May 21, 1935. A. M. KAMPER 2,002,265

APPARATUS FOR ATTACHING METAL STRIPS TO SHEETS OF WOOD, COMPOSITION BOARDING, OR THE LIKE

Filed March 23, 1933 9 Sheets-Sheet 1

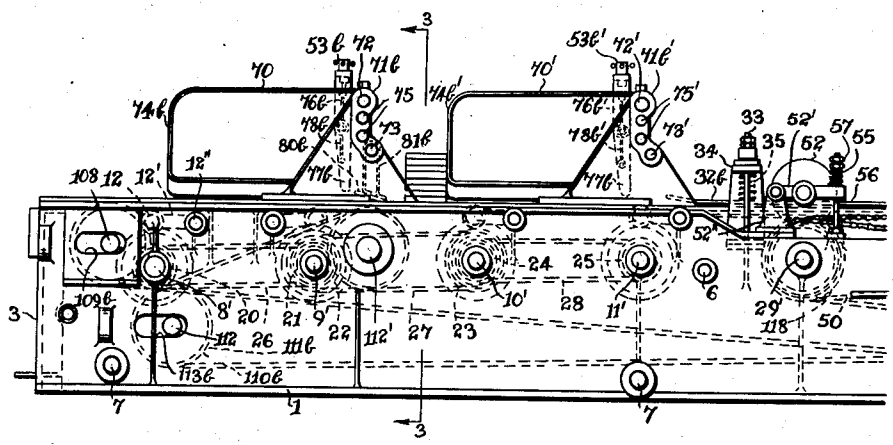


Fig. 1A.

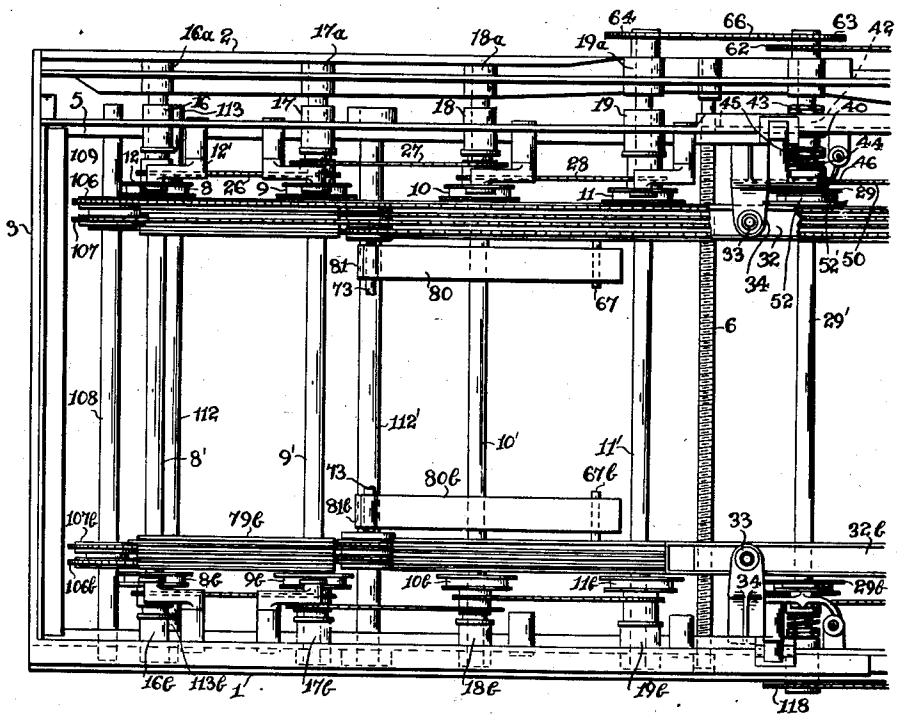


Fig. 2A.

Inventor
Andrew M. Kamper
By Cushman, Bryant, Darby & Cushman
Attys

May 21, 1935. A. M. KAMPER 2,002,265

APPARATUS FOR ATTACHING METAL STRIPS TO SHEETS OF WOOD, COMPOSITION BOARDING, OR THE LIKE

Filed March 23, 1933 9 Sheets-Sheet 2

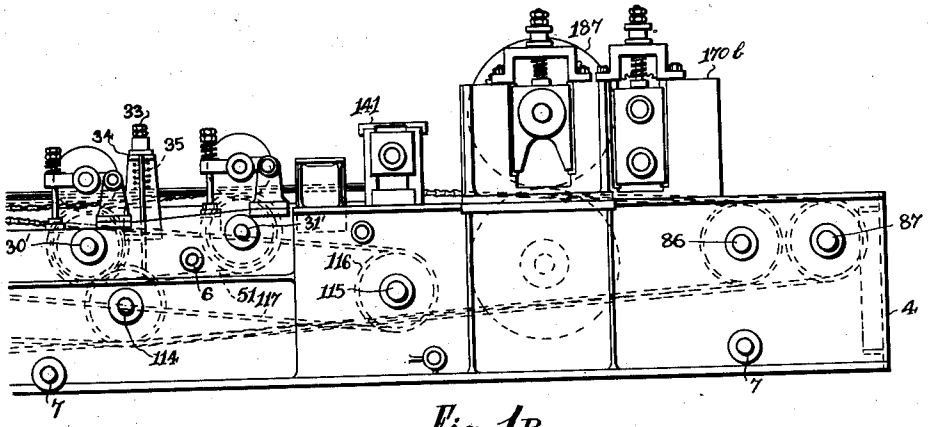


Fig. 1B.

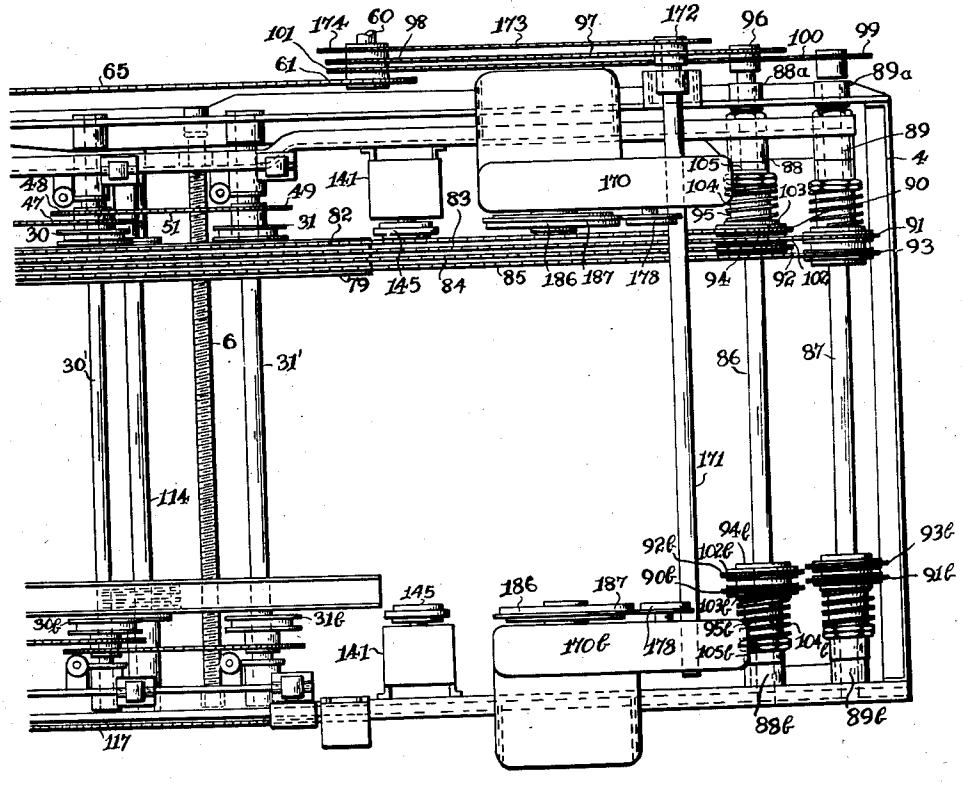


Fig. 2B.

Inventor
Andrew M. Kamper
By Lockwood, Dyer & Lockwood
Attys

May 21, 1935. A. M. KAMPER 2,002,265

APPARATUS FOR ATTACHING METAL STRIPS TO SHEETS OF WOOD, COMPOSITION BOARDING, OR THE LIKE

Filed March 23, 1933 9 Sheets-Sheet 3

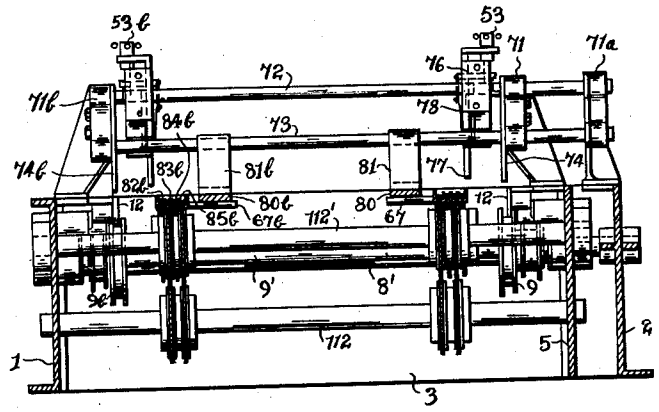


Fig. 3.

