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2,190,680

PROCESS OF PRODUCING CORRUGATED PAPERS

Original Filed Aug. 5, 1935

FIG. 1.

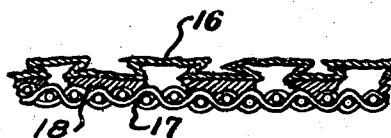
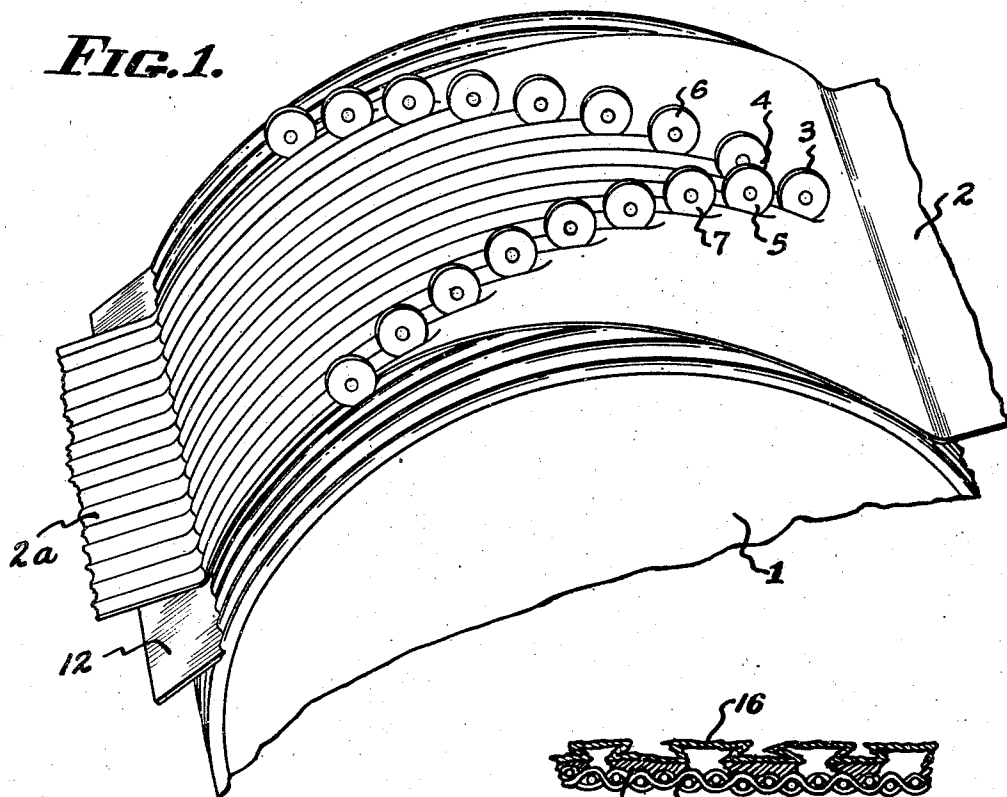


FIG. 4.

FIG. 2.

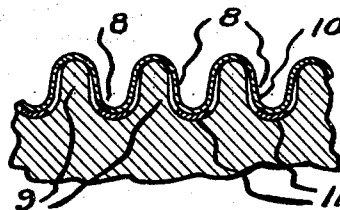
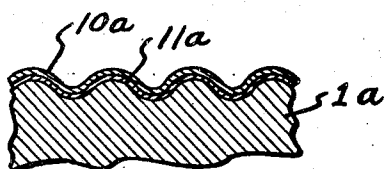
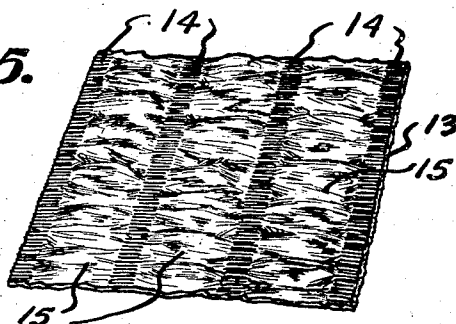


FIG. 3.

FIG. 5.



