July 31, 1962 A. MATVEEFF 3,047,051

LAMINATING PRESS

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FIG. 1

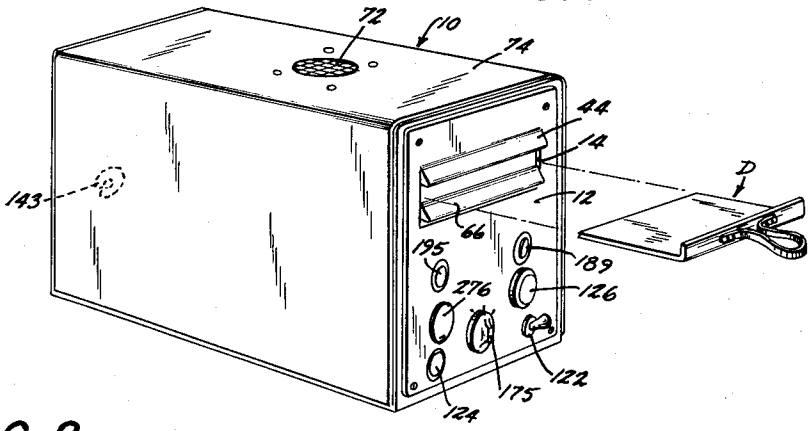
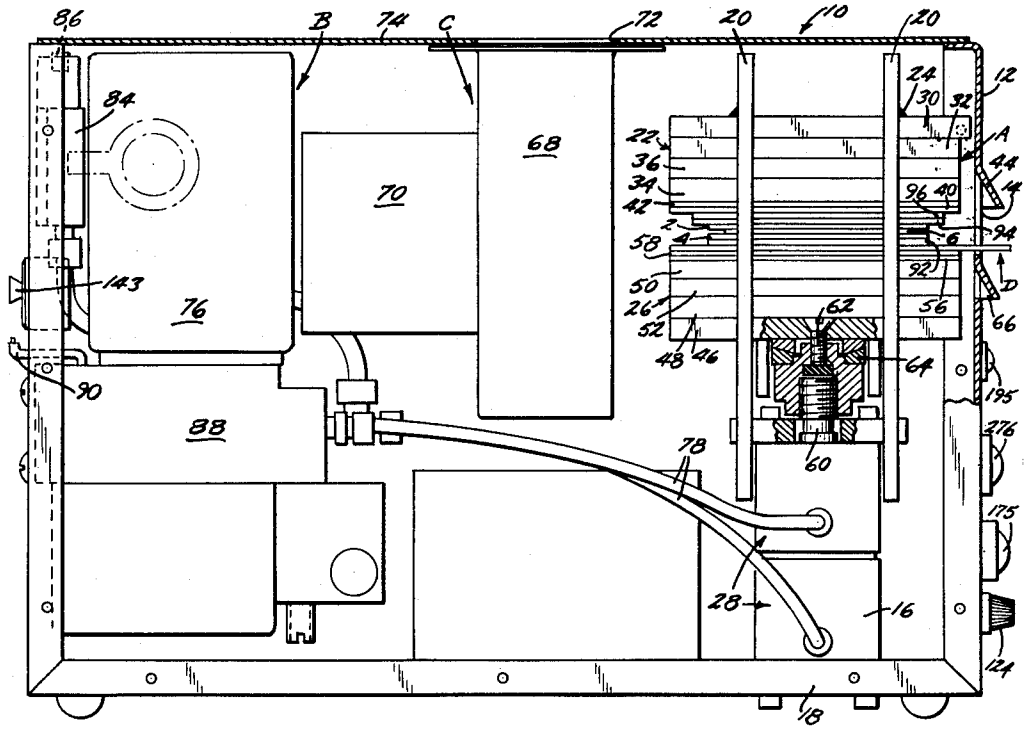


FIG. 2



INVENTOR.
ALEXANDER MATVEEFF
BY

James and Franklin

ATTORNEYS.

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FIG. 3

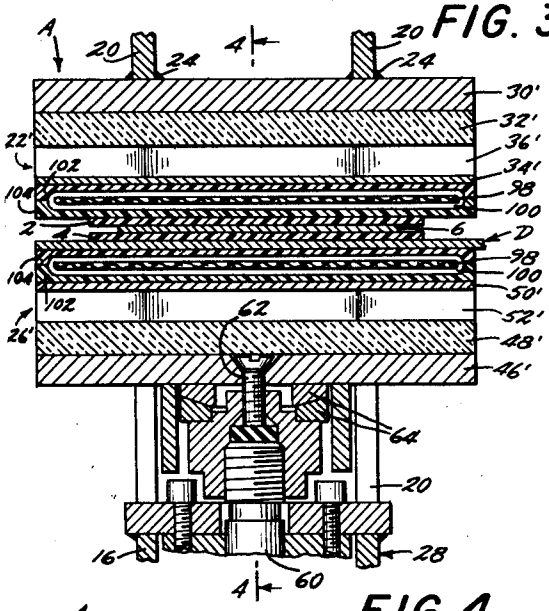
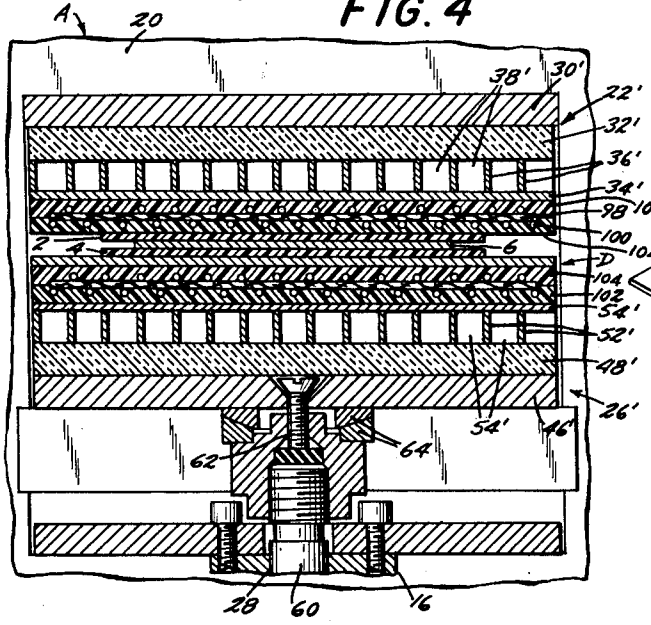


