METHOD AND APPARATUS OF STRIP WEBBING

Filed Dec. 4, 1963

2 Sheets-Sheet 1

Fig. 1

Fig. 7

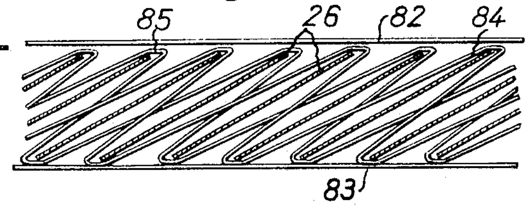


Fig. 2

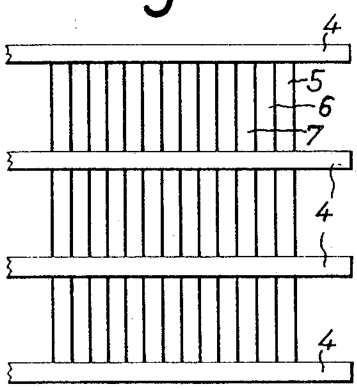


Fig. 8

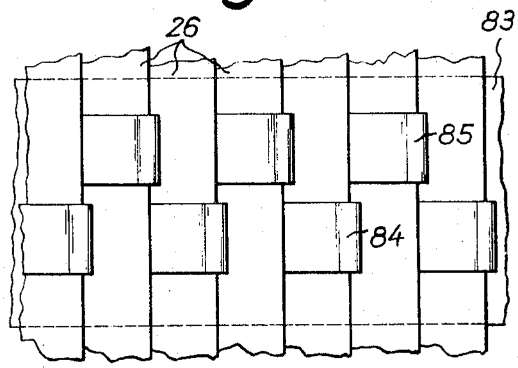


Fig. 3

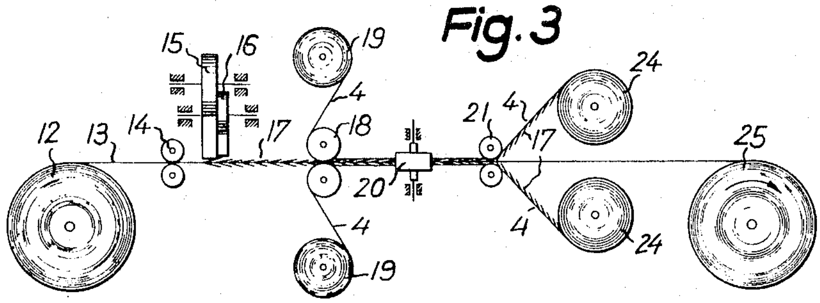


Fig. 9

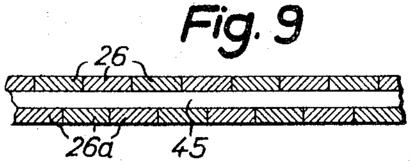
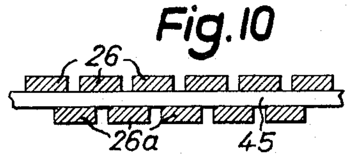


Fig. 10



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METHOD AND APPARATUS OF STRIP WEBBING

