Jan. 22, 1957 A. L. BALL 2,778,169

FLEXIBLE ABRASIVE BANDS

Filed Oct. 20, 1953

2 Sheets-Sheet 1

Fig. 1.

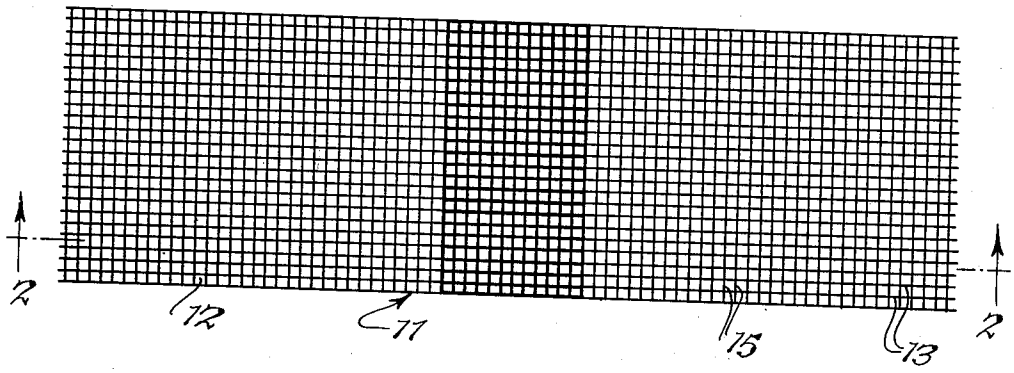


Fig. 2.



Fig. 3.

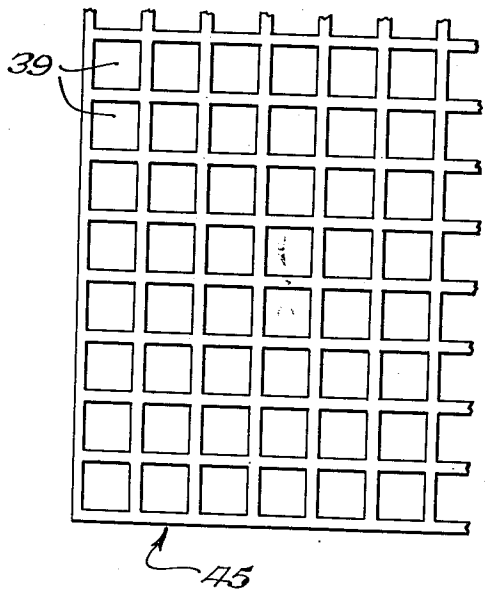
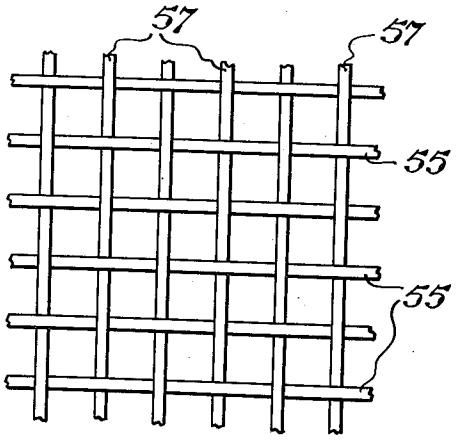


Fig. 4.



