Jan. 8, 1957 J. D. KLOPFENSTEIN 2,776,510

MACHINE FOR APPLYING FILMS TO BASE SHEETS

Filed June 23, 1953 5 Sheets-Sheet 1

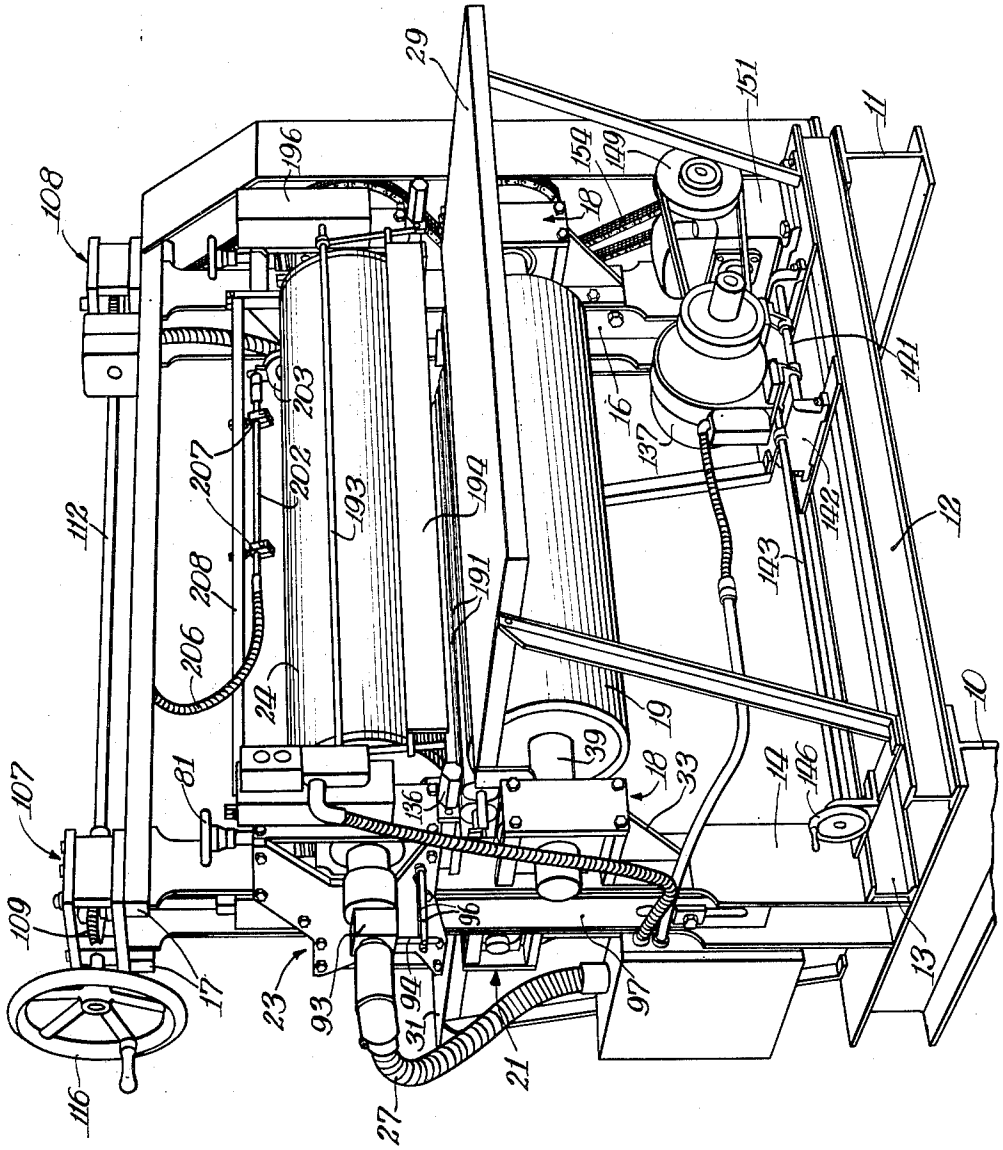

Fig. 1.

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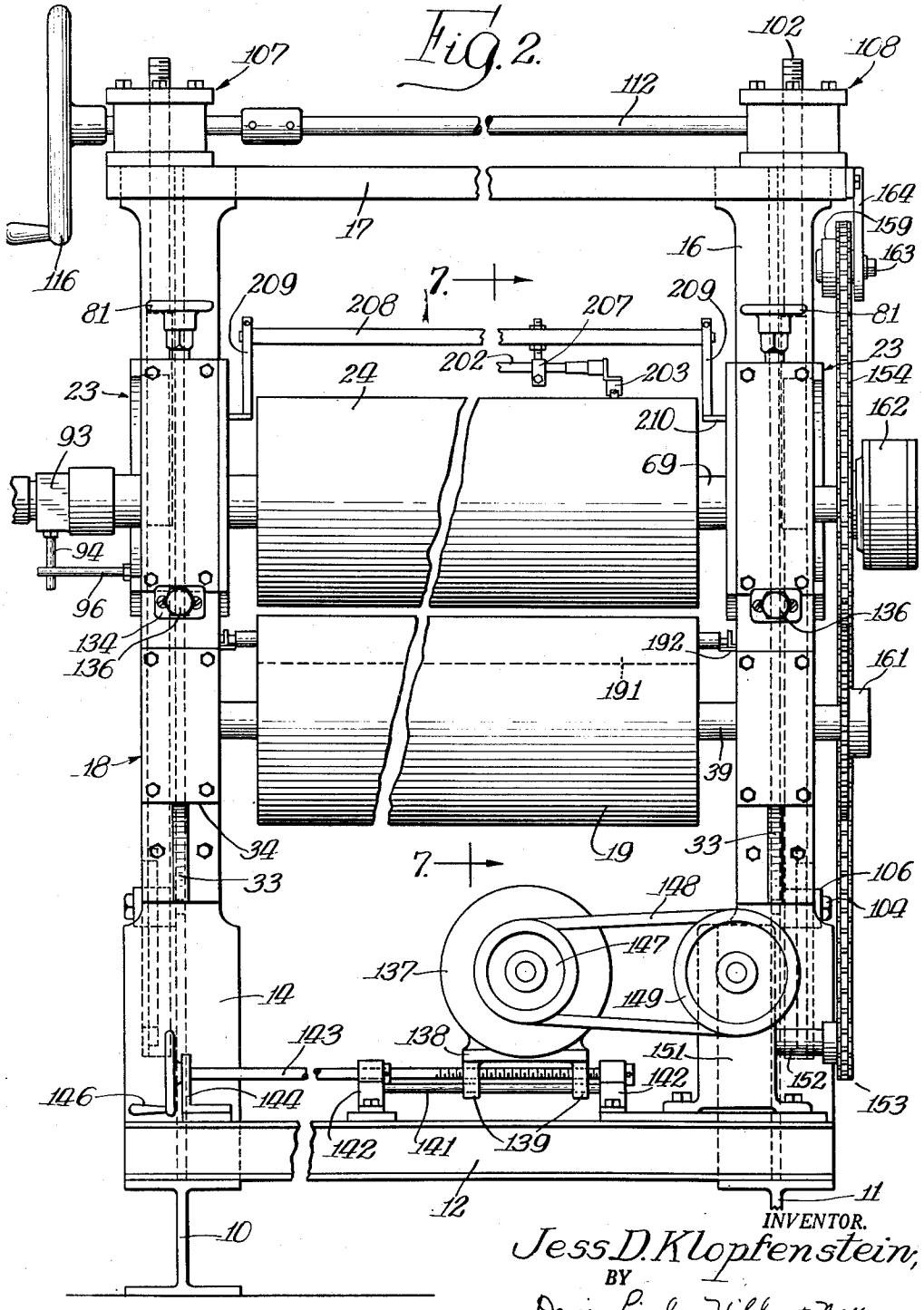
Fig. 2.



