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W. W. ROWE ET AL

2,139,285

PROCESS AND MACHINE FOR MAKING CRUSHED CORRUGATED PAPERS

Filed Nov. 21, 1934

2 Sheets-Sheet 1

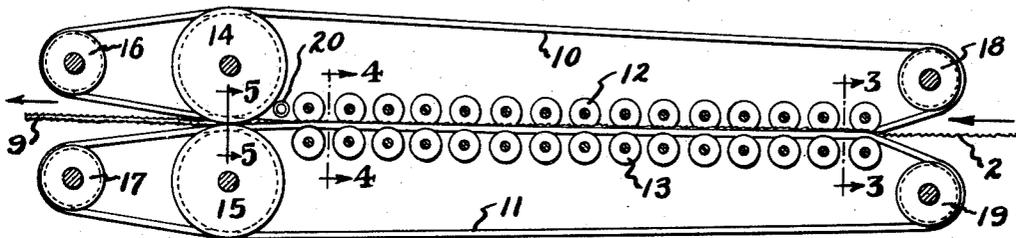
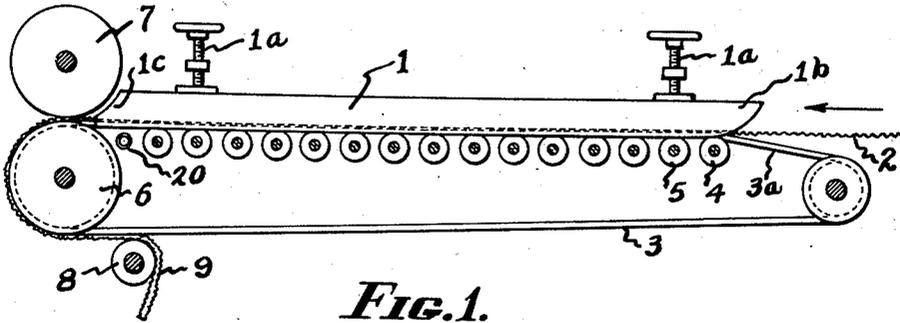


FIG. 3.

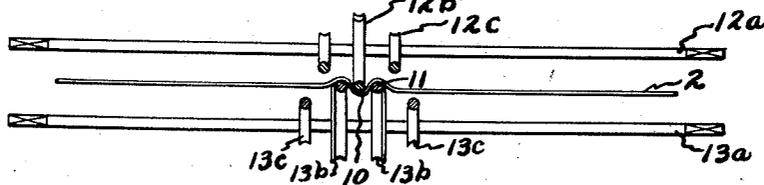
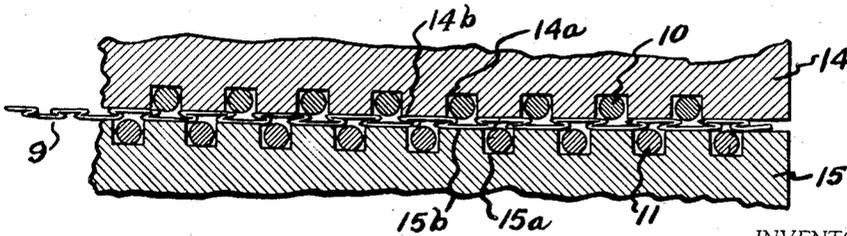
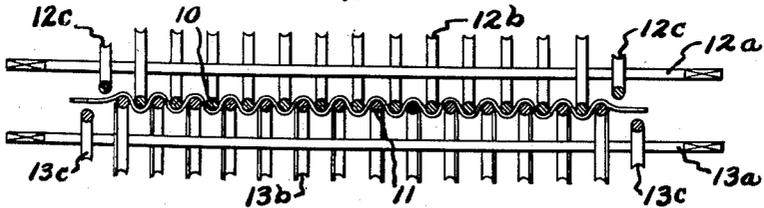


FIG. 4.



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FIG. 6.

