Oct. 31, 1944. D. CORBIN 2,361,459

WEB AND SHEET HANDLING MECHANISM

Original Filed April 6, 1937 9 Sheets-Sheet 1

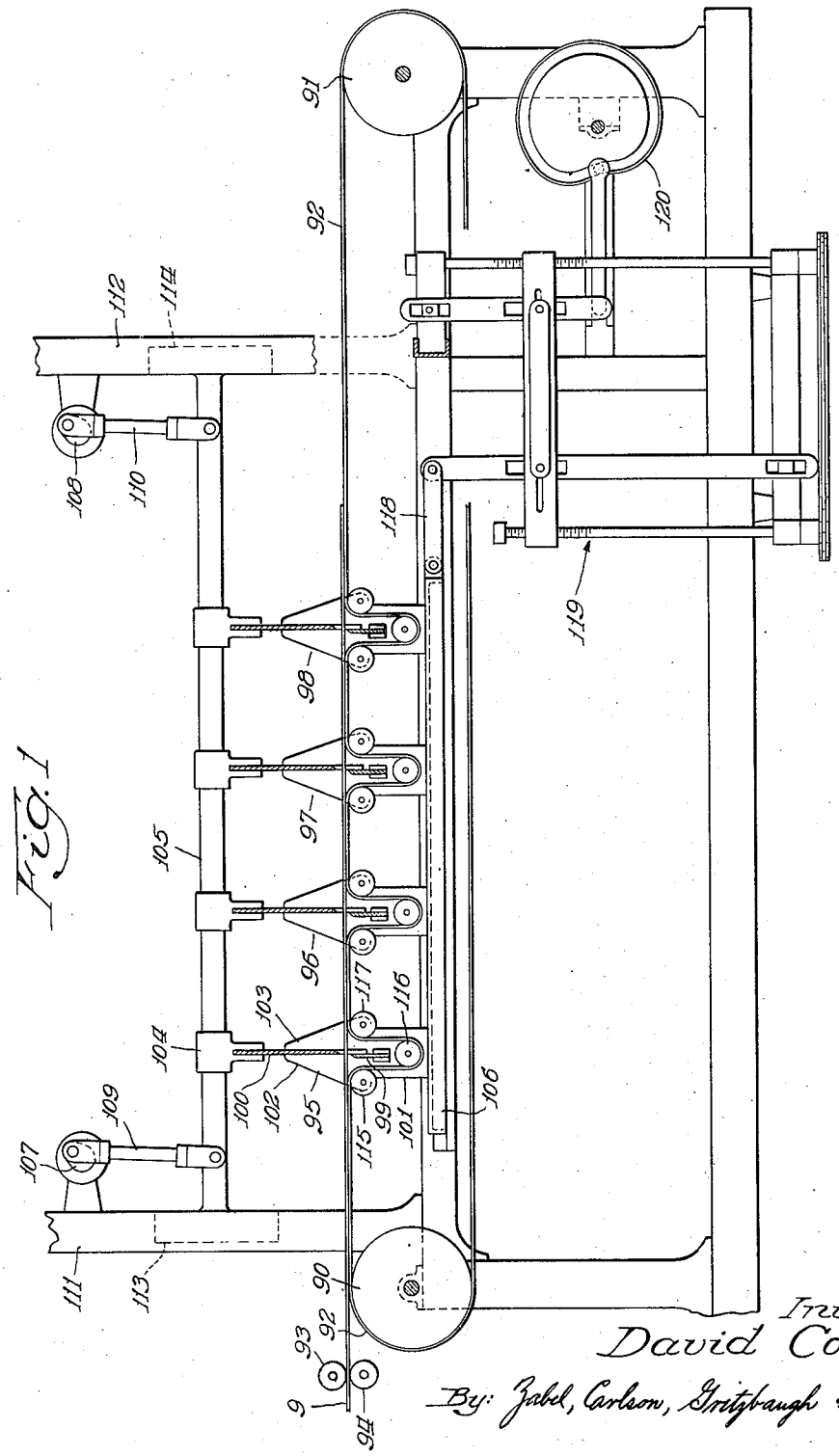


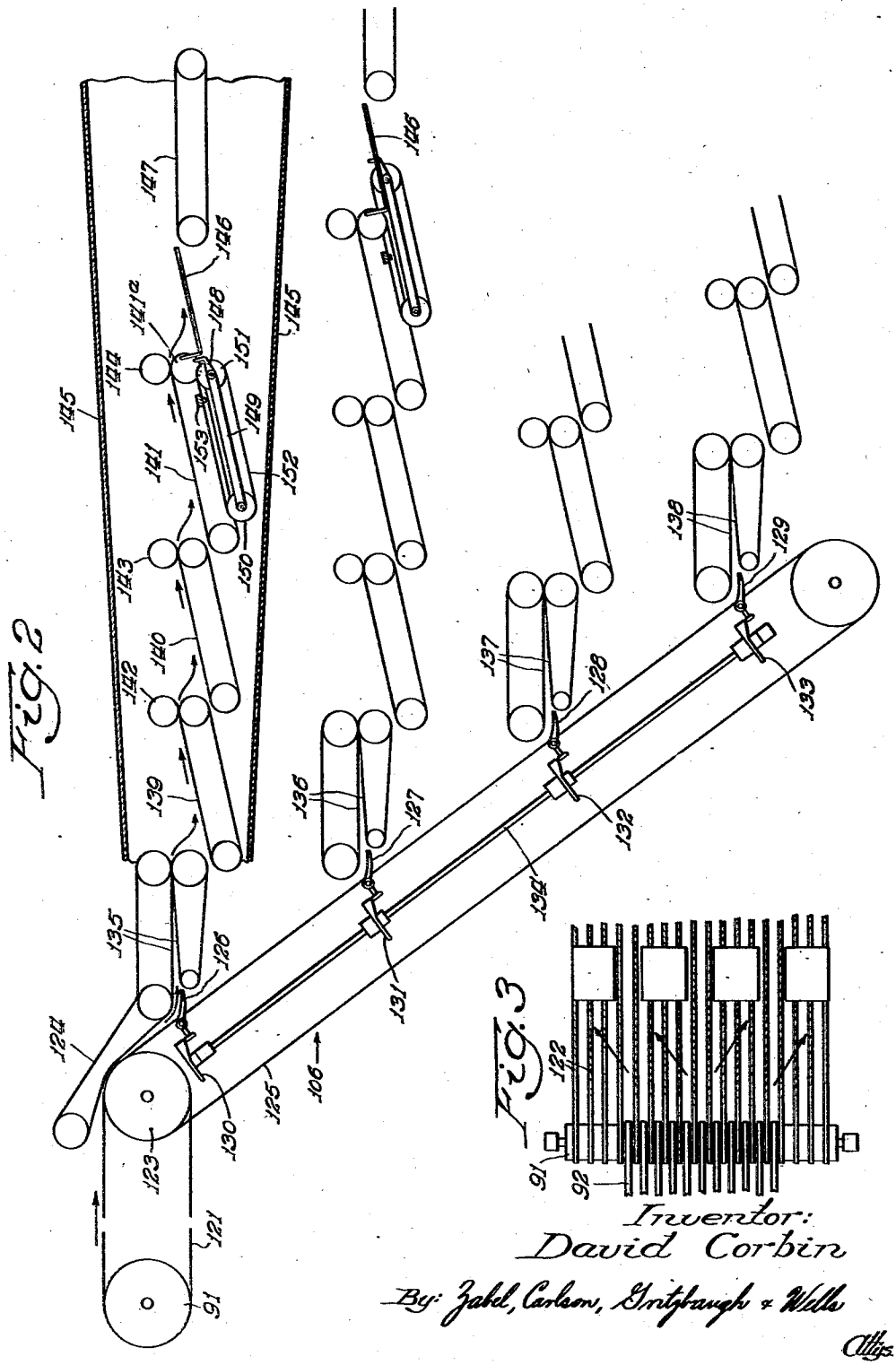
Fig. 1

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WEB AND SHEET HANDLING MECHANISM

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WEB AND SHEET HANDLING MECHANISM

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Fig. 4

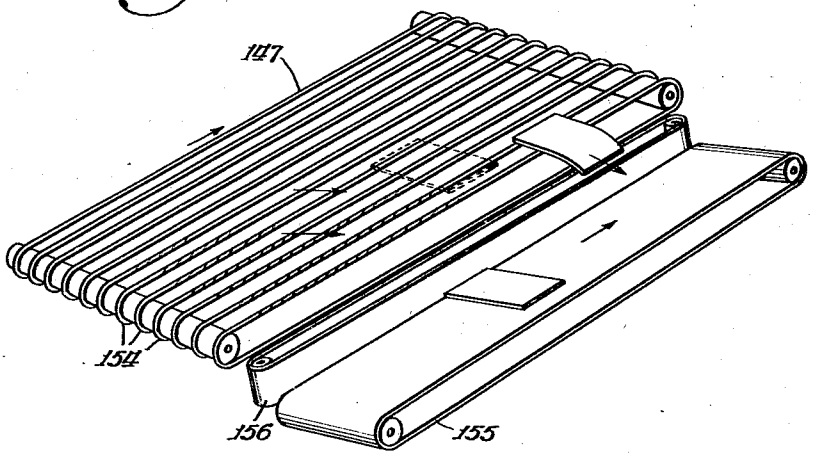
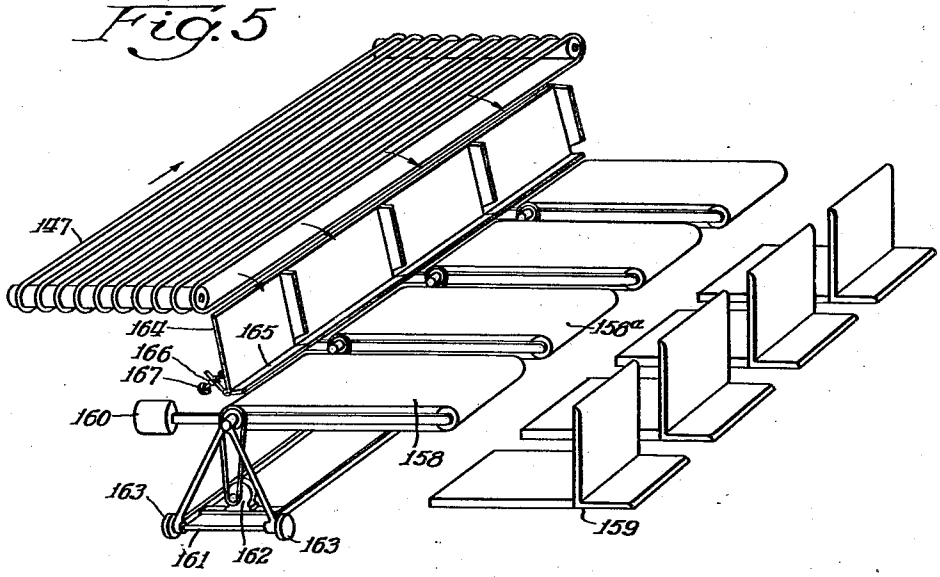


