June 7, 1955 M. HUBMEIER 2,710,043

APPARATUS FOR CORRUGATING PAPER OR CARDBOARD

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FIG. 1

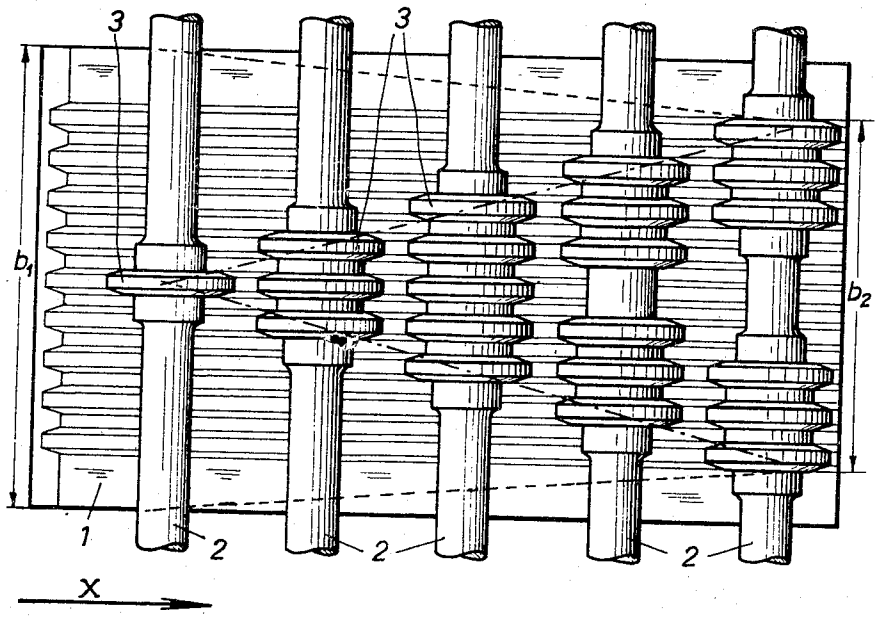


FIG. 2

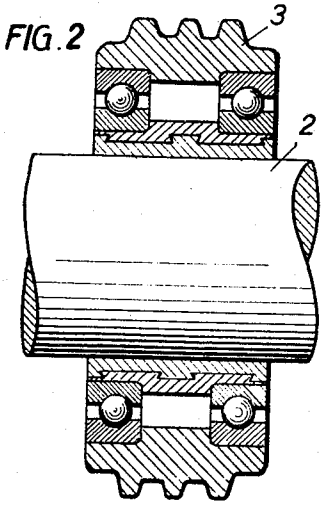
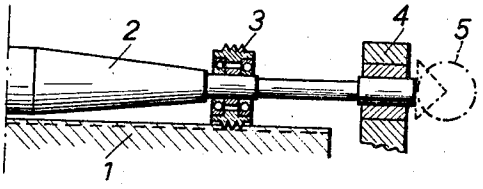


FIG. 3



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June 7, 1955 M. HUBMEIER 2,710,043

APPARATUS FOR CORRUGATING PAPER OR CARDBOARD

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FIG. 4

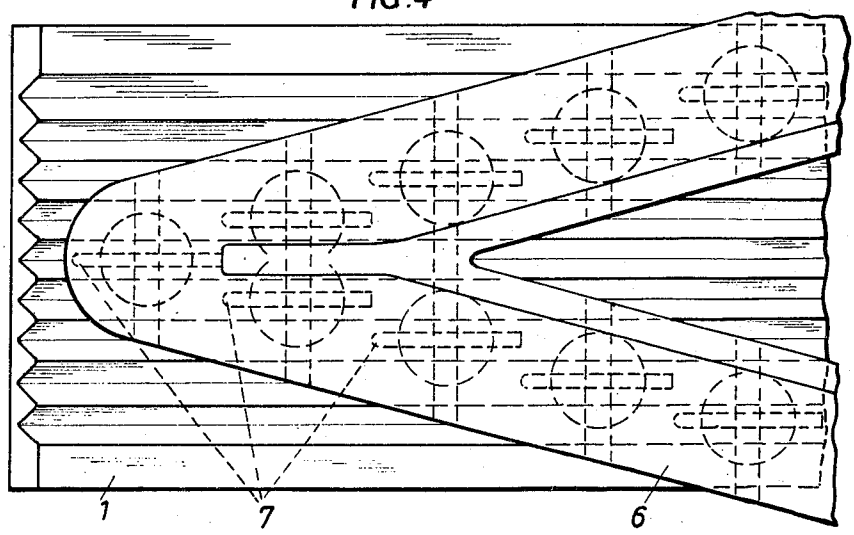


FIG. 5

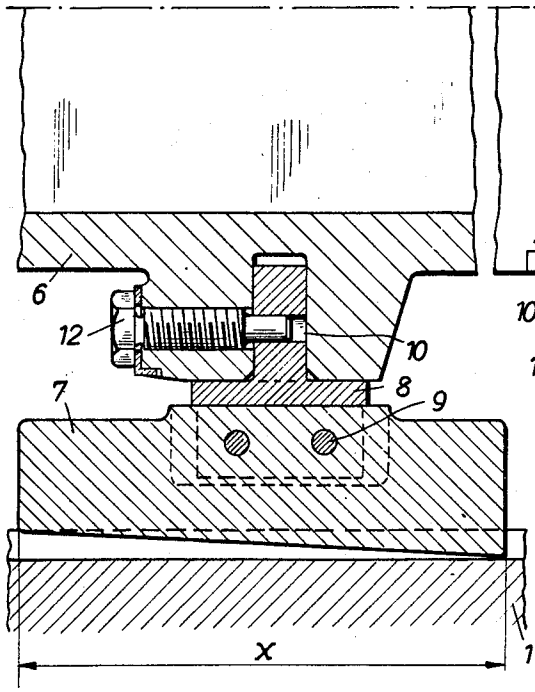
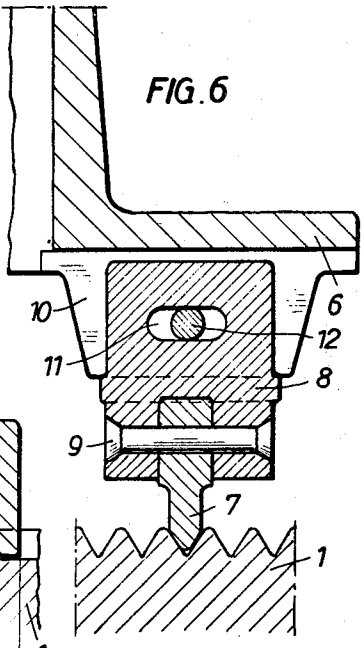


