

[54] **APPARATUS FOR STACKING SHEETS**
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[51] Int. Cl. **B65h 29/66, B65h 31/38**
[58] Field of Search. **271/DIG. 7, 89, 76, 271/75, 69, 86**

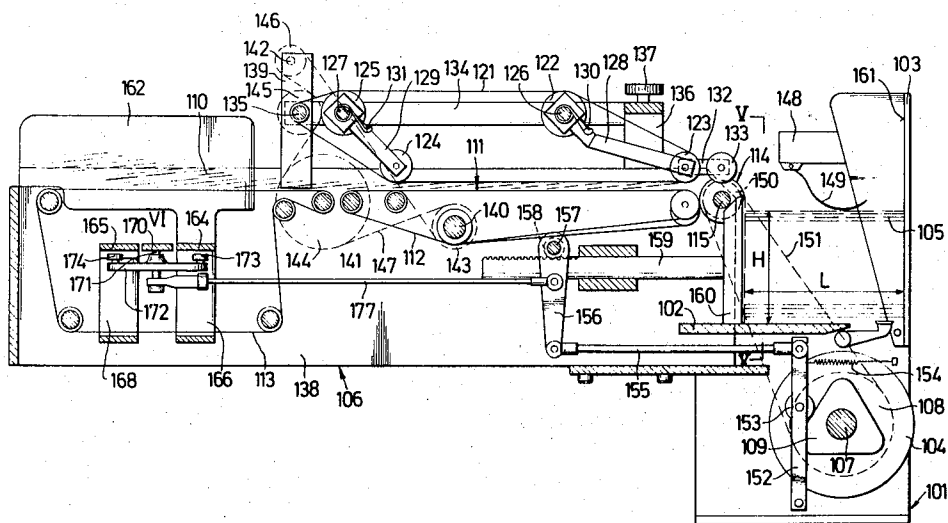
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[57] **ABSTRACT**
A support has an upper supporting surface and an abutment projects upwardly from the supporting surface and has an abutment surface normal thereto. A conveyor feeds sheets onto this support in direction normal to the plane of the the abutment surface, and has a discharge end which is spaced from the abutment surface in the direction of conveyance of the sheets, and which is also located upwardly from the support surface at a level corresponding to the maximum height of a stack to be formed on the support surface. Various arrangements are provided by means of which the sheets can be oriented and centered with reference to one another while on the conveyor and/or while on the support surface. A detector is arranged in the region of the support and includes a detecting element which can move normal to the support surface to and from an upper position located at the aforementioned level. When the member reaches the level it interrupts the main electrical supply circuit for the conveyor drive.