Fig. 5



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WEB AND SHEET HANDLING MECHANISM

Original Filed April 6, 1937 9 Sheets-Sheet 4

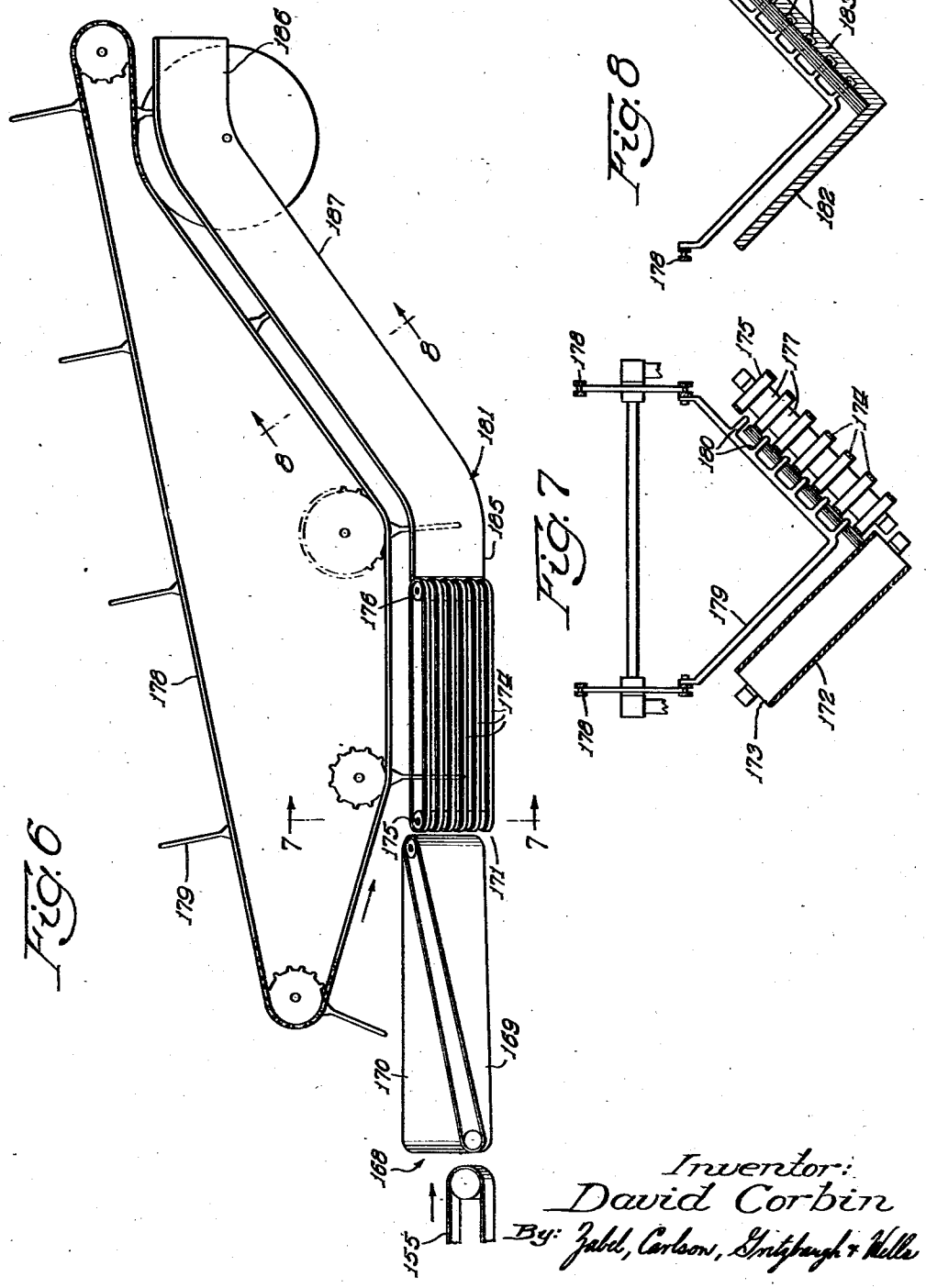


Fig. 6

Fig. 8

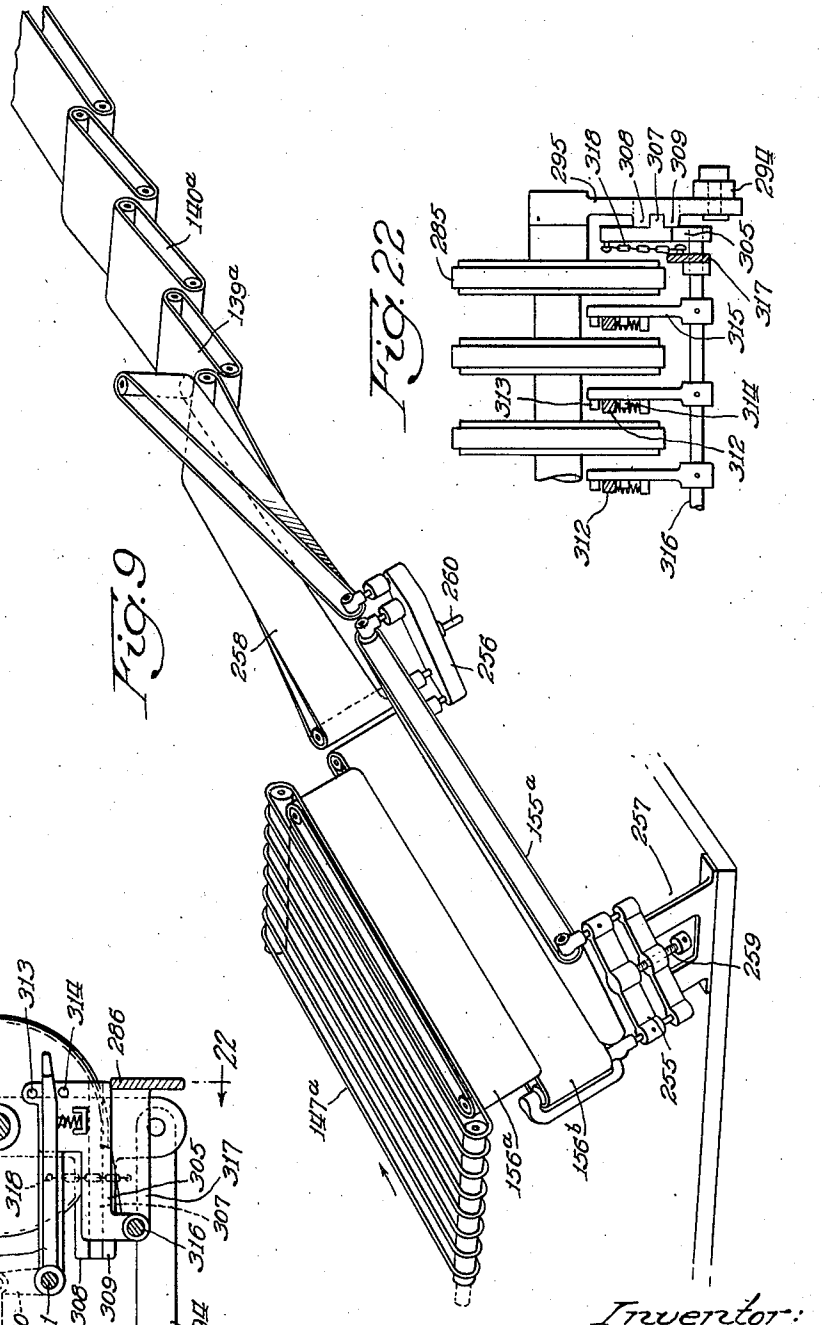
Fig. 7

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WEB AND SHEET HANDLING MECHANISM

Original Filed April 6, 1937 9 Sheets-Sheet 5



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WEB AND SHEET HANDLING MECHANISM

