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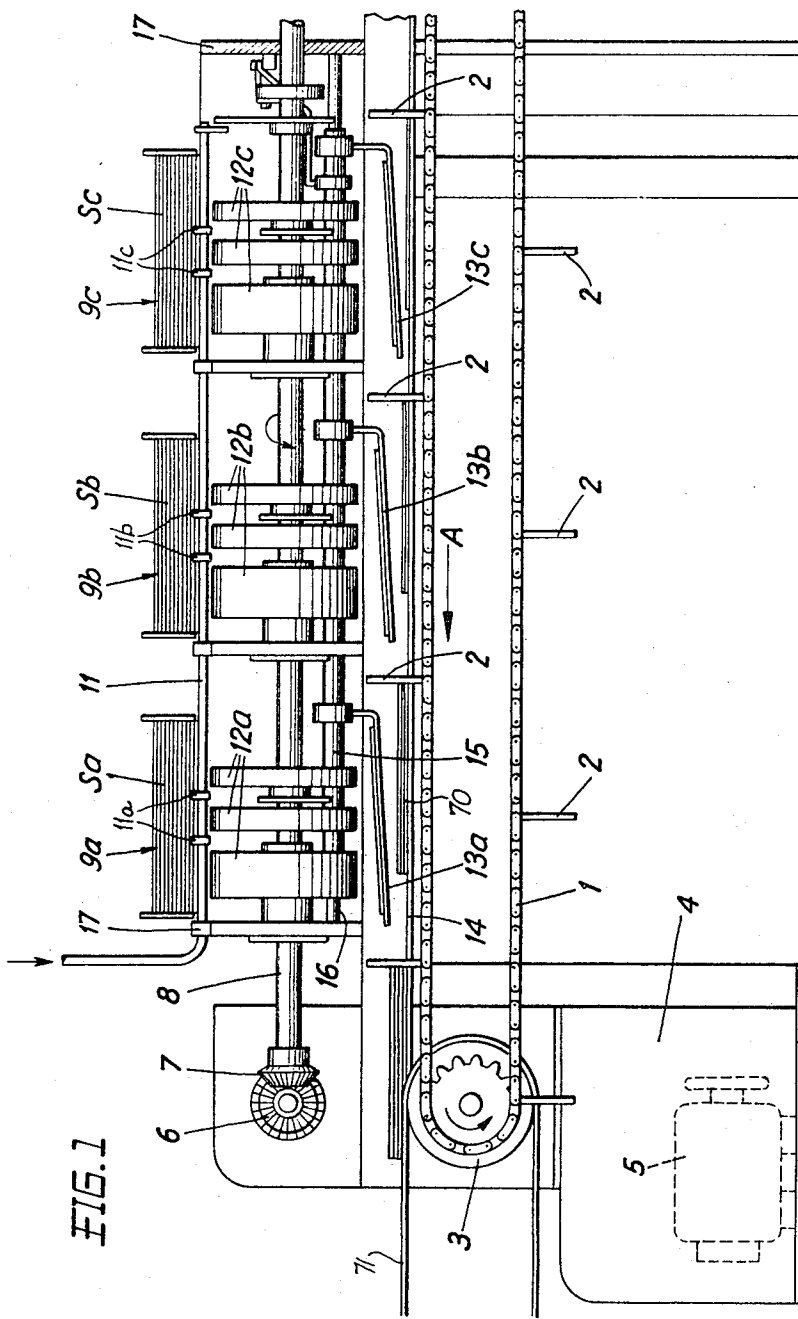
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SHEET FEEDING AND COLLATING APPARATUS