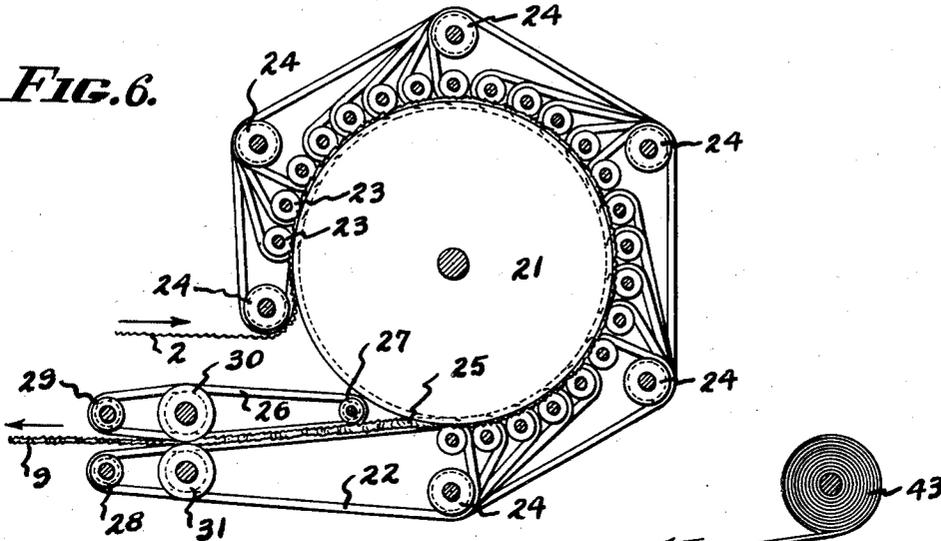


FIG. 7.

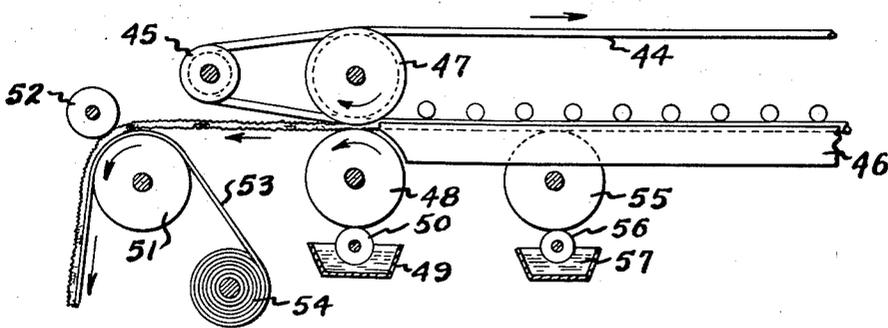
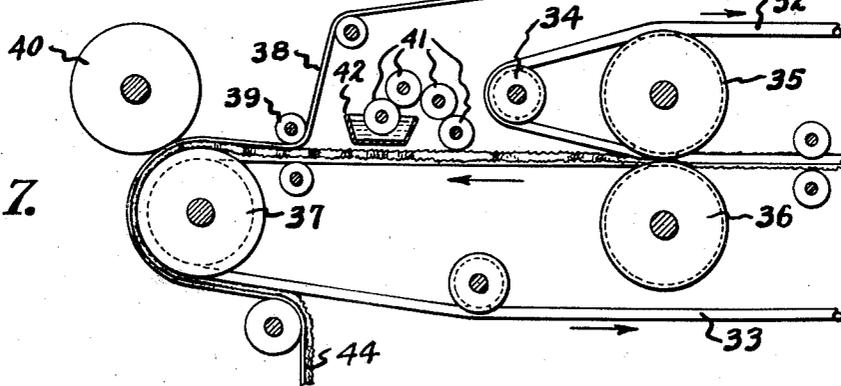


FIG. 8.

