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[54] STACKING OF SHEETS

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[52] **U.S. Cl.**.....**271/87,** 198/25, 198/33 AD, 214/7

[51] **Int. Cl.**.....**B65h 31/04,** B65g 47/00

[58] **Field of Search**....198/25, 33 AD; 271/87; 214/7

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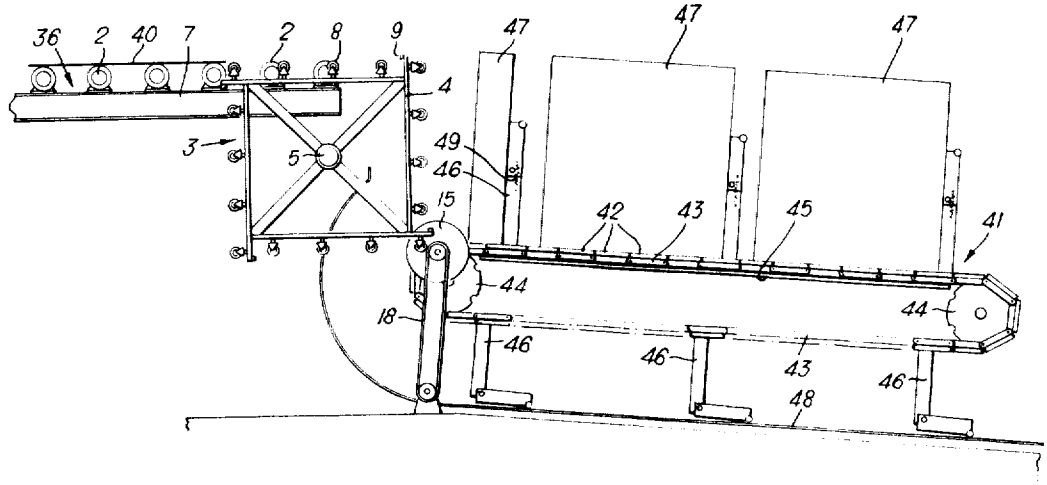
[57] **ABSTRACT**

Apparatus for stacking a succession of sheets generally vertically on a support surface, comprises a sheet carrying face which is presented generally horizontally beneath a sheet to be stacked, and then moved to a substantially vertical position with the sheet. Means are provided to engage the lower edge of the sheet and to carry the lower edge into a desired position on the support surface. The succession of sheets thereby form a stack of sheets, e.g. on a pallet.

11 Claims, 6 Drawing Figures



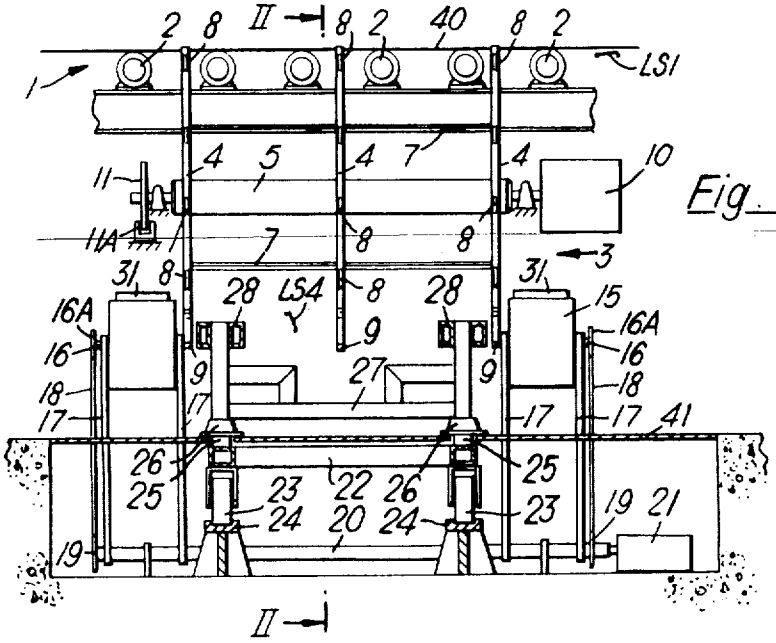


Fig. 1.