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MACHINE FOR APPLYING FILMS TO BASE SHEETS

Filed June 23, 1953 5 Sheets-Sheet 3

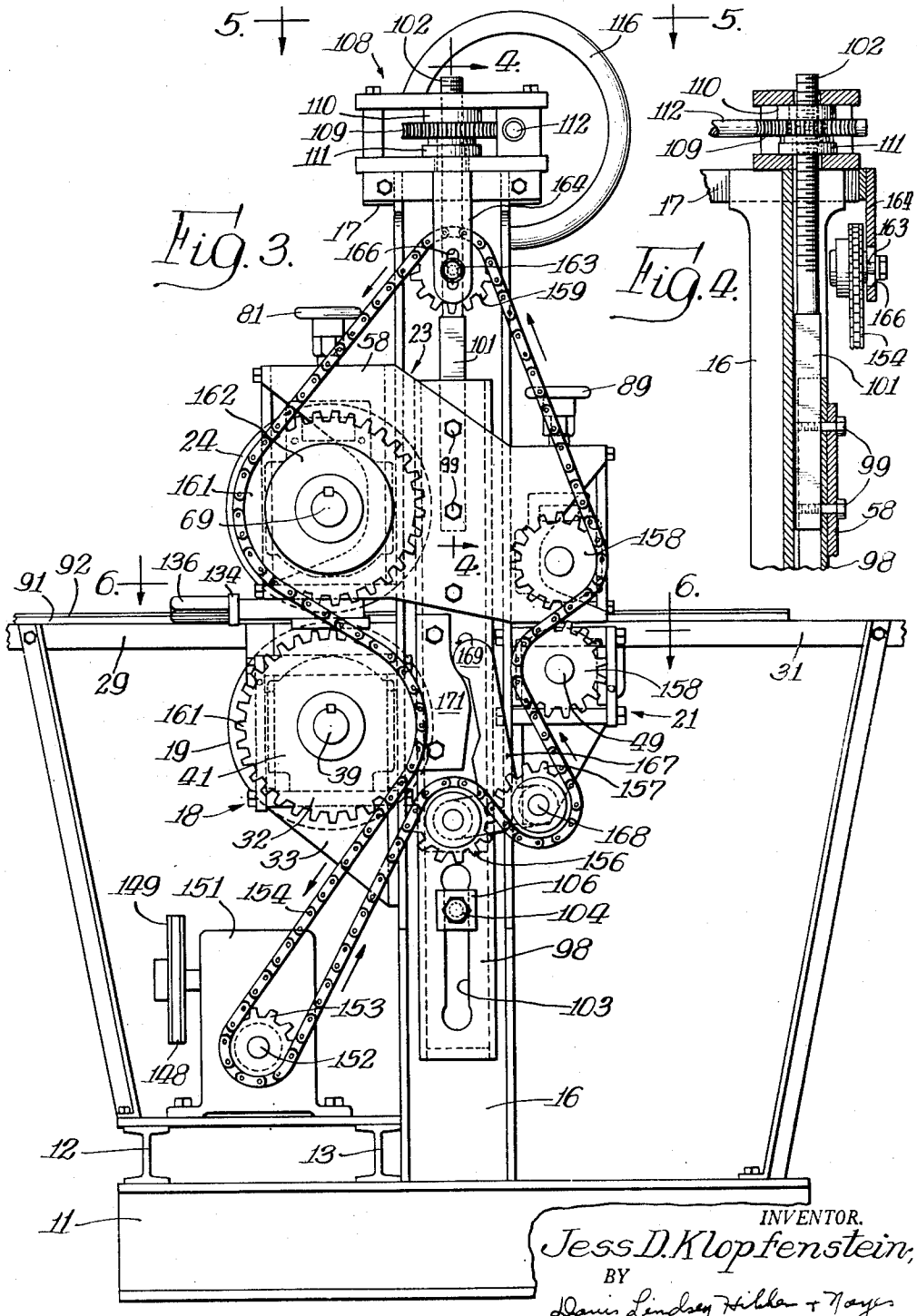

Fig. 3.

Fig. 4.

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MACHINE FOR APPLYING FILMS TO BASE SHEETS

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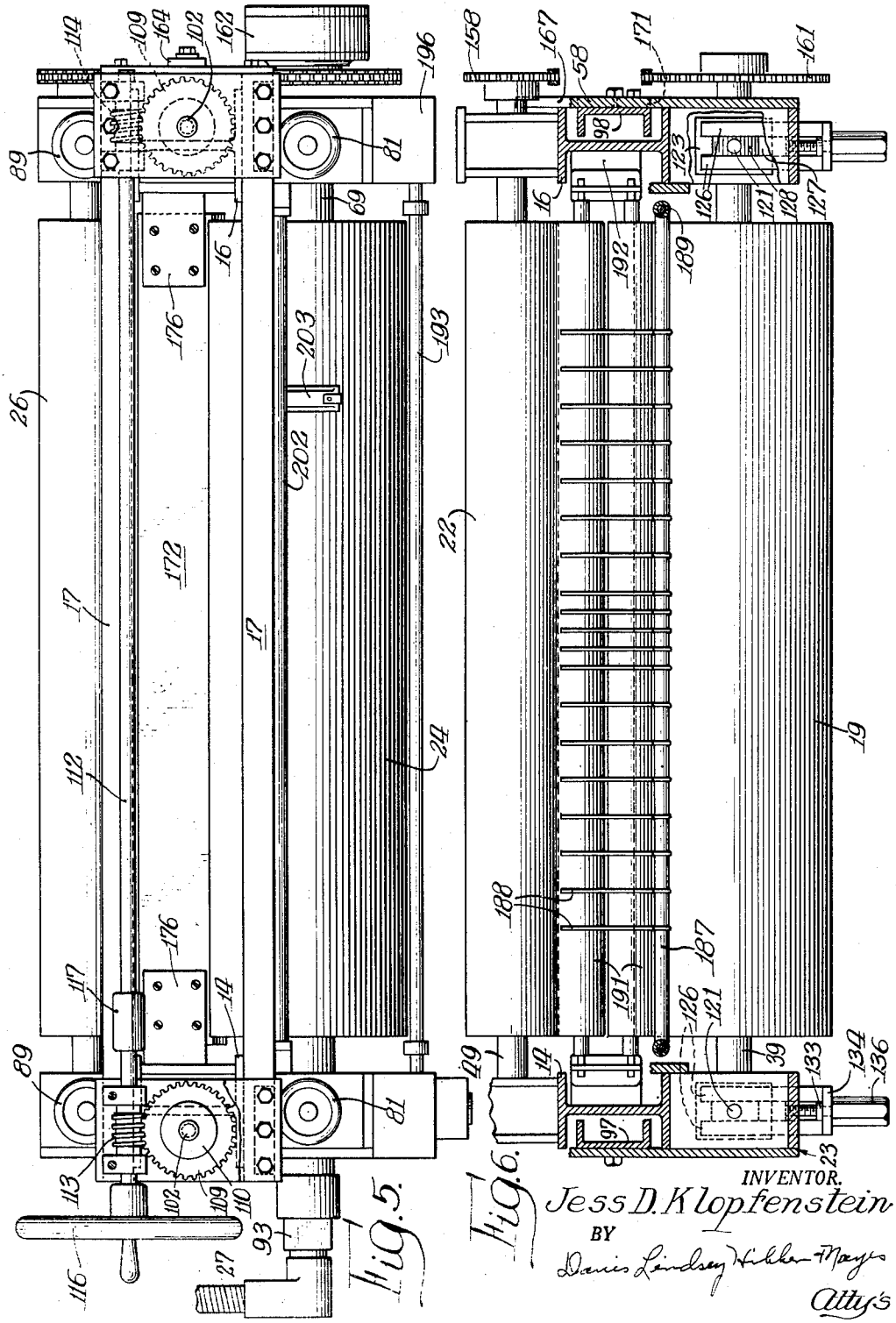

FIG. 5.

FIG. 6.

