

June 18, 1968

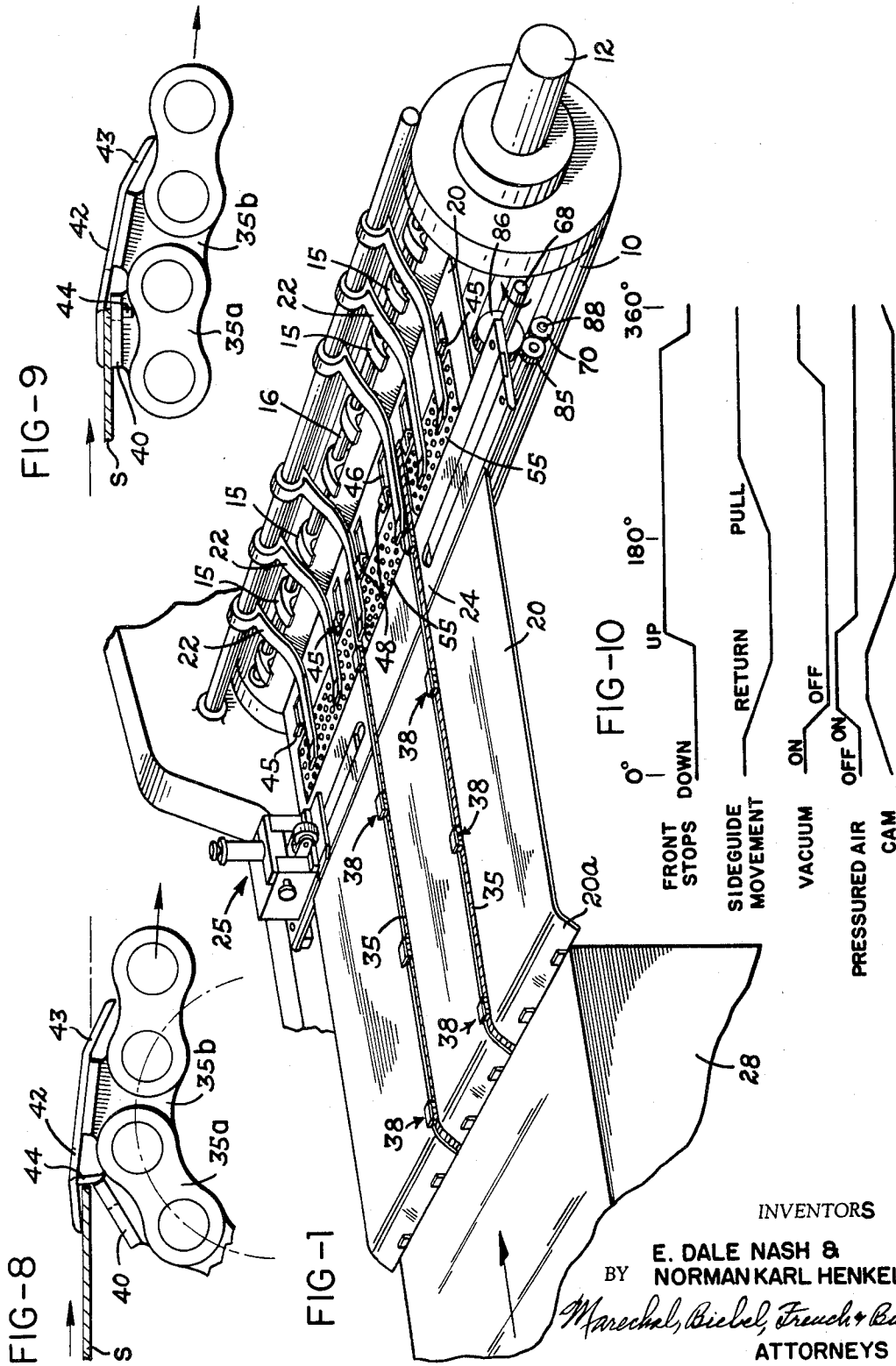
E. D. NASH ET AL

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SHEET FEEDING MEANS HAVING REGISTER MEANS FOR UNDERLAPPING FEED

