Aug. 3, 1954 E. L. CROSTON 2,685,374

SHEET TRANSPOSING APPARATUS

Filed Dec. 22, 1950 6 Sheets-Sheet 1

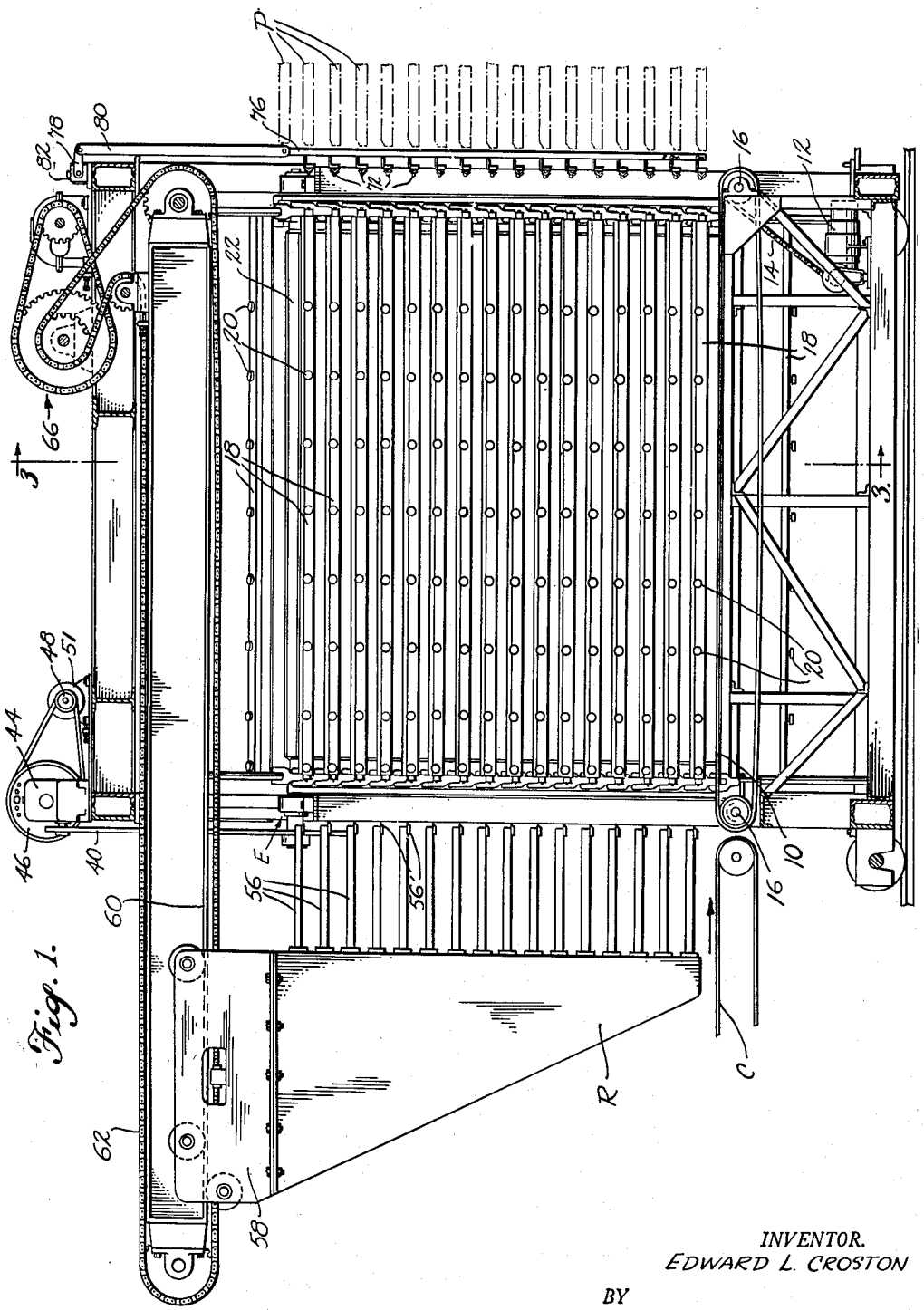

Fig. 1.