FIG. 6



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APPARATUS FOR CORRUGATING PAPER OR CARDBOARD

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FIG. 7

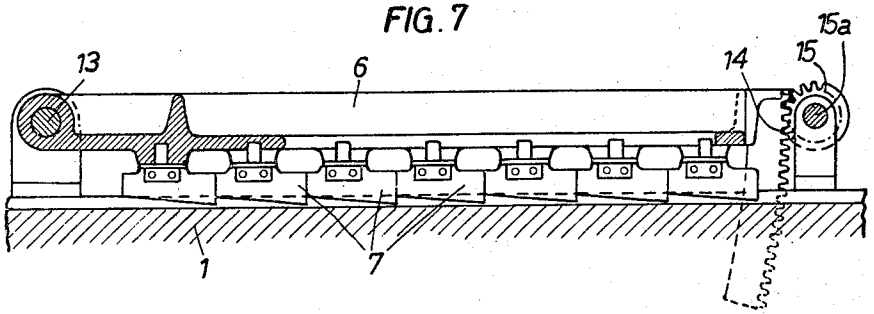
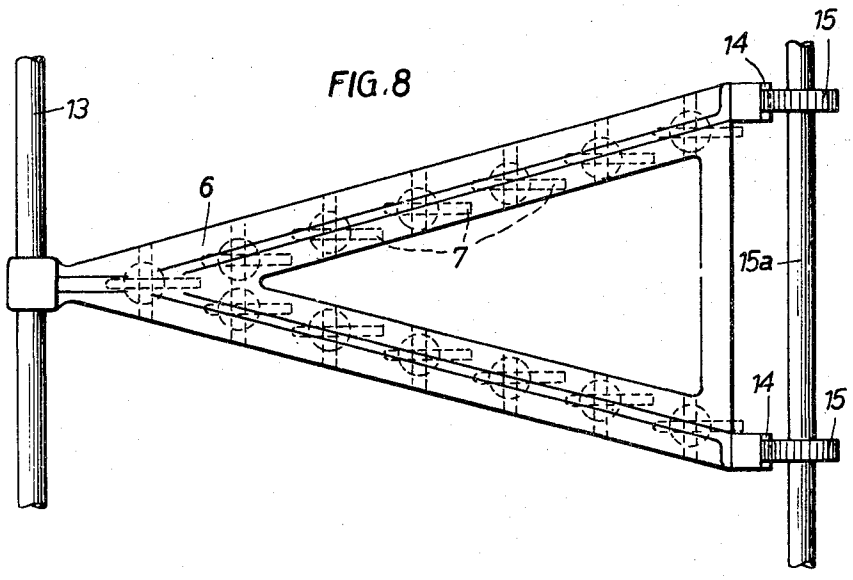


FIG. 8



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APPARATUS FOR CORRUGATING PAPER OR CARDBOARD

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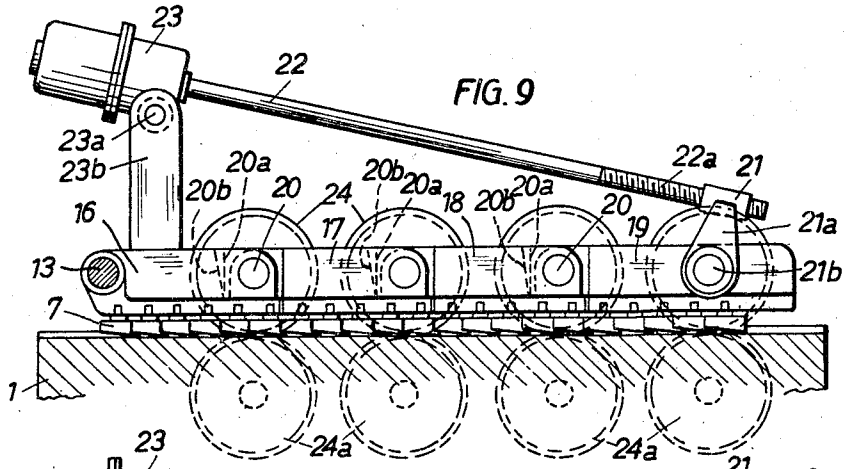