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2 Sheets-Sheet 2

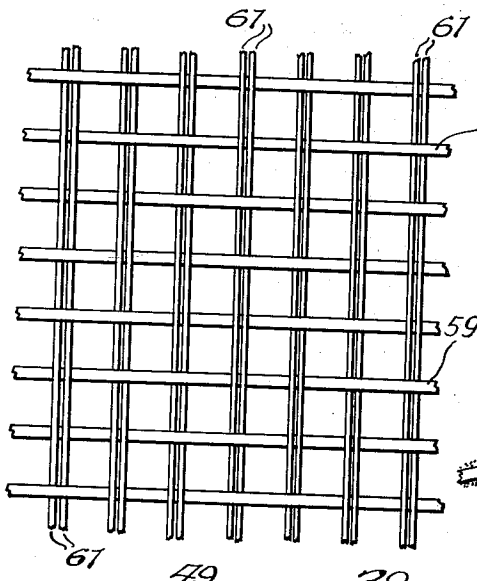
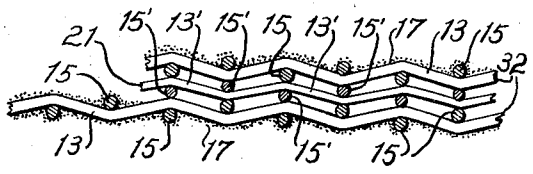


Fig. 5.

Fig. 8.



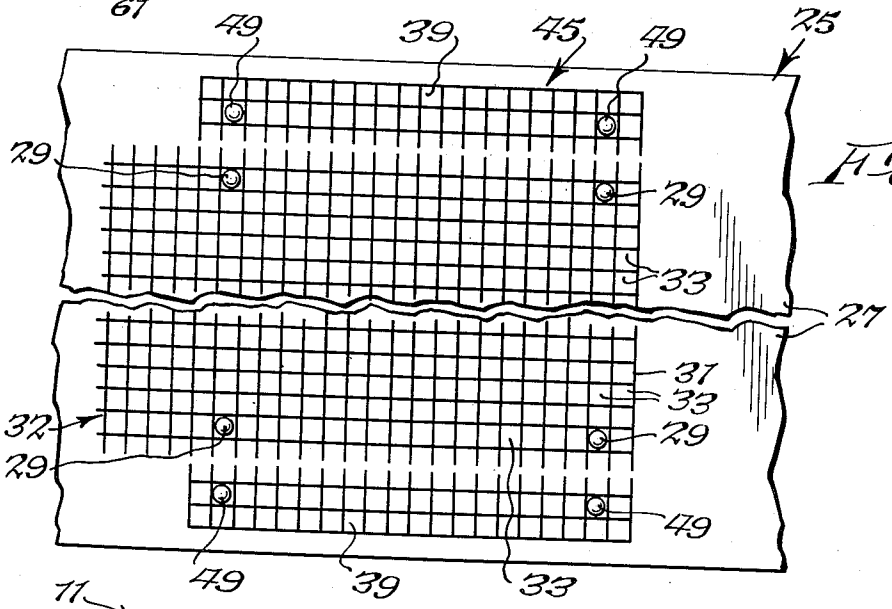


Fig. 6.

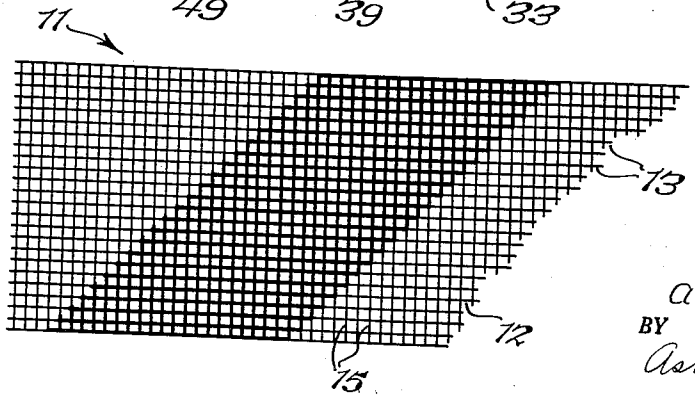


Fig. 7.

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United States Patent Office 2,778,169 Patented Jan. 22, 1957

2,778,169

FLEXIBLE ABRASIVE BANDS

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Application October 20, 1953, Serial No. 387,099

8 Claims. (Cl. 51—188)

The invention of this application relates to abrasive belts, bands, sleeves and the like. More particularly, it is concerned with such abrasive articles formed from abrasive products of the type in which a deposit of abrasive granules is provided around the yarns of an open mesh fabric and with methods of making such articles from abrasive products of the character described.

