Jan. 21, 1958 J. R. CAULFIELD 2,820,633

STREAM SHEET DELIVERY SYSTEM

Filed June 22, 1953

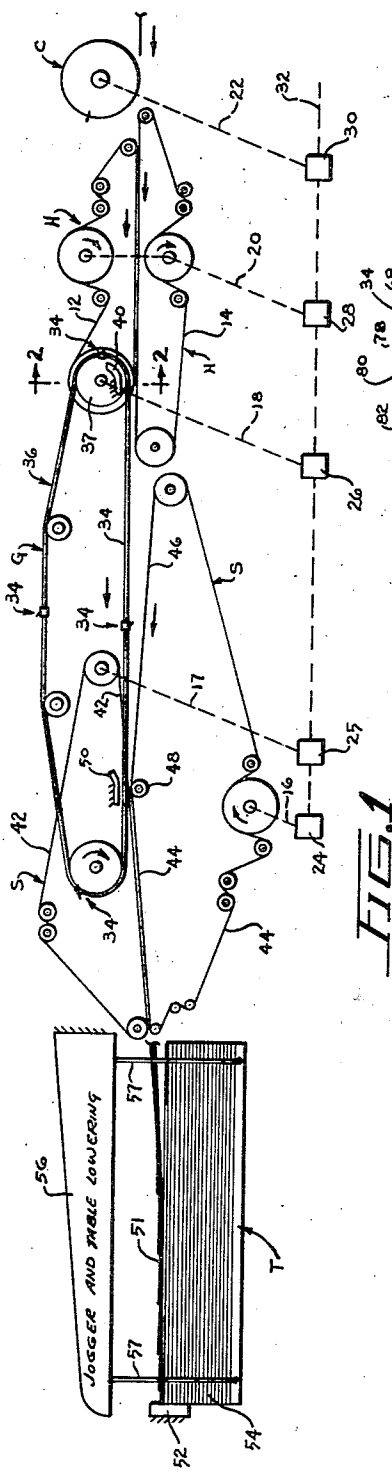


FIG. 1

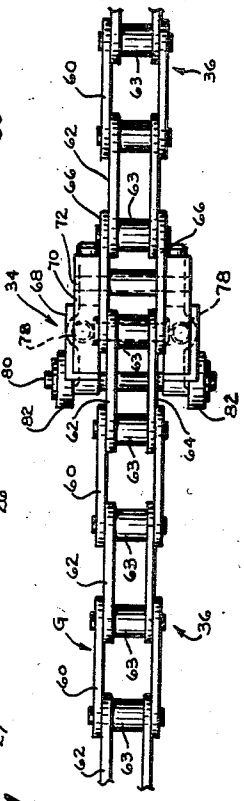


FIG. 3

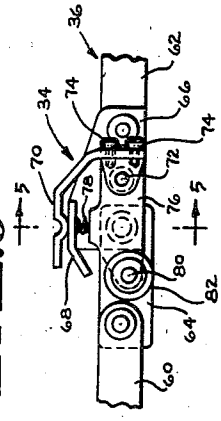


FIG. 4

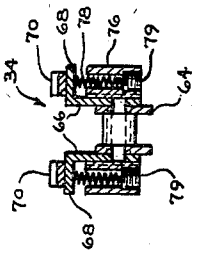


FIG. 5

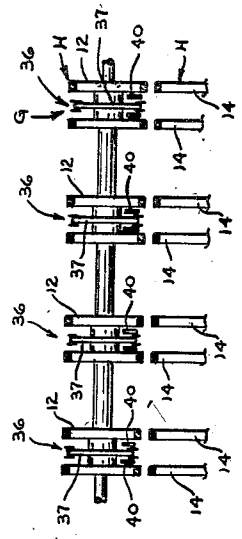


FIG. 2

INVENTOR.
JOSEPH R. CAULFIELD
BY James and Franklin
ATTORNEY

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2,820,633

STREAM SHEET DELIVERY SYSTEM

Joseph R. Caulfield, West Norwood, N. J., assignor to Champlain Company, Inc., Bloomfield, N. J., a corporation of New York

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13 Claims. (Cl. 271—76)

This invention relates to stream sheet delivery systems, and more particularly such a system for stacking sheets initially fed at very high speed.

