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Liebert et al.

[15] **3,703,281**

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[54] **SHEET FEEDING APPARATUS HAVING GRIPPER CONTROL, FOR USE WITH PRINTING MACHINES**

[72] Inventors: **Oskar Liebert**, Westheim; **Klaus Theilacker**, Neusass, both of Germany

[73] Assignee: **Maschinenfabrik Augsburg-Nurnberg AG**, Augsburg, Germany

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[52] **U.S. Cl.**.....**271/79**

[51] **Int. Cl.**.....**B65h 29/28**

[58] **Field of Search**.....271/79, 82, 85, 68; 198/180

[56] **References Cited**

UNITED STATES PATENTS

2,836,418	5/1958	Blättner et al.	271/68
3,109,644	11/1963	Reinartz	271/68

FOREIGN PATENTS OR APPLICATIONS

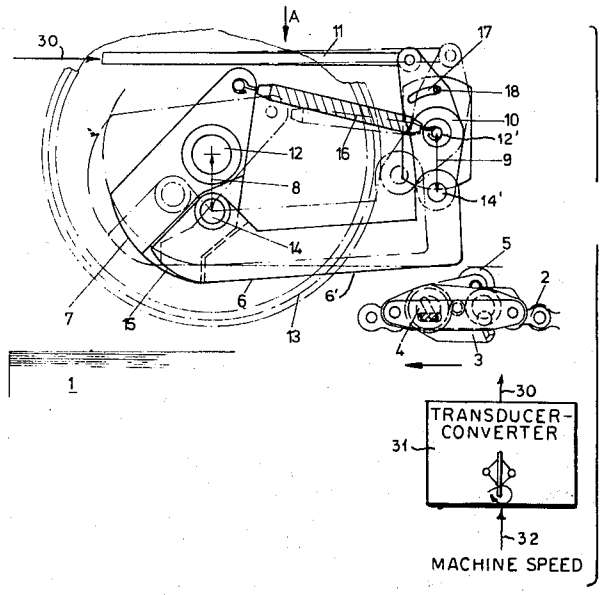
818,365	9/1951	Germany	271/79
1,219,045	6/1966	Germany	271/79

Primary Examiner—Evon C. Blunk
Assistant Examiner—Bruce H. Stoner, Jr.
Attorney—Robert D. Flynn et al.

[57] **ABSTRACT**

The grippers on a sheet feeding apparatus from a printing machine are controlled by having a follower contacting the leading cam formed as a parallelogram - shiftable track, suspended on leading and trailing swing arms of equal length, having one end each pivotable about leading and trailing points, the shiftable track being arranged at shallow angle with respect to the center of the chain conveyer; and a trailing cam, formed as a swingable segmental-like element swinging about a pivot point and having a leading edge thereof located approximately in the prolongation of a line connecting the pivot point thereof and the suspension point of the trailing swing arm of the shiftable track. The trailing cam means being formed to have a leading edge outline which matches substantially with the trailing edge outline of the leading cam, so that the gripper control follower will be smoothly engaged by both leading and trailing cams to release sheets carried by the grippers, and the release position is readily adjustable for various sizes of printed material.