FIG. 4



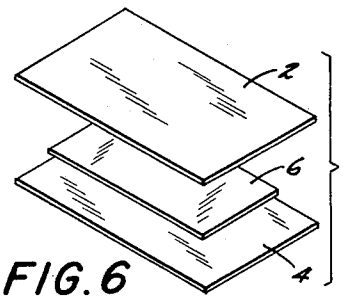


FIG. 6

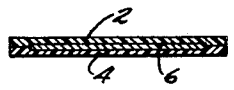


FIG. 7

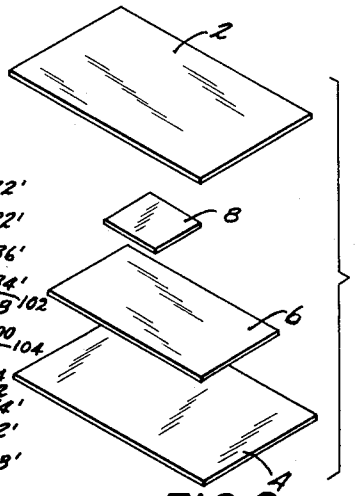


FIG. 8

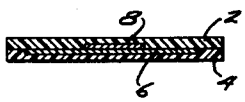
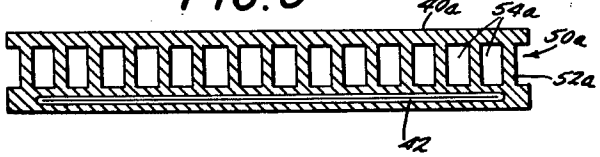


FIG. 9

FIG. 5



INVENTOR.
ALEXANDER MATVEEFF
BY
James and Franklin
ATTORNEYS.

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LAMINATING PRESS

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FIG. 13

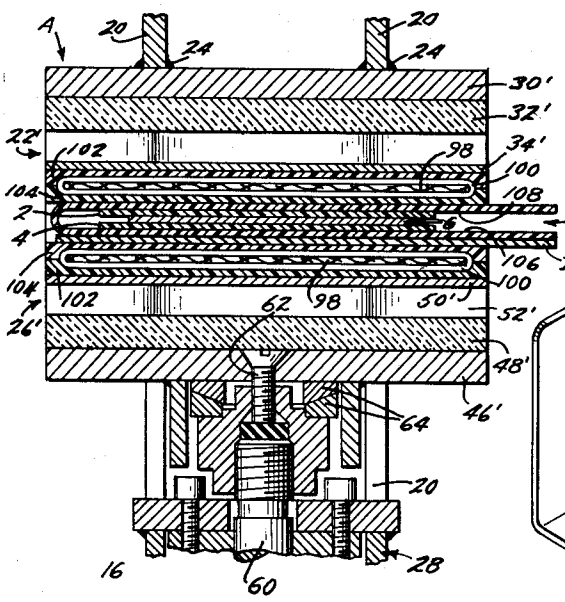


FIG. 10

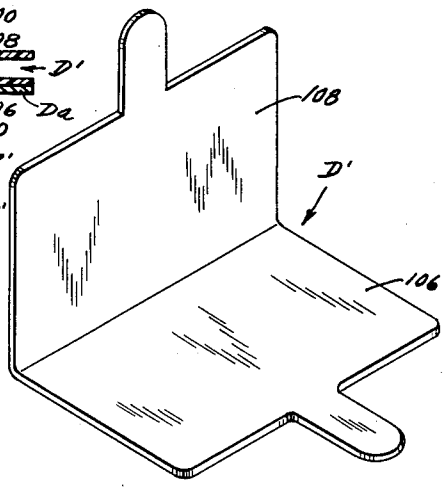


FIG. 12

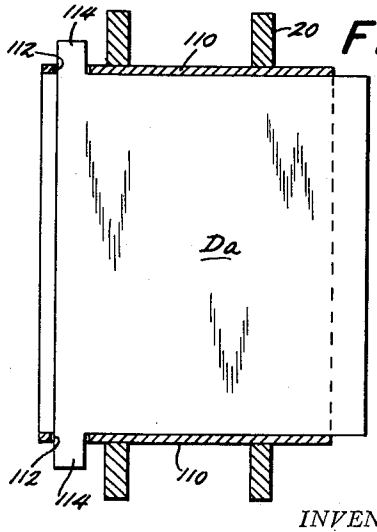
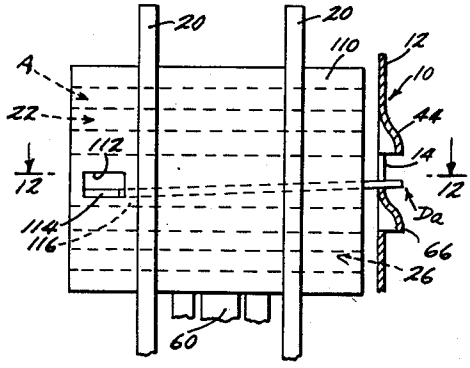


FIG. 11



INVENTOR.
ALEXANDER MATVEEFF
BY
James and Franklin
ATTORNEYS.

