April 15, 1924. 1,490,454

J. G. CALLAN ET AL

TEXTILE BELT AND METHOD OF MANUFACTURE

Filed March 14, 1922

Fig. 1.

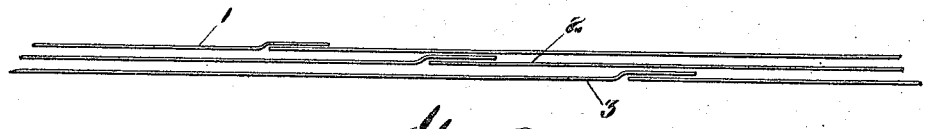

Fig. 2.

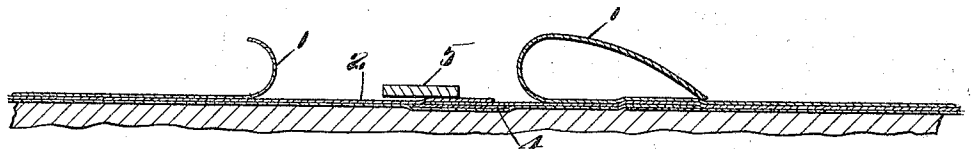

Fig. 3.

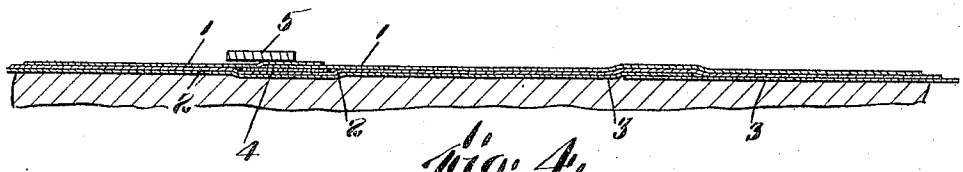

Fig. 4.

Fig. 5.

Inventors:
John Gurney Callan
George B. Craven

by
Cleveland Brown Dunlop & May
Attys.

Patented Apr. 15, 1924. 1,490,454

UNITED STATES PATENT OFFICE.

JOHN GURNEY CALLAN, OF CAMBRIDGE, MASSACHUSETTS, AND GEORGE B. CRAVEN, OF HAMPDEN, MAINE, ASSIGNORS TO EASTERN MANUFACTURING COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

TEXTILE BELT AND METHOD OF MANUFACTURE.

Application filed March 14, 1922. Serial No. 543,666.

To all whom it may concern:

Be it known that we, JOHN GURNEY CALLAN and GEORGE B. CRAVEN, both citizens of the United States, and residents, respectively, of Cambridge, in the county of Middlesex and State of Massachusetts, and of Hampden, in the county of Penobscot and State of Maine, have invented new and useful Improvements in Textile Belts and Methods of Manufacture, of which the following is a specification.

In a paper-finishing machine employing endless fabric belts passing between heavily loaded rollers as a means for impressing a fabric-like surface upon a web or upon sheets of paper passing between the belts, and pressed into contact therewith by said rollers,—as for example in the machine disclosed in United States Patent No. 1,277,714 dated September 3, 1918, issued to Henry J. Guild, it is essential that the joint in the belt should not leave a mark on the paper which is more noticeable than is the mark made by a thread of the textile itself, since otherwise the joint-mark will spoil the salability of that part of the paper where it appears, and the rejected paper from this cause will alone be sufficient to condemn the process. With the form of joint hereinafter disclosed, made with reasonable skill in the manner specified, we have found it possible to reduce the conspicuity of the joint-mark to a point where it in no wise interferes with the value of the paper.

The belts that we have employed are usually three-ply, but are sometimes two-ply, four-ply and even thicker belts have been tried. The making of a three-ply joint is the usual procedure, and is the one described, but it will be seen that the same process is directly applicable to other thicknesses, and we do not limit ourselves to any particular number of plies.

The problem is two-fold,—first, the formation of a joint which shall initially leave no greater mark than that due to a thread of the textile, and second the finding of means to insure the continuance of this degree of excellence during the useful life of a belt operated under heavy and locally variable tension, and under very heavy intermittent pressure. It has been found more difficult to meet the latter condition than the former.