12 Claims, 2 Drawing Figures



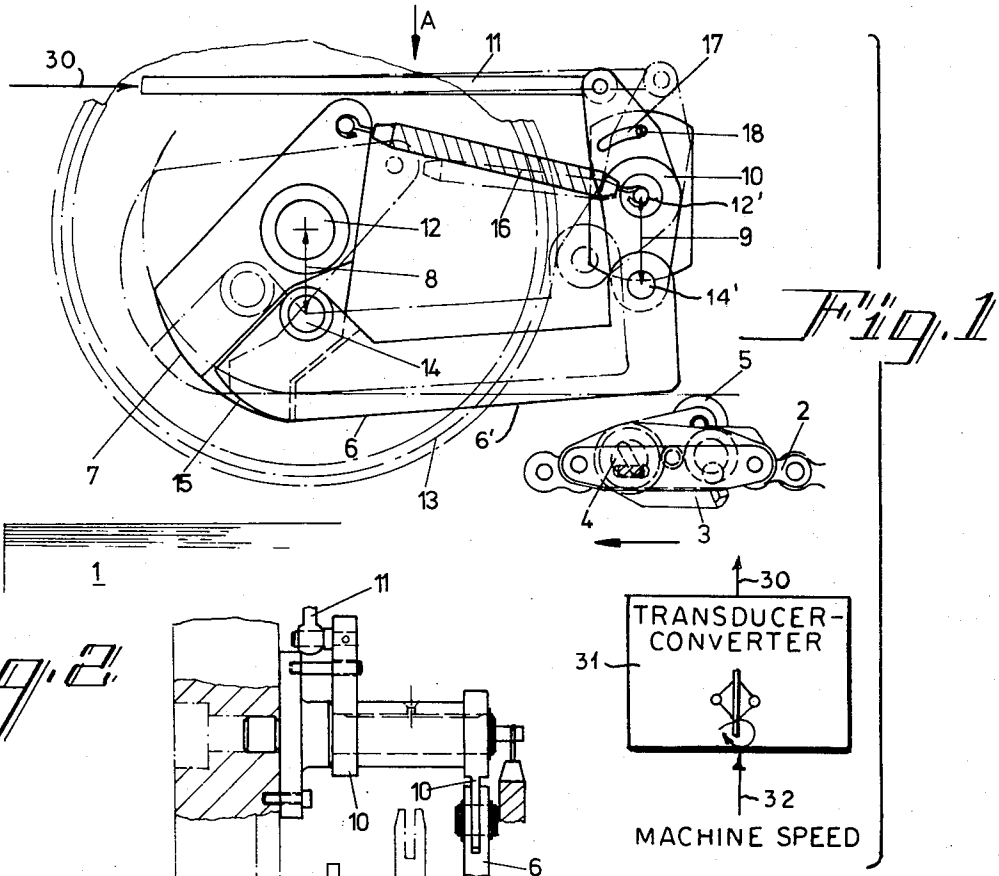

A
30
11
17
18
10
12'
16
9
12
8
14'
14
5
2
6
6'
7
15
13
4
3
1
30
TRANSDUCER-CONVERTER
31
32
MACHINE SPEED

Fig. 1

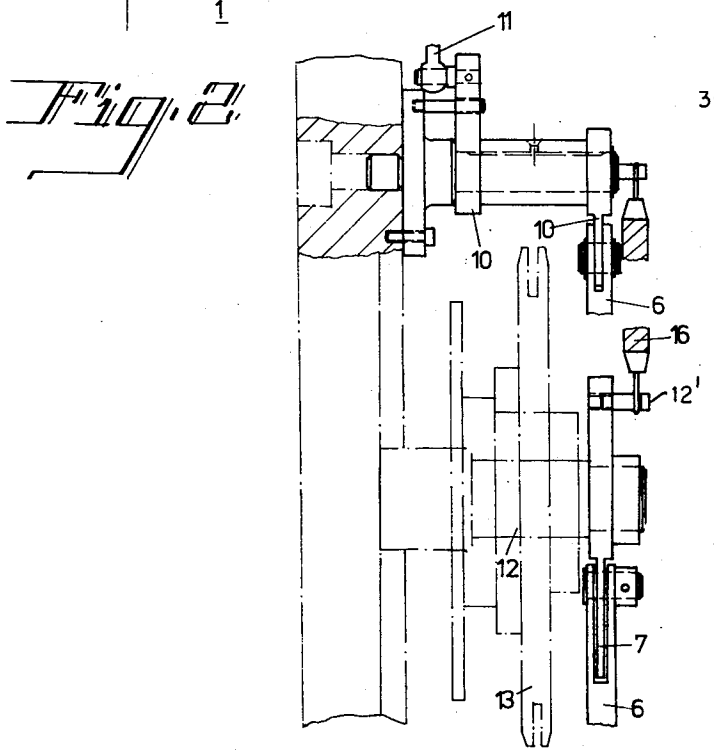

11
10
10
6
16
12'
12
7
13
6

Fig. 2

SHEET FEEDING APPARATUS HAVING GRIPPER CONTROL, FOR USE WITH PRINTING MACHINES

The present invention relates to printing machines, and more particularly to sheet feeding apparatus in connection with printing machines to transport sheets which have been printed on the machines to a stack.

Sheet transporting apparatus for use with printing machines has been proposed in which a chain carries grippers which, when they reach the position of the stack, engage a control surface or a camming surface, to release the sheets which they grip. Usually a follower wheel is provided to engage this control surface; an illustration of such a device is found in U.S. Pat. No. 2,631,038. Controlling the grippers by means of a cam surface consisting of two parts has already been proposed (see German Pat. No. 1,219,045—to which British Pat. No. 1,151,894 corresponds). The leading edge of the cam, with respect to the travel of feed, is interconnected with the trailing cam portion, which is circular, by means of a pivot which can slide along a slit with respect to the sprocket wheel, so that, by means of an intervening link to the sprocket wheel, the position of the trailing edge curve can be matched to the respective position of the leading edge cam curve. This is a complicated arrangement and can be adjusted only over very small limits.

Another known control for the grippers (see German Pat. No. 818,365) utilizes a control cam having a leading portion which is straight and a bent, bow-shaped trailing portion. The control cam can be pivoted by means of a hydraulic transmission, so that the control roll of the grippers engages the cam surface sooner, or later, as desired. This arrangement, also, is capable of adjustment only over narrow limits and has the disadvantage that the angle of attack with respect to the roll changes.

Single-element straight control cams can be used only when the sprocket wheel for the transport arrangement is beyond the receiving stack, since, otherwise, there is danger that the sheet which is to be stacked is caught again by the grippers which are in the process of reclosing.

