Aug. 19, 1941. F. O. ALBERTSON 2,252,683

METHOD OF FORM SETTING ABRASIVE DISKS

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Fig. 1.

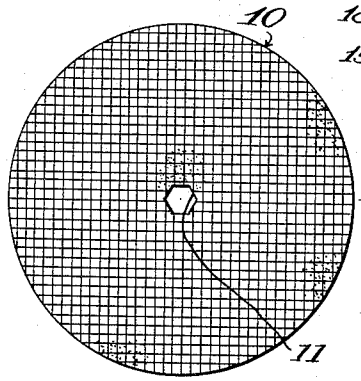

Fig. 2.

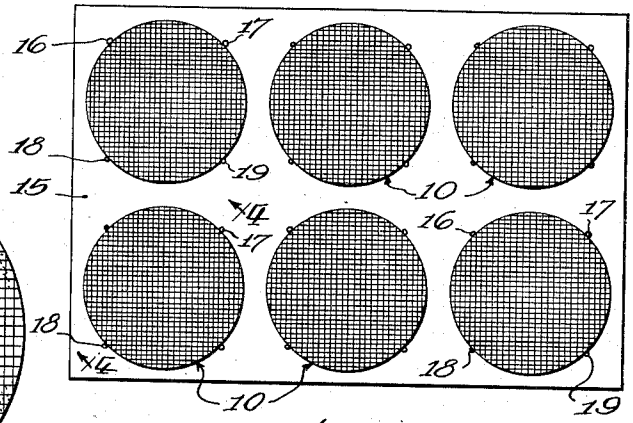

Fig. 3.

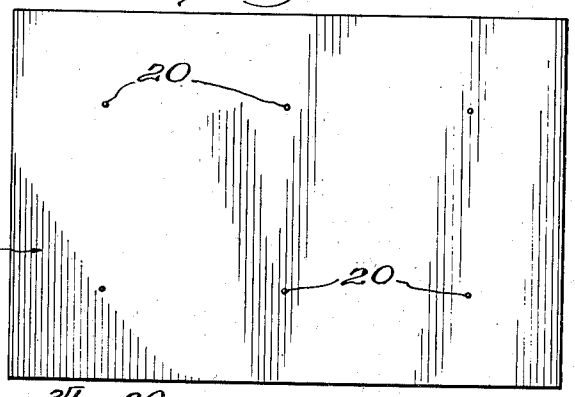

Fig. 6.

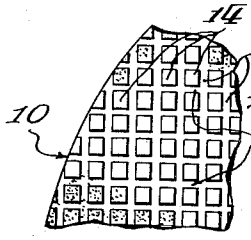

Fig. 4.

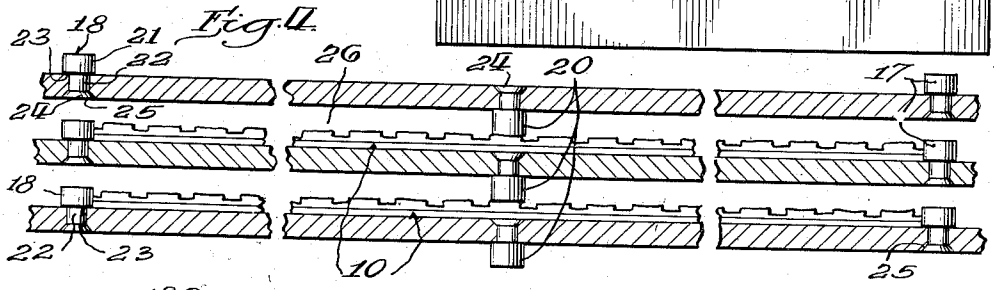

Fig. 5.

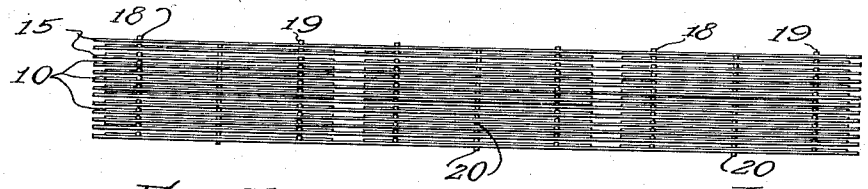

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Fig. 7.