FIG. 9

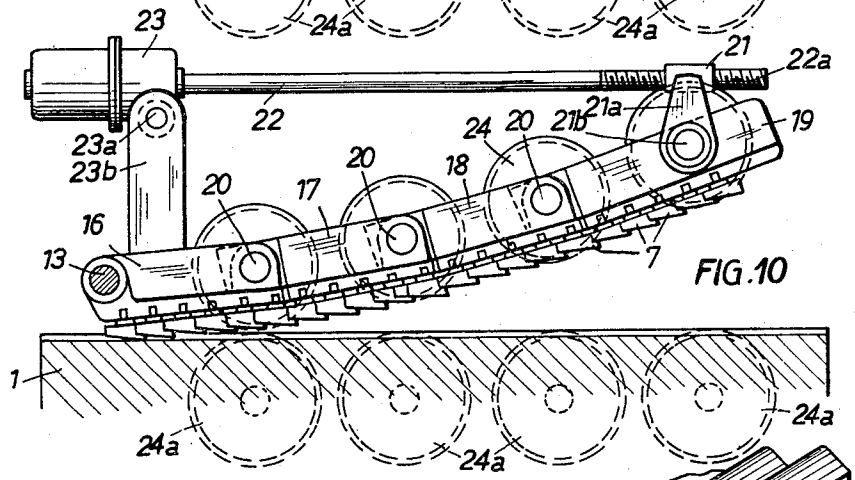

FIG. 10

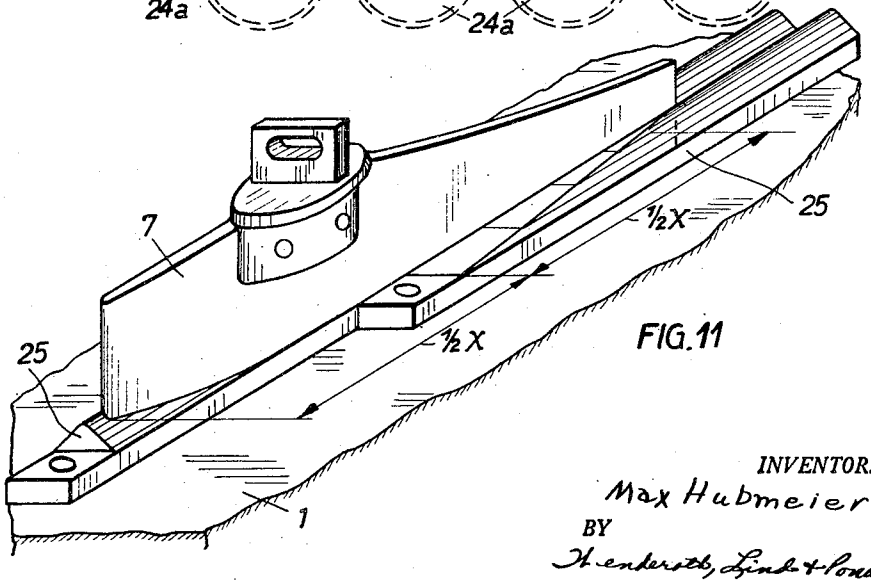

FIG. 11

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FIG. 12

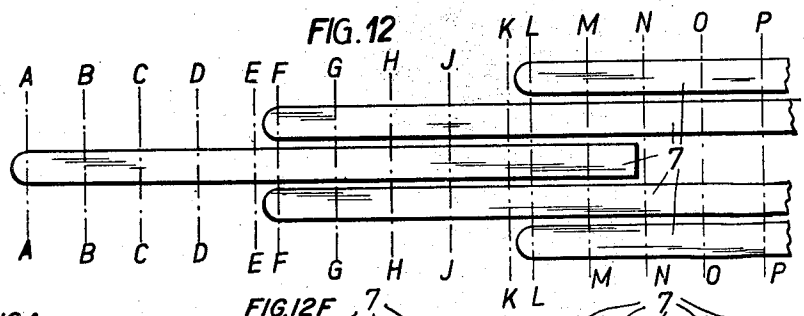


FIG. 12A

FIG. 12B

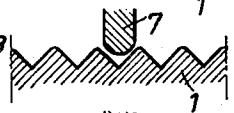


FIG. 12C

FIG. 12D

FIG. 12E

FIG. 12F

FIG. 12G

FIG. 12H

FIG. 12J

FIG. 12K

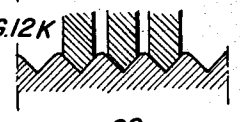


FIG. 12L

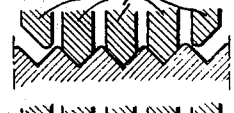


FIG. 12M

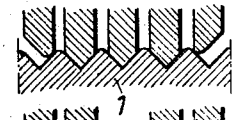
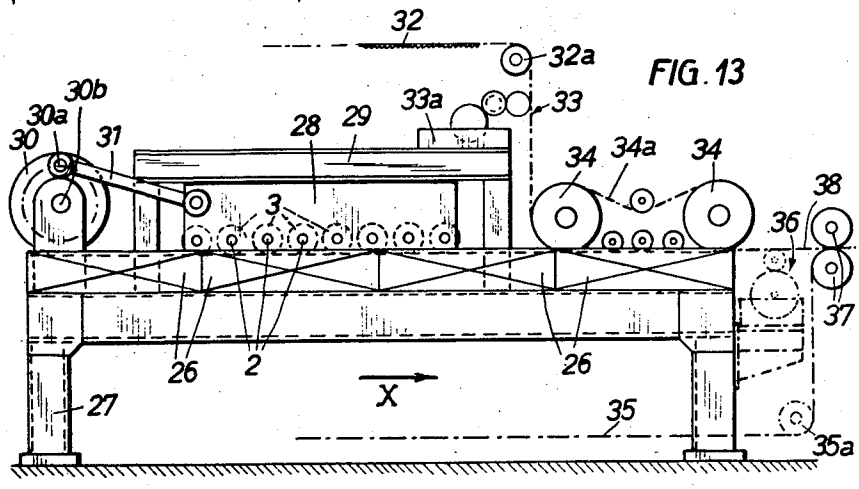


FIG. 12N

FIG. 12 "O"

FIG. 12P

FIG. 13



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June 7, 1955 M. HUBMEIER 2,710,043

APPARATUS FOR CORRUGATING PAPER OR CARDBOARD

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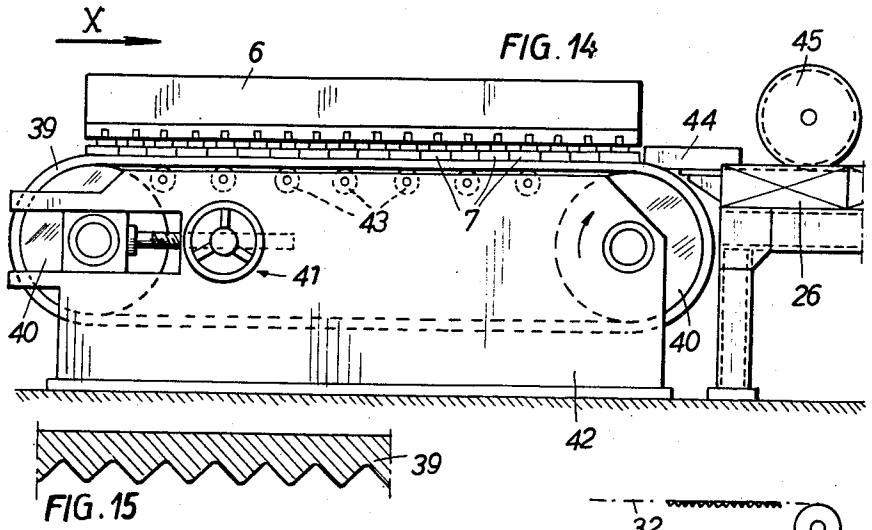

