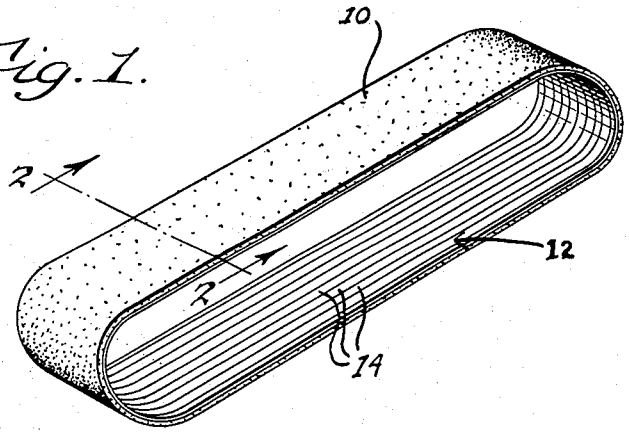
July 6, 1954 O. S. BUCKNER 2,682,733

FLEXIBLE ABRASIVE BAND

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Fig. 1.



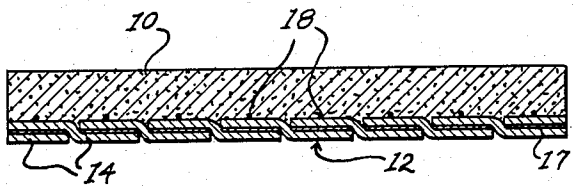


Fig. 2.

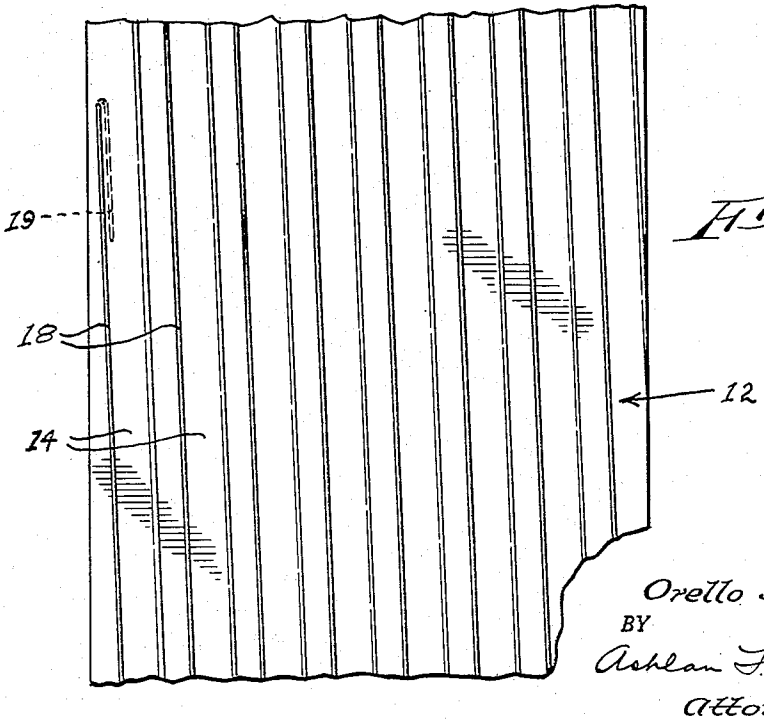


Fig. 3.