It is an object of the present invention to provide a sheet transport arrangement for use with printing machines in which the grippers can be controlled over wide ranges, that is, to provide a wide range of adjustment for the leading edge of the control cam, while maintaining an essentially even, or constant angle of attack of the leading edge with respect to the gripper controller itself throughout this adjustment range.

SUBJECT MATTER OF THE PRESENT INVENTION

Briefly, the gripper control for the sheet transport apparatus of the machine includes a leading cam which is formed as a parallelogram - shiftable track, adapted to be engaged by a gripper control follower, which controls the gripper opening. The parallelogram - shiftable track is suspended on a pair of swing arms of equal length, one end each being pivoted about leading and trailing points. The shiftable track is so arranged that it has a shallow angle with respect to the center line of the transport conveyor. A trailing cam as provided is formed as a swingable segment-like element, swingable about a pivot point, and having a leading edge located approximately in the prolongation of a line connecting the pivot point of the segment-like element and the suspension point of the trailing swing arm of the shiftable track. The trailing cam is formed to have an outline merging smoothly with the outline of the leading cam means, so that the gripper control is smoothly engaged by the overall, articulated cam arrangement formed of the leading and trailing cam means.

The apparatus provides wide adjustment of the opening of the grippers, depending on paper quality, printing speed, paper thicknesses and other perameters. The inclination of the leading curve with respect to the gripper control will be constant, due to the parallelogram attachment, and thus hard impact of the control followers on the grippers with the gripper opening cams is avoided. The trailing ends of the leading cam are preferably formed to surround the portion of the trailing cam itself so that the entire running width of the follower rollers on the grippers can be completely utilized in the region of the greatest application of force thereon, that is, just upon opening of the grippers. The arrangement can be simply manufactured and is, therefore, inexpensive.