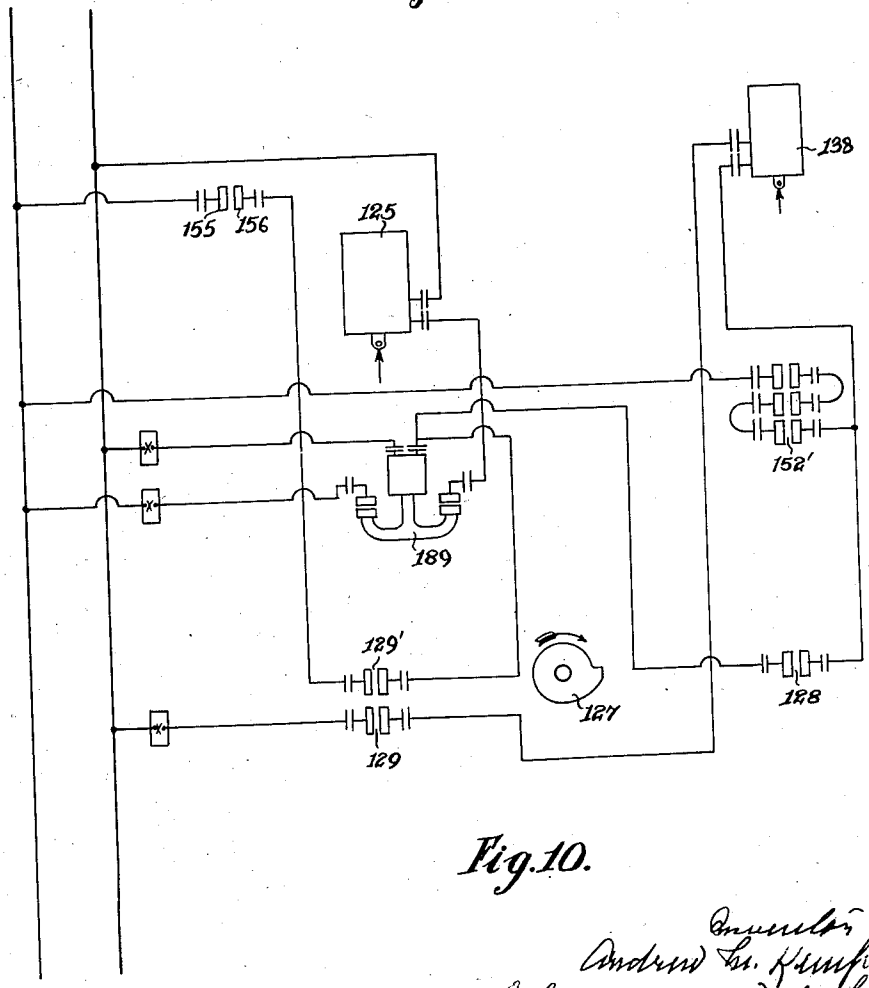


Fig. 10.

Inventor
Andrew M. Kamper
By Cushman, Bryant, Darby & Cushman
Attys

May 21, 1935. A. M. KAMPER 2,002,265

APPARATUS FOR ATTACHING METAL STRIPS TO SHEETS OF WOOD, COMPOSITION BOARDING, OR THE LIKE

Filed March 23, 1933 9 Sheets-Sheet 4

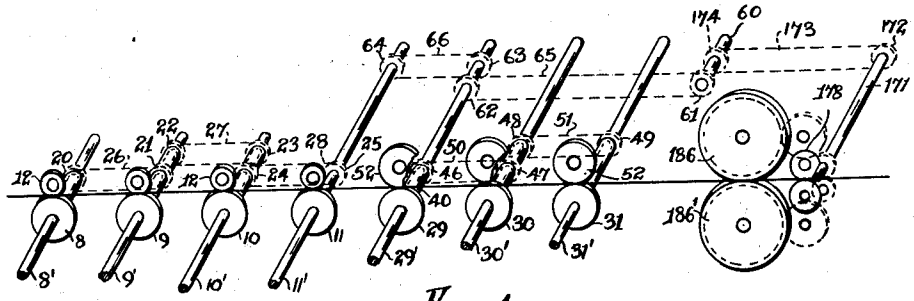


Fig. 4.

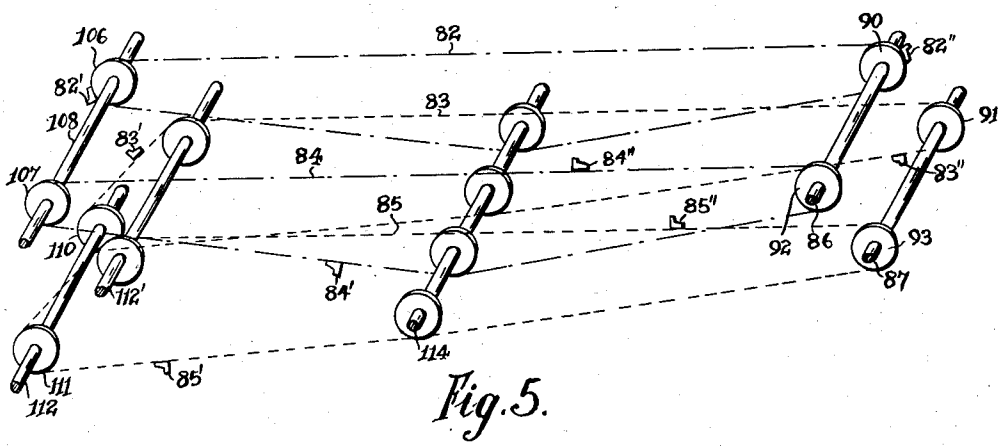


Fig. 5.