It is an object of the invention to provide from abrasive products of the character described abrasive bands, belts, sleeves and the like in which the novel and desirable characteristics of the abrasive products are retained.

Another object of the invention is to provide from abrasive products of the character described abrasive bands, belts, sleeves and the like which have a high efficiency.

A further object of the invention is to provide abrasive bands, belts and sleeves of the type described above which are cool cutting and which may be used on both sides.

Another object of the invention is to provide abrasive belts, bands and sleeves of the type described above which are strong, durable and economical, and which may be conveniently manufactured.

Still another object of the invention is to provide methods of manufacturing abrasive bands, belts and sleeves of the type described above which may be inexpensively and conveniently carried out.

Other objects and advantages of the present invention will be apparent from the following description taken in conjunction with the accompanying drawings in which:

Figure 1 is a diagrammatic, fragmentary, plan view of an abrasive belt or band constructed in accordance with the present invention;

Figure 2 is an enlarged, fragmentary, diagrammatic view of a portion of the abrasive belt or band shown in Figure 1, taken on the line 2—2 of Figure 1;

Figure 3 is a fragmentary, plan view of an adhesive film such as may be used in constructing belts, bands and the like according to the present invention;

Figure 4 is a fragmentary, enlarged, diagrammatic plan view of a typical open mesh fabric of the kind employed as a base in manufacturing the abrasive products from which abrasive belts, bands and the like are formed according to the present invention;

Figure 5 is a view similar to Figure 4 of another type of open mesh fabric base;

Figure 6 is a fragmentary, plan view of a portion of a positioning guide or jig suitable for use in splicing abrasive belts and the like according to the method of the present invention with one end of an abrasive strip and an adhesive film thereon;

Figure 7 is a view similar to Figure 1 in which the splice of the abrasive belt or band is arranged diagonally thereof; and

Figure 8 is an enlarged, fragmentary, diagrammatic view similar to Figure 2 illustrating a modification.

In a copending application, Serial No. 365,722, filed July 2, 1953, which matured as Patent No. 2,740,239, April 3, 1956, novel abrasive products or materials are disclosed which products comprise an open mesh fabric base, the yarns of which are covered over their entire exposed surfaces with a deposit of adhesively held abrasive granules. The present application relates to flexible abrasive sleeves, bands, belts and the like (these articles being hereinafter generically referred to as "abrasive bands") formed from such novel abrasive products. Abrasive bands of this type are particularly useful since the large number of open spaces provided by the mesh openings therein facilitates rapid elimination of the detritus produced during sanding or polishing. Further, the complete coating of the yarns of the fabric with a substantially uniform deposit of abrasive granules permits such bands to be used on both sides, thus greatly prolonging their useful abrasive life.

In forming such abrasive bands it is desirable to interfere as little as possible with the regular mesh formation of the abrasive products from which they are made. By maintaining a regular mesh arrangement throughout the circumference of the band, uniformity of abrasive action will be obtained. Consequently, the conventional method of splicing an abrasive band formed from a length of sandpaper or the like, which involves the use of a liner or reinforcing strip fastened to the band under the abutting ends thereof, is, of course, not feasible. The present invention, therefore, includes a novel method of forming abrasive bands that results in the production of abrasive bands in which the mesh openings of the abrasive product are left substantially unobstructed.

Referring to Figures 1 and 2, the reference character 11 indicates a band made from a strip 12 of abrasive coated, open mesh fabric of the type described in the copending application mentioned above. The fabric comprises interlaced, warp yarns 13 and filling yarns 15 and the exposed surfaces of the yarns are covered with a deposit of abrasive granules indicated by the reference character 17. Broadly, the band 11 is formed by overlapping the ends of the strip 12 and adhesively joining them together after first removing the abrasive coatings 17 from the facing portions of the ends as illustrated in Figure 2. The abrasive coatings may be removed in any desired way as by scraping or by grinding them away with an abrasive wheel. It will be understood that in the removal of the coatings care must be exercised to prevent damage to the open mesh fabric base of the abrasive strip.

