No. 657,100. Patented Sept. 4, 1900.

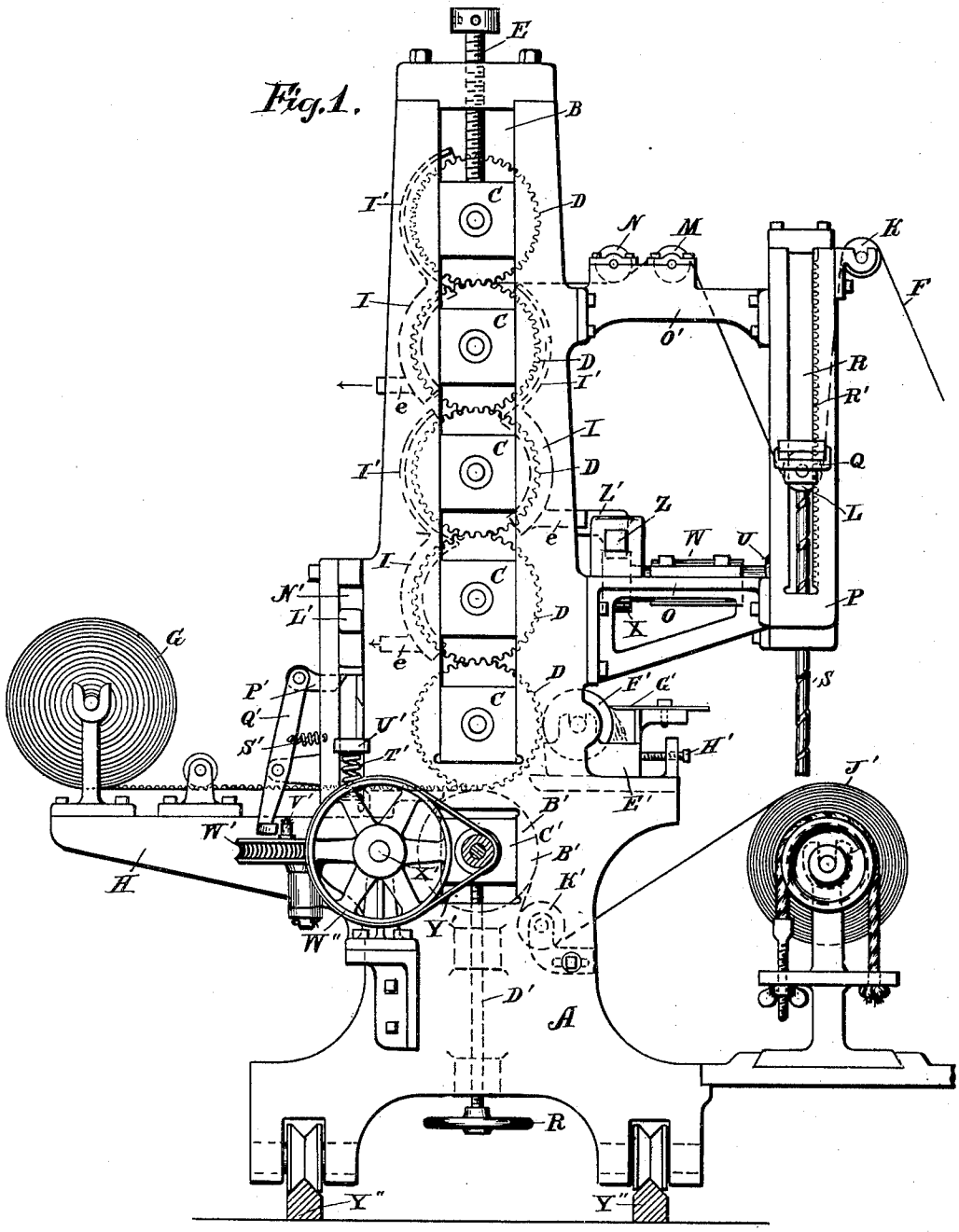
J. T. FERRES.

APPARATUS FOR MAKING CORRUGATED PAPER.

(Application filed Mar. 13, 1899.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.