Filed Nov. 1, 1966

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

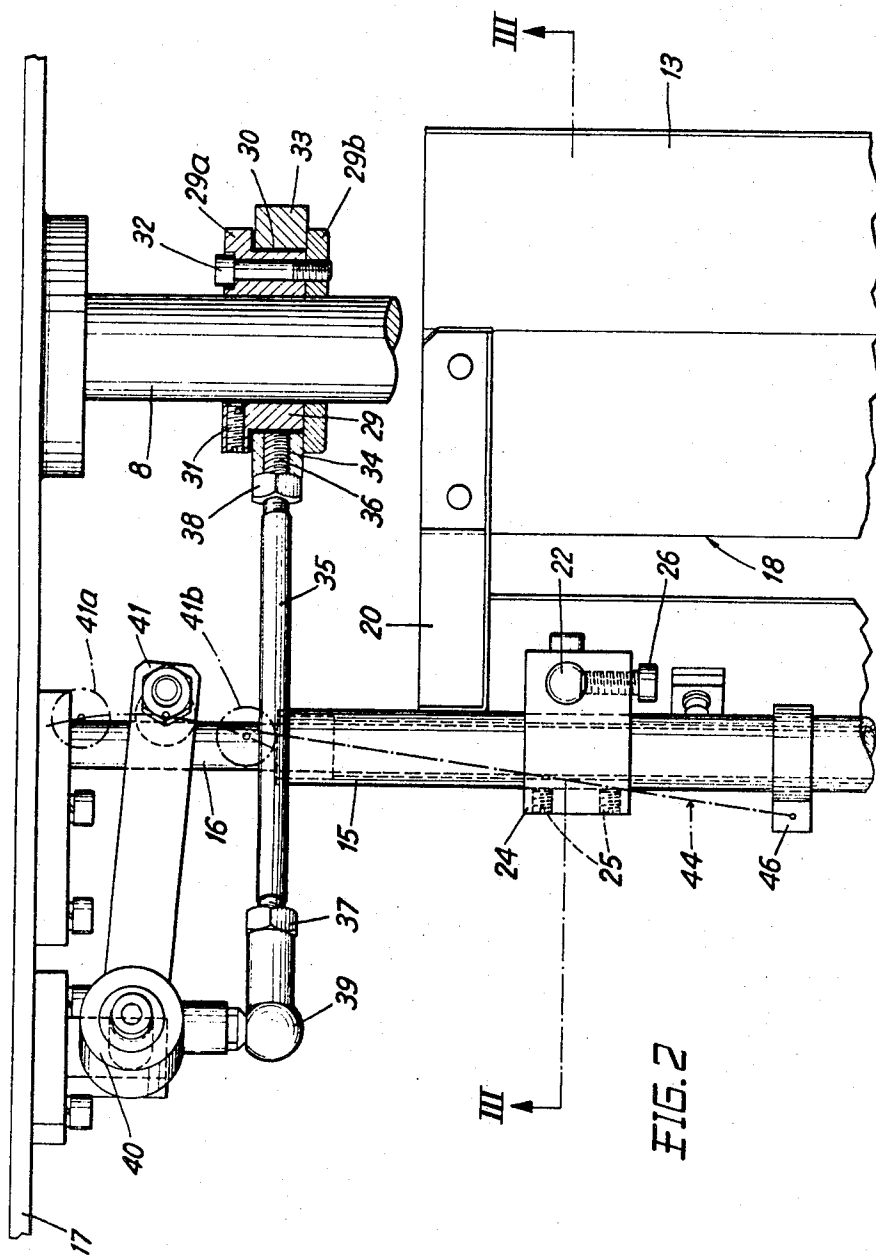


FIG. 2

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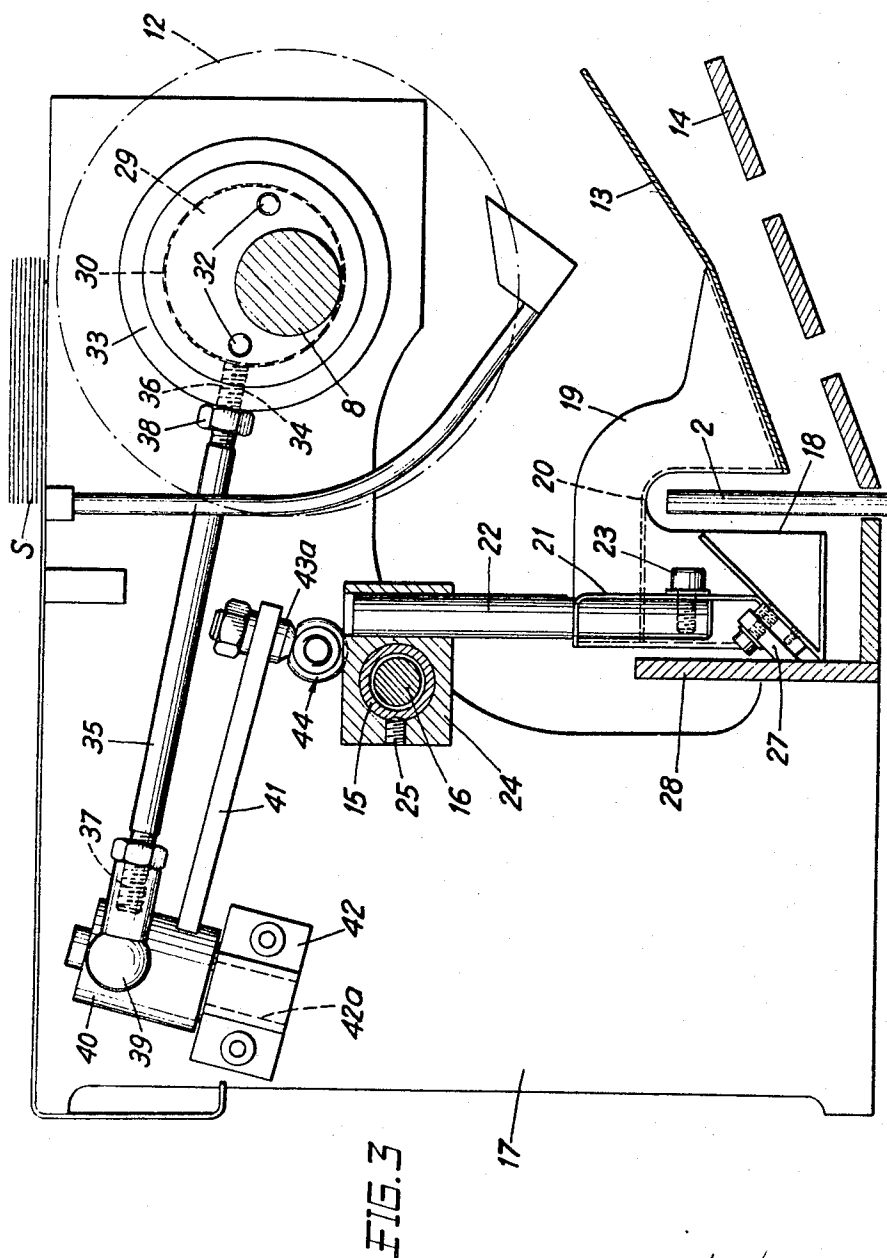
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4 Sheets-Sheet 3



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SHEET FEEDING AND COLLATING APPARATUS

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14 Claims. (Cl. 270—58)

ABSTRACT OF THE DISCLOSURE

A sheet collating machine of the type having a plurality of stations, an intercepting platform at each station and a conveyor adjacent the platforms. The conveyor has an entraining finger which strips sheets off the intercepting platforms. The intercepting platforms are reciprocated parallel to the conveyor whereby a sheet achieves a certain velocity before being contacted by an entraining finger to minimize damage to the sheets.

The present invention relates to improvements in apparatus for feeding paper sheets or the like. More particularly, the invention relates to an apparatus for feeding sheets from one or more sources and for simultaneously assembling such sheets in piles which can be advanced to a sheet binding or another sheet processing machine.

It is already known from the British Patent No. 901,816, of the same inventor, to provide a sheet feeding apparatus with a conveyor having an endless travelling element which receives sheets from a succession of sources through the intermediary of suitable transfer units. Such transfer units withdraw sheets from the respective sources and deposit them on the travelling conveyor element so that the sheets form piles which are thereupon fed on to a further processing station. The conveyor element is provided with sheet entraining portions which engage the sheets and accelerate them abruptly from zero speed to full conveyor speed. The transfer units are capable of withdrawing and transferring sheets at very short intervals; however, their operational speed is limited because, once the speed of the conveyor element exceeds a certain limit, the sheets thereon are likely to be misaligned, deformed, damaged and/or otherwise affected due to abrupt acceleration from zero speed beyond a permissible speed which is well below the maximum operational speed of the transfer units.