For a more complete understanding of the invention reference may be had to the accompanying drawings in which Figures 1 to 5 are side elevations illustrating the belt in different stages of completion and showing the various steps in the process.

In carrying out our invention with a three-ply belt our preferred procedure is as follows: The three plies of linen or other marketing fabric 1, 2, 3, are stretched with moderate tension over each other on a horizontal frame adapted to hold them tightly by the edges leaving the top of the top ply, and the bottom of the bottom ply exposed, and leaving the ends projecting in non-coterminous form to make the lap, in the manner shown in Figure 1. A transverse mark is then made about a foot from each end, as at *a* and *b* of Figure 1, to set off the part constituting the body of the belt from the end sections that will be concerned in making the lap. The whole of the linen is then wet and allowed thereafterward to dry, with the effect of shrinking the several plies of the fabric and causing them to be stretched tightly and evenly in contact with each other. An adhesive which is preferably a hot water solution of animal glue of good quality tempered with 25% of its dry weight of glycerin, is next applied to the top of the top ply within the area respresenting the body of the belt, preferably by means of a large brush, and this is worked down rapidly through the several plies, wetting them thoroughly and evenly, and the excess is scraped off top and bottom, preferably with a wide rubbed-edged scraper moved in a direction approximately parallel to the long axis of the belt. This glue solution may be about as thick as that used in cabinet-making. The areas representing the end sections concerned in making the lap are similarly treated with a different and less tenacious adhesive, which can well be a strong starch paste reinforced with glue to the amount of about 20% of dry glue to 80% of dry starch dissolved in enough hot water to form it into a paste about as thick as that used in paper-hanging. The belt thus treated is allowed to air-dry for something like twelve hours, and the top and bottom is then brushed over with a solution of formaldehyde of about the strength represented by the commercial solution known

as "formalin", and again allowed to air-dry. It is well to have the operator wear a gas mask during this operation. Obviously this sequence of steps can be carried out on other apparatus than a horizontal skeleton table, but we have made excellent belts without more elaborate means.

The belt after the final drying is cut from the skeleton table leaving the somewhat imperfect edges to be thrown away. Care should be taken to leave the edges straight and parallel, so that subsequent trimming may not be necessary. It is then put on the machine,—that is, threaded through the "nip" and carried over the various guide and take-up rolls, and the ends with about an inch of the plies separated at their extremities are brought together on a wooden table or "making board" temporarily laid on a convenient part of the frame. These ends are brought to a relation shown in Figure 2, the alignment of the ends is carefully checked, and the ends are secured in proper relation by clamps or tacks, and the laps are carefully pasted together and ironed down with a hot flat-iron. A good paste for this purpose is the same that was used for sticking the end sections.

It will be seen that each ply, as 1, 2, and 3, overlaps the corresponding end of the adjacent ply to a comparatively great extent and that there is a subsidiary relatively short lap of the opposite ends of each ply, so that the butt joint between the ends of a given ply,—say ply 1, which is essential to a belt that shall not make joint-marks on the paper, is not yet realized, and there are as many ridges across the belt from this cause as there are plies. The reason for this will be explained in due course.

The next step in the manufacture is to run the belt under working tension through the rolls for a considerable period—say half an hour—with good pressure—say 500 pounds per linear inch of nip—thus not only rolling down the joint and smoothing it, but performing the very essential function of stretching the component plies to dimensions that they will retain under working tension and pressure. In view of the importance of this last-named function it will be considered somewhat more in detail. The initial tension applied to the belt operates to stretch the belt much as would be expected, and requires no particular explanation further than to say that if the belt is longer on one side than on the other it is well to adjust the relative position of the rolls so as to give additional tension on the short side during the period of stretching or "breaking-in" and thus to even up such irregularity. On the other hand the effect of the pressure in the nip in stretching the belt is one which might not be foreseen and is as follows. When the slightly compressible belt passes through the heavily weighted nip the heavy compression flattens and squeezes it somewhat as do the rolls in a roll train in the manufacture of sheet-metal, and for the same reasons that govern that operation the stretch is mostly longitudinal,—this being the free direction. This lengthwise stretch proceeds at first rapidly and afterwards more slowly until the initial looseness of the textile has been taken up and it is in a condition as to weave and stretch of warp-threads such that it more forcibly resists further stretch, and finally comes to a state where the temporary stretch as it passes through the nip is recovered immediately afterward, or in other words is an elastic rather than a permanent stretch. After this condition is reached the belt retains its longitudinal dimensions permanently unless materially heavier pressure is applied to the nip. This stretching by squeezing at the nip is of very substantial amount with the pressures that are necessary in an apparatus such as that here considered, and this action furnishes the reason for using the subsidiary short lap illustrated in Figure 2, as will next be explained.

