The present invention relates to machines for making abrasive disks of the type adapted to be utilized on abrasive machines of the type exemplified in the prior patent of F. O. Albertson, No. 2,123,222, issued July 12, 1938, and on supporting disks of the type illustrated in Patent No. 2,132,917 of F. O. Albertson, issued October 11, 1938.

Such abrasive machines have come to be used not only for the preparation of surfaces to be painted, or sanding down soldered fillings in the repair of automobile bodies, but also for various types of abrasive work where grinding wheels or stones had been previously used.

The cement-bound or glue-bound sanding disks of the prior art are subject to the disadvantages that they are not able to withstand the temperatures which are generated when such sanding disks are applied to very hard grinding operations. Neither will they withstand the action of water or other liquids, and consequently they were not adapted to types of service where water or other liquids might be encountered.

When a glue-bound or cement-bound abrasive disk of the prior art is used for grinding steel or other hard metals, such as may occur in uses to which sanding machines are now put, the heat generated causes a melting or blooming of the binder at a point of intense application of the disk to the work, and this raises a gummy surface on the disk, which prevents it from cutting. The gummy surface immediately causes a sticky stubbing effect, which tends to cause the disk to bounce and vibrate irregularly during its rotation, and diminishes the cutting action of other undamaged parts of the disk.

With these devices of the prior art the inevitable result is that in order to get cutting action the operator presses still harder on the grinding machine, with the result that more gummy surfaces are produced on the sanding disc and in a very short time the sanding disk is completely gummed up at the point of its application and incapable of producing the abrasive action desired.

One of the worst effects of this type of action is the effect of such handling on a grinding machine. In effect, the operator is endeavoring to cut with a poor or dull tool, e.g., the ineffective or inefficient grinding disc of the prior art, and because of the dullness of his cutting or grinding tool, terrific overloads are placed upon the grinding machine, so that the grinding machine breaks down, and it is practically impossible to construct, at a reasonable cost, a grinding machine which will withstand the abuse which it secures when using the ineffective and inefficient sanding disks of the prior art.

The object of the invention is the provision of an improved machine adapted to be used in the manufacture of sanding disks of the type described and capable of turning out sanding disks at a much faster rate than any of the devices of the prior art, in a greatly reduced operating space.

Other objects and advantages of the invention will be apparent from the following description and the accompanying references, in which similar characters of reference indicate similar parts, throughout the several views.

Referring to the drawings, of which there are two sheets:

Fig. 1 is a diagrammatic illustration of a machine assembly which may be utilized for the carrying out of the method of manufacturing abrasive disks constructed according to the invention;

Fig. 2 is a plan view of one of the supporting plates for abrasive disks utilized in the machine of Fig. 1;

Fig. 3 is a side elevational view of the plate of Fig. 2 in partial section;

Fig. 4 is a fragmentary side elevational view of one of the pressure plates utilized in the press which is shown at the right of the machine diagram of Fig. 1;

Fig. 5 is a bottom plan view of the press plate of Fig. 4;

Fig. 6 is a plan view of an abrasive disk; and Fig. 7 is an enlarged fragmentary sectional view illustrating the structure of an abrasive disk constructed according to the invention.

As an understanding of the type of abrasive disk is necessary to an understanding of the machine, the abrasive disks which the machine is adapted to make are first described in detail.

Referring to Figs. 6 and 7, the abrasive disks to which the Invention relates comprises circular members 10, preferably provided with non-circular aperture 11, located at the center thereof for receiving the securing threaded member, which is of complementary shape, and which secures the disk to a supporting pad, as shown in the patent above-mentioned.

The disks are made in various standard sizes, such as five inch, seven inch, nine inch, etc., and may be made in any size desired.

One of the preferred modes of use of such disks is to utilize the larger size and, as the outer edge thereof becomes worn away by use, it is trimmed off to the next smaller size and applied to a
smaller supporting pad or a supporting pad with smaller backing disks, as shown in the above-mentioned patent.

The abrasive disks preferably comprise a reinforcing layer 12, such as one or more layers of strong cotton to hold the cloth. I desire it to be understood that the various animal, vegetable, and mineral fibers may be utilized in cloth for reinforcing my abrasive disks; but the above-mentioned fabric is preferred on account of its strength and economical cost.

The fabric should be such as to give a maximum strength and temperature and water resistant characteristics at a minimum cost.