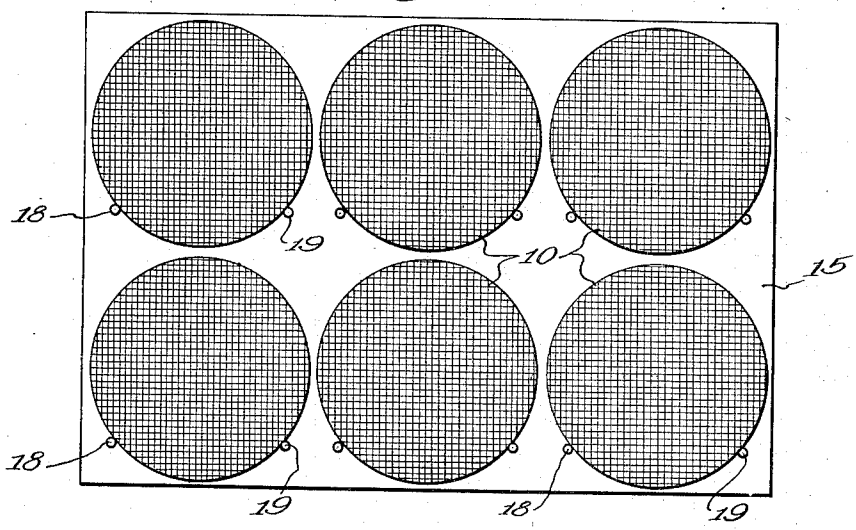


Fig. 8.

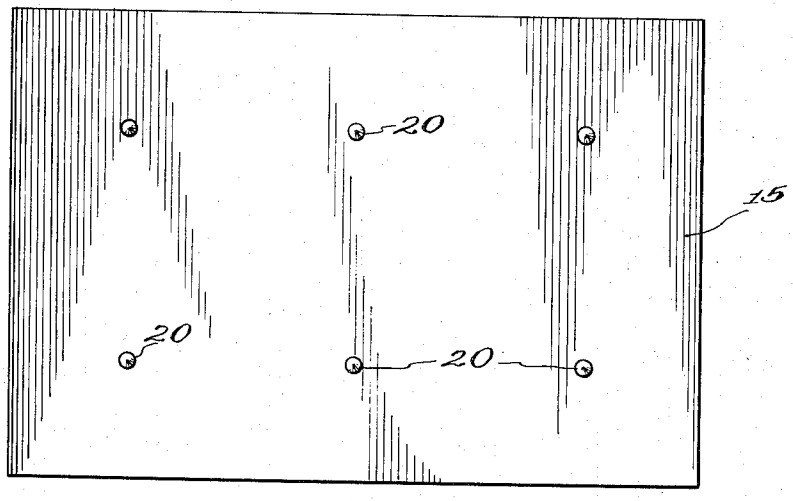
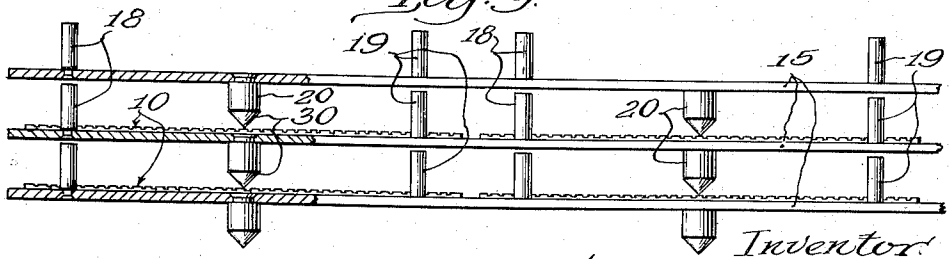


Fig. 9.



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UNITED STATES PATENT OFFICE

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METHOD OF FORM SETTING ABRASIVE DISKS

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Application April 29, 1939, Serial No. 270,755

5 Claims. (Cl. 51—293)

The present application relates to methods and apparatus for form-setting abrasive disks, and is particularly concerned with abrasive disks of the type including a vulcanized fiber backing and abrasive particles secured thereto by a phenolic condensation binding compound.

One of the objects of the invention is the provision of an improved apparatus for holding the abrasive disks in substantially flat position, without marring or changing the contour of the abrasive surface, and which is also adapted to provide adequate space for ventilation of the abrasive disk so that the gases resulting from evaporation of the solvent can be discharged freely from the disks during the baking operation.

Another object of the invention is the provision of an improved method and apparatus for use in form-setting of abrasive disks, by means of which the blistering of any part of the binding compound or surface of the disk is avoided.