The invention will be described by way of example with reference to the accompanying drawings, wherein:

FIG. 1 is a highly schematic side view of the control for the transport grippers;

FIG. 2 is a top view of the transport gripper control, partly developed in the direction of the arrow A of FIG. 1.

Sheets are to be stacked on a stack 1, located beyond the sheet transport chains. They are transported by means of a gripper arrangement 3, secured to endless chains 2, and removing the sheets from the printing presses, in the direction of the arrow of FIG. 1. Such grippers and sheet removal conveyors are well known in the art. The gripper shaft 4 is connected to a torsion bar suspension control follower roll 5, which cooperates with a leading cam portion 6 and a trailing cam portion 7. When roller 5 meets the cam portion 6, 7, grippers 3 open and release and the printed sheet floats on stack 1, due to inertia, and gravity. Heavy paper, or carton stock which was printed requires early opening of the gripper in order to prevent hard impact of the sheets on the abutment and limit stops of the stack. If the paper is thin, the gripper should open later. This differential adjustment of gripper openings requires adjustment of leading cam track 6. The trailing cam track 7 is provided in order to hold grippers 3 open for such a period that the once released sheet will not be caught again by the grippers and, inadvertently, continued to be transported.

Large differences in weight of paper sheets to be handled require wide adjustment limits of the gripper opening, during any one cycle.

The leading cam 6 is formed as a track 6' which forms part of a parallelogram suspension, that is, which is suspended by a pair of crank arms, schematically indicated at 8, 9, which are of equal length. The cranks 8, 9, may be defined as the distance from a pivot point 12, 12' thereof to the linkage point 14, 14' of arms 8, 9, with the track portion 6'. The crank arm 9, itself, may form part of a double armed lever 10, and the pivot point of the trailing arm 8, remote from the track portion 6' is coaxial with the swing, or center pivot point of

the trailing cam portion 7. The position of track portion 6' is adjustable by means of an adjustment rod 11, engaging the double arm lever 10. Adjustment rod 11 may be manually adjusted; as shown, however, the position of rod 11 can be controlled automatically in dependence on machine speed by providing a transducer-converter 31, receiving a machine input, which controls as its output the position of rod 11, as schematically indicated by the connecting arrow 30. The transducer-converter can be entirely mechanical, as schematically shown a centrifugal controller, or maybe electrical, hydraulical or otherwise, so long as machine speed is senses and converted into motion being transmitted to arm 10. Arm 10 itself pivots about point 12', which causes a shift in height of the leading edge 6 with respect to the conveyor chain, and additionally swinging of the trailing cam portion 7 about shaft 12 of the sprocket wheel 13. When the adjustment is automatic, the transfer function relating speed of the main drive, and the position change of the cam tracks may be linear, or non-linear, to provide an adjustable transmission ratio which can take into consideration format, that is size of the printed sheet, as well as paper quality. Thus, transducer-converter 31 may have linear, or non-linear, or manually adjustable and variable transfer characteristics. The two final positions of which the adjustment cams, that is element 6 and element 7 are capable is illustrated by full line and chain dotted lines, respectively.

The controlling edge of the leading cam 6 is arranged to form a flat, shallow angle with respect to the center line of the conveyor chain 2. If so arranged, a maximum adjustment angle of approximately 40°, that is, a shift in position of 40° of the lever 10, and hands of arm 8, provides a large range of adjustment, as indicated in FIG. 1, without change of the angle of attack of roller 5 with respect to track 6'.

The transfer of control surface from track 6 to the trailing cam 7 should be smooth. To provide such a smooth transfer, the start of the trailing cam is arranged to be approximately in the prolongation of a connecting line interconnecting the pivot point 12 of the trailing curve 7 and the suspension point 14 of the trailing end of the leading cam 6. The trailing suspension point 14 of the leading cam track 6 can be, itself, connected on or formed on the trailing cam 7. The controlling cam edge of the trailing cam 7 is eccentric with respect to its axis 12, in such a way that the radial distance decreases in direction of movement of the control roller 5. The track 6' is arranged to partly overlap with the cam surface 7 and, in this region, is formed with a bowed control edge 15 having a lesser radius than the radius of the cam portion 7.