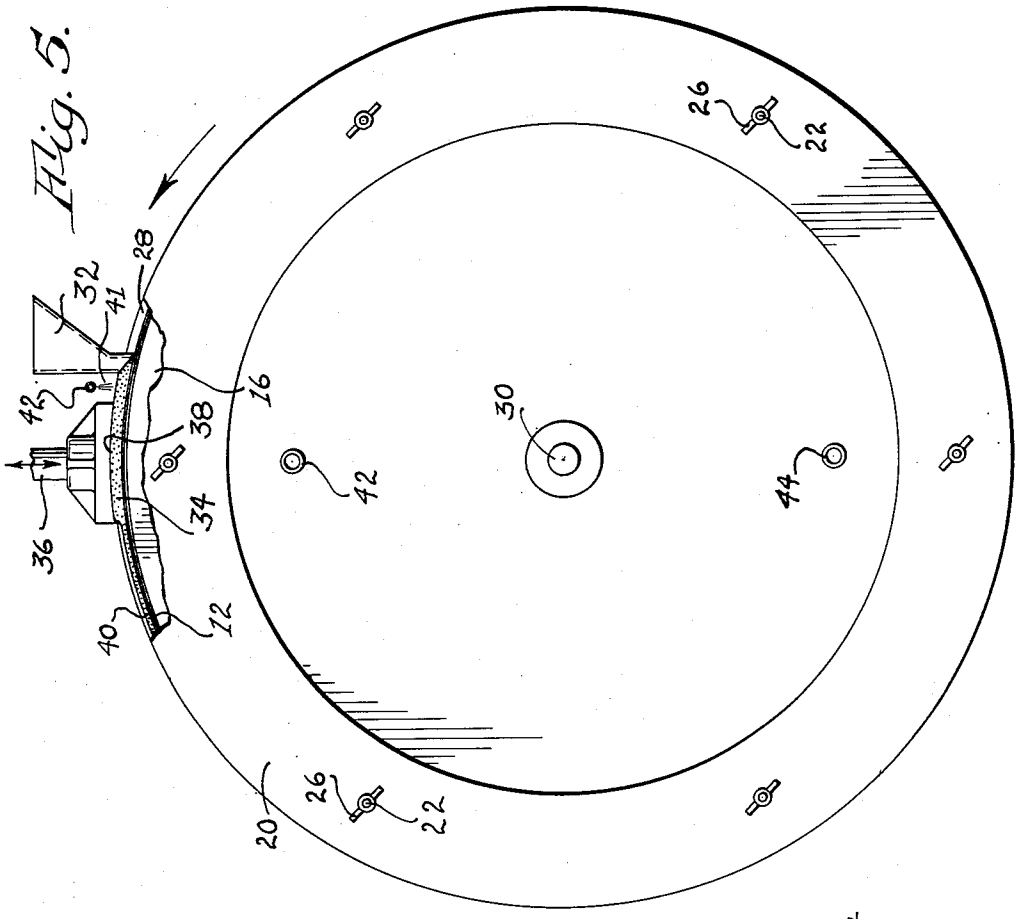
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July 6, 1954 O. S. BUCKNER 2,682,733

FLEXIBLE ABRASIVE BAND

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Fig. 3.



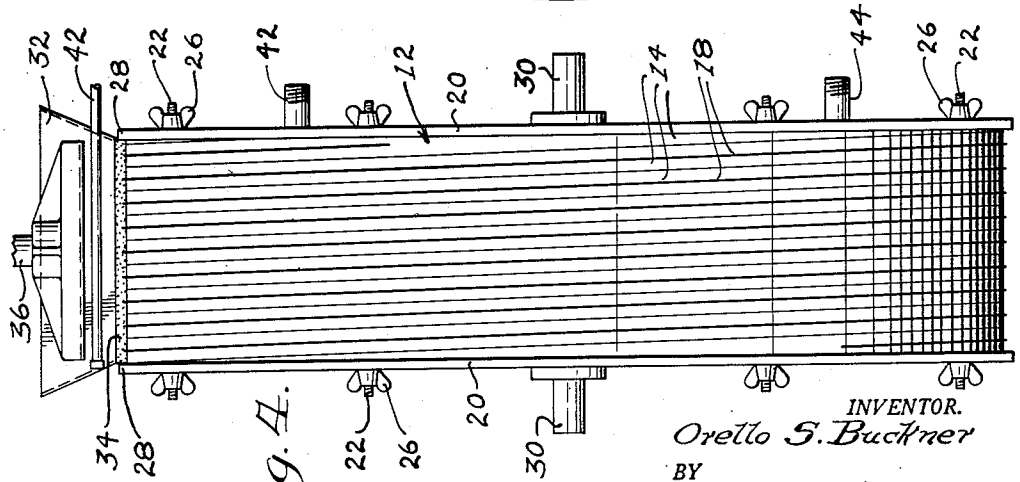


Fig. 4.

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Fig. 7.