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SHEET TRANSPOSING APPARATUS

Filed Dec. 22, 1950 6 Sheets-Sheet 2

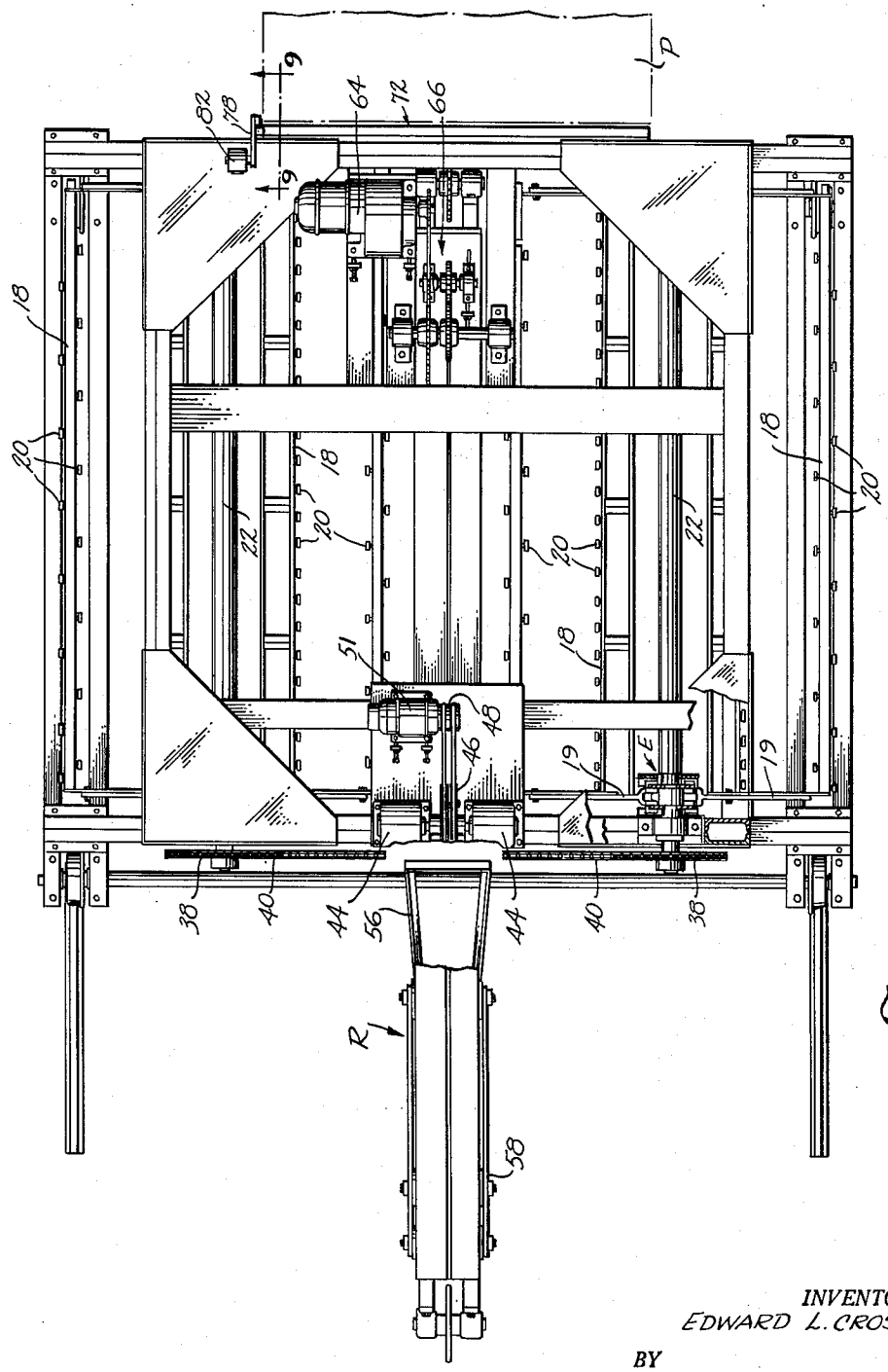

Fig. 2.

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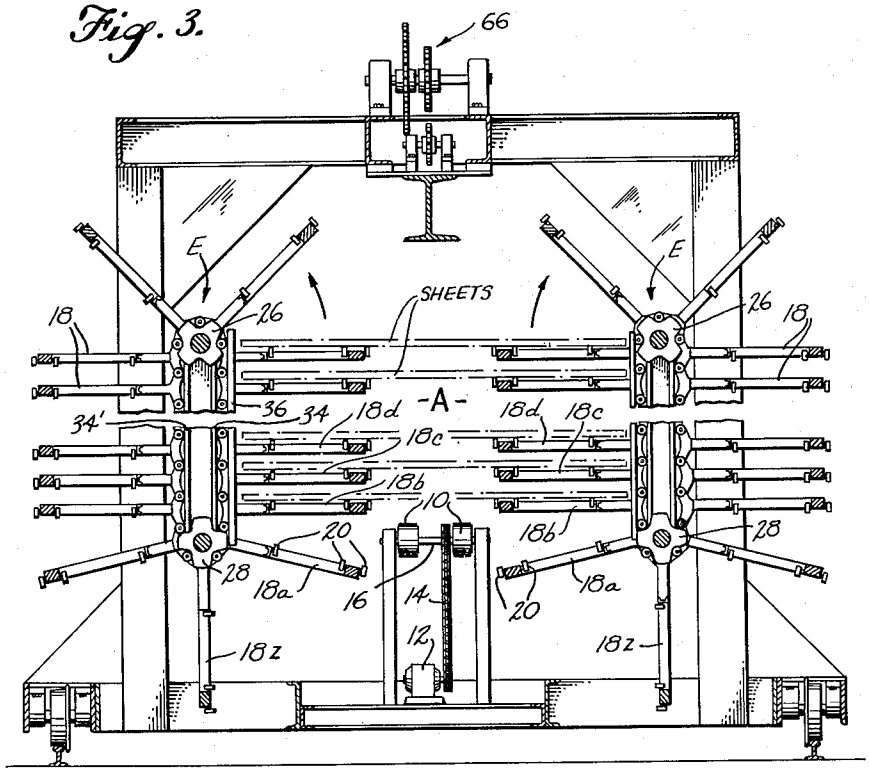
SHEET TRANSPOSING APPARATUS

Filed Dec. 22, 1950 6 Sheets-Sheet 3

Fig. 3.



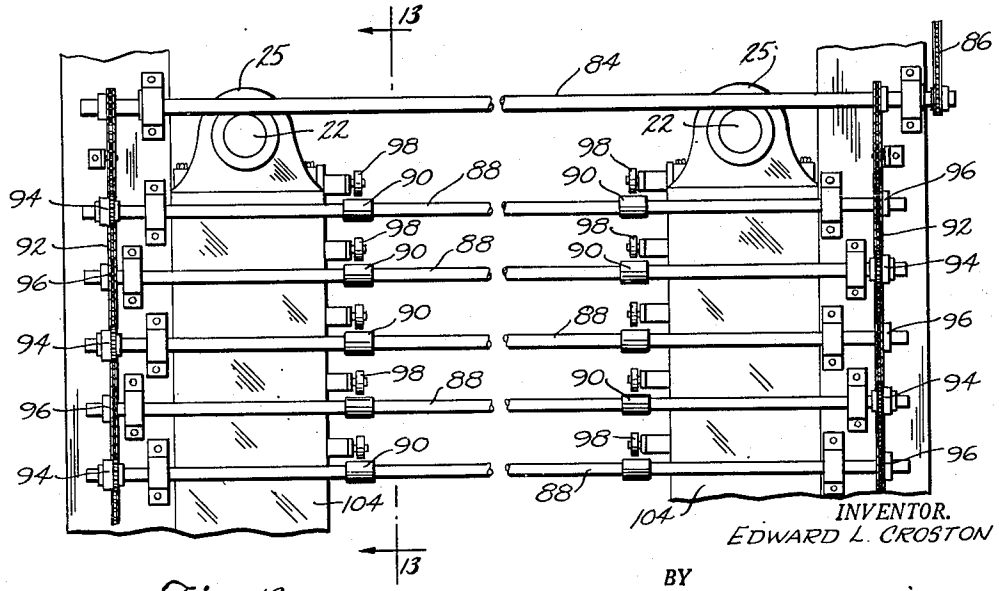


Fig. 12.