13 Claims, 6 Drawing Figures



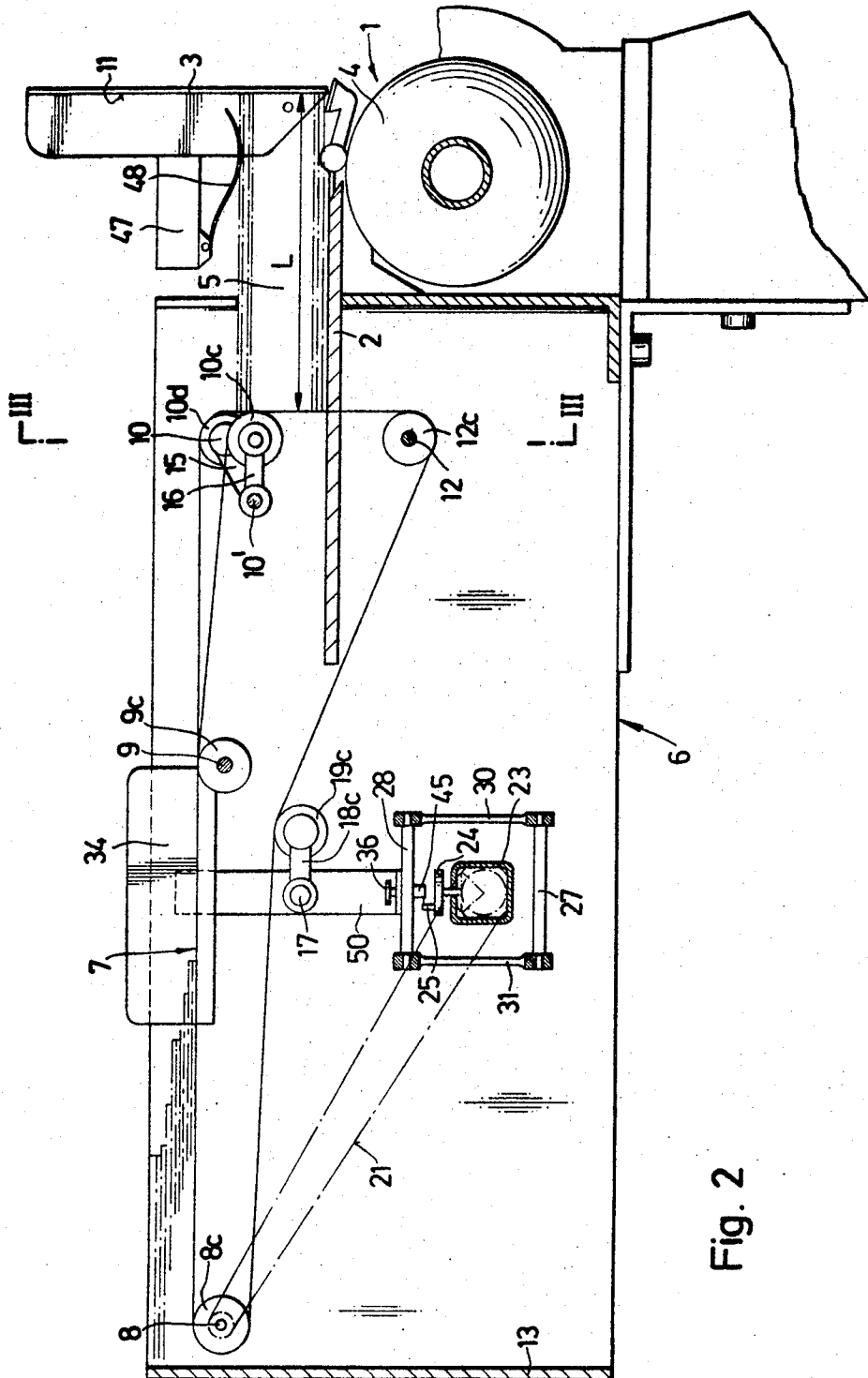
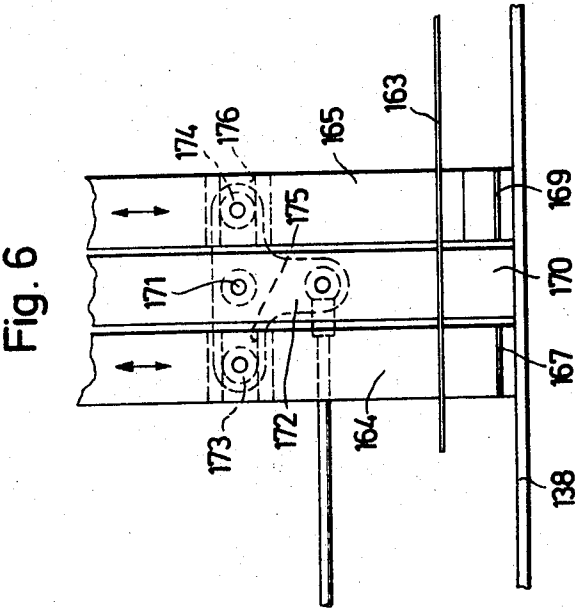
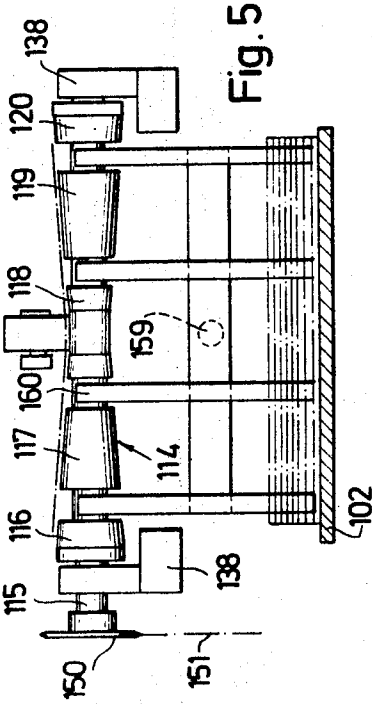
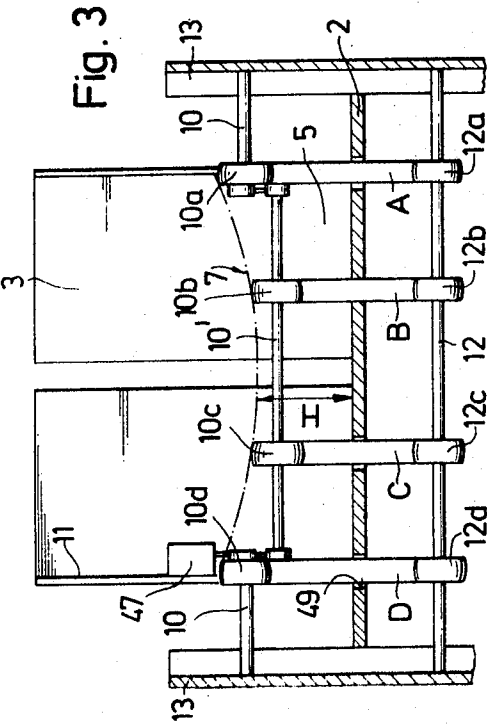