Filed Dec. 23, 1965

3 Sheets-Sheet 1



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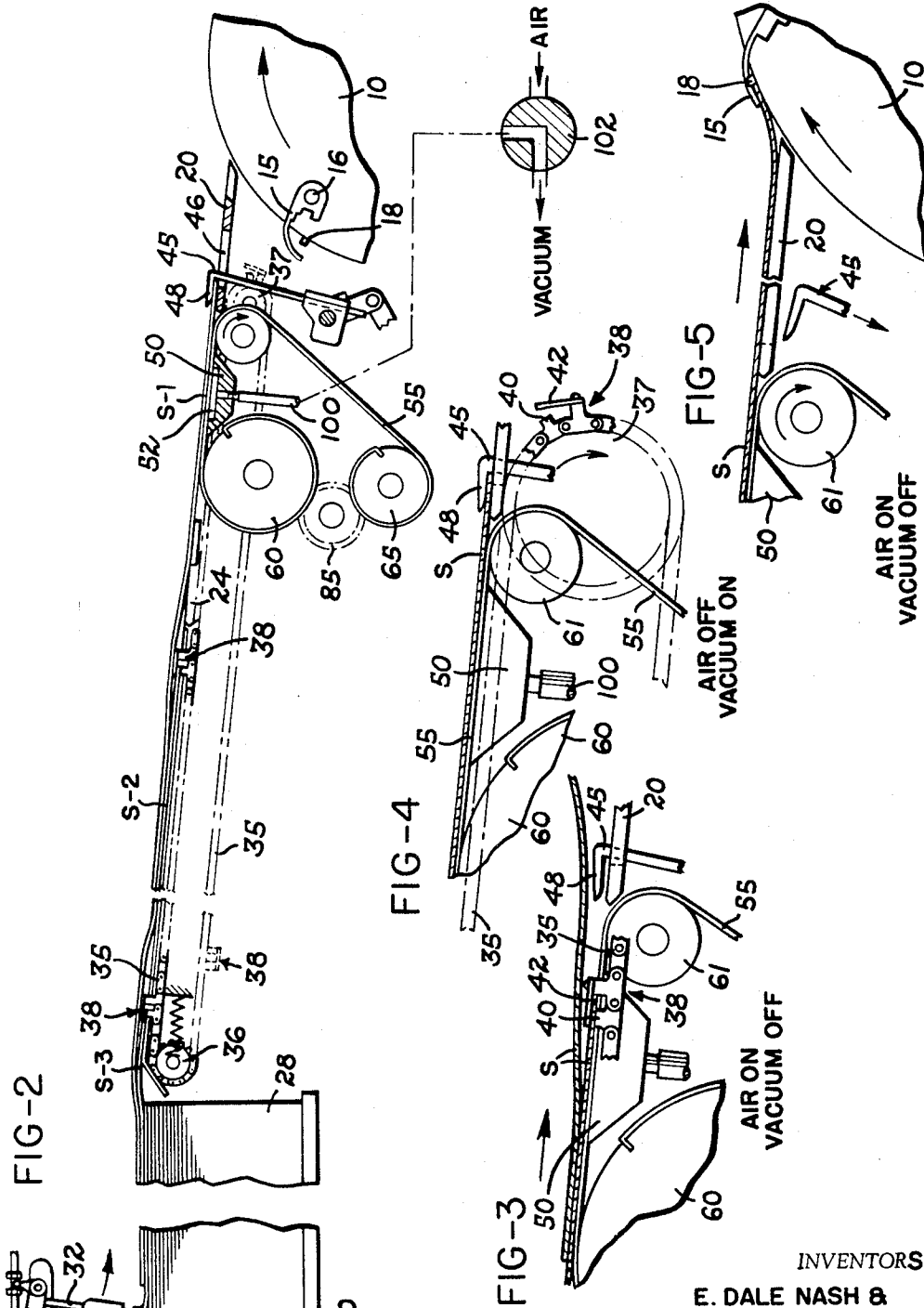
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3 Sheets-Sheet 2