If the belt is made up in its final form as indicated in Figure 5, with all the laps accurately butted at the start, this stretch during the early period of running is found to open up all the joints enough to make them record a clearly perceptible mark on the paper after that period.

The corrective procedure with the short lap is as follows:

The rolling-down process leaves the textile in a hard smooth-ironed condition with the laps stuck together with starch paste or something of about that degree of adhesiveness and strength. The joint in this condition is now tacked or clamped on the "making board," and the top lap is carefully pulled open as shown in Figure 3, particular care being used not to fray or crumple the component laps, but on the other hand to leave them as smooth and stiff as possible. This operation can be performed even if glue is used to fasten together the whole belt, but in that case it is extremely difficult, while with the end sections secured with paste it is easily accomplished. Next a very thin piece of metal 4 is run across the belt under the joint in the second ply. This may be done by cautiously pushing a piece of metal with a well rounded end in lengthwise between the third ply and the joint of the second, letting it open its own way between the adherent laps as it goes, or if the adhesion is found in the particular case to be too strong, the lap may be opened up, the metal laid in, and the flaps folded down over it again. This metal strip is best of a material softer than steel, but hard

and elastic. We have found hard rolled zinc satisfactory. The next step is to trim the second ply to a precise butt joint. This is done by cutting preferably to a straight edge 5 down through the two overlapping thicknesses where the ends of the second ply lap, to the underlying strip of thin metal. We have found the corner of a safety razor blade of round-cornered design held in a suitable holder to be eminently satisfactory for this purpose. Enough pressure should be used to make the cut go quite through at a single stroke. Next the severed strips are pulled off, and finally thin paste is worked under the abutting edges which already have some dry paste on their under surfaces, and they are ironed down into place. The paste for this operation may be a thin starch or dextrin paste or a gum mucilage. If it is too thick, or too much is applied, or if it is not skilfully applied and pressed, there will be a "glue mark" at the joint that will show on the paper, and if the operator is greatly lacking in skill and speed, the edges may become so softened during the operation that ravelling will begin and the remarkable precision of jointing that the process is capable of be lost. A good operator soon acquires speed and skill enough to enable him to reliably fasten down these abutting edges into a joint fulfilling all requirements even though the paste be a solvent for the stiffening already in the plies, and once the requisite skill is developed such a paste is preferable on the whole. If there is trouble from this source it can be obviated by using for this purpose an adhesive which is not a solvent for the stiffener in the plies,—as for instance a collodion cement. This would be preferable but for the fact that the edges are commonly somewhat softened and occasionally are somewhat stretched and puckered by the operation of opening the lap, where that is resorted to, and they benefit by ironing down in a damp condition, as is done where paste is used; however, we have made excellent joints by both procedures.

This finishes the butt joint on the second ply, and it is next necessary in a three-ply belt to make the joint in the first ply. This operation is similar to that just described, but simpler. Referring to Figure 4, the procedure is as follows: The ends of the first ply are stuck down again in the relation that they had before they were raised to make the joint in the second ply, but with a strip of thin metal under the joint. The preferable adhesive is a thin paste sparingly applied and quickly ironed down; this operation requires a fairly high degree of skill and speed. The butt joint is next trimmed to straight edge 5 exactly as in the case of the second ply.

The trimming of the joint of the lowermost of the plies is comparatively simple; the belt must be turned over, after which it involves only the introduction of a thin strip of metal 4 under the joint either by forcing it in endwise or by opening the joint and laying it in, and afterward trimming to straight edge, removal of severed strips, and pasting down the ends, as described in connection with the second ply, all the joints then being accurately butted as shown in Figure 5.