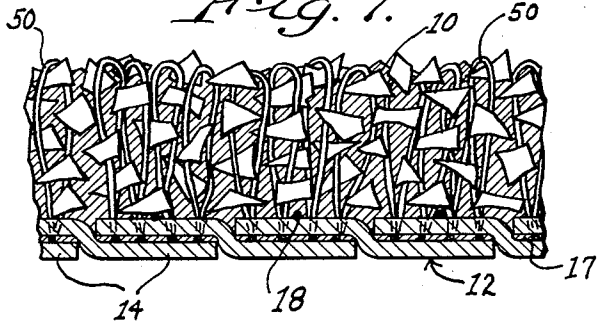


Fig. 8.

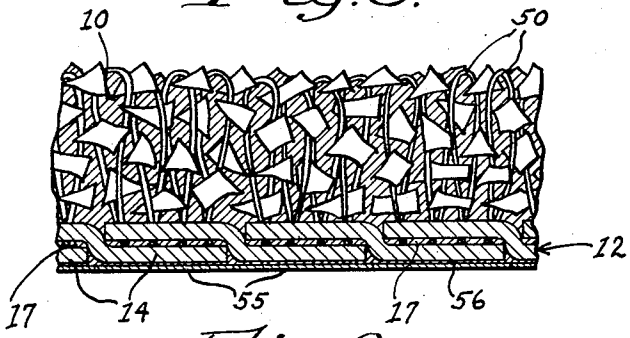


Fig. 6a.

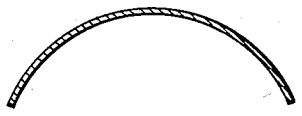


Fig. 6b.



Fig. 6c.



Fig. 9.

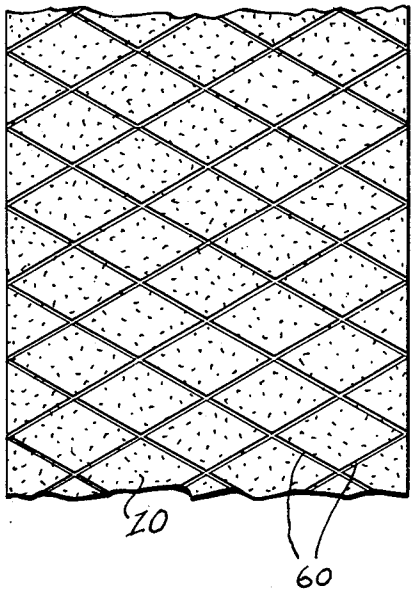
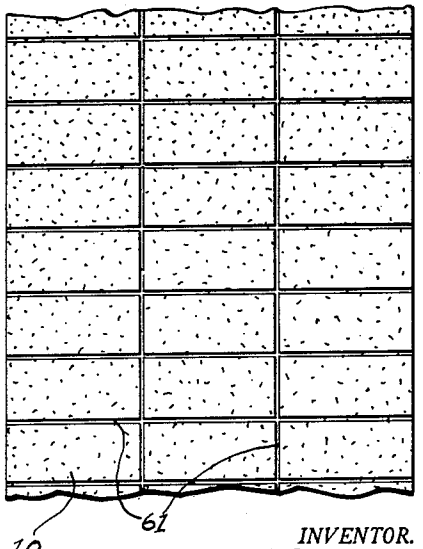


Fig. 10.



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UNITED STATES PATENT OFFICE

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FLEXIBLE ABRASIVE BAND

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Application August 16, 1950, Serial No. 179,857

2 Claims. (Cl. 51—188)

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This invention relates to flexible abrasive articles and is particularly concerned with abrasive flexible bands such as belts, sleeves, and the like and with novel processes for producing them.

It is an object of the invention to provide flexible abrasive bands which are extremely flexible and which may be easily manufactured in shapes with curved cross-sections.

Another object of the invention is to provide flexible abrasive bands such as belts, sleeves, and the like which are endless and have no splices, thus eliminating the surface irregularity and expense resulting from splicing the ends of such bands and furnishing less probability of rupture of such bands.

A further object of the invention is to provide flexible abrasive belts, sleeves, and the like which may be formed with relatively thick abrasive layers so as to permit them to replace economically the set-up wheels and single-layer abrasive belts which are now generally used for polishing and light grinding operations.

Still another object of the invention is to provide a convenient and inexpensive method of manufacturing endless flexible backings for abrasive bands such as belts, sleeves, and the like.