Printing, punching or other operations are often performed on a continuous moving web, and as a final step the web is severed into separate sheets. To stack these sheets in superposed relation they may be delivered between moving belts, or by means of grippers, until they reach suitable vertical stops at a table or the like on which the sheets are collected. Such arrangements have worked well at slow and moderate speeds, but at very high speeds, say five hundred feet a minute, the impact of the sheet against the stops tends to damage the leading edge of the sheets.

It has already been attempted to overcome this difficulty by first slowing the sheets between slow speed belts, following which the sheets reach the stationary stops where the sheets are stacked. Such systems have not proved altogether satisfactory because in moving the sheets from high speed belts to low speed belts there is some loss of control of the sheets, and they may assume angular positions instead of remaining in alignment.

The primary object of the present invention is to generally improve sheet delivery systems, and to overcome the foregoing difficulties and disadvantages. A more specific object is to provide a high speed delivery system which utilizes slow speed belts, but in which the sheets are kept under positive control and alignment during the transition from the high speed belts to the slow speed belts. For this purpose I employ in series positive or chain driven grippers between high speed belts and slow speed belts, for the transition from one to the other.

In accordance with further features and objects of the invention the chains are preferably interjacent the belts, so that they extend past one another, thereby facilitating the maintenance of control of the sheets during the transition from high speed belts to the grippers, and from the grippers to the slow speed belts. To make possible a close interleaving of chains and belts, I provide single chain grippers, that is, grippers which are carried by a single chain instead of being carried by or disposed between two spaced collateral chains.

To accomplish the foregoing objects, and other more specific objects which will hereinafter appear, my invention resides in the sheet delivery and stacking elements, and their relation one to another, as are hereinafter more particularly described in the following specification. The specification is accompanied by a drawing, in which:

Fig. 1 is a schematic elevation of a sheet delivery and stacking system embodying features of my invention;

Fig. 2 is a transverse section taken approximately in the plane of the line 2—2 of Fig. 1;

Fig. 3 is a plan view of one of the single chain grippers, with some adjacent chain links;

Fig. 4 is a side elevation of the gripper; and

Fig. 5 is a section taken approximately in the plane of the line 5—5 of Fig. 4.

Referring to the drawing, and more particularly to Fig. 1, the sheet delivery system there shown receives sheets which are cut from a continuous web by means of a high speed rotary cutter symbolically represented at C. The delivery system comprises high speed belts, generally designated H, followed by a closed loop of positively driven or chain carried grippers generally designated G, which in turn is followed by slow speed belts, generally designated S, from which the sheets may be delivered to and stacked on a table, generally designated T.

The high speed belts H are in pairs, there being an upper belt **12** disposed over a lower belt **14** to form one pair of belts. There are a number of such pairs disposed collaterally across the width of the web, and in Fig. 2 it will be seen that in the present case there are eight such pairs, which would take care of a web width of, say, 36". The high speed belts H are preferably driven at a speed somewhat higher, say 10% higher, than the web speed, and higher than the gripper speed at the chains G. The belt speed is higher than the web speed in order to move the cut sheets away from the cutting knife C and to slightly separate the sheets. The belt speed is somewhat higher than the chain or gripper speed in order to be able to feed the leading edge of a sheet into the rearwardly facing open jaws of the travelling grippers.

The specific drive means for the various parts of the system have not been shown in detail, but the fact that the relative speeds of the various parts should be and are suitably inter-related, is schematically indicated by the dotted lines **16**, **17**, **18**, **20** and **22** symbolizing shafts, which are geared at **24**, **25**, **26**, **28** and **30** to a main shaft **32**. This is shown extending toward the right, because it may and usually would run alongside various other units on the web line, such as multicolor printing and/or punching units. It will be understood that the gear ratios at the gear boxes **24**, **25**, **26**, **28** and **30** are appropriately selected, in relation to the pitch diameters of the pulleys for the belts, and the sprocket wheels for the chains, to establish the desired relative linear speeds.