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PROCESS AND MACHINE FOR MAKING
CRUSHED CORRUGATED PAPERS

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Application November 21, 1934, Serial No. 754,030

17 Claims. (Cl. 154—31)

Our invention relates to corrugating paper webs longitudinally, and in its commercial development relates more particularly to the corrugating of previously creped webs, the general purpose being to produce a web characterized by multi-lateral stretchability and a condition in the final product in which this stretchability is not too easily lost. It will be clear that corrugated and creped papers, as well as articles made therefrom, have a tendency to lose some of their lateral stretchability, due to the flattening out of the longitudinal corrugations therein. Especially is this true where the paper or articles made therefrom are subjected to compression, as in rolls, stacks or bales.

The corrugated paper may be made by those processes and on machines which are described and claimed in the co-pending application of Rowe and Morris, Serial No. 622,698, filed July 15, 1932, which has now matured under date of March 17, 1936 into United States Letters Patent No. 2,034,421. This application teaches a crushing of the creped and corrugated product in order to set the corrugations, by forming them, as it were, into somewhat irregular pleats which have to be folded out before the lateral stretch can be removed from the paper. It was further taught, in the said application, that in order to conduct the paper from the corrugation-forming instrumentalities into the bite of a pair of crushing rolls, a felt or like supporting means should be brought into contact with the corrugating paper and led with it through the bite of the rolls. It is an object of our present invention to provide means for crushing corrugated papers without loss of stretchability, which means may either be supplementary to, or may be used in the place of, a felt or other supporting web.

It is a further object of our invention to set the pleats formed by the crushing step as will hereinafter be more fully described.

These and other objects of our invention which will be set forth hereinafter, or will be apparent to one skilled in the art upon reading these specifications, we accomplish by that certain construction and arrangement of parts of which we shall now describe certain preferred embodiments which, it will be understood, are exemplary and not limiting in character. Reference is made to the accompanying drawings, wherein—

Figure 1 is a diagrammatic representation of a type of corrugating machine employing fixed lands or ridge members forming a corrugating surface upon one side of the web and traveling belts upon the other, this machine embodying our novel crushing mechanism.

Figure 2 is a diagrammatic representation of a corrugating apparatus involving sets of traveling belts upon both sides of the sheet.

Figure 3 is a cross section of a portion of the machine of Fig. 2, taken along the line 3—3.

Figure 4 is a cross section of a portion of the machine of Figure 2 taken along the lines 4—4.

Figure 5 is a cross section of the machine of Fig. 2, taken along the lines 5—5 and showing the action of the crushing rolls.

Figure 6 is an elevational view of another type of corrugating apparatus employing a corrugated cylinder.

Figures 7 and 8 show types of straight away corrugating apparatus analogous respectively to those of Figs. 2 and 1, and showing means for attaching a backing web to the corrugated web prior to crushing.

In carrying out our invention, in one of its aspects, we make provision for the positive conduction of the corrugated web into the bite of crushing rolls without loss of stretch, by utilizing for the purpose the elements which have produced the corrugations. In the embodiment of Figure 1 we have shown a series of lands which, in this instance, are disposed on the upper side of the sheet so as to reduce friction. These lands are stationary in the sense that they do not travel with the web, and they may either be discrete members held together by a suitable framework or supporting structure, or they may be formed by suitably grooving a plate or series of plates. They may be raised or lowered by means of the screw shafts 1a. The sheet of crinkled paper is represented at 2, passing beneath these lands in a direction from right to left. Below the lands we provide a series of forming and retaining members preferably consisting of belts, such as coiled spring belts, rubber belts or the like. The belts are indicated at 3. They deform the paper by pushing it upwardly between the lands or ridges; and in order to provide for the lateral contraction of the paper as it is being corrugated, we cause our belts to come into interdigitating relationship with the lands successively or in echelon formation. Thus, the center belt deforms the paper first between the two center lands. The next adjacent belts on either side deform the paper between the center lands and the next adjacent lands, and so on. The belts are shown passing over successively arranged rollers 4, 5, etc. These rolls may be journaled upon shafts across the face of the machine, and may be employed not only to bring the particular belts which return over them successively between the lands as shown, but also to hold previously positioned belts in interengagement with the lands. Thus, the belts are held in the proper corrugation-forming relationship by these rolls at short intervals, in spite of the strains which are placed thereon by the natural springiness of the paper,

and by the deformation of the paper to form additional corrugations.