FIG. 14

FIG. 15

FIG. 16

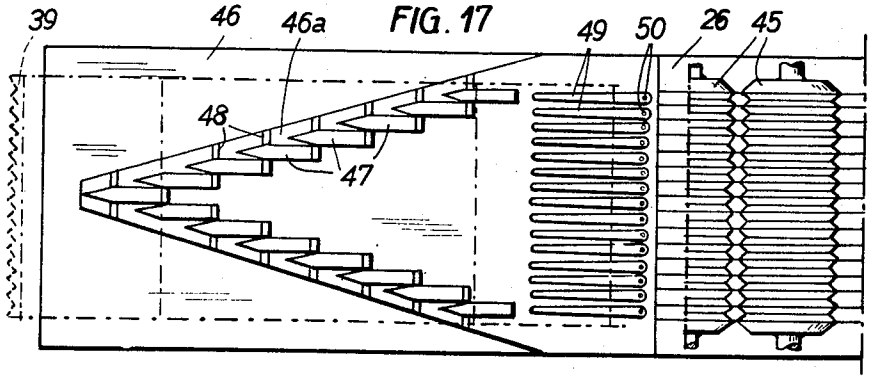

FIG. 17

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APPARATUS FOR CORRUGATING PAPER OR CARDBOARD

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FIG. 18

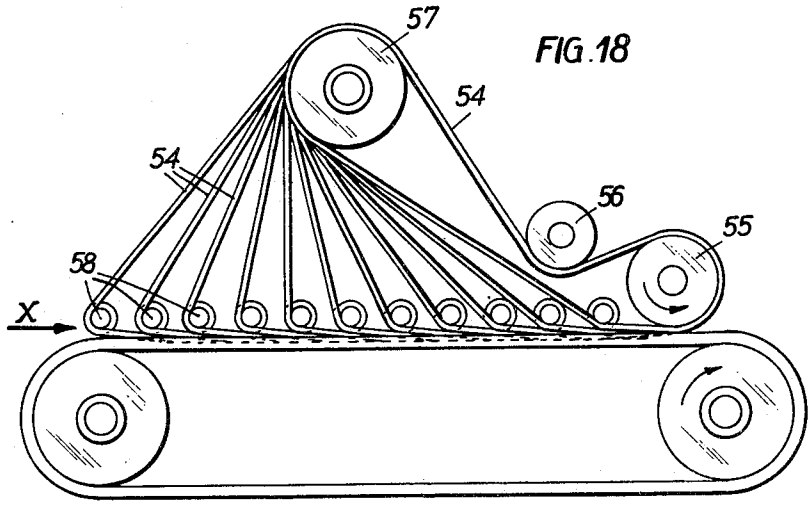
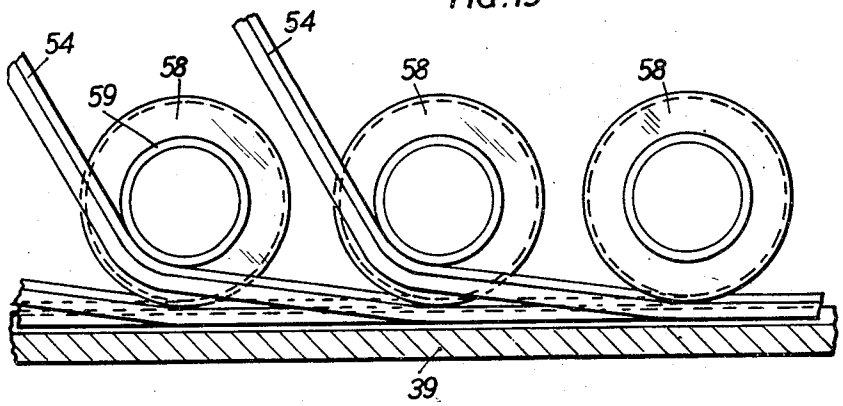


FIG. 19



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APPARATUS FOR CORRUGATING PAPER OR CARDBOARD

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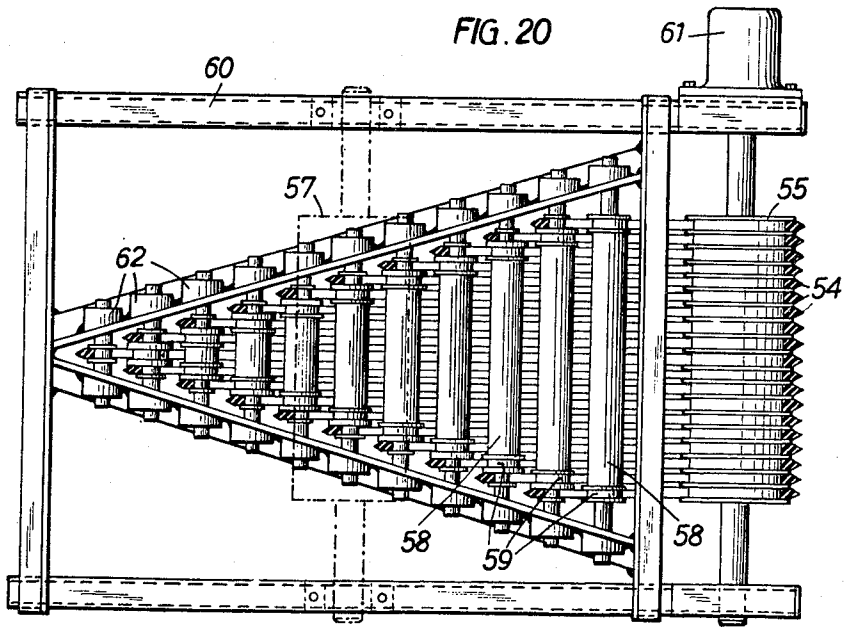
FIG. 20



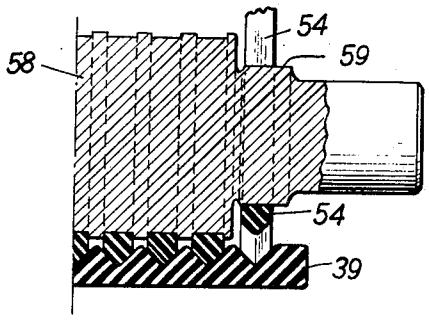


FIG. 21

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June 7, 1955 M. HUBMEIER 2,710,043

APPARATUS FOR CORRUGATING PAPER OR CARDBOARD

Filed April 14, 1952 9 Sheets-Sheet 9

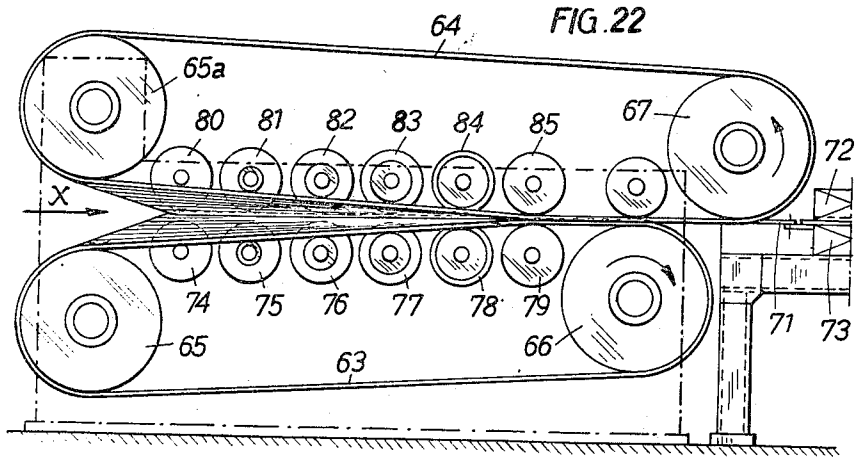

FIG. 22

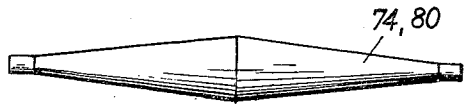

FIG. 23

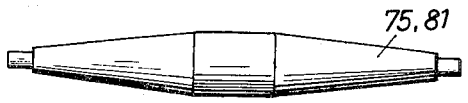

FIG. 24

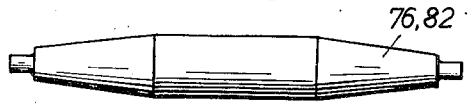

FIG. 25

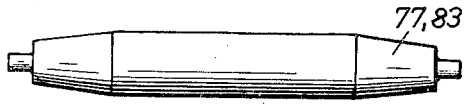

FIG. 26

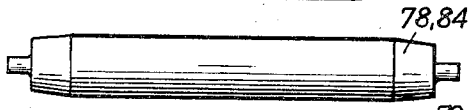

FIG. 27

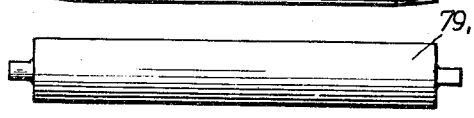

FIG. 28

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United States Patent Office

2,710,043

Patented June 7, 1955

2,710,043

APPARATUS FOR CORRUGATING PAPER OR CARDBOARD

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Application April 14, 1952, Serial No. 282,124

6 Claims. (Cl. 154—30)

The present invention relates to an apparatus for providing, in continuous operation, a run of paper or cardboard with corrugations extending longitudinally of the said run.