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Fig. 10

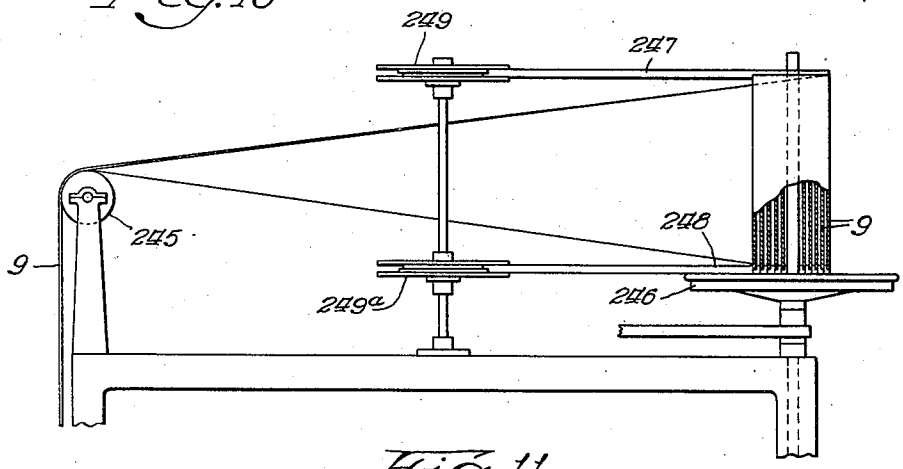


Fig. 11

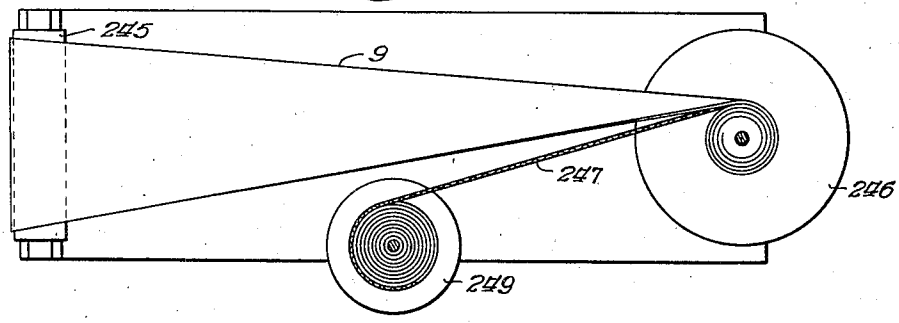


Fig. 12

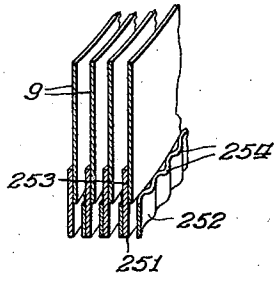
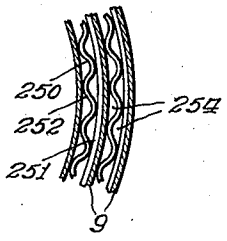


Fig. 13



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WEB AND SHEET HANDLING MECHANISM

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Fig. 14

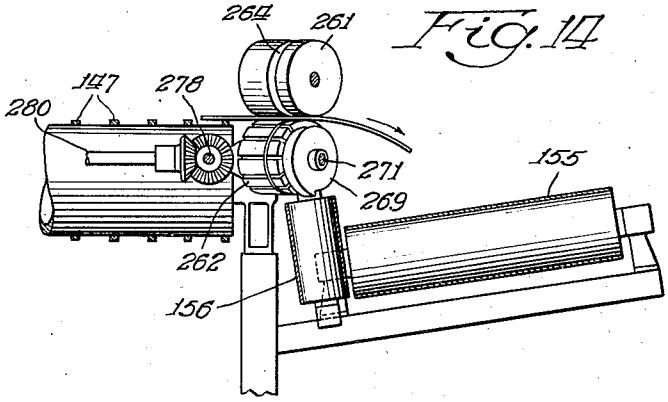


Fig. 17

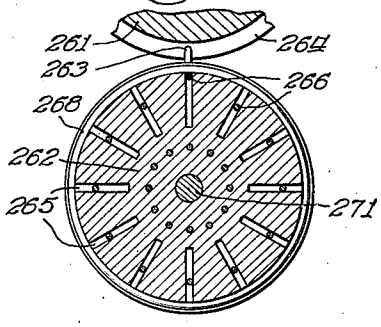


Fig. 15

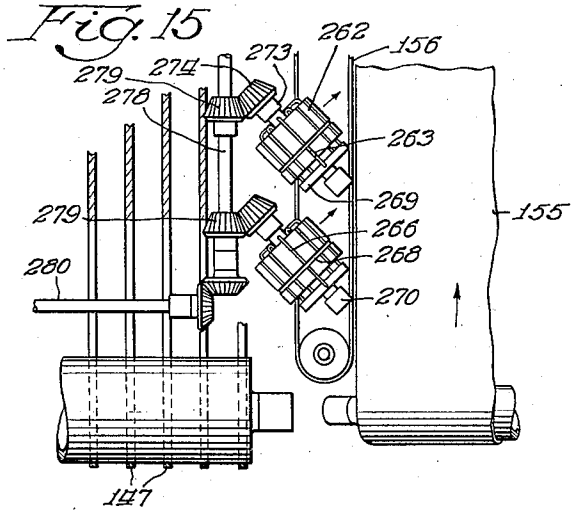


Fig. 16

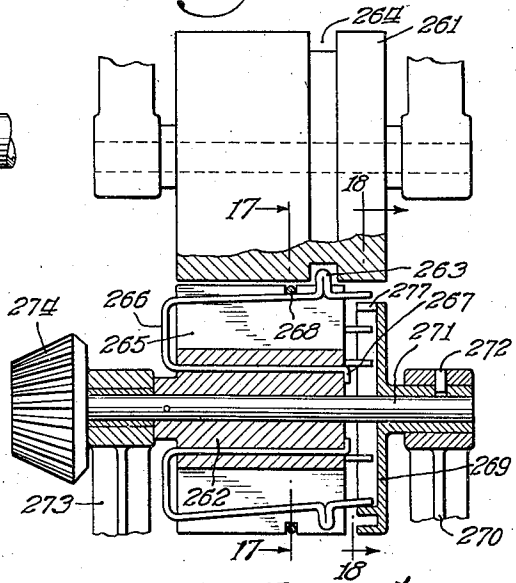
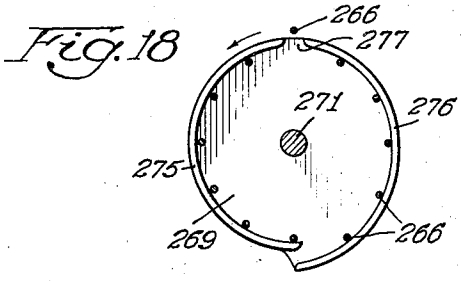


Fig. 18



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WEB AND SHEET HANDLING MECHANISM

Original Filed April 6, 1937 9 Sheets-Sheet 8

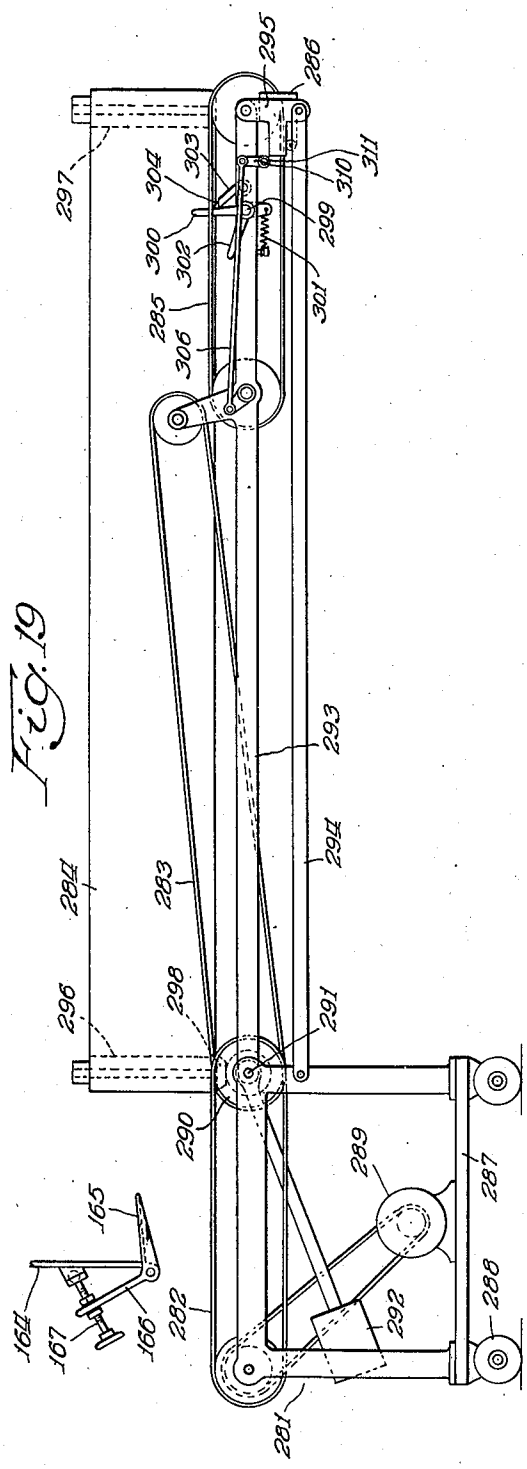


Fig. 19

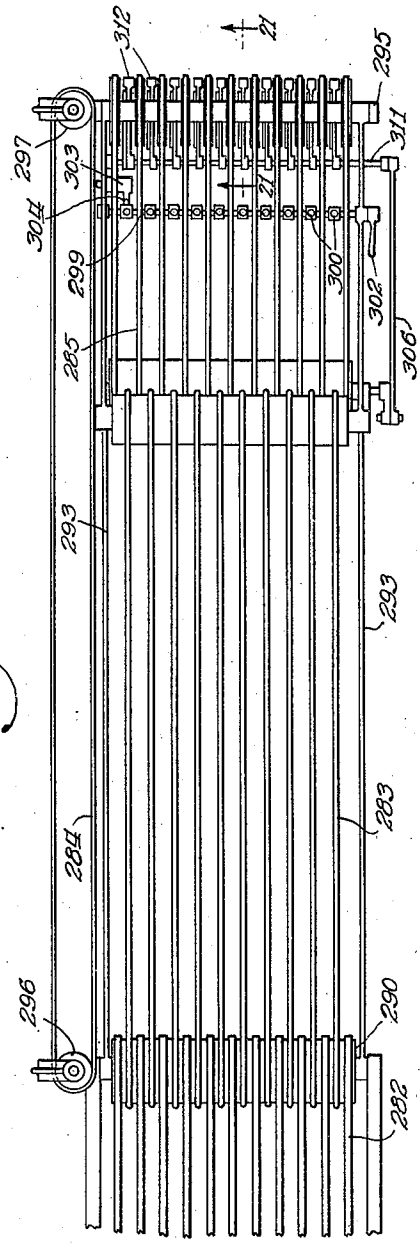


Fig. 20

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WEB AND SHEET HANDLING MECHANISM