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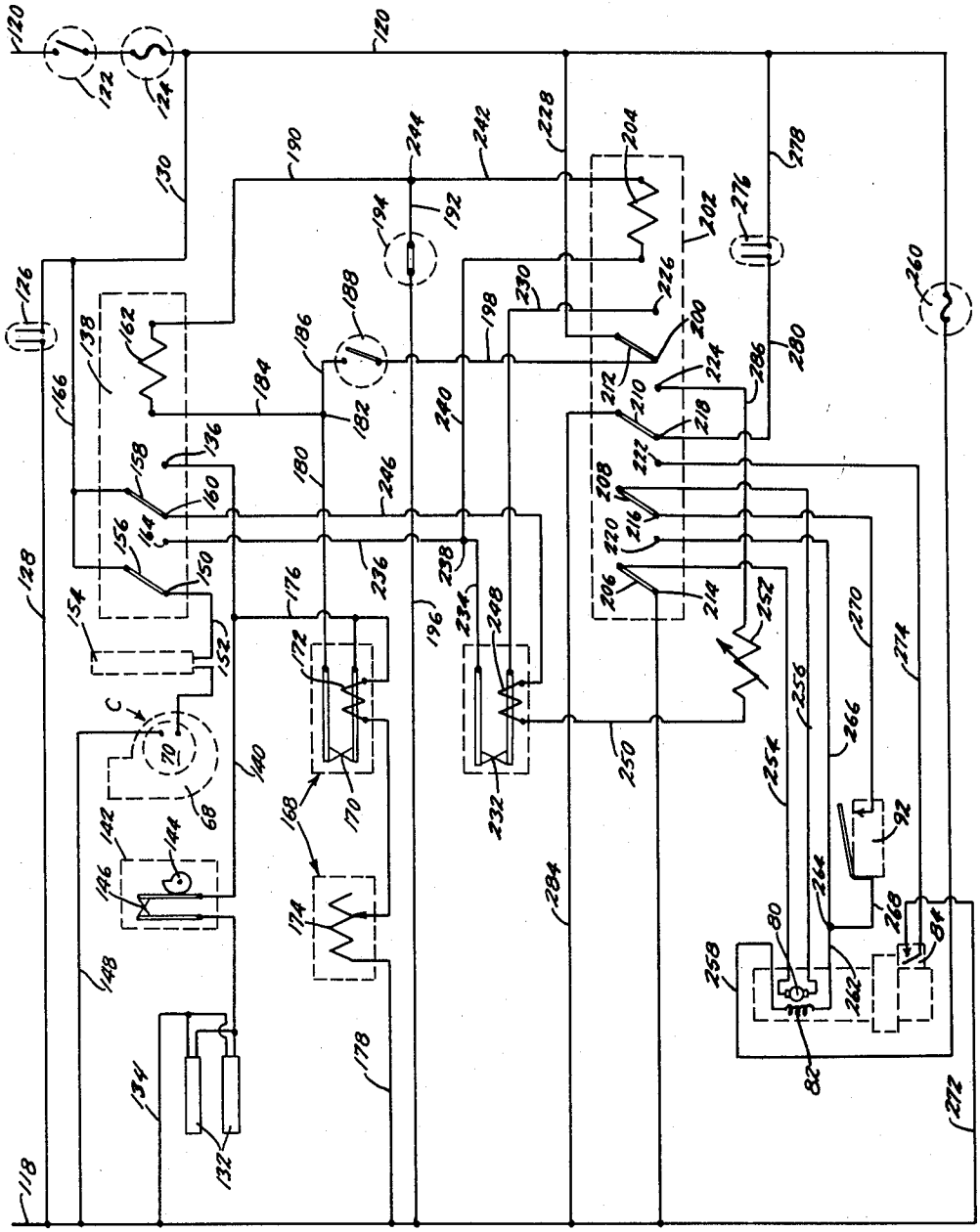


FIG. 14

INVENTOR.
ALEXANDER MATVEEFF
BY
Jamesand Franklin
ATTORNEYS.

United States Patent Office

3,047,051
Patented July 31, 1962

3,047,051

LAMINATING PRESS

Alexander Matveeff, Tomkins Cove, N.Y., assignor to Glassoloid Corporation of America, Clifton, N.J., a corporation of New York

Filed July 16, 1958, Ser. No. 748,858
3 Claims. (Cl. 156—539)

The present invention relates to the construction of a press designed to laminate a plurality of sheets of plastic material, with or without the interposition therebetween of non-plastic material, and to the organization of a system for controlling the operation thereof.

There is a great demand for machines which will cover documents or photographs with sheets of transparent plastic material for purposes of preservation, attractiveness and ready handling. For example, in many establishments each employee is issued an identification card which may include a photograph as well as data indicating his identity, his job, and perhaps the places in the plant where he is permitted to go. Each time that a new employee is hired, or each time that an old employee changes his status, a new card is required, and in large enterprises a truly surprising number of identification cards must be issued each month. These cards are subject to considerable wear and tear, and consequently must, as a practical matter, be protected. This is commonly done by sandwiching the card between a pair of transparent plastic sheets which are sealed to one another along their edges, thus producing a unitary laminated product. The same procedure is employed to protect photographs, driving licenses, credit cards, and many other types of documents.

The laminated object is formed by subjecting the document and plastic sheet "sandwich" (the term "sandwich" will be employed hereinafter to refer to an assembly of outer plastic sheets with an object therebetween) to heat and pressure sufficient to press the plastic sheets closely against the document therebetween and to cause the projecting edges of the plastic to be pressed against and sealed to one another. Pressures on the order of 200 lbs. per square inch and temperatures on the order of 250° F. are usually required. These pressures and temperatures will vary depending upon the nature and composition of the sandwich. If excessively high pressures and temperatures are employed the sandwiched document may become damaged. If the pressures and temperatures are insufficient, or if they are applied for insufficient periods of time, the lamination may be faulty.

A special problem is involved when a large number of sandwiches must be made in a short period of time, when the time involved in effecting a lamination is otherwise critical, or when only relatively unskilled personnel are available to perform the operation. Because the sandwich must be subjected to high temperatures for an extended period of time, it is quite hot when the lamination process has been completed, as are the parts of the laminating equipment which press the plastic sheets together. If the sandwich is permitted to cool in the laminating machine without artificial assistance a long period of cooling time is involved. Even with artificial assistance, cooling of the sandwich while confined between the platens of the press takes an appreciable period of time because of the thermal inertia of the platens. If the sandwich is removed while hot from the laminating machine, great care must be exerted in handling it, not only to prevent damage to the sandwich but also to prevent injury to the operator.