Additional objects and advantages of the invention will be perceived from the following description taken in conjunction with the accompanying drawings in which:

Figure 1 is a perspective view of a flexible abrasive belt or sleeve which embodies the invention of the present application;

Figure 2 is an enlarged cross-sectional view on line 2—2 of Figure 1;

Figure 3 is an enlarged, fragmentary plan view of the backing of the flexible abrasive belt or sleeve illustrated in Figures 1 and 2 before the layer of abrasive material is applied thereto;

Figure 4 is a front elevational view illustrating diagrammatically apparatus which may be used in applying an abrasive layer to a flexible backing such as is shown in Figure 3;

Figure 5 is a diagrammatic, side elevational view of the apparatus shown in Figure 4 with a portion of the drum broken away to show the abrasive layer;

Figures 6*a*, 6*b*, and 6*c* illustrate diagrammatically in cross-section several of the many possible contours with which flexible abrasive sleeves may be manufactured in accordance with the present invention;

Figure 7 is a further enlarged fragmentary cross-sectional view, similar to Figure 2, of a

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flexible abrasive sleeve or belt manufactured in accordance with the present invention in which flexible loops are provided on the flexible backing for reinforcing and anchoring the abrasive layer;

Figure 8 is a view similar to Figure 7 showing a modification of the backing of the flexible abrasive belt or sleeve; and

Figures 9 and 10 are reduced fragmentary views of the working surface of a flexible abrasive belt or sleeve, constructed in accordance with the teachings of the present invention, illustrating two of the numerous patterns or combinations of grooves with which the outer face of a thick abrasive layer thereon may be provided.

The flexible abrasive belts and sleeves heretofore used commercially comprise a backing of sheet material having on one surface a substantially single-layer coating of abrasive granules attached to such backing by an adhesive. The backing material employed is commonly a woven cloth or a fibrous sheet material such as paper. In forming such abrasive articles it has been the practice to provide a web of abrasive coated material of the type desired and which is of the proper length and width and then to form the web into a continuous abrasive band by splicing the ends thereof together. Although considerable effort has been expended in attempts to provide an entirely satisfactory splice or joint for belts and the like, the attempts have been in vain. A large percentage of the failures of abrasive coated belts are the result of defective or weak joints or splices which part during the constant and rapid flexing to which they are subjected in abrasive operations. Moreover, splices necessarily cause an irregularity in the continuity of the abrasive surface of the belt or sleeve which is objectionable in polishing operations.

By the method of the present invention, it is possible to make endless flexible abrasive belts or sleeves which do not require transverse splicing and, as a result, are free from any irregularity resulting therefrom, and which carry an abrasive layer that may be several times thicker than the backing or than the average diameter of the abrasive granules therein. Such improved flexible abrasive bands (the term "abrasive band" being hereinafter intended, except where the context may otherwise indicate, to include both flexible abrasive belts which are intended to be carried, in use, on a plurality of pulleys or wheels and flexible abrasive sleeves which are intended to be mounted for use on a

single, expansible wheel) are convenient because the absence of a splice does not require their being mounted to run in a specified direction. In addition, as such abrasive bands are stronger, they are less likely to fail in use and they have a much longer useful abrasive life.

Furthermore, the present invention permits the construction of such abrasive bands having a degree of flexibility heretofore unobtainable, and allows the manufacture of flexible abrasive sleeves having irregular or curved cross-sections but carrying abrasive layers of substantial thickness.

The essence of the present invention is the employment of spirally overlapped flexible tape in forming an endless backing for abrasive bands. Since the abrasive layer on said bands is supported by what is in effect a series of overlapping pliable plates, the resultant abrasive band is quite flexible. The use of an overlapping tape backing also makes it possible to provide abrasive bands with various curved contours in cross-section without forcing a distortion of a full width sheet backing.

Referring to the drawings, Figure 1 depicts an abrasive band constructed in accordance with the present invention and having an outwardly facing abrasive layer **10** and a backing **12** to which the abrasive is attached. As will be seen more clearly in Figures 2 and 3, the backing **12** is composed of a number of convolutions of flexible tape **14** which overlap one another across the width of the abrasive band.

In forming an abrasive sleeve in accordance with the present invention, a cylindrical mandrel or drum **16** (see Figures 5 and 6) having a periphery of the desired length is provided. The cylindrical outer face of the mandrel **16** is preferably first covered with a layer of cellophane or similar smooth-surfaced material (not shown) and then flexible tape **14** of suitable material is spirally wound thereon. Each convolution of the tape **14** subsequent to the first overlaps substantially half the width of the previous convolution and thus there is formed a backing of substantially uniform thickness the width of the periphery of the mandrel **16**. The backing is preferably formed of a single long strip of tape but may, if desired, be formed of a number of overlapping strips.