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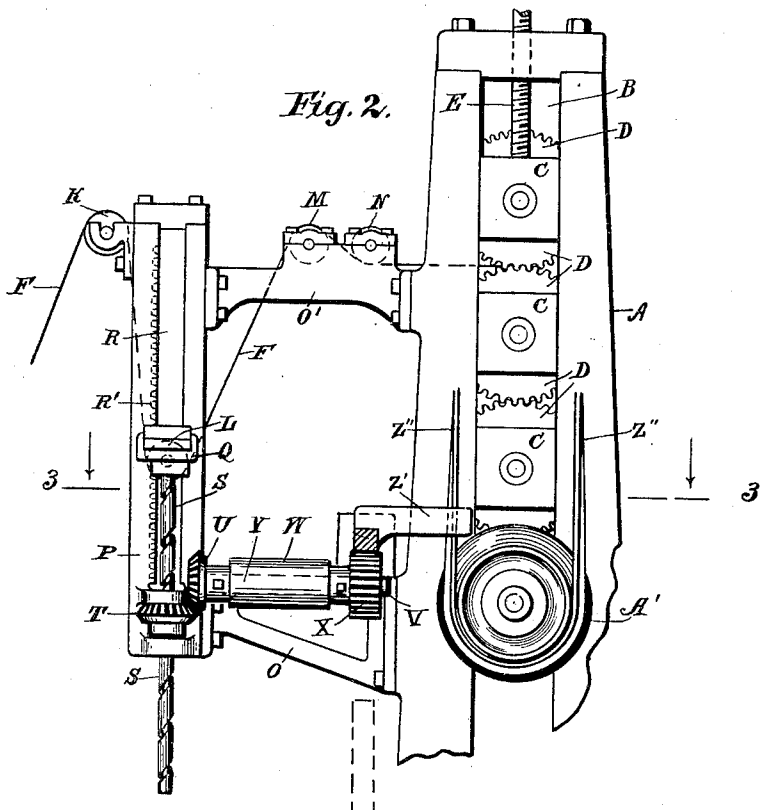
(No Model.) 3 Sheets—Sheet 2.

Fig. 2.



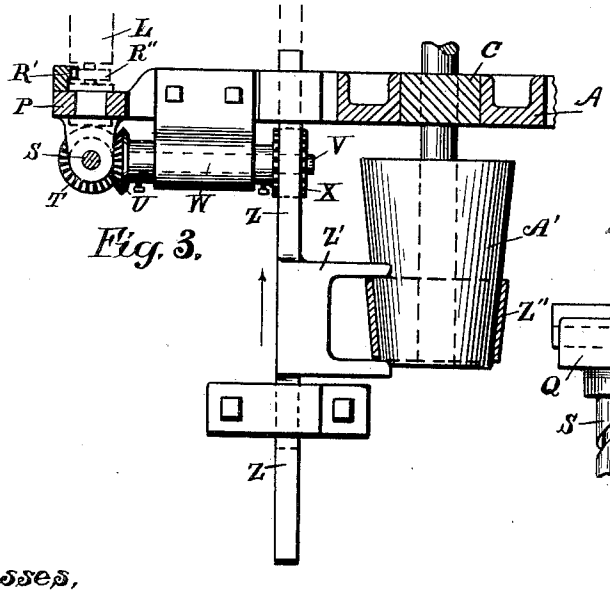


Fig. 3.

Fig. 2a

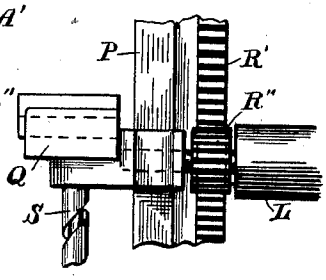


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Fig. 4.