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Fig. 23

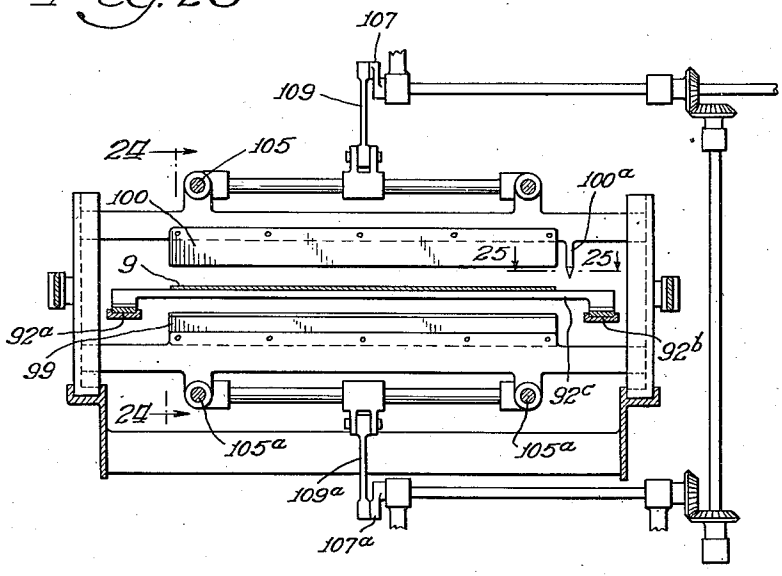


Fig. 24

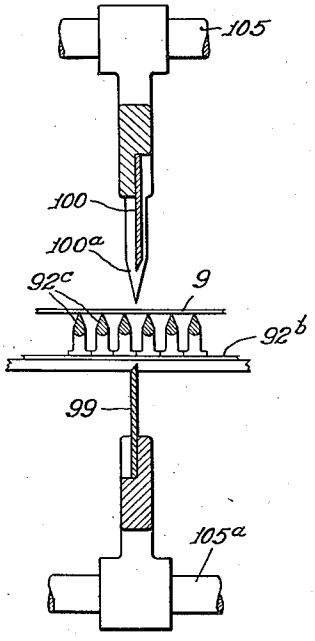
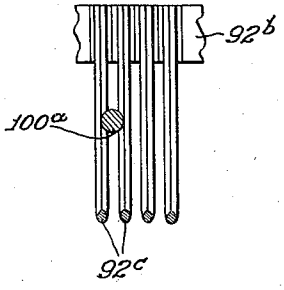


Fig. 25



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Patented Oct. 31, 1944

2,361,459

UNITED STATES PATENT OFFICE

2,361,459

WEB AND SHEET HANDLING MECHANISM

David Corbin, Chicago, Ill.

Original application April 6, 1937, Serial No. 135,329. Divided and this application March 25, 1940, Serial No. 325,821

10 Claims. (Cl. 271—76)

The present invention relates to machines which operate upon sheet material, and to feeding, registering, cutting, delivering, assembling and winding mechanisms adapted to cooperate with each other in the performing of operations upon the web such as printing on one or both sides thereof and the subsequent division of the web into sheets.

This application is a division of my application Serial No. 135,329, filed April 6, 1937, for Rotary web printing machines, which has matured into Patent No. 2,194,467, March 26, 1940.

It is a purpose of the present invention to provide in a machine of this character having mechanism by means of which a web or line of material is subjected to one or more operations as a web, may be singly, or in combination with other webs similarly operated upon, be cut up into separate sheets or sections while moving, and the sheets advanced in columns and rows to a gathering mechanism which gathers the several sheets together in a definite order in one or more piles.

The particular objects of the invention within the scope of the above general objects include the provision of specific mechanisms, as hereinafter outlined, capable of carrying out the several steps just mentioned.

It is a purpose of the present invention to provide a high speed accurate means for slitting and cutting a web so that no trimming whatever is necessary except in the case where the ultimate unit is single folded, and stitched in the fold. In this case, the sheets are cut that they may be creased and folded in such a manner that waste is cut down to a minimum.

In this connection, the present invention contemplates the use of multiple flying shears that move at the same speed as the web during the entire period of the cutting, and that may be accurately adjusted to produce this sameness of speed so that a precision and velocity of cutting can be obtained that makes subsequent trimming unnecessary.

As is well known in the art, flying shears that move at the same speed as the material to be cut during the entire period of cutting is the most accurate type of cut off so long as the number of cuts per second is not too great. As the inertia strains in this type of cut off vary as the square of the number of cuts per second but only as the first power of the weight, I am enabled to obtain almost any desired rate of cutting by flying shears by arranging a series of flying shears in tandem, which I have designated multiple flying shears. For carrying material through these shears I use looping belts or travelling slats or any conveyor separated by the knives. With even the most modern presses, it is still the custom to fold a single large sheet into what is called a signature. These sheets when folded are put into gathering machines that then deliver it to trimmers, gluers, and stitchers. The use of the trimmers is a necessity with the folded sheets and leads to a waste of paper that runs commonly from three to five per cent. With my device, the web is cut and slit into sheets of exact size which may be assembled together into a completed unit such as a book, newspaper, or magazine without the necessity of any trimming waste.

Another object of the present invention is to cut and assemble from an original web a multiplicity of sheets which are cut into their ultimate sizes, the assembling being accomplished by taking the sheets arranged in rows and columns and moving at a high speed as they leave the cutting device and arranging the sheets into a single pile or a plurality of piles in a definite order of piling.

The present invention contemplates the provision of means whereby a fast moving assemblage of any number of rows and columns of sheets of the same size are delivered into a single exactly aligned pile of sheets with the sheets arranged in a definite order so that they are ready to be glued and stitched or otherwise bound together. In this connection, means are provided whereby successive assemblages of sheets are delivered to a number of different conveyors, the columns of sheets being separated so that they may be assembled with the sheets in the column on top of one another in a definite order. Then the several groups of sheets so piled may be placed together in a definite order or separately piled as desired.

The present invention contemplates also the provision in a system of this character of a sheet gathering and delivering mechanism by which sheets of different widths and lengths that are moving in adjoining columns may be stored in different piles, each one of which contains only sheets that are of the same size. In shops which do a large variety of work, the cost of maintaining a stock of sheet material of the various sizes and grades needed is considerable. On the other hand, if only a few sizes are stocked, considerable waste is produced whenever a size wider than that needed is used. These difficulties can be practically in a substantial degree overcome

by stocking wide rolls only and selecting widths to be used at the same time that will, as closely as possible, use up the entire width of the roll. The present mechanism is particularly useful in the delivering and stacking of such sheets as well as the delivering and stacking of sheets of different widths and lengths.

It is often desirable in the handling of a web to perform one operation thereon, such for example as the printing on one side, and thereafter store the web by rewinding in such a fashion as to avoid excess strains and offsetting. The cumulative effect of winding at high tension is by far the most serious cause of offsetting in rewinding. Winding webs tightly give rise to strains that differ greatly at different depths in the roll. The cumulative effect of tight winding may press together surfaces near the centre of the roll so tightly that offset will be produced when the surfaces would not offset under pressure of a five foot pile of paper. Strains and stretch in the web produced by gravity occur when stored horizontally. The inequalities of stretch are produced slowly during storage due to a "slow" plasticity of the paper.

I overcome the difficulties by providing means for winding and rewinding the web on edge so that the accumulative weight of the roll is prevented from pressing the sheets against each other. Winding on edge facilitates winding loosely. In some cases, it is desirable to provide means for spacing successive turns of the web as it is wound on a vertical axis, and the present invention contemplates means for accomplishing this result and also, in the case of one end spacing, for rewinding leaving the spacer wound.

The features of the present invention hereinbefore mentioned, and other features and advantages which will appear more clearly from the following detailed description, are combined in a machine of the form shown whereby to produce a sheet forming and handling device of great flexibility and capable of operating at high speed. The several parts of the device may have individual merit for other purposes than their use in this general combination. They are, however, so combined herein as to make possible accurate cutting and assembling at speeds heretofore not considered to be obtainable and with the waste of material greatly reduced over existing structures well known to the trade. The combination, therefore, of the several elements in the present device results in a machine of high speed and efficiency.

The features and advantages of the invention will appear more fully from the following description reference being had to the accompanying drawings wherein a preferred form of the invention is shown. It is to be understood, however, that the drawings and description are illustrative only and that the details of the mechanism may be varied considerably without departing from the scope of the invention as it is defined by the claims.