Some play of the drive is difficult to compensate; to overcome play, a spring 16 is hooked to the end of the trailing cam opposite the cam surface 7 to interconnect with the shaft point, or pivot point of the double arm lever 10.

As best seen in FIG. 2, the leading cam 6 both overlaps as well as surrounds cam 7, as well as the double armed lever 10. This permits engagement by the full width of roller 5, and particularly during the greatest acceleration, and thus during occurrence of the greatest dynamic forces, that is, upon opening of the grippers; the inter-engaging portions themselves become active only in the region of substantially lesser forces being transferred to the rollers.

Both cam curves 6, and 7 can be adjusted during actual operation, and without stopping the machine; the limit of adjustment is provided by an elongated opening 17 in the double arm lever 10, in which a pin 18 fixed in position on the machine is engageable.

The present invention has been illustrated in connection with sheet transport apparatus for use in combination with a printing machine; various changes and modifications may be made within the inventive concept to adapt the invention to various uses.

We claim:

1. In a sheet transport apparatus having a chain conveyor (2), gripper means (3, 4) secured to the chain conveyor, control means for said grippers and a follower (5) adapted to be contacted by said control means, said control means comprising

leading cam means (6) being formed as a parallelogram-shiftable track (6') and leading and trailing swing arms (8,9) suspending said shiftable track (6'), said swing arms being of equal length and having one end each pivotable about leading and trailing points (14', 12), the shiftable track being arranged at a shallow angle with respect to the center line of the chain conveyor (2);

and trailing cam means (7) formed as a swingable segmental-like element swinging about a pivot point (12) and having a leading edge thereof located approximately in the prolongation of a line connecting said pivot point thereof (12) and the suspension point (14) of the trailing swingable arm with the shiftable track (6');

the trailing cam means (7) being formed to have an outline merging smoothly with the outline of the leading cam means (6).

2. Apparatus according to claim 1 wherein the segmental-like element of the trailing cam means has a control edge which is eccentric with respect to its pivot point (12) the radial distance of the trailing cam means decreasing in direction of movement of the follower (5).

3. Apparatus according to claim 1 wherein the leading cam means (6) partly overlap the trailing cam means (7), to form a combined camming surface (15), the combined camming surface having a lesser radius than the radius of the trailing cam means.

4. Apparatus according to claim 1 wherein said swing arms are formed as double arm cranks (8, 9);

and adjustment means (11) engaging one of said cranks at the end thereof not connected to the shiftable track.

5. Apparatus according to claim 4 wherein the adjustment means comprises a control rod (11) connected to one of said cranks, said control rod being shiftable in position in dependence on machine speed.

6. Apparatus according to claim 4 wherein the adjustment means comprises a control rod (11) connected to one of said cranks;

and means (31) sensing machine speed and connected to shift said control rod in dependence on sensed machine speed.

7. Apparatus according to claim 4 wherein one of the crank arms (10) is formed with limit means (17, 18) to limit the extent of movement thereof.

8. Apparatus according to claim 7 wherein said limit means comprises a pin engaging an elongated slot.

9. Apparatus according to claim 1 wherein the angle of swing of said swing arms is about 40°.

10. Apparatus according to claim 1 wherein the shiftable track and the trailing cam means are formed as interdigited elements.

11. Apparatus according to claim 1 wherein the pivot point (12) of the trailing swing arm (8) and the pivot point (12) of the trailing cam means (7) are coaxial.

12. Apparatus according to claim 1 including a tension spring interconnecting the arms to counteract play in the swing and pivots points thereof.

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