This invention relates to heat processing machines, and in particular to conveyor-type heat processing machines.

One object of this invention is to provide a heat processing machine for automatically conveying and heat-processing sheets or plates of material such as lithographed plates.

Another object is to provide a heat processing machine as set forth in the previous object wherein means is provided at the outlet end of the machine for momentarily advancing the lower edge of the sheet faster than the upper edge so that when the sheet falls as it nears the end of the conveyor it will not be damaged by slicing or buckling.

Another object is to provide a heat processing machine having a travelling conveyor with sheet carriers spaced at intervals therealong, these sheet carriers being constructed and arranged with elongated central supports to convey either large or small sheets without leaving the lower edge unsupported at its ends.

Another object is to provide a carrier for sheets of material consisting of a framework of rods or bars adapted to be carried by a conveyor and having provisions for leaving portions of the lower edge accessible for engagement by other portions of the machine yet providing an elongated central support for several different sizes of sheets or plates.

This is a division of my application filed February 20, 1949 for Heat Processing Machine, Serial No. 432,541, and now Patent No. 2,406,831, granted September 3, 1946.

In the drawings:
Figure 1 is a side elevation, partly in section, of the outlet end of a heat processing machine according to a preferred embodiment of the present invention;
Figure 2 is a view similar to Figure 1, but showing the inlet end and adjacent machinery;
Figure 3 is a horizontal section along the line 3-3 in Figure 1, with the sheet carriers removed to disclose the construction more clearly;
Figure 4 is a horizontal section similar to Figure 3 but taken along the line 4-4 in Figure 2;
Figure 5 is a cross section along the line 5-5 in Figure 1;
Figure 6 is a side elevation of a portion of a conveyor chain with the sheet carriers mounted thereon;
Figure 7 is a horizontal section along the line 7-7 in Figure 6;
Figure 8 is a vertical section along the line 8-8 in Figure 6;

Figure 9 is a detailed view of the clutch shown in the lower central portion of Figures 2 and 4;
Figure 10 is a diagrammatic side elevation of the conveyor at the outlet end of the machine, showing the means whereby the lower edge of the sheet or plate is momentarily advanced more rapidly than the upper edge so as to make it fall without injury.

General arrangement

In general, the heat processing machine of this invention includes an oven within downwardly-inclined ends for conserving heated air which is circulated through the oven by fans or blowers.

An endless conveyor moves through the oven and is provided with spaced sheet carriers at intervals therealong. The sheet carriers consist of open frames (Figure 5) having gaps at the bottom thereof to permit engagement of the sheet with other conveying apparatus yet having a downwardly depending central support for the midportion of the lower edge of a large sheet or the end portion of a small sheet, thereby adapting the conveyor for conveying various sizes of sheets without changing the sheet carriers.

The spacing of the carriers along the conveyor and the mounting of the carriers at their opposite ends on a pair of parallel conveyors enables the central portions to be maintained comparatively free from obstructions. Heaters and blowers are provided for circulating heated air upward and downward between the sheets on their carriers in a zigzag path, this heated air being finally exhausted from the oven by an exhaust fan located near the inlet of the oven, thereby causing the heated air to travel in the opposite direction to the conveyor and sheets.

An auxiliary conveyor is provided at the outlet end of the machine for temporarily moving the lower edges of the sheets ahead of the upper edges, so that as the carriers swing downward at the ends of the conveyor, the sheets will fall gently and without shock, thereby preventing damage to the sheets and possible injury to the machine and operators. A withdrawal conveyor is provided adjacent this auxiliary conveyor for carrying away the sheets as they are unloaded from the oven conveyor.

Machine driving mechanism

Referring to the drawings in detail, Figures 1 to 4 inclusive show the heat processing machine of this invention as consisting of an oven generally designated 10 containing an endless conveyor generally designated 11 having sheet car-
2,576,218

The jaw clutches 34 and 38 are of similar construction in that they are arranged to drive their particular shafts 2 in one direction and to slip relatively thereto in the opposite direction. Accordingly a single description suffices for each of the clutches 34 and 38 (Figure 9), the clutch 38 being selected for this purpose. The clutch 38 consists of a driving member 75 connected to the pulley 78 and to portions 79 interconnected by inclined portions 80. The pulley 78 is loosely rotatable upon the shaft 31, and seats against a collar 81 pinned as at 82 to the shaft 31. Cooperating with the clutch member 78 is a clutch member 83 having driving shoulders 85 interconnected by inclined portions 86, the clutch member 83 being keyed or splined to the shaft 37 as at 86, so as to be slidable longitudinally along the shaft 37 by means of a spring 87 seated against a collar 88 pinned as at 89 to the shaft 37. In this manner each clutch 34 or 38 drives its shaft 32 or 37 in one direction but slips and clicks without driving connection when the drive is in the opposite direction.