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UNITED STATES PATENT OFFICE

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PROCESS OF PRODUCING CORRUGATED PAPERS

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Renewed November 21, 1938

11 Claims. (Cl. 154—33)

Fundamentally my invention relates to the corrugating of papers or other webs, and finds its most important, though not exclusive application, in the formation in webs of corrugations which are parallel to the longitudinal axis of the web and which may be formed in a continuous manner.

My invention relates to a novel step or series of process steps which have importance in a plurality of different fields, among which may be mentioned, but without limitation:

- (a) The production of plain corrugated webs,
- (b) The corrugating of previously creped webs,
- (c) The corrugating and creping of webs as a part of a substantially unitary operation,
- (d) The creping of previously corrugated webs,
- (e) The formation of composite fabrics of the general types set forth in my co-pending application Serial No. 724,936, filed May 10, 1934, now Patent No. 2,081,308, dated May 25, 1937, and
- (f) The production of special types of creped papers.

Especially in connection with item (c) mentioned hereinabove, this case is a division in part of my co-pending application Serial No. 509,163, filed January 16, 1931, now Patent No. 2,030,156, dated February 11, 1936.

The fundamental and ancillary objects of my invention will be set forth hereinafter, or will be entirely clear to the skilled worker in the art on reading these specifications. For clarity in the disclosure, which is to follow, reference is now made to the drawing, wherein:

Figure 1 is a semi-diagrammatic perspective view of one mechanism with which my invention may be carried on.

Figure 2 is a sectional view of a portion of one type of corrugating surface showing one method of binding the web to that surface.

Figure 3 is a sectional view of another type of corrugating surface.

Figure 4 is a sectional view of an exemplary fabric of composite nature.

Figure 5 is a perspective view of a special type of creped article.

(a) In the production of longitudinally corrugated sheets, by continuous processes several problems arise. If by corrugations the web is to be given lateral expansibility, it follows that the web must be gathered widthwise during the corrugating operation. A number of ways of doing this are set forth in the co-pending application of Rowe and Morris, Serial No. 622,698, filed July 15, 1932, now Patent No. 2,034,421, dated March 17, 1936. It will be clear that the forma-

tion of corrugations to give widthwise expansibility is to be distinguished from embossing processes where the structure of the paper is disrupted, i. e., the processes to which this aspect of my invention is applicable, are processes in which the web is actually taken up or gathered transversely. It is therefore not possible to contact the web simultaneously across its width with gathering elements which inter-digitate simultaneously to produce the desired gathering. If this were done, the web would bind and split. As a consequence it is the usual practice to begin to gather the web at one point (usually, though not necessarily, in the center of it) and then as the web moves, progressively form additional lateral gatherings until ultimately the whole web is gathered transversely. Ordinarily a central longitudinal corrugation is formed first and after this has been formed, another corrugation is formed on each side of it, the additional corrugations being formed in pairs until the operation is completed for any given length of the web. If it is assumed that corrugating is being done by presenting to the web upon one side, means providing a corrugated surface, and by presenting to it on the other side, means which successively and progressively depress the paper between the lands or ridges of the first mentioned corrugating means, it will be found in actual practice that there are forces tending to cause previously formed corrugations to come out or be lost during the progress of the web. One of these forces is the natural resilience of the web which causes it to tend to become flattened out after it has been corrugated. Another of these forces is the actual pull on a previously formed corrugation, caused by the depressing of laterally disposed portions of the web to form additional corrugations. As a consequence, it has been found in actual practice, as set forth in the application referred to above, that given corrugating means upon one side of the web and depressing means on the other which act successively to form corrugation by inter-digitation, some means must also be provided for holding previously formed corrugations as such, at least until the formation of laterally adjacent ones. This presents a substantial mechanical problem, which problem has been solved mechanically by the teachings of said Rowe and Morris, to which reference has been made.

It is an object of my invention to provide a solution for this problem which is positive, which has a series of advantages of its own, and which is not bound up with holding means which are

machine elements. Essentially in the practice of my invention, I accomplish this purpose by binding the paper to a corrugating means, at least at the time of the formation of any given corrugation in a way which will be positive. This avoids a number of mechanical difficulties, and also makes for simplification of the apparatus.