Another object of the invention is the provision of an improved method of making abrasive disks which is simple, economical, effective, and capable of producing disks which are substantially flat and which do not have the tendency to curl which is present in the disks of the prior art.

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

Referring to the sheets of drawings, accompanying the specification:

Fig. 1 is a diagrammatic plan view of an abrasive disk of the type manufactured according to the invention;

Fig. 2 is a diagrammatic top plan view of one of the clamping plates;

Fig. 3 is a bottom plan view of one of the clamping plates;

Fig. 4 is a fragmentary vertical sectional view of a stack of plates holding the abrasive disks;

Fig. 5 is a side elevational view of a clamping plate and disk assembly;

Fig. 6 is a fragmentary plan view of the abrasive surface of a disk constructed according to the invention.

Fig. 7 is a view similar to Fig. 2 of a modified form of apparatus, requiring only two pins for positioning each disk;

Fig. 8 is a view similar to Fig. 3 of this modification; and

Fig. 9 is a view similar to Fig. 4 of the modification, which is the preferred form of the apparatus used.

The abrasive disks of the prior are are subject to the disadvantage that they are not flat, but are curled or warped, due to the uneven expansion of different parts of the disc. Such abrasive disks of the prior art have a backing including cloth which is hygroscopic and tends to expand at a different rate from other parts of the disk, and they are not form-set, as described herein, and the result is that the disk is warped and has two high spots which tend to strike the work with an uneven action. This tends to cause vibration and undesirable characteristics, and it is an object of the invention to provide a method and apparatus to manufacture substantially flat abrasive disks, which will not warp or curl.

Referring to Fig. 1, this is a plan view of an abrasive disk, the disk being indicated by the numeral 10, and being a substantially circular member, preferably provided with an aperture 11 of suitable size for the arbor, upon which it is to be used.

The backing of the disk comprises a piece of cardboard of the type usually called in the trade "vulcanized fiber," which comprises a plurality of thin sheets of cellulosic material united to form a single sheet. These thin sheets are unsized, cut cellulose paper which has been subjected to the action of zinc chloride, to effect a partial hydration.

The hydrated fibers are then compressed and subjected to heat, to secure them together. Such fiber board is relatively stiff, yet capable of flexing, and the first step in the method of manufacture of the abrasive disks is the cutting out of the disks by means of suitable dies, which, however, preferably do not cut out the centrally located aperture 11 at this time.

The next step in the manufacture of the disks is the drying out of the fiber board disks by means of the application of a dried and heated atmosphere, which preferably passes over the discs at a high velocity and is discharged or again dried so as to remove substantially all of the free moisture, without, however, attacking the chemical composition of the paper.

The next step is the spraying of the back of the abrasive disk with a phenolic condensation compound which is thinned with a suitable solvent, such as, for example, alcohol, to such a degree that it is suitable for spraying action. For example, 50% resin and 50% solvent may be employed.

As the fiber board disks have been dried thoroughly, the impregnating phenolic resin compound is taken up very readily, and it penetrates

to all parts of the interstices between the fibers and appears on the front side of the disc also. By means of the thorough impregnation of the fiber board disk with this phenolic condensation compound, it is made waterproof, but its flexibility is maintained, and the composition of the disc throughout is substantially homogeneous, comprising the cellulose and impregnating compound.

The phenolic condensation resin may consist of a colloidal solution of resin of one of the types disclosed in U. S. Patent No. 1,854,600, issued April 19, 1932, to Fritz Pollak and Alfons Ostersetzer. The resin which is employed in the successive steps of manufacture is preferably all of the same composition, but of different concentration or dilution, depending upon the functions of the particular application of the resin in question.

The impregnated disks are then subjected to a baking for the purpose of evaporating the solvent, and the baking is carried on for a number of hours at a moderate temperature, and thereafter finished at a higher temperature, to set the resin. For example, the impregnated disks may be baked first for one hour at 176° F. temperature, and thereafter for one hour at 230° F. temperature. The application of these two degrees of heat is conveniently accomplished by means of an oven having two temperatures of operation, so that the discs need not be moved between these two operations.

The disks are next provided on the face thereof with a layer of tacky phenolic condensation resin binder which is applied by means of a pair of rollers, one roller dipping in the resin, and being suitably spaced from the other roller so as to provide the other roller with a layer of predetermined thickness of the binder. The other roller then is brought into engagement with the disk to apply uniform layers of tacky binder to the face of the disk.