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MACHINE FOR APPLYING FILMS TO BASE SHEETS

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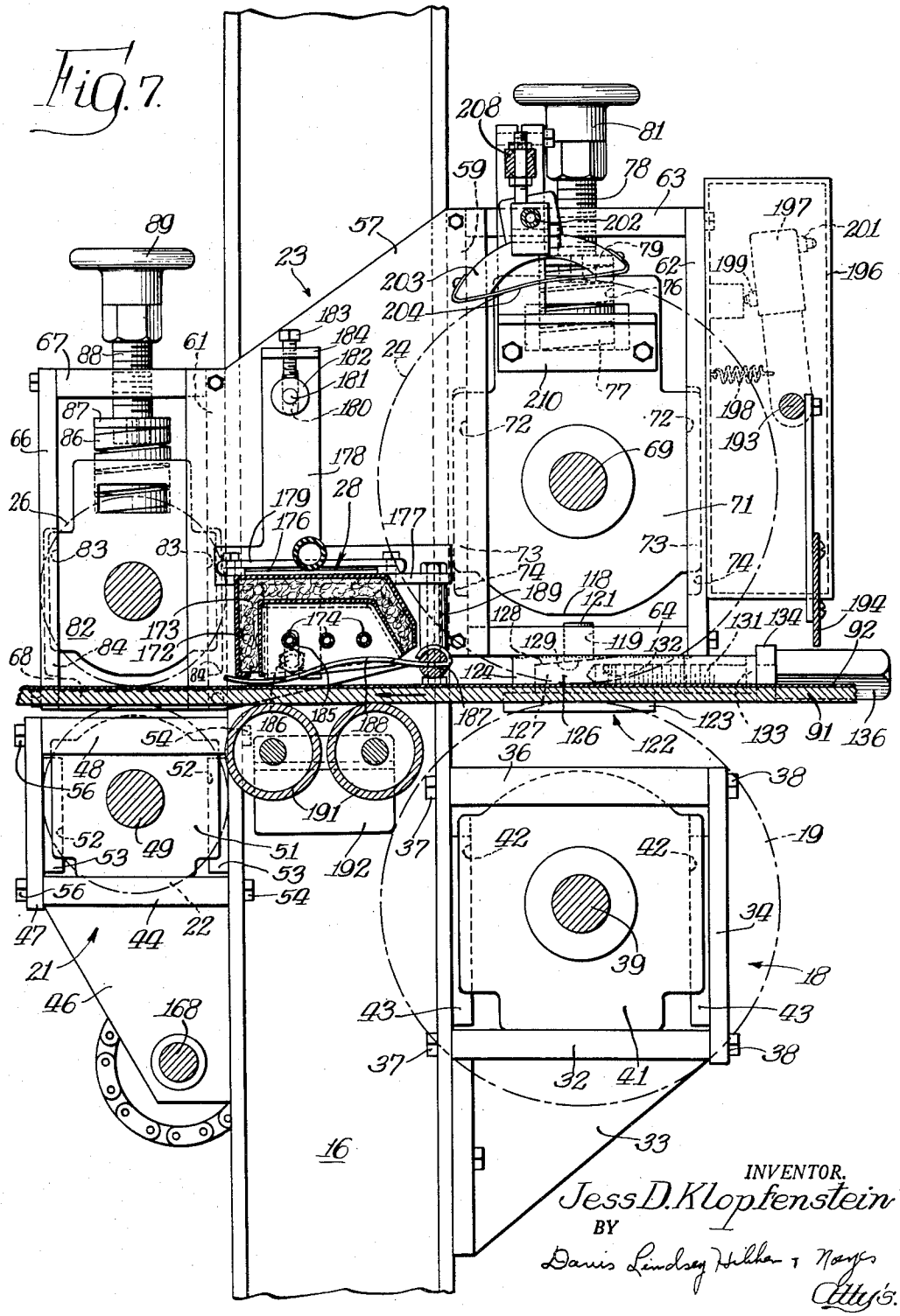
Fig. 7.



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United States Patent Office 2,776,510 Patented Jan. 8, 1957

2,776,510

MACHINE FOR APPLYING FILMS TO BASE SHEETS

Jess D. Klopfenstein, Oak Park, Ill., assignor to The Meyercord Co., Chicago, Ill., a corporation of Illinois

Application June 23, 1953, Serial No. 363,643

13 Claims. (Cl. 41—1)

This invention relates to improvements in the application of films to base sheets and more particularly to an improved roll type machine and method for applying decalcomania transfers by heat and pressure to base sheets of wood, fibrous materials and other types of sheet material.

In my U. S. Patent No. 2,643,475 there is described and claimed a novel machine of the foregoing character having a pair of opposed rolls between which a base sheet and a superimposed film may be passed under heat and pressure. As described therein, the machine is provided with an overrunning clutch arranged so that the driving connection with one of the rolls is disrupted in response to an increase in surface speed of the roll thereby permitting initial positive drive of both rolls followed by positive drive of only one roll and free running of the other roll. In this way both rolls rotate during the major portion of the process at the same surface speed thereby avoiding creepage, slippage or buckling of the thin transfer film relative to the base sheet.

One important application of a machine of the foregoing type is in the production of large wood panels of plywood, Masonite or the like having an artificial wood grain or other decorative finish, the desired finish being provided by a decalcomania transfer film which is firmly adhered or bonded by heat and pressure to the wood surface. It has been found that incomplete or faulty bonding of the decorative film is frequently encountered, especially along the marginal edges of the panels, because of irregularities and lack of smoothness in the surfaces of the original wood panels. During the sanding operation which takes place in the manufacture of plywood or Masonite sheets there is apparently an unavoidable tendency to sand off the marginal edges of the sheets a few thousandths of an inch more than the main central portions of the sheets. Consequently, the edges of the sheets tend to be rounded off to a degree which varies somewhat with individual manufacturers but is sufficient in most cases to cause a marginal edge bond failure on the order of 10 to 15% when the decorative film is applied by heat and pressure rolls.

As described in my patent hereinbefore mentioned, the base sheet or panel having a heat activatable coating of nitrocellulose or the like and the superimposed transfer film are passed between a pair of opposed pressure rolls. The roll in contact with the base sheet has a traction surface such as rubber, and the roll in contact with the transfer film is a heated metal roll which is necessary in order to activate the heat responsive material of the base sheet coating and the transfer film for bonding the latter to the base sheet. Under normal roll pressures the heated metal roll is unable to press the decorative film into tight engagement with the rounded-off edge portions of the base sheet and as a result sufficient heat does not penetrate the work to obtain a satisfactory bond in these areas. If excessive roll pressures are used, the transfer film is crushed or squeezed to such an extent that the desired decorative

appearance of the film is disfigured or destroyed. Consequently, the problem is presented of securing adequate bonding over the entire area of the base sheet in spite of edge rounding and other surface irregularities in the sheet while at the same time avoiding detrimental squeeze pressures between the rolls.

A primary object of the present invention is to provide an improved machine for applying a decorative film or the like to a base sheet which is capable of producing an effective bond of the entire area of the sheet.

A further object of the invention is to provide an improved machine of the foregoing character which is adapted to produce proper bonding of the film to the base sheet in spite of the presence of rounded marginal edges or other irregularities in the surface of the base sheet while at the same time avoiding the application of detrimental squeeze pressure to the film.

Another object of the invention is to provide an improved roll type machine of the foregoing character having novel means for adjusting the roll spacing and the associated drive means in order to accommodate work of different thicknesses.

Other objects and advantages of the invention will become apparent as this description progresses, reference being had to the accompanying drawings, in which:

Figure 1 is a perspective view of a machine comprising a preferred embodiment of the present invention;

Fig. 2 is a fragmentary front elevational view of the machine shown in Fig. 1;

Fig. 3 is an end or side elevational view of the machine as seen from the right end in Fig. 1;

Fig. 4 is a fragmentary sectional view of the upper portion of the machine as taken along the line 4—4 of Fig. 3;

Fig. 5 is a top plan view taken on the line 5—5 in Fig. 3;

Fig. 6 is a fragmentary horizontal sectional view taken on the line 6—6 in Fig. 3; and

Fig. 7 is a fragmentary sectional view on an enlarged scale as seen along the line 7—7 of Fig. 2.