In the drawings—

Fig. 1 is a side view partly in section of a cutting device operable to slit and cut a web into a plurality of sheets;

Fig. 2 is a somewhat diagrammatic view in side elevation of a delivering mechanism for sorting and delivering sheets received from the cutting mechanism;

Fig. 3 is a fragmentary plan view of a spreading conveyor forming a part of the mechanism shown in Fig. 2;

Fig. 4 is a perspective view of a sorting and piling device which receives the sheets from the mechanism shown in Fig. 2;

Fig. 5 is a perspective view of a slightly modified form of piling device;

Fig. 6 is a view in side elevation showing a trough conveyor mechanism which receives the piles of sheets from the mechanism shown in Fig. 4;

Fig. 7 is a sectional view on the line 7—7 of Fig. 6;

Fig. 8 is a sectional view on the line 8—8 of Fig. 6;

Fig. 9 is a view in perspective of a modified form of mechanism for sorting and piling sheets;

Fig. 10 is a view in side elevation partly in section of a winding mechanism forming part of the invention;

Fig. 11 is a plan view of the structure shown in Fig. 10;

Fig. 12 is an enlarged fragmentary sectional view illustrating the manner in which successive turns of the web are spaced from each other;

Fig. 13 is an enlarged fragmentary sectional view taken crosswise of a roll;

Fig. 14 is a transverse sectional view through a portion of a side drifting conveyor system, such as is shown in Fig. 4, illustrating the addition of positive means for causing the sheets to move off the side drifting conveyor;

Fig. 15 is a fragmentary plan view of the structure shown in Fig. 14;

Fig. 16 is an enlarged fragmentary view partly in section of the rollers employed for removing sheets from the side drifting conveyor;

Fig. 17 is a sectional view on the line 17—17 of Fig. 16;

Fig. 18 is a sectional view on the line 18—18 of Fig. 16;

Fig. 19 is a view in side elevation of a stacking conveyor unit of a somewhat different form than that shown in Fig. 5;

Fig. 20 is a plan view of the structure shown in Fig. 19;

Fig. 21 is a fragmentary sectional view taken on the line 21—21 of Fig. 20;

Fig. 22 is a fragmentary view taken on the line 22—22 of Fig. 21;

Fig. 23 is a vertical sectional view through a modified form of structure for the multiple flying shears utilizing a conveyor system where the paper conveyor is composed of slats that are adapted to be separated by the knives of the shears;

Fig. 24 is an enlarged sectional view taken on the line 24—24 of Fig. 23; and,

Fig. 25 is a fragmentary sectional view taken on the line 25—25 of Fig. 23.

Referring now to the drawings, there is illustrated in Fig. 1 a mechanism by which the slitting and cutting of one or more webs may be accomplished with such precision as to avoid the need of further trimming and with such velocity as to avoid the necessity of slowing down the web travel.

By the use of multiple flying shears that move at the same speed as the web during the entire period of cutting, and by providing accurate adjustment means for producing this sameness of speed, a precision and velocity of cutting can be obtained that makes subsequent trim unnecessary. There, of course, must be means associated with the multiple shears to convey the sheets through the shears after cutting.

One form of multiple shearing mechanism is illustrated in Fig. 1. In this form, a pair of pul-

leys 90 and 91 have a belt 92 thereon. This belt is adapted to receive a web 9 or a plurality of such webs superimposed one upon the other. The pulleys 90 and 91 move the belt 92 at the same speed as the web 9 is being uniformly advanced. A suitable paper slitting and creasing mechanism may be used to longitudinally slit the web before it reaches the belt 92. The creasers are used in the case where the sheets are to be single folded and stitched in the fold. For purposes of the present application, I have shown diagrammatically upper and lower paper slitting rollers 93 and 94 in Fig. 1. A plurality of shearing units 95, 96, 97 and 98 are shown. Each of these units comprises a pair of knives 99 and 100. The lower knife 99 is carried by a frame 101 which also has guide portions 102 and 103 for guiding the upper knife 100. The upper knife 100, however, has collars 104 longitudinally slidable upon vertically reciprocable bars 105. The knife 100 is moved vertically by the bars 105, but is free to slide longitudinally thereon. The knife 99 may be fixed in the frame 101 at the proper height to cooperate with the knife 100 in cutting the web 9. The several frames 101 are longitudinally adjustable upon a supporting bed 106 which is slidable lengthwise of the belt 92 and is slidably mounted in the frame of the machine. Suitable cranks 107 and 108 drive links 109 and 110 for moving the bars 105 up and down. The bars 105 may be mounted for vertical movement in a pair of standards 111 and 112, for example, by providing vertical slots 113 and 114 in the standards 111 and 112. Each of the frames 101 carries a series of rollers 115, 116, and 117 around which the belt 92 is trained so that the web 9 passes between the knives 99 and 100 of the shearing units 95, 96, 97 and 98 while the belt 92 passes around the lower knife.

Mechanism is provided whereby to cause the shearing units to move forward with the web 9 during the cutting operation and then to be retracted while the web is advancing the distance necessary before a new cut should be made by the multiple shears. For example, let us assume that sufficient shears are provided so as to cut at one operation a length equal to the length printed by a printing cylinder in one rotation, then once for each rotation of the printing cylinder the shearing units must cut the web and be retracted. During the cutting operation, the bed plate 106 is moved forward at a speed equal to the velocity of the belt 92. This movement is accomplished by linking the sliding bed plate 106 through links 118 to a compound lever mechanism indicated generally by the numeral 119. This mechanism will not be described specifically because it may be substantially a duplicate of that shown in Figs. 3 and 4 of my co-pending application hereinbefore identified (Patent No. 2,194,467). A cam 120 is utilized to operate the compound lever mechanism 119 as will be readily understood. Suitable drive mechanism is provided for the belt 92, the cranks 107, 108, and the cam 120, for driving the several parts in timed relation to each other and to the advancing speed of the web or webs 9 which are to be cut.

Instead of the belt 92 which loops around the knives 99, a system of travelling slats may be used for a belt, the slats being so arranged that they may pass straight through the knives and are separated by the knives during the period of cutting. In Figs. 23, 24 and 25, a modified structure is shown whereby the multiple flying shears may be used with a system of travelling slats.

In this form of the device, the upper knives 100 are carried by the rods 105 as in Fig. 1. Rods 105a also carry the lower knives 99, and suitable bell cranks 107 and 107a are adapted to drive links 109 and 109a to move the knives 99 and 100 toward each other to cut a web 9 as it passes between them. In this form of the invention, belts 92a and 92b carry a plurality of slats 92c on which the web 9 is passed between the knives 99 and 100. The slats are formed, as shown in Figs. 24 and 25, and, in order to prevent the knives from cutting into a slat, a conical slat separating pin 100a is arranged at the end of the knife 100 and projects beyond the knife, as shown best in Fig. 24, so as to enter between the slats 92c and cause the knives to go between the slats rather than to strike the surface thereof. I have found that, by using a conical separating pin such as the pin 100a, the slats can always be prevented from catching on the knives so that the flying shears will function in the proper manner. This is one example of a conveyor in which the web supporting elements may be divided by the knife or knives that cut the web. Obviously, there are many other variations and forms of web conveyors in which the web supporting elements may be divided by the knife of the flying shears.

Owing to the inertia strains produced at high speeds, a flying shears normally is not capable of operating at the speeds necessary for cutting a rapidly moving web such as would be delivered from a printing couple in the machine shown in my co-pending application. The inertia strains produced by the shifting of the flying shears increase as the square of their velocity. These inertia strains, however, only increase in direct proportion to increase in weight. Therefore, by utilizing multiple flying shears, thereby increasing the weight but decreasing the number of reciprocations of the flying shears, I have been able to provide a multiple shearing mechanism that is capable of accurately cutting the web when the web is travelling at such high speeds as those needed in commercially successful printing.

After a web 9 has passed through the rotary slitters 93 and 94 to be divided into strips and the strips have been cut by the multiple shears, there is an assemblage of columns of sheets leaving the multiple shearing device at the same speed as the web 9 entered it. These sheets must now be delivered, for example to a gluing or stitching mechanism, but they must first be assembled in a definite order into a single pile if they are all to go together. For example, let us assume that one printing operation of the print cylinder prints 20 ultimate sheets as they are cut up by the shearing device. These sheets may be arranged so that the slitters cut the web into five columns and the shears cut off four rows at each operation. If these twenty sheets are to be bound together in a definite order, they can now be assembled and piled by means to be described, and there is no further waste due to the necessity of trimming as would be the case in folding the sheets into signatures and trimming the signatures.

There is disclosed herein a method and machine for delivering the fast moving assemblage of rows and columns of sheets, such as are received from the cutting device, into one or more exactly aligned piles of sheets with the sheets arranged in a definite order. For convenience of description, the assemblage of the sheets may be better described by taking the

several steps separately and describing one order in which the steps may be carried out to produce the final result. The several steps may be classified as follows:

1. Separating the columns.
2. Delivering successive assemblages of sheets corresponding to successive turns of the print cylinder to a number of different conveyors.
3. Delivery of the sheets in the columns on top of one another in a definite order.
4. Pushing forward these column piles onto an assembling conveyor.
5. Causing the assembling conveyor to deliver these column piles onto a side conveyor in a single pile or in some cases a plurality of piles.
6. Delivery by the side conveyor of the single pile into a troughing conveyor that accurately aligns the sheets in a pile, and delivery of the piles to a receiving mechanism, as for example, as to the gluers and stitchers which are not shown herein.

As an example of the mechanism for performing the several operations, I will refer now to the devices shown in Figs. 2, 3, 4, 5, and 9. We may assume that the belts 92 deliver the sheets at the pulley 91 to a spreading conveyor 121. The spreading conveyor may be composed in one form of a multiplicity of belts 122 interspersed with separate sections of the belt 92 which may be composed of a plurality of separate narrow belts upon the pulley 91. The belts 122 are twisted, the number of twists in each belt increasing with the distance of the belt from the transverse center of the pulley 91. The belts on either side of the central line of the conveyor 121 are twisted in such a manner that they will move a sheet away from the center at the same time that it moves forward. This system of belts will cause the separation of the columns received from the shearing device shown in Fig. 1. The spreading conveyor 121 must of a necessity be somewhat wider than the necessary width of the conveyor belt 92. Other equivalent means for separating the columns, such as diverging belts or diverging pulleys or rollers, may be used to accomplish the same purpose as is accomplished by the spreading conveyor 121.