As an exemplary way of doing this, I have illustrated in Fig. 1, a cylinder 1, which is grooved on its peripheral surface. A suitable web 2 is led to the surface of this cylinder in any suitable way, and in order to form corrugations therein, the paper is successively depressed into the grooves of the cylinder by a series of progressively acting elements starting with a center roller or sheave 3, followed by laterally adjacent ones 4 and 5, and additional pairs of laterally adjacent ones 6 and 7, etc. This arrangement alone would not be commercially successful for the manufacture of corrugated paper without the provision of holding means as aforesaid. This holding means I provide by adhesively binding the paper to the cylinder as the corrugations are formed therein, the adhesive being sufficient to maintain the corrugations while others are being formed, but so used or of such character as not to interfere with the formation of the corrugations. By this is meant that the adhesive must either be of such character as to permit side-slip of the paper during widthwise contraction, or it must be positioned in such a way as not to become effective until a corrugation has been formed, as where the adhesive is applied only to the bases of the grooves; yet it must be effective in maintaining the corrugations after they have been formed, all as is more fully set forth hereinafter. The binding power of the adhesive employed must not interfere with the formation of corrugations yet must act to maintain the formed corrugations at least during the formation of adjacent corrugations, whether or not this involves a change in the binding power during the process, all as is more fully set forth hereinafter. As an example of an adhesive, asphalt is one, the binding power of which can be readily controlled as will be appreciated by the skilled worker. When sufficiently cold and solid it is not even tacky; on the other hand, it may be so highly heated as to have very little binding power. Between these extremes its binding power can be controlled over a wide range. I have shown in Figure 3 an exemplary form of corrugated surface useful where fairly large amounts of lateral stretch are required. Here the cylinder is grooved as at 8 and between these grooves there are relatively narrow, but relatively high lands or ridges 9. A paper web 10 is shown in a somewhat exaggerated form following the corrugations of the cylindrical surface. I have indicated this paper as being bound to the cylindrical surface by an adhesive substance 11. I have shown this adhesive substance as lying in the bases of the grooves so as to cement the paper to the cylinder only at this point. This has a number of advantages, one of which because it has to do with the corrugating of the paper, may be mentioned at this point. It is convenient in this operation to apply the adhesive substance to the cylinder rather than to the paper, and to locate it in lines in the base of the grooves. This may be accomplished by coating the groove base with the adhesive prior to leading the paper to the web as by means of small coating rollers which enter the grooves and which turn in the pan of adhesive or otherwise have adhesive applied to their peripheral surfaces. The paper be-

ing free of adhesive, and the portions of the cylinder surface which contact the paper prior to the formation of corrugations therein, being also free of adhesive, no resistance is interposed to the sidewise gathering of the paper through the action of the interdigitating means 3, 4, 5 etc. Nevertheless as soon as any portion of the paper has been depressed into the grooves, such portion of the paper is firmly bound thereto in a way which will maintain its corrugated form.

It is not outside the scope of my invention however, to coat either the entire surface of the cylinder or the entire surface of the paper or both with adhesive, prior to the corrugating of the paper. It is also possible to employ an adhesive substance which is normally non-adhesive or which has been caused to assume a non-adhesive state, and then to develop adhesiveness therein as and when desired, viz., upon the corrugating of the paper. Asphalt or other bituminous substances though not the only adhesives which I may employ, are highly advantageous for certain types of work. Bitumens may be chosen which are substantially non-adhesive at ordinary temperatures, but which may be caused to become adhesive upon the application of heat, and heat may be applied either by external means, by controlling the temperature of the corrugating member 1, or by heating the depressing means 3, 4, 5, etc.

It will be clear from the foregoing that the adhesive in my process acts as the holding means, and permits the corrugation of the entire sheet transversely. The next step is of course, the removal of the now corrugated sheet (2a in Figure 1), from the corrugating means. When corrugating plain papers, the paper simply may be stripped from the cylinder or other corrugating surface, if desired. It is convenient however, to employ a doctor or scraper means, indicated at 12 in Figure 1. This doctor will of course be shaped to conform to the configurations of the corrugating surface. This serves to start the paper from the corrugating means without destroying the corrugations therein; but the corrugations may be set by other means subsequent to the removal step. If plain paper is being corrugated, the doctor may be so set as to scrape it from the corrugating surface without producing additional rugosities therein. The doctor may also be set so as to crowd the paper back on itself and produce rugosities there-in transverse to the lines of corrugations, i. e., the doctor may be a creping doctor and may crepe the paper as it is being removed.