The grippers **34** are carried by chains **36**, which in turn are driven by sprocket wheels **37**. In the present case there are four such chains, as will be seen in Fig. 2, and it will also be seen that these chains are interjacent the upper belts **12**. The grippers will be described in greater detail later, but for the present it may be said that they are single chain grippers, and it is that fact which makes it possible for the gripper chains to be interleaved with the belts as shown in Figs. 1 and 2. The gripper jaws are normally closed by spring action, and are momentarily opened by a cam action.

Suitable cams for this purpose are located at **40**, so that the jaws are open at a point where the sheets are fed into the open jaws by the high speed belts. The grippers are spaced uniformly around the chain, preferably at a distance somewhat greater than the maximum length of the sheet to be handled. In the specific case illustrated the system will handle sheets up to 34" long, and the grippers are spaced 36" apart on the chain. Thus in the present case there is no attempt to slow the sheet speed by means of the chains **36**, and for simplicity and convenience of design and adjustment, these are moved at exactly web speed.

Of course, the timing of the parts, that is, the location of the grippers, must be properly adjusted when first setting the apparatus into operation. Specifically a gripper must be at the cam **40** when the leading edge of a cut sheet reaches the cam **40**, and the latter in turn is related to the rotative position of the cutting knife C, which again must be in proper relation to the printing and/or punching of the web. The adjustment means may be made quite simple, as by using releasable screws and a clamp between the

gear box 26 and the shaft 18, or between the latter and the sprocket wheels 37 carried thereby, thus making it possible to shift the chain and gripper position in one direction or the other until the grippers are properly located relative to the position of the leading edge of the travelling sheet.

The slow speed belts S are also in pairs, each pair consisting of an upper belt 42 and a lower belt 44. The number of slow speed belts preferably matches the number of high speed belts, so that in the present case there would be eight pairs of slow speed belts interjacent the four chains, much as indicated in Fig. 2. The slow speed belts are driven at a speed which is much slower than, and preferably only a fraction of the web speed or the chain speed, say one-fourth or one-fifth. Thus the sheets are greatly slowed down in the slow speed belts, and if the sheets are long, they necessarily greatly overlap one another.

The bottom belt 44 has a relatively long upwardly sloping approach portion 46 leading to an idler 48 which forms the pinch point between the belts 42 and 44. It is evident that the grippers 34 must release the sheet at about the same instant that it is frictionally retarded by the belts, which takes place at the pinch point 48. For this purpose the grippers are opened by a second set of cams 50, and these are located approximately at the pinch point. In the specific case here shown the cams 50 begin about 2" before the pinch point. They may extend for only a few inches, or may continue further if desired because continued unnecessary opening of the jaws does no harm.

The long sloping approach portion 46 of the lower belt 44 serves to support the sheets while they come into overlapping relation because of the retarding action of the belts. The belt parts 46 would also support a sheet while it is still being moved by the grippers, but in practice this does not happen because of the high speed of operation. The apparatus shown will handle sheets cut from a web travelling at a speed of, say, five hundred feet per minute, and with the grippers moving at that speed there is no tendency for the trailing ends of the sheets to drop. However, when the sheets are decelerated by the slow speed belts S, the situation changes, and the trailing ends of the sheets do tend to drop, whereupon they rest on and move with the belt portions 46.

The slowed sheets leave the slow speed belts in the form of a continuous stream of overlapped sheets. These feed out over a suitable table T or other appropriate stacking means, as shown at 51. Such stacking means are well known and require no detailed description. They usually include a suitable vertical stop surface 52 against which the leading edges of the sheets move. They also include automatic table lowering means, not shown, to gradually lower the table T as the stack of sheets 54 becomes higher, thus keeping the top of the stack at a constant height. They further include jogging means, not shown, to vibrate or jog the stacker, thereby helping bring the superposed sheets into registration. These mechanisms are not shown in detail but are indicated schematically on the drawing by the overhanging hood 56, which houses the shafts, gears, sprockets, and the upper ends of the table support chains for the lowering mechanism, and also the jogging mechanism. The vertical chains which support the table T have been schematically suggested at 57.