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SHEET TRANSPOSING APPARATUS

Filed Dec. 22, 1950 6 Sheets-Sheet 4

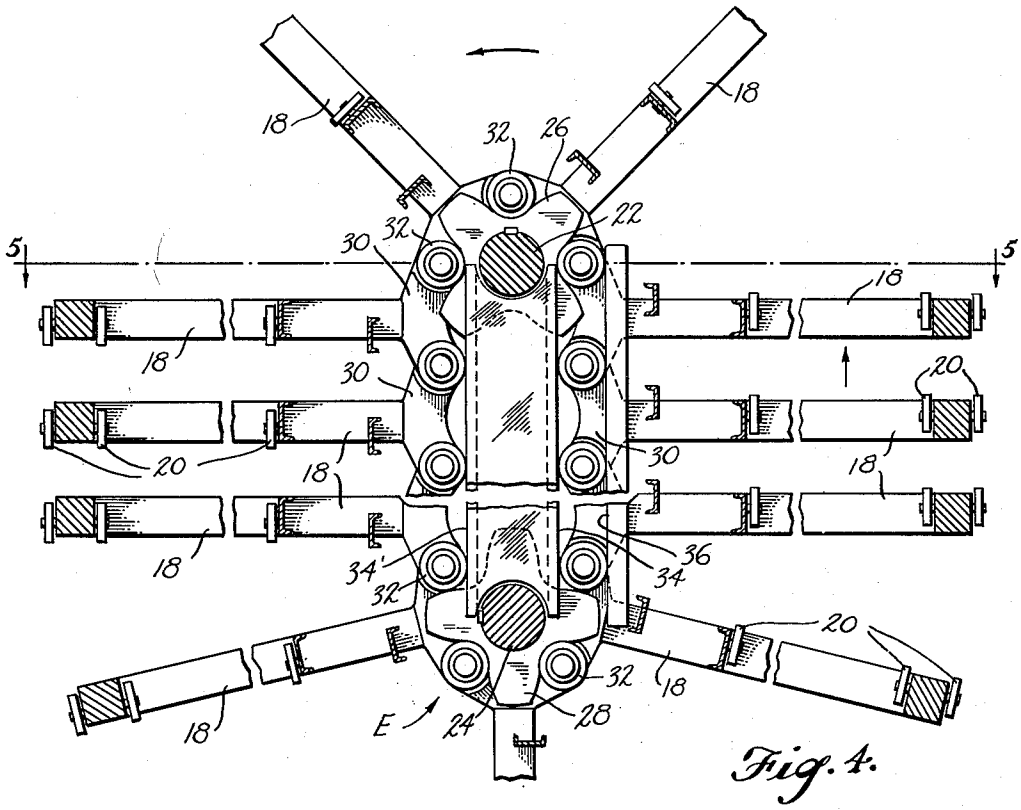

Fig. 4.

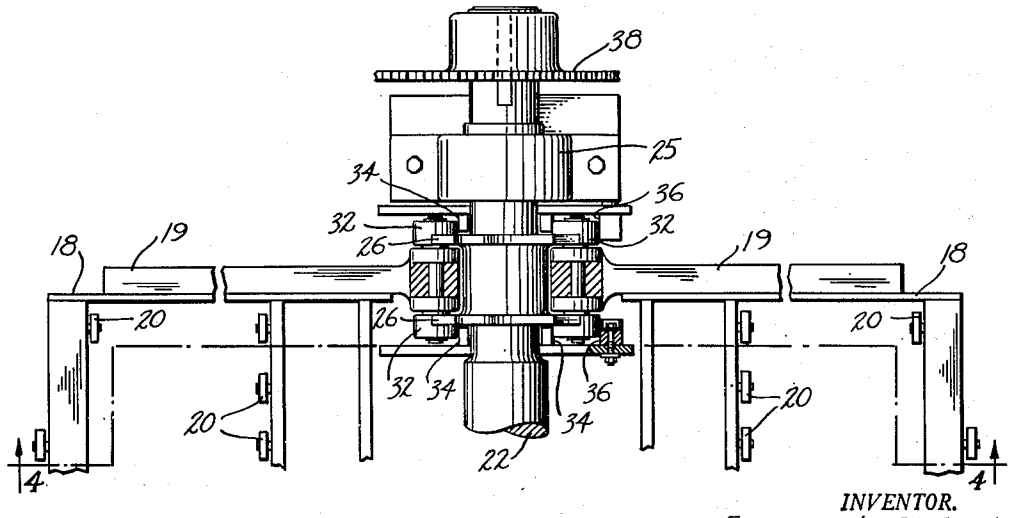

Fig. 5.

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SHEET TRANSPOSING APPARATUS

Filed Dec. 22, 1950 6 Sheets-Sheet 5

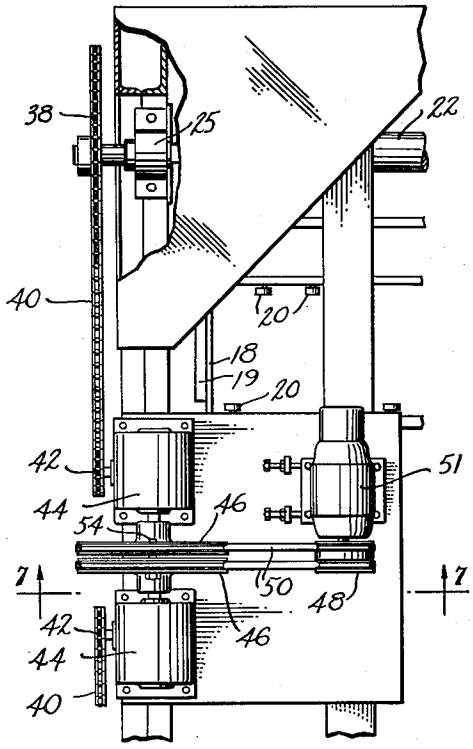

Fig. 8.