The fabric reinforcement 12 is preferably first impregnated with a resinous impregnating compound, such as a phenolic condensation compound of suitable consistency, so that it can be forced through the fabric by pressure rolls and caused to appear on both sides of the supporting fabric and impregnating all of the fibers of the fabric of the composite.

This produces a relatively tough flexible disk, upon both sides of which the canvas or cotton threads are still visible as such, and in some embodiments of the invention such resin-impregnated disks may be used for the support of the abrasive without further finishing costs.

I prefer, however, to provide the back of the supporting disk with a smooth and bright calendared surface, and therefore prefer to apply an additional coat 13 of the impregnating resinous compound, which is preferably of the same composition, but of a thicker consistency, to the back or under side of Fig. 7.

This layer is subjected to pressure, and the calendaring action of heated rollers, which gives it a smooth, shiny surface that is capable of withstanding high temperatures and the action of water and other liquids, without any possibility of attacking the cotton reinforcing fibers. The smooth, shiny back also presents a better appearance, and increases the salability of the disks and the disks are more easily kept clean than when provided with the rough canvas surface on the back side.

The front side of the supporting disk or abrasive is then coated with a layer of the same resinous impregnating compound, which is preferably of a suitable consistency, so that it will receive and retain the abrasive particles. The resinous layer is indicated by the numeral 14, and the abrasive particles by the numeral 15.

The binder used is preferably of the same phenolic condensation compound, previously used for the other two layers, but of different consistency, so that the complete abrasive disk will be constructed of the phenolic condensation compound in all its parts.

While the resinous layer 14 is in an adhesive or tacky condition, the abrasive particles 15 are distributed over the surface of the resin in a uniform layer, an excess of abrasive being provided so that all parts of the resin will be covered with abrasive. Some of the abrasive sinks down into the resinous layer and other abrasive particles lie with a major portion of their surface exposed at the top side of the disk at this time.

The abrasives which are used may be of any standard type, and are usually furnished in slivers, angles, or squares. I prefer the square formation, but may utilize other formations also.

The abrasive disk is preferably formed in its finished condition with a plurality of grooves 16 and ridges 17. The ridges 17 are preferably wider than the grooves 16 in order to increase the amount of working surface in the plane of the ridges 17. However, the reverse may also be true in some embodiments of the invention, the ridges and grooves being of suitable width for the disks, or equal in width to the grooves, and in some embodiments the abrasive disks may be provided with a multiplicity of relatively narrow ridges spaced by narrow grooves.

The abrasive disk is provided with a final coat of the same resinous compound, which may be indicated by the numeral 18. This coat is preferably made with resin of thinner consistency, and should be relatively tough, but capable of being worn away quickly at the sharp edges of the abrasive particles on the working surface. Thus, the final coat of resin will eventually coat only the external parts of the abrasive, which are inward of the cutting edges so as to anchor the abrasives firmly to the resinous base.

The resins employed in the manufacture of my abrasive disks are preferably of the phenolic condensation type, and are provided with a suitable accelerator so that they will be hardened quickly enough to facilitate the manufacture of the abrasive disks in a minimum length of time. Such resins may be affected by water, and its binder is unaffected by the temperatures to which it may be subjected.

It may be utilized for grinding steel for extended periods of time without the binder causing any gumming or without any apparent effect upon the abrasive surface. It cuts so easily that it is scarcely necessary to place any pressure upon the abrasive disk other than the ordinary weight of the machine or supporting pad and its driving assembly, and therefore no overloads are placed upon the driving motor and other equipment.

The machine which forms the subject of the present patent is adapted to utilize backing disks comprising a fabric which has been impregnated with a resinous binding compound and hardened by means of heat and pressure. The first action of the machine on these disks may consist of the application of a suitable thin uniform layer of the same phenolic condensation compound of suitable consistency, to the front side of the disk. This may be done by the use of a pair of rollers, one of which dips in the binding compound and carries it between the rollers to coat the second roller. The two rollers may be provided with a micrometer adjustment for their spacing, by moving the bearings of one or both of the rollers, so that this layer may be of pre-determined uniform thickness and accurately gauged to a very small fraction of an inch.

The second roller is then used for application to the front side of the disk, which is held upon a suitable support, and due to the accurate thickness of the layer of binder on the second roller, adhesive is applied only to the disk, and not to the support, even though it may be disposed beneath the disk at the edge or center. The thickness of the binding layer is not such that it will reach to the support. Thus the disks may be cleanly coated with the layer of phenolic condensation compound for the reception of the abrasive particles.