To preserve the open mesh characteristics of the abrasive product, it is important that the mesh openings in the overlapping ends of the strip 12 be in registry. Such registration is also important to the strength of the band as the joint between the ends of the strip will be stronger when the yarns of the open mesh fabric base in the two ends are in contact over the maximum area. Accordingly, it is desirable to provide a jig or positioning guide when forming abrasive bands from abrasive coated open mesh fabrics. Such a positioning guide, designated generally by the numeral 25, is shown in Figure 6.

The guide 25 comprises a plate 27 of substantial thickness. Mounted in the plate 27 and projecting from the upper surface thereof are a plurality of spaced, resiliently supported, retractable pins 29 of such diameter as to pass through the mesh openings of an open mesh, abrasive coated fabric strip. The fit of the pins 29 in the mesh openings should be snug enough, however, to prevent any substantial shifting of the strip. In Figure 6 one end 31 of an abrasive coated strip 32, similar to the strip illustrated in Figures 1 and 2, is shown in place on the plate 27 with the pins 29 extending through spaced mesh openings 33 therein.

In forming an abrasive band the abrasive is removed from the upper surfaces of the yarns in the end 31. Then,

after locating the end on the positioning guide or jig in the manner shown in Figure 6, a coating of suitable adhesive such, for example, as a liquid phenol-formaldehyde condensation product resin, is applied to the upper surfaces of the yarns. The other end of the strip **32**, after removal of the abrasive from the opposite side thereof has a similar coating of adhesive applied to the exposed yarn surfaces thereof. After allowing the adhesive coatings to dry slightly if necessary, the second-mentioned end of the strip **32** is placed in position on the plate **27** overlapping the end **31** already located thereon. Proper registration of the mesh openings **33** in the second-mentioned end of the strip with the mesh openings in the end **31** is ensured by the retractable pins **29**. Pressure is then applied by a hydraulic press, clamps or other suitable means to press the adhesive coated yarns on the ends of the strip into firm contact. The adhesive may thereafter be set or cured in any desired and convenient manner as by application of heat while continuing the pressure.

Alternatively, instead of applying liquid adhesive to the contacting ends of the abrasive strip from which an abrasive band is to be formed, bonding of the strip ends may be accomplished by the use of a separate intermediate bonding layer. Thus, a film of adhesive may be employed, the film being punched or cut out to provide a recticular sheet **45**, such as is shown in Figure 3, the openings **39** in which are of substantially the same size as those of the abrasive strip employed. In forming a joint in an abrasive band with such a film of adhesive, the end **31** of an abrasive strip **32**, after removal of the abrasive coating, is placed on the plate **27** of the jig **25** in the manner described above and shown in Figure 6. A reticular sheet of adhesive **45** of proper size is then placed on the positioning guide **25** over the end **31** of the strip **32**. The end **31** is, as before, held in position by the engagement of the retractable pins **29** in the mesh openings **33** of the strip. Registration of the openings **39** in the sheet **45** with the openings **33** is secured by additional retractable, resiliently supported pins **49** mounted in the plate **27**. The pins **49** are similar to the pins **29** and a plurality of the former are provided in the plate **27** adjacent each side edge thereof and outwardly from the edges of the strip **32** in such positions that when they engage in the openings **39** of the adhesive sheet **45** the openings **39** will be aligned with the mesh openings **33** of the abrasive strip. The other end of the strip **32**, after removal of the abrasive coating from the yarns thereof on the proper side, is then placed in overlapping position on the end **31** in the same manner as before where it is held in proper registering position by the pins **29**. The combination is then pressed together by suitable means and is heated to cause the adhesive film **45** to flow into intimate contact with the adjacent yarns of the two ends of the strip **32** and cause them to adhere together. Adhesive films of the type described are widely used for various purposes and may be formed of any suitable heat-flowable material. Films of an "A" stage phenol-formaldehyde resin may be used conveniently.