Inventor
Andrew M. Kamper
By Cushman, Darby & Cushman
Attys

May 21, 1935. A. M. KAMPER 2,002,265

APPARATUS FOR ATTACHING METAL STRIPS TO SHEETS OF WOOD, COMPOSITION BOARDING, OR THE LIKE

Filed March 23, 1933 9 Sheets-Sheet 5

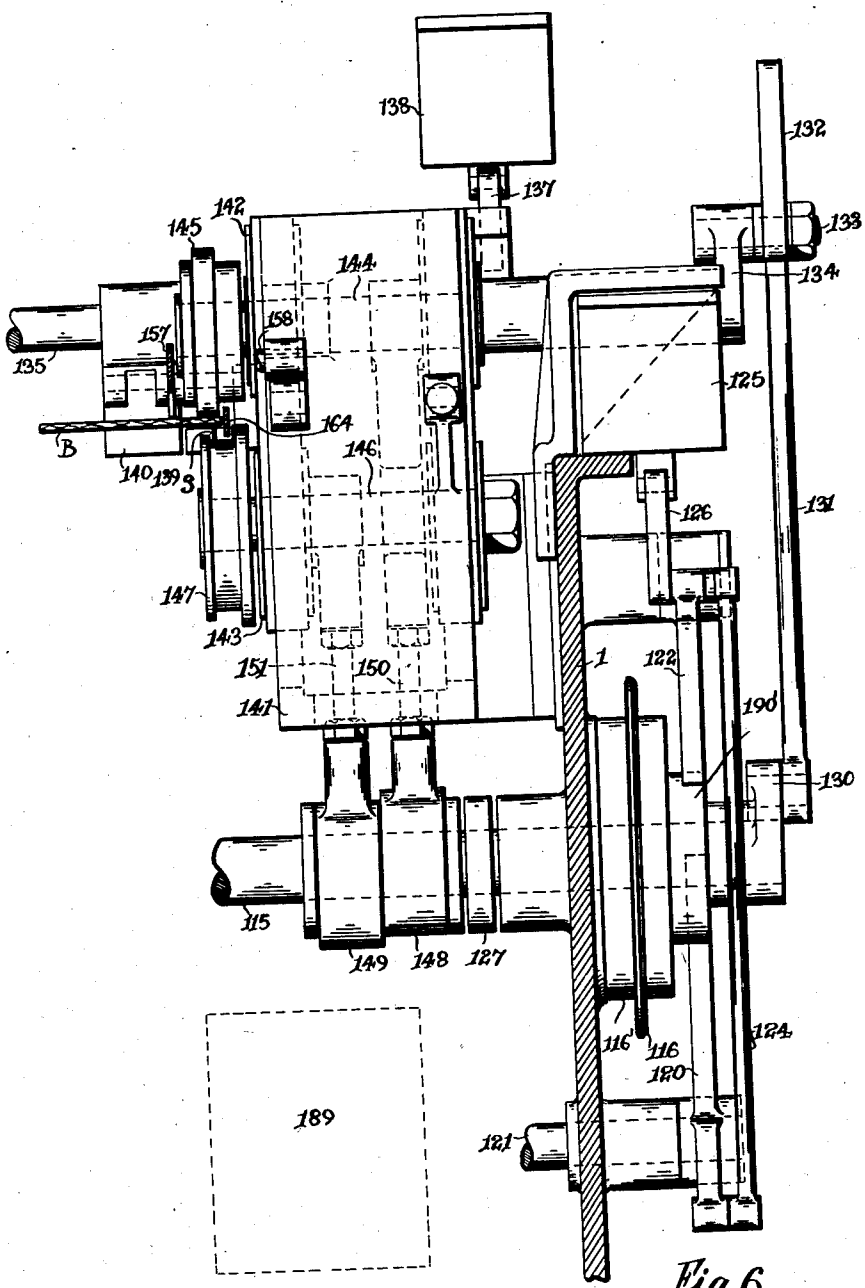


Fig. 6.

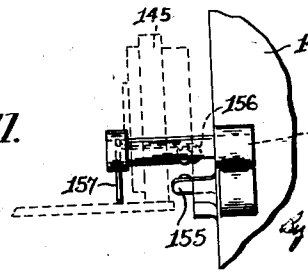


Fig. 11.

Inventor
Andrew M. Kamper
By Cushman, Darby & Cushman
Attys

May 21, 1935. A. M. KAMPER 2,002,265

APPARATUS FOR ATTACHING METAL STRIPS TO SHEETS OF WOOD, COMPOSITION BOARDING, OR THE LIKE

Filed March 23, 1933 9 Sheets-Sheet 6

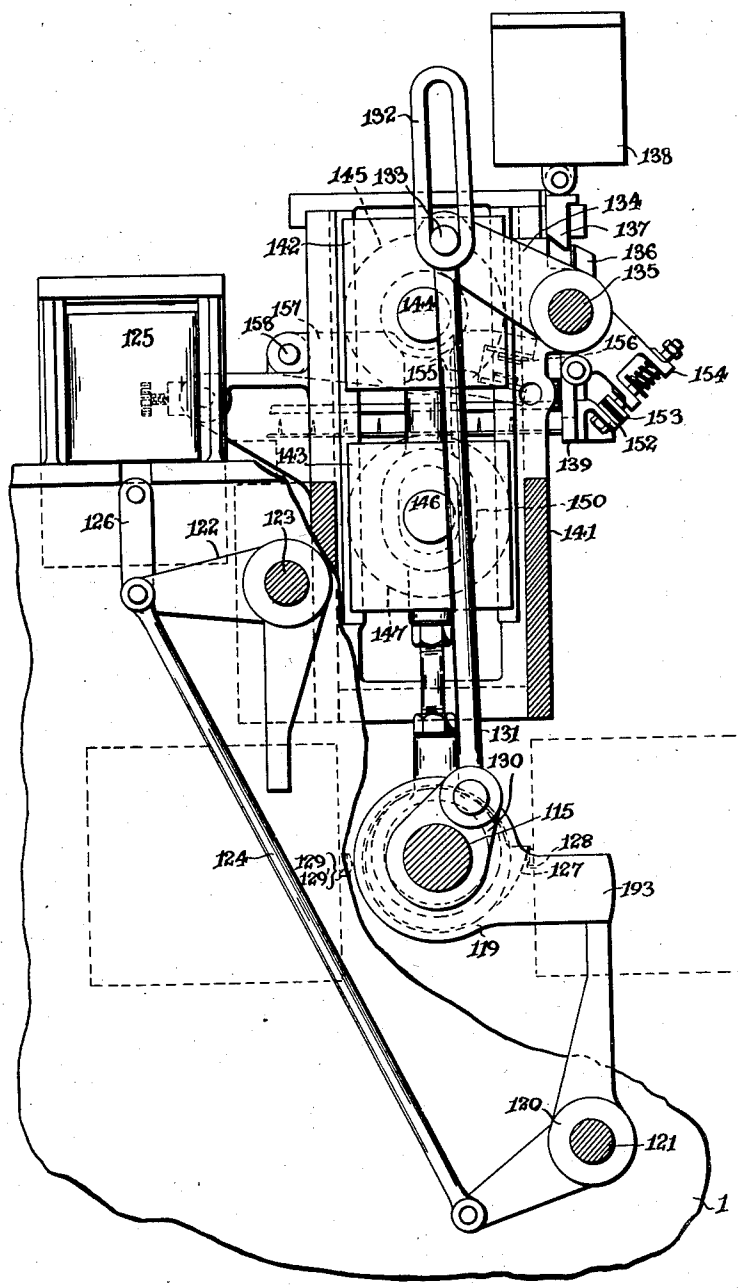


Fig. 7.

Inventor
Andrew M. Kamper
By Cushman, Bryant, Darby & Cushman
Attys

May 21, 1935. A. M. KAMPER 2,002,265

APPARATUS FOR ATTACHING METAL STRIPS TO SHEETS OF WOOD, COMPOSITION BOARDING, OR THE LIKE

Filed March 23, 1933 9 Sheets-Sheet 7

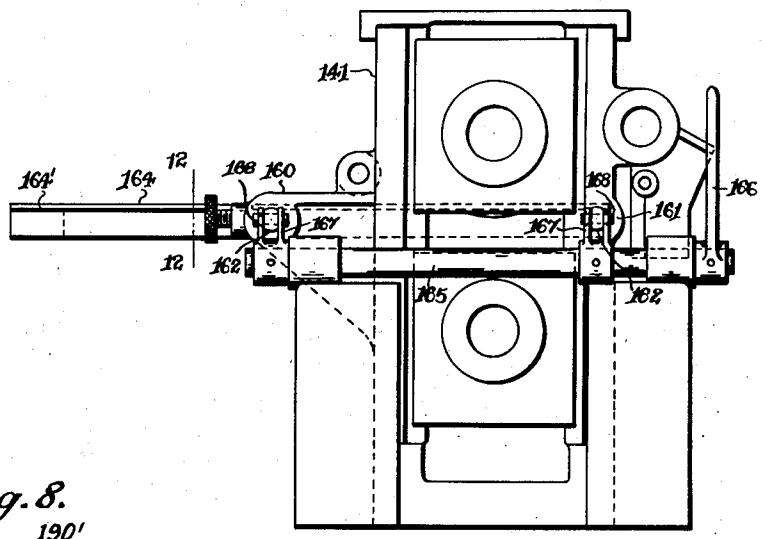
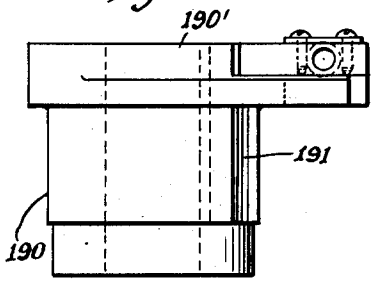


Fig. 13.

Fig. 8.



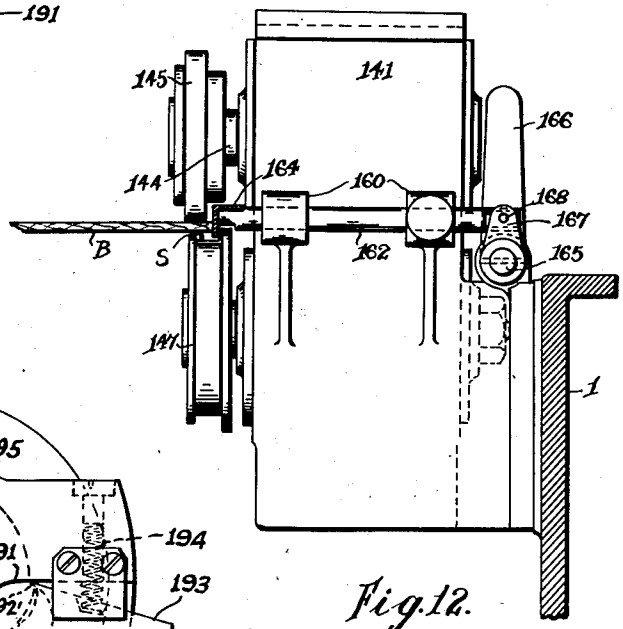
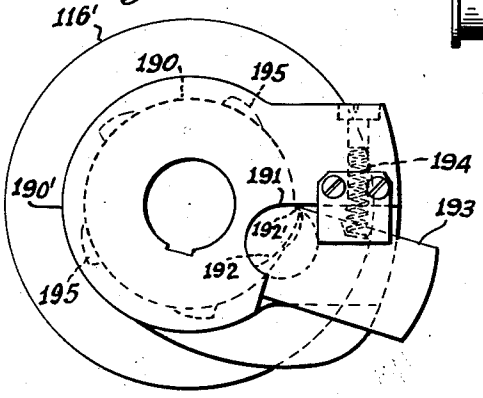


Fig. 12.