A preferred form of single chain gripper is shown in Figs. 3, 4 and 5 of the drawing. The construction of the gripper per se is not claimed herein, it being disclosed and claimed in a copending application Serial No. 370,541, filed July 27, 1953, now Patent No. 2,773,585, entitled "Single Chain Gripper." The gripper is shown in the drawing as though on the top run of the chain 36, that is, while travelling from left to right, and it will be understood that when the gripper is actually holding and pulling a sheet it is in a position inverted from that shown, and is running from right to left as viewed in Fig. 1.

In any event the main chain 36 is a standard roller chain comprising links 60 and 62 with rollers 63 therebetween. The grippers are spaced along the chain at relatively long intervals, in this case every 36". There the standard links 60 and 62 are replaced by special links 64 and 66. The links 64 are slightly deeper than the standard links, as is best shown in Fig. 4. The links 66 extend upwardly and are then bent outwardly to form stationary jaws 68. The stationary jaws 68, best shown in Figs. 4 and 5, cooperate with movable jaws 70, which are pivoted at 72 outside the links 66. The pivoted ends of the jaws are secured, as by means of screws 74, to members 76 which extend collaterally of the chain immediately outside the links of the chain. These members extend beneath the stationary jaws 68, and are normally urged downward by compression springs 78, which thus serve to normally keep the jaws 70 closed down against the jaws 68 (as viewed in Fig. 4). The lower ends of the springs 78 are received within and housed by the members 76, and if desired may be supported at their lower ends by removable screws 79, as best shown in Fig. 5. At their free or trailing ends the members 76 carry a pin 80 on which cam rollers 82 are rotatably mounted. The members 76 have bearing holes for the pin 80, while the links 64 have vertical slots through which the pin 80 passes, the said slots affording room for some up-and-down movement of the pin 80 and cam rollers 82. It will be evident that in Fig. 4 the cam rollers are shown in their inner position with the jaws closed, and that when the rollers reach suitable cams, such as the cams 40 and 50 shown in Fig. 1, the rollers are pressed outwardly (downwardly in Fig. 1), thus moving the jaws 70 outwardly (downwardly in Fig. 1) to their open position.

While the sprocket wheel on which the chain runs has not been shown in detail, it may be mentioned that it may be generally conventional, except that a sprocket wheel is used having a pitch only half that of the chain, with the consequence that two teeth of the sprocket wheel fit between any successive two of the regular chain rollers 63. This deviation from standard practice provides a space between sprocket teeth which space is located halfway between the rollers 63. This space accommodates or provides clearance for the cam roller pin 80 and the pivot pin 72, which, it will be noted in Fig. 3, are located exactly halfway between the regular chain rollers 63.

The high speed belts H may be run approximately 10% faster than web speed. The chains 36 are run at exactly web speed in the machine here illustrated, and no attempt is made to overlap the sheets or to slow their speed while being handled by the grippers, although some preliminary slowing action could be accomplished at this point. The slow speed belts are run at only a fraction of the chain speed, and at this point the sheets are brought into overlapping relation (unless they are extremely short), and they issue from the slow speed belts in the form of a stream of overlapped sheets which are fed to the stacking means.

The stacking unit has been indicated as having a table T, but it will be understood that this may equally well be a skid or pallet which is removable by means of a fork truck when the skid has been sufficiently lowered (i. e., the stack has grown sufficiently high), as is well known and common practice.

It is believed that the construction and operation of my improved apparatus for the delivery and stacking of sheets, as well as the advantages thereof, will be apparent from the foregoing detailed description. It will also be understood that while I have shown and described the invention in a preferred form, changes may be made in the structure shown without departing from the scope of the invention, as sought to be defined in the following claims.

I claim:

1. A sheet delivery system for sheets cut from a continuous web travelling at high speed, said system compris-

ing high speed belts followed by positive grippers followed by slow speed belts, said high speed belts being collateral pairs of superposed belts for receiving the cut sheets between the superposed belts, means for driving the belts at a speed somewhat higher than the web speed, collateral chains carrying positive grippers which face rearwardly, means for driving said chains at a speed slower than the high speed belts, the slow speed belts being collateral pairs of superposed belts for receiving sheets from the grippers and slowing and bringing said sheets in overlapping relation, and means to drive said slow speed belts at a speed which is much slower than the chain speed.