Fig. 2



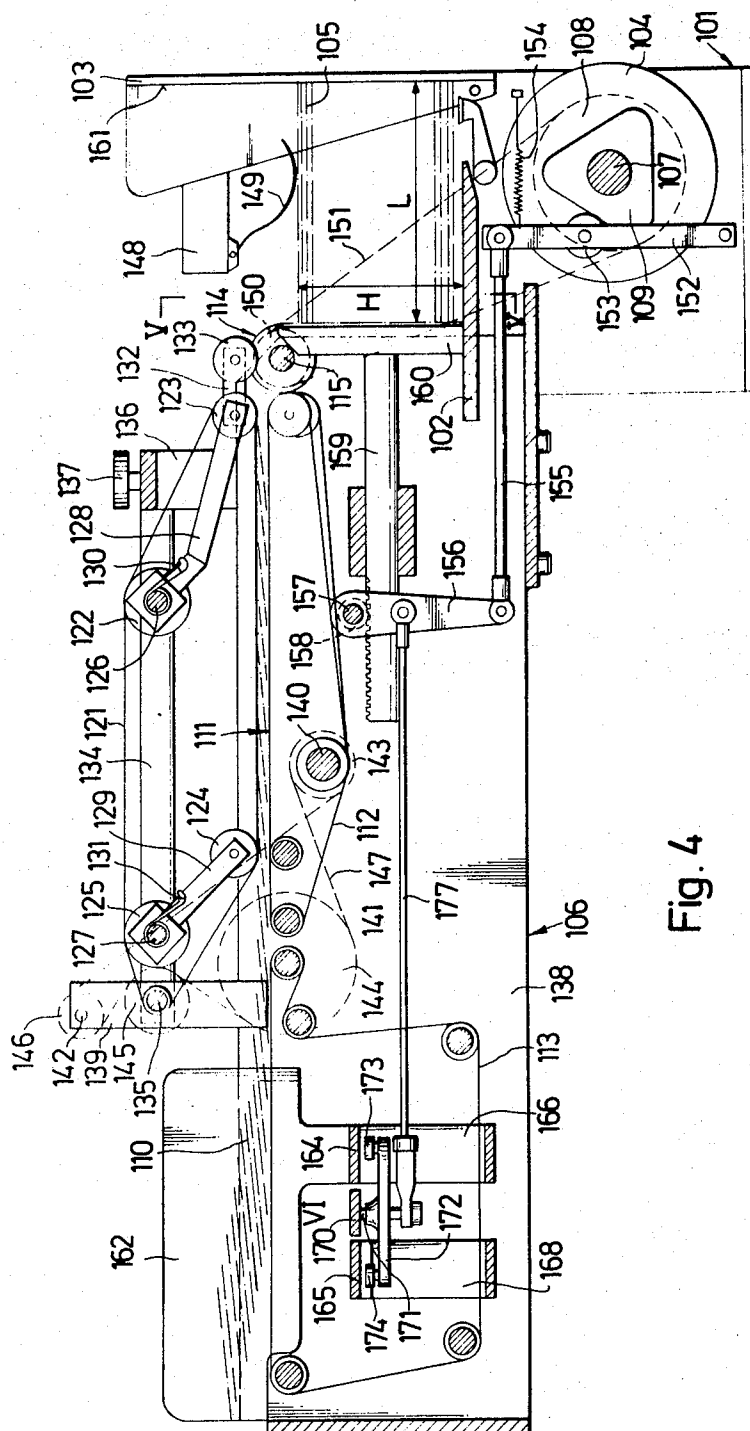


Fig. 4

APPARATUS FOR STACKING SHEETS

BACKGROUND OF THE INVENTION

The present invention relates generally to an apparatus for stacking sheets, and more particularly to an apparatus by means of which sheets can be supplied by a conveyor onto a support on which a stack of such sheets is to be assembled.