Referring first to Figs. 1 and 7 of the drawings, a decalcomania applying machine comprising a preferred embodiment of the present invention is shown supported on a stationary base or frame comprising transversely extending H beams 10 and 11 at each side of the machine and a pair of spaced longitudinally extending I beams 12 and 13 welded or otherwise secured to the top sides of the transverse beams 10 and 11. A pair of upright posts or standards 14 and 16 (also H beams) are secured to the top side of the transverse beams 10 and 11 at the rearward portions thereof and near their upper ends they are united by a pair of cross-bars 17.

A pair of stationary bearing supports 18 are rigidly mounted on the standards 14 and 16 at the front or forward sides thereof for journaling a bottom inlet or feed roll 19 having a rubber traction surface. A similar pair of stationary bearing supports 21 are rigidly secured to the standards 14 and 16 at the back or rearward sides thereof for journaling a bottom outlet or delivery roll 22 which is of rubber for pressure application. A pair of vertically movable bearing boxes or supports, designated generally at 23 and hereinafter described in detail, are carried on the upright standards 14 and 16. The movable boxes 23 extend both forwardly and rearwardly from the standards 14 and 16 for rotatably mounting an upper feed roll 24 which coacts with the roll 19 and an upper delivery roll 26 which is the same as the roll 22 and coacts therewith. The roll 24 is a hollow metal roll having a plurality of internal electric heating elements which are connected through one end of the roll to suitable electrical conductors contained in a flexible conduit 27, as more fully illustrated and described in

my U. S. Patent No. 2,643,475. In addition, a radiant heating unit 28, more fully described below, is located between the inlet rolls 19—24 and the outlet rolls 22—26.

Thus, the machine comprises two sets of upper and lower rolls arranged side-by-side so that work may be fed from a feed table 29 at the front of the machine into the rolls 19 and 24, which are power driven at least in part, thence beneath the radiant heater 28, and finally discharged through the rubber pressure rolls 22 and 26 onto an outlet work-receiving table 31 at the rear of the machine. By this arrangement the difficulties heretofore encountered with faulty bonding due to surface irregularities in the base sheet are completely overcome and effective uniform adherence of the film to the base sheet is obtained.

As seen more particularly in Figs. 1, 2, and 7, the bearing supports 18 for the bottom feed roll 19 are box-shaped structures each comprising a base plate 32, a bracket 33, a front plate 34, and a pair of transversely spaced tie bars 36 extending between the front plate 34 and the upright standard 14 or 16. The supports 18 are rigidly mounted by screws 37 on the front walls of the standards and the front plates 34 are likewise detachably secured by screws 38 to facilitate access to the bearings. The roll 19 is provided with end shafts 39 which are journaled in a pair of bearing blocks 41 having channels 42 in their front and rear faces in which are slidably received a pair of opposed vertical guides 43 secured to the front plates 34 and to the uprights 14 and 16 at the front and rear of the bearing supports 18, respectively. The bearing blocks 41 are thus secured against lateral movement and rest upon the base plates 32 of their respective bearing supports. The roll 19 is an elongated metal cylinder on the outer surface of which is a relatively thick layer of rubber, as previously mentioned. This rubber layer is slightly compressible and by its gripping characteristics is adapted for frictional engagement with the under surface of a base sheet to drive the same between the feed rolls 19 and 24 during operation of the machine.

The stationary bearing supports 21 for the lower delivery roll 22 at the rear of the machine are similar to the supports 18, each support 21 comprising a base plate 44, a bracket 46, a cover plate 47, and a pair of tie bars 48. The end shafts, indicated at 49, of the roll 22 are journaled in a pair of bearing blocks 51 having channels 52 which coact with guide strips 53 in the same manner as in the bearing supports 18. The bearing supports 21 are rigidly mounted on the rear sides of the uprights 14 and 16 by a plurality of screws 54, and the cover plates 47 are detachably fastened by screws 56 as before.

The construction of the bearing boxes or supports 23 for the upper rolls 24 and 26 will best be understood by reference to Figs. 3 and 7. Each such bearing box 23 comprises a pair of parallel inner and outer plate members 57 and 58 disposed closely adjacent the inside and outside of each of the upright standards 14 and 16. The plates 57 and 58 are interconnected by transversely extending plates or walls 59 and 61 at the front and rear of the standards, respectively, thereby defining a central opening of rectangular cross section through which the corresponding upright standard 14 or 16 extends for slidable mounting of the bearing box relative to the standard. The plate members 57 and 58 comprising the inner and outer bearing box walls extend both forwardly and rearwardly of the upright standards 14 and 16 to define a pair of box-like bearing enclosures. At the front of each bearing box 23 a bearing support for the upper feed roll 24 is formed by a vertical cover plate 62, a top plate 63, and a bottom plate 64, all of which are bolted to each other and to the side plates 57 and 58. Similarly, at the rear of each bearing box 23 a smaller bearing enclosure for the upper pressure roll 26 is formed by a cover plate 66, a top plate 67 and a bottom plate 68 which are likewise bolted to each other and to the side plates 57 and 58.

The upper rolls 24 and 26 are journaled in bearing blocks which are generally similar to the bearing blocks 41 and 51 for the lower rolls hereinbefore described. Thus, the roll 24 is provided with end shafts 69 which are received within a pair of bearing blocks 71 mounted in the forwardly extending enclosures of the bearing box 23. The front and rear sides of each bearing block 71 are formed with elongated channel portions 72 in which are received a pair of vertical guide ribs 73 provided in the walls 59 and 62 of the bearing enclosure. As will best be seen in Fig. 7, the portions of the walls 59 and 62 carrying the guide ribs 73 are recessed, as at 74, to permit limited vertical sliding movement of the bearing blocks 71 relative to their housings. The upper portion of each bearing block 71 is formed with a cylindrical recess 76 for receiving a helical spring 77 which is seated therein and which extends above the bearing block 71. A pressure screw 78 is threaded in the top plate 63 and carries a thrust member 79 at its lower end and a handle 81 at its upper end for varying the degree of compression of the spring 77.

A similar arrangement is provided for journaling each end of the upper pressure roll 26 and comprises a bearing block 82 slidably mounted in the rearwardly extending portion of the box 23 by means of a pair of elongated channels 83 which coact with complementary guide ribs 84 provided in the housing walls 61 and 66. The bearing blocks are likewise slidable vertically to a limited degree relative to their enclosures, and a helical spring 86 coacts between the upper end of each bearing block 82 and a thrust washer 87 carried on a pressure screw 88. As before, the screw 88 is threaded in the top plate 67 of the bearing enclosure and has a handle 89 for adjustment of the spring pressure.

Prior to the introduction of a work piece between the respective sets of rolls, the upper bearing blocks 71 and 82 will rest on the bottom plates 64 and 68 of the respective bearing enclosures. However, when a piece of work, such as a base sheet 91 and a superimposed film 92, as illustrated in Fig. 7, is fed in between the rolls, the upper rolls 24 and 26 will be forced upwardly to a slight degree corresponding substantially to the thickness of the work. The vertical slidability of the bearing blocks 71 and 82 permits this upward movement of the upper rolls and the springs 76 and 86 are thus compressed during upward shifting of the rolls so that the work is subjected to a predetermined resilient spring pressure between the respective sets of upper and lower rolls. Obviously, the roll pressure between the feed rolls 24—19 and the roll pressure between the delivery rolls 26—22 can thereby be adjusted independently of each other by means of the pressure screws 78 and 88. As hereinbefore mentioned, the upper feed roll 24 is made of metal in order to permit heating thereof and as a result there is a limit to the amount of pressure which can be exerted between the rolls 24 and 19 without crushing and disfiguring the transfer film 92. However, the pressure or delivery rolls 22 and 26 are both compressible and resilient so that the screws 88 can be adjusted to provide a substantially greater pressure loading between these rolls thereby obtaining intimate final bonding between the film 92 and the base sheet 91 without crushing the film.