Thereafter the abrasive particles are spread on the layer of tacky binder in a uniform layer, an excess of abrasive particles being employed, and the abrasive particles are subjected to the action of rollers for embedding them in the binder. The excess of abrasive particles which are not held by the binder are then shaken off by striking the disk edgewise, and the face of the disk is suitably molded or formed to give it the structure and appearance of Figs. 1 and 6. This is accomplished by means of suitable dies, the lower die being flat, and the upper one having two series of ribs, each series extending at right angles to each other.

The ribs on the die form a plurality of grooves **12**, **13** at right angles to each other in the face of the disk, as shown in Fig. 6, leaving the upstanding, substantially square or rectangular islands **14** of abrasive.

The grooves **12**, **13** are adapted to provide a clearance for the particles which are ground off the work piece, and the islands **14** give a reduced contact area, which provides a faster cutting action and longer life for the disk.

After the islands **14** have been worn down, the disk is still adapted to be used, due to the abrasive in the balance of the surface, comprising the grooves **12** and **13**.

The faces of the abrasive disks are then subjected to a final spraying of a phenolic resin compound of the same characteristics, but of a thinner character, so that it is adapted to be sprayed, and this compound may also consist of 50% resin and 50% solvent, such as alcohol. The final sprayed coat covers all parts of the abrasive, and being of the same resin, it combines with and becomes integral with the balance of the binder, so that each particle of the abrasive is effectively anchored by a binder, which extends over the outer surface of each particle. The sharp points are covered with this sprayed coat, also; but the coat is worn off quite quickly because the binder is not capable of resisting the action of the abrasive particles because the binder immediately wears off the sharp points of the abrasive.

The abrasive disks are then preferably placed in a form with the face up and the back resting upon the metal plate in the manner shown in Figs. 4 and 5. For example, the metal plates **15** may be of such size that they will support six of the abrasive disks, and on the upper surface of each plate there may be a plurality of series of metal studs **16**, **17**, **18**, and **19** for each disk.

The studs **16**—**19** are spaced sufficiently so that they engage the periphery of the disk when the disk is flattened out.

At this time, in the manufacture of the abrasive disks, there is a tendency of the disk to curl upward at the middle, and downward at two edges, so that the abrasive face of the disk bulges upward from the top of a plate **15**. The disks may be held flat by the application of force to the center of each disk. For this purpose each plate is provided with a plurality of depending metal studs **20**, six in number in the example shown, to engage exactly at the center of each disk, when the plates are in registry.

The metal studs **16**—**20** may have an enlarged outer portion **21** and a reduced cylindrical portion **22** forming an annular shoulder **23**. The reduced cylindrical portion has its end riveted over at **24** in a counter-sunk aperture **25**.

Each plate of a plurality has six disks placed upon it, face upward, and engaged by the depending lugs **20** of the next plate, and thus a plurality of plates and disks may be built up to the form shown in Fig. 5, leaving the spaces **26** between the surface of each disk, and the plate above it for ventilation. The weight of the metal plates is sufficient to hold the abrasive disks flat, and the studs **16**—**19** engage the edges of the disks and hold them in predetermined position, but permit them to flatten out.

The depending studs **20** engage at the center of the disk, which represents a portion that is going to be cut out to form the aperture **11** and every part of the effective surface of the disk is free of the application of the studs **16**—**20**.

The abrasive disks are then subjected to a baking operation for the purpose of evaporating the solvent in a predetermined number of hours at a moderate temperature, and a shorter number of hours at a higher temperature, to give the disks a final set. For example, the disks may be subjected, while held between the plates **15**, to a dry atmosphere at high velocity for fifteen hours at 176 degrees temperature, and thereafter for an additional number of seven hours at 230 degrees temperature. The dry air passes over the disks through the spaces **26** at a high velocity, and carries off the gases resulting from evaporation of the solvent, and the preliminary baking at a moderate temperature effects the removal of the solvent without any blistering of the compound. The abrasive disks are held flat during this drying and baking operation, and they are set in a flat condition.

The next step is the cutting of the apertures

11, which may be hexagonal or round, but I prefer to use a hexagonal aperture of predetermined size so that it can be used upon a round arbor also of that size.

Surrounding the aperture 11 there may be a plurality of perforations, as described in my prior application, for the purpose of permitting the breaking out of the border 11, to provide a larger arbor hole.