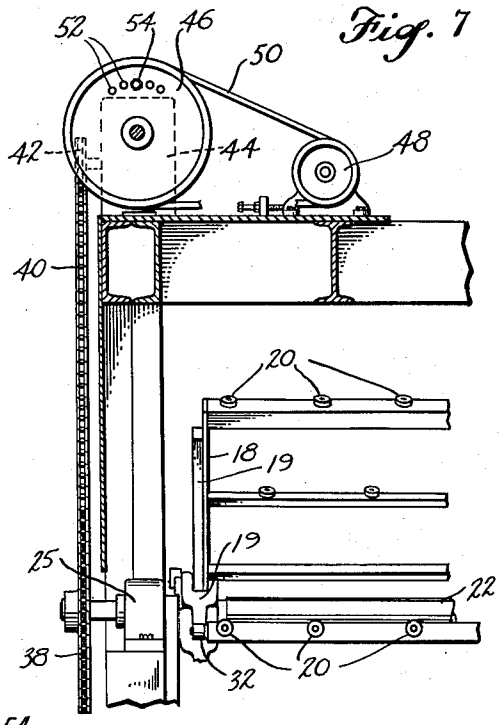

Fig. 7

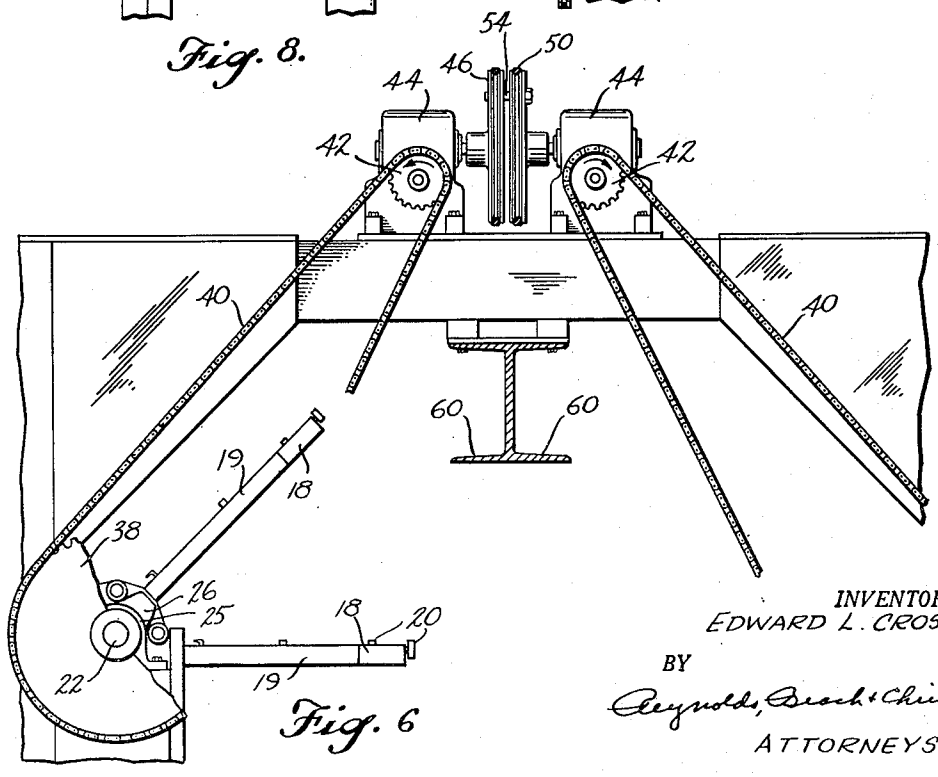

Fig. 6

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SHEET TRANSPOSING APPARATUS

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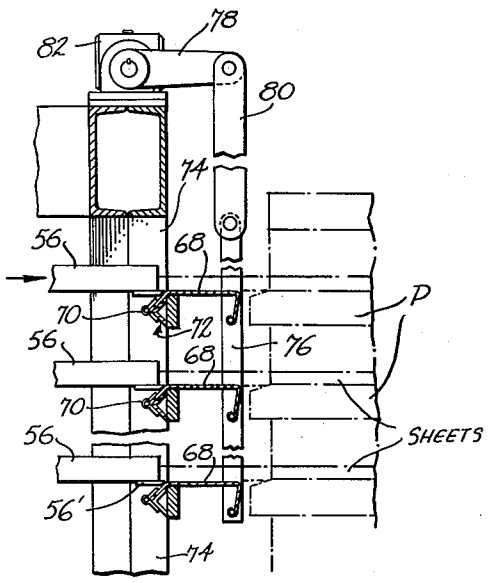

Fig. 9.

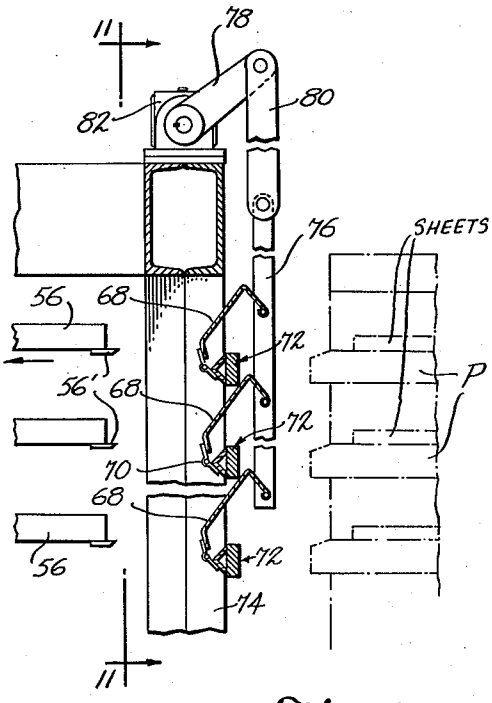

Fig. 10.

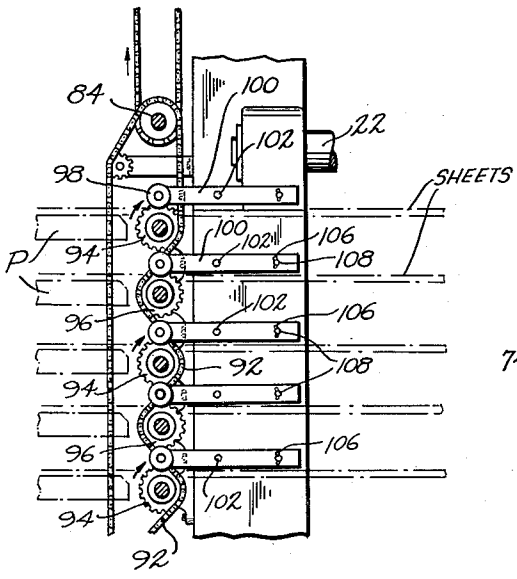

Fig. 13.

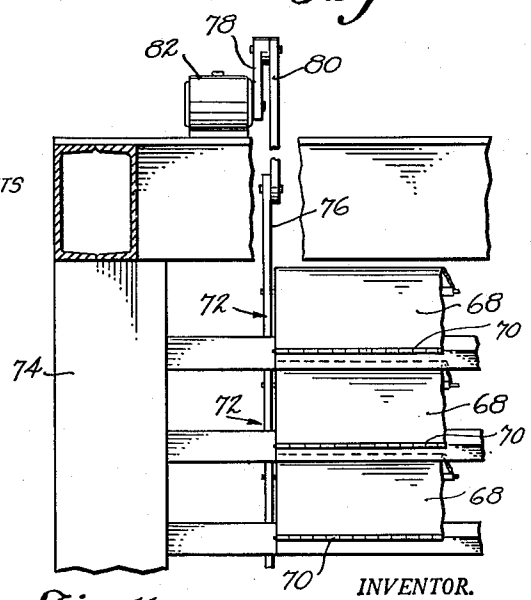

Fig. 11.