As described in greater detail in my U. S. Patent No. 2,643,475, the electrical conductors extending from the conduit 27 into the electrical resistance heating elements contained within the roll 24 extend through a hollow shaft which is concentric with the stub shafts 69 provided for journaling the roll 24 in its bearings. In order to prevent rotation of this hollow conductor shaft (not shown), I provide a square collar 93 (Figs. 1 and 2) which is rigidly mounted on the hollow shaft and has a depending bar 94. The bar 94 extends between a pair

of spaced rods 96 which project outwardly from the bearing box 23 mounted on the upright standard 14. It will be readily understood that this arrangement prevents rotation of the hollow shaft which carries the electrical conductors but at the same time does not interfere with vertical adjustment of the upper roll 24 relative to the lower roll 19, as hereinafter described.

For slidably mounting the bearing boxes 23 on the upright standards 14 and 16, I provide a pair of elongated upright channel members 97 and 98 which are rigidly bolted to the outer plates 58 of the bearing boxes 23 carried on the standards 14 and 16, respectively. Thus, the channel members 97 and 98 are received within the outermost channel portions of the H beams comprising the upright standards 14 and 16, as best seen in Fig. 6. Referring particularly to Fig. 4, the upper end portions of the channel members 97 and 98 have secured thereto, as by screws 99, a pair of elongated hanger rods 101 having threaded upper end portions 102 projecting upwardly above the standards 14 and 16 for operative engagement with an adjusting mechanism which coacts with the threaded hanger rods for raising or lowering the bearing boxes 23 relative to the standards 14 and 16. It will be understood that in this manner the spacing of the upper rolls 24 and 26 carried by the bearing boxes 23 may be readily adjusted relative to the fixed rolls 19 and 22. For guiding the vertical movement of the boxes 23 on the standards 14 and 16, the lower end portions of the channel members 97 and 98 have elongated slots 103, and a cap screw 104 carrying a slide block 106 projects through the elongated slot 103 of each channel member into the corresponding upright standard for insuring vertically aligned sliding movement of the channel members 97 and 98 relative to their respective standards. In this way, inadvertent cocking of the bearing boxes 23 and binding thereof against the front and rear sides of the upright posts or standards 14 and 16 is avoided.

The adjusting mechanism for raising and lowering the threaded hanger rods 101 comprises a pair of worm gear boxes 107 and 108 mounted on the cross-bars 17 at the upper ends of the standards 14 and 16, respectively. The worm gear boxes 107 and 108 are each apertured at the top and bottom thereof for permitting the upper threaded end portions 102 of the hanger rods 101 to extend therethrough (Fig. 4). A worm gear 109 is supported on each of the threaded rod portions 102 within the gear boxes by means of a bushing 110 rigidly secured to the upper flat face of the worm gear 109 and having a threaded axial bore operatively engaging the threaded portion 102 of the hanger rod. A thrust bearing 111 is interposed between each of the wormgears 109 and the bottoms of their respective gear boxes. By rotation of the worm gears 109 in either direction it will be readily understood that the hanger rods 101 and the bearing boxes 23 suspended thereon are thereby raised or lowered as required.

For raising or lowering both of the hanger rods 101 simultaneously, I provide an elongated shaft 112 (Fig. 5) extending between the bearing boxes 107 and 108 and journaled therein rearwardly of the uprights 14 and 16. A pair of worm gears 113 and 114 are carried on the worm shaft 112 in operative engagement with the worm gears 109, and a hand wheel 116 is affixed to a projecting end portion of the shaft 112 adjacent the upright 14 for manually rotating the shaft 112 and thereby operating both of the worm gears 109 simultaneously. For independently adjusting the elevation of the opposite ends of the rolls 24 and 26 in order to obtain parallelism between the upper and lower rolls when the machine is adjusted for initial operation, the worm shaft 112 has a two-piece construction with a coupling 117 detachably connecting the two parts of the shaft. Thus, the coupling 117 may be loosened, the shaft parts rotated relative to each other to raise or lower one of the supports 23 independently of the other in order to obtain parallelism between the upper and lower rolls, and the coupling 117 retightened. Thereafter, both of the bearing boxes 23 may be moved vertically at the same time and to the same extent so that the upper rolls 24 and 26 will be maintained in predetermined parallel relationship with the lower rolls 19 and 22 for all vertically adjusted positions.

Although the mechanism just described provides for vertical adjustment of the upper rolls 24 and 26 as a unit, it will be desirable on occasion to effect vertical adjustment of one of the upper rolls relative to the other without disturbing the elevation of the bearing boxes 23 relative to the standards 14 and 16. For this purpose, a sliding wedge arrangement (Fig. 7) is provided at each end of the upper feed roll 24. As hereinbefore mentioned, the bearing blocks 71 normally rest on the bottom plates 64 of their enclosures but are free to slide upwardly relative to the enclosures and against the pressure of the springs 76 when the work is fed between the rolls 24 and 19. The bottom edges of the bearing blocks 71 are flattened, as at 118, for firm supporting engagement on the bottom plates 64. However, each of these bottom plates 64 has an aperture 119 for slidably receiving an upright lifting stud 121 which may be adjusted to project upwardly above the bottom plate 64 for engaging the flattened portion 118 of the corresponding bearing block 71. A rectangular channel track housing 122 comprising a bottom plate 123, a rear plate 124, and a pair of spaced side plates 126 defining a channel track therebetween is rigidly secured, as by welding, below the bottom plate 64 of each bearing enclosure. A wedge member 127 having a tapered upper surface 128 slidably engaging a tapered lower surface 129 on the lifting stud 121 is slidably mounted within the channel track in the housing 122, and an elongated adjustment screw 131 extends into the forward end of the housing 122 and is operatively engaged with a threaded bore 132 in the wedge 127. The outer end of the adjusting screw 131 carries a rigid thrust member 133 which coacts with the rear side of a front plate 134 secured to the front ends of the channel sides 126, and a hexagonal handle portion 136 is also provided which coacts with the front side of the plate 134 for manually adjusting the screw 131.

By manipulating the hexagonal head 136 of the adjusting screw 131, the sliding wedge 127 may be shifted forwardly or rearwardly of the machine for lowering or raising the position of the lifting stud 121. In the position of the device illustrated in Fig. 7, the wedge 127 has been moved inwardly of its housing 122 to a sufficient extent to cause the lifting stud 121 to project slightly above the bottom plate 64 of the bearing enclosure for the bearing block 71. Thus, when there is no work piece interposed between the upper and lower rolls 24 and 19, the lower flattened portion 118 of the bearing block 71 will rest on the upper end of the lifting stud 121 rather than on the bottom plate 64 and in this manner the relative spacing between the rolls 24 and 19 will be increased slightly without disturbing the spacing between the rolls 26 and 22 as determined by the adjustment of the bearing boxes 23 on the standards 14 and 16. By reason of this arrangement and also by reason of the adjustability of the bearing boxes 23 and the individual pressure loading adjustments for each of the upper rolls 24 and 26, the invention provides a high degree of flexibility of operation to meet the requirements of different types of work and affords many different combinations of roll spacings and pressure loadings.

It will be understood that the sliding wedge arrangement just described in connection with the upper feed roll 24 could also be provided for the upper delivery roll 26 with the same operating advantages and results. In either case, the bearing boxes 23 and the pressure adjusting screws 78 and 88 are first regulated to provide the desired operating relation between one set of rolls and then the wedge adjustment mechanism can be manip-

ulated to obtain any desired slight differential in roll spacing and operating relation for the other set of rolls.

Referring now to Figs. 2, 3 and 4, in particular, the feed and delivery rolls are each positively driven by means of an electric motor 137 through a chain and sprocket drive. The motor 137 is mounted on a base 138 having depending flanges 139 which are in turn slidably supported on two spaced elongated rods 141 extending between a pair of spaced upright supports 142 secured across the I beams 12 and 13. An elongated threaded screw 143 is journaled between the supports 142 and has a threaded engagement with the depending flanges 139 of the motor base. The outer end of the screw 143 is journaled in a bracket 144 and has secured thereto an operating wheel or handle 146 so that by rotating the screw 143 the motor 137 can be shifted for varying the drive ratio and the rotating speed of the rolls. This latter result is accomplished by means of a variable speed pulley 147 mounted on the motor shaft, the driving diameter of the pulley 147 being self-adjusting as the motor 137 is shifted in one direction or the other as is well understood in the art.