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Fig.5

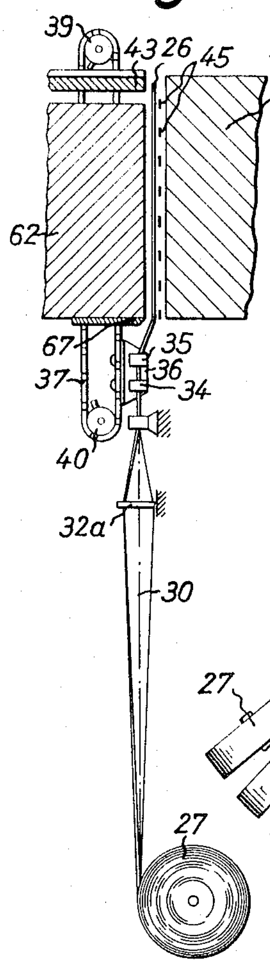


Fig. 4

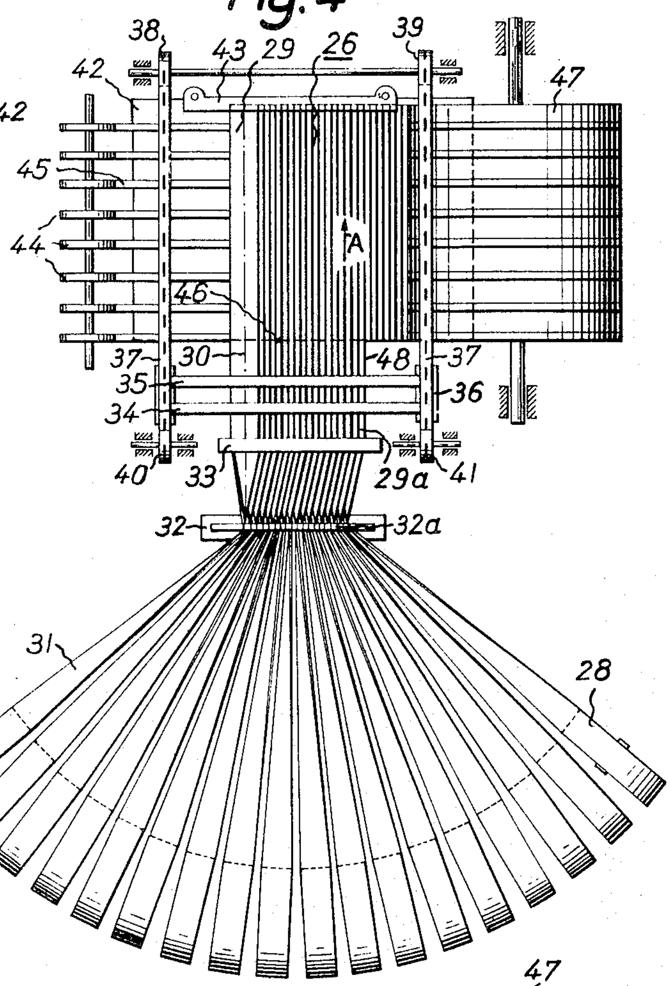
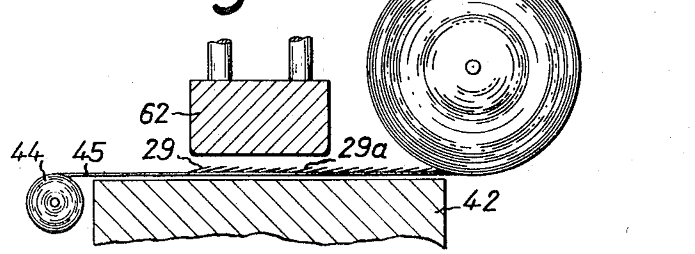


Fig. 6



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METHOD AND APPARATUS OF STRIP WEBBING

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33 Claims. (Cl. 156—65)

The present invention relates to strip webbing.

High voltage equipment and machinery is often provided with insulation which is made up of thin layers of insulating material which are wound, in layer form, onto the part to be insulated. One edge of the layer generally projects beyond the part and is rent over. More particularly, a portion of the wound-on insulation which extends beyond the piece being insulated is torn by forcibly rending the strip over so as spatially to deform the insulation, thereby to provide a boundary field insulation. This type of insulation is frequently used for oil-filled high-voltage transformers with layer windings, the insulation having an angled-over flange portion which is rent over. While such insulation produces very good boundary field insulation, the same is very expensive, and accordingly, various efforts have been made to reduce the costs of this type of insulation.

According to one proposal, disclosed in my co-pending application Serial No. 310,565, filed September 23, 1963, the insulation is constituted by strip webbing consisting of multiple overlapping transverse insulating strips, which strips are applied onto one or more longitudinal bands at approximately right angles thereto, the purpose of the longitudinal bands being to hold the transverse strips together at least until the webbing is applied to the equipment. The insulating flange which extends at approximately right angles to the axis about which the insulation has been wound is formed by removing the longitudinal bands which are in alignment with that portion of the insulation that extends beyond the winding being insulated, and by then bending the insulation at about right angles to the axis. These flanges can then be retained between rings made of suitable insulating material, such as press board. Insulation of this type is shown, in side and plan views, respectively, in FIGURES 1 and 2, in which the transverse strips **1**, **2**, **3**, arranged in scale-like overlapping relationship, are connected together by means of longitudinal bands **4**. FIGURE 2 shows, at **5**, **6**, **7**, those portions of the transverse strips **1**, **2**, **3**, which are visible from above. The longitudinal bands **4** are suitably connected to the transverse strips, such as by welding or by means of adhesive.