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Patented Aug. 3, 1954

2,685,374

UNITED STATES PATENT OFFICE

2,685,374

SHEET TRANSPOSING APPARATUS

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Application December 22, 1950, Serial No. 202,381

4 Claims. (Cl. 214—1)

1

This invention relates to apparatus for transposing large sheets of material from horizontal, coplanar series relationship to superposed, parallel series relationship, for example, or conversely. The invention is herein illustratively described by reference to its preferred application, in which, in alternative forms, the transposing machine functions either as a loader or unloader, respectively, for multiplaten presses and is capable of handling fiberboard mat, plywood veneer, or similar large sheets, treated in such presses. It will be understood, however, that the invention is not necessarily limited to that type of application, but may have use in other similar or related situations.

In one of its illustrated forms, as herein described, the transposing machine functions as an automatic loader for multiplaten presses, and in a slightly modified form, also illustrated and described herein, the transposing machine functions as a receiving rack or unloader for such presses. Fundamentally, the general way in which the sheets are handled for loading and unloading the press is not new in itself. The uncured sheets are received in succession from an input conveyor and are placed in superposed positions of alignment with and adjacent to the respective press openings. Such sheets are then injected simultaneously into the press as soon as it opens, and, at the same time, the batch of cured sheets then in the press are ejected into an awaiting unloader or receiving rack. In this way potential operating time of the press is utilized to the maximum possible extent, and the system fits into a manufacturing plant production line without interrupting the regular flow sequence of sheets from initial to final operations.

A general object of the invention is a transposing machine for the purposes indicated, which is relatively inexpensive to manufacture and maintain.

Another object is such a machine which is relatively compact, although it includes the means for transposing the sheets as well as the means for supporting them either for leaving or for entering the press openings, depending upon the application or form of the machine, that is, whether as a press unloader or loader, respectively.

Another object of the invention is a machine of the kind indicated which, although necessarily large in its dimensions and divided into numerous shelf spaces to support large sheets in considerable numbers, has the special advantage of

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direct and easy accessibility to its sheet supporting shelf structure or parts, for examination and maintenance purposes.

Described briefly, the improved sheet transposing machine comprises coacting elevating conveyors positioned side by side and each including an endless series of projecting arms, pairs of which on the respective conveyors cooperate to support the individual sheets in horizontal position, one above another. Because of the flimsy nature of the large sheets, the conveyor arms supporting them must be relatively wide and long to engage ample areas of the sheets, preventing distortion thereof which would interfere with their insertion into the narrow press openings. Moreover, for similar reasons the coacting pairs of conveyor arms must be maintained substantially coplanar or horizontal. These requirements create special problems with relation to the provision of a satisfactory conveyor mechanism capable of withstanding the large mechanical moments imposed on the arm supports and of properly guiding the coacting arm supports for vertical travel with accurately correct phasing as between conveyors.

Such conveyor mechanism traveling arm supports comprise a series of links interconnected to form an endless conveyor chain. Along the inner stretches of such chains in which the link-supported arms project cooperatively toward corresponding arms on the opposing conveyor, rollers at the ends of the links are guided between vertical guide surfaces to provide cantilever support for the arms and maintain such arms accurately horizontal as well as guide them for movement along straight, vertical paths in the respective conveyors.

Because the arm supporting links must be closely guided in the inner stretches, as mentioned above, a problem resulted therefrom which made it difficult to obtain smooth operation of the conveyors. It was found that a conveyor might operate roughly or with considerable vibration resulting from periodic variation in tension of its chain due to constraint of the chain links caused by the vertical guides. Such guides would deflect the chain links out of the paths which the stretches of chain would normally assume between sprockets, without guides.

Another feature of the invention solving this particular problem resides in the provision of a conveyor mechanism of that type in which the effective length of the chains between opposite sprockets is made such that the phase position

of one such sprocket is displaced by a certain amount relative to that of the other.

Still another object of the invention is drive coupling mechanism by which the relative phase positions of the coacting conveyors may be adjusted quickly and easily to compensate for dimensional differences of parts and other factors which might otherwise prevent attaining accurate coplanar relationship of the pairs of sheet supporting arms.

In its application as a press loader the improved sheet transposing machine additionally incorporates special heat shield mechanism, including a plurality of movable shutters which, when closed, provide a solid heat barrier across the end of the machine adjacent the press to protect the uncured sheets carried by its conveyor arms from premature applications of heat which would impair the effectiveness of the binder or other thermo-active material in the sheets to be cured in the press.

In the case of its application as a press loader the machine also includes a traveling ram having forwardly projecting pusher arms which engage the edges of the sheets supported by the conveyor arms and advance the sheets into the press openings, the traveling ram moving along the aisle space in the machine between the coacting conveyors to accomplish that result. In the case of its application as a receiving rack or press unloader, the transposing machine does not include the ram, but instead employs pinch roll mechanism by which sheets discharged from the press are engaged and advanced the full distance into the receiving rack shelf spaces, clear of the press.

The control mechanism, whether automatic or otherwise, by which the elevating conveyors and other moving parts of the machine in either of its applications are controlled, forms no part of the present invention. Because control techniques which may be used for the purpose are well known, the controls are not included in the description or drawings which set forth the present invention.

The foregoing and additional features, objects and advantages of the invention, including certain details of construction of its preferred form, both as a press loader and as a press unloader, will become more fully evident from the following description thereof, based upon the accompanying drawings.

Figure 1 is a side elevation view of the improved sheet transposing machine as a loader for multiplaten presses.

Figure 2 is a corresponding plan view.

Figure 3 is a transverse sectional view in a vertical plane, taken on line 3—3 in Figure 1.

Figure 4 is an enlarged sectional detail view of one of the elevating conveyors taken on line 4—4 in Figure 5, which is generally as it appears at a smaller scale in Figure 3.

Figure 5 is a longitudinal sectional view in a horizontal plane, taken on line 5—5 in Figure 4.

Figure 6 is a fragmentary end elevation view, partly in section, illustrating the adjustable-phase drive coupling for the two elevating conveyors.

Figure 7 is a longitudinal sectional view taken on line 7—7 in Figure 8.

Figure 8 is a fragmentary plan view with parts broken away, supplementing the illustrations of Figures 6 and 7.

Figure 9 is a fragmentary longitudinal vertical section taken substantially on line 9—9 in Figure 2 and illustrating the heat shield shutter mechanism in the loader side of the machine, with the heat shield shutter elements in open position to permit passage of the sheets from the loader into the press.

Figure 10 is the same view as Figure 9, the shutter elements being closed in this figure.

Figure 11 is a transverse vertical sectional view taken on line 11—11 in Figure 10.

Figure 12 is a fragmentary end elevation view of the transposing machine adapted as a press unloader or receiving rack, the view illustrating pinch roll mechanism on the end of the unloader adjacent to the discharge end of the press for completing discharge movement of the sheets from the press into the unloader.