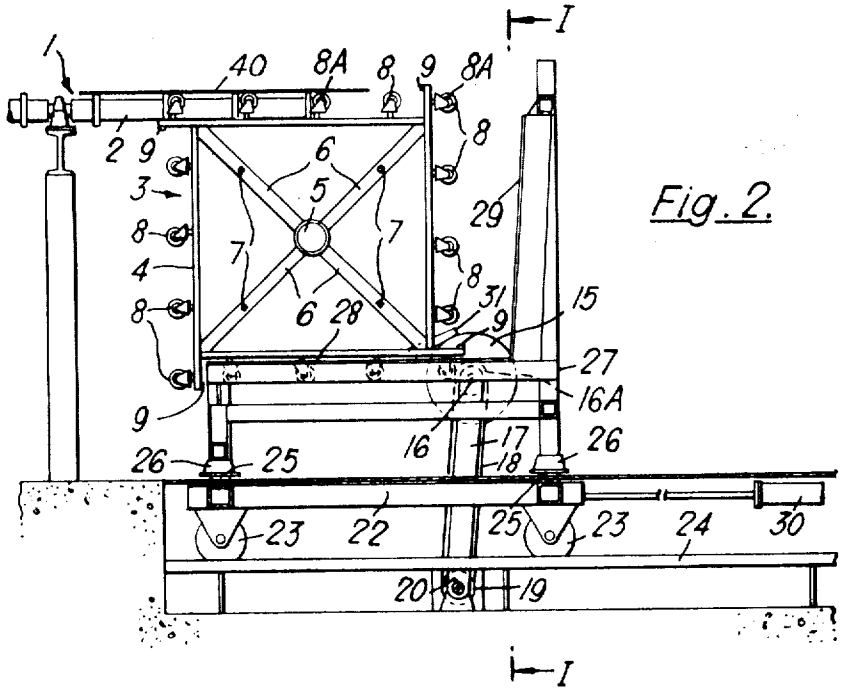


Fig. 2.

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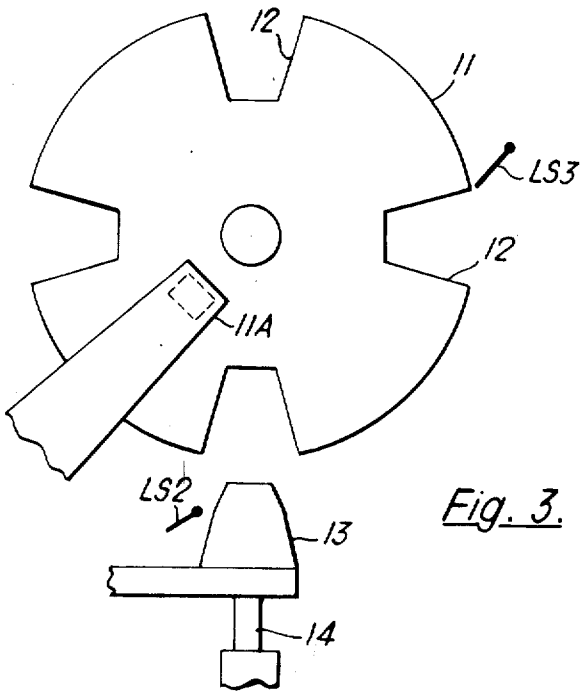

Fig. 3.

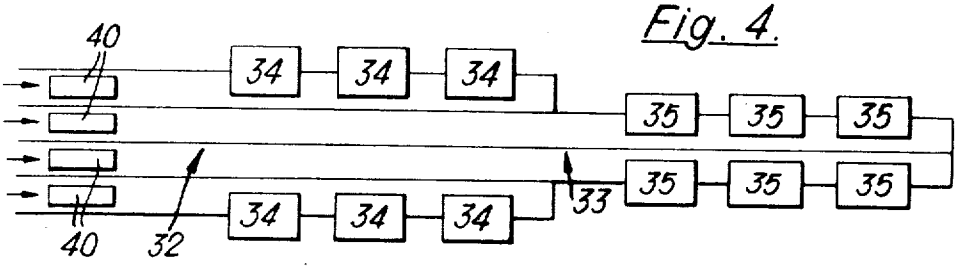

Fig. 4.

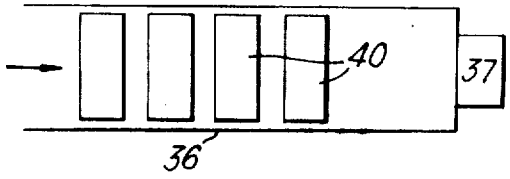

Fig. 5.