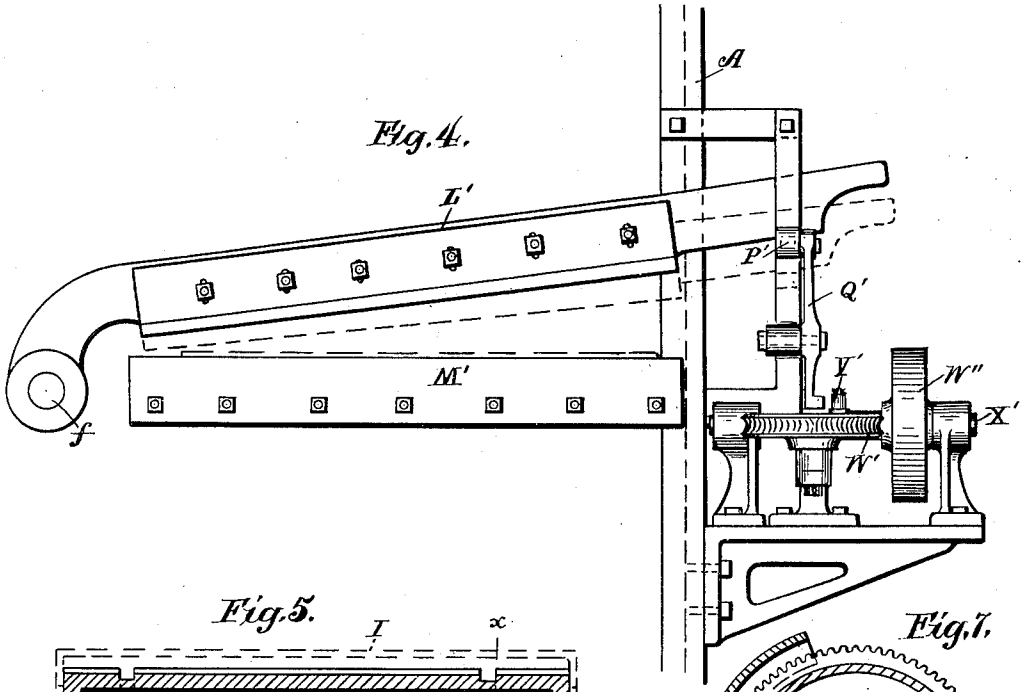


Fig. 5.

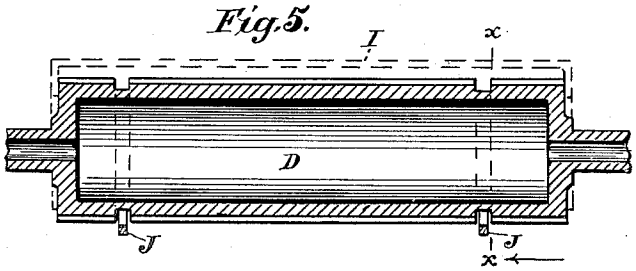


Fig. 7.

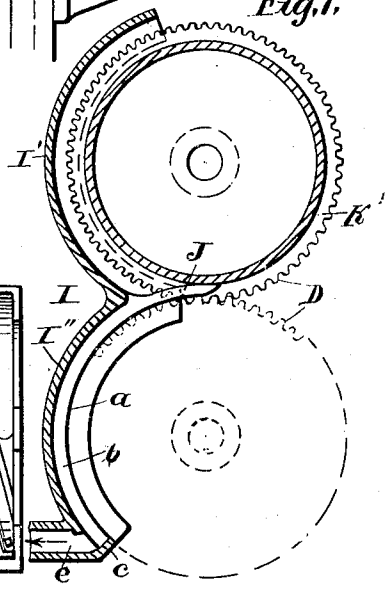


Fig. 6.

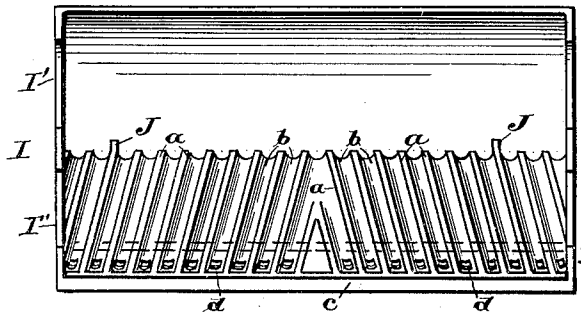
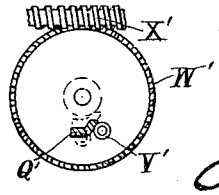


Fig. 8.



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UNITED STATES PATENT OFFICE.

JEFFREY T. FERRES, OF ANDERSON, INDIANA.

APPARATUS FOR MAKING CORRUGATED PAPER.

SPECIFICATION forming part of Letters Patent No. 657,100, dated September 4, 1900.

Application filed March 13, 1899. Serial No. 708,932. (No model.)

To all whom it may concern:

Be it known that I, JEFFREY T. FERRES, a citizen of the United States, residing at Anderson, in the county of Madison, in the State of Indiana, have invented a certain new and useful Apparatus for Making Corrugated Paper, of which the following is a description, reference being had to the accompanying drawings, forming part of this specification.

My invention is designed more particularly for use in connection with a machine of the usual or any suitable character for making the plain "strawboard" paper from which corrugated paper is commonly formed, and my novel apparatus is intended to be placed adjacent the delivery end of such machine and receive the strip of plain paper directly therefrom.

The novelty of my invention consists in the means for converting the plain strip of paper into a corrugated strip and drying or partially drying the same, so that the corrugations will become set and retain their form; means for applying, when desired, a strip of facing-paper to one side of the corrugated strip; means for automatically cutting the completed corrugated strip into sections of desired lengths, and means for automatically regulating the speed of the corrugating-machine in accordance with the speed of the paper-making machine in which the plain paper is made and from which it is delivered to the corrugating-machine, all as hereinafter more fully explained, and particularly pointed out in the claims.