Feeders in printing machines are well known. They receive sheets, and the supply of such sheets heretofore has been manually fed. Specifically, the sheets are grasped by an operator in bunches which are flexed to and fro repeatedly so that the individual sheets of the bunch become loosened, that is do not adhere to one another. They are then placed onto the supporting table of the feeder as a stack, and moved against an abutment surface provided so that their edge faces will be located in precisely vertical planes. The feeder then withdraws the sheets sequentially from the stack.

Evidently, this is a relatively slow procedure, and there has long been a need to increase the speed of operation or, even better, to permit automation of the supply of the sheets to the feeder. However, heretofore no such possibility has been brought forth.

SUMMARY OF THE INVENTION

It is, accordingly, a general object of the present invention to provide an apparatus for stacking sheets which overcomes the aforementioned difficulties and which provides the desired advantages.

More particularly it is an object of the present invention to provide such an apparatus which permits an accelerated supply of sheets to form a stack on the feeder, and which is suitable for automation so that the sheets can actually be automatically supplied without requiring any manual aid.

In pursuance of the above objects, and others which will become apparent hereafter, one feature of the invention resides in an apparatus for stacking sheets which, briefly stated, comprises a support having an upper supporting surface and an abutment having an abutment surface extending upwardly from the supporting surface normal thereto. A conveyor is arranged to feed sheets to the support in direction normal to the plane of the abutment surface and has a discharge end spaced from the abutment surface by a first distance and upwardly spaced from the support surface by a second distance so as to be located at a level corresponding to the maximum desired height of a stack of sheets to be assembled on the supporting surface. Orienting means is provided for orienting and centering sheets fed by the conveyor, and a drive is provided for the conveyance. Detecting means is also provided, being located in the region of the support and including a detecting element which is movable in direction normal to the plane of the support surface to and from the aforementioned level, and the detecting means is operative for switching off the drive of the conveyor in response to the detecting element moving to this level.

With the apparatus according to the present invention the difficulties of the prior art are overcome. At most the novel apparatus requires that an attendant supply rough bunches of sheets (that is bunches which have not been flexed and whose edges have not been aligned) and place these onto the conveyor, fanning them out slightly longitudinally of the direction of the movement of the conveyor, an operation which can be

carried out by a single movement of the hand. It is, however, equally possible to utilize the apparatus according to the present invention for automated supply of sheets in that a continuous stream of sheets is automatically deposited on the conveyor which then advances it to the support of the feeder.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a top-plan view, with some parts omitted for clarity and others broken away, illustrating a first embodiment of the invention;

FIG. 2 is a section taken on line II—II of FIG. 1;

FIG. 3 is a section taken on line III—III of FIG. 2;

FIG. 4 is a view similar to FIG. 2 illustrating a further embodiment of the invention;

FIG. 5 is a section taken on line V—V of FIG. 4; and

FIG. 6 is a view of FIG. 4, as seen in the direction of the arrow VI shown in that Figure.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing now the drawing in detail, and firstly the embodiment illustrated in FIGS. 1-3 thereof, it will be seen that reference numeral 1 generally identifies a feeder of a construction which is well known per se to those conversant with the field. The feeder 1 is provided with a support table 2 and an abutment 3 having an abutment surface 11 which extends upwardly and normal to the upper supporting surface of the support 2. A stack 5 of sheets, printed sheets or the like, is to be assembled on the surface of the supporting table 2 as is diagrammatically illustrated by the broken lines in FIG. 2. From this stack the respectively lowermost sheet is removed by a gripper drum 4 in known manner which forms no part of the present invention. It will be appreciated that in order to assure proper withdrawal of these sheets it is essential that the edges of the sheets of the stack 5 will all abut against the abutment surface 11.

The apparatus according to the present invention further comprises a unit 6 which supplies the sheets to the feeder 1, and which is movable and adjustable with reference to the supporting table of the feeder 1.

As the drawing shows, the unit 6 has a rigid frame 13 in which a drive shaft 8 is turnably journaled, whereas a shaft 9 is fixedly mounted in it. The shafts, generally speaking, serve for the support and advancement of a conveyor 7 which will be described in more detail later.