Fig. 9.



Inventor
Andrew M. Kamper
By Cushman, Darby & Cushman
Attys

May 21, 1935. A. M. KAMPER 2,002,265

APPARATUS FOR ATTACHING METAL STRIPS TO SHEETS OF WOOD, COMPOSITION BOARDING, OR THE LIKE

Filed March 23, 1933 9 Sheets-Sheet 8

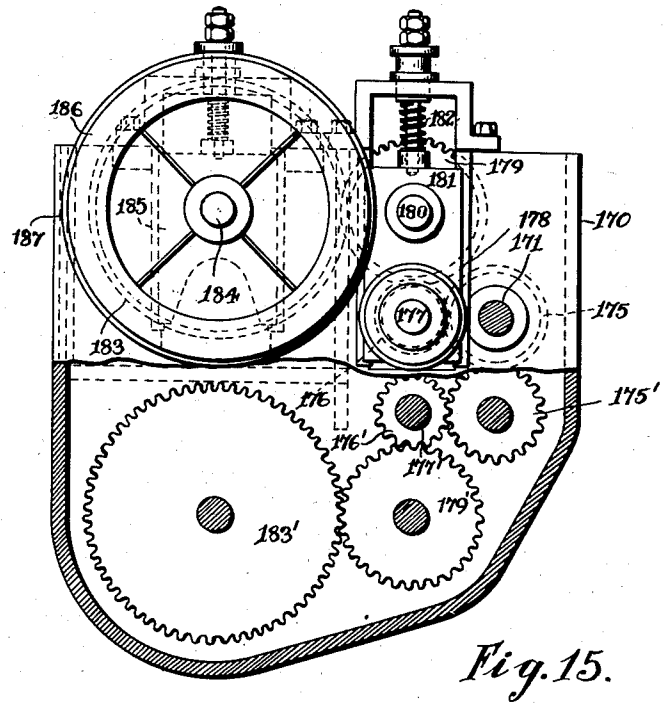


Fig. 15.

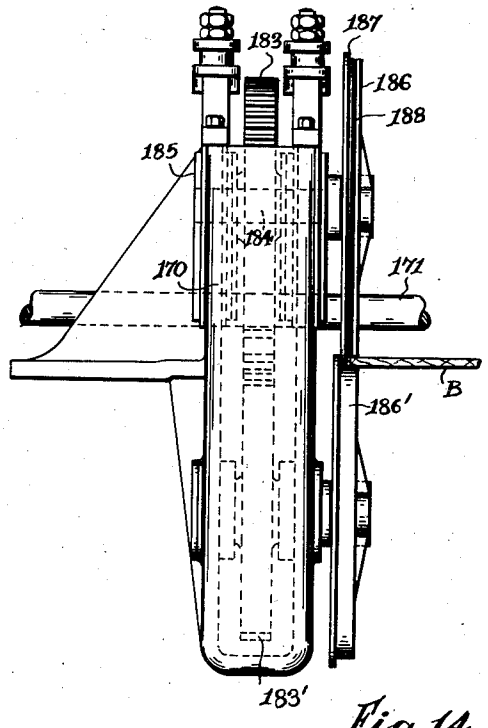


Fig. 14.

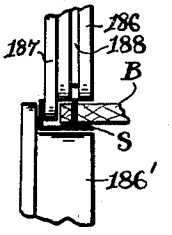


Fig. 16.

Inventor:
Andrew M. Kamper
By Cushman, Bryant, Darby & Cushman
Attys

May 21, 1935. A. M. KAMPER 2,002,265

APPARATUS FOR ATTACHING METAL STRIPS TO SHEETS OF WOOD, COMPOSITION BOARDING, OR THE LIKE

Filed March 23, 1933 9 Sheets-Sheet 9

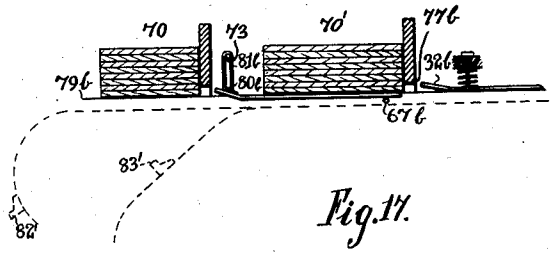


Fig. 17.

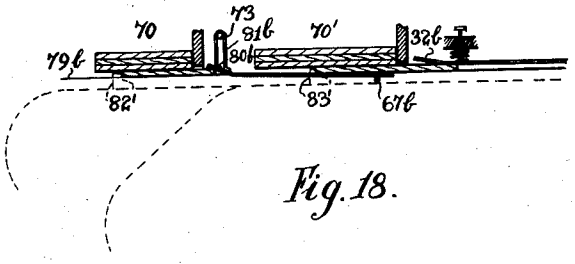


Fig. 18.

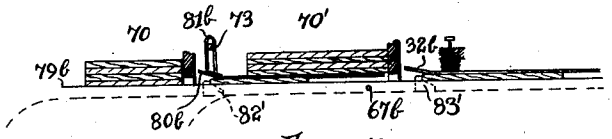


Fig. 19.

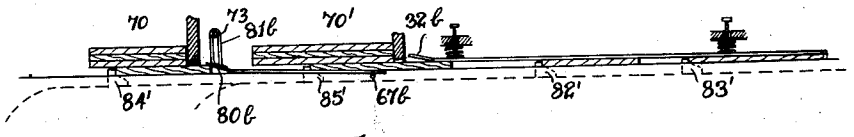


Fig. 20.

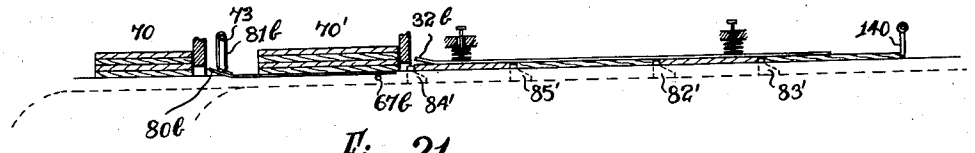


Fig. 21.

Inventor
Andrew M. Kamper
By Cushman, Darby & Cushman
Attys.

Patented May 21, 1935 2,002,265

UNITED STATES PATENT OFFICE

2,002,265

APPARATUS FOR ATTACHING METAL STRIPS TO SHEETS OF WOOD, COMPOSITION BOARDING, OR THE LIKE

Andrew Mathis Kamper, Surbiton, England, assignor to No-Nail Cases Proprietary Limited, London, England, a company incorporated with limited-liability of Victoria, Australia

Application March 23, 1933, Serial No. 662,400
In Great Britain April 2, 1932

18 Claims. (Cl. 1—12)

The present invention relates to apparatus of the kind adapted to attach metal strip to a sheet of wood, composition boarding or the like by causing a part of the metal strip to penetrate the wood or like penetrable material, and it is especially, but not exclusively adapted for attaching to a board a metal strip of angular cross section which serves to retain another board in a definite relationship with the first-mentioned board.

The operation with which this invention is concerned is performed, for example, in the assembly of containers, such as boxes, packing cases, crates or drums of the kind comprising a number of panel boards or staves held together by metal binding strip. In one design of container of this kind the metal strip is of channel section, or comprises a part of channel section, one of the limbs of the channel having the form of a series of teeth which are adapted to be driven into or through the edge of a panel board.

In one method of constructing such containers, a number of panel boards are secured to metal strips while the boards are in substantially the same plane, and the boards are subsequently moved out of the common plane into the position they will finally occupy in the finished container, this relative movement of the boards being permitted by yielding of the connecting portions of the metal strips.

An object of the present invention is the provision of apparatus for securing the toothed limbs of one or more such channel strips to a panel board.

A further object is to provide apparatus for securing one or more of such channel strips to a series of boards spaced at predetermined intervals.

A still further object is to provide apparatus which ensures that the channel strip and the panel board or boards will occupy a predetermined relative position after they have been secured together thereby.

Yet another object is the provision of apparatus for securing two lengths of channel strip symmetrically to the opposite edges respectively of a series of panel boards.

It is frequently required to assemble containers comprising panels of different dimensions, and accordingly another object of the invention is to provide means for feeding the apparatus with the different size panels in proper sequence, whereby manual selection of the panels may be obviated.