When a conventional laminating press is employed considerable skill, time and trouble are involved in preparing the sandwich for lamination. It is usually not enough

merely to place the sandwich in a press. Means must be provided for cushioning the effect of the press and ensure that the pressure is applied evenly over the entire surface of the sandwich.

The equipment of the present invention solves all of the above problems in a signally effective manner. It is small enough so that it can be placed on a desk top or counter. It is light enough so that it can be moved from place to place. By reason of its internal construction the making of the sandwich is greatly simplified and the insertion of the sandwich into the apparatus is substantially foolproof. The lamination process is carried out entirely automatically; the operator need merely start the equipment running and may then walk away. The sandwich is cooled in the press, and that cooling, through appropriate and novel control of the various steps involved in the process, is effected in a significantly short period of time, by opening the press and using artificial means to cool the press and the sandwich at the same time, but separately. The overall operation of the device is substantially foolproof.

According to one aspect of the present invention the sandwich is cooled in the press by causing a flow thereover of air at room temperature, this cooling effect continuing automatically until temperatures of a predetermined minimum value have been reached. The press is caused to open while this flow of cooling air is operative, and in a preferred embodiment the sandwich is supported in the press so that the air can cool both surfaces of the sandwich simultaneously. The heated press platens are provided with passages through which the flow of cooling air (not the same air that cools the sandwich) can pass in order to facilitate platen cooling at the same time that sandwich cooling is taking place.

In accordance with another aspect of the present invention the press platens are so constructed that the surfaces thereof which engage the sheets to be laminated are formed of a material, such as that plastic sold under the trade name "Teflon" and having the chemical composition tetrafluoroethylene, which, despite the high temperatures to which it is subjected will provide proper cushioning for the sheets to be laminated, will not adhere to the sandwich, and will impart the desired smooth surface characteristic to the sandwich, those platen surfaces preferably being directly heated so as to enhance the efficiency of the apparatus.

In accordance with another aspect of the present invention the various operative parts of the equipment, including a press, press actuating means effective to close and open the press, and means for cooling both the press and the sandwich, are assembled together in order to define a small, light and compact piece of equipment.

In accordance with yet another aspect of the present invention a simplified automatic control system is provided for all of the operative parts of the press, the various laminating steps being carried out automatically from start to finish, with proper application of the desired temperatures, pressures and cooling for the appropriate periods of time. Means are provided for adjusting the pressures, temperatures and time schedules for different types of lamination, but when, as is usually the case, a particular type of lamination is carried out many times in succession, initial setting of the equipment for that type of lamination leaves the operator the tasks only of preparing the sandwich, inserting it into the apparatus, and initiating the operating cycle, as by pushing a button.

To the accomplishment of the above, and to such other objects as may hereinafter appear, the present invention relates to the construction and mode of operation of a laminating press with associated actuating and control

equipment, as defined in the appended claims and as described in this specification, taken together with the accompanying drawings, in which:

FIG. 1 is a three-quarter perspective view of one embodiment of the present invention, the tray on which the sandwich is to be placed being shown removed for the placement of a sandwtich thereon;

FIG. 2 is a side elevational view of the device, but with a side wall of the cabinet removed;

FIG. 3 is a side cross sectional view of the laminating press of FIG. 2, taken from the right hand side thereof as viewed in FIG. 2, differing from FIG. 2, however, in that a different and preferred type of platen is employed, with a correspondingly different arrangement of elements between the platens, the press being shown in partially closed position;

FIG. 4 is a cross sectional view taken along the line 4—4 of FIG. 3;

FIG. 5 is a cross sectional view of an alternative platen construction specifically shown as a bottom platen;

FIG. 6 is a three-quarter perspective exploded view of that type of sandwich shown in FIG. 3;

FIG. 7 is a cross sectional view thereof after lamination has been completed;

FIG. 8 is a three-quarter perspective exploded view of a second form of sandwich;

FIG. 9 is a cross sectional view of the sandwich of FIG. 8 after lamination has been completed;

FIG. 10 is a three-quarter perspective view of a modified form of tray on which the sandwich may be placed preliminary to being inserted into the apparatus;

FIG. 11 is a side elevational view of an alternative press construction having a non-removable tray, the press being shown in fully open position;

FIG. 12 is a cross sectional view taken along the line 12—12 of FIG. 11;

FIG. 13 is a cross sectional view similar to FIG. 4 but showing the tray of FIG. 10 and the sandwich of FIG. 6 used in conjunction with the non-removable tray of FIGS. 11 and 12; and

FIG. 14 is a circuit diagram of a preferred control system.

INTRODUCTION

The operative parts of the lamination apparatus of the present invention comprise a heated laminating press generally designated A, actuating means therefor generally designated B and comprising a reversible hydraulic pump together with appropriate control equipment, a motor operated blower generally designated C for producing a flow of cooling air, and a tray generally designated D on which the sheets to be laminated are adapted to be received.

There are many types of laminated sandwiches which the apparatus of the present invention is adapted to produce, typical sandwiches being disclosed in FIGS. 6–9. These sandwiches comprise upper and lower sheets **2** and **4** of any appropriate thermoplastic material, at least one of which is usually transparent. In the sandwich of FIGS. 6 and 7 a paper sheet **6** is positioned between and is of a smaller size than the plastic sheets **2** and **4**, so that the plastic sheets **2** and **4** extend beyond the paper sheet **6** completely around the periphery of the latter. Upon the application of heat and pressure the plastic sheets **2** and **4** are softened, the paper sheet **6** may imbed itself in them (or one of them), and the outwardly extending peripheries of the plastic sheets **2** and **4** are welded to one another so as to completely seal and protect the paper sheet **6**. In the embodiment of FIGS. 8 and 9 an addiitonal sheet **8**, which may be a photograph or the like, is positioned on top of the sheet **6** and beneath the plastic sheet **2**, the end result again being an imbedment of the documents **6** and **8** in the plastic sheets **2** and **4** and a sealing of the plastic sheets around the documents. Although the term "document" is here used with reference to the elements **6** and **8**, it will be appreciated that the word is used in its broadest sense as indicating something which conveys intelligence, even though it may be in a most elementary form. Thus either the sheets **6** or **8**, or both, could constitute color samples, specimens of plant, animal or mineral matter, or almost anything else desired. It will further be appreciated that the sandwiches could be considerably thicker than here disclosed and could include a great many more plies than are specifically shown.