At the lateral sides of the rigid frame 13 there are provided two axially aligned stub shafts 10, and there is further provided a fixed shaft 12 which extends across from one to the other lateral side of the frame 13. A pair of arms 15 are each mounted on one of the stub shafts 10 and have free ends which are connected with one another by a rod, for instance a rod of circular cross section and identified with reference numeral 10'. The rod 10' carries two further arms 16 which are located intermediate the arms 15, each arm 16 being spaced from the associated arm 15 at the same distance

as the other arm 16 is spaced from its associated arm 15. The free ends of the arms 16 are configured as to further axially aligned stub shafts 16a.

Drive rollers, of which four are shown in this embodiment and are identified with reference numerals 8a, 8b, 8c and 8d, are mounted on the shaft 8 for rotation therewith. Similarly, the shaft 9 carries four supporting rollers 9a-9d which are freely turnably journaled on the shaft 9. Reversing rollers 10a and 10d are freely turnably journaled on the respective stub shafts 10, and reversing rollers 10b and 10c are freely turnably journaled on the respective stub shafts 16a. Four additional reversing rollers 12a-12d are freely turnably journaled on the shaft 12, as shown in FIG. 3. The conveyor 7 is in the illustrated embodiment composed of four conveyor belts A, B, C and D each of which is endless and each of which is trained over one set of rollers, that is over the rollers 8a, 9a, 10a and 12a, or over the rollers 8b, 9b, 10b, 12b, and so on. Tension rollers 19 are mounted by means of arms 18 for pivoting movement about a circular rod 17 which is fixedly connected with the frame 13. Each of the arms 18 is associated with a torsion spring 18a which is pretensioned and coaxial with the rod 17, serving to bias the associated roller 18 against the cooperating belt A-D, respectively. The shaft 8 is driven in rotation by a suitable motor 14.

FIGS. 2 and 3 show that intermediate the shafts 9 and 10 the conveyor 7 constituted in this embodiment by the endless belts A-D has a trough-shaped or concave transverse contour line C as shown in FIG. 3 in particular. The discharge end of the conveyor 7 is provided above the upper surface of the supporting table 2, at a distance H from this support surface which corresponds to the maximum desired height of the stack 5. This is the upper level, in other words, to which a stack 5 being formed on the support surface of the table 2, or being maintained thereon, is to be allowed to rise. The discharge end is further spaced by the distance L (see FIG. 2) from the abutment surface 11, this distance L corresponding to the width of the sheets which are to be supplied to the stack.

The device 6 is connected with the device 7 adjustably in such a manner that the distances H and L can be varied. Furthermore, the device 6 can be accommodated to different dimensions of different sheets in that the supporting table 2 is configured as a rake, being provided with slots 49 which are open in the direction towards the device 6 and through which the respective belts A-D pass, as is quite evident from FIGS. 1-3, so that a movement of the device 6 towards or away from the abutment surface 11 is possible.

A chain sprocket 20 is mounted on the shaft 8, being fixed thereto for rotation with the shaft and drives a chain sprocket 22 (which in turn is mounted on the drive shaft of an angle drive 23) via a chain 21. The angle drive 23 is physically connected with the frame 13 and drives a horizontally oriented eccentric disc 24 having an eccentric pin 25. To the latter, a reciprocable rod 26 is pivoted. Also connected to the frame 13 is a horizontal plate 27 and located above the latter, are provided two further plates 28 and 29 which extend in parallel with the plate 27 and whose upper surfaces are coplanar with one another. Parallel articulated pairs of arms 30 and 31 connect the blade 28 with the blade 27 so that it forms with the latter an articulated parallelogram linkage. Similarly, the plate 29 is connected in the

same manner with the plate 27 via the pairs of articulated arms 32 and 33.

Laterally of the conveyor 7 are located centering members 34 and 35 which extend upwardly beyond the upper conveying surface and each of which is provided at its lower region with an angular portion 50 or 51, respectively, by means of which it is supported on the plate 28 or 29, respectively. The portions 50 and 51 are each provided with a longitudinal slot through which a setting screw 36 or 37 passes which is threaded into a suitable bore provided in the respective plates 28 and 29. It will be appreciated that by loosening the screws 36 and 37 the respectively associated members 34 or 35 can be laterally displaced with reference to the conveyor 7, in accordance with differential dimensions of sheets being conveyed.