According to the present invention, apparatus of the kind set forth comprises means adapted to feed the metal strip and the sheet simultaneously to a device for securing them together by the application of pressure, means being provided which ensure that the strip, when brought into contact with the sheet, automatically occupies with respect thereto a predetermined position which is maintained while the strip and sheet are fed into the pressure device.

According to the invention in a further aspect, apparatus of the kind set forth comprises means adapted to feed the metal strip and a series of sheets to a device for securing the sheets in succession to the strip by the application of pressure, wherein there are provided means adapted automatically to maintain each sheet in a predetermined relationship with respect to an adjacent sheet or sheets and to the strip until the sheet thus located is secured to the strip by the pressure device.

According to a further feature of the invention, apparatus of the kind set forth comprises means adapted to feed a plurality of metal strips and a sheet simultaneously to a device for securing the strips to the sheet by the application of pressure, a movable stop disposed in the path of each strip and a movable stop disposed in the path of the sheet, said stops being adapted to prevent admission of the strips and sheet respectively to the pressure device, and means adapted to withdraw said stops simultaneously only when all of them are in contact with a strip or the sheet respectively.

The invention will be described, by way of example, with reference to the accompanying drawings which show apparatus for attaching a pair of toothed channel strips to the opposite edges of four rectangular wooden boards forming ultimately the lid, back, bottom and front of a packing case, one limb of the channel, which is in the form of a series of teeth, being forced into the boards at such a distance from their edges that a groove is formed between the edge of a board and the adjacent limb of the channel for accommodation of the edge of an end panel of the case.

In the drawings, Figs. 1A, 1B, and 2A, 2B, are respectively a side elevation and a plan of the apparatus, certain parts being omitted for the sake of clearness.

Fig. 3 is a sectional end elevation on the line 3—3 in Fig. 1A,

Fig. 4 is a diagrammatic view of the part of the strip feeding gearing on the left-hand side of the apparatus (as viewed from the end where the

strips are fed in) that is, the upper part as viewed in Figs. 2A and 2B,

Fig. 5 is a diagrammatic view of the part of the board feeding gearing on the left-hand side of the apparatus,

Fig. 6 is an end elevation of a detail,

Fig. 7 is a part sectional side elevation of the detail shown in Fig. 6,

Figs. 8 and 9 are respectively an under side plan and a side elevation to an enlarged scale of a part shown in Figs. 6 and 7,

Fig. 10 is a diagram of electrical connections,

Fig. 11 is an end elevation of a part shown in section in Fig. 6,

Figs. 12 and 13 are respectively an end and a side elevation of another detail,

Figs. 14 and 15 are respectively an end elevation and a part sectional side elevation of a further detail,

Fig. 16 is a view to an enlarged scale of a part of Fig. 14,

Figs. 17–21 are diagrams showing various stages in the feeding of boards.

The apparatus comprises series of feed rollers for drawing the channel strips into the machine and feeding them between rolling-in rollers which secure them to the boards, a plurality of band conveyors, the bands being in the form of endless chains, for transferring boards in the required sequence from a pair of board hoppers to the rolling-in rollers, movable stops serving to control the admission of boards and channels to the rolling-in rollers, and, associated with the stops, guides and auxiliary pressure rollers serving to bring the boards and channels into the desired relationship and maintain them in that relationship while they are fed between the rolling-in rollers.

The apparatus includes a fixed framework comprising side members 1 and 2 and end members 3 and 4 forming substantially an elongated rectangular frame. Adjacent to the side member 2 is fitted an inner side member 5 slidably mounted on transverse rods 7 and adapted to be slid towards and away from the member 2 by means of transverse screws 6 suitably journalled in the parts 1 and 2 and threaded in correspondingly screwed bosses on the part 5. Means for feeding the right hand and left hand strips into the apparatus are mounted respectively on the fixed frame member 1 and the movable member 5 whereby the gauge between pairs of strips can be readily adjusted.

The strip feeding mechanism (Figs. 1A, 2A and 4) includes four strip feeding rollers 8, 9, 10 and 11 mounted adjacent the movable frame 5 and four similar rollers 8*b*, 9*b*, 10*b* and 11*b* mounted adjacent the fixed frame member 1. The rollers 8, 8*b*, 9, 9*b* and 10, 10*b* are journalled respectively on transverse shafts 8′, 9′ and 10′ carried in bosses 16*a*, 16*b*, 17*a*, 17*b* and 18*a*, 18*b* respectively, formed in the fixed side frames and these shafts are also steadied by bosses 16, 17 and 18 respectively, provided in the movable frame 5. The rollers 11 and 11*b* are keyed to a shaft 11′ journalled in bearings 19*a*, 19 and 19*b*. The rollers 8, 9, 10 and 11 are capable of being slid along the shafts on which they are mounted so that they remain at a fixed distance from the movable frame 5.

Co-operating with each of the rollers 8, 8*b*, 9, 9*b*, and so on, is a loaded idler wheel 12 journalled on a radius rod 12′ which is pivotally mounted on a pin 12″ fixed to the adjacent frame member, the rollers 12 being of such a width that they engage the strip between the upstanding elements of the channel and maintain the base of the strip in contact with the tread of the larger rollers with which they co-operate.

Fixed to the rollers 8, 9, 10 and 11 are chain sprockets 20, 21 and 22, 23 and 24 and 25 co-operating with endless chains 26, 27 and 28 whereby the rollers 8, 9 and 10 are driven from, and at the same speed as the roller 11. Similar chain transmission is provided connecting the rollers 8*b*, 9*b*, 10*b* and 11*b*.

After the strips have been drawn into the machine by the rollers just described, they are transferred to a second series of feeding rollers 29, 29*b*, 30, 30*b*, 31, 31*b* mounted on shafts 29′, 30′ and 31′. The roller 29 is fixed to a chain sprocket 46 and is journalled on a sleeve 40 which is keyed on the shaft 29′, journalled at 42 in the movable side frame 5 and retained by lock nuts 43, a spring 44 compressed between lock nuts 45 secured to the sleeve 40 and the side of the sprocket 46 serving to urge the roller 29 into frictional engagement with a shoulder formed on the sleeve 40. The arrangement is such that the sprocket and roller normally rotate with the shaft 29′ on which they are mounted but are capable of slipping when the resistance offered to their rotation exceeds a predetermined value.

Adjacent the fixed side frame 1 is arranged a similar slippable drive clutch for the roller 29*b*.

The shaft 29′ is journalled in the frame members 1 and 2 and on its end are keyed two chain sprockets 62 and 63. The sprocket 63 is arranged to drive a sprocket 64 keyed to the shaft 11′ by a chain 66 while sprocket 62 is connected by a chain 65 to a sprocket 61 keyed to the driving shaft 60.

The chain sprocket 46 which is fixed to the roller 29 drives the roller 30 through a chain 50 and a sprocket 47, the roller 30 being journalled on the shaft 30′ which is carried by the frame members. A sprocket 48 fixed to the roller 30 drives the roller 31 through a chain 51 and a sprocket 49, the roller 31 being journalled on the shaft 31′ which is carried by the frame members.

The series of rollers 29*b*, 30*b* and 31*b* adjacent the side frame 1 are similarly arranged and therefore need not be described in detail.

Co-operating with each of the clutch driven rollers just described is a spring-loaded wheel 52 journalled on an arm 52′ which in turn is pivotally mounted on a bracket 52″ mounted on the fixed frame member 1 or the movable member 5 as the case may be. A rod 56 secured to the appropriate frame member carries a helical spring 55 which is compressed between lock nuts 57 and the arm 52′ and which serves to urge the wheel 52 into contact with the co-operating feed roller.

Near the end of the machine where the strips are fed in is provided a hopper 70 for the front and back panel boards. This hopper comprises a standard 71*a* mounted on the frame member 2 and a standard 71*b* mounted on the frame member 1. These two standards are united by rods 72 and 73. A standard 71 is mounted on the movable frame member 5 and adapted to slide along the rods 72 and 73. Side plates 74 and 74*b* are secured by screws 75 to the standards 71 and 71*b* respectively. The front of the hopper is provided with members 76 and 76*b* having pivoted lower ends 77 and 77*b* against which the leading edges of the boards rest. Springs 78 and 78*b* tend to maintain the pivoted members in the configuration shown, but permit them to yield under abnormal pressure. The parts 76, 76*b*, and 77, 77*b*

can be raised and lowered by adjusting screws 53 and 53b to suit various thicknesses of board. Between the hopper 70 and the outlet end of the machine is provided a hopper 70' for the lid and bottom panel boards, arranged similarly to the hopper 70, corresponding parts of the hopper 70' being denoted by dashed reference numerals.