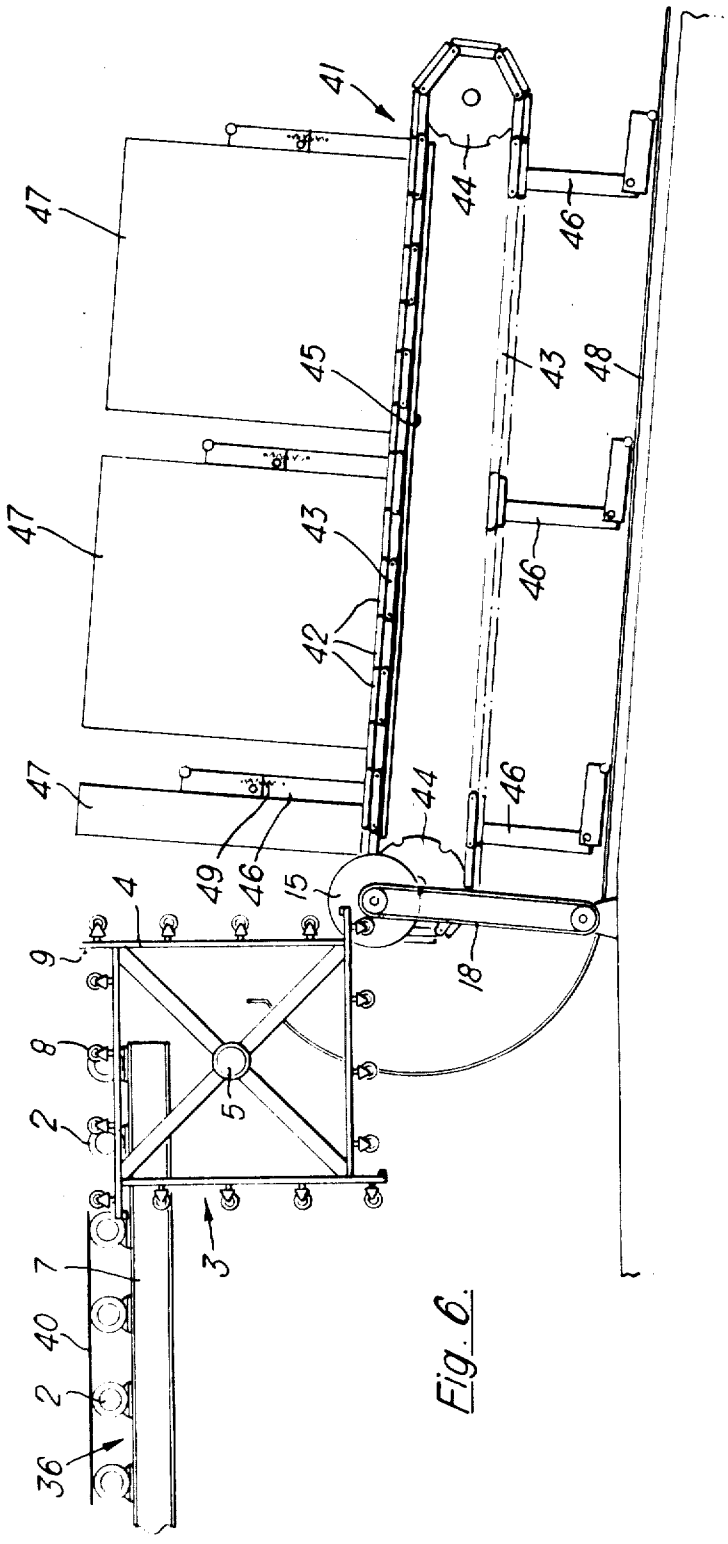

Fig. 6.

STACKING OF SHEETS

BACKGROUND OF THE INVENTION

This invention relates to the stacking of a succession of sheets generally vertically on a support surface.

SUMMARY

According to the invention such apparatus comprises at least one sheet carrying face adapted to be presented generally horizontally beneath a sheet to be stacked, and means for inclining said sheet carrying face first to transfer said sheet into at least a substantially vertical position and then to displace the upper part of the sheet laterally away from the sheet carrying face, which apparatus includes means for engaging the lower edge of the sheet, on inclination of the sheet carrying face, and for positively carrying said lower edge of the sheet into a desired position on the support surface.

The apparatus of this invention may be applied to the stacking of a succession of sheets generally vertically on the base of a pallet, the first sheet to be stacked resting against a slightly backwardly inclined upright member, the apparatus including a trolley for location of the pallet for reciprocal movement towards and away from said sheet carrying face or faces along tracks disposed below floor level, and means for moving said trolley away from said sheet carrying face or faces in steps equal to the thickness of the sheets being stacked.

Alternatively the apparatus may be applied to the stacking of a succession of sheets generally vertically on the surface of a conveyor, the first sheet to be stacked resting against a slightly backwardly inclined upright member or members on the conveyor surface, and means being provided for moving said conveyor in a direction leading away from said sheet carrying face or faces in steps equal to the thickness of the sheets being stacked.

The apparatus may include a conveyor for delivering a succession of sheets to one or more off-loading stations, and at least one said sheet carrying face disposed at the or each said off-loading station for receiving each sheet in turn delivered thereto and for stacking said sheets in a generally vertical, closely assembled order on a respective support surface.

The invention also provides a method of stacking a succession of sheets generally vertically on a support surface, comprising presenting each sheet in turn to a sheet carrying face or to one of a series of sheet carrying faces disposed generally horizontally beneath the sheet, inclining the sheet carrying face and thereby transferring said sheet into a substantially vertical position, displacing the upper part of the sheet away from the sheet carrying face, and engaging the lower edge of the sheet by means which positively carry the lower edge of the sheet into a desired position on the support surface.

