52. Any kind of hold-down device may be utilized instead of that shown and in most instances a simple hardwood hold-down will suffice.

Any device as thus far described would alone be wholly uneconomical if used in polishing wood trim because the abrasive wheel 40 would become

loaded with wood fill in a very short time, cutting would cease and the mouldings would burn. The wheel would have to be replaced very often and the cost of the wheels is relatively so great that the apparatus so far is entirely impractical.

However, this impracticability is overcome by the addition of a cleaning attachment as diagrammatically shown in Fig. 5 applying the principle previously described in connection with the apparatus of Figs 1 to 4. Thus, there is mounted on a bracket 13 adjacent the wheel 40 a pipe 80 having a series of aligned apertures 82 similar to the jets 22 of the apertured pipe 20 of Figs. 1 to 5. However, because of the dressed contour of the peripheral surface of the wheel 40, the pipe is positioned at an angle to the axis of the wheel, as shown in Fig. 7, so that all points on the surface of the wheel will be more nearly equidistant from the points of steam release from apertures 82.

Also shown in Fig. 5 is a steam feed-line 84 connected to a source S of steam, the line 84 having interposed therein a quick-opening valve 86 similar to the valve 24 of the apparatus of Fig. 1.

While, as in the case of the valve of Fig. 1, the valve 86 may be hand operated at suitable intervals to clean the wheel, the cleaning operation may be made automatic by linking the valve 86 through suitable linkage 88 to a cam follower 90 cooperating with a cam 93 which is driven in timed relation to the work feed, so that the cam 93 will operate the valve 86 after so many feet of work feed. The drawing being diagrammatic, no attempt is made to illustrate accurately the cam lobe contour, it being understood that the valve is open for only a fraction of a second in one revolution of cam 93, which may revolve at a rate of only one revolution every 5 to 10 minutes or slower; or, translated into rate of feed, approximately one revolution per every 1200 feet of work depending upon the speed of work feed.

Fig. 5 shows a further refinement in that the apertured pipe 80 is provided with a second bore 94 which is in continuous connection with the steam source S through infeed and outfeed pipes 95 and 96, respectively. In this manner the pipe 80 is heated, for example, to about 220° F. by the ever-present steam in bore 94 and as a consequence there is less likelihood that steam will condense on cold walls of the pipe 80 upon opening of the valve 86. It will be understood that other means for heating the pipe 80, or the pipe 20 in Fig. 1, may be adopted, for example, an electric heating element, though the necessary presence of the steam source S renders the expedient shown in Fig. 5 particularly appropriate, and applicable equally to the device of Fig. 1.

It will be understood that for each contour of moulding a different abrasive wheel 40 dressed to the particular moulding contour must be used. In cases where the general contour of the wheel forms a re-entrant angle in transverse cross-section, a pipe having the contour of that shown in Fig. 8 is desirable in order that the distance that the steam travels from its point of release from the pipe 80a is again substantially uniform across the whole surface of the wheel 40a. This conformance of the jet pipe to the general contour of the wheel is found to be advantageous in securing satisfactory quick cleaning, indicating that the temperature and/or the velocity of the steam are of controlling significance.

In so far as steam pressure and jet distances are concerned for the apparatus of Fig. 5 they are substantially those previously recommended for use in the flexible sheet type of sanding machine.

There has thus been provided both for flexible and solid abrasive material finishers an effective fill-removing attachment and method which, for reasons hereinbefore given, permits significant advances by way of improved and more quickly produced work and tremendous savings in replacement labor costs, as well as in material cost in ratio to the amount of work done.

While reference has been made to wood operations for the purpose of specific description, the invention is, of course, applicable to abrading operations on any type of material which causes troublesome loading with moisture absorbent fill.

I claim:

1. In combination with an abrading machine of the type adapted to continuously drive an abrasive surface through an endless closed path, that improvement for prolonging the cutting power of the surface so driven which includes a source of water vapor in the form of steam, a conduit for leading said steam to said machine, an apertured pipe connected to said conduit and extending across and closely adjacent to said endless path of movement for forcibly directing steam onto the abrading surface as it is driven and a longitudinally extending spiral baffle contained internally of said pipe to create turbulence and revaporization in a steam stream passing through said pipe to said apertures.

2. The method of prolonging the effective cutting life of abrasive grit materials set up for movement in an endless path in power driven apparatus for abrasive finishing, comprising subjecting the abrasive grit surface of such material, after it has picked up abraded dust, to moisture in vapor form by the impact of a long, thin vapor jet and immediately followed by the impact of a long, thin air jet.

3. The combination of an abrading machine comprising an abrasive surfaced material mounted for movement through an endless closed path, means to support said abrasive material, means for driving said support, guide means for directing material to be abraded adjacent said path, a conduit connected to a source of water vapor in the form of steam, a pipe extending across and closely adjacent said abrasive material having a plurality of axially aligned relatively small closely spaced apertures therein which extend longitudinally thereof for forcibly directing a plurality of jets of steam onto the abrading surface of said material as it is driven in the machine a valve in said conduit adapted to supply steam under pressure momentarily to said pipe for releasing steam through said pipe onto the abrading surface in momentary jets to limit the quantity of steam directed to the material to prevent liquid pools forming thereon by condensation, and means for actuating said valve.

4. An abrading machine as claimed in claim 2 having means adjacent said pipe for heating the same when said valve is closed to prevent the steam from condensing therein.

5. An abrading machine as claimed in claim 2 wherein said pipe has a separate bore and connections for continuous steam heating thereof.

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