So far reference has been made only to insulation. In practice, however, strip webbing of the above-described type may include conductive material thereby to form spatially deformable conductive screens. Such screens are used, for example, as control screens which are incorporated in insulating webbing that is interposed between the high and low-voltage windings of a transformer. Here, the transverse strips consist either of a material that is a poor conductor of electricity, or of a metallic material which is covered with stripping made of poor conductors such as carbon paper and which may additionally be covered with insulating material. The ends of such webbing which project beyond the part on which the webbing is applied may then be rent over in the same manner as in the case of the insulating webbing.

The strip webbing shown in FIGURES 1 and 2 may be made by means of a machine such as is shown schematically in FIGURE 3. For purposes of explanation, the operation of the machine will be described in conjunction with the manufacture of insulating strip webbing,

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it being clear that, by using different materials, a conductive webbing may be made.

A wide carrier band **13** is taken off a supply roll **12** and passes between two guide rollers **14**, to be wound ultimately onto a take-up reel **25**. The carrier band **13**, during its travel from the guide rollers **14** to the take-up reel **25**, is provided with the thin, overlapping transverse insulating strips supplied by two supply rolls **15**, **16**, that are continuously wound around the band **13**. These transverse strips are thus "spun" onto the carrier band **13**, in a manner somewhat similar to that in which insulating paper or foil is spun onto flat wires which themselves ultimately serve as windings for machinery. The transverse strips are shown, in cross section, at **17**. Two supply rollers **19**, arranged, respectively, above and below the band **13** carrying the overlapping transverse strips **17**, apply self-adhering longitudinal insulating bands **4** to the top and bottom, respectively, of the transverse strips, these longitudinal insulating bands **4** being pressed on by means of pressure rollers **18**. In this way, the transverse strips **17** are adhered to the upper and lower longitudinal bands **4** and are secured to the carrier band **13**.

Next along the work path are suitable cutting knives **20** which cut open the webbing on both sides of the carrier band **13**, thereby separating the webbing from the band. The now-finished webbing at the top and bottom is then taken off the carrier and run, via guide rollers **21**, onto take-up reels **24**.

One basic drawback of the above method of making the strip webbing is that the supply reels **15**, **16**, have to be replenished very frequently, since the transverse stripping "spun" about the longitudinal carrier is very long in comparison to the length of the longitudinal carrier band **13** onto which this transverse stripping is applied. This means that whenever a new reel has to be put in place, the entire machine has to be stopped, which, in practice, results in a very inefficient way of making the product. The problem is particularly acute in the case of wide strip webs whose width is of the order of 2 to 3 meters.

It is, therefore, an object of the present invention to provide a method and an apparatus for making webbing of the above-described type, namely, webbing which consists of thin transverse strips and longitudinal bands which hold the transverse strips in position, which method and apparatus overcome the above drawbacks, and, with this basic object in view, the present invention resides in the fact that a plurality of transverse strips are, approximately simultaneously, pulled off supply rollers, are thereafter intermittently, i.e., in a step-wise manner, secured to the longitudinal bands, and are cut to the proper length.

Additional objects and advantages of the present invention will become apparent upon consideration of the following description when taken in conjunction with the accompanying drawings in which:

FIGURES 1 and 2, already referred to above, are cross-sectional and plan views, respecially, of strip webbing of the type produced by the present invention.

FIGURE 3, already referred to above, is a diagrammatic view of a machine in which the webbing of FIGURES 1 and 2 is produced by continuously spinning transverse strips about longitudinal bands.

FIGURE 4 is a diagrammatic plan view of a machine for carrying out the method of making the webbing of FIGURES 1 and 2 in accordance with the present invention.

FIGURE 5 is a side elevational view of the machine shown in FIGURE 4, as viewed from the left side thereof.