The undersides of the plates 28 and 29 are each provided with a pivot pin 45 and 46, respectively. A pivot shaft 38 is mounted on the plate 27, extending vertically upwardly intermediate the plates 28 and 29 and carrying in the region of its upper end turnably a triangular plate 39 which in turn has pivot pins 40, 41 and 42. A rod 43 connects the pivot pin 41 with the pivot pin 45, and a similar rod 44 is articulated connected with the pivot pins 46 and 42, respectively. The free end of the rod 26 is articulated to the pivot pin 40 so that when the eccentric disc member 24 is turned, the triangular plate 39 is pivoted to and fro about the pivot axis 38, causing the centering members 34 and 35 simultaneously and symmetrically to be moved towards and away from the conveyor 7. This oscillatory movement of the members 34 and 35 provides for precise centering and orienting of the sheets which are being conveyed on the conveyor 7. Rearwardly of bent edge portions 34a and 35a on the members 34 and 35, facing in upstream direction of the movement of the conveyor 7, assure that even if the sheets are strongly laterally offset on the conveyor 7 (for instance overhanging the latter), proper centering will be achieved.

An end or limit switch 47 of known construction, for instance a microswitch, is mounted on the abutment 3 and provided with a feeler or detecting element 48. The switch 47 is connected in the main supply circuit of the motor 14 and the feeler 48 moves between a lower end position and an upper end position in which latter it is spaced at the distance H from the upper surface of the supporting table 2. When the feeler is in the lower end position it closes the circuit for the motor 14 and when it is in the upper end position it interrupts this circuit. Thus, when only a few sheets are located on the supporting table 2, the feeler 48 will assume its lower end position and the conveyor 7 supplies sheets and deposits them on the table 2. As the stack being formed increases in height, the feeler 48 rises until it achieves the upper end position shown in FIG. 2 at which it is spaced from the upper surface of the supporting table 2 by the distance H. On reaching this end position it interrupts the circuit to the motor 14, so that the latter is shut off and the conveyor 7 comes to a halt. This reliably avoids a back-up of sheets on the conveyor 7 as would otherwise be the case if the advancing sheets were to encounter a stack 5 of excessive height.

In the operation of this embodiment it is of course necessary, in order to ensure a proper operation of the unit 1, that the individual sheets do not adhere to one another. For this purpose a relatively large quantity of sheets are stacked at the rear or receiving end of the

conveyor 7, extending transversely thereof with their leading edge extending transversely of the conveyor 7. This is shown in FIG. 2 in broken lines, from where it is also evident that they are fanned in longitudinal direction of the conveyor 7 by hand, separating the individual sheets from one another.

It will be appreciated, of course, that the sheets could also be supplied in form of a continuous stream of sheets by means of a suitable non-illustrated transporting system which would deposit them on the conveyor 7.

During the advancement of the sheets on the conveyor 7, they are centered and oriented by engagement with the oscillating members 34 and 35, and any further adhesion between consecutive sheets will thereby also be terminated. Such termination of adhesion is also favorably effected by the concave configuration at the discharge end of the conveyor 7, as pointed out before, because this causes the sheets to bend through in the middle and to separate the sheets which might still adhere to one another.

From the discharge end the sheets are expelled onto the surface of the tape 2. As the drawing shows (see FIG. 2) the conveyor 7 has a section which extends intermediate the rollers 10a-10d on the one hand, and the rollers 12a-12d on the other hand, in direction normal to the surface of the table 2 and in parallelism with the abutment surface 11, at the distance L from the latter. Because this distance L corresponds to the width of the sheets being conveyed, the latter are pushed by this vertical section of the conveyor 7 against the abutment surface 11, thereby assuring that the edges of the stack 5 being formed will abut against the surface 11 and that all sheets will be properly oriented with the stack having edges located in vertical planes.

Coming to the embodiment in FIGS. 4-6 it will be seen that here the unit 1 is replaced with the unit 101 having the supporting table 102, the abutment 103 with the abutment surface 161, and the gripper and withdrawing drum 104. The unit 106 replaces the unit 6 of the preceding embodiment and is again connected with the unit 101 adjustably relative thereto. A stack 105 of sheets is shown in broken lines on the table 102 in FIG. 4.

In this embodiment the gripper drum 104 is turnably mounted on the shaft 107, and also mounted on the shaft 107 for rotation therewith is a ball chain sprocket 108 and a cam 109 of the illustrated configuration.