In the accompanying drawings, Figure 1 represents an elevation of my new apparatus looking at its left-hand side or end. Fig. 2 is an elevation of the upper part of the apparatus looking at its opposite side or end; Fig. 2ª, a detail view of one end of the idle roller and coöperating parts shown in Fig. 2; Fig. 3, a horizontal sectional view on the line 3 3 of Fig. 2. Fig. 4 is an enlarged detail elevation of the knife and its coöperating devices looking at the delivery end of the apparatus; Fig. 5, a longitudinal section of one of the corrugating-rolls; Fig. 6, an inside face view of one of the drying-shields applied to the corrugating-rolls; Fig. 7, a transverse vertical section of two of the corrugating-rolls with their adjacent drying-shields on the line *x x* of Fig. 5, and Fig. 8 a detail of the worm-wheel and worm which operates the trip for the knife-support.

The same letters of reference are used to indicate identical parts in all the views.

The main frame of the apparatus consists of two vertical columns or uprights A, separated from each other a sufficient distance to receive between them the corrugating-rolls of desired length and rigidly connected by suitable cross-bars. The uprights A are provided with vertical guideways B, in which fit square blocks or boxes C, containing the bearings for the journals of the stack of corrugating-rolls D. In the present instance five rolls D are shown, resting one directly upon another, so that each roll supports the weight of those above it. The journal-boxes C for the lowermost rolls rest in the bottoms of the guideways B, while the boxes of the rolls above it are free to move vertically in the guideways in the uprights within the limit permitted by adjusting-screws E, passed through the cross-pieces at the upper ends of the uprights and bearing at their lower ends upon the uppermost boxes C. The rolls D and their journals are made hollow, as shown in Fig. 5, for the purpose of being heated by steam and drying the paper as it passes around the rolls.

The strip of strawboard or plain paper F as it is delivered from the machine in which it is made passes over suitable guide-rollers, hereinafter more particularly referred to, and is drawn between the two uppermost corrugating-rolls D, passing thence downward around the rearward side of the second roll, thence forward between the second and third rolls and downward around the front side of the latter, thence between the third and fourth rolls and downward around the rear side of the latter, thence forward between the fourth and fifth rolls and downward around the front side of the latter, and thence rearward in a horizontal line to the under side of a storage-roll G, journaled in supports upon a supplemental frame H, secured to and projecting forward from the uprights A and driven by any suitable connection with the machine to wind up the strip of corrugated paper as the latter is delivered to it from the corrugating-rolls.

The strip of paper F as delivered from the

machine in which it is made and received by my machine will be in a moist condition, which facilitates the action of the corrugating-rolls upon it to give it corrugated form, but requires that it be gradually dried as it passes through the series of rolls, in order that its corrugations may become set and retain their form. The strength of the paper of course gradually increases as the moisture is expelled from it, so that a gradually-increasing pressure may be safely applied to it as it passes through the series of corrugating-rolls, and this gradually-increasing pressure is attained by the arrangement of the rolls in a vertical stack, with each roll directly supporting the weight of all the rolls above it. Thus as the strip enters between the first pair of rolls at the top of the stack it is in such moist condition that it would be in danger of being crushed and mutilated if the maximum final pressure desired were applied to it, and therefore the pressure applied is simply that produced by the weight of the single roll, increased to such a slight extent as may be found needful by means of the adjusting-screws E. As the paper passes between the second and third rolls it is subjected to the weight of the two rolls above, and as it passes between the third and fourth it is subjected to the weight of the three rolls above, and as it passes between the fourth and fifth to the weight of the four rolls above, giving it at this latter point the maximum pressure needed. In this manner and by these means the strip of moist paper F received from the paper-making machine is passed between a series of corrugating-rolls and subjected to a gradually-increasing pressure as it becomes gradually drier and stronger, so that as it emerges from the corrugating-rolls it has become dried and its corrugations firmly pressed into shape and set.