Instead of using an auxiliary film of adhesive alone to secure the ends of the abrasive strip **32** together, it is possible in some cases to use an intervening layer of an open mesh fabric having the same cloth count as the base fabric of the strip. A piece of such a fabric may be saturated with a suitable adhesive, such as a liquid phenol-formaldehyde resin, and then, either with or without drying, inserted between the overlapping ends of the strip **32** on the positioning guide **25** in the same manner as the adhesive film **45**. When pressure and heat are applied to the composite structure, the adhesive in the saturated yarns of the interposed fabric will flow into contact with the exposed yarns in the overlapping ends of the strip **32** and cause them to be firmly held together. The adhesive saturated fabric may be woven of yarns of the same sizes as those of the base fabric of the strip **32**. It is preferred,

however, to use a fabric that has the same cloth count as the base fabric, but in which somewhat finer yarns are used. The amount of material in the joint will, in such case, be somewhat reduced and the thickness of the joint will be less. Such a construction is illustrated diagrammatically in Figure 8. There the overlapping ends of the abrasive coated strip **32** have interposed a strip of adhesive saturated fabric **21** the warp and filling yarns **13'** and **15'**, respectively, of which are somewhat smaller than the yarns **13** and **15** of the strip **32**.

It will be evident that when the mesh openings of the interposed adhesive-saturated fabric sheet are larger than the mesh openings of the abrasive coated fabric the retractable positioning pins **49** must be larger than the pins **29** to maintain the sheet in proper position. A convenient arrangement is to have the retractable pins **29** and **49** mounted in blocks (not shown) of predetermined fixed size which may be inserted in holes provided therefor in the plate **27**. Thus, not only can adjustment be made for differences in the sizes of the mesh openings of the abrasive strip and the intervening adhesive sheet, but the same plate **27** may be used in forming abrasive bands from abrasive coated fabrics of different mesh sizes by inserting blocks having pins of suitable size in the plate. It will also be evident that the plate **27** may be provided with a longitudinal slot or passage adapted to receive the strip **32** to facilitate the superposition of the strip ends on the top of the plate. When such a slot or passage is provided the positioning guide or jig **25** may be used between the platens of any conventional press and the upper press platen may be used to apply pressure to the joint.

The joints of abrasive bands formed according to the present invention may extend across the width of the band at an angle of 90° to the length thereof as shown in Figures 1 and 2 or may be diagonal as shown in Figure 7 or of any other suitable and desired configuration. In most cases sufficient pressure can be applied to the splice or joint to reduce its thickness to substantially the same thickness as the original abrasive strip. It is desirable to prevent, as far as possible, damage to the abrasive coatings on the yarns of the base fabric during formation of a band in accordance with the present invention.

This may be accomplished by pressing the lapped ends of the abrasive coated strip on the jig **25** only sufficiently to cause them to adhere with the mesh openings thereof in properly registering positions. The band may then be removed to another suitably constructed press, the platens of which are provided with thin facings of silicone rubber, and further pressed. The silicone rubber is resilient and cushions the abrasive particles projecting from the yarns of the abrasive coated fabric and prevents fracturing of such particles, thus preserving the sharp cutting character of the spliced area. Since silicone rubber has a considerable resistance to heat, the press platens may be heated to soften the adhesive used for splicing the bands and, when thermosetting adhesives such as phenol-formaldehyde resins are used, to cure the adhesive. If necessary to prevent sticking of the abrasive granules to the silicone rubber a mold release agent such as one of the widely used silicone mold lubricants may be employed. It will be understood that, if desired, the cure of the adhesive need not be completed on the press but that, after pressing and an initial cure, the bands may be removed and the cure completed in any other suitable way.