The conveyor is here in form of two sections, being in toto identified with reference numeral 111 and being composed of the sections 112 and 113. The sheets 110 are supplied onto the section 113 which advances them towards the section 112 whose speed of advancement is greater than that of the section 113. The purpose is to assure that as the stream of sheets is supplied from the section 113 onto the section 112, it will be drawn apart in the direction of advancement of the conveyor 111.

As before, the section 112 is composed of four parallel endless belts, and the same is true also of the section 112. Because this has been previously illustrated and described, an additional illustration and description with respect to this embodiment is not believed to be necessary.

Located downstream of the discharge end of the section 112 is an accelerator roller 114 composed, as

shown in FIG. 5, of five accelerator rolls 116, 117, 118, 119 and 120 which are mounted on a shaft 115.

At least in cooperation with the section 112 there is provided a presser belt 121 whose lower run extends in parallelism with the upper run of the section 112 and which is trained about rollers 122, 123, 124 and 125. Of these the rollers 123 and 124 are mounted on arms 128 and 129 which themselves are pivotable about the roller axis 126 and 127 of the rollers 122 and 125. Springs 130 and 131 urge the arms 128 and 129 downwardly, biasing them against the upper run of the conveyor section 112, to thereby press the lower run of the presser belt 121 against it. The free end of the arm 128 carries a member 132 provided with a presser roller 133 which is resiliently biased against the accelerator roller 114.

A frame 134 is provided which is pivotable about an axis 135 and which carries the roller axis or shafts 126 and 127. The formed end portion of the frame 134 rests upon a socket 136 with which it is releasably connected by means of a screw 137 or similar fastening device. A socket 136 in turn is fixed with a frame 138, and the axes 135 is in form of a shaft which is fixed to a pair of sockets 139 (only one visible) which in turn is fixed with the shaft 138.

Roller chain sprockets 143, 144, 145 and 146 are fixedly mounted on the shafts 135, 140, 141 and 142, and a roller chain 147 is trained about these sprockets for driving the sections 112 and 113. A non-illustrated electromotor drives the shaft 141 in rotation and its similarly non-illustrated current supply circuit has interposed in it the switch 148 which is provided with the feeler 149 having the same function and operation as the feeler 48 described with respect to the embodiment of FIGS. 1-3. The accelerator roller 114 is driven via a ball chain sprocket 150 which is mounted on the shaft 115 and driven via the ball chain sprocket 108 by means of a ball chain 151.

An arm 152 is mounted in the support of the unit 101, pivotal about an axis 152a together with a follower roller 153. A spring 151 urges the follower roller into constant contact with the cam 109. A rod 155 is articulated to the arm 152 at one end, whereas the other end of the roller is connected to an arm 156 which is fixed with a shaft 157 turnably mounted in the frame 138 and carrying fixedly thereon a pinion 158. The latter cams with a rack 159 which is mounted for axial displacement and carries at its free end a rake 160 so that, when the shaft 107 turns, the rack 160 will have imparted to it a vibratory to-and-fro movement and will push the sheets of the stack 105 against the abutment surface 161 of the abutment 103.

As before, means is provided for laterally affording orientation and centering of the sheets which are advanced on the conveyor 111. This means is here in form of two centering members 162 and 163 which are located at opposite lateral sides of the section 113. The member 162 is mounted on a flat rod 164 and the member 163 on a similar rod 165. The rod 164 is connected with its opposite ends on two lamellas 166 and 167 which consist of spring steel and whose lower ends are fixed with the frame 138. The rod 165 is similarly mounted on two spring steel lamellas 168 and 169 which are also carried by the frame 138. This mounting permits the rods 164 and 165 to oscillate in direction of the longitudinal axis in the frame 138. A flat rod 170 is mounted intermediate the rods 164 and 165, being

connected to the frame 138 and carrying midway intermediate its ends a pivot 171 on which a T-shaped member 172 is turnably journaled. A pair of rollers 173 and 174 are provided on the member 172 and engage in respective grooves 175 and 176 of the rods 164 and 165. The third arm of the T-shaped member 172 has articulated to it one end of a push rod 177 whose other end is articulated to the arm 156 so that to and fro movement of the arm 156 causes the member 172 to be pivoted to and fro whereby a symmetrical oscillatory movement is imparted to the centering members 162 and 163 which latter will thus provide the desired orientation and centering function for the sheets advanced on the conveyor 111.