The above method may include the step of indexing the support surface away from said sheet carrying face between the deposition of each sheet on the support surface, by an amount equal to the thickness of the sheets being stacked.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a section along line I—I in FIG. 2 of apparatus, by way of example, for off-loading and stacking glass sheets;

FIG. 2 is a section along line II—II in FIG. 1;

FIG. 3 is a detailed view of part of the stacking apparatus of FIG. 1;

FIG. 4 is a schematic plan view of a sheet handling system;

FIG. 5 is a schematic plan view of a further sheet handling system; and

FIG. 6 is an elevation of another apparatus for off-loading and stacking glass sheets.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 to 3, a roller conveyor 1 comprises a series of parallel horizontal tyred rollers 2 which are driven to convey glass sheets 40 in spaced succession along a horizontal path. At a position along the roller conveyor is an off-loading station at which sheets can be off-loaded and deposited to form a stack on a pallet 27, the sheets lying vertically, or near vertically, in the stack.

At the off-loading station is a transfer device, generally indicated by the reference 3, which is operative to lift a sheet 40 from the roller conveyor 1 and move it into a substantially vertical position. The device 3 comprises three spaced generally square frames 4 mounted vertically on a shaft 5 by means of diagonal struts 6 (FIG. 2), the frames 4 being connected one to another by horizontal struts 7. The transfer device 3 thus comprises a structure of cuboid form which effectively has four sheet carrying peripheral faces. The frames 4 have rollers 8 mounted on their peripheral faces, i.e. each of the sheet carrying faces of the transfer device has rollers 8 mounted for rotation about axes parallel to the axis of the shaft 5. Further, as can be seen from FIG. 2, each side of each frame 4 projects at one end beyond one of the adjacent sides and carries a stop 9 which is aligned with the rollers 8 of said one adjacent side so that a sheet resting on the rollers of one sheet carrying face can have one edge abutting the respective stops 9.

In this example, each of the rollers 8 has an associated anti-reverse device 8A (see FIG. 2) such that the roller can rotate only in the direction appropriate to movement of a sheet towards the respective stops 9. The devices 8A comprise free-wheel devices of known form and serve to avoid the possibility of a sheet failing to be properly collected by a sheet carrying face of the transfer device during initial acceleration of the device due to movement of the sheet relative to the sheet carrying face in a direction away from the stops 9.

The shaft 5, whose axis is horizontal and parallel to the path of the roller conveyor, is driven by a suitable drive motor 10 to rotate the transfer device 3 about the shaft axis. Carried by the shaft 5 is a disc 11 against which a disc brake 11A acts for a purpose described later. The disc 11 has cut-outs 12 (FIG. 3) spaced apart around its periphery into which a locking member 13 can be inserted to lock the disc 11, and hence the transfer device 3, at a desired position, which in this example is after rotation of the transfer device through 90°. The locking member 13 can be actuated by means of a hydraulic ram 14.

The size of the transfer device 3, and the level of the shaft 5 below the roller conveyor, is such that when the device 3 is in the position shown in FIGS. 1 and 2 the rollers 8 on the uppermost face are just below the level

of the rollers 2, each frame 4 being vertically positioned between a pair of adjacent rollers 2 of the roller conveyor 1 as shown in FIG. 1. Thus, as the device 3 is rotated it can lift a sheet from the roller conveyor, the sheet being received on the rollers 8 of the operative sheet carrying face.

A pair of rollers or wheels 15 is positioned with one wheel adjacent each end of the transfer device with respect to the length of the shaft 5, and disposed substantially beneath the outer side sheet carrying faces of the transfer device at a level such that the projecting parts of the transfer device carrying the stops 9 pass between the wheels 15 as the device is rotated. The wheels 15 are carried on respective horizontal shafts 16 rotatably mounted in support bars 17. Each shaft 16 carries a sprocket 16A about which passes an endless chain 18. The chains 18 pass round respective sprockets 19 on a common drive shaft 20 which is driven from a suitable drive motor 21. Thus the drive from the motor 21 effects rotation of the wheels 15, the rotation being in a clockwise direction as viewed in FIG. 2, and about an axis parallel to the axis of the shaft 5. Each roller 15 is formed of resilient material, or at least has a resilient rim, to provide a cushioning effect on the lower edge of the sheet 40 being transferred to the stack, firstly to reduce the shock to the glass and secondly to assist the driving effect of the rollers towards the stack.

The precise position for the rollers 15 with respect to transfer device will be determined, in practice, according to the size and thickness of the sheet 40 being transferred. However, it is to be appreciated that if the rollers are positioned so that the lower edge of the sheet engages the rollers in the vertical plane of the axis of the rollers, the rotary movement of the rollers will tend to bounce the sheet towards the stack. Such a condition may be allowable in the case of small sheets to increase the rate at which the sheets are stacked, but is undesirable with larger sheets, since as it will be appreciated the direction of movement of the sheets is changed instantaneously by the wheels 15 from a substantially downward direction to a substantially forward direction. At least in the case of larger sheets, it is preferred to position the wheels 15 so that they are engaged by each sheet at a point behind the vertical plane of the axis of the rollers, with the sheet sill inclined backwardly from the vertical. The rollers will thereby catch the sheet and move it to its stacking position whilst remaining in contact with the sheet. However, the position of contact between the sheet and the wheels must not be so far behind the vertical that the sheet will not move forwardly with the wheels.