General Description of the Apparatus

All of the operative parts of the apparatus are enclosed within a casing generally designated **10** having a front wall **12** with an opening **14** formed therein through which the sheets to be laminated may be inserted. The press A is located in the casing **10** immediately inside the front wall **12**. It comprises, in the form disclosed in FIG. 2, a base **16** secured to the bottom wall **18** of the cabinet from which struts **20** extend upwardly. A fixed upper platen generally designated **22** is secured to the struts **20** in any appropriate manner as by welding **24**. A lower and movable platen generally designated **26** is positioned inside the struts **20** beneath the upper platen **22** and is adapted to be moved toward and away from the fixed upper platen **22** by means of an hydraulic ram generally designated **28** which may be mounted in the base **16**.

The upper platen **22** comprises a top metal plate **30** welded to the struts **20**, to the undersurface of which an asbestos pad **32** is secured. A metal plate **34** is secured to the undersurface of the pad **32** and is provided with a series of spaced fins **36** extending generally inwardly from the front cabinet wall **12** so as to provide a plurality of passages **38** through which air can flow, the fins **36** and passages **38** in the embodiment of FIG. 2 being located at the top of the plate **34**. Secured to the lower surface of the plate **34** may be a polished metal plate **40**, with an electrical heating layer **42** interposed between the plates **34** and **40**. The lower surface of the plate **40** is substantially in line with the upper edge of the opening **14** in the front cabinet wall **12**, and a louvre **44** may be provided in the front cabinet wall **12** so as to permit air access to the outer ends of the passages **38**.

The lower platen **26** is similar to the top platen **22** and comprises, reading from bottom to top, a bottom metal plate **46**, an asbestos pad **48**, a plate **50** provided with fins **52** and air passages **54**, a heating element **56** and a polished top plate **58**. The bottom plate **46** of the lower platen **26** is connected to the piston **60** of the hydraulic ram **28** in any appropriate manner, as by screw **62** and spherical thrust washers **64**. When the ram piston **60** is withdrawn and the lower platen **26** is lowered the upper surface of its top plate **58** is substantially in line with or somewhat below the lower edge of the opening **14** in the front cabinet wall **12**, and a louvre **66** may be provided in the front cabinet wall **12** to provide for air access to the air passages **54**.

Mounted on the opposite side of the press A from the cabinet front wall **12** is a blower generally designated **68** which is driven by motor **70** and which acts to suck air in axially and eject it tangentially out through the opening **72** in the cabinet top wall **74**. The blower **68** is so positioned that its axial air intake is substantially in line with the opening **14** in the front cabinet wall **12** and hence with the space between the platens **22** and **26** when the latter are spaced apart.

Mounted in the cabinet **12** adjacent its rear end is a reversible hydraulic pump generally designated **76** which is connected by pipes **78** to the ram **28**. The pump **76** is driven by a reversible electric motor comprising an armature **80** and a field winding **82** (see FIG. 14). A pressure sensitive switch generally designated **84** is associated therewith, and the pressure setting thereof may be adjustable from the rear of the apparatus at **86**. The tank **88** for reception of the hydraulic fluid for the

pump 76 and the ram 28 may be filled through pipe 90 at the rear of the apparatus. A limit switch 92 is associated with the movable platen 26 and is adapted to be normally closed and to open only when the movable platen 26 has been fully lowered.

When a sandwich of the type shown in FIGS. 6 and 7 is to be laminated with the press platens 22 and 26 of the type shown in FIG. 2, the sandwich sheets 2, 4 and 6 are placed upon the tray D while the latter is withdrawn from the apparatus. In order to provide for even application of pressure to the sheets 2—6 when platens of the type shown in FIG. 2 are used it is usually required that a cushioning sheet 92 of suitable plastic material be positioned beneath the lower plastic sheet 4 of the sandwich, that a metal plate 94 be positioned atop the upper plastic sheet 2, and that a cushioning sheet 96 be interposed between the metal sheet 94 and the bottom plate 40 of the upper platen 22.

Preferred Platen Construction

The platens 22′ and 26′ of FIGS. 3 and 4 differ from the platens 22 and 26 of FIG. 2 in a manner which is believed to represent an important improvement in devices of this nature. In FIGS. 3 and 4 the upper platen 22′ comprises a top plate 30′, an asbestos sheet 32′ and a plate 34′ provided with fins 36′ and passages 38′, similarly to the platen 22 of FIG. 2, but with the exception that the plate 34′ is not as thick as the plate 34 of FIG. 2, this latter differentiation being optional. Secured to the underside of the plate 34′ is an assembly comprising a core 98 formed of heat resistant material such as glass cloth impregnated with "Teflon," around which the heating wire 100 is coiled. This assembly 98, 100 is itself sandwiched between a pair of plastic sheets 102 and 104, the upper sheet 102 being adhesively secured to the plate 34′ by means of a suitable thermosetting adhesive, the sheets 102 and 104 being secured to one another around their periphery and outside the heating element 98, 100 also by means of a thermosetting adhesive. The combined thicknesses of the sheets 102 and 104 may be on the order of 0.1 inch. In a preferred embodiment the upper sheet 102 has a thickness of .030 inch and the lower sheet 104 has a thickness of .060 inch. The material of which these sheets 102 and 104 are formed is such that it will present a smooth surface at the end of the platen where the sandwich to be laminated is engaged, it will at laminating temperatures of approximately 300–350° F. become cushion-soft without losing its shape or cohesion, and it will at those temperatures exhibit no adhesion to the materials being laminated. The material having the chemical composition tetrafluoroethylene and sold commercially under the trade name "Teflon" has proved to be exceedingly effective for this purpose. The adhesive which secures the sheets 102 and 104 to one another and to the plate 34′ is thermosetting so as to be unaffected by the temperatures to which it will be subjected during the operation of the apparatus.