A belt 148 extends around the pulley 147 and around a larger pulley 149 which is rotatably supported from a gear box 151 containing reduction gearing (not shown) of conventional form. A drive shaft 152 projects from the gear box 151 at the drive end of the machine and carries a drive sprocket 153 which engages a drive chain 154. The chain 154 is trained rearwardly over a pair of idler sprockets 156 and 157, thence upwardly in engagement with a pair of sprockets 158 carried on the pressure rolls 22 and 26, over another idler sprocket 159 at the upper end of the machine, thence forwardly in engagement with a pair of larger sprockets 161 carried on the feed rolls 24 and 19, and finally back to the drive sprocket 153. Each of the sprockets 158 are of the same size and pitch so that the pressure rolls 26 and 22 will be driven at the same rate of speed, and the same is true of the sprockets 161 so that the feed rolls 24 and 19 are likewise driven at the same rate of speed. As viewed in Fig. 3, when the motor 137 is operated to drive the chain 154 in the direction of the arrows, it will be seen that the lower rolls 19 and 22 are rotated in a clockwise direction while the upper rolls 24 and 26 are rotated in a counterclockwise direction so that the work 91—92 when placed in position on the feed table 29 will be drawn between the feed rolls 19 and 24 and moved through the machine from the front to the rear thereof for delivery from the pressure rolls 22 and 26 to the rear delivery table 31.

It should be mentioned that an overrunning clutch 162 (Fig. 2) is provided for the heated feed roll 24 and the sprocket 161 is mounted on a projecting sleeve portion (not shown) of the clutch 162 so that the heated roll 24 is driven through the overrunning clutch. This feature of the machine is more fully described and claimed in my copending U. S. Patent No. 2,643,475 and need not be described in detail here.

In order to avoid disturbing the driving efficiency between the drive chain 154 and the various sprockets when the roll spacing is adjusted by vertical movement of the bearing boxes 23, the invention utilizes the idler sprockets 156, 157, and 159 for adjusting and maintaining a predetermined chain tension. For regulating the initial chain tension of the drive arrangement, the uppermost idler sprocket 159 is carried on a stud 163 (Figs. 3 and 4) which is mounted for vertical adjustment on a bracket arm 164 rigidly secured to the ends of the cross bars 17 at the top of the frame. The bracket arm 164 has an elongated slot 166 so that the stud 163 can be moved upwardly or downwardly relative to the bracket arm 164 and tightened in any desired vertically adjusted position thereon.

In order to maintain the predetermined tension in the chain 154 when the roll spacing is varied, a cam arrangement is employed which automatically tightens or loosens the chain in response to vertical travel of the bearing boxes 23 on the upright standards. For this purpose, an inverted generally T-shaped cam lever 167 (Fig. 3) is rigidly secured adjacent the outer end of the cross bar of the T to an elongated pivot shaft 168 which extends across the frame of the machine and is journaled in the brackets 46 (Fig. 7). The idler sprocket 157 is also carried on the end of the pivot or rock shaft 168. The idler sprocket 156 is rotatably mounted at the opposite end of the cross bar of the T-shaped cam lever 167 and is thereby adapted to swing in an arc relative to the pivot shaft 168. The outer end of the upright portion of the cam lever 167 has a rounded cam surface, as at 169, and coacts with a cam plate 171 having a curved cam edge of predetermined shape and rigidly secured to the channel member 98 which depends from the bearing box 23 at the drive end of the machine adjacent the upright standard 16. It will be seen that as the roll spacing adjustment means is manipulated to elevate or lower the bearing boxes 23, the channel member 98 and the cam plate 171 carried therewith will likewise be elevated or lowered and the coaction of the cam plate 171 with the cam portion 169 of the lever 167 will cause the idler sprocket 156 to swing upwardly or downwardly thereby tightening or slackening the chain tension as required. By proper selection of the operating contour of the cam plate 171, it will be understood that the tension of the drive chain 154 can be maintained automatically to conform substantially to the initial chain tension as set by the adjustment of the upper idler sprocket 159.

The radiant heating unit 28 which is interposed between the feed rolls and the delivery rolls comprises an elongated generally U-shaped reflector or housing 172 (Fig. 7) which has a pair of spaced metal walls with a suitable insulating material 173 therebetween. A plurality of elongated electrical radiant heating elements 174 are mounted within the housing 172 so that the radiant heat is reflected downwardly through the open bottom portion of the housing against the film side of the work 91—92 passing thereunder. The heating unit 28 is suspended between the inner walls 57 of the bearing boxes 23 and is thus carried immediately between the upper rolls 24 and 26. For thus supporting the heating unit 28, a pair of bracket plates 176 (Fig. 5) are fastened to the opposite ends of the top portion of the housing 172 and are supported on the horizontal flanges 177 of a pair of adjustable brackets 178 (Fig. 7). A straddle strap 179 is secured to each of the flanges 177 and extends over the bracket plates 176 for retaining the same thereon. Each of the heater brackets 178 has an upright portion with an elongated slot 180 and a stud 181 carrying a collar 182 extends through the slot 180 into the adjacent wall 57 of the corresponding bearing box 23. An adjusting screw 183 is threaded through a horizontally extending upper flange 184 on the bracket 178 and engages the collar 182 so that the elevation of the brackets 178 relative to the bearing boxes 23 may be adjusted by means of the screws 183. The brackets 178 also have depending portions provided with endwise slots 185 which coact with a pair of guide screws 186 extending from the bearing box walls 57 to insure vertical alignment of the brackets.

Consequently, it will be seen that the radiant heating unit 28 is carried between the bearing boxes 23 and is, therefore, adjustable as a unit with the upper rolls 24 and 26 during regulation of the roll spacing. Moreover, the elevation of the heating unit 28 may also be adjusted relative to the bearing boxes 23 and the rolls carried therebetween by means of the adjusting screws 183. By this arrangement, the proximity of the heating unit 28 relative to the work passing thereunder may be controlled and regulated to a high degree in order to accommodate a wide variety of operating conditions.

As will be hereinafter explained, the radiant heater 28 is normally operated at a relatively high temperature

in order to permit effective operation of the machine at relatively high speeds. If for any reason, the film **92** should not be preliminarily bonded to the base sheet **91** during use of the machine, there would be a dangerous tendency for the heat sensitive film **92** to curl or buckle upwardly and come into contact with the radiant heating elements **174** thereby creating a serious fire hazard. In order to eliminate this possibility, I provide a guard over the lower open end of the heating unit **28**. This guard is in the form of an elongated comb comprising a shaft **187** (Figs. 6 and 7) having a plurality of rearwardly extending fingers **188** which are rigidly secured to the shaft **187** and extend across the opening of the heater housing to guard the same. As best seen in Fig. 7, the fingers **188** are preferably of resilient construction and have an upwardly bent or bulged configuration to insure their tight engagement with the lower edges of the heater housing. The shaft **187** is suspended from the horizontal flanges **177** of the heater brackets **178** by means of a pair of tubular collars **189** bolted to the opposite ends of the shaft **187** and also to the bracket flanges **177**.

For supporting the work **91—92** as it passes between the feed rolls **19—24** and the pressure rolls **22—26**, a pair of intermediate idler rolls **191** (Fig. 7) are journaled in a pair of brackets **192** secured to the insides of the upright standards **14** and **16**. As will be apparent from Fig. 7 of the drawing, the idler rolls **191** are so positioned that they engage and support the under surface of the base sheet **91** in alignment with the upper edges of the rolls **19** and **22**.