Figure 13 is a longitudinal vertical sectional view taken on line 13—13 in Figure 12.

The receiving end portions of the platens P of a multiplaten press in open position appear at the right in Figures 1 and 2, which show the improved sheet transposing machine as a loader for such a press. In Figure 1 the horizontal input belt conveyor C carries uncured sheets in succession edgewise to the press loader. Such sheets may be veneers laid up to be face-joined to form plywood, or cauls carrying fiber mats to be pressed into fiberboard, as examples. Upon entering the loader each sheet continues its edgewise advance in the same direction and in the same plane on a local conveyor comprising the parallel endless belts 10 (Figures 1 and 3), driven by a motor unit 12 through a sprocket 14 at the same linear rate of travel as the conveyor C, the belt pulley shafts 16 being appropriately journaled upon frame uprights at opposite ends of the machine, respectively.

As will be seen in Figure 3, the parallel belt conveyors 10 are mounted along the bottom of the longitudinal aisle space defined between the coacting sheet-racking or elevating conveyors E. These intermittently driven synchronized endless conveyors have radiating sheet-supporting arm structures 18 which move in the direction of the arrows. The conveyor arms are stationary at all times except in the intermittent periods immediately following transferals of sheets by conveyor C to their full length upon the local conveyor belts 10 and between succeeding pairs of elevating conveyor arms 18. In Figure 3 the lower pair of arms 18*a* is in process of moving upward into sheet-receiving position at or slightly below the supporting plane of belts 10, in which position the several series of rollers 20 on these arm structures support the oncoming sheet against sagging over the sides of belts 10. Thereafter the elevating conveyors are operated to lift the sheet bodily from conveyors 10 by an incremental amount equal to the conveyor arm pitch distance and thereby position the succeeding set of conveyor arms 18*a* to receive the next sheet delivered by input conveyor C. Intermittent movement of the elevating conveyors timed with delivery of sheets by conveyor C continues until the pairs of arms 18*b*, 18*c* and 18*d* etc. which occupy the inner stretches of the conveyor chains in Figure 3 all carry sheets in superposed vertical series relationship, thereby completing the transposing operation of the loader. The capacity of the elevating conveyors E as a storage rack for the sheets is established by the number of arms 18 carried by the inner stretch of each elevating conveyor or which at a given time project horizontally toward coplanar arms of the other elevating conveyor, less one which is neces-

sary to allow clearance for the traveling ram R, as the ram must clear the input conveyor C. In Figure 1 it will be seen that the capacity of the two conveyors as a press loader rack for the sheets is the equivalent of sixteen rack shelves.

In the loader application of the sheet transposing machine the central aisle space A above the belt conveyors 10 is wide enough to allow passage of the ram R longitudinally between the conveyors for sliding of the sheets from the conveyor arms 18 into the press. However, the width of this aisle space is made no greater than necessary because of a tendency for the flimsy fiberboard mats or similar sheets to sag if left unsupported over wide areas between the inner edges of coacting conveyor arm structures as sheet supports. This is true even though the sheets be carried by caul plates as in the case of fiberboard mats and is true to a lesser extent in the case of veneer for plywood manufacture. In other words the projecting width of the arms 18 transversely of the machine or of the line of movement into the press is made as great as possible to prevent sagging of the sheets between coacting arms, it being noted that any appreciable distortion of the sheets would interfere with their movement into the narrow press openings. Preferably the arm structures are as long or longer than the sheets longitudinally of the machine.

It is likewise important that the pairs of coacting arms of the elevating conveyors E be maintained accurately coplanar when supporting the sheets, so that the latter will lie accurately in registry with the press openings intended to receive them.

In Figures 4 and 5 details of the preferred elevating conveyor mechanism are illustrated. The upper and lower longitudinally-disposed conveyor sprocket shafts 22 and 24, respectively, are journaled in pillow blocks 25 at opposite ends of the machine frame, as shown (Figure 2). A conveyor drive sprocket 26 of double construction is splined or keyed upon each end of the upper shaft 22 and similar sprockets 28 upon the ends of the lower shaft 24. The conveyor chain links 30 are interconnected in endless series by pivot pins which rotationally support the sprocket-engaging rollers 32. An arm member 19 is fixedly carried by each such link in projecting transverse relationship therewith. The individual sheet-supporting arm structures 18 are carried each by and between two such arm members 19 located in corresponding positions at opposite ends of the machine, and are thereby maintained at right angles to the supporting links 30, hence generally at right angles to their line of movement, respectively.

Chain sprockets 26 and 28 having a minimum practicable diameter, hence minimum number of teeth, are selected in order to provide a machine as compact in width and height as can be attained while accommodating the desired number of sheets of a particular size. In the illustration each sprocket has four teeth, although three or more may be used if desired.

Because of their considerable projecting width transversely of the machine the sheet-supporting arm structures 18 impose large tilting moments on their supporting links 30, resulting in forces which must be properly distributed if smooth operation is to be obtained and wear of the conveyor parts is to be minimized. Moreover, the links 30 of each conveyor E should be closely guided for linear movement with constant orientation vertically during their upward travel along the inner stretch of the conveyor chains in order to maintain the arm structures which they support spaced unvaringly from the corresponding arm structures of the other elevating conveyor mechanism as the sprockets rotate. For these purposes the link rollers 32 are constrained to run between inner and outer vertical guides 34 and 36, respectively, which thereby establish the paths of the conveyor chains' inner stretches. Along the outer stretches these rollers merely roll against a vertical guide 34' corresponding to the guide 34, as shown, and no outer guide corresponding to the guide 36 is there needed. The guides extend vertically substantially between horizontal planes containing the rotational axes of the respective sprocket shafts 22 and 24, so that the path of the chain rollers is linear over as great a distance as possible for a given sprocket spacing.

Although the tilting moments directly imposed upon the individual links by their supported arm structures are transmitted to adjoining links and tend to counterbalance the moments to which the latter in turn are subjected by their arm structures, and in net effect tend to maintain a straight chain stretch between sprockets, there is a resultant combined load concentration toward a line joining the axes of the sprockets on the lower end links, and perhaps a load concentration away from such line on the upper end links, tending to cause tilting of the chain stretch from the vertical. Engagement of such lower links with the lower sprockets and the vertical guides 34, and of such upper links with the upper sprockets and vertical guides 36 support the links in the desired vertical alignment.