The lower platen 26′ is constructed similarly to the upper platen 22′, and comprises the base plate 46′, the asbestos sheet 48′, the metal plate 50′, the ribs 52′ and air passages 54′, the heating assembly 98, 100 and the covering sheets 102 and 104 therefor.

The platen construction disclosed in FIGS. 3 and 4 has many advantages. The heating elements 98, 100 are located very close to the surfaces which engage the material to be laminated, and the plastic interposed between said elements and said surfaces is of low specific heat, thus making for a rapid cycle of operation and efficient use of heating current. The heated portion of the platen is comparatively thin and consequently may rapidly be cooled. The lower surface of the Teflon sheet 104 imparts a desired smoothness to the upper surface of the upper plastic sheet 2 of the sandwich. The Teflon sheets 102 and 104 become sufficiently soft at laminating temperatures to provide for adequate cushioning. Consequently when the platens of FIGS. 3 and 4 are employed it is no longer necessary to utilize the cushioning and metal layers 92, 94 and 96 shown in connection with the embodiment of FIG. 2.

Alternative Constructions

FIG. 5 discloses an alternative construction for a portion of the platen. The plate 50*a* there disclosed has its ribs 52*a* and its air passages 54*a* positioned between the upper sandwich-engaging surface 40*a* and the heater element 42 which is imbedded in the lower portion of the plate 50*a*. With this arrangement cooling of the sandwich-engaging portion of the platen is facilitated, but the heating thereof is somewhat less efficient.

FIG. 10 illustrates an alternative embodiment for the tray D′. The tray D of FIG. 1 may be formed of metal. The tray D′ of FIG. 10 may be formed of softer material than metal so as to itself provide for cushioning. In a preferred form it may be made of Teflon or a fabric impregnated with Teflon. It comprises a bottom portion 106 and a top portion 108 foldably associated therewith and of approximately the same size. The sheets to be laminated, such as the sheets 2—6 of FIG. 6, are placed on the bottom portion 106, the top portion 108 is folded thereover, and the tray D′ is then inserted into the apparatus, the bottom and top portions 106 and 108 providing for appropriate cushioning and also imparting to the exposed surfaces of the plastic sheets 2 and 4 the desired surface characteristic.

Preferred Tray Mounting

In FIGS. 11 and 12 a preferred arrangement is disclosed in which the tray D_a is non-removably located in the apparatus and is adapted to be supported in a position separated from the lower platen 26 when the latter is fully withdrawn. To that end there is provided on each side of the press a side wall 110 supported by the struts 20, the walls 110 having an appropriately positioned vertically elongated aperture 112 therein through which ears 114 on the tray D_a extend. Thus, as may be seen from FIG. 11, when the lower platen 26 is completely withdrawn the ears 114 will engage with the bottom of the opening 112, the bottom of the opening 112 acting as a positive stop structure to support the tray D_a with a space 116 between itself and the lower platen 26. This space 116 is of particular significance in connection with the cooling step hereinafter described, since it permits cooling air to flow over both top and bottom of the sandwich and permits the sandwich to cool independently of the platens 22 and 26. Hence the sandwich will, at the end of the cooling step, usually be at a lower temperature than the platens. When the lower platen 26 rises it will engage the tray D_a and move it upwardly until the sandwich positioned thereon is pressed against the upper platen 22, the slots 112 being sufficiently vertically elongated to permit this to occur. FIG. 13 discloses the operative position of the various parts when the non-removable tray D_a and the foldable Teflon tray D′ are both employed in conjunction with the efficient and effective platen constructions of FIGS. 3 and 4.

Laminating Cycle Control System

For apparatus of the type here involved to be truly commercially useable it is not ordinarily sufficient that it can be made to operate satisfactorily. It is also necessary, particularly when one is dealing with a piece of equipment to be used in an office or in a public place, that it operate in a reliable manner substantially all of the time, even when in the hands of non-technical personnel, such as clerical help or counter attendants. The apparatus of the present invention is thus capable of use. Its overall dimensions are 8″ x 16″ x 11″ and its total weight is approximately fifty pounds. It is expressly designed to be used almost any place and moved from one place to another. Accordingly controls have been built into the

apparatus which will enable it to be used to make many different types of laminations but which will at the same time permit it to be used by unskilled personnel. The control system is shown schematically in FIG. 14.

In order to produce a proper lamination the sheets to be laminated must be pressed together with the proper pressure and must be maintained at the proper temperature for a proper period of time in order for the intermediate sheets 6 and 8 to imbed themselves in one or both of the covering sheets 2 and 4 and in order for the projecting edges of the covering sheets 2 and 4 to properly bond to one another. If the temperature, pressure or time of curing is insufficient a faulty lamination will result, and if any of these variables are too great the intermediate sheets 6 or 8 may be damaged or the covering sheets 2 and 4 themselves may be "burned" or unduly thinned and elongated. Moreover, the sandwich is hot when the lamination procedure has terminated, and if it is handled improperly before it is cooled it may be marred for damaged. Means must be provided to minimize the possibility of injury to the sandwich and to the operating personnel.

In accordance with the present invention all of the variables involved in the laminating cycle may be adjusted to fit a particular application, but the actual operation of the machine when the proper settings have been made is entirely automatic and all of the variables are accurately controlled. The system by mens of which this is accomplished is illustrated schematically in FIG. 14.