Accordingly, it is an important object of the present invention to provide a sheet feeding apparatus wherein the conveyor which receives sheets from one or more magazines or like sources can be operated at speeds which exceed the speed of conveyors in conventional sheet feeding apparatus and wherein such operation at high speeds does not affect the accuracy with which the sheets are deposited and stacked on the conveyor.

Another object of the invention is to provide a sheet feeding apparatus whose output is a multiple of the output of presently known sheet feeding apparatus.

A further object of the invention is to provide a sheet feeding apparatus which can be utilized to assemble piles of single sheets or folded sheets and which can assemble piles consisting of any desired number of sheets.

An additional object of the invention is to provide an apparatus which can be readily adjusted to manipulate larger or smaller sheets, to assemble larger or smaller sheets into larger or smaller piles, and to manipulate such

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sheets without causing wrinkling, tearing or other damage.

A concomitant object of the invention is to provide the sheet feeding apparatus with a safety device which can bring the movable parts to a halt in the event of unsatisfactory operation.

Still another object of the invention is to provide a sheet feeding apparatus which occupies little room, which requires little attention once its parts are set in motion, and wherein the progress of sheets from the respective sources to the machine which receives sheets from the conveyor can be observed by the operators.

Briefly stated, one feature of my invention resides in the provision of an apparatus for feeding folded or unfolded sheets and comprising a magazine or an analogous source of stacked sheets, a conveyor arranged to advance the sheets in a predetermined direction along a predetermined path, an intercepting device which can resemble a platform and is adjacent to the aforementioned path, drive means for reciprocating the intercepting device between a forward position and a rearward position as seen in the direction of movement of the conveyor along the path, transfer means for supplying sheets from the source to the intercepting device while the latter assumes or approaches its rearward position, and entraining members provided on the conveyor at such intervals and in such proximity of the intercepting device that a sheet supplied by the transfer means is stripped off the intercepting device while the latter at least approaches its forward position so that the sheet already travels in the desired direction prior to entering the path.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved sheet feeding apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of a specific embodiment with reference to the accompanying drawings, in which:

FIG. 1 is a front elevational view of a sheet feeding apparatus which embodies my invention;

FIG. 2 is an enlarged view of a detail of the structure shown in FIG. 1;

FIG. 3 is a section as seen in the direction of arrows from the line III—III of FIG. 2; and

FIG. 4 is an enlarged partly sectional view of a safety device.

Referring first to FIG. 1, there is shown a sheet feeding apparatus which comprises a conveyor including an endless flexible element constituted by one or more link chains 1 trained around rollers 3 (only one shown) so that the upper stringer of the chain 1 travels along a horizontal path and in a direction to the left as indicated by the arrow A. The roller 3 of FIG. 1 is mounted via frame 4 and is driven at a constant speed by a prime mover here shown as an electric motor 5. The chain 1 comprises a series of equidistant entraining members 2 which serve to advance piles 70 of sheets onto a take-off conveyor belt 71.

The motor 5 further drives a bevel gear 6 meshing with a bevel gear 7 at one end of a horizontal main shaft 8 which is parallel with the upper stringer of the chain 1 and forms part of drive means for a set of novel intercepting platforms 13a, 13b, 13c disposed at a level above the upper stringer of the chain 1. The main shaft 8 also drives a set of transfer units 9a, 9b, 9c, one for each of the intercepting platforms. The end portions of the shaft 8 are journaled in bearing brackets 17 form-

ing part of the frame 4, and this frame further supports a set of three magazines Sa, Sb, Sc each of which contains a stack of sheets. The transfer units respectively comprise suction cups 11a, 11b, 11c carried by a suction pipe 11 which is rotatable in the brackets 17 and is driven by the motor 5 through the intermediary of a transmission which is not shown in the drawings. One end of the pipe 11 is connected to a suction fan or to another air evacuating device. The pipe 11 is parallel with and is located at a level above the main shaft 8. The transfer units further include groups of so-called gripper drums 12a, 12b, 12c which can receive sheets seriatim from the respective suction cups 11a, 11b, 11c to deliver such sheets to the associated intercepting devices 13a, 13b, 13c. The magazines Sa-Sc can accommodate stacks of folded or unfolded sheets and the suction cups 11a-11c are arranged to remove the lowermost sheet of the respective stack in response to each revolution of the pipe 11.