(b) In either event it will be seen that my process and mechanism is adaptable to the corrugating of papers which have previously been creped. A doctor may be so set as to impart additional longitudinal stretchability to the paper as suggested in my co-pending application, Serial No. 509,163, now Patent No. 2,030,156 or it may be set to remove the paper from the corrugating surface with substantially its initial or original stretchability.

(c) Likewise, if plain paper is being operated upon, it may be creped transversely at the time of the removal of such paper from the corrugating means. I am aware that it has hitherto been suggested to lead paper on to a corrugated cylinder and remove it therefrom by a serrated knife so as simultaneously to crepe and wave the paper. This however, has not proved to be commercially successful, largely for the reason that no successful way has been found to bind the paper to the

corrugated cylinder. The operation is not successful if moisture alone is depended upon, and the use of vacuum or air blasts has likewise not been a success. Where however, a positive adhesive union of the paper and the corrugated cylinder or the like is maintained, such an operation does become commercially successful. Also it permits of a number of variations. I have indicated in Figure 2, a corrugated cylinder 1a, with a paper web 10a cemented solidly to the surface thereof, over its entire area, by the cementing medium 11a, which may in this case be an asphalt or the like, but may also comprise a number of other adhesives, such as latex. Here the paper will be delivered in a substantially even corrugated and creped form. However, when operating with plain papers, it is likewise possible to cement the paper only to the bases of the grooves and/or to the tops of the lands, the first being shown in Figure 3, and the second being a variant thereof. When this is done, the paper is not bound to the corrugating surface over its entire area. In those places where the paper is free the crowding action of the doctor is somewhat relieved and the paper is evenly and finely creped along those lines where it is positively adhered to the corrugating means, but is ruffled or more or less imperfectly creped elsewhere, giving a paper of novel appearance.

(f) The use of interspaced lines of positive adhesive suggests the use of this device to make semi-creped papers of novel appearance without substantially corrugating them. In this aspect paper may be bound to a plain cylinder or other plain creping surface by means of interspaced lines, areas or dots of positive adhesive and then may be removed therefrom by a doctor, giving a fine creping in the areas of adhesive union, and a ruffled appearance elsewhere. A sheet creped by means of inter-spaced lines of adhesive is illustrated at 13 in Figure 5, where 14 indicates areas of creping and 15 indicates areas of ruffling.

(d) It will be clear that previously corrugated papers may be treated in accordance with any of the processes set forth above, and thereby creped, and/or additionally corrugated. Thus paper having either longitudinal or transverse corrugations may be corrugated and/or creped by my process.

Again adverting to the removal of the paper from the creping and/or corrugating means, it may be said that if a thermoplastic is used as the adhesive, and if the grooved cylinder or other corrugating surface is heated, it will be possible to peel the paper away from the surface without destroying much, if any, of its longitudinal stretchability, since the thermo-plastic adhesive may be caused to become fluid enough at any given point to release the paper. If rubber latex is used as the adhesive, it is again possible to peel the paper, together with its latex coating, away from a smooth and polished cylinder in spite of the fact that the latex has enough bonding power to maintain the corrugations while on the cylinder.

(e) In my co-pending application, Ser. No. 724,936, filed May 10, 1934, now Patent No. 2,081,308, I have taught, among other things, the making of composite fabrics comprising a base material and a multi-laterally stretchable web secured to said base material only at intervals, such fabrics having a number of novel and useful characteristics. It will be clear from the foregoing that the process of binding the paper to corrugating means at interspaced intervals, or along

interspaced lines, greatly facilitates the formation of such fabrics. Not only is the adhesive applied as a part of the corrugating operation, so that additional adhesive application may not be required, but where the paper is bound to the corrugating means, at the bases of the grooves, the adhesive will be found properly placed to bind a corrugated sheet to the base material at the crests of the corrugations. Where the tackiness of the adhesive substance has been relieved at the time of removal of the web from the corrugating surface, it will be redeveloped therein at the time of the union of this web to the base material, by the application of heat, a solvent, moisture or otherwise. Moreover, the corrugated web may be joined to the base material prior to the crushing of the corrugations therein. If this is done, and the base material and the corrugated web pasted together through crushing means, the base material of course acts to maintain the corrugations during the crushing and prevents the loss of stretchability.