The columns of sheets that have been separated by the spreading conveyor 121 are fed over a pulley 123 between an upper belt 124 and a lower belt 125. The purpose of the belt 124 is to prevent the sheets which are moving at high speed as yet, from shooting off into the air at the bend between the spreading conveyor 121 and the switching conveyor 125. Other equivalent means such as suction devices may be used for the same purpose. The conveyor 125 has associated therewith a plurality of directing switches in the form of pivot fingers 126, 127, 128 and 129. These fingers are controlled by a series of cams 130, 131, 132, and 133 on a cam shaft 134. These switches are movable from the position shown in Fig. 2 to a position where they permit sheets to pass unobstructed along the conveyor 125. The conveyor 125 is made up of a plurality of belts through which pivot fingers may operate. Where the slope of the conveyor belt 125 is greater than the angle of friction, means for preventing the sheets from sliding on the fingers 126, 127, 128, and 129 may be necessary. The shaft 134 is geared to the multiple shearing mechanism in such a manner that it makes one revolution to each four operations of the shearing device for the specific mechanism shown in Fig. 2. That is, the number of operations of the flying shears for one turn of the shaft 124 is equal to the number of directing switches that are spaced along the conveyor belt 125. The cams 130, 131, 132, 133 are arranged to operate progressively, that is, in such a fashion that successive assemblages of sheets corresponding to successive operations of the flying shears are delivered successively to several pairs of receiving belts 135, 136, 137, and 138. The several pairs of belts deliver the successive assemblages of sheets to identical mechanisms one of which only will be described in detail.

Sheets directed by the switch 126 between the belts 135 are delivered from the belts 135 onto a belt 139 which runs somewhat slower than the belts 135. By a cascading arrangement, the sheets are successively delivered onto belts 140 and 141, each belt being slowed up slightly from the preceding belt. Only three of these slowing belts are illustrated, but it is obvious that the number may be added to until the speed of the sheets is reduced to a speed which enables the sheets to be handled in the mechanism following the cascading belts. For preventing the sheets on the belts from flying, idler pulleys such as 142, 143, and 144 may be used, or these idlers may be replaced by equivalent means for holding the sheets down on the belts and causing the sheets passing in contact with the belt to move at the same speed as the belt until they have passed beyond it.

In order to prevent the sheets from aeroplaning, that is, lifting up and flying due to the air currents where the speed is sufficient to produce it, the several cascading belt arrangements fed by the belts 135, 136, 137, and 138 may be housed in wind tunnels such as are indicated by the lines 145 in connection with Fig. 2. The tunnels are arranged in such a fashion that movement of air at the same speed for example as the belts 135 at the entrance to the tunnel may be gradually diminished so as to keep pace approximately with the sheets on the cascading conveyor. One method of producing this result is to provide a tunnel whose cross section gradually enlarges in the direction of movement of the sheets.

It is desirable, in order to insure that the sheets as they slow up will overlap one another always in the same order in leaving the belts 135, to produce a down draft of air upon the sheets issuing from between the belts 135. The last belt 141 of a cascading series delivers the sheets onto a grating 146. Obviously the sheets in each column will fall upon the grating 146 in a definite order, that is, the first sheet on the bottom, the second sheet next, and so on. The grating 146 receives the sheets from one operation of the flying shears each time the shaft 134 is rotated. In other words, it receives every fourth transverse row of sheets cut by the flying shears in the structure shown in Fig. 2.

Means are provided for pushing the piles formed on the grating 146 forward onto an assembling conveyor 147. There may be one of these assembling conveyors 147 for each cascading conveyor system just as there is one grating 146 for each cascading conveyor system. For pushing the sheets off the grating 146, I provide a pusher 148 operating through the grating 146. This pusher is reciprocated across the grating 146 once for each revolution of the cam shaft 134 and is connected therewith for driving purposes by any suitable means not shown. Each pusher 148 carries a frame 149 having two pulleys 150

and 151 around which belts 152 are placed. The belts 152 are spaced apart to pass through the spaces in the grating 146 as the pusher 148 is advanced. The belts 152 are fixed to a stationary bar 153 which is above the pusher 148 so that, when the pusher moves forward carrying with it the frame 149 and with it the pulleys 150 and 151, the belts 152 are merely rolled out through the spaces in the grating 146 to establish a stationary surface upon which a new pile of sheets may be delivered while the pusher 148 is returning to its starting position. In its starting position, as shown in Fig. 2, the top of the pusher 148 is sufficiently withdrawn between the pulleys 141a for the belt 141, which is composed of a plurality of spaced narrow belts, so that any sheets that have been dropped on the belts 152 can drop completely onto the grating 146 and not be caught by the pusher 148.

Referring now to Figs. 4 and 5, the assembling conveyor 147 is adapted to place the column piles delivered thereon from the gratings 146 into a single pile. For example, let us assume that four column piles such as are shown by the four sheets across Fig. 3 are formed on the grating 146 for each rotation of the print cylinder. These four column piles are delivered at once on the conveyor 147. This conveyor is of such a type that it gives a slow lateral movement to the piles while it is giving them a slow forward movement. Thus the piles are gradually moved off one side edge of the conveyor 147. As an example of means for accomplishing this result, I show in Fig. 4 a conveyor 147 in which the belts 154 are all twisted in the same direction and with the same twist so as to impart a uniform side drift to the sheets as they advance along the conveyor. The belts 154 may, for example, be composed of uniformly twisted belts. The conveyor 147 delivers the piles onto a side receiving conveyor 155. A vertical conveyor 156 may be provided at the edge of the conveyor 155. The conveyors 155 and 156 are usually not placed precisely horizontal and vertical but are preferably tilted slightly so that the outer edge of the conveyor 155 is higher than the edge adjacent the conveyor 156. It is desirable that the sheets already delivered onto the conveyor 155 will not be pushed out of position by sheets newly arriving from the conveyor. The tilting avoids this to a certain degree sufficient for most purposes. In any case, however, where difficulty is encountered due to the particular characteristics of the sheets, the conveyors 155 and 156 may be suitably changed so that the tendency of one sheet to push the other out of position as it comes from the conveyor 147 is overcome.

In Fig. 9, I have shown a slightly different form of side drifting and side receiving conveyor structure in which a side drifting conveyor 147a, which may be the same as the conveyor 147, delivers the sheets onto a side receiving conveyor 155a on edge. A pair of conveyors 156a and 156b travelling at the same forward speed as the conveyors 147a and 155a are tilted somewhat to the vertical so that the sheets coming off of the conveyor 147a slide down over the conveyor 156a until the edge of the sheet engages the conveyor 155a. The width of the conveyor 156b is such that a sheet resting on the conveyor 155a will drop back beneath the conveyor 156a so that the next sheet will not strike the top edge of the sheet already delivered and will come down on the outside thereof so as to arrange the sheets in the proper order.

Means are provided by which the conveyors 155a and 156b may be adjusted up and down to accommodate wider or narrower sheets. A pair of yokes 255 and 256 support the conveyors 155a and 156b on a suitable frame 257. The yoke 255 also supports one end of a twisted conveyor 258 so as to raise and lower this conveyor with the conveyors 155a and 156b. The yokes are vertically adjustable by means of screws 259 and 260 threaded in the frame 257 and are set at such an angle as to move the conveyor 156b in a direction parallel to the conveyor 156a.

With the device shown in Fig. 9 or similar devices, the spreading conveyor may be dispensed with and the sheets led directly from the cutting mechanism onto the side drifting conveyor 147a or the side drifting conveyor 147 where the sheets in the various rows are piled on the side receiving conveyors such as 155 and 155a—156b. To illustrate this method of delivery, I have shown in Fig. 9 how the sheets from the conveyor 155a can be delivered to a twisted conveyor 258 which lays the piles of sheets down flat, and the piles are then delivered to the cascading conveyors 139a, 140a, etc. The cascading conveyors, which are like those shown in Fig. 2, will gradually slow down the piles of sheets and arrange them for delivery to the aligning trough structure shown in Fig. 6. For example, the cascading conveyors may deliver directly into the tilted conveyor structure 168 of Fig. 6.

In connection with the grating 146 and the conveyor 155, any well known mechanism for jarring the conveyor or grating to cause the sheets to be shaken down into registration with each other, can be used.

A great variety of constructions may be employed to produce the side drifting action of the conveyor 147. Therefore, it is to be understood that the form shown in Fig. 4 is merely illustrative of a class and is not to be considered as specifically limiting this part of the invention. Diagonal rollers or diagonal belts may be used in part or entirely. For example, in Fig. 14 the side drift conveyor 147 is supplemented by diagonally placed rollers 261 and 262 which are driven at such a rate as to receive and discharge the sheets at the edge of the conveyors 147 so as to give a positive discharge action. The upper roller 261 is driven by contact with the roller 262 or with a sheet passing between the rollers. The rollers 261 and 262 are set at such an angle and given such a velocity that the sheets fed between them have the same forward and lateral velocity that is produced by the rest of the conveyor 147. The function of these pairs of rollers is to insure that the lateral movement of the sheets is not stopped by their scraping over the conveyor 155 or sheets carried thereon.

In order that the rollers may properly perform their function, the lower roller 262 is provided with guide controlled dogs 263 (see Figs. 15, 16 and 17) arranged around its periphery. The dog 263 that is uppermost at any moment is allowed to thrust itself upward in an annular slot 264 provided in the roller 261 provided there is no sheet of paper between the rollers. If one of the dogs 263 is thrust upward, guide means are provided to hold it that may as long as it can be useful in pushing a sheet in front of it onto the conveyor 155. After the dog has completed its usefulness as a pusher, it is again guided back into the rim so that, as long as there is any paper between the rollers 261 and 262, the dogs do not project beyond the surface of the roller 262.

The dogs 263 are mounted in a plurality of radial slots 265 formed in the roller 262. The dog 263 is a part of a spring wire 266 which extends through the roller 262, as indicated in Fig. 16, and is bent over at 267 to secure it in place. The spring wire 266 has a little spring tension tending to make the dog 263 project radially from the slot. The degree of projection is limited by a wire band 268. A stationary guide cam 269 is fixed to a standard 270 that supports the free end of a shaft 271 on which the roller 262 is secured. The guide 269 is held against rotation by a pin 272 and provides a bearing for the shaft 271. The shaft 271, at its other end, is supported by a standard 273, and is provided with a bevelled gear 274 by means of which it may be driven. The guide 269 has a rib 275 and a rib 276 which are separated at the top, as indicated at 277, so that the free end of the wire 266 may, if it is not held down by paper between the rollers 261 and 262, rise above the guides. At the bottom of the member 269, the guide 275 extends inside the guide 276 so that the end of a wire 266 will always be returned inside the guide 276.