The tape **14** which is employed is preferably narrow, tape one inch in width having been found very satisfactory for most purposes. However, the tape width may be varied where desired from about one-half inch to two inches. Various materials including organic fibers such as cotton, linen, etc., as well as inorganic fibers such as glass may be used in forming the tape **14**. Furthermore, the tape may be either woven or felted. Good results have been obtained with a woven cotton tape of the type used commercially for binding seams and the like. A suitable adhesive material **17** such, for example, as a liquid phenolic resin is preferably applied to the portion of the tape **14** which is to have the succeeding turn of tape wound over it so that the successive convolutions will be held in place and, when the winding is completed, form an endless backing.

In cases where the tape used has a low tensile strength or has a tendency to stretch to an undesirable extent, it has been found desirable to reinforce the tape backing **12**. A convenient method of reinforcing it is to wind around it, on the mandrel **16**, a number of turns of thin wire **18** of steel, bronze, or other suitable metal. The reinforcing wire is preferably wound spirally and may be anchored at its ends by pushing it through the tape **14** and forming the ends into hooks **19** (see Figure 3) which engage in the tape.

When the backing **12** is completed, the portions of the tape **14** that overhang the edges of the drum or mandrel **16** are turned over the edges and covered by the removable mandrel end rings **20**. Each of the end rings **20** has an outside diameter somewhat greater than the diameter of the mandrel **16**. The rings are arranged concentrically on the opposite ends of the drum or mandrel, being secured thereto by suitable means such as studs **22** which are preferably integral with the ends of the drum and extend through holes in the end rings to cooperate with the wing-nuts **26** in holding the rings **20** tightly in place. The mandrel **16** is thus provided, by the projecting edges of the rings **20**, with a pair of spaced peripherally-extending flanges **28**. Each end of the mandrel **16** is also preferably provided with a centrally disposed stub shaft **30** which is adapted to be rotatably mounted in a suitable support (not shown) so that the mandrel may be freely turned about a horizontal axis.

In Figures 4 and 5 there is illustrated diagrammatically the preferred manner in which the bonded abrasive layer **10** is applied to the backing **12** on the mandrel **16**. Although a simple mixture of abrasive particles and bond may be employed, better uniformity and structure (i. e. the space and volume relation of bond, abrasive and pores) may usually be obtained by using abrasive granules that have been pre-coated with a heat-settable resinoid bond in any of the ways well known in the art. The coated abrasive granules are fed from the hopper **32** and deposited in a thick loose mass **34** of even thickness on the outer surface of the backing **12**. As the mandrel **16** is rotated slowly in a counterclockwise direction as shown in Figure 5, the loose mass **34** of bond-covered abrasive is carried under a plunger **36**. When pressure is applied by the plunger **36** to the loose mass **34** of bond-covered abrasive granules, the mass is compressed into a thinner, more compact layer **40**.

The lower face **38** of the plunger **36** is the same length as the width of the cylindrical face of the drum or mandrel **16** and has a transverse arcuate curvature of suitable radius to form the compressed abrasive layer **40** with an outer surface that is concentric with the cylindrical face of the mandrel. The plunger may be actuated to provide a tamping or compacting action on the abrasive mass **34** by any suitable source of power (not shown). If desired, the adhesion of the particles to one another and to the backing **12** may be increased by applying a light spray **41** or coating of bond solvent or plasticizer to the mass **34** of bond-covered abrasive between the hopper **32** and the plunger **36** through a perforated pipe or nozzle **42** that extends transversely of the mandrel **16**. The pressing procedure just described is successively carried out on adjacent loosen masses of bond-covered abrasive granules until the entire outer surface of the backing is covered with a compacted abrasive layer **40**. The compacted layer **40** is then finally compressed and the heat-settable bond thereof is cured in any suitable manner.