If the sprockets 26 and 28 are rotationally positioned on their respective shafts 22 and 24 with similar orientation or phasing of their teeth, that is, the rotative position of each tooth on one sprocket relative to a line joining the rotative axes of the sprockets will correspond to the rotative position of a tooth on the other sprocket with respect to such line, the conveyor mechanism will not operate satisfactorily. This is the result of deflection or constraint of the conveyor chain caused by the guides 34 and 36 in a fixed path not coincident with the periodically laterally shifting path which the chain would normally assume if extending freely between the two sprockets. It was found that this constraint imposed by the guides in the case of upper and lower sprockets in phase resulted in periodic fluctuation in chain tension, causing undesired looseness and excessive tightness, which would result in wear of the parts. It was then discovered, however, that smooth and satisfactory operation of the mechanism could be obtained simply by spacing the sprockets 26 and 28 at a distance of separation such that the correct length of conveyor chain for that spacing would cause the teeth of one sprocket to occupy a phase relation approximately mid-way between those of the other sprocket. In the case of four-tooth sprockets, as illustrated in Figure 4, the teeth would be 45 degrees out of phase. It will be understood that a different angle of phase separation of the sprockets would be required in the case of sprockets having a different number of teeth. In general, the correct phase separation of corresponding teeth on the two sprockets should approximate one-half the pitch angle of the sprocket teeth.

In Figures 6, 7 and 8 certain details of a pre-

ferred drive mechanism for the elevating conveyors E are illustrated. A drive sprocket 38 on each of the conveyor drive shafts 22 is engaged by a drive chain 40 which passes around a power sprocket 42. The sprockets in turn are rotated through reduction gearing units 44 which are driven by identical belt and pulley drives including the coaxial driven pulleys 46, double drive pulley 48 and connecting belts 50. The drive pulley 48 is driven by an electric motor unit 51, the drive assembly being mounted in a suitable manner upon the top of the machine frame as shown.

In order to establish the rotational phase relationship of the two elevating conveyors accurately, so that their coacting sheet-supporting arms will be coplanar as desired, provision is made in the drive mechanism for adjusting the phase position of one conveyor relative to the other. The adjustable-phase coupling mechanism accomplishing this result comprises the closely adjacent coaxial pulleys 46 each having a group of apertures 52 in their respective webs extending in series along arcs of the same radius with reference to the common rotational axis of the pulleys. A coupling bolt 54 inserted through transversely aligned apertures in the two pulleys constrains them to rotate together in a given phase relationship. If the relative phasing is not correct, it may be easily changed simply by removing the coupling bolt and rotating one pulley relative to the other until a different aperture in one lines up with a reference aperture in the other to receive the coupling bolt. Such an adjustable-phase coupling arrangement relaxes the requirements of manufacturing tolerances which otherwise might be necessary to obtain the requisite phase correspondence of the conveyors, by permitting compensative adjustments to be made.

It will be understood from what has already been said that the motive power unit 51 operating the elevating conveyors will be turned on and off intermittently by suitable automatic control mechanism (not shown) to move the conveyors a distance equal to the arm spacing each time sheet arrives in the transposing machine from the input conveyor C, until the capacity of the machine is filled, as previously mentioned. Such automatic control mechanism forms no part of the present invention and needs no description herein as it may employ well known control techniques involving the use of electrical switches or their equivalent. It will also be appreciated that by a proper selection of control apparatus operation of the transposing machine which accumulates the sheets for insertion into the press openings may be made as rapid as desired so that the machine can easily feed a load of sheets into the press between delivery of successive sheets by input conveyor C fully into the transposing machine. The loader will receive its full load of sheets, properly arranged for injection into the press, in a period of time approximately equal to but not less than the operating period of the press. Consequently, at least almost as soon as the press is opened to discharge from it the previous batch of sheets the new batch in the loader is ready for insertion into the press openings without delay.

The press-loading ram R carries a plurality of forwardly projecting pusher arms 56, located at the correct levels to engage the edges of the sheets in different loader shelves as defined by vertically adjacent arms 18 of the elevating conveyors. The ram, supported on an overhead carriage 58 having wheels rolling on the lower flanges of a longitudinal I-beam as a track 60, is reciprocated toward and from the press through the longitudinal aisle space A (Figure 3) to slide the sheets from the supporting arms into the press openings and then to retract. Such reciprocation of the ram is accomplished by means of the reversible drive chain 62 coupled to the ram carriage 58. The chain 62 is driven by the reversible motor unit 64 (Figure 2) through appropriate chain and sprocket transmission mechanism designated generally by the numeral 66.

The provision of generally similar forwardly projecting pusher arms in a sheet-charging apparatus is illustrated and described in copending application Serial No. 94,774 of Alfred F. Pierce, filed May 23, 1949. Such pusher arms shove the sheets the required full distance into the press openings despite physical barriers at the end of the loader adjacent the press which prevent the ram R itself reaching the very edge of the press platens. At the lower corners of their forward ends each of these pusher arms carries a forwardly projecting slide shoe which is received under the engaged sheet to prevent its edge slipping down under the end of the arm during forward movement of the ram R. In addition to preventing the sheets from slipping beneath the pusher arms, the shoes 56' also act as deflectors, having chamfered lower forward edges insuring that the arms will not catch on the corner of a press platen or transverse frame element of the loader itself, but will be deflected up and over the corner if there is any slight misalignment of the pusher arms with the spaces between these parts.

Because the sheets of uncured material, such as fiberboard mat or adhesively coated veneer sheets are necessarily stationed quite close to the press when held in the loader preparatory to injection into the press, it has been found that radiation and convection of heat from the press tends to set the binder prematurely. Thus when the sheets in the loader are later cured in the press the prematurely heated portions nearest the press are not as strongly bonded as those which were unaffected by such heat. Accordingly, further features of the invention reside in novel heat shield mechanism by which the end of the loader adjacent the press is automatically closed off at all times except during the recurring operations of sliding the sheets into the press by the ram R, at which times the heat shield elements are opened in order to permit passage of the sheets into the press.

In Figures 9, 10 and 11, illustrating the preferred type of heat shield mechanism, shutters 68 are provided which have pivotal lower edges connected by piano hinges 70 to the transverse supports 72. These transverse supports or frame elements are mounted horizontally between the machine frame corner posts 74 just below the levels of the different respective press platens served by the loader. Near their pivotal edges the shutters 68 are bent along a transverse line so that when swung downward to lie against the upper sides of the transverse supports 72 their general body portions extend approximately horizontally in respective planes permitting sliding of the sheet material over them from the elevating conveyor arms 18 into the press openings (Figure 9). Their swinging or outer edges are pivotally connected at spaced intervals to a vertical draw bar 76 which in turn is connected by

its upper end through a link 80 to a shutter-actuating crank 78. Near their edges pivotally connected to the draw bar 76 the shutters are turned downward at approximately a right angle to increase their stiffness against bending when upward pull on them is exerted by the draw bar 76.