In operation of the embodiment in FIGS. 4-6 the sheets are supplied to the trailing end of the section 113 in the overlying manner illustrated in broken lines in FIG. 4. They are transported by the section 113 to the section 112 on which they become deposited. During movement on the section 113 they are laterally centered and oriented. On entering onto the section 112, which advances at a higher speed than the section 113, the stream of sheets is drawn apart in longitudinal direction of the section 112. The concave configuration of the section 112 at the discharge end thereof assures again that any sheets which may still adhere to one another become separated.

As each sheet reaches the discharge end it is pressed by the roller 133 onto the accelerator roller 114 and is flung by the latter onto the stack 105 where it is pushed with the abutment 103 by the rake 160. As the stack 105 grows in this manner, the feeler 149 rises upwardly and, on reaching its upper end position, it operates the switch 148 which de-activates the drive motor for the conveyor 111, so that no further sheets are supplied to the stack. Because the accelerator roller 114 is driven by the shaft 107 and thus continues to turn even when the drive of the conveyor 111 is interrupted, the leading sheet which at the time of interruption of the drive is between the pressure roller 133 and the accelerator roller 114, is still deposited on the stack 105, thus assuring that when the drive of the conveyor 111 is restored subsequently the possibility of malfunction arising from an entrapped sheet between the rollers 133 and 114 is eliminated.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in an apparatus for stacking sheets, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

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 that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention 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 set forth in the appended claims:

1. Apparatus for stacking sheets, comprising a support having an upper supporting surface; an abutment having an abutment surface extending upwardly from said supporting surface normal thereto; a conveyor arranged to feed sheets to said support in direction normal to the plane of said abutment surface, and having a discharge end spaced from said abutment surface by a first distance and spaced by a second distance upwardly from said supporting surface so as to be located at a level corresponding to the maximum desired height of a stack of sheets to be assembled on said supporting surface; orienting means for orienting and centering sheets fed by said conveyor; a first drive for said conveyor; detecting means in the region of said support and including a detecting element movable in direction normal to the plane of said supporting surface to and from said level, said detecting means being operative for switching off said drive in response to said detecting element moving to said level; an accelerator drum rotatably mounted adjacent said discharge end for receiving sheets therefrom and advancing them against said abutment surface; and a discrete second drive for said accelerator drum.

2. Apparatus as defined in claim 1; further comprising varying means for varying said first distance.

3. Apparatus as defined in claim 1; further comprising varying means for varying said second distance.

4. Apparatus as defined in claim 1, wherein said conveyor comprises at least one endless belt; and further comprising varying means for varying at least one of said distances.

5. Apparatus as defined in claim 1, said conveyor comprising at least one endless belt; and said orienting means comprising a belt section located at said discharge end and extending in at least substantial parallelism with said abutment surface.

6. Apparatus as defined in claim 1, said conveyor comprising at least one endless belt having opposite lateral sides; and wherein said orienting means comprises orienting and centering members located at said opposite lateral sides, and actuating means for symmetrically displacing said members transversely of said belt.

7. Apparatus as defined in claim 6, said orienting means further comprising adjusting means for adjusting the spacing of said members with reference to said belt.

8. Apparatus as defined in claim 1, said conveyor comprising at least one endless belt, and said belt having a conveying surface which is of concave contour in transverse direction of said belt and at least in the region of said discharge end.

9. Apparatus as defined in claim 8, wherein said belt is composed of a plurality of parallel, discrete endless belt portions.

10. Apparatus as defined in claim 15, said first drive comprising an electromotor having an energy-supply circuit; and wherein said detecting means comprises a switch controlled by movement of said detecting element and interposed in said circuit for interrupting the same in response to movement of said element to said level.

11. Apparatus as defined in claim 1, said conveyor comprising a downstream section including at least one endless belt and having said discharge end and a receiving end, and an upstream section also including at least one endless belt and adapted to supply sheets onto said downstream section at said receiving end thereof; and

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wherein said drive advances said downstream section at a higher rate of speed than said upstream section.

12. Apparatus as defined in claim 11; further comprising a pressure-exerting belt having a run juxtaposed and moving in parallelism with a conveying surface of at least said downstream section.

13. Apparatus as defined in claim 1, said orienting

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means comprising a rake mounted in the region of said discharge end and movable toward and away from said abutment surface normal thereto and above said supporting surface, for engaging said stack and orienting the sheets thereof relative to one another and to said abutment surface.

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