The drums 12a, 12b, 12c are provided with grippers (not shown) which are actuated by eccentrics in a manner well known from the art of sheet feeding apparatus. These drums rotate continuously and operate in synchronism with the suction cups 11a-11c. The function of cups 11a-11c is to place the lowermost sheets of stacks in the magazines Sa-Sc into the range of orbiting grippers on the drums 12a-12c, and these drums thereupon deliver the sheets onto the respective intercepting platforms 13a-13c. The grippers engage the sheets while traveling at a maximum distance from the chain 1.

The apparatus further comprises a stationary table 14 which is installed between the platforms 13a-13c and the upper stringer of the chain 1. This table can be said to form part of the conveyor because it supports from below such sheets which form the piles 70 and guides the piles on their way onto the conveyor belt 71. The table 14 resembles a grid provided with elongated slots (see FIG. 3) one of which receives successive entraining members 2 when the chain 1 is in motion. This table 14 can consist of a group of metallic bars or strips which are fixedly mounted on the frame 3 and prevent the sheets from coming in direct contact with the links of the chain 1. Of course, the chain 1 may be replaced by one or more belts.

FIGS. 2 and 3 show one of the intercepting platforms which is identified by the numeral 13 and receives sheets from a magazine (indicated at S) through the intermediary of a set of gripper drums marked 12. The drive for this platform 13 comprises the aforementioned motor 5, bevel gears 6, 7, main shaft 8, a guide rod 16 which is parallel to the main shaft 8 and is fixedly mounted in the frame 4, a sleeve-like carrier 15 which is slidably telescoped onto the guide rod 16 and is supportingly connected with the platform 13, a transmission including an eccentric 29 and an annular strap 33, and an actuating device which includes a link train 35, 41, 44 receiving motion from the transmission 29, 33 and serving to transmit motion to the carrier 15. The intercepting platform 13 has an elongated slot 18 for the entraining members 2 of the chain 1. When a member 2 passes through the slot 18, it strips a sheet off the platform 13 and transfers it onto the table 14 for movement along the table toward the take-off conveyor belt 71.

As shown in FIGS. 2 and 3, the rear portion of the platform 13 carries an upwardly extending transverse end wall 19 which is stiffened by a rib 20 and is integral or rigidly connected with the sheet-supporting bottom wall of the platform. This end wall 19 serves as an abutment for the rear edge of a sheet which is delivered by the grippers of the drums 12 and insures that the sheet shares the forward movement of the platform in a direction toward the conveyor belt 71. The platform 13 abuts with one lengthside against a side wall 28 and forms at this lengthside a substantially V-shaped pocket which serves

as a guidance for the sheets from the drums 12 and guides moreover such sheets during forward movement with the platform.

The rear end wall 19 is rigidly connected with a profile member 21 of sheet metal having a horizontal leg provided with a bore for a vertical coupling rod 22. The lower end of the rod 22 is fixedly but adjustably and detachably affixed to the member 21 (and hence to the platform 13) by a screw 23. The upper end portion of the rod 22 extends into a bore provided in a block 24 which is adjustably fixed to the carrier 15 by one or more screws 25. The connection between the block 24 and rod 22 comprises one or more screws 26. On the inclined leg or side of the V-shaped pocket is fixed a plastic member 2F with which the lower edge or lengthside of the platform 13 is supported on the side wall 2 and which member 2F slides along the side wall 28 when the platform is moved forwardly or rearwardly.

As stated above, the drive for the platform 13 includes the main shaft 8 which carries the aforementioned transmission including the two-piece eccentric 29 and the strap 33. The ring-shaped section 29a of the eccentric 29 has a cylindrical peripheral surface for the strap 33 and is connected with the other section 29b by screws 32. One or more screws 31 fix the section 29a to the main shaft 8.