INVENTORS
E. DALE NASH &
BY NORMAN KARL HENKEL

Marshall, Wiebel, French & Bugg
ATTORNEYS

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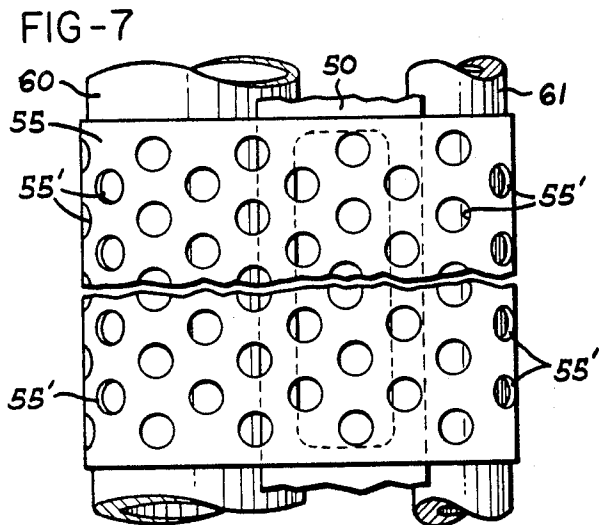
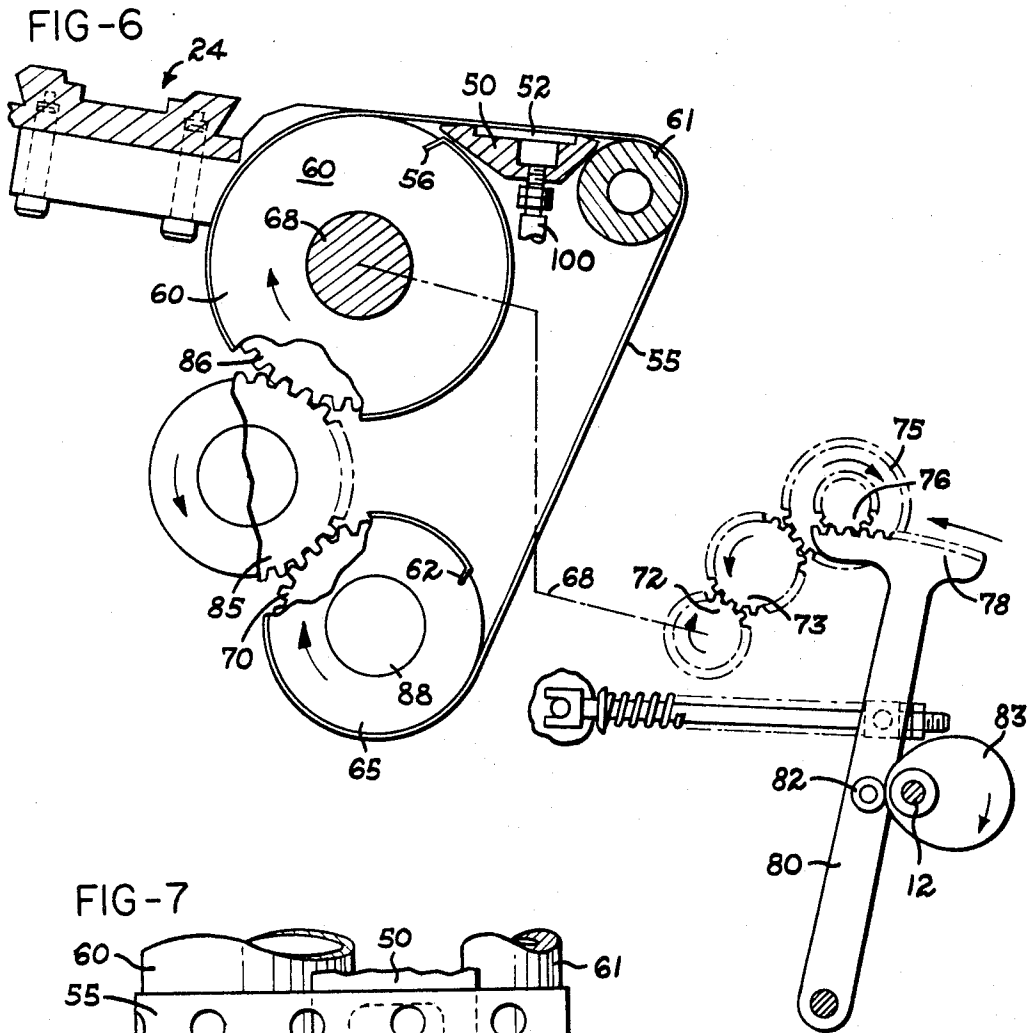
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3 Sheets-Sheet 3