2. A sheet delivery system for stacking sheets cut from a continuous web travelling at high speed, said system comprising high speed belts followed by positive grippers followed by slow speed belts followed by a table, said high speed belts being collateral pairs of superposed belts for receiving the cut sheets between the superposed belts, means for driving the belts at a speed somewhat higher than the web speed, collateral chains carrying positive grippers which face rearwardly and are spaced on the chains at a distance exceeding the maximum sheet length to be handled, means for driving said chains at a speed somewhat slower than the high speed belts, the slow speed belts being collateral pairs of superposed belts for receiving sheets from the grippers and slowing and bringing said sheets in overlapping relation, means to drive said slow speed belts at a speed which is much slower than the chain speed, a table for receiving the overlapping sheets from the slow speed belts, and stop means to bring the delivered sheets into superposed relation.

3. A sheet delivery system for stacking sheets cut from a continuous web travelling at high speed, said system comprising high speed belts followed by positive grippers followed by slow speed belts followed by a table, said high speed belts being collateral pairs of superposed belts for receiving the cut sheets between the superposed belts, means for driving the belts at a speed somewhat higher than the web speed, collateral chains interjacent the upper belts and carrying positive grippers which face rearwardly and are spaced on the chains at a distance somewhat exceeding the maximum sheet length to be handled, means for driving said chains at web speed, the slow speed belts being collateral pairs of superposed belts for receiving sheets from the grippers and slowing and bringing said sheets in overlapping relation, means to drive said slow speed belts at a speed which is only a fraction of the chain speed, the upper slow speed belts being interjacent said chains, a table for receiving the overlapping sheets from the slow speed belts, and stop means associated with said table to bring the delivered sheets into superposed relation.

4. A sheet delivery system for sheets cut from a continuous web travelling at high speed, said system comprising high speed belts followed by positive grippers followed by slow speed belts, said high speed belts being collateral pairs of superposed belts for receiving the cut sheets between the superposed belts, means for driving the belts at a speed somewhat higher than the web speed, collateral chains carrying positive grippers which face rearwardly, means for driving said chains at a speed slower than the high speed belts, the slow speed belts being collateral pairs of superposed belts for receiving sheets from the grippers and slowing and bringing said sheets in overlapping relation, means to drive said slow speed belts at a speed which is only a fraction of the chain speed, the bottom ones of the slow speed belts sloping upwardly in the direction of sheet travel for a substantial distance before reaching the gripper release point in order to provide a support for the trailing part of the sheet as it is abruptly slowed when the forward edge of the sheet is released by the gripper.

5. A sheet delivery system for stacking sheets cut from a continuous web travelling at high speed, said system comprising high speed belts followed by positive grippers followed by slow speed belts, said high speed belts being collateral pairs of superposed belts for receiving the cut sheets between the superposed belts, means for driving the belts at a speed somewhat higher than the web speed, collateral chains interjacent the upper belts and carrying positive grippers which face rearwardly, means for driving said chains at a speed slower than the high speed belts, the slow speed belts being collateral pairs of superposed belts for receiving sheets from the grippers and slowing and bringing said sheets in overlapping relation, and means to drive said slow speed belts at a speed which is only a fraction of the chain speed, the upper slow speed belts being interleaved with said chains.

6. A sheet delivery system for stacking sheets cut from a continuous web travelling at high speed, said system comprising high speed belts followed by positive grippers followed by slow speed belts, said high speed belts being collateral pairs of superposed belts for receiving the cut sheets between the superposed belts, means for driving the belts at a speed somewhat higher than the web speed, collateral chains interjacent the upper belts and carrying positive grippers which face rearwardly, means for driving said chains at a speed slower than the high speed belts, the slow speed belts being collateral pairs of superposed belts for receiving sheets from the grippers and slowing and bringing said sheets in overlapping relation, and means to drive said slow speed belts at a speed which is only a fraction of the chain speed, the upper slow speed belts being interleaved with said chains, said grippers being single chain grippers in order not to interfere with interleaving of the chains and belts.