FIGURE 6 is a front elevational view of the machine of FIGURE 4, as seen in the direction of arrow A in FIGURE 4.

FIGURE 7 is an elevational view of a component used in the machine of FIGURES 4 to 6.

FIGURE 8 is a plan view of the component shown in FIGURE 7.

FIGURES 9 and 10 are sectional views of other types of strip webbing which may be produced according to the method of the present invention.

Referring now once again to the drawings and now to FIGURES 4 to 6 therein in particular, FIGURE 4 shows approximately twenty transverse strips **26** which are drawn off a corresponding number of supply rolls at the same time. For the sake of simplicity, a group of such transverse strips, all of which are processed simultaneously, will hereinafter be referred to as one transverse cluster.

The individual transverse strips of each cluster are, as stated, taken off a corresponding number of individual supply rolls. The first of these is indicated at **27**, the last at **28**. The leftwardmost transverse strip of a cluster is indicated at **29**, the longitudinal center line or axis of this strip at **30**. The rightwardmost strip is shown at **29*a***. Each strip is drawn off in approximately horizontal direction and runs past one of the approximately vertically oriented tines **32*a*** of a comb-like member **32**, from there to a stationary strip-posioning guide member **33**, and from there to a point between a press member **34** member **35**. The strip-positioning guide members **33** and **35**, one embodiment of which will be described in detail below, serve to position the transverse strips so that the same will lie in the desired overlapping relationship. The components **34**, **35**, are secured, by means of attaching devices **36**, to transport chains **37**. These chains run over two sprocket drive wheels **38**, **39**, which are mechanically connected to each other for rotation, and two idler sprockets **40**, **41**, so that the components **34**, **35**, can be drawn to overlie a work table **42**.

The transport device constituted by the press member **34**, the guide member **35**, and the attaching devices **36** is movable between the starting position shown in FIGURE 4, and an end position in which the transverse strips of the cluster, whose end portions are clamped, at points spaced from the extreme ends of the strips, between components **34** and **35**, have been drawn transversely so that the extreme free end portions of the transverse strips have come to lie below a press member **43**. Once the transport device is in this end position, the press member **43** is brought down thereby to hold in place the strip of the cluster, so that after the components **34**, **35**, have been separated, the transport device can be withdrawn back to its starting position.

The longitudinal holding bands, indicated at **45**, are then drawn off supply rolls **44**. These longitudinal bands are made to lie immediately above the work table **42** but below the transverse strips of the cluster (see FIGURE 6).

After the transport device has been returned to its starting position and the transverse strips of the cluster are held in place by the press member **43**, the transverse strips are pressed down against the longitudinal bands **45** by means of a suitable pressing member **62** (FIGURES 5 and 6). These longitudinal bands **45** will, in practice, be of the self-adhering type, i.e., they will carry a suitable adhesive coating so that once the transverse strips have been pressed down, they will be held by the longitudinal bands **45**. As the transverse strips of the cluster are pressed down against the longitudinal bands **45**, the transverse strips are cut along the line **46**, which coincides substantially with the lateral edge of the work table **42**, by a knife **67** (FIGURE 5) carried on and movable with the pressing member **62**. The pressing member **62** and the press member **43** are then raised, and the take-up reel **47** is rotated to take up so much of the now finished strip webbing that the right-hand edge **48** of the rightwardmost transverse strip **29*a*** of the next cluster will come into proper overlapping relationship with the leftwardmost strip **29** of the cluster that has just been finished. This finishes one cycle of operation. The next cycle of operation commences as soon as the transport device grasps the next cluster and moves the same over the work table **42**.

One of the most significant advantages of the above-described method is that the transverse strips are taken off a large number of individual rolls. In practice, it is readily feasible to provide 100 or 200 individual supply rolls. If the transverse strips of one cluster overlap by, say, 5 to 10 mm., one cluster can have a width of 50 cm. to 2 meters, as a result of which a very high operating speed and production rate is achieved.

The individual supply rolls are shown, in FIGURE 4, as being spread out in a fan-like arrangement. This makes each of the rolls readily accessible. If each of the rolls is arranged in a suitable cradle in which each roll is guided by the side walls and braked by externally acting pressure springs, a spent roll can readily be replaced—for example, by adhering a wedge-shaped end of a strip from a fresh roll to the strip of the roll that is about to run out—without it being necessary to stop the operation of the machine.