INVENTORS
E. DALE NASH &
BY NORMAN KARL HENKEL
Mueckel, Kiebel, French & Bugg
ATTORNEYS

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SHEET FEEDING MEANS HAVING REGISTER MEANS FOR UNDERLAPPING FEED

Elmer Dale Nash and Norman Karl Henkel, Dayton, Ohio, assignors to Harris-Intertype Corporation, Cleveland, Ohio, a corporation of Delaware

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ABSTRACT OF THE DISCLOSURE

In a printing press, an endless sheet feeding conveyor is provided by endless chains extending along the feed table and having grippers spaced by a distance such as to convey sheets with the leading edge lapping a trailing portion of the preceding sheet; the grippers open to release the leading edge of a sheet under retaining hooks downstream along the feed table, the hooks opening automatically by deflecting the path of the chain causing spreading of the gripper parts after the grippers pass beneath the hooks.

This invention relates to sheet feeding devices for printing presses or other sheet handling machines, particularly such devices arranged to stream feed individual sheets to a sheet-fed rotary printing press.

The present invention comprises novel combinations of elements which enable the stream feeding of sheets from a stack thereof in underlapped relation, under register of each sheet, and subsequent feeding of these registered sheets, one sheet at a time, to a high speed printing press or other sheet handling apparatus. The features of the invention are particularly useful in providing accurate and rapid alignment and registry of the individual sheets such that a sheet-fed press can be operated at a continuous relatively high speed. Another advantage of the present invention is derived from the manner in which the individual sheets, although stream fed, are positively handled for registering purposes and to avoid double feeding of sheets which can lead to jamming, delays, and possible damage to the press.

Accordingly, the present invention has for its principal object the provisions of a novel sheet-feeding and registering device, in which the individual sheets are fed to an alignment or registering position with the leading edge of sheet underlying the trailing edge of the preceding sheet, and wherein the leading edge of each sheet is registered in a preliminary way and is positively carried into the registering position from the supply pile.

Another object of the invention is to provide such a sheet feeding device in which positive control is maintained over the leading edge of the sheet from the time a sheet is separated from the supply stack or pile until that leading edge is released underneath the hooks which, cooperating with the front register stops, function to separate the underlapped sheets as a registered sheet is fed to the sheet handling mechanism while the succeeding sheet is being positioned for registration.