7. A sheet delivery system for stacking sheets cut from a continuous web travelling at high speed, said system comprising high speed belts followed by positive grippers followed by slow speed belts, said high speed belts being collateral pairs of superposed belts for receiving the cut sheets between the superposed belts, means for driving the belts at a speed somewhat higher than the web speed, collateral chains interjacent the upper belts and carrying positive grippers which face rearwardly, means for driving said chains at a speed slower than the high speed belts, the slow speed belts being collateral pairs of superposed belts for receiving sheets from the grippers and slowing and bringing said sheets in overlapping relation, and means to drive said slow speed belts at a speed which is only a fraction of the chain speed, the upper slow speed belts being interjacent said chains, said grippers being single chain grippers in order not to interfere with the interjacent relation of the chains and belts, said grippers having cam rollers at the sides of the chain, a stationary cam mounted adjacent the chain near the delivery end of the high speed belts to open the grippers to receive the sheets, and stationary cams adjacent the chains near the inlet pinch point of the slow speed belts to open the grippers in order to release the sheets as they come under the control of the slow speed belts.

8. A sheet delivery system for stacking sheets cut from a continuous web travelling at high speed, said system comprising high speed belts followed by positive grippers followed by slow speed belts, said high speed belts being collateral pairs of superposed belts for receiving the cut sheets between the superposed belts, means for driving the belts at a speed somewhat higher than the web speed, collateral chains interjacent the upper belts and carrying positive grippers which face rearwardly, means for driving said chains at a speed slower than the high speed belts, the slow speed belts being collateral pairs of superposed belts for receiving sheets from the grippers and slowing and bringing said sheets in overlapping relation, and means to drive said slow speed belts at a speed which is only a fraction of the chain speed, the upper slow speed belts being interjacent said chains, the bottom ones of the slow speed belts sloping upwardly in the direction of sheet travel for a substantial distance before reaching

the release cam in order to provide a support for the trailing part of the sheet as it is abruptly slowed when the forward edge of the sheet comes under the control of the slow speed belts.

9. A sheet delivery system for stacking sheets cut from a continuous web travelling at high speed, said system comprising high speed belts followed by positive grippers followed by slow speed belts, said high speed belts being collateral pairs of superposed belts for receiving the cut sheets between the superposed belts, means for driving the belts at a speed somewhat higher than the web speed, collateral chains interjacent the upper belts and carrying positive grippers which face rearwardly, means for driving said chains at a speed slower than the high speed belts, the slow speed belts being collateral pairs of superposed belts for receiving sheets from the grippers and slowing and bringing said sheets in overlapping relation, and means to drive said slow speed belts at a speed which is only a fraction of the chain speed, the upper slow speed belts being interjacent said chains, said grippers being single chain grippers in order not to interfere with the interjacent relation of the chains and belts, said grippers having cam rollers at the sides of the chain, a stationary cam mounted adjacent the chain near the delivery end of the high speed belts to open the grippers to receive the sheets, and stationary cams adjacent the chains near the inlet pinch point of the slow speed belts to open the grippers in order to release the sheets as they come under the control of the slow speed belts, the bottom ones of the slow speed belts sloping upwardly in the direction of sheet travel for a substantial distance before reaching the release cam in order to provide a support for the trailing part of the sheet as it is abruptly slowed when the forward edge of the sheet comes under the control of the slow speed belts.

10. A sheet delivery system for stacking sheets cut from a continuous web travelling at high speed, said system comprising high speed belts followed by positive grippers followed by slow speed belts followed by a table, said high speed belts being collateral pairs of superposed belts for receiving the cut sheets between the superposed belts, means for driving the belts at a speed somewhat higher than the web speed, collateral chains interjacent the upper belts and carrying positive grippers which face rearwardly and are spaced on the chains at a distance somewhat exceeding the maximum sheet length to be handled, means for driving said chains at web speed, the slow speed belts being collateral pairs of superposed belts for receiving sheets from the grippers and slowing and bringing said sheets in overlapping relation, means to drive said slow speed belts at a speed which is only a fraction of the chain speed, the upper slow speed belts being interjacent said chains, a table for receiving the overlapping sheets from the slow speed belts, stop means associated with said table to bring the delivered sheets into superposed relation, said grippers being single chain grippers in order not to interfere with the interjacent relation of the chains and belts.