Preferably the mandrel **16** is hollow and is pro-

vided with nipples 42, 44, or other suitable connections for attaching steam lines (not shown). Steam is supplied through the nipple 42 to heat the mandrel to about 290° F. At that temperature the resinoid bond in the abrasive layer 40 is soon softened and the layer may again be pressed against the mandrel 16 by the plunger 36 in the same manner as before, the heating being continued for about an hour until the resinoid bond which has adhered to the tape backing 12 is partially cured and set. The sleeve may then be removed from the mandrel and the cure of the abrasive bond may be completed by heating the sleeve in an oven (not shown) at approximately 320° F. for about one hour. After the bond is cured the sleeve which is now provided with a dense, compact abrasive layer preferably several times thicker than the backing and the average diameter of the individual abrasive granules therein, is made ready for use by trimming off the protruding edges of tape 14 and grinding or cutting off any exposed free ends of the reinforcing wire 18.

An alternative procedure is preferred when the length of the abrasive bands is such that the cylindrical mandrel required for their production would be undesirably large in size. According to the alternative method, the flexible tape backing for a long abrasive band is formed on a belt of the desired size, which is supported on two or more wheels or pulleys with the tape being wound on the belt in overlapping convolutions in a manner very similar to the construction of such backings on the cylindrical drum 16. When the backing is completed the abrasive layer is formed in generally the same manner as before by successively pressing areas of the backing which are covered with an abrasive granule-bond mixture using either a flat or curved mandrel and a cooperating platen or plunger of suitable size and shape. The resinoid bond used with the long bands may be heat-set in the same way as with the shorter bands by partially curing on the mandrel and then in an oven.

Although flexible abrasive bands of the types described above may be formed and used with a smooth abrasive surface 10 as shown in Figure 1, it is in many cases advantageous to provide the abrasive face thereof with a plurality of grooves. Such grooves may be easily molded into the abrasive layer during the cure thereof in any desired pattern, the patterns of intersecting grooves 60 and 61, illustrated in Figures 9 and 10 respectively, being merely examples. Beneficial results of employing such intersecting groove patterns are the obtaining of greater flexibility in the abrasive bands, the reduction in the loading of the abrasive surface during use, the grooves serving to carry away detritus formed during grinding, and cooler cutting.

The use of relatively narrow flexible tape as a backing for abrasive sleeves permits the construction of such sleeves with contoured surfaces so that the carrying out of abrading and polishing operations on articles having non-planar surfaces is simplified. Thus moldings, castings, and forged or pressed articles such as automobile bumpers and the like may be ground or polished with sleeves having correspondingly shaped abrasive surfaces. In Figure 6 there are shown in cross-section several of the many possible shapes in which flexible abrasive sleeves may be constructed in accordance with the present invention.

Although the same general method may be employed in producing abrasive sleeves of curved or irregular cross-section as in producing the flat abrasive bands described above, it is necessary to modify in some respects the manufacturing procedure hitherto described. For example, in producing such an abrasive sleeve on a mandrel or drum the cylindrical face thereof must be formed in the desired shape. Moreover, it will be necessary, if the sleeve is to carry an abrasive layer of uniform thickness, to employ a scraper or other means to form the loose mass 34 of bond-coated abrasive granules deposited from the hopper 32 on the surface of the pliable tape backing 12 into the desired shape prior to pressing. In shaping the mass 34 a suitably formed template or scraper (not shown) may be supported on the opposed peripherally extending flanges 28 in contact with the mass.

The plunger 36 must also, of course, be modified so that its bottom face 38 will be of proper shape and curvature to cooperate with the curved surface of the mandrel 16 in forming the abrasive layer 10. The abrasive layer may be compacted on the backing and the bond thereof may be cured in substantially the same way as previously described.

It will be seen that by using a comparatively narrow tape a shaped backing which is substantially smooth and free of wrinkles may be easily provided. A flexible abrasive sleeve utilizing such a backing will preserve its shape better and will be subject to less stress in operation than will an abrasive sleeve in which a single sheet or web of a backing is forced to assume the desired shape.

In Figure 7 there is shown in enlarged cross-section an abrasive band embodying the invention of the present application but modified by the provision of outwardly projecting filaments 50 of thread or similar material on the flexible tape backing 12. Although they may be straight the filaments 50, as shown in Figures 7 and 8, are preferably formed as unmatted, stitch loops. They may be applied to the tape 14 prior to forming the backing in any desired or convenient way such as with a sewing machine which may be adjusted to provide loops of the required height, spaced in rows as desired. The loops 50 are provided on one half of one side only of the tape and are preferably of such length as to extend outwardly from the surface of the tape about ¼ inch. Their length, however, may be varied in accordance with the thickness of the abrasive layer which is desired. It is also preferred to closely space the loops 50, a spacing between adjacent loops of from ⅛ inch to $\frac{3}{16}$ inch having been found satisfactory.