A further object of the invention is to provide a feed conveyor arrangement including simplified grippers for engaging the leading edge of the sheets, in which the grippers automatically pre-register and carry the leading edge of the sheet under the front hooks before releasing the sheet for registration.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

In the drawings:

FIG. 1 is a general perspective view, partly schematic,

2

illustrating the overall arrangement of a sheet feeding device in accordance with the invention;

FIG. 2 is a diagrammatic view, partly in section and partly in side elevation, of the device shown in FIG. 1;

FIG. 3 is an enlarged detail view showing certain parts of the device at the time a leading edge of a sheet is approaching the register stops and hooks of the device;

FIG. 4 is a detail view similar to FIG. 3, showing the leading edge of a sheet under control of the hooks, and with the sheet transport mechanism having released the leading edge of the sheet;

FIG. 5 is a view showing the manner in which an accelerating mechanism advances the sheet into the grippers of a printing press;

FIG. 6 is a detail view in an enlarged scale, with some parts shown schematically, and some parts shown in section, illustrating the construction of a preferred form of sheet accelerating mechanism and associated parts;

FIG. 7 is a broken plan view of a portion of the device shown in FIG. 6, illustrating the cooperative arrangement of one perforated friction feeding belt, the vacuum-air box, and the cooperating parts for controlling motion of the belt;

FIG. 8 is an enlarged detail view of one section of feed chain and one gripper in its open position;

FIG. 9 is a view similar to FIG. 8 with the gripper closed on the leading edge of a sheet; and

FIG. 10 is a timing diagram.

Referring to the drawings, which illustrate preferred embodiments of the invention, and particularly with reference to FIGS. 1 and 2, a cylinder of a sheet handling device, such as a printing press, is shown at 10, mounted to be driven in rotation by a shaft 12. This cylinder includes grippers 15 carried on a supporting shaft 16, and as is well known, these grippers are controlled by suitable mechanism to engage the leading edge of a sheet. Beneath or between the grippers, as may be desired, there are suitable gage pins 18 against which the leading edge of a sheet is engaged just prior to clamping thereof by the grippers 15, in order to obtain accurate final register of the sheet.

The sheets are supplied to the cylinder 10 over a supporting table 20 which may be made up of several sections as shown, and guide fingers 22 are supported to extend over a portion of the table adjacent the cylinder to assist in guiding the sheets. Intermediate the table 20 there is a plate 24 which forms a part of a conventional side register mechanism indicated by the general reference numeral 25. This mechanism may be of any suitable construction, for example the type shown in U.S. Patent No. 2,857,160, although the device shown is not in exactly the same configuration as shown in said patent.

The sheets to be printed are supplied from a stack or pile 28 which is carried on a suitable support means 30, incorporating the usual construction for lifting the pile as it is depleted to maintain the top level of the pile convenient to the separator and sheet feed initiating device, parts of which are shown schematically in FIG. 2.

Basically, this device includes one or more suckers 31 mounted to swing with a reciprocating arm 32. These are arranged to lift a part of the tail of the uppermost sheet on the pile, and the tube 33 is arranged to direct a stream of air underneath the thus separated top sheet, after which the suckers swing forward in known manner to advance the top sheet with its leading edge moving toward the table 20.

Cooperating with the table is a novel transport conveyor in the form of a pair of endless chains 35, extending around sprockets 36 and 37 which are mounted beneath the front and rear of the table 20 such that the chains 35 extend almost the full length of the table. The

sprocket 37 is continuously driven at constant speed, and in timed relation to rotation of cylinder 10, during operation of the sheet feeding apparatus.

The chains contain cooperating pairs of transport grippers, details of which are shown in FIGS. 8 and 9. The grippers are indicated by the general reference numeral 38, and they include a lower pad member or the like 40 formed on certain links 35a of chains 35, together with cooperating upper gripper finger members 42 formed on the preceding links 35b. When these links pass around the sprockets 36 and 37, the members 40 and 42 are opened as shown in FIG. 8, but when these links pass along the level flights of the chain, the parts 40 and 42 come together as shown in FIG. 3 to grip an edge of a sheet S, as shown in FIG. 9.