It is believed to be evident from Figs. 15 to 18 how the dogs 263 will project upwardly behind a sheet and force it out onto the conveyor 155 so as to insure positive delivery of the sheets to the conveyor 155. The several rollers 262 are driven by a shaft 278 which has bevelled gears 279 meshing with the bevelled gears 274 of the several rollers. Shaft 278 is driven by a shaft 280 which may be coupled to any suitable power mechanism so as to drive the rollers 262 at the proper speed with respect to the speed at which the side drifting conveyor 147 delivers the sheets into the rollers 261 and 262.

In Fig. 5, the side drift conveyor 147 is shown as being utilized as a means for separating the piles in several columns from each other and arranging the piles received from the several columns in individual stacks. In this case, the first column to fall off the conveyor 147 is received on a stacking conveyor 158 which delivers it to a platform 159. The stacking conveyor 158 may be counterweighted by a counterweight 160. The entire stacker conveyor mechanism is preferably supported upon a framework 161 which carries its own driving motor 162 and which is portable being provided with wheels 163. Each successive column of piles will be delivered to the next adjacent stacking conveyor 158*a* until all of the columns have been piled upon the platform 159. A vertical guide 164 is adapted to direct the sheets and piles of sheets onto the conveyors 158 and 158*a* from the conveyor 147.

The member 164 may be provided with a shelf 165 which is pivotally secured thereto so it may be tilted up and down and used as a means for directing the sheets from the conveyor 147 right side up onto the conveyors 158 and 158*a* or alternatively to cause the sheets to be turned over as they fall from the conveyor 147. Sheets falling off the edge of the conveyor 147 drop and strike with their lower edges against the shelf 165. When the shelf 165 extends upwardly from the member 164, the lower edge of the sheet remains on the shelf while the upper edge swings out and down upon the conveyor 158 thereby inverting the sheet. If the shelf 165 is sloped down from the member 164, the lower edge of the sheet slips off immediately to the conveyor 158 which carries the sheet forward right side up. For tilting the shelf 165, a suitable arm 166 and an adjusting screw 167 may be provided, the adjusting screw being secured in the proper manner to the member 164 so that it can be turned.

It is evident, of course, that single sheets arriving upon the conveyor 147 in columns may be arranged in piles in which the number of sheets is equal to the number of columns by the mechanism shown in Fig. 4. That is, each row of sheets coming from the belt 92 may be placed in a single pile by feeding the columns directly to the conveyor 147 before going through the spreading conveyor and cascading conveyor system. In this case, the conveyor 155 will deliver a column of piles in which each pile contains the sheets that were arranged transversely in a row across the conveyor 92. Similarly, where the conveyor 147 is used in the manner shown in Fig. 5 to deliver the sheets to stacking conveyors 158, all the sheets from one column delivered directly to the conveyor 147 from the conveyor 92 can be delivered to one of the stacking conveyors, the sheets in the next column being delivered to the next stacking conveyor. Thus it will be evident that a very flexible assembly mechanism for assembling sheets in a definite order is provided by the combination of the spreading conveyor, cascading conveyor, side drift conveyor, and side receiving conveyor or stacking conveyor structures just described.

In Figs. 19 to 22 inclusive, there is illustrated a structure which is particularly useful in stacking sheets upon skids or trucks in front of the backboards 159, shown in Fig. 5. This device consists of a portable conveyor unit 281 adapted to receive sheets from a conveyor 147 of the side delivery type onto a conveyor 282 which feeds the sheets onto a side drifting conveyor 283 that lines the sheets up again a moving wall 284 and delivers the sheets onto a delivery and storage conveyor 285. The delivery and storage conveyor 285 also has thereon a climbing pusher device 286 by which the delivery end of the conveyor 285 and its associated conveyors 283, together with the moving wall 284, can be raised automatically as the pile of sheets increases in height. The climbing pusher also aligns the pile of sheets against the back stop as they are piled. Since the unit 281 is portable, it can be adjusted to stack one pile in front of the other after the first stacked pile has been built against the back stop.

The construction of the unit 281 and its associated conveyors comprises a truck 287 having wheels 288. A motor 289 drives the conveyor 282, and through it drives pulleys 290 by which the conveyors 283 and 285, the moving wall 284, and the climbing pushers 286 may be operated.

The conveyors 283 and 285 are pivoted at 291 on the truck 287 and are counterweighted by means of the counterweight 292 carried by the truck 287. A parallel link arrangement comprising a pair of links 293 and 294 provide the supporting means for the conveyors 283 and 285 and the climbing pusher 286. At their outer ends, the links 293 and 294 are connected by a vertical link 295 which retains its vertical position in all positions of the conveyor mechanism and which acts as a guide for the pushers 286. The moving side wall 284 comprises merely a conveyor belt on edge operated by means of pulleys 296 and 297 which are driven by suitable bevelled gears indicated at 298. The arrangement is such that the conveyor belt 284 moves forward at the same speed as the side drifting conveyor 283. Therefore, sheets being advanced by the conveyor 283 are lined up against the

wall 284 and delivered on the conveyor 285 which in turn transfers them to a pile in front of the back stops 159.

The conveyor 285 has been called a storage conveyor because it has means whereby a number of sheets may be piled thereon and held against delivery during the interval, for example, when a pile of sheets or a number of piles of sheets on a skid are being removed to make room for further stacking. For this purpose, a shaft 299 is journalled in the links 293 and has fixed thereon a plurality of stop fingers 300 arranged in a row across the conveyor 285. A spring 301 tends to hold the pins 300 down between the several belts of the conveyor 285 so as not to obstruct its delivery of sheets. However, when it is desired to hold up the delivery of sheets by the conveyor 285 and merely let them pile up temporarily, the fingers 300 may be operated by a handle 302 to swing them into vertical position, as shown in Fig. 19. Then a latch 303 is engaged beneath a shoulder 304 formed on one of the fingers 300 to hold apart the fingers 300 in raised position. When the necessity for holding the sheets back has ended, the latch 303 is released, and the accumulated sheets upon the conveyor 285 can be fed in the usual manner.

Means are provided whereby the sheets delivered by the conveyor 285 are pushed against the back stop 159, and the conveyor is automatically raised as the height of the stack against the back stop increases. This means comprises a climbing pusher having a frame portion 305 that is pushed back and forth by a yielding drive through a connecting rod 306. The yielding drive may comprise a telescoping connection in the rod 306 in which a spring yieldingly opposes advance of the link. The frame 305 is guided by means of a rib 307 riding in guides 308 and 309 provided on the links 295. An arm 310 connects the link 306 to a shaft 311 which carries a plurality of lifting bars 312 which extend between the several pulleys of the conveyor 285. The lifting bars 312 ride between pins 313 and 314 which are formed upon brackets 315. The brackets 315 are fixed to a cross rod 316 which is fixed to the frame members 305. The action is as follows: When the link 306 moves the arm 310 counterclockwise, as shown in Fig. 21, the bars 312 move up against the stops 313, and then the entire pushing mechanism including the frames 305 is drawn back into the position shown in Fig. 21 with the free ends of the bars 312 within the outline of the conveyor 285. On the forward movement of the climbing pushers, the pusher frame 305 and the associated bracket 315 are moved forward with the arms 312 until pressure begins to build up against the pusher. When this occurs, the free ends of the bars 312 will press down on top of the stack and slightly raise the entire conveyor system. In this way, the climbing pusher continues to elevate the free end of the conveyor 285. At the beginning of a stack, it is desirable to have some sort of yielding shoe mechanism to engage on the skids and ride thereon during the initial stacking operations. Such a shoe is shown at 317 in Figs. 21 and 22. This shoe is pivoted on the cross rod 316 and supported by links 318 which connect to the pusher frame 305.

The operation of the stacking device is believed to be readily apparent from the above description. Sheets delivered and either turned or left with the same side up by means of the shelf 165 are fed by the conveyor 282 onto the side delivery conveyor 283 which aligns the sheets against the moving wall 284 and delivers them to the storage conveyor 285. The storage conveyor 285 discharges the sheets against a back stop. As the stack of sheets builds up, it will eventually engage against the under surface of the pusher bars 312 so that, as the pusher moves forward, the pusher bars will cause the pusher to be lifted, and, since the pusher is connected with the free end of the conveyor 285, the conveyor will also be lifted at its delivery end. There are many forms of climbing pushers that may be utilized to lift the free end of the conveyor 285. The present device, however, will sufficiently disclose the advantages of such pushers in connection with the mechanism for stacking sheets.

Referring now to the delivery of the sheets from the side delivery conveyor 155, if this conveyor does not already arrange the piles of sheets so that they are at a diagonal slope of about forty-five degrees, the conveyor 155 is caused to deliver the sheets onto a trough shaped conveyor 168. This trough shaped conveyor is composed of a belt 169 and a belt 170 arranged at right angles to each other and twisted, as illustrated in Fig. 6, so that, at the delivery end, both belts 169 and 170 slope at an angle of about forty-five degrees with the horizontal. The trough shaped conveyor 168 delivers the piles into a second trough shaped conveyor 171. One side of the conveyor 171 is formed by a solid belt 172 running on pulleys 173. The other side of the conveyor 171 is formed by a series of belts 174 which are spaced apart as illustrated clearly in Figs. 6 and 7. The bottom of the piles delivered to the conveyor 171 rest against the belts 174, and the lower edges of the piles rest against the belt 172. The belts 174 are driven by pulleys 175 and 176. These pulleys are recessed between the belts as indicated at 177 in Fig. 7.

A pushing conveyor 178 has a plurality of V-shaped pushers 179. The V-shaped pusher 179 has projections 180 along one arm thereof. The projections 180 are arranged to mesh with the grooves 177 in the pulleys 175 and 176 so as to travel between the belts 174.