While FIGURES 5 and 6 show the pressing means which press the drawn off transverse strip of a cluster against the longitudinal bands as being constituted by a reciprocatory press member, the pressing means may be constituted by equipping the transport device with a press roller which comes down into an operative position while the transport device moves from its end position back to its starting position. Suitable means will then be provided, e.g., a camming device, which raises the press roller during the time that the transport device brings a new cluster over the work table.

The longitudinal bands which serve to hold the transverse strips in place will generally be made of very thin insulating material which, as set forth above, carry an adhesive. In practice, the adhesive will be one which will allow the longitudinal bands to be "peeled" off the transverse strips after the strip webbing has been placed on the apparatus with which it is to be used, thereby to allow the webbing to be spatially deformed, as explained above.

If the strip webbing is to constitute insulation, not only the longitudinal bands but also the transverse strips will be made of insulating material. The transverse strips and longitudinal bands may be made of different materials; for example, the transverse strips may be made of high quality absorbent insulating paper while the longitudinal bands are made out of high-strength thin plastic foils. Also, the transverse strips and the longitudinal bands may have different thicknesses.

If the strip webbing is to be conductive, the transverse strips will be made of conductive material and the longitudinal bands of insulating material. The transverse strips can be made of conductive paper, e.g., carbon-type paper, or of thin bare metal strips or of metal strips which are covered with a conductive paper coating, or, under certain circumstances, of metal strips which are covered with a conductive paper coating and over that, a layer of insulating material.

The purpose of covering the metallic transverse strips with conductive paper is to cover the sharp edges of the metal strips. In order electrically to connect with each other the individual conductive transverse strips of a conductive-type strip webbing, there can be provided, together with the insulating longitudinal bands, one or more electrically conductive longitudinal bands which may be made of metal and which are soldered with the metallic center of the transverse strips or which are adhered to conductive transverse strips by means of a conductive lacquer. These conductive longitudinal connections of the transverse strips can be provided at, or just prior to, the final processing of the strip webbing.

The above-described guide members **33**, **35**, play an important role in the present invention. It has been found that the thinner the individual guide elements of these members are made, the more uniformly will the transverse strips be placed in position. Accordingly, the machine according to the present invention may include guide members corresponding to the stationary and movable guide members **33** and **35**, described above, which guide members comprise thin stripping which is wound at least twice about the path to be followed by the transverse strips **26**, so that each of the latter will be guided at both of its edges. Such an arrangement is shown in FIGURES 7 and 8 which includes upper and lower cover plates **82** and **83** (the upper plate **82** having been removed in FIGURE 8 to permit illustration of the parts), between which are two zig-zag strips **84**, **85**, that loop back and forth so as to provide passages through which the transverse strips **26** extend. As is best shown in FIGURE 7, the passages formed by the zig-zag strips are so arranged that the strips **26** are in multiple overlapping relationship, i.e., each strip **26** overlies not only the immediately adjacent strips **26**, but also the strips beyond.

The zig-zag strips **84**, **85**, are secured to the cover plates, or to at least one of them, preferably the lower one, by suitable means such as by riveting or welding.

In order that the strips **26** be guided through as reliably as possible, the cover plates are extended beyond the zig-zag strips **84**, **85**, against the direction of travel of the transverse strips **26**. Also, the point at which the strips **26** enter the guide member will be narrowed at the cover plates so that already here the strips **26** will assume the proper position.

The strip webbing described so far involves the provision of overlapping transverse strips. In practice, however, the strip webbing may be so constructed that the transverse strips of one cluster all lie in the same plane, these strips being either immediately next to each other (FIGURE 9) or spaced apart a small distance (FIGURE 10). In that case, the webbing will include a further layer of co-planar transverse strips **26*a***, as shown in FIGURES 9 and 10, so that the machine of FIGURES 4 to 6 will include two transport devices, namely, an upper and a lower transport device, the latter being arranged to pull a second cluster of co-planar transverse strips below the longitudinal bands **45**. In order to avoid any gaps, the strips of the upper and lower clusters will be staggered with respect to each other, as illustrated.