It has been tried for decades to provide an operable machine for corrugating paper or cardboard in the direction of its run, not in order to obtain longitudinally corrugated paper or cardboard as a separate commercial product but rather in order to manufacture, mechanically and in continuous operation, so-called crosswise corrugated board or double-double board comprising at least two corrugated layers the corrugations of which run crosswise of each other, with or without an intermediate smooth sheet.

Two basically different methods have been shown to be applicable for producing longitudinally corrugated paper or cardboard.

According to the first of these methods, one begins from the outset to press all the corrugations, whereby a longitudinally corrugated fan is produced from the flat paper or cardboard run by continuous engagement between top and bottom pressing members, with the said paper or cardboard run tapering progressively in breadth. For this purpose, two radially tapering plates engaging each other and having grooves of continuously changing transverse profile may be used. Alternately, pairs of rollers of corresponding shape, or corresponding rollers cooperating with such a grooved plate may be used.

With the second method, one first presses only one or two longitudinal corrugations along the center line of the paper or cardboard run, and one begins to press the two adjacent corrugations right and left thereof only when the preceding corrugations have been completed or nearly so, and so on. For carrying out this method, various devices have been suggested as well, among others with corresponding corrugating members engaging each other from above and from below, or with pressing rollers in V-shaped arrangement above a cylinder having parallel grooves. Other suggestions related to the use of a larger number of roller pairs ararnged one behind the other, whereby again one pair of longitudinal corrugations after the other are formed continuously, beginning from the center, each pair of rollers producing one pair of corrugations.

Besides, it has been proposed, in order to avoid entirely the difficulties of producing longitudinal corrugations, to manufacture crosswise corrugated cardboard by assembling sheets of ordinary transversally corrugated cardboard, these sheets being cut to the same size but differing in the orientation of the corrugations, which in each sheet run at right angles to those of the other sheet. This method, however, does not permit to manufacture crosswise corrugated board in continuous runs and at high working speeds.

Therefore, it has not yet been possible up to now to manufacture longitudinally corrugated paper or cardboard, or crosswise corrugated cardboard or double-double board, by means of machines and in continuous operation.

It is the main object of the present invention to provide means for producing longitudinally corrugated paper or cardboard, and crosswise corrugated cardboard or double-double board, in continuous process and at high speeds of operation.

Various embodiments of the invention are shown by way of example in the accompanying drawings in which:

Fig. 1 is a plan view of a corrugating apparatus comprising a grooved plate and a set of grooving rollers cooperating with it;

Fig. 2 is an axial section through a grooving roller of the apparatus according to Fig. 1;

Fig. 3 shows, in cross-section, the grooving roller represented in Fig. 2, with half of its shaft;

Fig. 4 illustrates, in plan view, another embodiment of the grooving apparatus, comprising a grooved plate and grooving shoes cooperating with it;

Figs. 5 and 6 are a longitudinal and a transversal section, respectively, through a grooving shoe of the apparatus shown in Fig. 4;

Figs. 7 and 8 show, in longitudinal section and in plan view, respectively, part of an apparatus of the kind shown in Figs. 5 and 6, in which the frame carrying the grooving shoes can be swung upwards;

Figs. 9 and 10 illustrate in lateral view, in two different positions, an alternative arrangement for swinging the grooving shoes clear of the grooved plate;

Fig. 11 shows, in perspective, a grooving shoe cooperating with folding bars, in still another alternative arrangement;

Fig. 12 diagrammatically indicates the disposition of the grooves in a grooved plate intended for cooperation with grooving shoes; Figs. 12A to 12P are fifteen cross-sections through the cooperating active portions of the grooving shoes and grooved plate, taken on lines A—A to P—P of Fig. 12, respectively.

Fig. 13 is a diagrammatic lateral view of a further embodiment of an apparatus according to the invention, including a paper corrugating device with a reciprocating set of grooving rollers and with devices for bonding further layers of transversely corrugated and/or smooth paper to the longitudinally corrugated run of paper;

Fig. 14 shows, in lateral view as well, an alternative embodiment comprising a grooved belt and grooving shoes cooperating with it;

Fig. 15 is a cross-section through the belt of Fig. 14;

Figs. 16 and 17 represent, in a diagrammatic lateral view and in plan view respectively, still another alternative embodiment comprising a grooved belt on the top side, cooperating with grooving bars at the bottom side of the paper to be corrugated;

Fig. 18 shows, in a diagrammatic lateral view, a further embodiment having a grooved belt at the bottom and a series of individual grooving belts at the top;

Fig. 19 shows a detail of the arrangement illustrated in Fig. 18;

Fig. 20 represents, in plan view, with top parts removed, the supporting means for the individual belts of the embodiment according to Fig. 18;

Fig. 21 is a detail of the same embodiment, in cross-section;

Fig. 22 illustrates, in a diagrammatic lateral view, still another embodiment of the invention in which one top belt cooperates with one bottom belt; and

Figs. 23 to 28 are views of various rollers used in the embodiment of Fig. 22.

In Fig. 1, the reference numeral 1 indicates a stationary plate provided with parallel grooves the profile of which corresponds to that of the longitudinal corrugations it is desired to obtain in a run of paper or cardboard. A

number of pressing devices cooperating with the plate 1 are arranged above the latter, each of these devices comprising a shaft 2 on which grooving rollers 3 are rotatably mounted. The run of paper or cardboard to be corrugated is introduced from the left and proceeds between the plate 1 and the rollers 3 in the direction indicated by the arrow X. A first corrugation in the paper or cardboard is produced by the roller on the first shaft from the left along the center line of the paper run; the rollers on the second shaft produce a further corrugation on each side of the said first one, those on the third shaft produce two further corrugations, and so on. Thus, about half as many shafts with their rollers are required as there are to be corrugations in the finished longitudinally corrugated paper run. The initial breadth b_1 of the paper run in this process diminishes to the final effective breadth b_2 of the corrugated run.