The two sides of a source of appropriate A.C. or D.C. power are designated 118 and 120. Connected in line 120 is a power switch 122 and a fuse 124, both accessible on the front casing wall 12. A pilot light 126 mounted on the front casing wall 12 is connected to line 118 by lead 128 and is connected to line 120 below fuse 124 by lead 130, so that the pilot light 126 will be illuminated whenever the switch 122 is closed. The heating elements for the platens 22 and 26 are designated 132 in FIG. 14. They are connected to line 118 by lead 134 and are connected to terminal 136 of power relay 138 by means of lead 140 and adjustable thermostatic heat control 142. By appropriate settings of the movable element 144 of the control 142, as by manipulation of knob 143 at the rear of the casing, which will apply a predetermined tension to the thermostatic switch assembly 146, the maximum temperature to which the platens 132 will be raised is determined. The blower motor 70 is connected to line 118 by lead 148 and is connected to terminal 150 of power relay 138 by lead 152 and thermostat 154 which may be located in one of the platens 22 or 26. The thermostat 154 is designed to be closed whenever the temperature which it senses exceeds a predetermined value, which value in the instant application is that temperature, approximately 100° F., to which the platens 22 and 26 are to be cooled at the end of a cycle before the sandwich is to be removed from the casing.

The power relay 138 is provided with a pair of switch arms 156 and 158 which normally assume the position shown in FIG. 14, engaging terminals 150 and 160 respectively, until such time as the actuating coil 162 is energized, after which they will engage the terminals 164 and 136 respectively. The arms 156 and 158 are both connected by lead 166 to the line 120 via the lead 130.

The heat control unit 142 controls the maximum temperature to which the platens are heated. The timing unit 168 controls the length of time that the platens are to be heated. The timing unit 168 comprises normally closed thermostatic switch assembly 170 adapted to be heated by coil 172 the current through which is determined by variable resistor 174, the setting of the resistor 174 by manipulation of knob 175 on the front casing wall 12 thus controlling the time which will elapse before the normally closed thermostatic switch assembly 170 opens. The coil 172 is connected at one end via lead 176 to lead 140 and terminal 136, and is connected at its other end, through the resistor 174 and lead 178, to line 118. One end of the thermostatic switch assembly 170 is connected to lead 176, and its other end is connected by lead 180 to point 182, from which lead 184 goes to the power relay actuating coil 112, and from which lead 186 goes to normally open starting switch 188, controlled by button 189 on the front casing wall 12. The opposite end of the power relay actuating coil 162 is connected by leads 190 and 192 to normally closed reject switch 194, controlled by button 195 on the front casing wall 12, and from there via lead 196 to line 118.

The other end of the starting switch 188 is connected by lead 198 to terminal 200 of reversing relay 202. That relay comprises an actuating coil 204 and four switch arms 206, 208, 210 and 212, which, when the coil 204 is de-energized, assume their position shown in FIG. 14 in which they engage respectively with terminals 214, 216, 218 and 200. When the coil 204 is energized the contact arms 206, 208, 210 and 212 will move so as to make electrical connection with the terminals 220, 222, 224 and 226 respectively. The switch arm 212 is connected by lead 228 to line 120. The terminal 226 is connected by lead 230 to one end of a thermostatic switch assembly 232 the other end of which is connected by means of leads 234 and 236 to terminal 164 of power relay 138. Leads 234 and 236 are connected at point 238 to lead 240 which goes to one end of the reversing relay actuating coil 204, the other end of that coil being connected by lead 242 to leads 190 and 192 at point 244. Terminal 160 of the power relay 138 is connected by lead 246 to one end of the heating coil 248 for the thermostatic switch assembly 232, the other end of the coil 248 being connected by lead 250, variable resistor 252 and lead 286 to terminal 224 of the reversing relay 202. The thermostatic switch assembly 232, heating coil 248 and variable resistor 252 constitute means for delaying the opening of the press for a predetermined period of time.

The switch arm 206 is connected by lead 254 to one end of the armature 80 of the motor for the hydraulic pump 76, the other end of the armature 80 being connected by lead 256 to switch arm 208. One end of the field winding 82 of the pump motor is connected by lead 258 and fuse 260 to line 120. The other end of the field winding 82 is connetced by lead 262 to point 264 from which extend leads 266 and 268. Lead 266 connects with terminal 220 of the reversing relay 202. Lead 268 goes to limit switch 92 which is associated with the movable platen 26 so as to be closed only when the movable platen 26 has been fully lowered. The other end of the limit switch 92 is connected by lead 270 to terminal 216. One end of the adjustable pressure limit switch 84, sensitive to the pressure exerted by the press when it is closed, is connected by lead 272 to line 118. Its other end is connected by lead 274 to terminal 222. The switch 84 is normally closed, and will only open when the pressure in the hydraulic system exceeds a predetermined value. A pilot light 276 located on the front casing wall 12 is connected between line 120 and terminal 218 by means of leads 278 and 280.

To operate the apparatus the heat control 142 is preset for a desired maximum platen temperature, the pressure switch 84 is preset for the press to exert a predetermined pressure, the heating time control 168 is preset so that the platen temperature will be exerted for a predetermined period of time, and time delay unit 232, 248, 252 is preset for a desired delay in opening of the press. The equipment is then ready for operation.

When the switch 122 is closed and when the press is open, in stand-by condition, the pilot light 126 will light, indicating that the power is on, and the pilot light 276 will light, indicating that the equipment is ready for a cycle of operation. A circuit is also completed by power relay switch arm 156 through the blower motor 70, but since the platens will be at a low temperature the thermostat 154 will be open and hence the blower will not operate.

The operator positions a sandwich to be laminated with-

in the equipment and then presses the starting button **189** to close the switch **188**. This closes the circuit through the actuating coil **162** of the power relay **138**, that circuit being traced from line **118** to lead **196**, normally closed switch **194**, leads **192** and **190**, the coil **162**, leads **184** and **186**, the switch **188**, lead **198**, switch arm **212** and lead **228** to the other line **120**. The switch arms **156** and **158** will move to engage terminals **164** and **136** respectively. This will establish a holding circuit for the coil **162** which may be traced from line **118** through lead **196**, switch **194**, leads **192** and **190**, the coil **162**, leads **184** and **180**, the thermostatic switch assembly **170**, leads **176**, and **140**, terminal **136**, switch arm **158** and leads **166** and **130** to line **120**. Consequently release of the starting button **189** once it has been pushed will not interrupt the cycle.