To facilitate the drying of the paper as it passes through the series of corrugating-rolls, I provide means for passing currents of hot air over the surface of the paper while upon the rolls to carry away the moisture driven from the paper by the heat of the rolls. Such means consists of the shields I. (Shown in Figs. 1, 5, 6, and 7.) These shields are secured in position between the uprights A of the framework and fit against or adjacent the front and rear sides of the rolls in alternating order, as shown in Fig. 1. Each shield cooperates with two rolls and consists of two halves or portions—an upper half I′, shaped to conform to the surface of the upper one of the two rolls, and a lower half I″, shaped to conform to the surface of the lower roll. The upper half I′ of each shield consists of segments of a cylinder with flanged ends fitting against the ends of the roll, as shown in Fig. 5, and having a plain inner surface removed a slight distance from the surface of the roll. The shield has no flange along its upper edge, a free open space being left between the edge of the shield and the surface of the roll for the entrance of air. The lower half I″ of each shield is thicker than the upper half and provided upon its inner surface with diagonal or outwardly-inclined ribs *a*, adapted to fit snugly against the surface of the paper passing around said roll and forming between the ribs *a* inclined or diagonal grooves *b*, open at their upper ends and in free communication with the space between the upper part I′ of the shield and its roll and closed at their lower ends by an inwardly-projecting flange *c* along the bottom of the shield, Figs. 6 and 7. Near their lower ends the grooves *b* open by holes *d* into a transverse passage extending the full length of the shield and having an exhaust-outlet *e*, which is connected in any suitable manner with an exhaust-fan or other means for exhausting air. It results from this arrangement and application of the shields that air will be drawn in at the top of each shield and pass downward between the part I′ of the shield and the adjacent roll, being heated by the latter, and will thence enter the grooves *b* in the lower part of the shield and pass downward through them over and immediately adjacent the surface of the paper on the lower roll, thus taking up and carrying away the moisture expelled from the paper by the heat of the rolls. The shields are arranged alternately upon opposite sides of the rolls, so that the upper part I′ of each shield is adjacent the side of the roll over which no paper is passing, while the inner surface of the lower part I″ of the shield bears against the surface of the paper passing over the roll beneath. There is therefore no moist paper between the part I′ of each shield and its adjacent roll, so that the air drawn downward through the space between them will be heated by the roll and enter the grooves in the lower part of the shield in comparatively-dry condition, and thus be caused to act most efficiently in carrying away the moisture from the paper within such lower part of the shield. Thus, as shown in Fig. 1, the upper shield is applied to the rear side of the two upper rolls. There is no paper passing around the rear side of the upper roll, but there is paper passing around the rear side of the second roll, so that the air drawn downward between the upper half of the shield and the upper roll and heated by the latter is carried over and in close contact with the surface of the paper on the rear side of the second roll. The second shield is applied to the front sides of the second and third rolls, its upper half being opposite the front side of the second roll, which has no paper passing over it, and its lower half fitting against the paper passing over the front side of the third roll, while the third shield is applied to the rear sides of the third and fourth rolls in the same relation to the rolls and paper. In the present instance no shield is applied to the lowermost or fifth roll, owing to the employment of a paste-roll for apply-

ing paste to the paper as it passes around the front side of said roll preparatory to applying a strip of facing-paper to the corrugated strip, as hereinafter explained; but where the machine is being used simply for the purpose of making plain unfaced corrugated paper a fourth shield may be applied with advantage to the front side of the fourth and fifth rolls.

For the purpose of readily separating the paper from the under side of one roll and directing it around the side of the roll beneath the shields I are provided along their rearwardly-bent middle portion with inwardly-projecting fingers J, Figs. 5, 6, and 7, which fit in grooves K′, formed in the corrugated faces of the rolls D. These grooves K′ are arranged out of line with each other on adjacent rolls, so that each groove on a given roll will be opposed by a corrugated surface upon the adjacent roll, Fig. 7, and the grooves thus prevented from forming longitudinal creases in the paper. For the same purpose the ribs *a* in the lower halves of the shield are arranged in the diagonal or inclined position described, so that the surface of the paper will have to travel across the ribs in moving from their upper to their lower ends, and thereby prevent the formation of lines or creases on the paper by the ribs.