Thus, as a sheet is moved forward by the separator mechanism it is guided over the turned edge 20a of table 20 toward the transport grippers 38 which come around the sprocket 36 beneath this portion of the table, and the leading edge of each sheet is pushed into the space between the separated members 40 and 42 and is gripped thereby as these parts come together and the grippers 38 proceed down the table 20. The gripper holding force is provided by tension in the upper flight of the chain, since the driven sprocket 37 is pulling the upper flight. The upper gripper finger members 42 have a sloped forward portion 43 which is of sufficient length to extend below the table surface, as the gripper travels along the slot in table 20. This forward portion will prevent interference with the tail of the preceding sheet, especially when the sheets are of such length as to overlap only a slight amount, or if the separator should miss a sheet, leaving a gap in the stream. A preceding sheet will be detained at the registering position, while chain grippers carrying the succeeding sheet will continue to move under the trailing part of the sheet being registered.

The finger members 42 also have a depending tang 44 which functions as an initial or pre-register stop. As shown in FIG. 8, a sheet moved forward from the pile by the separator mechanism will have its leading edge pushed against this gripper stop 44 while the grippers are still open, coming up around sprockets 36. Since there are two sets of chains and grippers, this action will result in an initial front edge alignment of the sheets before the grippers 38 close. Obviously, the pre-register stops could be formed as part of the lower pad member 40; however, the construction shown is believed preferable since the links 35a are first to reach a position generally transverse to the incoming sheet, hence the tangs 44 are in position to align the sheet well before the grippers close.

The present invention is particularly directed to sheet feeding devices of the stream type, in which the sheets are fed in what might be termed an underlapped stream. In other words, the tail or trailing edge of each sheet lies over the leading edge of each succeeding sheet, and thus successive transport grippers 38 are spaced apart on the chains 35 by the distance desired between the leading edges of successive sheets. In FIG. 2 sheets S-1, S-2 and S-3 are shown in this relation, the sheet S-3 having not yet completed its passage from the top of the supply pile 28. It will be apparent that the transport grippers 38 maintain control of the sheets during the stream feeding thereof over the major length of the table 20, and as these grippers pass around the sprockets 37 they open (opposite sequence from FIGS. 8 and 9) and release the leading edge of the sheet at that time.

As this release occurs, the leading edge of the sheet S is under and engaged by a plurality of hook-like stops 45 which are mounted to swing through slots 46 formed in the front section of the table 20. The timed swinging action of these hook stops can be obtained by any known mechanism for lifting and lowering the stops into and out of the path of the sheet moving over the table 20. It should be understood also that the hook-like projections 48 may be provided on the top of only some of

the stops 45, or the actual stop members may be mounted on different arms from the arms carrying the hooks, in a manner such as shown for example in the U.S. patent to Kist No. 2,984,483.

The functions required are that (1) the stops 45 engage the leading edge of each sheet at a plurality of locations after the sheet is released by the transport grippers, thus acting to align or register the leading edge of the sheet transversely of the table, and (2) the hook-like portions 48 function to hold down the leading edge of the sheet and prevent it from following the overlying trailing edge of the preceding sheet as that sheet is being pulled ahead by the press cylinder 10. Thus, the hooks prevent the leading edge of a sheet from clinging to the trailing edge of the preceding sheet for any reason and assure that only a single sheet is fed at a time to the press cylinder. The arrangement is such that the transport grippers 38 do not release the leading edge of a sheet until after it is under the hook projections 48.

With the leading edge of the sheet engaged by the stops 45, the side register mechanism 25 next functions to move the sheet laterally against a predetermined stop position. The function of such side register mechanism is well known, and suitable constructions are described in the aforementioned U.S. patents.