The trough shaped conveyor 171 delivers the piles to a stationary V-shaped trough 181. This V-shaped trough, as illustrated best in Fig. 8, has one side 182 smooth while the other side 183 is provided with spaced grooves 184 into which the projections 180 of the pushers 179 extend. The trough 181 may start horizontally and finish horizontally, as indicated at 185 and 186, but the intermediate portion is directed upwardly at an angle of about thirty-five and one-fourth degrees for some distance. The bends between the horizontal portions 185 and 186 and the intermediate portion 187 are made preferably as smooth curves so that the piles of paper will slide along the trough. The conveyor 178 is so arranged as to cause the V-shaped pushers 179 to follow the contours of the trough 181.

The trough 181 may be jarred by any well known mechanism so that the piles of sheets when travelling up the inclined section 187 have the several sheets aligned with each other. When the sheets being handled are so limber that the edges would crease rather than align themselves when held in a forty-five degree trough, or push up at a forty-five degree slope, then the slope at the side of the trough upon which the bottom of the pile rests and also the slope of the section 187 may be made sufficiently less so that this creasing will not occur. The

aligning can be accomplished by jarring even when the slope is very small. If the piles are evened up before they are delivered into the trough 181, then it would be unnecessary to change the angle of the trough or to use any jarring mechanism.

The conveyor 178 moves a distance equal to the distance between consecutive pushers 179 every time the cam shaft 134 makes one revolution. No adjustment whatever is needed for variations in the size or number of sheets being delivered when the length printed on is always the same. When the length printed on is changed, a phase adjustment of the conveyor 178 is necessary.

The foregoing mechanism, shown in detail in Figs. 6, 7 and 8 provides a means for aligning uneven piles of sheets while in motion. This trough aligning system may be modified somewhat to suit particular installations and purposes. Briefly the operation may be said to consist of exactly aligning the sheets in the piles by delivering the uneven piles into a trough that extends diagonally upward, pushing the piles up the trough by means of pushers and, whenever necessary, jarring the trough to exactly align the sheets in the piles.

The accurately aligned piles of sheets may be delivered by any suitable mechanism to the various forms of gluers and stitchers. These mechanisms as well as the gluers and stitchers are well known in the art and will, therefore, not be described or shown herein.

The correcting mechanism shown in my application hereinbefore identified may also be supplied in conjunction with the slitters and multiple flying shears, shown herein. For example, webs, that have been re-run and perfected, may be stored in rolls; these rolls may then be fed forward past an indicating or noticing device of the present character, and several webs laid one on top of the other in accurate registration before they are delivered to the cutting mechanism. In a like manner, accurate registration of the cutting mechanism, with the particular marks on one or more webs, may be accomplished.

The present invention, since it makes it desirable in many instances to rewind the web, contemplates the provision of an improved rewinding apparatus and method. In the ordinary method of rewinding, the roll is held horizontal and the web is wound at a high tension. The cumulative effect of the tension as the winding progresses becomes greater and greater on the inner layers. To wind, therefore, under considerable tension is objectionable in producing off-set.

Moreover, the storing of a roll with its axis horizontal is objectionable because of the different tensions produced in the web in different parts of the roll by the weight of the paper which composes the roll. Irregularity in stretching results from these different tensions. This irregularity is objectionable when rerunning the roll through a press intended to register with the printing already done. The irregularity is also objectionable in other forms of handling such as in cutting and slitting.

The above difficulties are overcome herein by winding the roll on a horizontal turn table with its axis vertical. The roll is wound loosely in the preferred method with just enough tension being maintained to form a roll. The excess pressure and the unequal stretch are in this manner largely eliminated. Any additional method of preventing off-setting, such as running the web over heaters before winding, using static eliminators, ozonators, or using paraffin mist, or any of the well known vegetable oil sprays before winding, may be used.

The winding may be further improved, particularly in avoiding off-setting or contact between successive layers by the insertion of spacer strips between successive turns on the turn table at one or both edges of the web. The winding may be accomplished in such a fashion where spacer strip is used only at the lower edge to permit unwinding of the roll with the spacer strip lift on the turn table. This is done by merely unwinding the roll at a slightly upwardly directed angle so as to lift the lower edge of the web from between the turns of the spacer strip.

Referring now to Figs. 10, 11, 12 and 13, I have illustrated a winding mechanism embodying the present invention. In Fig. 10, the web 9 is being fed over a roller 245 onto a horizontal turn table 246 which may be driven by any suitable mechanism. The web 9 is shown in Fig. 10 as being wound with upper and lower spacers 247 and 248 which are in the form of strips fed from a pair of drums 249 and 249a. The strips 247 and 248 may desirably take the form shown best in cross section in Fig. 12 where the successive turns of the web 9 are spaced apart by the use of strips made from corrugated board having one smooth side 251 and the other side 252 composed of the corrugated member. As illustrated, the smooth member 251 of the strip is wider and has a portion 253 extending up between the turns of the web 9. The corrugated strip 252 forms a shelf which receives the lower edge of the web. Openings at 254 between the corrugated strip 252 and the smooth strip 251 are particularly useful in providing for air circulation. In Fig. 13, the successive turns of the web 9 are not placed upon the shoulders, but are placed between successive turns of the roll spacer strip 250 which is again composed of a smooth strip 251 and a corrugated strip 252. The strips 251 and 252 in case where no shoulder is desired may well be of the same width. When it is desired to unwind the web 9, the web can be turned slightly diagonally with respect to the turn table and removed from between the strips resting on the turn table without the necessity of unwinding the strip. The strip thus can be used over and over again by being fed from that turn table to another one during rewinding.

Throughout the foregoing description, only specific examples of the various mechanisms used in combination have been described and shown. It is obvious that many equivalent forms of mechanisms differing in details from those shown may be employed without departing from the scope of the invention as defined in the claims.

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

1. In sheet delivering machinery, the combination of a side drifting conveyor, adapted to gradually move a transverse row of sheets or piles of sheets thereon off the conveyor at one side thereof while advancing the sheets, with a side receiving conveyor having its top surface offset below the level of the top surface of the side drifting conveyor and extending lengthwise alongside the first named conveyor and travelling at the same forward rate, and upon which sheets from the first named conveyor drop, whereby the rows of sheets on the side drifting

conveyor are placed in piles on the side receiving conveyor.

2. In sheet delivering machinery, the combination of a side drifting conveyor, with a side receiving conveyor and a cascade conveyor whereby travelling columns of sheets arranged transversely in rows are arranged in a single pile.

3. In combination, a side drifting conveyor, and means at the delivery side of said conveyor for positively pushing sheets off the edge thereof comprising a pair of rollers at the delivery edge of said conveyor rotating in the direction of movement of sheets on said conveyor, and one of said rollers having radially extensible fingers thereon, extensible radially beyond the periphery of the roller when they are opposite the other roller, and means to retract the fingers before they again reach the position where they may be extended beyond the periphery of the roller.

4. In combination, a side drifting conveyor, and means at the delivery side of said conveyor for positively pushing sheets off the edge thereof comprising a pair of rollers at the delivery edge of said conveyor rotating in the direction of movement of sheets on said conveyor, and one of said rollers having radially extensible fingers thereon, extensible radially beyond the periphery of the roller when they are opposite the other roller, and means to retract the fingers before they again reach the position where they may be extended beyond the periphery of the roller, the other roller being recessed to receive the fingers.

5. In combination, a side drifting conveyor, and means at the delivery side of said conveyor for positively pushing sheets off the edge thereof comprising a pair of rollers at the delivery edge of said conveyor rotating in the direction of movement of sheets on said conveyor, and one of said rollers having radially extensible fingers thereon, extensible radially beyond the periphery of the roller when they are opposite the other roller, and means to retract the fingers before they again reach the position where they may be extended beyond the periphery of the roller, said fingers being spring pressed outwardly whereby the presence of a sheet between the rollers prevents extension of the fingers.

6. In sheet delivering machinery, the combination of a side drifting conveyor, adapted to gradually move a transverse row of sheets or piles of sheets thereon off the conveyor at one side thereof while advancing the sheets, with a side receiving conveyor, traveling alongside the first named conveyor at the same forward rate, and upon which sheets from the first named conveyor drop, whereby the rows of sheets on the side drifting conveyor are placed in piles on the side receiving conveyor, said side receiving conveyor being composed of two conveyors meeting at an angle.

7. In sheet delivery machinery, the combination of a side drifting conveyor with a side receiving conveyor alongside said first named conveyor and traveling at the same forward speed, and means at the side edge of the side drifting conveyor engaging the sheets as they arrive at said side edge and positively pushing them off the side drifting conveyor onto the side receiving conveyor, said side receiving conveyor being composed of two conveyors meeting at an angle.

8. In sheet delivery machinery, the combination of a side drifting conveyor with a side receiving conveyor alongside said first named conveyor and traveling at the same forward speed, and means at the side edge of the side drifting conveyor engaging the sheets as they arrive at said side edge and positively pushing them off the side drifting conveyor onto the side receiving conveyor, said means comprising pairs of rollers gripping the sheets between them.

9. In sheet delivery machinery, the combination of a side drifting conveyor with a side receiving conveyor alongside said first named conveyor and traveling at the same forward speed, and means at the side edge of the side drifting conveyor engaging the sheets as they arrive at said side edge and positively pushing them off the side drifting conveyor onto the side receiving conveyor, said means comprising pairs of rollers gripping the sheets between them, and positive drive means for the lower roller of each pair.

10. In sheet delivering machinery, the combination of a side drifting conveyor, adapted to gradually move a transverse row of sheets or piles of sheets thereon off the conveyor at one side thereof while advancing the sheets, with a side receiving conveyor, traveling alongside the first named conveyor at the same forward rate, and upon which sheets from the first named conveyor drop, whereby the rows of sheets on the side drifting conveyor are placed in piles on the side receiving conveyor, the last named conveyor being spaced below the side drifting conveyor and comprising a pair of conveyor belts, the planes of which intersect, both belts being placed at an angle to the horizontal whereby to provide a trough below the side edge of the side drifting conveyor.

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