During the application of the resinous binding compound to the surface of the impregnated fabric disk, the disk preferably has its face in horizontal or nearly horizontal position, so that
there will be no running of the layer of binding compound on the disk. The disk is also preferably supported with its face in horizontal position, while the abrasive particles and other coatings are applied to it and until the resinous compounds used are so hardened as to prevent any running. The abrasive particles may next be applied to the disk 16 by supporting the disk with its sticky or tacky side upward, and sprinkling a supply of abrasive particles on top of it, the excess falling through into a container for receiving excess abrasive particles. The abrasive particles are preferably supplied at this time in the form of a uniform sheet, issuing from a container, and the abrasive receiving disk is preferably passed through said sheet at a uniform rate.

The container for abrasive particles may be located at a suitable elevation so that by the acceleration of gravity they achieve a predetermined velocity at the moment of impact with the binding compound of the supporting disk to effect an embedment and firm securing of the abrasive particles in the binding compound.

Furthermore, abrasive particles may be applied by means of a nozzle and a stream of compressed air, into which the abrasive particles have been fed, so that they are driven against the binder at a predetermined velocity, which will insure their firm securing and embedding in the binder.

The disks are next preferably subjected to a vibrating or jarring action, while they are held in horizontal position, for the purpose of embedding the abrasive particles firmly into the resinous binding compound on the face of the disk, and for the purpose of shaking off such excess as may be loosely supported on top of the abrasive disk.

During this time the hardening of the resinous compound is taking place, and this is accelerated by a suitable hardening accelerator. The abrasive disks may next be subjected to an edge impact for the purpose of shaking off all the loose abrasive particles. This may be done by holding the disks at a downward angle of forty-five or sixty degrees, and striking the edge against a suitable support.

The disks are next preferably subjected one at a time to a pressing operation, by means of a ribbed pressing plate, and a flat support, the ribs being preferably narrower or half as wide as the grooves between them in an upper plate, which engages the abrasive surface, while the disc is supported upon a flat plate.

This may be done by hand, using an ordinary screw press provided with two such plates, or it may be done more quickly by a stamping machine operating at the same rate and adapted to be fed by hand or automatically.

The abrasive disks are thus provided with raised ridges 17 of abrasive particles, and the depressed grooves 18, which give the abrasive disk a better cutting characteristic. In addition to this, after the raised portions or ridges have been worn down, the disk is still capable of giving further service, due to the secondary abrasive surface, which is located in a lower plane, at the bottom of the grooves 18. The pressure operation shapes the positions and location of the abrasive particles and the binding compound so as to form the ribs and ridges, as illustrated in Fig. 7.

The abrasive disk is next preferably subjected to an additional covering operation by means of a layer of the same resinous compound of thinner consistency, which is preferably applied by means of spraying, so that it will be applied in a uniform layer, not only to the ridges 17, but the grooves 18, without filling the grooves. The spraying of this compound covers the projecting portions of the abrasive particles and anchors them to the body of the binding compound of the disk. The final layer should preferably be of relatively tough consistency, yet capable of being worn off the pointed portions of the abrasive particles so as to permit them to come into cutting action as soon as possible.

Thereafter the abrasive disks may be strung on rods, wires, or other supports, or otherwise suitably supported, while they are carried through a drying and heating atmosphere, so that the fumes from the curing of the phenolic condensation compound will be carried away and the curing expedited.

In other embodiments of the method the disks may be suitably supported in still position in a chamber through which the drying and heated atmosphere passes, while the disks are supported in spaced relation to each other.

Referring to the drawings, Figs. 2 and 3 are illustrations of suitable supports for a disk, which comprises the impregnated fabric, while the binding layer of resinous compound is applied to this disk. The supporting plate is a part of the machine of Fig. 1, and is indicated by the numeral 22. It may be a hollow member which has a multiplicity of spaced suction apertures 23 on its face 24, and is provided with a suction pipe connection 25 at its rear side. A pair of parallel grooves 26 traverse its face 24, and are adapted to receive a pair of metal fingers, which are used to strip the disks from the supporting plate 22 and deposit them upon a suitable conveyor 27 (Fig. 1).

The supporting plate 22 is thus adapted to fixedly support the impregnated fabric disk, while the binding compound is applied to its face, and this is done by air suction, which is applied to the hollow plate 22 by means of the pipe 26.