The particular advantage of this arrangement is that the paper or cardboard is guided in the stationary plate 1 during the whole corrugating operation from the moment it is seized by the first roller to that at which it leaves the last rollers. The plate 1 may be extended to the right to a device (not shown) in which the corrugated paper or cardboard is bonded to a flat covering layer of paper or cardboard or directly to a layer of transversely corrugated paper or cardboard. During the bonding operation, the longitudinally corrugated run still rests on the grooved plate 1 and does not leave the latter until after its corrugations have been fixed by the covering bonded at least to one of its faces.

The grooved plate 1 is heated during operation. In order that the grooving rollers 3 may follow the lateral dilatation of the plate as its temperature varies depending on the rate of heating, it is essential that these rollers be laterally displaceable on their shafts 2, as shown in Figs. 2 and 3. The ball bearings shown in these figures may, however, be omitted if the shafts 2, which are supported at their ends in bearings 4, are to drive the rollers 3 by means of keys or splines; in this case lateral displaceability of the rollers on the shafts may be provided by plain bearings. The shafts 2 are then driven from a common driving shaft by means of a pair of bevel gearwheels 5.

In the embodiment shown in Figs. 4, 5 and 6 grooving shoes 7 are provided instead of the rollers 3. These are mounted on a frame 6 which is V-shaped in plan view. Here again, it is essential that the grooving shoes 7 be mounted in the frame 6 so as to be easily displaceable laterally. For this purpose, an intermediate member 8 is provided, to which the grooving shoe 7 is fixed by rivets 9, while the intermediate member 8 itself is guided in a guide slot 10 of the frame 6 so as to be laterally displaceable in the latter. To prevent the intermediate member 8 from falling out, a retaining screw 12 is provided in the frame 6, which screw extends into an elongated hole 11 of the member 8.

While it is comparatively easy to introduce a new run of paper or cardboard into the device when rollers are used as a grooving means, this operation presents some difficulties when grooving shoes are used with a stationary grooved plate. In order to facilitate it, the support 6 is swingably mounted on a shaft 13 and provided with a pair of toothed segments 14 each engaged by a gearwheel 15 mounted on a shaft 15*a*, as shown in Figs. 7 and 8, so that it can be swung up and down in an easy way by rotating this shaft.

When a new run of paper is to be introduced, the frame 6 is raised, the front portion of the paper run is placed on the grooved plate 1, and the frame 6 with the shoes 7 is gradually lowered. With this arrangement, however, only the first five or six pairs of shoes engage the paper one after the other, while the remaining shoes begin almost simultaneously to press down the paper into the grooves of the plate 1.

This drawback is avoided in the arrangement shown in Figs. 9 and 10, in which the frame comprises several parts 16, 17, 18 and 19 which are swingable individually one after the other about shafts 20 each linking one of the said parts to the adjacent one. Each part carries five or six pairs of shoes.

To swing the parts 16 to 19 into and out of working position, a geared electric motor 23 is swingably mounted on a trunnion 23*a* itself supported by a pillar 23*b* mounted on the grooved plate 1. A spindle 22 driven by the motor 23 and having a threaded portion 22*a* engages a nut 21 which is carried on an arm 21*a* itself swingably supported by a shaft 21*b* extending through the extreme part 19 of the frame. Relative angular displacement about the shafts 20 of adjacent parts 16 to 19 of the frame is limited by cooperating abutments 20*a*, 20*b*.

To raise the parts 16 to 19 of the frame from their working position shown in Fig. 9, into the position shown in Fig. 10, the motor 23 drives the spindle 22 in such a direction that the nut 21 is screwed to the left along the said spindle. Thereby, the part 19 of the frame is swung anti-clockwise about the shaft 20 by which it is linked to part 18, until the abutment 20*a* of part 19 contacts the abutment 20*b* of part 18. Thereupon, both parts 18 and 19 continue to move in unison about the shaft 20 linking parts 17 and 18; similarly, after the abutments 20*a* and 20*b* of parts 17 and 18, respectively, have met, the parts 18 and 19 continue to rise jointly with part 17, and finally the whole frame, including part 16 as well, swings upwards about shaft 13 into the position shown in Fig. 10. After the front portion of a paper run has been placed on the grooved plate 1, the motor 23 is reversed and the parts 16, 17, 18 and 19 of the frame, in this sequence, descend on the paper, so that their shoes press the paper into the grooves of the said plates.

Profiled top driving rollers 24 are rotatably supported on the shafts 20, and corresponding bottom driving rollers 24*a* are lodged within the grooved plate 1 the top surface of which in this case has interruptions through which the bottom rollers 24*a* project into contact with the paper running in the grooves of the plate 1. The profile of each bottom roller 24*a* is the same as the transversal profile of the plate 1 at the point where this roller projects through the latter, so that the surfaces of the rollers and of the plate are flush with each other. The profile of the corresponding top roller 24 is complementary to that of the bottom roller in question, so the top and bottom rollers 24 and 24*a* cooperate for seizing between them the paper. Means (not shown) are provided for driving the rollers for advancing the paper between the plate 1 and the shoes 7 from left to right.

In all the embodiments thus far described, the longitudinal corrugations of the paper or cardboard are obtained by pressure between top and bottom. However, it is possible to obtain these corrugations by way of folding and for this purpose the arrangement shown in Fig. 11 is used. Here, the bottom plate 1 is not provided with grooves but carries a set of folding bars 25 cooperating with the grooving shoes 7. The bars 25, two of which are shown in Fig. 11, are mounted along each other with their front ends in staggered position. Towards these front ends, the bars 25 may be pointed or flattened. While in the foregoing examples the front half ($\frac{1}{2}x$) of the length of each shoe 7 serves for pressing down the paper to form both sides of a corrugation, this part of the shoe length here only serves to fold the paper on the inner side, i. e. the side nearer to the center line of the paper run, against the corresponding folding bar. The outer side of the corrugation is only formed, against the outwardly adjacent bar 25, by the rear half ($\frac{1}{2}x$) of the shoe 7. The shoe 7 thus extends to the rear between the two adjacent bars at least up to the point at which the corrugation has been completed.

This arrangement has the advantage that it permits to

form corrugations in paper of poor grade and such brittleness that it scarcely would withstand pressing.

The same effect may be obtained by means of a grooved bottom plate provided that the cross-profile of the grooving shoes 7 is shaped as indicated in Fig. 12 and Figs. 12A to 12P. These figures show successive cross sections of the first five grooving shoes. The first or central grooving shoe should have the symmetrical profile shown in Figs. 12A to 12E, while all other grooving shoes should be shaped as indicated in Figs. 12F and 12P, i. e. they should form the corrugations by unilateral pressure against the inner side of the corresponding groove of plate 1, the outer side of each corrugation being left free to assume its final shape without the application of any pressure.

It is important that at the finished longitudinal corrugations the paper be guided without interruption until the paper has been bonded to that first overlay sheet, which may consist of flat or of transversely corrugated paper or cardboard. Preferably, the bonding thus takes place while the corrugated paper still is on the grooved plate 1. For this purpose, a machine as shown in Fig. 13 may be used.