In order that the press member will cause both layers of transverse strips to be secured to the longitudinal bands **45**, the latter will have an adhesive coating on both sides.

As set forth above, the connection between the longitudinal bands and transverse strips should be such that the longitudinal bands can be peeled off. If, instead of an adhesive connection between the bands and strips, the same are welded together, the welding should be in the nature of a temporary or "tacking" weld which allows the bands to be removed from the strips.

It will be understood that the above description of the present invention is susceptible to various changes, modifications and adaptations, and the same are intended to be comprehended within the meaning and range of the appended claims. For example, the strip webbing produced in accordance with the present invention is not limited for use as insulation or winding intended for high-voltage machinery, since the strip webbing, being so constructed as to enable it to be spatially deformed after it has been applied, can be used for packaging various types of articles.

What is claimed is:

1. A method of making strip webbing which is made up of transverse strips and of longitudinal bands that are secured to the transverse strips for holding the same together, said method comprising, the steps of positioning the longitudinal bands; drawing simultaneously a cluster of transverse strips, each from its respective supply roll, across the longitudinal bands for placing the

transverse strips on the longitudinal bands; and cutting the cluster of transverse strips so that each has a length that corresponds to the width of the strip webbing, whereby a plurality of individual transverse strips are applied to the longitudinal bands in a stepwise manner.

2. A method of making strip webbing which is made up of transverse strips and of longitudinal bands that are secured to the transverse strips for holding the same together, said method comprising the steps of positioning the longitudinal bands; drawing simultaneously a cluster of transverse strips, each from its respective supply roll, across the longitudinal bands for placing the transverse strips on the longitudinal bands; cutting the cluster of transverse strips so that each has a length that corresponds to the width of the strip webbing; drawing the now-assembled strip webbing, in the direction of the longitudinal bands, away from the place at which the cluster of transverse strips was applied to the longitudinal bands; and repeating the above steps, whereby a plurality of individual transverse strips are applied, in clusters and in a stepwise manner, to the longitudinal band.

3. A method of making strip webbing which is made up of transverse strips and of longitudinal bands that are secured to the transverse strips for holding the same together, said method comprising the steps of positioning the longitudinal bands; drawing simultaneously a cluster of transverse strips, each from its respective supply roll, across the longitudinal bands for placing the transverse strips on the longitudinal bands; cutting the cluster of transverse strips so that each has a length that corresponds to the width of the strip webbing; pressing the cluster of transverse strips and the longitudinal bands together for securing the strips and bands together; drawing the now-assembled strip webbing, in the direction of the longitudinal bands, away from the place at which the cluster of transverse strips was applied to the longitudinal bands; and repeating the above steps, whereby a plurality of individual transverse strips are applied, in clusters and in a stepwise manner, to the longitudinal band.

4. The method defined in claim **3** wherein the transverse strips, while the same are being drawn across the longitudinal bands, are in overlapping relationship.

5. The method defined in claim **3** wherein the transverse strips, while the same are being drawn across the longitudinal bands, are in multiple overlapping relationship.

6. The method defined in claim **3** wherein the longitudinal bands are provided with a self-adhering coating.

7. The method defined in claim **6** wherein the self-adhering coating affords a temporary tacking-type connection between the longitudinal bands and the transverse strips, thereby to allow the longitudinal bands to be peeled off the transverse stripping after the strip webbing has been applied to an object and is to be spatially deformed.

8. The method defined in claim **3** wherein the longitudinal bands and the transverse strips are connected by a tacking-type welded connection.

9. The method defined in claim **3** wherein the longitudinal bands and the transverse strips are made of insulating materials.

10. The method defined in claim **3** wherein the longitudinal bands and the transverse strips are made of different insulating materials.

11. The method defined in claim **3** wherein the transverse strips are made of conductive material.

12. The method defined in claim **11** wherein the transverse strips are covered with a material which is a poorer conductor than the material of which the transverse strips are made.

13. The method defined in claim **12** wherein the covered transverse strips are additionally provided with insulation.

14. The method defined in claim **3** wherein clusters of transverse strips are drawn, simultaneously, over and under the longitudinal strips, both clusters being processed similarly and in synchronism with each other.