Referring to Figs. 4 and 5, these are illustrations of the upper figures of the pressure plate, which is used for forming the ridges 17 in the grooves 18.

The pressure plate comprises a steel die member 28, which may be of circular shape, and provided with a supporting shank 29. On its lower surface it has the transverse ridges 30 of rectangular cross-section, and the transverse grooves 31 between the ridges, also of rectangular cross-section. The grooves are preferably wider and approximately twice as wide as the ridges, as it is preferred to make the ridges 17 on the abrasive wider than the grooves 18.

Referring to Fig. 1, this is a diagrammatic illustration of a part of the apparatus which may be used for carrying out the method. The disk supporting plates 22, each provided with its suction pipe 25, are fixedly mounted upon a relatively large wheel 32, which is rotatably mounted upon a shaft 33 and suitably driven by means of electric motors.

It should be understood that the illustration is diagrammatic, and all of the suitable driving connections are not shown, but may readily be understood by one skilled in the art.

The wheel 32 is provided with a suitable rotating suction connection to a source of air suction and connection leads to all of the suction pipes 26.
Each of the suction pipes 25 preferably has a shut-off valve 33, which is adapted to be actuated by a lever 34, having a roller engaging a cam 35 supported in fixed relation adjacent the wheel 20. The cam 35 and lever 34 are adapted to turn on the suction for the supporting plates 22 when the operator or the feed mechanism brings a resin impregnated disk adjacent the plate for support thereby.

The cam 35 is also adapted to turn off the air value 33 after the resin impregnated fabric disks, which have been coated with an additional layer of resin, are stripped from the supporting plates 22 by the spring fingers 36. For this purpose the cam 35 is provided with its camming surface 37 of increased radius at the top.

During all of the rest of one rotation of the wheel 22 the suction plates 22 are without application of suction so as to conserve the operation of the pumps producing the suction.

The container for resins binding compound is disposed adjacent to the conveyor above the conveyor 22 and rotates therewith, and the cam 44 engages a suitable cam roller carried by the shaft of roller 40 in such manner that the roller 40 is lifted from the fabric disk 43 at the point 45 of the cam 44 and again deposited on another disk at a point 46 of the cam 44.

Thus the binder applying roller 40 is lifted from the fabric disks at the proper time and applied to the next one at the proper time, by means of the cam 44.

The construction of the cam 44 and its action on the roller 40 is preferably of sufficient accuracy so that whenever there is no fabric disk applied to a supporting plate 22, the roller 40 and its layer of binder 41 are spaced just enough from the supporting plate 22 so that no resinous binder will get on the face of the supporting plate 22.

The impregnated fabric disk 28, 29, 51 may be fed to the suction plates 22 by hand or by means of a feeding mechanism utilizing suction fingers similar to that employed upon printing presses.

The wheel 32 has its shaft 33 mounted in suitable bearings upon a framework, indicated in its entirety by the numeral 50. The conveyor 27 may consist of a conveyor belt suitably supported upon driving and supporting rollers 51, 52, 53 in position to receive the resin covered disks, as they are stripped from the suction plates 22 by the fingers 36, which engage in the slots 26. The slots 26 extend in a peripheral direction on the wheel 32.

The supply of abrasive particles may be contained in a suitable hopper 54, supported on the frame 50 above the conveyor belt 27, and provided with an electrically driven feed roller 55, which is located adjacent a discharge slot 56, so that a continuous sheet of abrasive particles drops from the hopper 54 on the conveyor belt 27 and on the disks 43, which it supports.

The conveyor belt 27 may be of an apertured character so that the excess of abrasive particles 15 will drop through the belt and will be caught in a suitable container and conveyed by automatic conveying means back to the hopper 54.

The abrasive covered disk 10 is then dropped edgewise off the conveyor 21 onto a second conveyor 87, which may be utilized for passing it through the drying and heating atmosphere for curing purposes.

At the right hand of Fig. 1, 58 indicates a power stamp, having a suitable frame 59 and a lower flat pressure plate 60. The upper ribbed plate 55 is that described with respect to Fig. 4, and it may be driven by means of a crosshead and crank connection to the shaft 51 and drive wheel 62 of the stamp 51.

The same machine, comprising the wheel 32 and associated mechanism, may be of use for applying additional layers of resinous compound, if desired.

It will thus be observed that I have invented an improved method of making abrasive disks, which results in an improved product and which may be carried out by hand or by the improved apparatus, which is diagrammatically illustrated.