If desired, the wheels 15, as viewed in FIG. 1, may be disposed on the same horizontal axis as before but inside the adjacent outer frame 4 of the transfer device. This means that, in use, the wheels 15 contact the lower edge of each sheet 40 nearer the center of the sheet instead of adjacent the ends of said leading edge, and thereby minimizes bowing of the sheet while it is being transferred by the rollers 15 to its position in the stack. This is advantageous since undue bowing of the sheet causes the sheets to form a stack having the lower edges of the sheets spaced apart.

The apparatus further includes a trolley 22 supported on wheels 23 which can run along horizontal tracks 24 extending in a direction orthogonal to the axis of rotation of the transfer device 3. The trolley 22 carries upwardly projecting supports 25 on to which can fit recessed feet 26 of the pallet 27 on which the glass sheets 40 are to be stacked. The pallet 27 is of well known form having substantially horizontal base parts 28 and a substantially vertical (e.g. inclined at about 3° to the vertical) back rest 29. As can be seen from FIGS. 1 and 2, in this example the trolley 22 runs in a pit below floor level 41, so that the pallet 27 can conveniently be deposited on the trolley or lifted therefrom by means of a fork lift truck. The trolley 22, and hence the pallet it is carrying, can be moved horizontally along the tracks 24 by means of a double-acting hydraulic drive 30. This drive is capable of inching the trolley and hence the pallet, at least in the direction leading away from the transfer device 3, in short distance increments which are in practice equal to the thickness of the sheets 40 to be stacked. A time delay is provided in the control means so that the inching steps of the trolley away from the transfer device are effected immediately following the stacking of a further sheet 40 by the wheels 15. In the case of the alternative embodiment described above, in which the wheels 15 are disposed inside the outer frames 4 of the transfer device, the upwardly projecting supports 25 of the trolley 22 are likewise disposed inwardly of the wheels 15.

The cycle of the stacking apparatus will now be described, commencing with the situation where the transfer device 3 is locked by the member 13 in the position shown in FIGS. 1 and 2.

A sheet 40 conveyed by the roller conveyor 1 comes to rest over the transfer device 3, i.e. at the position shown occupied by the sheet 40 in FIGS. 1 and 2. The transfer device 3 is unlocked by operation of the ram 14 to retract the locking member 13 from the respective cut-out 12, and is then rotated in a clockwise direction as viewed in FIG. 2. On such rotation, the rollers 8 on the upper horizontal sheet carrying face of the transfer device 3 lift the sheet 40 from the rollers of the roller conveyor 1, and, as the rotation continues and that face becomes further inclined, the sheet by its own weight runs on the rollers 8 until its leading edge abuts the respective stops 9. On continued rotation of the transfer device 3 the outer parts of said leading edge of the sheet 40 come into engagement with the wheels 15, the length of the sheet being greater than that of the cuboid device 3. The wheels 15 are, at this stage, being rotated by the motor 21 in a clockwise direction as viewed in FIG. 2. The moving peripheries of the wheels 15 then carry the leading or lower edge of the sheet 40 engaged thereby towards the back rest 29 of the pallet 27 and gently deposit the lower edge of the sheet at the required position on the base parts 28 of the pallet. The speeds of rotation of the transfer device 3 and of the wheels 15 are such that the sheet 40 moves as a body towards the back rest 29 of the pallet, i.e. the top and bottom edges of the sheets move towards the back rest 29 away from the transfer device 3 at essentially the same time, the lower edge being carried on the wheels 15 and the top edge being caused to move in said direction by the rotating action of the transfer device. After the sheet is deposited substantially vertically on the pallet, the trolley 22 is moved by a distance equal to

the thickness of one sheet in a direction away from the transfer device **3** so that the pallet is then correctly located for receipt of a further sheet. Rotation of the transfer device **3** is stopped when the device has rotated through **90°** from its initial position by operation of the ram **14** to insert the locking member **13** in the following recess **12** in the disc **11**, the transfer device thereby being locked in this new position. A second cycle can then commence to transfer a further sheet from the roller conveyor **1** on to the pallet **27**, and in this way a stack of sheets is built up on the pallet, each sheet being deposited with its lower edge lying closely adjacent the lower edge of the preceding sheet due to the action of the wheels **15** and the indexing movements of the pallet **27**.

When the stack on the pallet is complete i.e. contains a desired number of sheets, the hydraulic drive **30** acts to move the trolley **22** and the pallet **27** clear of the transfer device **3**. The loaded pallet is then removed and replaced by an empty pallet which, by means of the drive **30**, is moved into an appropriate position relative to the transfer device **3**.