The width of the joints in abrasive bands according to the invention may vary within rather wide limits depending upon numerous factors such as the mesh size of the fabric, the size of the yarns, and the type of adhesive employed for the joint. In general, joint or splice widths of about ½ inch have been found satisfactory for bands in which the base fabric of the abrasive strip is woven from 300 denier yarns and has a cloth count of 24 x 24, and the adhesive employed is a phenol-formaldehyde

resin. It will be realized that a certain minimum area of contact between the yarns of the overlapping band ends must be obtained in each case. Consequently, some experimentation may be necessary to determine the narrowest splice that may be satisfactorily used with different combinations of yarn sizes, cloth counts and adhesives. Obviously, however, larger yarns, higher cloth counts and stronger adhesives will tend to a reduction in the splice width required.

Figures 4 and 5 illustrate types of open mesh fabrics on the yarns of which abrasive deposits may be secured to form the flexible abrasive products from which bands are made according to the present invention. In Figure 4 there is shown a fabric having a plain weave, i. e. one in which each filling yarn **55** passes under and over alternate warp yarns **57** and each warp yarn passes over and under alternate filling yarns. Such fabrics are inexpensive and strong and abrasive coated products may be readily made therefrom by the process described in the copending application mentioned above.

Figure 5 shows a fabric having a "two and two" twill weave. In this, each filling yarn **59** passes under two warp yarns, then over the next two warp yarns, and repeats this sequence across the width of the fabric. With each successive filling yarn the sequence is shifted to the right or left, as the case may be, thus forming a diagonal pattern in the fabric which is characteristic of twill weaves. Doubled warp yarns **61** are employed in the twill illustrated in Figure 5, each pair of yarns **61** being picked as a single yarn. The use of doubled warp yarns tends to make a flatter, smoother fabric. Abrasive coated, open mesh fabrics in which the base fabric is a twill weave may be preferred in some cases to those abrasive products having a plain woven base fabric for making abrasive bands as the characteristic diagonal of twill weaves results in a more uniform and smoother finish on the work.

The base fabrics for the open mesh abrasive coated product from which abrasive bands may be formed according to the present invention are preferably woven from continuous filament yarns such as rayon, nylon, glass and the like. Although other weaves may be used in producing open mesh fabrics for this purpose, it is preferred to employ either a plain weave (illustrated in Figure 4) or an even twill weave, such as a "two and two" (illustrated in Figure 5), a "three and three" or a "four and four." In the latter two twills the filling yarns interlace three and four warp yarns, respectively. Doubled warp yarns may be used with either plain or twill weaves if desired. The size of the yarns used may vary widely depending upon the intended use of the product, the strength of the yarns, the cloth count of the fabric, and the desired size of the mesh openings. In general, the yarn sizes used in the warp and filling are substantially the same and, when doubled warp yarns are employed, the size of each is preferably about half that of the filling yarn.

Preferably the yarns of the woven open mesh fabric are impregnated and coated, while the fabric is still under normal tension on the loom, with a flexible material such, for example, as neoprene latex and the impregnant is dried or cured before removing the fabric from the loom. Such impregnation by preventing penetration of the yarns by the adhesive or bond used for securing the abrasive coating thereon, permits the obtaining of very flexible abrasive products. Moreover, the fabric is more durable, since the yarns are attached at their points of interlacing and the mesh openings therein are more uniform.