The shutter-actuating crank is swung up and down about a horizontal axis by motor unit 82, to raise and lower the shutters 68 simultaneously. When the shutters are raised by the draw bar 76 they contact the lower edges of the adjacent transverse supports 72 continuously along the full length of the shutters. Consequently, the series of shutters, together with the intervening supports 72 engaged thereby complete a solid heat barrier or screen interposed between uncured sheets supported on the elevating conveyor arms, and the press (Figures 10 and 11).

Suitable automatic control mechanism (not shown) may be provided for energizing the motor unit 82 to raise the shutters 68 automatically immediately following retraction of the pusher arms 56 far enough to clear the shutters after a press loading operation, but such automatic mechanism constitutes no part of this invention.

As previously mentioned, when the transposing machine is to be applied as a press unloader or receiving rack unit, the ram R will not be included, nor, of course, its drive mechanism and overhead I-beam forming the ram carriage track 60. However, in that case the machine is preferably equipped with power driven pinch rolls at its receiving end adjacent the discharge end of the press. Such pinch rolls engage the sheets as they emerge from the press and move them the full distance into the rack, whereas otherwise they would not completely leave the press unless it incorporated its own special discharge conveyor mechanism.

In Figures 12 and 13, illustrating pinch roll mechanism accomplishing that result, a transverse countershaft 84, driven through a sprocket and chain 86 from a suitable power source (not shown) supplies rotational power to the roll shafts 88 carrying the lower pinch rolls 90, which are preferably of rubber or like material. Each such roll shaft carries two such pinch rolls at spaced locations thereon, the upper surfaces of the rolls being located approximately at the level of the work-supporting surfaces of the platens P of the open press (Figure 13). Arranged in vertical series, the transverse shafts 88 journaled upon the end of the machine frame are rotatively driven by two chains 92 each engaging shaft-drive sprockets of alternate shafts at each side of the machine, the chains passing around chain-tensioning idler sprockets on the same ends of the intervening shafts. Thus the sprockets 94 on shafts 88 at the left in Figure 12 are keyed as drive sprockets to their respective shafts, whereas the sprockets 96 rotate freely as chain-tensioning idlers on their respective shafts. At the right in Figure 12, the alternate arrangement of keyed and idler sprockets exists, so that each shaft 88 has a drive connection to but one chain 92. Such an arrangement for driving a series of closely spaced shafts in simple manner saves space and is relatively inexpensive.

Cooperating with the power rolls 90 are the hold-down rolls 98 carried by the ends of adjustable arms 100. The arms 100 are connected at intermediate locations by pivot pins 102 to the inside faces of the frame uprights 104. The ends of the arms opposite the hold-down rolls 98 have arcuate slots 106 centered at the pivot axes defined by the respective bolts 102. Clamp bolts 108 thread into the frame uprights 104 through the arcuate slots 106 and have heads which bear against the outside faces of the respective arms 100 to hold the arms against shifting out of adjustment. However, these clamp bolts may be loosened to permit adjustment of the hold-down rolls 98 up or down in accordance with variations in the thickness of the material sheets passing between the sets of pinch rolls 98, 90.

It will be understood that in the case of the unloader application of the transposing machine the elevating conveyors E will be rotatively positioned with the arms 18 of their inner stretches located in registry with the press openings, to receive the cured sheets discharged from the press with the aid of the pinch rolls 90, 98. Thereafter the elevating conveyors will be operated in intermittent or step-by-step manner to lower the sheets one at a time upon the local conveyor belts 19 which carry them off to a suitable output conveyor (not shown). Thus the machine operates as a transposing machine in the reverse sense from that in the loader application. In this case the sheets are transposed from vertical superposed series relationship to horizontal or linear series relationship. The only difference in the operation of the machine to accomplish this converse transpositioning operation is in the direction of movement of the elevating conveyors E, which in this case are moved oppositely from their direction in the loader application. It will be understood in this same connection that the shutter mechanism affording the heat shield in the press loader form of the transposing machine may be omitted from the unloader or receiving rack form thereof, because heat from the press reaching the cured sheets in the receiving rack through radiation or convection can have no harmful effect upon such sheets at this stage.

While the invention has been illustratively described in its preferred application, namely to the loading and unloading of multiplaten presses for manufacture of plywood or fiberboard sheets, for example, it will be understood that the principles involved may be useful in other or similar applications requiring transposing operations where large or flimsy sheets difficult of handling mechanically are involved.

I claim as my invention:

1. In a sheet transposing and conveying machine, a pair of generally upright, parallel, endless sheet-elevating conveyors, including sheet-supporting structures spaced apart vertically to define sheet-receiving spaces, and shield means including a plurality of horizontal shutters pivotally supported by corresponding horizontal edges thereof at levels corresponding to the levels of such sheet-receiving spaces, respectively, and forming an openable protective barrier across one end of said sheet-elevating conveyors, and means operable to swing said shutters about their pivots simultaneously between open position generally parallel to such sheet-receiving spaces for passage of sheets between said shutters and closed position generally perpendicular to such open position.

2. In a multiple-sheet handling machine, a plurality of substantially horizontal sheet supports arranged in vertically spaced relationship to support material sheets in superposed vertical series relationship, means engageable with the sheets and guided for movement to advance such sheets simultaneously along the spaces between

said sheet supports and through one end of the machine, and heat shield means forming an openable protective barrier across said end of the machine, said heat shield means comprising a plurality of horizontal shutters pivotally supported by corresponding edges thereof on the machine at the respective levels of the sheet supports, and means operable to swing said shutters about their pivots simultaneously, between open position generally parallel to the supported sheets to permit passage of the sheets through said end of the machine, and closed position generally perpendicular thereto.

3. In a multiple-sheet handling machine, a plurality of substantially horizontal sheet supports arranged in vertically spaced relationship to support material sheets in superposed vertical series relationship, means engageable with the sheets and guided for movement to advance such sheets simultaneously along the spaces between said sheet supports and through one end of the machine, and heat shield means forming an openable protective barrier across said end of the machine comprising a series of closure elements disposed horizontally across said end of said machine adjacent the respective sheet supports, and means supporting and actuating said

closure elements for reciprocative movement thereof simultaneously between open position defining horizontal spaces therebetween aligned with the respective spaces between said sheet supports, and closed position forming a substantially continuous barrier across said end of the machine.

4. The machine defined in claim 3, wherein the closure elements comprise edge-pivoted shutters formed in cross section to bow upward between their pivoted edges and swinging edges, as sheet edge deflectors, in open position of such shutter elements.

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