Once the trailing edge of the preceding sheet has cleared the stops 45, the grippers 15 on the cylinder 10 will shortly be presented at the front edge of table 20 to receive the next sheet, and at this time the stops 45, including the hook portions 48, are moved away from the leading edge of the sheet (FIG. 5) to free the sheet S for advancing movement, it being desired to accelerate the sheet and advance its leading edge against the gage pins 18, after which the grippers 15 will clamp the leading edge to the cylinder. Control of the sheet then is assumed by the cylinder 10 to draw the sheet from the feed mechanism.

The device provided for thus advancing the registered sheet, may be of any suitable type, but a preferred device is that disclosed in copending application Ser. No. 379,605, filed July 1, 1964, now U.S. Patent No. 3,309,078. It consists of a box-like member 50 extending through a suitable aperture in the table 20, between the side register support plate 24 and the stop members 45. The member 50 has openings 52 which face upward, between chains 35 and between these chains and the side edges of table 20. These openings 52 face toward the underside of each sheet as it passes along the table, and each opening is closed off at its side edges.

The openings 52 are covered by perforated belts 55 which may take different forms in accordance with the invention. One suitable form shown in FIGS. 2, 6 and 7 consists of a strip of synthetic material, preferably having a relatively high coefficient of friction at its surface presented to the sheets. This belt has a relatively large number of perforations or holes 55', in offset or staggered relation as shown in FIG. 7.

The belt 55 is fastened at one end 56 to a small drum or roller 60, and it passes from this roller to a guide roller 61, these being located at opposite rear and front edges of the box member 50 as shown in FIG. 6. The other end 62 of belt 55 is fastened to a take-up roller 65 which is mounted generally below the main roller 60. Roller 60 is driven from a shaft 68, and this shaft carries a drive gear 86 and a driven gear 72, the latter being in turn driven through idler 73 by a main drive gear 75. The main drive gear is mounted on a common shaft with a pinion 76, and this pinion is in mesh with a sector 78 carried on the end of a pivotally mounted arm 80. The arm is oscillated by means of a roller 82 which follows cam 83, and the cam is driven from the press cylinder 10, as indicated by the segment of the cylinder shaft 12 shown in FIG. 6. A drive gear 86 meshes with an idler 85, and this idler in turn drives a gear 70 mounted on shaft 88.

The interior of the box member 50 is connected through

a conduit such as a flexible hose 100 (FIGS. 2 and 6) to a three-way valve 102 which is shown schematically in FIG. 2. This valve is arranged to connect the hose 100 alternatively with sources of vacuum and air under pressure, as indicated schematically in FIG. 2. Valve 102 can occupy a third position wherein both the vacuum and air sources are cut off from the hose 100. Movement of valve 102 is provided by suitable operating linkage (not shown) timed to the operation of the sheet feeding mechanism as shown by the timing diagram in FIG. 10.

This drive mechanism provides a means for causing the drive rollers 60 and 65 to rotate with a motion that stops and starts, and follows a predetermined cycle of acceleration and deceleration, resulting in a similar linear motion of each belt 55. When the transport grippers 38 are carrying a sheet up to the stops 45, these stops are raised as shown in FIG. 3, the vacuum supply to the box member 50 is cut off, and the pressure air supply is on, as indicated in FIG. 3 and 10. As the transport gripper 38 moves around sprocket 37, and thus releases the leading edge of the sheet S, this edge engages the stop 45 and extends under the hook portion 48. In the meantime, the previous sheet is being pulled away by the cylinder 10, and the hook portions 48 assure separation of the sheets.

At an appropriate time, the stops 45 and hooks 48 are withdrawn or lowered, and the drive mechanism shown in FIG. 1 causes the perforated belts 55 to move. The air is cut off and vacuum is supplied to conduit 100 prior to the stops being withdrawn, and thus the sheet is drawn to the belt 55 and held firmly thereto. The relatively large area of the sheet which is thus exposed to the negative pressure or vacuum, enables this device to use a lower vacuum, reducing the tendency to offset any incompletely dried ink onto the underside of the belts.