This machine comprises a table-like structure 27 on which are mounted heatable boxes 26 the tops of which provide a grooved support plate for the paper. A separate housing 28 slidably supported by a guide rail 29 carries a set of grooving rollers 3 rotatably mounted on shafts 2, the arrangement of the grooved plate and the rollers 3 being as shown in Fig. 1. However, the rollers 3 may be replaced by grooving shoes such as those indicated at 7 in Figs. 4 to 6, with the housing 28 replacing the frame 6 shown in these figures. The housing 28 is reciprocated along its guide rail 29 by means of a link rod 31, which at its opposite end is articulated on a crank pin 30*a* carried by a disc 30. The latter is fixed on a driving shaft 30*b* which is driven by a motor (not shown) through a suitable transmission.

For introducing a new run of paper, seizing devices, not shown in the drawing, are provided both on the grooved plate formed by the boxes 26, and on the housing 28. The paper is introduced into the machine while the housing 28 is in its extreme right-hand position and the front portion of the paper run is placed on the grooved plate with its front edge as far as possible to the right. Thereupon, the reciprocating motion of the housing 28 is initiated, so that the latter moves to the left, in a direction opposite to that indicated by arrow X, and the rollers 3 form the first corrugations in the said front portion of the paper run. As soon as the motion of the housing 28 is reversed and the latter moves to the right in the direction of the arrow X, the said seizing devices on the housing 28 engage the paper and carry it forward over the grooved plate. When the housing 28 again reaches its extreme right hand position, these seizing devices release the paper, while the seizing devices mounted on the boxes 26 engage it. Thus, the paper again remains stationary while the rollers 3 proceed over it to the left, forming a further stretch of the corrugation. At the end of this stroke of housing 28, the paper again is disengaged from the boxes 26 and seized by the seizing device on housing 28, and so on. This stepwise advance of the paper continues until the front edge of the paper run has reached the paper advancing devices associated with heating and cooling devices later to be described. Although from this moment the reciprocating motion of the housing no longer is necessary, it is, however, recommended to continue it throughout the time of operation of the machine.

A run of smooth or transversely corrugated paper, the latter being itself preferably already bonded to a smooth overlay run, is indicated at 32. It arrives continuously from any suitable source (not shown), such as a supply roll or (in the case of transversely corrugated paper) a conventional corrugating machine and is first carried over a roller 32*a* and then over a glue applying device 33 comprising a set of rollers for transporting liquid glue from a reservoir 33*a* to the surface of the paper 32. Thence, the paper proceeds to an assembling device comprising a pair of rollers 34 over which a felt belt 34*a* is carried. This belt applies the paper run 32 to the longitudinally corrugated paper which at this point still rests on one of the heated boxes 26, with its corrugations still guided in the grooves of the top face of the box. Both layers of paper are thus glued together.

A further run of smooth paper 35 may be applied from below to the under face of the longitudinally corrugated paper run. Additional devices provided for this purpose are indicated in dash-and-dot lines at the right of Fig. 13. They comprise a device 36, similar in principle to that indicated at 33, for applying glue to the under face of the longitudinally corrugated paper after it has left the last-mentioned box 26. The glue only is applied to the apices of the downward corrugations formed in the grooves of the grooved plate. The smooth covering paper arrives over a roller 35*a* and is applied to the said under face by the lower one of a pair of cooperating rollers 37 between which the previously assembled sheets advance to the right. If the paper run 32 consists of transversely corrugated paper with a smooth top sheet, the assembled material 38 leaving the pair of rollers 37 is a stiff "double-double board" consisting of two corrugated layers having their corrugations running at right angles, with both faces of the board covered by a smooth sheet. This "double-double board" then proceeds to drying and cooling devices not shown in the drawing, whereupon it is ready for cutting to panels of desired length or size.

The pair of rollers 37 is driven by suitable means not shown and is the main device for drawing the various runs of papers through the machine; other advancing means such as the rollers 3 and the belt 34*a* if driven serve mainly to relieve the paper run or runs in question of excessive or otherwise undesirable stresses.

It has already been pointed out that a stationary grooved plate, especially when the cooperating grooving members, such as grooving shoes, are stationary as well, may cause certain difficulties for the initial introduction of a fresh run of paper to be corrugated and also always causes high stresses in the paper. These difficulties are the smaller, the more of these members are mobile. The most preferable construction is one in which all grooving members permanently move in the same direction and at the same speed as the paper advances. If this condition is to be fulfilled for the grooved plate, one is led to provide an endless transporting belt the top face of which is grooved longitudinally. However, most of the materials suitable for such a belt, such as rubber, special textile products, synthetic resins and the like do not in the present state of technology withstand without damage the high temperature which is necessary for heating, i. e. 150 to 180 deg. C. For the corrugating operation itself, heating is not necessary and does not facilitate this operation at all, but if the corrugations are to have some degree of permanence, heating is indispensable. This consideration leads to a subdivision of the operation into a first folding or grooving step carried out at ordinary temperature and a second "hot-ironing" step for giving permanence to the corrugations formed in the first step. This renders it possible to use the above-mentioned flexible but not heat-resistant materials for an endless grooving belt.

The embodiment shown in Fig. 14 thus comprises an endless grooving belt 39 made from rubber, the cross-section of which is shown in Fig. 15, and which runs over a pair of rollers 40, the left-hand one of which is provided with a tensioning device generally indicated at 41, which will not be described in detail, being of conventional construction. The rollers 40 and the tensioning device 41, as well as a number of supporting rollers 43

for the top leg of the belt 39 are mounted in a housing 42. Over it is mounted a frame 6 with grooving shoes 7 of similar construction as that shown in Fig. 3. Due to the good adhesion between the rubber of the belt 39 and the paper, it is now merely necessary, in order to introduce a new run of paper, to advance the front edge of this paper in the direction of the arrow X and to push it under the first shoe 7 while the belt is moving. The belt then advances the paper through the machine, and the paper leaves the belt at the right-hand end in a completely corrugated condition; no paper is wasted even in the front part of the run in the introducing operation. To ensure that on leaving the belt the paper will not expand laterally and lose its corrugated shape, although it markedly tends to do so because the corrugating takes place at ordinary temperature, guides 44 made from sheet metal are provided. Each of these engages a groove both of the belt 39 and of the grooved top of a heating box 26 arranged in alignment with the belt. A rotatable grooving roller 45, provided with parallel circumferential grooves corresponding to the ridges of the grooved top of box 26, engages the latter over the corrugated paper, which is thus "hot ironed" between the heated box 26 and the roller 45. The result thus is the same as if the paper had been corrugated at elevated temperature from the outset.

Figs. 16 and 17 show a further arrangement of this kind in which the respective positions of the belt and shoes are so to say reversed upside down.