15. The method defined in claim **14** wherein the transverse strips of the two clusters are staggered with respect to each other.

16. The method defined in claim **15** wherein the transverse strips of each cluster are immediately adjacent each other.

17. The method defined in claim **15** wherein the transverse strips of each cluster are spaced from each other.

18. The method defined in claim **14** wherein each longitudinal band has an adhesive coating on both sides.

19. An apparatus for making strip webbing which is made up of transverse strips and of longitudinal bands that are secured to the transverse strips for holding the same together, said apparatus comprising, in combination: means for positioning the longitudinal bands; means for drawing simultaneously a cluster of transverse strips, each from a respective supply roll, across the longitudinal bands for placing the transverse strips on the longitudinal bands; and means for cutting the cluster of transverse strips so that each has a length that corresponds to the width of the strip webbing.

20. An apparatus for making strip webbing which is made up of transverse strips and of longitudinal bands that are secured to the transverse strips for holding the same together, said apparatus comprising, in combination: a work table; means for positioning the longitudinal bands over the work table; means for drawing simultaneously a cluster of transverse strips, each from a respective supply roll, across the longitudinal band portions overlying said work table; means for pressing together the transverse strips and the longitudinal band portions which overlie said work table; means for cutting the transverse strips so that each has a length that corresponds to the width of the strip webbing; and means for drawing the strip webbing constituted by the pressed together longitudinal bands and transverse strips, in the direction of the longitudinal bands, away from said work table so as to leave overlying said work table longitudinal band portions which are free of transverse strips.

21. The apparatus defined in claim **20** wherein said drawing means include a transport device for releasably holding the transverse strips of each cluster in that position relative to each other which these strips occupy in the finished strip webbing.

22. The apparatus defined in claim **21** wherein said transport device is movable between a starting position in which it is on one side of said work table, there to receive and thereafter to hold the transverse strips, and an end position in which it is located at the opposite side of said work table, there to release the transverse strips, whereafter said transport device is free to move back to its starting position.

23. The apparatus defined in claim **22**, further comprising means arranged on said opposite side of said work table for holding the free ends of the transverse strips after the same have been released by said transport device.

24. The apparatus defined in claim **23** wherein said pressing means comprise a press roller carried by said transport device, said press roller being mounted for movement into its operative position in which it presses the transverse strips and the longitudinal bands together while said transport device moves from its end position to its starting position.

25. The apparatus defined in claim **23** wherein said pressing means comprise a press member movable toward and away from the surface of said work table for pressing the transverse strips and longitudinal bands together.

26. The apparatus defined in claim **25** wherein said cutting means are carried by said press member and are located at said one side of said work table, there to cut the transverse strips which have been drawn across the longitudinal bands and pressed thereagainst.

27. The apparatus defined in claim **21** wherein said transport device comprises a guide member for positioning the transverse strips in the desired positions and a clamping device for holding the positioned transverse strips while the same are drawn across the longitudinal band portions overlying said work table.

28. The apparatus defined in claim **26**, further comprising a second guide member for positioning the transverse strips in the desired position, said second guide member being stationary and arranged in alignment with the first-mentioned guide member.

29. The apparatus defined in claim **28**, further comprising deflecting means for guiding each of the transverse strips, from its respective supply roll, to move along the path defined by the aligned first and second guide members.

30. The apparatus defined in claim **29** wherein said deflecting means comprise a comb-like member having spaced apart tines which form narrow gaps between themselves, said tines being oriented such that the gaps are in planes that are at approximately right angles with respect to the plane of the strip webbing overlying said work table.

31. The apparatus defined in claim **30** wherein the individual supply rolls from which the transverse strips are supplied are arranged out of alignment with the paths which the respective transverse strips travel between said first and second guide members, said deflecting means thus serving to guide each respective transverse strip from its respective supply roll to its proper path between said first and second guide members.

32. The apparatus defined in claim **31** wherein said supply rolls are arranged alongside each other.

33. The apparatus defined in claim **27** wherein said guide member comprises at least two zig-zag strips spaced from each other in the direction of travel of the transverse strips, said zig-gaz strips being arranged to form aligned passages for the transverse strips.

No references cited.

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