The purpose of the disc brake **11A** mentioned previously is to prevent the transfer device **3** over-riding its drive motor **10** as it rotates. It will be appreciated that the weight of a sheet carried on the transfer device, and in particular the momentum of a sheet as it abuts the respective stops **9**, will tend to cause acceleration of the transfer device. The disc brake **11A** acts to oppose any such acceleration and to hold back the transfer device so that its movement is kept under control of its drive.

Preferably the motor **10** is arranged positively to drive the transfer device **3** through an arc slightly less than 90°, e.g. through 89°, and the final angular movement of the device, e.g. the last 1°, is effected by insertion of the locking member **13** in the appropriate precess **12** of the disc **11**. The locking member is provided with inclined surfaces as shown which can bear against the recess defining surfaces of the disc **11** and effect such a small angular movement. The purpose of this expedient is to avoid any risk of the transfer device over-running beyond the required 90° indexing step.

The above described cycle of operation of the apparatus is controlled by suitable limit switches or the like. Thus, for example, a limit switch **LS1** associated with the roller conveyor is tripped by the sheet **40** to stop the conveyor drive so that the sheet comes to rest in the correct position over the transfer device **3**. In practice, the conveyor may be arranged to bring the sheet to rest by more than one, e.g. two, deceleration stages. The limit switch **LS1** also actuates retraction of the locking member **13**, which action trips a further limit switch **LS2** (FIG. 3) effective to start the drive of the motor **10** to rotate the transfer device **3**. The drive to the transfer device **3** is cut off responsively to the tripping of a switch by a part of the rotating device, for example a switch **LS3** (FIG. 3) tripped by the disc **11**. The switch **LS3** also effects reengagement of the locking member **13** with a cut-off **12** in the disc **11**. The inching drive to the trolley **22** is actuated by a limit switch **LS4** tripped by a sheet as it is deposited on the pallet and is cut off by reverse tripping of the switch **LS4** as the sheet clears the latter when the drive has inched the pallet through a distance equal to the thickness of one sheet.

The wheels **15** may be driven by the motor **21**, intermittently in time relationship with the rotation of the transfer device **3**, the wheels being already rotating when the lower edge of a sheet is received thereon and the drive thereto being cut off after the sheet has been correctly deposited on the pallet. Alternatively the wheels **15** may be continuously driven.

Stop elements **31** (see FIG. 2) fixed to the stationary framework of the apparatus, may be associated with the wheels **15** as a positive means to overcome any tendency for the lower edge of the sheet **40** being stacked to engage the wheels **15** and then to move away from the back rest **29** of the pallet. It will be appreciated that any such movement of the sheet **40** would disrupt the operation of the apparatus.

In the mode of transfer of a sheet as described above, the sheet moves bodily from the transfer device on to the pallet, i.e. the top and lower edges of the sheet move away from the transfer device at essentially the same time. If preferred an alternative mode of transfer may be adopted whereby the lower edge of the sheet is first carried into engagement with the base parts **28** of the pallet by the wheels **15** while the top edge of the sheet remains supported against the transfer device, the top edge then being moved by the pushing action of the transfer device after the lower edge has already been deposited on the base parts of the pallet. This mode of transfer can be achieved by suitable adjustment of the speeds of rotation of the transfer device and the wheels **15**, and/or the angle of the sheet carrying face of the transfer device when the lower edge of the sheet first engages the rollers **15**. In another possible mode of transfer, the top edge of the sheet can be pushed towards the back rest of the pallet first and the bottom edge carried over by the wheels **15** afterwards. In this case, it is preferable to provide buffer pads fixed to the framework of the apparatus which are struck by the top edge of the sheet, when it has moved away from the transfer device, the top edge of the sheet moving downwardly when the lower edge of the sheet is transferred on to the base parts of the pallet and thereby clearing the pads. This mode of transfer can also be achieved by suitable adjustment of the speeds of rotation and the angle of the sheet carrying face as mentioned above, and may be further assisted by connecting the drive to the wheels **15** only after the top edge of the sheet has been pushed over.

As can be seen from FIG. 2, the edge of the roller conveyor, i.e. the right hand end of the rollers **2** as viewed in that Figure, lies substantially vertically above the axis of rotation of the transfer device **3**. This provides an optimum arrangement for lifting of a sheet from the roller conveyor since it permits the sheet to be lifted clear of the rollers **2** as rotation of the device **3** commences. However, if it is desired that the roller conveyor should extend further over the transfer device, i.e. beyond the vertical plane passing through the axis of rotation of the transfer device, the part of the roller conveyor extending beyond said plane may be inclinable to the horizontal. This part of the conveyor can then be inclined downwardly when the transfer device is rotated to enable satisfactory lifting of the sheet from the conveyor rollers to be achieved.