Belt 55 carries the sheet S forward on the table 20 advancing it toward the cylinder 10. By reason of the negative pressure continuously exposed to the underside of the sheet S through the holes in the belts 55, the belts have a secure grip on the sheet across a substantial area, and their linear speeds are the same. Hence, during advancing movement caused by belts 55 there is no relative movement between the belts and the sheet. This advancing movement is greater than the surface speed of cylinder 10 and continues until a short while after the leading edge of sheet S engages the gage pins 18 and the grippers 15 close, as shown in FIG. 5.

At this time, the vacuum supply is disconnected from conduit 100 and the pressure air is immediately connected to it, and air under pressure passes through the box member 50 and through the holes in belt 55, providing an effective "air breathing" between the sheet and the belt 55, and quickly releasing the sheet from the vacuum "grip." Therefore, the fact that the upper surface of the belt has a desirably high coefficient of friction does not impede the advance of the sheet once it is being pulled from the table 20 by the press cylinder, since a thin film-like flow of air exists between the belt and sheet at this time. Once the leading edge of the next sheet is carried over the belt 55, this succeeding sheet provides a buffer between the tail of the preceding sheet and the belt 55, and the air supply thus can be cut off if desired although it is possible to continue the pressure air supply until just before the transport grippers release the succeeding sheet coming to the register position.

The present invention, therefore, provides apparatus which positively conveys sheets, in lapping relation, from a supply source which includes separator mechanism, to a registering position, from which the sheets are advanced to sheet handling mechanism. The feeding apparatus includes a pair of chain conveyors, which can be driven continuously, and which include stops for pre-registering the sheets and subsequently releasing the leading edge of each sheet underneath hook members, to avoid double feeding of sheets, or mis-alignment in the registration

mechanism. The entire feeding and pre-registering device is of simple and economical construction and can readily be adapted to various forms of sheet handling mechanisms, particularly printing presses.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that this invention is not limited to this precise form of apparatus and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In sheet handling apparatus having a supply source of sheets including mechanism for presenting the sheets one at a time, mechanism spaced from said supply source for operating on the sheets individually, sheet-retaining members movable toward and away from a position extending across said path and including hook portions facing toward said supply source to engage over the leading edge of a sheet moving along said path, and advancing mechanism operating in timed relation to said operating mechanism to move the sheets released from said sheet-retaining members, by withdrawal of said members, to said operating mechanism;

the improvement comprising a transport conveyor for carrying the individual sheets from the supply source to said sheet-retaining members,

said conveyor having at least one endless chain guided around a first sprocket adjacent said supply source and a second sprocket adjacent said sheet-retaining members,

grippers on said chain operative to close automatically in response to tension in the chain in the region between said sprockets and to open during movement around said sprockets, and means mounting said second sprocket beneath said hook portions and sufficiently advanced toward said operating mechanism to assure that said grippers open automatically only after carrying the leading edge of a sheet under said hook portions.

2. Apparatus as defined in claim 1, wherein said conveyor includes two spaced apart and parallel endless chains, each of said chains having grippers in a corresponding location to the other for gripping a sheet at spaced locations on its leading edge, said grippers including relatively movable members carried on adjacent links of said chains and arranged to engage each other when said chain is pulled in a straight path and to separate when said chain is curved as around said sprockets, and means coordinating the movement of said two chains to each other and to the operation of said sheet presenting means and said advancing mechanism.

3. Apparatus as defined in claim 2 wherein each of said grippers includes a gripper pad member connected to one link of its chain and a gripper finger member connected to a preceding link of the chain and extending over said pad member, and a pre-register stop on one of said gripper members to position the leading edge of a sheet received from said supply source.

4. Apparatus as defined in claim 3 wherein said pre-register stops extend from said finger members toward said pad members for a distance sufficient to intercept the leading edge of a sheet in at least a partially open position of the gripper members.

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ALLEN N. KNOWLES, *Primary Examiner.*