The end roll 6 serves, in the embodiment of Fig. 1, as a common return member for all of the belts. It also co-operates with the roll 7 to form a crushing pair. The roll 7 is a smooth faced roll. The roll 6 is grooved to receive the belts, as indicated by the dotted line. The lands furthermore may be extended as at 1c, as far as desired into the bite of the rolls, and it will be seen in this construction that the paper is supported in its corrugated condition into the actual bite of the rolls by the lands upon its upper side.

The action of crushing the paper between pinch rolls through which the belts also pass, is likely to cause the paper to be caught sometimes between a belt and the grooved portion of the pinch roll in which the belt lies. An attempt, therefore, to remove the paper from the belts just after it has passed through the pinch, may result in tearing the paper where it is so caught, particularly at the edges of the web. As a consequence, our invention likewise contemplates the provision of means whereby the paper need not be removed from the wires until the wires themselves have removed it from the roll. This, in Figure 1, is accomplished by carrying the paper around the surface of the roll 6 to a point somewhere beyond the point at which the wires start to leave the surface of the roll 6. We have shown the paper being carried over an idler roll 8, the crushed paper web being indicated at 9.

In the embodiment of Figure 2, an upper series of wires is indicated at 10, and a lower series at 11. An upper series of holding and depressing rolls is shown at 12, and a lower series of holding rolls at 13. The creped web to be corrugated is again shown at 2. In this embodiment both sets of wires pass between the crushing rolls 14 and 15, which are grooved for the purpose. The manner of cooperation between the upper and lower sets of belts and rolls or sheaves is illustrated in Figs. 3 and 4. In the first of these figures we have shown an upper shaft 12a having a large center sheave 12b, and sidewise lying sheaves 12c. We have shown also a lower shaft 13a and a pair of large center sheaves 13b. Sidewise lying small sheaves are indicated at 13c. The belts are shown at 10 and 11. It will be seen that the web 2 has been formed with an initial corrugation by the interaction of the belts on the large sheaves, while the belts on the small sheaves leave the web free to contract width-wise in the formation of the corrugation referred to and additional ones. Figure 4 shows the assembly after all but the final sidewise corrugations have been formed. The corrugations are formed in a progressive manner and preferably from the center outwardly.

The small sheaves 12c and 13c may in most instances be omitted, however, in which case the end sheaves 18 and 19 (Figure 2) will usually be brought closer together. There may be a tendency when this is done to cause the sheet to contact the undepressed as well as the depressed wires; but this has not been found in practice substantially to retard widthwise contraction, first because machines of the type of Figures 1 and 2 are usually employed with dry or substantially dry paper, which has sufficient strength to pull in laterally, second, because the belts have no substantial tendency to pinch the sheet until actually positioned by the large sheaves, and third because if the positioning sheaves are of

large enough diameter with relation to the shafts, it is possible to separate the head rolls 18 and 19 sufficiently to avoid pinching the sheet outside the corrugated area as well as to avoid rubbing the wires against the shafts. Indeed a light frictional contact of the belts with uncorrugated portions of the web is believed to be somewhat beneficial by smoothing out the sheet prior to its deformation and as it is drawn toward the center of the machine during the formation of the corrugations.

The two sheaves 13b in Figure 3, may have a slight outside shoulder as shown. This shoulder is preferably about half the height of the wire and in no event should be higher than the wire. Such shoulders serve the purpose of preventing the belts 11 from being forced outwardly from the center of the machine and off their respective sheaves 13b. Such shoulders may be provided on the outside large sheaves only of other sets of sheaves on other shafts along the machine. It will be understood that the outside sheaves are the only ones in each set which are not depressed between other sheaves.

In Figure 2 where the paper may be caught between either set of wires and the grooves of the rolls in which these wires run, it would be inexpedient to follow the exact procedure set forth in Fig. 1, since if this were done, the paper might be torn upon the top cylinder. We eliminate this difficulty by causing both sets of wires to leave their respective rolls 14 or 15 as soon as possible after passing through the pinch, and we do this by carrying the sets of wires respectively around idler pulleys 16 and 17, located behind the press rolls. The corrugated, creped and crushed web is indicated at 9.