The strap 33 is concentric with the section 29a and has a tapped radially extending bore 34 receiving one end 36 of a first link 35 forming part of the aforementioned actuating means for the carrier 15. The link 35 is held against rotation with reference to the strap 33 by a lock nut 38. The other externally threaded end portion 37 of the link 35 is affixed to a spherical joint 39 which can oscillate a short cylinder 40 having a shaft 42a rotatable in a fixed bearing bracket 42. The cylinder 40 is rigid with a second link 41 which is rockable between the end positions 41a, 41b shown in FIG. 2 by phantom lines and carries a socket 43a connected to a clamp 46 on the carrier 15 by a third link 44 indicated in FIG. 2 by a phantom line but illustrated in greater detail in FIG. 4.

The link 44 constitutes a quick-release coupling or safety device and carries at one end a ball 43 which is free to swivel in the socket 43a of the link 41. The other end of the link comprises a ball 45 whose internally threaded extension meshes with one end 47 of a spindle 49. The ball 45 is received in a socket of the clamp 46 which latter is adjustable longitudinally of the carrier 15 and can be fixed thereto by one or more screws, not shown. This enable the operator adjust the length of strokes of the platform 13, depending on the format of sheets which are delivered by the gripper drums 12.

When the eccentric 29 rotates with the main shaft 8, the link 35 moves back and forth and rocks the cylinder 40 about the axis of the shaft 42a. The cylinder 40 rocks the link 41 which transmits motion to the link 44 whereby the latter reciprocates the carrier 15 along the guide rod 16. The position 41a is the rear end position of the link 41 and corresponds to a rearward position of the platform 13. The forward position of the platform 13 corresponds to the other position 41b of the link 41. While moving from its rearward position to its forward position, the platform 13 advances in the direction of the arrow A and is accelerated by the link 44 so that its maximum speed at most approximates the speed of the chain 1. As a rule, the maximum forward speed of the platform 13 will equal at least half the speed of the chain 1, preferably two-thirds of the chain speed. This insures that a sheet carried by the platform 13 is accelerated and moves in the same direction as the chain 1 prior to being actually stripped by the adjoining entraining member 2 which transfers the sheet onto the table 14 and continues to move the sheet along the table toward the take-off conveyor belt 71.

In accordance with a feature of my invention, the speed of the chain 1, the distance between the entraining mem-

bers 2, the forward speed of the platform 13, and the operation of the transfer unit including the respective suction cups 11a-11c and drums 12a-12c are selected in such a way that the platforms 13a-13c receive fresh sheets when they assume or approach their rearward positions (corresponding to the end position 41a of the link 41) and that an entraining member 2 catches up with the sheet on the respective platform when the latter reaches or approaches its forward position, preferably at the exact moment when the platform is accelerated to a maximum speed which equals at least half the speed of the chain 1 and its entraining members 2. The curve indicating forward acceleration of the platforms 13a-13c resembles a sine wave and the sheets stripped off the platforms by the adjoining entraining members 2 are deposited directly on the table 14 or onto a pile 70 which has been assembled of sheets deposited on the table by the preceding entraining member or members 2. Thus, and if the platform 13 of FIGS. 2 and 3 corresponds to the platform 13a of FIG. 1, the sheets transferred onto the table 14 will come to rest on top of sheets which were removed from the upstream platforms 13c and 13b. The apparatus may comprise one, two, three or more platforms and an equal number of magazines and transfer units. The distance between the platforms 13a-13c and the table 14 will be selected with a view to take into consideration the height of the piles 70, and such distance may be varied by moving the platforms up or down along the respective rods 22 and/or by moving the rods 22 up or down with reference to the blocks 24.

Referring again to FIG. 4, the link 44 comprises a second spindle 53 having a threaded end 48 meshing with an extension of the ball 43 and rotatably receiving one end of the spindle 49. Separation of the spindles 49, 53 will result in closing or opening of a limit switch (not shown) which will arrest the motor 5 so that the apparatus comes to a halt. This will become necessary when the link 44 is subjected to excessive tensional stresses, for example, when one of the platforms 13a-13c is too close to the table 14 and is held against forward or rearward movement by a pile 70.