For the purpose of transferring boards from the hoppers to the rolling-in rollers four pairs of conveyors are provided, one chain of each being adjacent the movable frame 5 and the second chain adjacent the fixed frame 1 (Figs. 1A, 1B, 2A, 2B and 5). Conveyors 82, 82b and 84, 84b are fed by the hopper 70 while conveyors 83, 83b and 85, 85b are fed from the hopper 70'. The top runs of these conveyors are accommodated in troughs 79 and 79b secured to the members 5 and 1 respectively. These troughs are interrupted between the hoppers 70 and 70' in order to allow chains 83, 83b and 85, 85b to pass beneath the portion of the troughs under the hopper 70.

The conveyors 82, 82b, 84, 84b are driven by a shaft 86 connected by a sprocket 96 and a chain 97 to a sprocket 98 on the motor shaft. The conveyors 83, 83b and 85, 85b are driven by a shaft 87 connected by a sprocket 99 and chain 100 to a sprocket 101 on the motor shaft. The shafts 86 and 87 are journalled at 88a, 89a, 88b and 89b in the members 2 and 1. Slidably keyed to the shaft 86 is a sleeve 95 journalled in a bearing 88 on the slidable frame 5. The inner end of this sleeve has the form of a disc 94 adjacent which is placed the sprocket 92 which drives the chain 84, the arrangement being similar to that of the corresponding sprockets 90b and 92b driving the chains 82b and 84b on the opposite side of the machine, which are more clearly shown in Fig. 2 as the conveyor chains have been omitted.

Two friction discs 102, 103 are slidably splined to the sleeve 95 and a spring 104 retained by lock nuts 105 on the sleeve 95 urges the disc 103 against a sprocket 90 driving the chain 82, the arrangement being such that the sprockets 90 and 92 normally rotate with the shaft 86 but either or both are free to slip when the load on the conveyors exceeds predetermined value. Sprockets 91 and 93 driving the chains 83 and 85 are drivably connected to the shaft 87 by means of a slippable clutch similar to that described with reference to the sprockets 90 and 92. The pair of sprockets 91b, 93b on the opposite side of the machine are connected to the shaft 87 by a similar slippable clutch.

The conveyors 82, 82b and 84, 84b supplied by the hopper 70 return round idler sprockets 106, 106b and 107, 107b journalled on a shaft 108 mounted in adjustable pads at 109 and 109b. The conveyors 83, 83b and 85, 85b are returned round sprockets 110, 110b and 111, 111b journalled on a shaft 112 mounted in adjustable pads 113 and 113b. The upper runs of the conveyors 83, 83b and 85, 85b are guided by idler sprockets journalled on a shaft 112'. The lower runs of all the conveyors pass under guide sprockets journalled on a shaft 114.

To each conveyor chain is fixed a pair of uniformly spaced dogs, as shown in Fig. 5, these dogs being adapted to withdraw boards from the hoppers and slide them along the troughs, the upper surfaces of which serve as runways, into the rolling-in rollers.

A pair of flat rails 80, 80b are secured at one end by slotted arms 81, 81b to the rod 73 on the hopper 70, their other ends resting on pins 67, 67b fixed to the troughs 79 and 79b in such a manner that the rails lie level with the upper edges of these troughs, except for their ends adjacent to the hopper 70, which are curved upwards.

A second pair of rails 32, 32b disposed above the troughs 79 and 79b respectively are supported by means of pins 33 slidably fitted in brackets 34 attached to the frame members 1 and 5. Springs 35 urge the rails towards the troughs.

Immediately beyond the last pair of strip feeding rollers is disposed the stop mechanism which regulates the admission of the boards and strips to the rolling-in rollers. This stop mechanism will be described with reference to Figs. 6–11. A transverse shaft 115 (Fig. 1B) journalled in the frame members is connected (Fig. 2B) by means of a chain 117 and sprockets 116 and 118 to the shaft 29'. The sprocket 116 forms the driving element of a clutch 119. In Fig. 7 this clutch is shown diagrammatically, and the sprocket 116 is omitted so as to reveal the parts behind. Referring to Figs. 8 and 9, the hub 116' of the sprocket 116 is journalled on a sleeve 190 keyed to the shaft 115 and having a flanged end 190'. A semicircular keyway 191 in the sleeve 190 houses a rotatable key 192 integral with a projecting arm 193 and journalled in the flange 190'. The arm 193 is urged in a clockwise direction by a spring 194 housed in the flange 190'. A number of recesses 195 are formed in the bore of the hub 116' so arranged that when the key 192 is opposite a recess 195 the key can be rotated by the spring 194 so that a shoulder 192' of the key engages with the recess and thus locks the sleeve to the sprocket. The projecting arm 193, upon meeting an obstruction, is rotated relatively to the sleeve 190 so as to displace the key 192 until it is flush with the surface of the sleeve, whereupon the hub 116' can rotate although the sleeve and shaft have been positively arrested.

A bell crank lever 120 (Figs. 6 and 7) journalled on a pin 121 fixed to the frame member 1 is adapted to engage the arm 193 of the clutch 119, while a second bell crank lever 122 journalled on a pin 123 and connected to the lever 120 by a link 124 is also adapted to engage the arm 193. A solenoid 125 is connected by a link 126 to the lever 122 in such a manner that when the solenoid is energized the levers 122 and 120 are drawn out of the path of the arm 193. A cam 127 fixed to the shaft 115 is adapted to engage with an electrical plunger switch 128 and also with a pair of plunger switches 129, 129' diametrically opposed to the switch 128. A crank 130 on the shaft 115 actuates a connecting rod 131 having a slotted eye 132 engaging with a pin 133 fixed in a lever 134 which in turn is fixed on a stop shaft 135 which extends from side to side of the apparatus. An oblique ended projection 136 fixed to the shaft 135 is adapted to engage behind an oblique ended bolt 137 connected to a solenoid 138 in such a manner that when the solenoid is energized the bolt 137 is disengaged from the projection 136 and the shaft 135 is thus permitted to rotate in an anticlockwise direction (Fig. 7). Pivoted to brackets attached to the shaft 135 are three stops. Two of these serve to prevent the strips from advancing, the right hand one (Fig. 6) being denoted by 139. A third stop 140 (Fig. 6) is similarly mounted and is adapted to prevent advance of boards. A casting 141 bolted to the frame member 1 and supporting the shaft 135 carries a pair of slides 142 and 143. The upper slide 142

carries a pin 144 on the inner end of which is journalled a flanged auxiliary pressure roller 145 adapted to bear on the upper side of a board B. The lower slide 143 carries a pin 146 on which is journalled a grooved auxiliary pressure roller 147 adapted to locate a strip S in the transverse direction. A pair of diametrically opposed excentrics 148 and 149 are keyed to the shaft 115 and connected by means of rods 150 and 151 respectively with the pins 144 and 146, the arrangement being such that when the shaft 115 is in the angular position shown, where the arm 193 of the clutch is in contact with the bell-crank lever 120, the rollers 145 and 147 are far enough apart from each other to allow a board B placed between them to move relatively to a strip S lying on the roller 147, while as the shaft 115 is turned through 180° so that the arm 193 is adjacent the bell-crank lever 122, these rollers are caused to approach each other and thus force the board into firm engagement with the strip.

A similar casting carrying a pair of pressure rollers actuated by excentrics is disposed on the opposite side of the machine and the stop which is adapted to prevent advance of the left-hand strip is disposed adjacent to this casting. On each of the strip and board stops is formed an electrical contact, as at 152 in Fig. 7, adapted to engage with an insulated contact 153 mounted on a bracket 154 carried by the shaft 135, so arranged that the contacts are normally open, but are closed when a strip or a board advances against the stop. The two strip contacts and the board contact are electrically connected in series, the set being denoted by 152' in Fig. 10. An insulated contact 155 (Figs. 7 and 11) mounted on the casting 141 co-operates with a moving contact 156 carried by an arm 157 pivoted on a pin 158 fixed to the casting 141. When a board is in position between the rollers, the arm 157 engages with the upper surface of the board and the contacts are thus kept open, while when there is no board between the rollers the arm drops and closes the contacts. A relay switch 189 is provided for controlling the solenoid 125, the electrical connections between the various switches and the solenoids being shown in Fig. 10.

The casting 141 is provided with bosses 160 and 161, (Figs. 12 and 13) which are bored to receive a pair of sliding bolts 162, to the inner ends of which are fixed an angular guide rail 164 having an outwardly turned end 164' and adapted to locate the edge of the board passing between the pressure rollers. A longitudinal shaft 165 suitably journalled on the casing and actuated by a handle 166 is connected by cranks 167 with pins 168 fitted into holes bored through the rods 162. As the handle 166 is moved towards and away from the centre of the machine the guide 164 moves correspondingly, the object of the arrangement being to permit the position of the edge of the board to be adjusted relatively to the strip, whereby the width of the groove formed between the edge of the board and the outer limb of the strip can be varied. A similar adjustable guide is provided on the opposite side of the machine.