The purpose of the clutches 34 and 38, as described in connection with the operation of the machine, is to permit the conveyor 11 to be driven normally by the main driving motor 22 when the machines 15 and 20 are in operation, yet to permit the auxiliary driving motor 23 to drive the conveyor 11 when the main driving motor 22 is halted and the machines 15 and 20 are shut down. In this way the sheets of paper which have been printed and possibly coated are carried through the oven 10 and dried even after the machines 15 and 20 and their driving motor 22 have ceased operation.


Oven construction. The oven 10 is an elongated box-like structure with side walls 91 (Figures 3 and 5), a top 92 and a bottom 93. The oven also has inlet and outlet ends 94 and 95 respectively (Figures 1 and 2). The inlet end 94 for the purpose of conserving heat is directed downwardly toward the inlet 18. The inlet end 94 is provided with a port 96 communicating with the conduit 97 in a casing 98 containing the exhaust fan 17 for creating a suction to remove air which has traversed the oven and has no further use. The fans or blowers 15, which are located in casings 104 having inlets 105 and outlets 106. The blowers 15 are operated by shafts 107 mounted in brackets 108 (Figure 5) secured to the walls 91. The shafts 107 carry pulleys 109 driven by belts 110 from pulleys 111 upon the shafts 112 of motors 113. The latter are mounted upon brackets 114 beneath the longitudinal frame.
members 115 interconnecting the oven supports 54. The brackets 114 are also matched by corresponding brackets 115 on the opposite side of the machine (Figure 5) and these together support the angle guide 117 upon which the conveyor chain 63 travels on its return path.

The interior of the oven is likewise provided with angle guide rails 118 which support the conveyor 63 in its travel through the oven, and these guide rails 118 are inclined downwardly at the opposite ends of the oven. Cooling fan motors 119 provided with fans 120 in casings 121 are located near the oven outlet 95 of the oven so as to cool the sheets or plates 90 as they emerge from the vestibule or hood 101.

Near the oven outlet 100 the guide rails 118 are supported by a cross member 122 and elsewhere within the oven by cross members 123 (Figure 5). The latter are connected to the longitudinal angle members 124 and also carry spaced longitudinal members 125 between which the air may circulate freely.

**Conveyor and carrier construction**

The conveyor 11 and carriers 12 include the conveyor chains 53 mounted upon the guide rails 118 and 117 as previously described. The conveyor chains 53 consist of links 126 and 127 pivotally connected to pivot pins 128 carrying rollers 129 which roll along the top edges of the guide rails 117 and 118. The pivot pins 128 are provided on one side with heads and on the other side are held in place by cotter pins 130. Mounted adjacent the links 127 are angle members 131 which extend out over the links 127 and provide rests for the lower edges of the sheets or plates 90 which form the work pieces handled by the machine. Adjacent the opposite links 126 are mounted channel members 132 having aligned apertures 133 and 134 (Figure 8) through which pass the side portions 135 of the carriers 12.

These side portions 135 are bifurcated as at 136a and spread apart after their insertion so as to prevent their accidental withdrawal.

The side portions 135 are bent inwardly to form top portions 136 and 137. The top portion 137 is bent downwardly in a diagonal portion 138 (Figure 5) to the portion 135 in any suitable way, as by spot welding. The top portion 135 is bent diagonally downwardly in a portion 140 which is secured at the top portion 141 to the diagonal portion 135. A diagonal portion 142, also secured at the top portion 143 to the diagonal portion 135, continues downwardly to a junction at the top portion 145 with the other side member 135. Secured at its opposite ends 145 to the diagonal members 135 and 142 is a U-shaped downwardly-extending frame 146 having side portions 147 and a cross portion 148 at the bottom thereof. Secured to the bottom portion 148 at the corners of the frame 146 are sheet supports 149. The sheet supports are inclined upwardly as at 149a (Figure 6) and serve to support the lower edges of the sheets 90.

The carriers 12 are thus spaced at intervals along the chain 53 and are interposed so that the sheets or plates 90 rest in inclined positions as they travel through the oven (Figure 6). The downwardly extending frame 146 with its supports 149 enables sheets smaller than the maximum size sheets to be conveyed, hence there is no necessity for changing the carriers 12 for different sizes of sheets. Moreover, the open spaces between the side members 135 and 146 permit the lower edges of the plates to be en-

**gaged by the auxiliary conveyor 68 (Figure 10) which passes through these spaces and serves to advance the lower edges of the sheets 90 ahead of their upper edges as previously described above.**

**Operation**

In the operation of the machine of this invention, the main and auxiliary driving motors 22 and 23 are energized to cause the conveyor 11 to pursue its orbital path through the oven 10 and also to drive the printing press 19 and coating machine 20. The switches 153 are then closed, energizing the blower motors 17, 113 and 119, and causing air to flow through the oven in a circular path opposite the direction travel of the conveyor 11. The baffles 102 cause the air to move up and down between the carriers 12, so that the air follows a zigzag path as indicated by the arrows in Figures 1 and 2.

The operator also lights the gas burners 16 to heat the oven. The flow of gas to the burners 16 is controlled by a safety control circuit disclosed and claimed in the Fox Patent No. 2,406,232, issued September, 1946.