A circuit will also be established via switch arm **158** through the platen heating elements **132** and the heat control device **142**, and also through the heating time delay coil **172** and variable resistor **174** associated therewith. The platens will heat quickly to the temperature determined by the heat control unit **142**, and the time delay unit **168** will commence timing.

A circuit is also established from line **118** through leads **196**, **192** and **142** to the actuating coil **204** of the reversing relay **202**, the other end of that coil being connected to line **120** via lines **240**, **236**, terminal **164**, switch arm **156**, and leads **166** and **130**. The switch arms **206**, **208**, **210**, **212** will then move to engage terminals **220**, **222**, **224** and **226** respectively. The pump motor will therefore be energized to cause the press to close, its circuit being traced from line **118** through lead **272**, switch **84**, lead **274**, terminal **222**, switch arm **208**, lead **256**, armature **80**, lead **254**, switch arm **206**, terminal **220**, lead **266**, lead **262**, field winding **82** and lead **258** to line **120**. The press will continue to operate until the sandwich is compressed with sufficient force to open the switch **84**. That force will continue to be exerted on the sandwich.

It will be noted that as soon as the power relay **202** was energized the switch arm **210** moved away from terminal **218**, thus extinguishing pilot light **276** and indicating that the equipment was not in a condition to start a new cycle.

Actuation of the power relay **138** also, by removing the switch arm **156** from the terminal **150**, positively opened the circuit to the blower motor **70**.

The situation as thus described, with the press closed and exerting a predetermined pressure on the sandwich and with the platens heated to a predetermined temperature, will continue for such time as is measured by the time delay unit **168**. When that time expires the thermostatic switch assembly **170** thereof will open. This will break the holding circuit to the actuating coil **162** for the power relay **138**, and that relay will then return to its original condition. The switch arm **156** will close the circuit to the blower motor **70**, and since the platens are at an elevated temperature the thermostat **154** will be closed and he blower will commence to operate, drawing a stream of cool air through the passages **38** and **54** in the platens so as to cool it. The circuit to the platen heating element **132** will, of course, be opened through movement of the switch arm **158** away from the terminal **136**.

The actuating coil **204** for the reversing relay **202** will, however, not be de-energized at this point. A holding circuit therefor may be traced from line **118** through leads **196**, **192** and **242** to one end of the coil **204**, and from the other end of the coil **204** through leads **240** and **234** to the thermostat assembly **232** of the press opening time delay, the other end of that assembly being connected by lead **230**, terminal **226**, switch arm **212** and lead **228** to the line **120**. De-energization of the power relay coil **162** will, however, establish a circuit through the heating coil **248** for the thermostat assembly **232**, that circuit being traced from line **118** through lead **284**, switch arm **210**, terminal **224**, lead **286**, resistor **252** and lead **250** to one end of the coil **248**, the other end of the coil **48** being connected by lead **246**, terminal **160**, switch arm **158** and leads **168** and **130** to line **120**. Accordingly, although the platens will no longer be heated and although the blower will be functioning, the press will remain closed for the period of time necessary for the thermostat switch assembly **232** to open. When it does open the actuating coil **204** for the reversing relay **202** will be de-energized, the switch arms **206—212** will return to their positions shown in FIG. 14, and the circuit through the pump motor will be established via limit switch **92** but with a reversed direction of current through the armature **80**. The pump will therefore operate to lower the movable platen **26**, and will continue to do so until the platen **26** is fully lowered, at which time the limit switch **92** will open and stop the action of the pump motor. The blower will continue to operate, cooling the platens and the sandwich. When the constructional embodiment of FIGS. 11 and 12 is employed, it will be noted that air will be drawn over the upper and lower sides of the sandwich, thus facilitating the cooling thereof. When the platens have reached a predetermined lower temperature, such as 100° F., the thermostat **154** will open and the blower will stop.

When the reversing relay **202** is de-energized and resumes its initial position the pilot **276** will light, thus indicating that, except for cooling of the sandwich, the equipment is ready for another cycle.

If at any time it should be desired to interrupt the cycle of operation, the switch button **195** is pushed opening the switch **194** and simultaneously de-energizing the actuating coils **162** and **204** of the power relay **138** and reversing relay **202** respectively.

Thus it will be seen that all the operator need do is to insert the sandwich into the apparatus and push button **189**. The rest is all automatic.

While but a limited number of embodiments have been here disclosed, it will be apparent that many variations may be made in the present invention without departing from the inventive concepts thereof as defined in the following claims.

I claim:

1. Lamination apparatus comprising a fixed casing having a front wall with an opening therethrough, and, within said casing, a press adjacent said front wall and including a pair of platens relatively movable toward and away from one another without escaping from said casing, said platens when separated having a space therebetween in line with said opening, a blower in said casing on the other side of said press from said front wall and in air flow communication with said opening, and means for actuating said press and moving said platens, the lower platen of said press being movable vertically and said press comprising a tray mounted between said platens for vertical movement between upper and lower positions, and stop structure engageable with said tray when said tray is below its upper position and effective to support it in its lower position against further downward movement, said lower platen when at its lower limit of movement being spaced below said tray and when in its upper limit of movement having engaged said tray and lifted it to its upper position.

2. The apparatus of claim 1, in which said platen comprises a pair of sheets of plastic material capable of softening without permanently losing shape at temperatures on the order of 300–350° F., between which sheets is received the heating element for said platen, said heating element comprising a coil of resistance wire wound about a glass cloth core.

3. The apparatus of claim 1, in which said platen comprises a pair of sheets of plastic material capable of softening without permanently losing shape at temperatures on the order of 300–350° F., between which sheets is received the heating element for said platen, said heat-

ing element comprising a coil of resistance wire wound about a glass cloth core, one of said sheets constituting that portion of said platen closest to the other platen.

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