Another safety feature of the machine is illustrated in Figs. 1 and 7 wherein an elongated rock shaft **193** is shown extending across the front of the upper feed roll **24**. An elongated guard member or skirt **194** is rigidly suspended from the rock shaft **193** and is located closely adjacent the feed table **29** and directly in front of the nip or entry between the feed rolls **19** and **24**. One end of the rock shaft **193** extends into a housing **196** containing a microswitch mechanism **197** which is actuated by rocking movement of the shaft **193**. A spring **198** normally retains the microswitch mechanism **197** in the tilted position shown in Fig. 7 whereby an operating button **199** is depressed for operating the machine in the normal manner for feeding work between the feed rolls **19** and **24**. However, if the hand of an operator should inadvertently get so close to the point of entry between the feed rolls as to be dangerous, the guard **194** would necessarily be pushed inwardly thereby causing the shaft **193** to rock in a clockwise direction (as seen in Fig. 7). The microswitch mechanism **197** would thereby be swung into contact with the opposite wall portion of the housing **196** so as to release the operating button **199** and at the same time depress another operating button **201** which would immediately cause reverse rotation of the rolls **19** and **24**.

The machine is also equipped with a temperature control arrangement for the heated roll **24** which differs substantially from the temperature control arrangement shown in my aforementioned copending patent. This temperature controller may be briefly described by reference to Figs. 1, 2, and 7 wherein an elongated rod **202** is mounted above the roll **24** and carries a shoe **203** having a thermostatic or temperature responsive element **204** adapted to engage the periphery of the roll **24** as the latter rotates. The surface temperature of the roll **24** is thus measured by the thermostatic element and suitable conductors carried in a flexible conduit **206** extend to a temperature control mechanism of a conventional type (not shown) which regulates the operation of the heating elements contained in the roll **24** in accordance with the setting of the controller. The rod **202** is suspended by means of a pair of angularly adjusted clamps **207** from a transversely extending bar **208**. The bar **208** is in turn supported at its ends on a pair of upright posts **209** having integral bracket portions **210** (Fig. 7) which are rigidly mounted on the inner walls of the bearing blocks **71** so that the temperature measuring means moves as a unit with the roll **24** and its bearings.

During operation of the machine, the rolls **19** and **24** will normally be spaced from each other a distance slightly less than the thickness of the base sheet **91** and the film **92** so that the roll **24** will necessarily lift slightly during passage of the work through the rolls. In this manner, the effective spring pressure of the springs **76** is applied to the roll **24** and likewise to the work. The base sheet **91** may comprise a sheet of plywood, Masonite, or the like having a dry hard coating of a thermoplastic material such as nitrocellulose containing a relatively high percentage of plasticizer. The film **92** may comprise a decalcomania transfer which is superimposed on top of the base sheet **91**. The decalcomania transfer is of the heat releasable dry strip type having a paper backing and a lacquer design film of ethylcellulose, nitrocellulose, or the like. As is well understood in this art, the design film side of the decalcomania transfer is disposed adjacent the thermoplastic coated side of the base sheet **91** so that upon the application of heat and pressure the material of the design film and the base sheet coating will be activated to develop adhesive properties therebetween and at the same time permitting release and dry stripping of the paper backing.

The base sheet **91** and superimposed film **92** are introduced between the feed rolls **19** and **24** and the latter are regulated both as to heat and pressure so as to obtain a preliminary bond of the film **92** to the base sheet **91**. Because of the fact that the base sheet **91** of plywood or the like frequently has substantial surface irregularities and especially a pronounced rounding off or beveling adjacent the edges of the base sheet, it is not possible to obtain intimate bonded contact between the film **92** and the base sheet **91** merely by means of the feed rolls **19** and **24**. The upper roll **24** must be heated and, therefore, must be of metal. If excessive pressure loading is provided for the metal roll **24**, detrimental crushing and disfiguration of the transfer film **92** is frequently experienced. Accordingly, in the present invention the feed rolls **19** and **24** provide merely a preliminary bonding of the film **92** to the base sheet **91**.

As the work passes from the feed rolls **19—24** it is introduced between the pressure or delivery rolls **22—26** which are made of resiliently compressible material such as rubber and can, therefore, be pressure loaded by the springs **86** to a substantially greater degree sufficient to press the film **92** into intimate bonded engagement over the entire surface area of the base sheet **91** including even the surface irregularities and rounded edge portions of the sheet. In other words, the compressible resilient nature of the rolls **22** and **26** permits these rolls to conform closely to all usual surface irregularities under substantially increased pressure while at the same time avoiding detrimental crushing of the film.

However, in order to insure complete final bonding of the film to the base sheet by means of the pressure rolls **22** and **26** the intermediate radiant heating provided by the heating unit **28** is essential. As previously explained, the heated metal roll **24** under normal non-crushing pressures is unable to press the film **92** into complete engagement with the irregular surface area of the base sheet **91** and for that reason the heat of the metal roll **24** does not penetrate the transfer film **92** down to the heat activatable nitrocellulose coating on the base sheet to any satisfactory degree. However, the radiant heater **28** is operated at a relatively high temperature so that the radiant heat readily penetrates through the film **92** into the surface coating of the base sheet **91** and develops to a higher degree the latent adhesive properties in these materials. Immediately thereafter the base sheet and superimposed film pass between the pressure rollers **22** and **26** and the high degree of intimate engagement obtained by these rolls insures com-

pletely effective bonding of the film 92 over the entire surface area of the base sheet.

Normally, the heated metal roll 24 may be operated at a surface temperature on the order of 200 to 400° F. dependent upon the nature of the transfer film and the base sheet. With moderate pressure loading of the roll 24, preliminary bonding of the film 92 to the base sheet 91 is effected so that there is no tendency for the transfer film 92 to curl or buckle under the extreme heat of the subsequent radiant heater 28. The radiant heater is normally operated at a temperature on the order of 1500° F. so as to obtain the necessary complete heat activation and penetration into the base sheet coating at relatively high operating speeds, e. g., 30 linear feet per minute. Thus, by the successive steps of preliminarily bonding the film to the base sheet under moderate heat and pressure between the feed rolls, subjecting the work to high temperature radiant heat, and then effecting complete final bonding by means of unheated resilient pressure rollers, all of the difficulties resulting from surface irregularities in the base sheet are overcome. As the work emerges from the pressure rollers at the delivery side of the machine, the heat releasable dry stripable paper backing comprising a portion of the transfer film may be readily stripped from the decorated base sheet.

Although the invention has been described with particular reference to a preferred structural embodiment of the machine for applying decalcomania transfer films to base sheets, it will be understood that various modifications and changes in details of structure may be made without departing from the scope of the invention as defined in the appended claims.

I claim:

1. A machine for applying a film to a base sheet comprising a pair of feed rolls between which a base sheet and a superimposed film may be passed under pressure, heating means for one of said feed rolls for effecting preliminary bonding of the film to the base sheet under heat and pressure, a pair of compressible pressure rolls mounted adjacent said feed rolls for receiving the base sheet and preliminarily bonded film from said feed rolls, said pressure rolls being adapted to conform to the surface irregularities of said base sheet for pressing the film into intimate bonded engagement with the base sheet over substantially the entire surface area of the sheet, radiant heating means interposed between said feed rolls and said pressure rolls for heating the film and the adjacent surface of the base sheet prior to the application of final bonding pressure by said pressure rolls, and a plurality of guard elements extending across said heating means and spaced from each other across the path of the work for preventing contact of the latter with said heating means.

2. A machine for applying a film to a base sheet comprising a pair of feed rolls between which a base sheet and a superimposed film may be passed under pressure, heating means for one of said feed rolls for effecting preliminary bonding of the film to the base sheet under heat and pressure, a pair of compressible pressure rolls mounted adjacent said feed rolls for receiving the base sheet and preliminary bonded film from said feed rolls, said pressure rolls being adapted to conform to the surface irregularities of said base sheet for pressing the film into intimate bonded engagement with the base sheet over substantially the entire surface area of the sheet, a heating unit interposed between said feed rolls and said pressure rolls for heating the film and the adjacent surface of the base sheet prior to the application of final bonding pressure by said pressure rolls, said heating unit comprising an inverted generally U-shaped reflector and a plurality of radiant heating elements mounted within said reflector, and a plurality of guard elements extending across the open lower end of said reflector and spaced from each other across the path of the work for preventing inadvertent protrusion of the work into said reflector and into contact with said heating elements.