In the meantime, the printing machine 19 and coating machine 20 have been imprinting designs on the sheets 90 of the tin or other material, and these have been deposited upon the carriers 12 as the conveyor 11 moves them through the oven. The heated air circulates in a zigzag path through the spaces between the carriers and the sheets, and follows a general direction opposite to the direction of travel of the conveyor 11, due to the operation of the exhaust fan 98. As the sheets or plates 90 emerge from the vestibule 101, they are cooled by the drafts of cool air coming from the cooling fans 120 operated by the motors 119.

It is to be noted that the fan 120 and blower 15 adjacent the outlet of the oven are arranged so that cool air will be directed upwardly through and between the plates 12 and will be further directed into the oven by reason of the hood 101 so as to be forced or drawn downwardly through the sheets 12 to the intake of said blower 15. In this manner, the heat from the oven may be prevented from escaping to the surrounding atmosphere so that operation of the oven may be continued during summer months without unduly heating the atmosphere in the building in which the oven is installed.

While the carriers 12 move over the auxiliary conveyors 68, the latter extend into the spaces in the bottom edges of the carriers 12, engaging the bottom edges of the sheets 90. Since the auxiliary conveyors 68 are moving more rapidly than the main conveyor chains 63, the bottom edges of the sheets or plates 90 are moved ahead of their top edges (Figure 10) so that as the carriers 12 swing downwardly around the shaft 62 as an axis, the sheets 90 lie flat against the back of each carrier, until they arrive at the withdrawal conveyors 73 and 77. The latter conveyors then convey the sheets to the next stage of operations such as the forming of cans from the sheets.

Meanwhile, the auxiliary driving motor 23 has also been operating but it has failed thus far to drive the shaft 37 since the automatic body clutch 38 prevents this by the slippage of the clutch members 78 and 83 relative to each other (Figure). If now the desired quantity of sheets or plates have been printed and coated and the main driving motor 22 is shut down to halt the machines...
2,576,218

19 and 28, the shaft 25 and the pulley or sprocket 36 immediately come to rest. Due to the provision of the automatic jaw clutches 34 and 38, however, the auxiliary driving motor 23 now drives the shaft 37 through the jaw clutch 38 while the clutch members of the jaw clutch 34 slip relatively to each other.

While a specific embodiment of the invention has been described and illustrated, it will be understood that various modifications may be made within the scope of the appended claims without departing from the spirit of the invention.

What I claim is:

1. A conveyor apparatus comprising a plurality of horizontally-movable laterally-spaced conveying devices, a plurality of sheet carrier frames secured near their opposite lateral edges to said conveying devices, whereby to provide access to said frames at locations between said conveying devices, said carrier frames having gaps in their bottom edge portions extending between said respective conveying devices for facilitating engagement of the sheets for removal from said frames and having secured thereto structures depending into and laterally spaced from the edges of such gaps, said structures having generally horizontally projecting sheet-upholding means adapted to engage and uphold the lower edges of sheets resting against said frames.

2. A conveyor apparatus comprising a longitudinally-movable conveying device, a plurality of sheet carrier frames secured at spaced intervals along said conveying device, said carrier frames having gaps in their bottom portions, and an auxiliary conveyor disposed beneath said frames adjacent the discharge end of said conveying device and engageable with the edges of said sheets in said gaps for engaging and advancing the bottom edges of said sheets more rapidly than the upper edges thereof, whereby to move said bottom edges from the front of one carrier frame toward the back of the preceding carrier frame, and a withdrawal conveyor positioned adjacent said auxiliary conveyor for carrying away the sheets deposited thereon by said conveying device.

5. A sheet carrier for a sheet conveyor comprising a sheet carrier frame having side members attachable to said conveyor, said carrier frame including diagonally extending cross arms connected at their intermediate portions and having their ends connected with the side arms, and a bracket-shaped member having downwardly-extending spaced legs depending from and connected to said diagonally extending cross arms, said legs being spaced inwardly from said side arms to provide gaps therebetween.

6. A sheet carrier for a sheet conveyor comprising a sheet carrier frame having side members attachable to said conveyor, said carrier frame including diagonally extending cross arms connected at their intermediate portions and having their ends connected with the side arms, and a bracket having downwardly extending spaced legs connected to said diagonally extending cross arms, said bracket including a U-shaped member having projections on the connecting portion thereof to provide a flange for engaging the lower edge of the sheet material.

7. A sheet carrier for a sheet conveyor comprising a frame having a pair of spaced side arms attachable to said conveyor, diagonally extending cross arms connecting opposed pairs of side arms, and a U-shaped bracket member having downwardly-extending spaced legs connected at their upper ends to said diagonally-extending arms and having a connecting portion at their lower ends provided with lug extensions for engaging the lower edge of a piece of sheet material, said bracket member being spaced laterally from the lower portions of said cross arms and from said side arms to provide open gaps therebetween.

VERNIE A. FOX.

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