I have indicated in Figure 4, a crushed and corrugated web 16, joined to a foundation material such, for example, as burlap 17, by being cemented thereto with adhesive 18, positioned essentially at the crests of the corrugations on that side of the corrugated web which falls against the foundation material.

Modifications of my invention may be made without departing from the spirit thereof, and I do not desire my invention to be limited otherwise than as set forth in the appended claims, wherein I have endeavored to set forth what I believe to be the essential novelty of my invention.

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

1. A process of corrugating a web which comprises providing a corrugated means, coating the bases only of the grooves therein with an adhesive substance, bringing paper into contact with said corrugated means and successively depressing said paper into the grooves thereof, whereby as each corrugation is formed therein it is held by said adhesive at least until the completion of the formation of adjacent corrugations therein.

2. A process of corrugating a web which comprises providing a corrugated means, coating the bases only of the grooves therein with an adhesive substance, bringing paper into contact with said corrugated means and successively depressing said paper into the grooves thereof, whereby as each corrugation is formed therein it is held by said adhesive at least until the completion of the formation of adjacent corrugations therein, and upon completion of the desired number of corrugations therein, causing said adhesive to release said paper.

3. A process of corrugating a web which comprises providing a corrugated means, coating the bases only of the grooves therein with an adhesive substance, bringing paper into contact with said corrugated means and successively depressing said paper into the grooves thereof, whereby as each corrugation is formed therein it is held by said adhesive at least until the completion of the formation of adjacent corrugations therein, removing said paper from said corrugated means with adhesive thereon and employing said adhesive to adhere said paper to a foundation material.

4. A process of corrugating a web which comprises providing a corrugated means, coating the

bases only of the grooves therein with an adhesive substance, bringing paper into contact with said corrugated means and successively depressing said paper into the grooves thereof, whereby as each corrugation is formed therein it is held by said adhesive at least until the completion of the formation of adjacent corrugations therein, removing said paper from said corrugated means with adhesive thereon and employing said adhesive to adhere said paper to a foundation material and crushing the corrugations of said paper on said foundation material.

5. A process of corrugating a web which comprises leading said web to a corrugating means with the interposition of an adhesive between said web and said means, successively depressing portions of said web into the grooves between the ridges of said corrugating means whereby to corrugate said web, the condition of said adhesive prior to the corrugating of said web being such as to permit the widthwise contraction of said web, and when a portion of said web has been caused to conform to at least the base portion of the grooves of said corrugating means, developing in said adhesive at said portion sufficient tackiness to maintain the corrugated condition of said web against the sidewise pull produced by the formation of adjacent corrugations, and afterward removing said web in corrugated condition from said corrugating means.

6. A process of corrugating webs which comprises causing webs to conform to a corrugated surface whereby to corrugate the same, with the interposition of an adhesive substance therebetween, under conditions in which said adhesive substance is ineffective to prevent the widthwise contraction of said webs during corrugating, and when said webs are corrugated, adhesively binding them to said corrugated surface in at least selected portions thereof by means of said adhesive, and then removing said webs from said

corrugated surface by means of a doctor, and delivering said webs coated, in part at least, with said adhesive substance.

7. A process of corrugating paper which comprises leading a web against a corrugated member presenting to said web lands or ridges, with the interposition of an adhesive between said web and said member, depressing said web between the ridges of said member so as to produce corrugations in said web, at the same time taking up said web widthwise across the face of said member, and after corrugating any portion of said web, causing said portion to adhere to said corrugated member by means of said adhesive so as to maintain the corrugations in said web during formation of adjacent corrugations, said corrugating being accomplished under conditions in which said adhesive is ineffective to prevent the widthwise contraction of said web, and afterward removing said web from said corrugated member.

8. The process as claimed in claim 7 in which the removal of the web from the corrugated member is accompanied by treating the adhesive to cause it in part at least to release the bond between the web and the corrugated means.

9. The process as claimed in claim 7 in which during the formation of corrugations in the web the binding power of the adhesive at said corrugations is caused to increase.

10. The process as claimed in claim 7 in which, during the formation of corrugations in the web the binding power of the adhesive at said corrugations is caused to increase by controlling the temperature thereof.

11. The process as claimed in claim 7 in which said adhesive is interposed substantially only between the tops of the lands of said corrugated member and adjacent portions of the webs.

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