It will be noticed in Fig. 4 that the corrugated web goes under and over the several belts in the sets 10 and 11. As shown in Fig. 5, when the paper reaches the crushing rolls 14 and 15, the belts 10 and 11 are displaced in grooves 14a and 15a, so that while the paper web 9 lies on the same sides of the sets of belts respectively, the belts no longer act to hold it deformed, but co-act with the portions 14b and 15b of the rolls 14 and 15 lying between the belts to crush the corrugated paper and form it into a series of pleats or folds, as shown. Nevertheless, the paper is supported by the belts into the bite of the rolls, and there is very little tendency for the paper to flatten out sidewise prior to the actual crushing. The actual crushing sets the paper and renders it unlikely to lose its stretchability in the ordinary handling operations.

It is of assistance in the formation of the corrugations in the paper to have the various corrugating agencies contact the paper gradually as the paper moves. Consequently, in Fig. 1, we have shown the lands tapered as at 1b on the entrance side of the machine, and the belts 3 passing into engagement with the rolls 4 aslant as at 3a. Likewise in Fig. 2 we have shown the belts passing over sheaves 18 and 19 and coming into engagement aslant with the rolls or sheaves 12 and 13.

We have discovered that a superior type of set pleats can be produced by having the paper in a softened condition at least at the time of crushing. If the paper has already dried, this may be accomplished by the application of moisture and heat just prior to the crushing operation. We have shown in both Figs. 1, and 2 a pipe 20, which will be understood as connected with a source of live steam, and perforated at

intervals throughout its length to produce jets of live steam impinging upon the paper before it enters the crushing rolls. The action of the steam is to moisten the paper and also to heat and soften the size therein, whereupon the paper can more easily assume the desired crushed form; and being cooled and dried as it does almost immediately, the paper is made more resilient in the crushed form by the resetting of the fibres and/or the size therein. The softening of the paper prior to crushing likewise has the effect of reducing the tendency to loss of stretch between the crushing rolls.

In Figure 6 we have shown a type of corrugating apparatus employing a grooved cylinder 21, and a single set of belts 22. The belts are laid against the cylinder in echelon formation by passing over a series of sheaves 23. The belts are brought into position to be engaged by 20 sheaves by means of guide rolls 24. This type of apparatus is set forth in applicant's copending case referred to hereinabove. Following out the teachings of the present case, when the corrugated paper leaves the roll 21 as at 25, another set of belts indicated at 26, passing over a set of sheaves 27, is brought into intermeshing engagement with the belts 22, which are carried out away from the roll 21 over a return sheave 28. A return sheave for the upper set of belts is indicated at 29. The pair of crush rolls grooved to accept the belts is indicated at 30 and 31. Immediately after leaving the cylinder 21 therefore the paper is engaged by intermeshing sets of belts and is carried by them into the pinch of the crushing rolls. The sheaves 28 and 29 serve to carry the belts out beyond the crushing rolls so as to avoid tearing the paper. Instead of a plurality of belts or wires 26, we may employ a single fiat belt, felt or web. If this is done the roll 27 may be made smaller and carried closer to the point at which the belts 22 leave the cylinder 21. Also in this event the roll 30 would be smooth and ungrooved and the roll 29 could be eliminated.

In Figure 7 we have shown the delivery end of a corrugating machine, having two sets of traveling belts, the upper one being indicated at 32 and the lower one at 33. The upper series of belts returns over a roll 34. An end sheave or roll assembly is shown at 35, beneath which there may be a back-up roll 36. The lower series of belts, however, extends beyond the rolls 35 and 36, and returns over a roll 37, which is grooved for the purpose. The extension of the belts between rolls 36 and 37 forms a table upon which the paper is still held in corrugated condition by the belts 33, but is free above. We may therefore lead against the paper in this portion from above, a supporting web 38 over an idler roll 39. The supporting web holds the paper against the belts 33 and additionally serves to maintain the corrugations therein. It is carried through the pinch of the crushing rolls, the upper one of which is indicated at 40. The web may be in the form of an endless belt of at least the width of the paper being treated, and may return, if desired.