Referring to Figs. 7, 8, and 9, Fig. 6 shows the top plan view of the modified form of supporting plate in which only two of the disk-engaging studs 18 and 19 are used for each disk. In using this plate the plates are supported at an angle, such as, for example, a slight angle, while the plates are being stacked

Thus the force of gravity urges the disks against the studs 18 and 19. The centrally located studs 20, which depend from the plates, are in this case provided with conical points 30, engaging the center of each disk below the plate in question. The pointed ends 30 are easy to clean with respect to the binder, which might adhere to the post, and they serve to hold the disks in flat condition while the setting operation is taking place.

It will thus be observed that I have invented an improved apparatus for form-setting and an improved method of making abrasive disks, which results in substantially flat abrasive disks.

The present disks are effectively protected against oil, water, or any other liquids or acids which will not attack the phenolic condensation compound, by the impregnation of the fiber board with the resin and coating of the complete disk on both sides and at its edges with the resin. The method used is adapted to effect a curing and form-setting of the abrasive disk without any blistering, and the present disks are adapted to cut more effectively than any of the devices of the prior art, due to their structure and composition.

While I have illustrated a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

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

1. The method of making abrasive disks which comprises impregnating and coating a fiber board disk with a phenolic resin compound, said coating being in a tacky condition, applying abrasive particles to said coating, and thereafter form-setting the abrasive disk by holding it in substantially flat condition while the phenolic condensation compound is set by the application of heat, the heat being applied at a moderate rate for a predetermined period of time for the preliminary removal of the solvent, and thereafter heat being applied at a higher temperature to effect a setting of the resin.

2. The method of making abrasive disks which comprises impregnating and coating a fiber board disk with a phenolic resin compound, said coating being in a tacky condition, applying abrasive particles to said coating, and thereafter form-setting the abrasive disk by holding it in substantially flat condition while the phenolic condensation compound is set by the application of heat, the heat being applied at a moderate rate for a predetermined period of time for the preliminary removal of the solvent, and thereafter heat being applied at a higher temperature to effect a setting of the resin, the application of heat being accomplished by means of circulating heated and pre-dried atmosphere about the abrasive disks.

3. The method of making abrasive discs which comprises impregnating and coating a fiber board disk with a phenolic resin compound, said coating being in a tacky condition, applying abrasive particles to said coating, and thereafter form-setting the abrasive disk by holding it in substantially flat condition while the phenolic condensation compound is set by the application of heat, the heat being applied at a moderate rate for a predetermined period of time for the preliminary removal of the solvent, and thereafter heat being applied at a higher temperature to effect a setting of the resin, the application of heat being accomplished by means of circulating heated and pre-dried atmosphere about the abrasive disks, and discharging the heated and pre-dried atmosphere for the purpose of carrying off the vapors from said abrasive disks.

4. The method of making abrasive disks which comprises applying a binder to a fibrous backing to impregnate the backing, making a further application of said binder to the backing in a tacky condition, applying an excess of abrasive to said tacky binder, embedding the abrasive particles in said tacky binder by rolling, subjecting the face of said disk to the action of grooved dies for the purpose of producing abrasive surfaces in two different planes, anchoring the abrasive particles to the tacky binder by the application of a spray coating of a more dilute form of said binder, and form-setting said abrasive disks by holding the disks in substantially plane condition while subjecting the disks to the action of heat for setting the binder and rendering it insoluble to water and other liquids with which it may come in contact.

5. The method of making abrasive disks which comprises cutting disks out of sheets of fiber board, subjecting the disks of fiber board to the action of a moving and drying atmosphere to remove substantially all of the free moisture from the fiber disks, spraying the fiber discs with a phenolic condensation compound dissolved in a suitable solvent to impregnate the disks with a phenolic condensation compound, making a second application of a similar phenolic condensation compound to provide a binder in a tacky condition, applying an excess of abrasive to said binder, embedding the abrasive particles in said binder by rolling, subjecting the face of said disc to the action of grooved dies for the purpose of producing abrasive surfaces in two different planes, anchoring the abrasive particles to the tacky binder by the application of a spray coating of a more dilute form of the same binder, and form-setting said abrasive discs by holding the discs in substantially plane condition while subjecting the discs to the action of heat for evaporating the solvent, setting the binder, and rendering it insoluble to water and other liquids with which it may come in contact.

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