On a support 46 having a wedge-shaped top portion 46*a*, grooving rods 47 are mounted in transverse slots 48 so as to be laterally movable. The rods 47 are mounted in staggered disposition, and the belt 39 passes above them. This belt runs over a pair of rollers 40, one of which is driven in the direction indicated by the arrow. Intermediate rollers 43 are provided to press the bottom leg of the belt towards the grooving rods 47. After having carried the paper over the grooving rods to provide it with corrugations, the belt remains in contact with the corrugated paper and carries it towards a set of longitudinal guide rods 49, which are swingably supported on vertical pins 50. The front ends of these rods each engage a groove of the belt 39 and their rear ends are aligned with the ridges in the grooved top face of a heated box or plate 26 of the kind described before. Thus, each paper corrugation formed by the grooving rods 47 in a groove of the belt 49, is safely carried over onto a ridge of the box 26 by a corresponding guide rod 49. Two grooved rollers 45 cooperate with the top surface of the box 26 in this instance for "hot-ironing" the corrugated paper.

A run 32 of transversely corrugated paper, to which glue is applied by an appropriate device 33 as in the embodiment shown in Fig. 13, is thereafter applied to the longitudinally corrugated run, by a roller 51.

Instead of grooving rollers, shoes or rods as described in the previous examples, individual belts 54 may be provided as shown in Fig. 18 each for producing one of the corrugations. All these individual belts are carried over a common roller 55 driven by a motor, then over a tensioning roller 56, and another common roller 57. If the paper runs are broad and if accordingly the machine must be long to accommodate all the grooving devices in staggered relation, two or more common rollers such as 57 will be required. From the roller 57, or from the foremost such roller if a plurality is provided, the belts 54 each run to their points of engagement with the paper. For each pair of corrugations to be provided in the paper, there is one shaft 58 defining the point of engagement of the corresponding belts with the paper. A single belt runs over the foremost shaft 58 to provide a corrugation along the center line of the paper run, the second shaft 58 supports two belts, one at the right and the other at the left (as seen in the direction of advance of the paper) of the first-mentioned belt and in addition to it. Each next pair of belts runs right and left of the foregoing ones, over a further shaft 58, as shown in detail in Figs. 19, 20 and 21. On the first shaft 58 which each belt 54 reaches, the latter is guided on a portion 59 of reduced diameter, while on the following shaft, it passes over the full diameter, whereby it forces the paper (not shown in these figures) into a corresponding groove of the common bottom belt 39 which extends over the full breadth of the paper run and is arranged as in the example of Fig. 14.

Fig. 20 shows in plan view the frame 60 on which the individual-belt mechanism is mounted. The shafts 58 are supported in bearings 62 and are not driven, while the roller 55 which is common for all individual belts 54 is driven by a geared motor 61.

Figs. 22 to 28 show a further simplified embodiment comprising a bottom belt 63 and a top belt 64. The bottom belt 63 runs over an idle roller 65 and over a motor-driven roller 68, while the top belt 64 is carried over an idle roller 65*a* and a motor-driven roller 67. Both the top and the bottom belts are longitudinally grooved according to the corrugated profile to be given to the run of paper, with the ridges of the top belt 64 being adapted to engage the grooves of the bottom belt 63, and vice-versa. The top belt 64 extends farther to the right than the bottom belt 63 and its grooves are engaged by guiding rods 71 supported from the heated "hot-ironing" portion of the machine. This comprises two heated boxes 72, 73 having cooperating grooved faces between which the corrugated paper is guided.

Between the rollers 65, 66, the top leg of the bottom belt 63 runs over a set of supporting rollers 74 to 79, while the bottom leg of the top belt 64 passes under a corresponding number of holding-down rollers 80 to 85. Each of the supporting rollers, e. g., 74, cooperates with a holding down roller, e. g. 80, and the rollers of each such pair are similar to each other. However, while the rollers 74, 80 of the first pair taper conically to both sides from the center line, as shown in Fig. 23, those of each subsequent pair such as 75, 81 or 76, 82 have shorter conical portions and a broader cylindrical center portion than those of the preceding pair, as shown in Figs. 24 to 27, and the rollers 79, 85 of the last pair are cylindrical over their full breadth. As a consequence, the top and bottom belts 63, 64 are pressed towards each other on the center line only as they pass between the rollers 75, 81, then on a progressively increasing part of their breadth as they proceed to the right, until their zone of cooperation extends over their full breadth as they pass between the rollers 79, 85. Accordingly, when a run of paper is introduced from the left between the two belts, first a corrugation is formed along its center line, then more and more corrugations are formed on either side of the said center line, and the paper is longitudinally corrugated on its full breadth on passing between the rollers 79, 85. From that point on, the paper proceeds with the top belt 64, and then over the guiding rods 71, to the pair of heating boxes 72, 73 where it is "hot-ironed" in its corrugated form before proceeding to further treatment.

What I claim is:

1. An apparatus for providing a continuous web of material with longitudinal corrugations, comprising a pair of parallel spaced rollers, means for driving one of said rollers, an endless belt of flexible material running over said rollers, the outer face of said endless belt having parallel longitudinal grooves, forming means engaging said grooves at stationary longitudinally and laterally offset points for pressing said web into said grooves of said belt as the latter passes said points so that said web is pressed first into a central groove of said belt and thereafter in succession into one adjacent lateral groove after the other at both sides of said central groove.

2. An apparatus as claimed in claim 1 in which said forming means comprise a support, a plurality of forming shoes mounted on said support with their forward ends

arranged in a forwardly pointing wedge pattern, each of said shoes engaging one of said grooves in said belt for pressing said web into said groove as the belt and the web advance past it.

3. An apparatus as claimed in claim 2 in which each of said shoes is laterally movable with respect to said support.

4. An apparatus as claimed in claim 2 comprising a heatable pressing device for stabilizing the corrugations formed in said web, a plurality of guide members mounted on said pressing device for guiding said corrugations into said device, each of said guide members extending into one of said grooves of said belt behind one of said forming shoes.

5. An apparatus as claimed in claim 1 in which said forming means comprise a plurality of individual belts each supported for engagement with one of the grooves of said endless belt, the points of initial engagement of said individual belts being offset with respect to each other in the direction of travel of said endless belt to form a wedge-shaped pattern.

6. An apparatus as claimed in claim 1 in which said forming means comprise a second pair of parallel spaced rollers parallel to said first pair of such rollers, a second endless belt of flexible material running over said second pair of rollers, said second endless belt having a plurality of parallel ridges each adapted for engagement with one of said grooves of said first endless belt, and means mounted on the inner side of one of said endless belts between its supporting pair of rollers for guiding said belt in a transversely flexed condition whereby the points of initial engagement of said ridges of said second endless belt with its cooperating groove of said first endless belt are longitudinally offset in a wedge-shaped pattern.

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