The abrasive coatings on the open mesh fabric may be formed with any desired type of natural or synthetic abrasive material in any suitable grit size or combination thereof. The abrasive granules, which may be either single particles or bonded aggregates of particles, are bonded to the fabric yarns, over the entire exposed surfaces thereof, by a suitable adhesive. Such adhesives are preferably relatively hard and inert so as not to be softened

by the heat generated in use or by the coolants commonly employed in grinding and polishing operations. It has been found that, while other bonds or adhesives may be used, phenol-formaldehyde condensation product liquid resins are suitable in most cases. After curing, such adhesives are not much affected by heat and are substantially insoluble in most solubles. The abrasive deposit on the yarns may be relatively thin or of substantial thickness. It is to be noted, however, that even though the abrasive deposits are so thick as to reduce the areas of the mesh openings to about half of their original areas, the remaining areas of the mesh openings are clear and unobstructed.

In manufacturing abrasive bands according to the process of the present invention care must be taken that the bonds used in the abrasive coated fabrics and the adhesives used for making the splices are compatible and that the curing conditions required for the latter will not damage the abrasive bond.

It will be apparent that the abrasive bands of the present invention are convenient, efficient, and economical. The relatively large openings in the bands permit free access of air to the work piece with consequent cooler grinding. Where the adhesives employed in forming the abrasive coated fabric and the band splice are insoluble, coolants may also be used if desired. Since the entire exposed surfaces of the yarns forming the fabric base are covered with an abrasive deposit that may be of substantial thickness, the bands may be used on both sides with resultant economy. Although, as pointed out above, it is desirable to have the mesh openings of the overlapping ends of the abrasive bands in registry, it will be understood that bands in which the mesh openings are not in registry or are partially or wholly blocked, though less desirable in some cases, are still useful.

It will be understood that many modifications and changes may be made in details of the present invention without departing from the spirit thereof. For example, an abrasive band of the character described herein may be formed by first overlapping and joining the ends of a strip of impregnated open mesh base fabric, such as is described above, using a suitable adhesive and maintaining the mesh openings of the overlapped ends in registry and thereafter adhesively securing a deposit of abrasive granules to the exposed yarn surfaces of the fabric base of the band. Accordingly, the invention is not to be considered as limited by the details of construction shown and described, but is to be interpreted as broadly as permitted by the appended claims.

I claim:

1. A flexible abrasive band comprising a strip of open mesh fabric, the ends of said strip being adhesively joined in overlapping relation, said band having an abrasive deposit on substantially all of the exposed surfaces of the yarns of said strip, and the overlapping ends of said strip being so disposed that the mesh openings of said ends are in registry.

2. A flexible abrasive band which comprises a strip of an open mesh flexible abrasive product having a base of an open mesh fabric and a coating of abrasive granules over substantially the entire exposed surfaces of the yarns of said fabric and held thereon by a hardened adhesive, the ends of said strip being free from abrasive on opposite sides and being adhesively joined in overlapping relation with the mesh openings thereof in registry and the abrasive-free surfaces facing.

3. A flexible abrasive band as set forth in claim 2 in which the yarns of said open mesh fabric are impregnated with a flexible material.

4. A flexible abrasive band as set forth in claim 2 in which said open mesh fabric has a twill weave.

5. A flexible abrasive band as set forth in claim 2 in which a piece of open mesh fabric is interposed between the overlapping ends of said strip and said ends and said piece of fabric are adhesively joined.

6. A process for forming an endless, flexible abrasive

band which comprises providing a strip of open mesh fabric having the exposed surfaces of the yarns of said fabric covered with a deposit of abrasive granules, providing a cleared area by removing the abrasive on one side of said strip from a relatively narrow area at one end thereof, providing a second cleared area by removing the abrasive on the other side of said strip from a similar area at the other end of said strip, overlapping said ends with said cleared areas facing in superposed relation with adhesive therebetween and with the mesh openings of said ends in alignment, and pressing said superposed areas.

7. A process as set forth in claim 6 in which a reticular sheet of heat-softenable, solid adhesive is interposed between said cleared areas before pressing.

8. A process as set forth in claim 6 in which, before pressing, a piece of open mesh fabric impregnated with a heat-softenable adhesive is interposed between said cleared areas with the mesh openings thereof in registry with the mesh openings of said strip.

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