The abrasive disks manufactured by means of the present machine are flexible and lay a layer of withstanding water and other liquids without damage. They provide better cutting tools than the devices of the prior art so that the driving motors are not subjected to overloads, as is the case when a disk is used that gums up with paint or with its own binder.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A machine for the manufacture of abrasive disks comprising a movable support provided with a plurality of disk supporting plates, said plates being provided with means for applying suction to a disk on said plate to hold the disk on the plate, a supply of binder, and a feed roller adapted to be supplied with binder, and having a predetermined clearance with respect to another applying roller, whereby the applying roller receives a uniform layer of binder, said applying roller engaging the disks on said supporting plates, whereby a uniform layer of binder is applied to the disks.

2. A machine for the manufacture of abrasive disks comprising a movable support provided with a plurality of disk supporting plates, said plates being provided with means for applying suction to a disk on said plate to hold the disk on the plate, a supply of binder, and a feed roller adapted to be supplied with binder, and having a predetermined clearance with respect to another applying roller, whereby the applying roller receives a uniform layer of binder, said applying roller engaging the disks on said supporting plates, whereby a uniform layer of binder is applied to the disks.

3. A machine for the manufacture of abrasive disks comprising a movable support provided with a plurality of disk supporting plates, said plates being provided with means for applying suction to a disc on said plate to hold the disc on the plate, a supply of binder, and a feed roller adapted to be supplied with binder, and having a predetermined clearance with respect to another applying roller, whereby the applying roller receives a uniform layer of binder, said applying roller engaging the disks on said supporting plates, whereby a uniform layer of binder is applied thereto.
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4. A machine for the manufacture of abrasive disks comprising a movable support provided with a plurality of disk supporting plates, said plates being provided with means for applying suction to a disk on said plate to hold the disk on the plate, a supply of binder, and a feed roller adapted to be supplied with binder, and having a predetermined clearance with respect to another applying roller, whereby the applying roller receives a uniform layer of binder, said applying roller engaging the disks on said supporting plates, whereby a uniform layer of binder is applied to the disks, a conveyor for receiving disks from said movable support, said conveyor being provided with a pair of stripping fingers, and said supporting plates having grooves into which the stripping fingers move to strip the disks from the supporting plates and convey them to the conveyor.

5. A machine for the manufacture of abrasive disks comprising a movable support provided with a plurality of disk supporting plates, said plates being provided with means for applying suction to a disk on said plate to hold the disk on the plate, a supply of binder, and a feed roller adapted to be supplied with binder, and having a predetermined clearance with respect to another applying roller, whereby the applying roller receives a uniform layer of binder, said applying roller engaging the disks on said supporting plates, whereby a uniform layer of binder is applied to the disks, a conveyor for receiving disks from said movable support, said conveyor being provided with a pair of stripping fingers, and said supporting plates having grooves into which the stripping fingers move to strip the disks from the supporting plates and convey them to the conveyor, and for impelling abrasive particles against the tacky surface of the disks while supported upon said conveyor.

6. A machine for the manufacture of abrasive disks, comprising a support for a plurality of backing disks adapted to receive an abrasive, said backing disks being supported in spaced relation to each other on said support, and being moved by said support, a supply of binder for binding the abrasive on said disks, means for applying a uniform layer of the binder from said supply to the disks successively as they are held on said support, said support being moved, as the binder is applied, a second movable supporting member located adjacent the first supporting member, and adapted to receive the backing disks coated with binder as they are discharged from the first-mentioned support, and means for applying abrasive particles against the binder on said disks while carried on said second movable support.

7. A machine for the manufacture of abrasive disks, comprising a support for a plurality of backing disks adapted to receive an abrasive, said backing disks being supported in spaced relation to each other on said support and being moved by said support, a supply of binder for binding the abrasive on said disks, means for applying a uniform layer of the binder from said supply to the disks successively as they are held on said support, said support being moved, as the binder is applied, a second movable supporting member located adjacent the first supporting member, and adapted to receive the backing disks coated with binder as they are discharged from the first-mentioned support, and means for applying abrasive particles against the binder on said disks while carried on said second movable support, and a third movable support located adjacent the discharge point of the second movable support, to receive the abrasive covered disks discharged from the second movable support, said third movable support being located below the second movable support, whereby the abrasive covered disks are adapted to drop into edgewise engagement with the third movable support to shake off excess abrasive particles.

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