In the manufacture of composite fabrics, however, it is preferable to cement the web 38 to the corrugated web. This may conveniently be done by means of applying rolls 41, one of which turns in a pan of suitable adhesive 42. The supporting web in this instance may be a web of burlap or other cloth to be used in the formation of the composite fabric. With the corrugated fabric supported by the belts 33 as shown, it is quite

convenient to apply the adhesive only to the crests of the corrugations, whereby we manufacture a composite fabric consisting, say, of a web of corrugated and crushed paper, and a web of burlap, in which the crushed paper is cemented to the burlap only at intervals, leaving the paper free to expand elsewhere. The lateral expansion of corrugated and crushed paper occurs primarily through the pulling out of pleats therein, and it is therefore advantageous not to have these pleats solidly cemented down. This provision is well taken care of by the application of adhesive primarily to the crests of the corrugations, although our invention is not limited in this particular. Where a composite fabric is being made, the web 38 will ordinarily be taken from a supply roll 43 and delivered as at 44 in combination with the web.

In Figure 7 it is possible and in some instances preferable, to crush the corrugated web prior to cementing the backing fabric thereto. In this event the rolls 35 and 36 could be employed as crushing rolls, being suitably grooved for the purpose. The rolls 37 and 40 would then act as combining rolls. By careful application of adhesive to a crushed corrugated web it is readily possible to avoid filling up the folds therein.

In the embodiment of Figure 8, an upper series of belts 44 is shown returning over a roll 45, arranged to carry the belts away from a crushing roll 47. Bands are shown at 46. A cooperating crushing roll 48 may be the means for applying adhesive to the paper, there being a pan of adhesive 49 and a transfer roll 50 therebeneath. The web may afterward be carried between combining rolls 51 and 52 over the lower of which a web 53 of burlap from a supply roll 54 passes. In addition to or in lieu of the application of adhesive by the roll 48, adhesive may be applied to the crests of the corrugations of the paper between the lands while still depressed by the belts 44, by means of thin applying rolls or discs 55 adapted to enter between the lands and receiving adhesive from a coating roll 56 turning in a pan 57 in which case the backing fabric can be combined at the bite of rolls 47 and 48.

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

1. In a corrugating apparatus, the combination of corrugating means comprising at least one set of belts traveling with the web and crushing means comprising a pair of rolls, said belts passing through the bite of said rolls, at least one of said rolls being grooved for the purpose.
2. In a corrugating apparatus, the combination of traveling belt members acting as deforming means on both sides of the web, and crushing means comprising a pair of grooved rollers, said belts passing between said rolls in said grooves.
3. In a corrugating apparatus, the combination of corrugating means comprising belts traveling with a web, crushing means comprising rolls, said belts passing through the bite of said rolls so as to support and carry the corrugated web into said bite without loss of stretch, means for causing said belts to leave the surface of at least one of said crushing rolls, and means for removing said web from said belts after said belts have left the surface of said roll.
4. In a corrugating apparatus, the combination of corrugating means comprising belts traveling with a web upon both sides thereof, crushing means through which said web is led, said corrugating means also passing through said crushing

means, and means beyond said crushing means in the direction of travel of said web to cause said belts to leave the surface of said crushing means so as to permit the subsequent withdrawal of said web from said belts.

5 5. In corrugating apparatus, corrugating means comprising a series of movable members traveling with a web upon one side thereof, means on the other side thereof presenting a surface characterized by ridges, crushing means, and extensions on
10 said ridges adapted to carry said web in undistorted corrugated condition into the bite of said crushing means, said extensions on said ridges extending into the crushing space between said
15 crushing means.