3. A machine for applying a film to a base sheet comprising a frame, a pair of horizontal lower rolls mounted in fixed relation to said frame, a pair of horizontal upper rolls disposed in coacting relation above said lower rolls whereby to permit passage of a base sheet and a superimposed film successively between each set of upper and lower rolls, a pair of vertically movable supports adjustably mounted on said frame and having said upper rolls journaled therebetween whereby to permit vertical adjustment of said upper rolls as a unit relative to said lower rolls for varying the spacing between the upper and lower rolls and thereby accommodating different thicknesses of work, and radiant heating means disposed between said supports and mounted thereon whereby the elevation of said heating means relative to the work passing between the rolls is likewise adjusted simultaneously with the adjustment of said upper rolls.

4. The machine of claim 3 further characterized in that said heating means is also vertically adjustable relative to said supports.

5. A machine for applying a film to a base sheet comprising a frame having a pair of spaced upright standards, a lower feed roll and a lower pressure roll rotatably mounted in parallel relation at opposite sides of said standards and in fixed relation thereto, a pair of vertically slidable supports adjustably mounted on said standards above said lower rolls, an upper feed roll and an upper pressure roll journaled in said supports above said lower feed and pressure rolls respectively whereby to permit passage of a base sheet and a superimposed film successively between said feed rolls and said pressure rolls, heating means mounted on and extending between said supports for heating the work as it passes from the feed rolls to the pressure rolls, and adjustable means mounted on said frame and coacting with said supports for regulating the elevation of said supports on said standards whereby to permit variation of the spacing between said upper and lower rolls for accommodating different thicknesses of work.

6. A machine for applying a film to a base sheet comprising a frame having a pair of spaced upright standards, a lower feed roll and a lower pressure roll rotatably mounted in parallel relation at the front and rear of said standards and in fixed relation thereto, a pair of vertically slidable bearing boxes adjustably mounted on said standards above said lower rolls, said bearing boxes having bearing support portions extending forwardly and rearwardly from said standards and having central portions through which said standards extend for slidable mounting of the boxes thereon, an upper feed roll and an upper pressure roll journaled in said forwardly-extending and rearwardly-extending bearing support portions, respectively, above said lower feed and pressure rolls, respectively, whereby to permit passage of a base sheet and a superimposed film successively between said feed rolls and said pressure rolls, adjustable means mounted on said frame and operatively connected to said bearing boxes for regulating the elevation of the latter on said standards whereby to permit variation of the spacing between said upper and lower rolls for accommodating different thicknesses of work, and an elongated heater unit supported at its ends between the central portions of said bearing boxes for heating the work as it passes between said feed rolls and said pressure rolls.

7. The machine of claim 6 further characterized in that said forwardly- and rearwardly-extending bearing support portions of said bearing boxes are provided with vertically slidable bearing members having said upper rolls journaled therein and said bearing support portions also having mounted thereon individual resilient pressure-applying means coacting with said vertically slidable bearing members for independently regulating the pressure loading between said feed rolls and said pressure rolls.

8. A machine for applying a film to a base sheet comprising a frame having a pair of spaced upright standards, a lower feed roll and a lower pressure roll rotatably mounted in parallel relation at opposite sides of said standards and in fixed relation thereto, a pair of vertically adjustable supports slidably mounted on said standards above said lower rolls, an upper feed roll and an upper pressure roll journaled in said supports above said lower feed and pressure rolls, respectively, whereby to permit passage of a base sheet and a superimposed film successively between said feed rolls and said pressure rolls, hanger means secured to said supports and having elongated threaded portions extending upwardly therefrom, and roll space adjusting means mounted on the top of said frame and including rotatable threaded means coacting with said threaded portions of said hanger means for regulating the elevation of said supports on said standards whereby to permit variation of the spacing between said upper and lower rolls for accommodating different thicknesses of work, said roll space adjusting means also including an elongated shaft extending across the upper end of said frame and having means operatively coacting with said rotatable threaded means for regulating the elevation of both of said supports simultaneously, and said shaft having a two-piece construction with a detachable coupling therebetween whereby to permit raising or lowering of one of said supports independently of the other when required in order to obtain parallelism between said upper and lower rolls.

9. A machine for applying a film to a base sheet comprising a frame, a pair of horizontal lower rolls mounted in fixed relation to said frame, a pair of horizontal upper rolls disposed in coacting relation above said lower rolls whereby to permit passage of a base sheet and a superimposed film successively between each set of upper and lower rolls, vertically movable support means adjustably mounted on said frame and carrying said upper rolls whereby to permit vertical adjustment of said upper rolls as a unit relative to said lower rolls for varying the spacing between the upper and lower rolls and thereby accommodating different thicknesses of work, and separate roll space adjusting means mounted on said supports and operatively coacting with at least one of said upper rolls for varying the spacing between one set of upper and lower rolls independently of the spacing of the other set of upper and lower rolls.

10. A machine for applying a film to a base sheet comprising a frame, a pair of horizontal lower rolls mounted in fixed relation to said frame, a pair of horizontal upper rolls disposed in coacting relation above said lower rolls whereby to permit passage of a base sheet and a superimposed film successively between each set of upper and lower rolls, a pair of vertically movable supports adjustably mounted on said frame and carrying said upper rolls whereby to permit vertical adjustment of said upper rolls as a unit relative to said lower rolls for varying the spacing between the upper and lower rolls and thereby accommodating different thicknesses of work, said supports having a pair of bearing members slidably carried thereon for limited vertical movement relative to the supports and having one of said upper rolls journaled therebetween, resilient pressure-applying means mounted on said supports and coacting with said bearing members for normally urging said one upper roll toward its companion lower roll, and adjustable wedge means mounted on said supports and operatively coacting with the bottom portions of said bearing members for adjusting the latter vertically relative to said supports whereby to permit variation of the spacing between said one upper roll and its lower coacting roll independently of the spacing between the other set of upper and lower rolls.

11. A machine for applying a film to a base sheet comprising a frame having a pair of spaced upright standards, a pair of horizontal lower rolls mounted at opposite sides of said standards and in fixed relation thereto, a pair of horizontal upper rolls disposed at opposite sides of said standards in coacting relation above said lower rolls whereby to permit passage of a base sheet and a superimposed film successively between each set of upper and lower rolls, a pair of vertically movable supports adjustably mounted on said standards and carrying said upper rolls for movement of the latter as a unit relative to said lower rolls whereby to vary the spacing between the upper and lower rolls for accommodating different thicknesses of work, drive means for said rolls including a plurality of sprockets operatively connected to said rolls and a drive chain trained over said sprockets, an idler sprocket pivotally supported on said frame and operatively engaged with said chain, and means operatively coacting between one of said supports and said idler sprocket for effecting pivotal movement of said idler sprocket in response to vertical adjustment of said supports relative to said standards whereby to maintain a predetermined driving tension in said chain for different roll spacings.

12. A machine for applying a film to a base sheet comprising a frame having a pair of spaced upright standards, a pair of horizontal lower rolls mounted at opposite sides of said standards and in fixed relation thereto, a pair of horizontal upper rolls disposed at opposite sides of said standards in coacting relation above said lower rolls whereby to permit passage of a base sheet and a superimposed film successively between each set of upper and lower rolls, a pair of vertically movable supports adjustably mounted on said standards and carrying said upper rolls for movement of the latter as a unit relative to said lower rolls whereby to vary the spacing between the upper and lower rolls for accommodating different thicknesses of work, drive means for said rolls including a plurality of sprockets operatively connected to said rolls and a drive chain trained over said sprockets, a cam lever pivotally mounted on said frame, an idler sprocket operatively engaging said chain and carried by said cam lever for swinging movement relative to the pivot axis of said lever, and a cam member rigidly connected to one of said supports for vertical movement therewith and disposed in operative camming engagement with said cam lever for effecting pivotal swinging movement of said idler sprocket in response to vertical travel of said supports along said standards whereby to maintain a predetermined driving tension in said chain for different roll spacings.

13. The machine of claim 12 further characterized in that said cam lever is a generally T-shaped member pivotally supported at one end portion of the T with said idler sprocket carried at another end portion of the T and with the remaining end portion of the T in operative camming engagement with said cam member.

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