It is necessary that the moist strip of paper passing from the paper-making machine into the corrugating apparatus above described shall be maintained in sufficiently-taut condition to prevent wrinkling. If the two machines were run at exactly the same uniform speed, so that the corrugating-machine would take up the paper strip as fast and no faster than delivered to it by the paper-making machine, the strip could be maintained in proper condition in its passage from one machine to the other by the employment of ordinary idle rollers; but it is extremely difficult to maintain this exact uniformity in the speed of the two machines, and I have therefore provided means for automatically regulating the speed of the corrugating apparatus to conform to the delivery of the paper to it by the paper-making apparatus, increasing the speed of the corrugating apparatus with any increase in the rate of delivery of the paper strip to it by the paper making apparatus, and vice versa. This automatic regulating means is shown in Figs. 1, 2, and 3, where it will be seen that the paper strip F, received from the paper-making apparatus, passes first upward over a roller K, thence downward beneath a roller L, thence upward over a roller M, thence downward beneath a roller N, and thence between two upper corrugating-rolls. These several rolls are supported in bearings upon a supplemental framework secured to and projecting rearward from the main uprights A and consisting of bracket-supports O O′, bolted at their forward ends to the front sides of the uprights A and carrying at their front ends vertical bars P. The rollers M N have their bearings in the upper supports O′ of this supplemental frame, and the roller K is supported in bearings upon the upper front sides of the vertical bars P. The roller L has its bearings in boxes Q, adapted to slide vertically in longitudinal slots R, formed in the upright bars P, the front wall of each of these slots R in the present instance having formed upon or secured to it a rack R′, with which meshes a pinion R″ upon the spindle of the roller L. This roller is not fast upon its spindle, but turns loosely as a sleeve thereon, the spindle and roller or sleeve thus being free to turn independently of each other. As will be apparent from the above description and by reference to Figs. 1 and 2, the roller L is suspended in and supported by the downwardly-extending loop of the paper strip F, being lowered when the strip slackens and the loop lengthens and raised when the strip tightens and the loop shortens, the weight of the roller and the parts carried by it serving to maintain the strip in taut condition at all times. Secured to and depending vertically from the journal-box Q at one end of the roller L, Figs. 2 and 2^a, is a screw-rod S of very long pitch, extending downward through the hub of a beveled gear T, mounted in a bearing in the lower end of the upright P. When the roller L and rod S are lowered, the pinion T will be turned in one direction as the rod S slides through its hub, and when said parts are lifted the pinion will be turned in the opposite direction. The pinion T meshes with a second pinion U, fast upon the end of a short shaft V, mounted in a bearing W upon the side of one of the lower bracket-supports O, and having fast upon its rear end a spur-pinion X, meshing with a rack formed upon the under side of a transversely-sliding bar Z, Figs. 2 and 3, which bar Z carries a shifter Z′, embracing the driving-belt Z″ of the apparatus, said belt in the present instance passing around a taper pulley A′, fast upon the spindle of the fourth corrugating-roll D, through the medium of which roll the driving power is in the present instance transmitted to the remainder of the apparatus. Under this construction and arrangement of the parts whenever the corrugating apparatus begins to draw the paper strip forward faster than it is being delivered by the paper-making machine the strip will be tightened in its passage from one apparatus to the other and its loop supporting the roller L shortened, with the result that through the medium of the instrumentalities above described the shifter Z′ will be moved in the direction of the arrow in Fig. 3 and the plate carried toward the larger end of the taper pulley A′, thereby decreasing the speed of the corrugating apparatus. If, on the other hand, the paper-making machine at any time delivers the paper strip F more rapidly than it is taken up by the corrugating-machine, the slack produced in the strip will lengthen the loop and lower the parts carried by it, with the result

of shifting the belt Z'' toward the smaller end of the pulley A' and increasing the speed of the corrugating-machine. In this manner and by these means the speed of the corrugating-machine is automatically regulated to accord with the rate of delivery of the paper to it by the paper-making machine.

So much of the apparatus as has been now described may be efficiently employed for the manufacture of plain unfaced corrugated paper, which will be delivered from the corrugating-rolls and wound up on the storage-roll G, as heretofore described; but I have also provided means in the apparatus to be used whenever desired for applying a strip of facing-paper to the corrugated strip as the latter emerges from the series of corrugating-rolls. To this end I provide immediately beneath the lowermost corrugating-roll D, Fig. 1, a plain-faced roller B', journaled in vertically-adjustable boxes C', guided in the apparatus A of the framework and supported upon the upper ends of screw-rods D', by means of which the roller B' may be raised into or lowered out of contact with the lowermost corrugating-roll D. Supported by the framework in front of this latter roller is a paste-reservoir E', in which is journaled a paste-roller F', engaged by a scraper G' and bearing at its rear side against the front side of the roll D, the roller F' being adjustable toward and from the roller D by means of adjusting-screws H' engaging the front side of the reservoir E'. As heretofore explained, the corrugated strip of paper passes downward around the front side of this lowermost corrugating-roll D, and will consequently have paste applied to the crowns of its corrugations by the roller F'. The strip of facing-paper is carried in a supply-roll J' and led thence rearward beneath an idle roller K', thence upward and rearward over the roller B', coming in contact with and being pressed against the pasted surface of the corrugated strip as the two pass between the roller B' and the corrugating-roll D. From these rolls the two strips now united will pass rearward and be wound upon the storage-wheel G, as in the case of the unfaced corrugated strip; but in the present instance the application of paste to the strips will have moistened them and necessitates the drying of the paper afterward in the rolls G in the usual manner.