In a modified form of the described apparatus the wheels **15** can be replaced by endless belts having a top

pass inclined to the base parts **28** of the pallet **27** so as to deliver the lower edge of a sheet on to the pallet.

It will be appreciated that a sheet handling system may incorporate a number of off-loading stations of the form described above. FIG. **4** schematically shows, by way of example, an arrangement comprising a conveyor **32** arranged to convey sheets in groups of four in line abreast, the conveyor having a narrow portion **33** adapted to convey two sheets in line abreast towards its downstream end. Three off-loading stations of the form described above and indicated in FIG. **4** by reference **34** are provided on each side of the main portion of the conveyor **32** and three further stations **35** are provided on each side of the extension portion **33** of the conveyor. The stations **34** are thus located to off-load the outer sheets of each group of four sheets and the stations **35** on the extension portion **33** are suitably located to off-load the two inner sheets of the said group of four sheets. Three off-loading stations are provided for each sheet and for each following sheet in the same line so that one station can be reserved for reject sheets, and another station can be operatively off-loading while the third station is having a pallet on which sheets have been stacked removed and replaced by an empty pallet. Thus the provision of three stations for each line makes continuous operation possible.

In the embodiment described previously the transfer device **3** rotates about a horizontal axis disposed parallel to the direction of conveying by the roller conveyor. A similar off-loading arrangement could be used at the end of a conveyor with the transfer device **3** arranged to rotate about a horizontal axis orthogonal to the direction of conveying by the conveyor. FIG. **5** schematically shows such an arrangement, the conveyor being indicated as **36** and the off-loading station as **37**. It will be appreciated that with this arrangement the need for each sheet to come to rest on the conveyor over the transfer device can be avoided, since the direction of off-loading is a continuation of the conveying path. Thus, provided the spacing between successive sheets is sufficient, the transfer device can be rotated through 90° after receipt of one sheet in readiness for receipt of a further sheet within the time between receipt of successive sheets, and the conveyor can be driven continuously.

Alternatively, the conveyor **36** and the transfer device **3** at the off-loading station **37** may be driven at different speeds, either by separate drive means or by a single drive means connected to the conveyor and the transfer device by appropriate variable speed drives. Hence, the speeds of the conveyor and the transfer device are adjustable, either as a unit or individually. The system is thereby adaptable for stacking sheets of different sizes, i.e. different lengths longitudinally of the conveyor.

Referring to FIG. **6**, there is shown a similar embodiment to the one described above with regard to FIG. **5**, in which the transfer device **3** is positioned at the end of a conveyor **36** for stacking each sheet in turn as it flows off the end of the conveyor, i.e. the sheet carrying faces of the transfer device comprise temporary extensions of the conveyor.

The transfer device **3** is of the same general construction and operates in the same manner as the device shown in FIGS. **1** and **2**, except that the central frame **4** is omitted and the two end frames are disposed outside the ends of the end roller **2** of the conveyor **36**. Also, in this embodiment, the wheels **15**, as mentioned above as an alternative embodiment, are disposed in between the frames **4** of the device **3**.

Also, the trolley **22** is replaced by sheet support means **41** comprising an endless succession of cross-members **42** attached to a pair of spaced apart chains **43**. These chains **43** each comprise a succession of rigid links and are driven by sprocket wheels **44**, the upper passes of the chains, in this example, resting on tracks **45** to maintain the cross-members flat in a single downwardly inclined plane. The drive to the sprocket wheels **44** is capable of being operated in steps equal to the thickness of one sheet **40**, in like manner to the drive for the trolley **22** in the embodiment of FIGS. **1** to **3**, but is also capable of faster movement between the formation of two stacks. At intervals around the support means **41** are uprights **46**, disposed in pairs of threes (only one of which is shown) across the support means, which uprights act in turn in the same manner as the back rest of the pallet shown in FIG. **2**. When each support and its appropriate stack **47** arrives at the far end of the path of the support means, with respect to the transfer device, the stack is delivered from the support means onto a waiting pallet (not shown), or alternatively directly onto a pair of spaced apart L-shaped brackets to which the stack is then strapped for transport of the stack to a customer. The construction of these L-shaped brackets is described in U.S. Application No. 57,929.

As shown in FIG. **6**, each upright **46** is capable of being folded by a guide **48** during its passage along the lower pass of the chain driven support means, the upright being extended again by a spring **49** before it is employed to support a stack of sheets.

In use, a set of the sheets **40** to be stacked are conveyed to the transfer device **3** and then there is a gap before the arrival of the next set of sheets, each set comprising the number of sheets required in the respective stack. This procedure enables the apparatus to operate continuously with the gaps between the sets synchronized to the movement of further uprights **46** into position for supporting the next stack. Whilst one stack is being formed, the stack at the far end of the support means **41** is being unloaded therefrom.