6. In corrugating apparatus, corrugating means comprising a series of movable members traveling with a web upon one side thereof, means on the other side thereof presenting a surface characterized by ridges, crushing means, extensions on said
20 ridges adapted to carry said web in undistorted corrugated condition into the bite of said crushing means, and means for bringing a supporting web into contact with said corrugated web while supported by said extensions.

7. In corrugating apparatus, corrugating means comprising at least one series of corrugating members traveling with a web, a crushing means, said series of corrugating members passing through
30 said crushing means, and means for bringing a supporting web into contact with said corrugated web while supported by said series.

8. In combination corrugating means comprising means presenting lands or ridges to a web,
35 means for deforming said web therebetween, crushing means, said first mentioned means terminating short of said crushing means and said second means supporting said web thereinto, means for applying adhesive to said web on said
40 crushing means, and means therebeyond for bringing a second web in contact with said first mentioned web, thereby causing said second web to adhere to said first web.

9. A process of producing a composite fabric
45 which comprises corrugating a web, crushing the corrugated web, applying adhesive to said web while crushing it and thereafter leading a second web against said crushed and corrugated web, thereby causing said second web to adhere to said first web.

10. In corrugating apparatus, the combination of corrugating members traveling with a web, and crushing means for said web as corrugated by said members, said corrugating members arranged
50 to pass with said web through crushing means, said crushing means comprising a crushing roll having annular grooves therein to permit displacement of said corrugating members from the corrugations in said web so that the corrugations in said web can be flattened by said crushing means.

11. A process of producing crushed corrugated paper, which comprises corrugating a web of paper through the use of corrugating means, and passing said web and said corrugating means through crushing means, while displacing said corrugating means from the corrugations in said web so that said corrugations may be flattened by said crushing means.

70 12. In combination, corrugating means for corrugating a web, means for applying adhesive to said web, means for bringing a second web into contact with said first mentioned web, and crush-

ing means operating upon said adhesively joined webs, said corrugating means passing through said crushing means with said web, said crushing means comprising a cylinder having grooves permitting displacement of said corrugating means from the corrugations in said corrugated web, whereby said crushing means may crush said corrugations in said web.

13. A process of producing a composite fabric which comprises corrugating a web so as to form therein corrugations extending in the direction of the length of said web, and while restraining said web against width-wise spread so as to maintain the corrugations therein, cementing said corrugated web to another web, and thereafter crushing said corrugated web.

14. A process of producing a composite fabric which comprises corrugating a web so as to form therein corrugations extending in the direction of the length of said web, and while restraining said web against width-wise spread, so as to maintain the corrugations therein, applying adhesive to the crests of said corrugations, leading a second web against said coated crests, and thereafter crushing said corrugated web against said last mentioned web.

15. A process of producing a composite fabric which comprises leading said web over members presenting lands or ridges extending in the direction of the length of said web and of its movement, depressing said web between said lands or ridges so as to form therein corrugations extending in the direction of the length of said web, applying adhesive to the portions of said web which have been depressed between said lands or ridges, carrying said web beyond the ends of said lands or ridges, and leading a second web against the first mentioned web on the side thereof to which adhesive has been applied, and afterward crushing said first mentioned web against said last mentioned web.

16. In combination, corrugating means comprising members presenting interspaced lands or ridges to a web in the direction of the length of said web, means for passing a web thereover in the direction of its length, means for deforming said web by depressing it between said lands or ridges, and means for applying adhesive to said web against the portions thereof which lie between said lands or ridges, and means operating in sequence with said first means and lying beyond the termination of said lands or ridges for leading a second web against said first mentioned web on the side thereof to which adhesive has been applied.

17. In combination, corrugating means comprising members presenting interspaced lands or ridges to a web in the direction of the length of said web, means for passing a web thereover in the direction of its length, and means for deforming said web by depressing it between said lands or ridges, means for applying adhesive to said web against the portions thereof which lie between said lands or ridges, and means operating in sequence with said first means and lying beyond the termination of said lands or ridges for leading a second web against said first mentioned web on the side thereof to which adhesive has been applied, and means for applying a crushing pressure concurrently to both webs after they have been adhered together.

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