Where the belt is two-ply the operation on each side is this comparatively simple one just described as applying to the lowermost ply. Where it is of more than three-ply the difficulties and the degree of skill required increase rapidly, although the general procedure is similar.

With a three-ply belt the principal real difficulty, as shown by many experiments, is with the joint on the first ply, on account of the rather large area which it is necessary to repaste. For this reason a permanently exact joint in this ply is made more certain if the joint in the second ply is trimmed before the rolling-down operation is finished, then the ends of the first ply that had to be torn up to get at it are pasted down, the rolling-down operation is then finished under additional tension and pressure, and finally the first and third plies are trimmed and re-pasted in the manner described as applying to the lowermost of the plies. This involves no great addition to complexity, since the belt is on the machine during the whole operation.

We claim:

1. An article of manufacture comprising a belt composed of a plurality of plies of textile, the plies in a relatively long intermediate section being cemented together with a relatively strong cement, and in relatively short end sections being cemented with a relatively weak cement.

2. An article of manufacture comprising a belt composed of a plurality of plies of textile, the plies in a relatively long intermediate section being cemented together with a relatively strong cement, and in relatively short end sections being cemented with a relatively weak cement, the ends of the plies being non-coterminous.

3. The method of joining a plural ply belt which comprises overlapping the ends of the plies so that the end of one ply overlaps to a relatively great extent the corresponding end of the adjacent ply and to a relatively short extent its opposite end, cementing the plies in position, subjecting said belt and joint to tension and pressure sufficient to develop approximately the entire stretch of which it is capable without injury, trimming the overlapping ends of each ply to exact conjugate form, removing

the trimmings, and cementing the conjugate ends against the adjacent ply to form butt joints.

4. The method of joining a plural ply belt which comprises overlapping the ends of the plies so that the end of one ply overlaps to a relatively great extent the corresponding end of the adjacent ply and to a relatively short extent its opposite end, cementing the plies in position, subjecting said belt and joint to tension and pressure sufficient to develop approximately the entire stretch of which it is capable without injury, raising certain of said lapped plies, trimming the overlapping ends of each ply except the outside plies to exact conjugate form, removing the trimmings, cementing the plies back in position, the intermediate plies then forming a butt joint, subjecting said belt and joint to additional tension and pressure, trimming the overlapping ends of said outside plies to exact conjugate form, removing the trimmings, and cementing the plies in position on the plies beneath with their ends in butting relation.

5. The method of joining a plural ply belt of textile whereby the impress on paper of the joint shall be substantially indistinguishable from that made by an intermediate portion of the belt, which comprises lapping the ends of the belt in such manner that each ply overlaps the end of an adjacent ply by a relatively large amount and over the opposite end of the same ply by a relatively small amount, cementing the plies in position, raising up the lapped plies from one side to an intermediate ply, inserting a thin metal strip beneath the overlapping ends of said intermediate ply, trimming these ends to conjugate form by cutting therethrough on to said strip, removing the trimmings and said strip, cementing the conjugate ends on to the adjacent ply to form a butt joint, and trimming and cementing the ends of each ply from said intermediate ply progressively outwardly in the same manner.

6. The method of joining a plural ply belt of textile whereby the impress on paper of the joint shall be substantially indistinguishable from that made by an intermediate portion of the belt, which comprises lapping the ends of the belt in such manner that each ply overlaps the end of an adjacent ply by a relatively large amount and over the opposite end of the same ply by a relatively small amount, cementing the plies in position, raising up the lapped plies from one side to an intermediate ply, inserting a thin metal strip beneath the overlapping ends of said intermediate ply, trimming these ends to conjugate form by cutting therethrough on to said strip, removing the trimmings and said strip, cementing the conjugate ends on to the adjacent ply to form a butt joint by a cement which is not a solvent for that used in first cementing the plies together, and trimming and cementing the ends of each ply from said intermediate ply progressively outwardly in the same manner.

In testimony whereof we have affixed our signatures.

JOHN GURNEY CALLAN.
GEORGE B. CRAVEN.