The rolling-in rollers are accommodated in two housings 170 and 170b mounted on the frame members 5 and 1 respectively. As these two sets of rollers are in general similarly arranged except for the fact that one is right-handed and the other left-handed, it will be sufficient to describe only the set carried on the movable frame member 5 and shown in Figs. 14 and 15. A driving shaft 171, connected by a sprocket 172 and chain 173 to a sprocket 174 on the motor shaft (Fig. 2B) passes through the housing 170, being slidably keyed to a gear wheel 175 meshing with a pinion 176 fixed to a shaft 177 to which is keyed a wheel 178 serving to bend over the points of the teeth after they have been forced through the board. The pinion 176 meshes with an idler wheel 179 carried by a shaft 180, the two shafts 177 and 180 being journalled in a slide 181 which is urged downwards by springs 182. The idler wheel 179 meshes with a gear 183 fixed to a shaft 184 journalled in a spring loaded slide 185 and to which is fixed the upper rolling-in roller 186. The driving gear wheel 175 meshes with a similar wheel 175' driving a train of gears 176', 179' and 183' similar to the above described train except that their spindles are all journalled direct in the housing. The gear 176' is fixed to a shaft 177' to which is keyed a wheel co-operating with the wheel 178, and the lower rolling-in roller 186' is rigidly coupled to the gear wheel 183'. The periphery of the upper rolling-in roller (Fig. 16) is in the form of a cylinder having a flange 187 at the outer side thereof and in the cylindrical surface is formed a groove 188 arranged to provide a clearance space for the points of the strip teeth. The ratio of the gearing is such that the peripheral speeds of the rolling-in rollers and the tooth-bending wheels are equal and lower than the linear speed of the conveyors and the peripheral speed of the strip feeding rollers.

The apparatus operates as follows:

A supply of boards for the back and front of the case is stacked in the hopper 70, and a supply of boards for the lid and bottom is stacked in the hopper 70', each stack resting on the troughs 79 and 79b (Fig. 17). The conveyors are adjusted so as to bring the dogs into appropriate relationship, as shown in Fig. 5, which illustrates the conveyors on the left hand side. The conveyors on the right hand side are similarly adjusted, so that the dogs on any left hand chain are level with the dogs on the corresponding right hand chain. The driving motor is now started, and a pair of dogs 83' on the chains 83 and 83b engage the lowest board in the hopper 70', and slide it under the members 77 and 77b and thence under the rails 32 and 32b towards the stop (Fig. 18). A pair of dogs 82' on the chains 82 and 82b engage the lowest board in the hopper 70 and slide it under the rails 80 and 80b which consequently are forced upward, as shown in Fig. 19, so that the boards in the hopper 70' are automatically raised to allow the passage under them of the board from the hopper 70. In a similar manner dogs 85' on the chains 85 and 85b remove a second board from the hopper 70', and dogs 84' on the chains 84 and 84b withdraw the last board of the series from the hopper 70 (Fig. 20).

As the boards are pressed against the troughs by the spring-loaded rails 32 and 32b, the resistance thus imposed against their advance keeps them firmly pressed against the dogs, whereby any risk of their being displaced laterally is avoided. The leading board enters between the splayed ends 164' of the angular guide rails 164 which serve to centre it accurately. As soon as the board reaches the stop 140 (Fig. 6) it is thereby arrested, and the clutches driving the chains 83 and 83b begin to slip. The second board now advances until it is arrested by its leading edge contacting with the dogs 83' which maintain a predetermined interval between the first two boards, and the clutches driving the chains 82

and 82b now slip. In a similar manner the remaining boards are arrested so that the series of boards is assembled in front of the stop in predetermined relationship (Fig. 21).

Meanwhile two channel strips have been fed over the rollers 8 and 8b respectively and transferred by them and the succeeding continuously running rollers 9, 10, 11 and 9b, 10b, 11b to the groups of clutch driven rollers 29, 30, 31 and 29b, 30b, 31b respectively. If, say, the right-hand strip happens to be in advance of the left-hand strip, it will be arrested by the stop 139, and the clutch driving the rollers 29b, 30b, 31b will slip. The lagging strip meanwhile continues to advance, and as soon as it reaches its stop, the circuit through the series of contacts 152' (Fig. 10) is thus completed. The driving shaft 115 of the stop mechanism is in the position shown in Fig. 7, so that the cam 127 holds the switch 128 closed, and the closing of the stop contacts 152' thus energizes the relay switch 139 which in turn energizes the solenoid 125. This solenoid thereupon rocks the bell-crank lever 120 out of engagement with the clutch arm 193; the clutch 119 now engages and the shaft 115 begins to rotate clockwise (Fig. 7), drawing the auxiliary pressure rollers together and thus forcing the leading board and strips into secure engagement. Rotation of the cam 127 opens the switch 128 and thus de-energizes the solenoid 125, with the result that the bell-crank lever 122 rocks back into the path of the arm 193 and thus arrests the shaft 115 after it has turned 180 deg. The cam 127 now closes the switches 129 and 129'. Switch 129 completes a circuit through the solenoid 138 and the stop contacts 152', with the result that the stop bolt 137 disengages from the projection 136 on the stop shaft 135 and permits the stops to be rotated by the pressure of the strips and board far enough to allow them to be fed forward to the rolling-in rollers, which cause the teeth of the strips to penetrate the boards, the teeth being finally clinched over by the wheels 178. Since the rolling-in rollers advance the boards at a lower speed than the maximum speed of the conveyors, the conveyor drive clutches continue to slip and thus maintain succeeding boards firmly pressed against the dogs separating them from preceding boards; each board is accurately centered as it passes between the guide rails 164 and is thereafter securely engaged with the strips by the action of the auxiliary pressure rollers.

As the last board of the series leaves the pressure rollers, the contact arm 157 falls and closes the contacts 155 and 156, which complete a circuit through the switch 129' and the relay switch 139 so that the solenoid 125 is re-energized; the bell-crank lever 122 is thus disengaged from the clutch arm 193 and the shaft 115 is again set in rotation. The further movement of the cam 127 opens the switches 129 and 129' and thus de-energizes the solenoids 138 and 125. As the crank 130 rotates it rocks the stop shaft 135 by the agency of the rod 131 and the lever 134 until the bolt 137 re-engages behind the projection 136 thus resetting the stops; and the shaft 115 is arrested upon the arm 193 engaging with the bell-crank lever 120 in readiness for the cycle to be repeated.

The conveyor dogs are disengaged from behind the assembled boards as they descend round the conveyor driving sprockets; and as soon as a dog is thus released, the conveyor chain to which it is attached accelerates to its maximum speed. This ensures that ample intervals are left between the second dogs on the several conveyors for the next series of boards to be engaged between them in the succeeding cycle of operations.

The apparatus may be associated with a machine for making successive pairs of strips and delivering them into the strip feeding rollers at suitable intervals, in which case it will continue automatically to deliver assembled sets of boards and strips so long as the hoppers contain boards.

I claim:

1. Apparatus of the kind set forth comprising a device for securing a metal strip to a sheet by the application of pressure, a hopper adapted to contain a supply of sheets of one size, a runway leading from said hopper to said pressure device, a band conveyor for transferring sheets along said runway, a second hopper adapted to contain sheets of another size and disposed above said runway, a second band conveyor disposed parallel to said first-mentioned conveyor for transferring sheets from said second-mentioned hopper to said pressure device, and means which serve automatically to raise the sheets contained in said second-mentioned hopper so as to allow the passage thereunder of a sheet from said first-mentioned hopper.

2. Apparatus of the kind set forth comprising a device for securing a metal strip to a sheet by the application of pressure, a plurality of parallel band conveyors each adapted to transfer sheets to said pressure device, dogs attached to said conveyors and adapted to engage behind a sheet and to serve as distance pieces between sheets transferred by different conveyors, a movable stop adapted to prevent admission of the sheets to said pressure device, and an individual drive including a slippable clutch for each conveyor, whereby a series of sheets can be assembled at predetermined intervals preparatory to admission of the series to said pressure device.

3. Apparatus of the kind set forth comprising a device for securing metal strips to a sheet by the application of pressure, means adapted to feed a plurality of metal strips and a sheet simultaneously to said pressure device, a movable stop disposed in the path of each strip and a movable stop disposed in the path of the sheet, said stops being adapted to prevent admission of the strips and sheet respectively to the pressure device, and means serving to prevent withdrawal of said stops until all of them are in contact with a strip or the sheet respectively.