The filaments or loops 50 may be formed of any preferred materials, a number of those which are suitable being set forth in applicant's copending application, Serial No. 171,165, filed June 29, 1950. The advantages and benefits accruing from the use of such reinforcing filaments in flexible abrasive articles are also set forth in the application referred to.

As will be evident from Figure 7, in constructing a flexible backing 12 from tape 14 to which filaments 50 have been attached, the tape convolutions overlap the portion of the preceding convolution on which filaments are not provided. There is thus formed a flexible backing the outer surface of which exhibits a substantially uniform array of filaments for reinforcement of the abrasive layer.

Before applying an abrasive layer to a flexible backing 12 having filaments 50 thereon, it is de-

sirable to stiffen the filaments or loops. As disclosed in applicant's copending application referred to above, this may conveniently be done by applying to them a solution of a stiffening agent such as latex. Furthermore, it is necessary to modify somewhat the above described method of forming the abrasive layer. In order to insure satisfactory packing of the abrasive-bond mixture within and around the loops or filaments **50**, after the loose mass **34** of the abrasive-bond mixture has been applied to the surface of the flexible backing **12**, a comb or stiff brush (not shown) is run through the mass to work it down into the nap provided by the filaments. When an even layer of the loose mass has thus been provided, pressing and curing of the abrasive layer may be carried out in the same manner as described above for the production of flexible abrasive bands in which filaments **50** are not used.

As pointed out above, in some cases the tape **14** employed in forming the backing **12** for flexible abrasive bands may be low in strength or may stretch excessively under tension. Instead of using the wire **18** as a reinforcing device to reinforce the backing, the backing may be provided (as illustrated in Figure 8) on the side opposite from that to which the abrasive layer is to be applied with a reinforcement of a strong, flexible material such, for example, as thin vulcanized fiber. In forming a flexible abrasive band on the mandrel or drum **16** with a vulcanized fiber reinforcement, a strip **55** of the fiber is preferably wound spirally around the drum and coated with a suitable adhesive **56** prior to starting the winding of the flexible tape **14**. The tensile strength of vulcanized fiber is great enough to provide adequate reinforcement even in very thin strips which do not interfere substantially with the flexibility of the backing. If desired, the reinforcing strips may be wider than that shown in Figure 8 and provided with longitudinal scoring which will permit easy flexing transversely of the abrasive band.

The flexible tape backings disclosed herein are, as pointed out above, of particular value in forming abrasive bands with thick abrasive layers. However, relatively thin layers of abrasive may also be employed and if desired such backings may be provided with a substantially single layer of adhesively secured abrasive granules by any of the well known and suitable methods described in the prior art. While the useful life of flexible abrasive bands according to the present invention having thin abrasive layers will be comparatively short, the substantial nature and strength of the backing is such that they can be recoated many times.

It is to be understood that the embodiments of the present invention hereinabove described may be considerably modified and varied without departing from the spirit of the invention. Thus, for example, the materials employed in forming the backing, the material used in forming the reinforcing filaments for the abrasive layer if such filaments are employed, and the manner in which the backing is reinforced are subject to wide variation as is the method employed in constructing the flexible abrasive back. Moreover, the abrasive granules used may be of any desired type and grit size and the bond therefor may be of any suitable type. The foregoing mention of some possible variations is not, however, to be considered as limiting the invention beyond the scope of the appended claims.

The invention claimed is:

1. A flexible abrasive band comprising an endless flexible backing and a porous abrasive layer attached to the outer face thereof, said backing being formed of a plurality of side by side, overlapping convolutions of flexible textile tape and having a plurality of unmatted stitch loops attached thereto and projecting from the outer face thereof, said abrasive layer encasing said loops and providing a relatively thick, continuous, substantially smooth, abrasive surface across substantially the whole width of said band without interruption at the overlapping edges of said convolutions.

2. A flexible abrasive band as set forth in claim 1 in which said abrasive layer is several times thicker than said backing and is molded on said backing from a granular mix.

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