The remaining feature of my invention consists in an automatic knife-operating mechanism for severing the paper strip delivered from the apparatus at predetermined intervals, so that when a given length of paper has been wound upon the roll G the paper will be automatically severed, permitting said roll to be removed and the end of the paper issuing from the apparatus secured to the spindle of a new roll mounted in place of the one removed. It is now common in machines of this general character to employ automatic signaling devices to call the attention of the attendant to the machine when a given length of paper has been delivered and wound upon the storage-roll, so that he may sever the paper and start a new roll; but these devices are not entirely satisfactory, for the reason that if the attendant fails to sever the paper and remove the roll and start a new one immediately upon the signal being given an excessive length of paper will be wound upon the roll and a correspondingly-deficient length of paper be wound upon the next succeeding roll, with the result that irregular rolls containing different lengths of paper will be formed.

Under the arrangement which I employ the movable knife-bar L', Fig. 4, is hinged at one end at one side of the machine at *f*, and coöperates with a fixed knife-bar or shearing-plate M', secured upon the framework. The right-hand end of the knife-bar is confined and guided vertically in a guideway N' upon the rear side of the framework, Fig. 1, and is normally supported in elevated position by a latch P', adapted to slide backward and forward in a guide-opening in the rear wall of the guideway N' and connected to the upper end of a lever Q', pivoted between its ends to the side of the framework. A spring S', connected to the lever Q' above its fulcrum, pulls its upper end forward and projects the latch P' into the path of the knife-bar L'. The rear end of the latch P' is beveled to form a flat upper surface for supporting the knife-bar and an upwardly and forwardly inclined under surface, which permits the knife-bar to force the latch forward out of its path in rising from a point beneath the latch. Confined in the lower end of the guideway N', Fig. 1, is a coiled spring T', upon whose upper end rests a block U', guided vertically in said guideway. This spring is of such length and strength that when the knife-bar is lowered and rests upon it it will support the knife-bar in sufficiently-elevated position (dotted lines, Fig. 4) to permit the paper strip to pass freely beneath the bar. The knife-bar operates by gravity, and when the latch P' is disengaged from it it will drop and shear off the paper against the fixed knife-bar M', the weight of the knife-bar L' being sufficient to cause it, when dropped from its highest position, to compress the spring T' and descend far enough to sever the paper, the spring, however, thereupon lifting the knife above the path of the paper and maintaining it in such elevated position until the attendant lifts it to its normal position again, where it will be engaged and supported by the latch P'. Inasmuch as the delivery of the paper from machines of this character is comparatively slow and some little time is required for a sufficient length to be delivered to form a full-sized roll G, the attendant has ample time and opportunity for resetting the knife between operations.

It remains to describe the means for tripping the latch P' at predetermined intervals, such means consisting of a stud V' project-

ing from the upper surface of a horizontal worm-wheel W', Figs. 1 and 8, and adapted to contact at each revolution of said wheel with the lower end of the lever Q' and force it forward, and thereby throw its upper end rearward and withdraw the latch P' from beneath the knife-bar L'. The wheel W' is driven by a worm-shaft X', which has fast upon it a pulley W'', which is connected by a belt Y' with the shaft of the roller B', or a small pulley thereon, by means of which the pulley W'' and shaft X' are driven at slow speed.

I have illustrated my machine as mounted to travel back and forth upon a track Y'' transversely of the delivery end of the paper-making machine from which it receives its supply of paper, the purpose being to permit the machine to be readily moved into and out of coöperative relation with any one of several paper-machines placed side by side.

Having thus fully described my invention, I claim—

1. The herein-described apparatus for making faced corrugated paper, comprising a vertical stack of intermeshing corrugating-rolls D resting one upon the other, whereby the moist strip of paper pressing through said rolls is subjected to a gradually-increasing pressure as it becomes gradually dried and strengthened, and a plain roll beneath the lowermost corrugating-roll, substantially as described.

2. The herein-described apparatus for making faced corrugated paper, consisting of a vertical stack of intermeshing corrugating-rolls D resting one upon the other, and each supporting the weight of the roll or rolls above it, a plain roll below the lowermost corrugating-roll, shields applied to said rolls, and means connected with said shields for passing currents of air between the shields and rolls, for the purpose described.