4. Apparatus of the kind set forth comprising a device for securing metal strips to a sheet by the application of pressure, means adapted to feed a plurality of metal strips and a sheet simultaneously to said pressure device, a movable stop disposed in the path of each strip and a movable stop disposed in the path of the sheet, said stops being adapted to prevent admission of the strips and sheet respectively to the pressure device, and means serving automatically to withdraw said stops simultaneously when all of them are in contact with a strip or the sheet respectively.

5. Apparatus of the kind set forth comprising a device for securing metal strips to a sheet by the application of pressure, separate means for feeding each of a plurality of strips simultaneously to said pressure device, a movable stop disposed in the path of each strip, a common driving shaft and a coupling device connecting each of said strip feeding means to said common driv-

ing shaft, said coupling device being of such a nature as to permit one strip to be advanced while another has been arrested.

6. Apparatus of the kind set forth comprising a device for securing metal strips to a sheet by the application of pressure, separate means for feeding each of a plurality of strips simultaneously to said pressure device, a movable stop disposed in the path of each strip, a common driving shaft and an individual drive including a slippable clutch connecting each of said strip-feeding means to said common driving shaft.

7. Apparatus of the kind set forth comprising a device for securing a metal strip to a sheet by the application of pressure, means for bringing the strip and the sheet into contact with each other in predetermined relationship, and thereafter feeding them simultaneously into said pressure device, a movable stop disposed on the entry side of said pressure device in the path of the strip, a pair of co-operating rollers adapted to bear on the strip and sheet respectively so as to press them together preparatory to their being secured together by said pressure device, and means adapted, upon a strip contacting with said stop, automatically to increase the pressure with which said rollers bear on the strip and sheet.

8. Apparatus of the kind set forth comprising a device for securing metal strips to a sheet by the application of pressure, means for feeding a plurality of metal strips and a sheet simultaneously into said pressure device, a movable stop disposed in the path of each strip and a movable stop disposed in the path of the sheet, said stops being adapted to prevent admission of the strips and sheet respectively to the pressure device, co-operating rollers adapted to press the strips against the sheet preparatory to their being secured together by said pressure device, and means for releasing said stops and increasing the pressure applied by said rollers between the strips and the sheet, said last-mentioned members being adapted to operate automatically only when all of said stops are in contact with a strip or the sheet respectively.

9. Apparatus of the kind set forth comprising a device for securing a toothed metal strip of channel section to a sheet by the application of pressure, means for feeding the strip and the sheet into said pressure device, guiding means serving to locate the strip transversely to its direction of motion into said pressure device, and guiding means adapted to locate a sheet transversely to its direction of motion into said pressure device, said pressure device serving to force a toothed limb of the strip into the sheet so as to form a groove between the edge of the sheet and the adjacent limb of the strip, the said strip-guiding means and said sheet guiding means being relatively adjustable whereby the width of said groove can be varied.

10. A pressure device adapted to secure a strip of channel section, a limb of which is in the form of a series of aligned teeth, to a sheet by causing the teeth to be driven through the sheet, said pressure device comprising a pair of co-operating rollers adapted to bear on the strip and sheet respectively, there being provided in the periphery of the roller that bears on the sheet a groove arranged to accommodate the points of the teeth.

11. Apparatus of the kind set forth comprising a pressure device including a pair of co-operating rollers adapted to secure to toothed metal strip to a series of sheets by the application of pressure, a plurality of conveyors each adapted to transfer sheets to said pressure device, dogs attached to said conveyors and adapted to engage behind a sheet and to serve as a distance piece between sheets transferred by different conveyors, an individual drive, including a slippable clutch, for each conveyor, a common driving shaft and transmission gearing connecting said driving shaft to said conveyor drive clutches and to said rollers in such ratios that the maximum linear speed of said conveyors exceeds the peripheral speed of said rollers.

12. Apparatus for delivering a series of sheets, comprising a hopper adapted to contain a stack of sheets, a runway, a band conveyor having dogs thereon said dogs serving to withdraw sheets from said hopper and slide them along said runway, a second hopper disposed above said runway and adapted to contain a stack of sheets, a second band conveyor having dogs thereon, said dogs serving to withdraw sheets from said second-mentioned hopper and slide them along said runway, a pair of rails disposed under said second mentioned hopper and longitudinally of said runway, the ends of said rails facing the direction of motion of the sheets being inclined upwards, and means for supporting said rails while permitting a limited displacement thereof whereby a sheet conveyed from said first-mentioned hopper along said runway when forced under the upwardly inclined ends of said rails causes said rails and the sheets contained in said second-mentioned hopper to rise clear of said runway.

13. In apparatus of the kind set forth, a device for securing a metal strip to a series of sheets by the application of pressure, a pair of parallel endless chain conveyors for feeding a sheet into said pressure device, a dog on each of said chains for engaging behind the sheet and serving as a distance-piece, a second pair of endless chain conveyors, disposed parallel to said first pair, for feeding a sheet to said pressure device, a power driven shaft, and gearing for transmitting power from said shaft to said conveyors, said gearing including a slippable clutch associated with each of said pairs of conveyor chains and serving as the sole means of transmitting power from said shaft to the pair of conveyor chains driven thereby.

14. Apparatus for attaching a metal binding and hinging strip to a series of sheets to form a folding-box blank, comprising a device for securing the strip to the sheets by the application of pressure, a hopper adapted to contain a supply of sheets of one size, a second hopper disposed between said first-named hopper and said pressure device and adapted to contain a supply of sheets of another size, at least one band conveyor leading from each of said hoppers to said pressure device, each of the bands of said conveyors having dogs adapted to engage behind sheets and spaced at an interval exceeding the length of the box blank, a movable stop in the path of the sheets on the entry side of said pressure device, and an individual drive for each of said conveyors, said drives including clutches which enable the leading sheet of the series to be arrested by said stop while a following sheet is still being advanced.

15. Apparatus for attaching a toothed metal binding and hinging strip to a series of sheets of penetrable material to form a folding-box blank, comprising means for feeding a series of sheets, arranged end to end in substantially the same plane, and a toothed strip disposed adjacent to

said series, and, arranged along the path of said strip and sheets, an auxiliary pressure device capable of forcing the strip teeth into preliminary engagement with the sheets, a pair of co-operating rollers capable of bearing on the strip and the sheets respectively and so spaced as to drive the strip teeth right through the sheets, the roller that bears on the sheet having a circumferential groove serving to accommodate the points of the strip teeth, and means for clenching over the protruding points of the strip teeth.

16. Apparatus for attaching a toothed and flanged metal binding and hinging strip to a series of sheets of penetrable material to form a folding-box blank, comprising a pair of co-operating rollers rotatable about parallel axes and so spaced and arranged as to be capable of driving the strip teeth fully home into the sheets, means for containing a supply of sheets, a conveyor system for withdrawing sheets from said supply means and assembling a series of sheets for one box blank into a predetermined position on the entry side of said rollers, so that said sheets lie end to end in substantially the same plane, means for feeding a length of strip, corresponding to the length of one box blank, into a position adjacent to said predetermined position of the series of sheets, and means which operate automatically, as a result of said strip and said series of sheets coming into juxtaposition, to feed said strip and said series of sheets between said rollers in one continuous rolling operation.

17. Apparatus for attaching a toothed and flanged metal binding and hinging strip to a series of sheets of penetrable material to form a folding-box blank, comprising a pair of rollers rotatable about parallel axes and so spaced and arranged as to be capable of driving the strip teeth fully home into the sheets, means for assembling, on the entry side of said rollers, a series of sheets for one box blank, arranged end to end in substantially the same plane, together with a strip lying adjacent to said sheets and for feeding the assembled sheets and strip between said rollers, a stop movable into and out of the path of said strip on the entry side of said rollers, an auxiliary pressure device disposed on the side of said stop remote from said rollers and having two relatively movable elements adapted to bear on the strip and the sheet respectively, power driven means for opening and closing said auxiliary pressure device by varying the spacing of said elements, and control mechanism which operates automatically, after said strip and said sheets are in juxtaposition, to actuate said power driven means so as to close said auxiliary pressure device and to withdraw said stop so as to permit the feeding of the strip and sheets between said rollers.

18. Apparatus for attaching a toothed and flanged metal binding and hinging strip to a series of sheets of penetrable material to form a folding-box blank, comprising a pair of co-operating rollers rotatable about parallel axes and so spaced and arranged as to be capable of driving the strip teeth fully home into the sheets, a movable stop on the entry side of said rollers, means for feeding a length of strip corresponding to the length of one box blank towards said rollers and into such a position that the leading end of said strip abuts against said stop, means for assembling a series of sheets for one box blank, arranged end to end and lying adjacent to said position, and means which operate automatically, as a result of said strip and said series of sheets coming into juxtaposition, to move said top out of the path of said strip and to feed said strip and said series of sheets between said rollers in one continuous rolling operation.

ANDREW MATHIS KAMPER.