Regarding any of the embodiments, described above, the sheet carrying faces of the cuboid may, instead of comprising rollers over which a sheet can run, be adapted to permit sliding movement of a sheet over the face, and may have associated means effective to produce an air cushion between the sheet and the sheet carrying face so as to provide an air bearing for such movement.

Furthermore, the polygonal transfer device **3** may comprise a structure having a cross-section of an equilateral triangle instead of a square. In such a case, for each stacking cycle, the transfer device would be rotated through 120°, this movement either being effected in two stages, i.e. through 90° to permit stacking of a sheet and then 30° to position the next aperture sheet carrying face, or in one stage only, the speed of rotation of the transfer device being selected to suit the circumstances and to avoid excess speed of movement of the sheet being stacked. The invention is thus not

restricted to a transfer device having any particular number of sheet carrying faces, although four such faces are preferred.

It will be appreciated that the apparatus described above provides a relatively simple system for stacking sheets, preferably glass sheets, in which the sheets are off-loaded from a horizontal conveyor and, through the agency of the transfer device and its associated feed wheels or belts, are stacked close together in a substantially vertical position directly on support means which may be a pallet. This compares advantageously with many previously proposed stacking systems in which the sheets are first formed into a horizontal stack which then has to be tipped to locate the sheets in a vertical position, which is the position in which they are normally required to be transported.

We claim:

1. Stacking apparatus for stacking a succession of sheets generally vertically on a support surface, which apparatus comprises:

rotary stacking means for receiving and transporting a sheet,

said rotary stacking means being rotatably mounted and having at least one sheet carrying face arranged to move around an axis of rotation from a generally horizontal loading position above the axis of rotation whereat a sheet may be loaded onto the stacking device from a conveyor to a substantially vertical unloading position,

said rotary stacking means further including means operatable to maintain a sheet on said sheet carrying face during inclination of said sheet carrying face, and

said rotary stacking means being returnable to the loading position by continued rotation in the same direction,

drive means for repeatedly rotating said rotary stacking means in a predetermined direction around the axis of rotation,

support means lower than the axis of rotation adjacent the unloading position of the sheet carrying face, for receiving a sheet in a substantially vertical position, and

transfer means adjacent a lower edge of the sheet carrying face when in the unloading position, for engaging a lower edge of a sheet as it is unloaded and for carrying said lower edge away from the sheet carrying face into a desired position on the support surface.

2. Apparatus according to claim 1, wherein said transfer means comprise roller means disposed adjacent said desired position on the support surface, means being provided for driving said roller means in the direction in which the said lower edge of the sheet is to be carried.

3. Apparatus according to claim 1, wherein said sheet carrying face comprises a rolling surface and said further included means includes stop means for engaging said lower edge of the sheet and for limiting relative sliding movement between the sheet and the sheet carrying face during inclination of the sheet carrying face.

4. Apparatus according to claim 3, wherein said sheet carrying face comprises rollers each having an associated anti-reverse device such that the rollers can rotate only in the direction for movement of the sheet to be stacked towards said stop means.

5. Apparatus according to claim 1, including means for halting rotation of the stacking device when said sheet carrying face is in the unloading position, said halting means being releasable to allow movement of the sheet carrying face into its horizontal position for reception of another sheet.

6. Apparatus according to claim 1, including means for moving said support means away from said sheet carrying face, said means being adapted to effect said movement of the support means in steps equal to the thickness of the sheets being stacked.

7. Apparatus according to claim 1, for stacking a succession of sheets generally vertically on the base of a pallet, the apparatus including a trolley for location of the pallet for reciprocal movement towards and away from said sheet carrying face along tracks disposed below floor level, and means for moving said trolley away from said sheet carrying face in steps equal to the thickness of the sheets being stacked.

8. Apparatus according to claim 1, including a conveyor for delivering a succession of sheets to at least one off-loading station, and at least one said rotary stacking device disposed at said off-loading station for receiving each sheet in turn delivered thereto and for stacking said sheets in a generally vertical, closely-assembled order on a respective support surface.

9. Stacking apparatus according to claim 1, wherein the rotary stacking means provides a plurality of sheet carrying faces spaced around the axis of rotation, to pass the sheet carrying faces in succession through the loading and unloading positions as the rotary means rotates.

10. Apparatus according to claim 9, in which the rotary stacking device has four said sheet carrying faces for inclining and transferring successive sheets into adjacent positions on the support surface.

11. Stacking apparatus according to claim 9, wherein said rotary stacking means comprises:

an open frame-work having a plurality of parallel frames spaced apart along the axis of rotation and secured by connecting members extending parallel to the axis of rotation at positions inset from the sheet carrying edges of the frames.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,713,650 Dated January 30, 1973

Inventor(s) Joseph B. Hodgkinson et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Title page, add -- [30] Foreign Priority Data Great Britain

9188/70 February 25, 1970 -- .

Signed and sealed this 20th day of November 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

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