The spindle 49 has a conical tip 50 which is received in a blind bore of the spindle 53. The latter is provided with a circumferential groove 51 bounded by two conical surfaces and receives portions of two spherical coupling elements 52. These coupling elements further extend into radial bores 54 of the spindle 53. The outer portions of the elements 52 extend into cutouts provided in the internal surface of a cylinder 58 which surrounds the major portion of the spindle 53 and has two conical internal surfaces 59 which urge the spherical elements 52 into the groove 51 under the bias of a helical expansion spring 57 operating between an internal shoulder of the cylinder 58 and an adjusting nut 56 on the spindle 53.

When the link 44 is subjected to stresses tending to withdraw the spindle 49 from the spindle 53, and when the magnitude of such stresses exceeds a value determined by the setting of the nut 56, the right-hand conical surface in the groove 51 forces the spherical elements 52 into the cylinder 58 by causing the elements 52 to bear against the conical surfaces 59 so that the spring 57 contracts and the spindle 49 is free to move to the left, as viewed in FIG. 4, and to actuate the aforementioned limit switch. The conical tip 50 enables the operator to rapidly reinsert the spindle 49 after the apparatus is properly adjusted, for example, by moving one of the platforms 13a-13c upwardly and further away from the table 14.

The nut 56 will be adjusted in order to change the force which is necessary to move the spherical elements 52 radially outwardly prior to separation of the spindles 49 and 53.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly consti-

tute essential characteristics of the generic and specific aspects of my contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is:

1. Apparatus for feeding sheets, comprising a source of sheets; a conveyor arranged to advance the sheets in a predetermined direction along a predetermined longitudinal path; an intercepting device adjacent to said path and reciprocable in a plane substantially parallel to said conveyor between a forward position and a rearward position as seen in said direction; drive means for reciprocating said intercepting device; transfer means for supplying sheets from said source to said intercepting device while the latter at least approaches said rearward position; and entraining members provided on said conveyor at such intervals and in such proximity of said intercepting device that a sheet supplied by said transfer means is stripped off said device while the latter at least approaches said forward position so that the sheet already travels in said direction prior to entering said path.

2. Apparatus as defined in claim 1, wherein said intercepting device is disposed above said conveyor and below said transfer means.

3. Apparatus as defined in claim 1, wherein said drive means is arranged to accelerate said intercepting device during movement toward said forward position to a speed which at most equals the speed of said conveyor and wherein said entraining members are arranged to strip the sheets when said intercepting device attains a maximum speed.

4. Apparatus as defined in claim 3, wherein said maximum speed at least equals half the speed of said conveyor.

5. Apparatus as defined in claim 3, wherein said maximum speed approximates two-thirds of the speed of said conveyor.

6. Apparatus as defined in claim 1, wherein said drive means comprises fixed guide means, carrier means reciprocable along said guide means in and counter to said predetermined direction and connected with said intercepting device, and actuating means for reciprocating said carrier means.

7. Apparatus as defined in claim 6, wherein said conveyor comprises an endless flexible element having a sheet-receiving stringer extending along said path, said guide means comprising a fixed guide rod extending in parallelism with said stringer and said carrier means comprising a sleeve slidably telescoped onto said guide rod.

8. Apparatus as defined in claim 7, wherein said drive means further comprises a main shaft supporting said transfer means and extending in parallelism with said guide rod, a prime mover for rotating said main shaft, and transmission means connecting said main shaft with said actuating means.

9. Apparatus as defined in claim 8, wherein said transmission means comprises an eccentric mounted on said main shaft and a strap mounted on said eccentric and connected with said actuating means.

10. Apparatus as defined in claim 9, wherein said actuating means comprises a link train.

11. Apparatus as defined in claim 6, further comprising at least one additional intercepting device connected with said carrier means and spaced from said first mentioned device in said predetermined direction, an additional source of sheets for said additional device, and additional transfer means for supplying sheets from said additional source to said additional device.

12. Apparatus as defined in claim 11, wherein the total number of said intercepting devices is three and wherein sheets stripped off successive devices are piled on top of each other during travel with said conveyor.

13. Apparatus as defined in claim 1, wherein said drive

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means comprises a prime mover and a quick-release coupling between said prime mover and said intercepting device.

14. Apparatus as defined in claim 13, wherein said drive means further comprises a link train connecting said prime mover with said intercepting device and said quick-release coupling forms part of said link train.

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