11. A sheet delivery system for stacking sheets cut from a continuous web travelling at high speed, said system comprising high speed belts followed by positive grippers followed by slow speed belts followed by a table, said high speed belts being collateral pairs of superposed belts for receiving the cut sheets between the superposed belts, means for driving the belts at a speed somewhat higher than the web speed, collateral chains interjacent the upper belts and carrying positive grippers which face rearwardly and are spaced on the chains at a distance somewhat exceeding the maximum sheet length to be handled, means for driving said chains at web speed, the slow speed belts being collateral pairs of superposed belts for receiving sheets from the grippers and slowing and bringing said sheets in overlapping relation, means to drive said slow speed belts at a speed which is only a fraction of the chain speed, the upper slow speed belts being interjacent said chains, a table for receiving the overlapping sheets from the slow speed belts, stop means associated with said table to bring the delivered sheets into superposed relation, said grippers being single chain grippers in order not to interfere with the interjacent relation of the chains and belts, said grippers having cam rollers at the sides of the chain, a stationary cam mounted adjacent the chain near the delivery end of the high speed belts to open the grippers to receive the sheets, and stationary cams adjacent the chains near the inlet pinch point of the slow speed belts to open the grippers in order to release the sheets as they come under the control of the slow speed belts.

12. A sheet delivery system for stacking sheets cut from a continuous web travelling at high speed, said system comprising high speed belts followed by positive grippers followed by slow speed belts followed by a table, said high speed belts being collateral pairs of superposed belts for receiving the cut sheets between the superposed belts, means for driving the belts at a speed somewhat higher than the web speed, collateral chains interjacent the upper belts and carrying positive grippers which face rearwardly and are spaced on the chains at a distance somewhat exceeding the maximum sheet length to be handled, means for driving said chains at web speed, the slow speed belts being collateral pairs of superposed belts for receiving sheets from the grippers and slowing and bringing said sheets in overlapping relation, means to drive said slow speed belts at a speed which is only a fraction of the chain speed, the upper slow speed belts being interjacent said chains, a table for receiving the overlapping sheets from the slow speed belts, stop means associated with said table to bring the delivered sheets into superposed relation, the bottom ones of the slow speed belts sloping upwardly in the direction of sheet travel for a substantial distance before reaching the release cam in order to provide a support for the trailing part of the sheet as it is abruptly slowed when the forward edge of the sheet comes under the control of the slow speed belts.

13. A sheet delivery system for stacking sheets cut from a continuous web travelling at high speed, said system comprising high speed belts followed by positive grippers followed by slow speed belts followed by a table, said high speed belts being collateral pairs of superposed belts for receiving the cut sheets between the superposed belts, means for driving the belts at a speed somewhat higher than the web speed, collateral chains interjacent the upper belts and carrying positive grippers which face rearwardly and are spaced on the chains at a distance somewhat exceeding the maximum sheet length to be handled, means for driving said chains at web speed, the slow speed belts being collateral pairs of superposed belts for receiving sheets from the grippers and slowing and bringing said sheets in overlapping relation, means to drive said slow speed belts at a speed which is only a fraction of the chain speed, the upper slow speed belts being interjacent said chains, a table for receiving the overlapping sheets from the slow speed belts, stop means associated with said table to bring the delivered sheets into superposed relation, said grippers being single chain grippers in order not to interfere with the interjacent relation of the chains and belts, said grippers having cam rollers at the sides of the chain, a stationary cam mounted adjacent the chain near the delivery end of the high speed belts to open the grippers to receive the sheets, and stationary cams adjacent the chains near the inlet pinch point of the slow speed belts to open the grippers in order to release the sheets as they come under the control of the slow speed belts, the bottom ones of the slow speed belts sloping upwardly in the direction of sheet travel for a substantial distance before reaching the release cam in order to provide a support for the trailing part of the sheet as it is abruptly slowed when the forward edge of

the sheet comes under the control of the slow speed belts.

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