3. The combination, with a train of intermeshing corrugating-rolls D, of shields I arranged upon opposite sides of the rolls in alternate order and each applied to two rolls and composed of a part I' conforming to but separated from the side of one roll and a part I'' fitting snugly against the surface of the paper upon the side of the adjacent roll and provided with the grooves *b*, means connected with said shields for passing currents of air between the shields and rolls, for the purpose described.

4. The combination, with a train of intermeshing corrugating-rolls D, of shields I, each consisting of the part I' and the part I'' provided with the diagonal ribs *a* forming the grooves *b* having the outlets *d* and the flange *c*, and means connected with said shields for passing currents of air between the shields and rolls, for the purpose described.

5. The combination, with the train of intermeshing corrugating-rolls D provided with non-registering circumferential grooves K, of the shields I applied in alternate order to the opposite sides of said rolls and provided with the fingers J fitting in the grooves K thereof, for the purpose described.

6. The combination of the uprights A provided with slots, the vertical stack of intermeshing corrugating-rolls D and plain roll journaled in boxes guided vertically in the slots in the uprights, the double shields I applied in alternate order to the opposite sides of the rolls D, and means connected with the shields for passing air between the same and the rolls, substantially as described.

7. The combination, with the vertical stack of intermeshing corrugating-rolls D, each supporting the weight of those above it, of the paste-roll F' and plain pressure-roll B' coöperating with the lowermost roll D and adapted to press together a plain strip and a corrugated strip passing between the plain roll and the lowermost roll D for the purpose of applying a facing-strip to the corrugated strip formed by the rolls D.

8. The combination, with the vertical stack of intermeshing corrugating-rolls D, each supporting the weight of the rolls above it, of the shields I applied in alternate order to the opposite sides of said rolls, means for passing air between the shields and the rolls, and the paste-roll F' and pressure-roll B' coöperating with the lowermost roll D, for the purpose described.

9. The combination, with a corrugating-machine adapted to receive a strip of plain paper from a suitable supply, and a taper pulley over which the driving-belt for the corrugating-machine passes, of a roller suspended in a depending loop of the strip of paper passing from the supply to the corrugating-machine and adapted to be lifted by the tightening of said paper and lowered by the slackening thereof, and a shifter for the driving-belt of the corrugating-machine actuated by the raising and lowering of said roller to regulate the speed of the corrugating-machine in accordance with the delivery of the paper strip to it by the supply.

10. The combination of upright P, the train of corrugating-rolls D, the taper driving-pulley A' and driving-belt Z'' for said rolls, the rollers K M over which the paper strip F supplied to the corrugating-rolls passes and between which it forms a depending loop, the roller L suspended in said loop, boxes Q vertically guided in the uprights P and in which said roller L is journaled, the shifter Z' for the driving-belt Z'', and connections between one of the boxes Q of the roller L and said shifter for operating the latter by the raising and lowering of the roller L due to tightening and slackening of the paper strip F.

11. The combination of upright P, the train of corrugating-rolls D, the taper driving-pulley A' and driving-belt Z'' for said rolls, the rollers K M over which the paper strip F supplied to the corrugating-rolls passes and between which it forms a depending loop, the roller L suspended in said loop, boxes Q ver-

tically guided in the uprights P and in which said roller L is journaled, the pinion T mounted beneath one of the boxes Q of the roller L, the screw-rod S depending from said box and passing through said pinion, the sliding rack-bar Z geared to the pinion T, and the shifter Z′ operated by the bar Z and coöperating with the driving-belt Z″, substantially as and for the purpose described.

12. The combination of upright P, the train of corrugating-rolls D, the taper driving-pulley A′ and driving-belt Z″ for said rolls, the rollers K M over which the paper strip F supplied to the corrugating-rolls passes and between which it forms a depending loop, boxes Q vertically guided in slots R in the uprights P, a spindle journaled in said boxes, the roller L suspended in said loop and loosely mounted upon said spindle, pinions R″ fast upon opposite ends of said spindle, racks R′ on the uprights P with which said pinions mesh, the beveled pinion T mounted in the framework below one of the boxes Q, the screw-rod S depending from said box and passing through the pinion T, the shaft V, the pinion U fast on shaft V and meshing with the pinion T, the spur-pinion X fast on the shaft V, and the sliding rack-bar Z meshing with the pinion X and provided with the shifter Z′ coöperating with the driving-belt Z″, substantially as and for the purpose described.

JEFFREY T. FERRES.

Witnesses:
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