

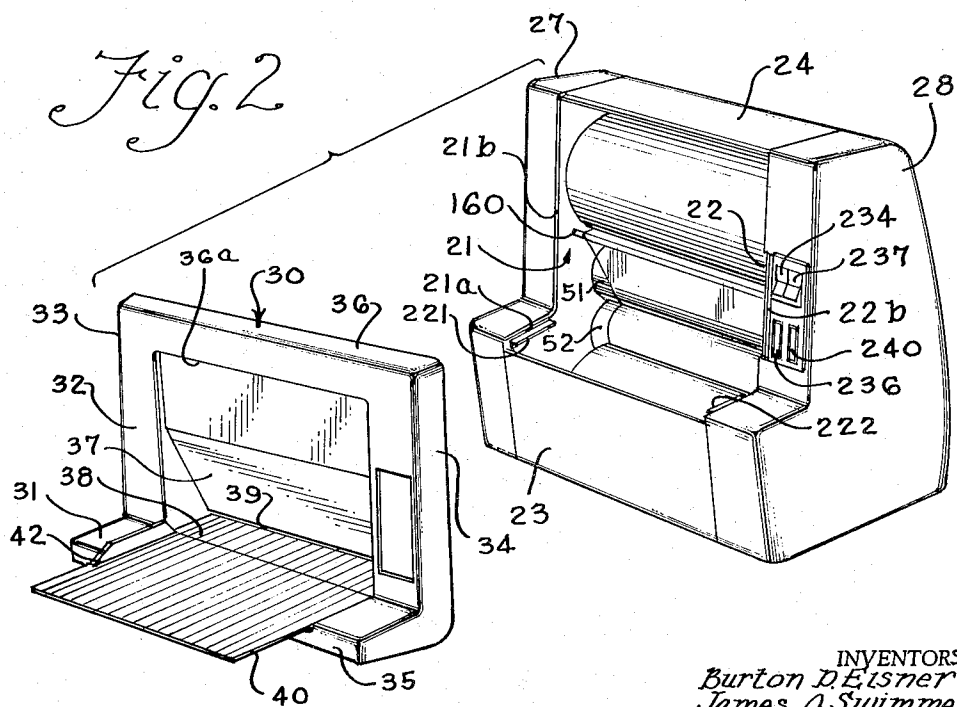
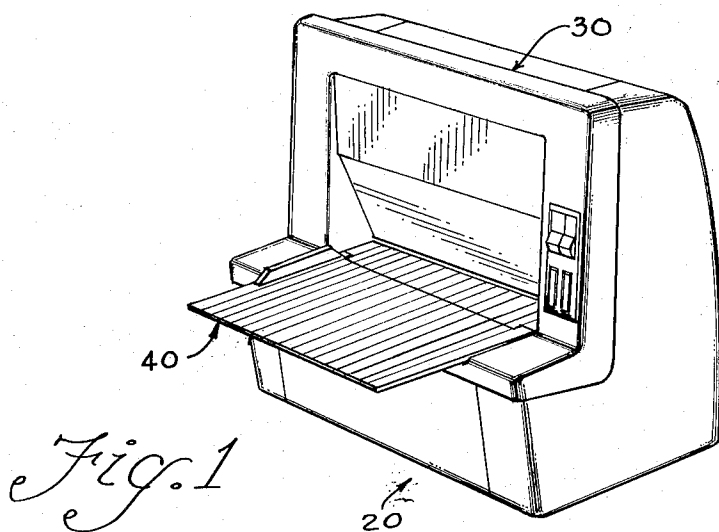
March 27, 1962

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OFFICE LAMINATING MACHINE

3,027,285

Filed Aug. 28, 1958

5 Sheets-Sheet 1



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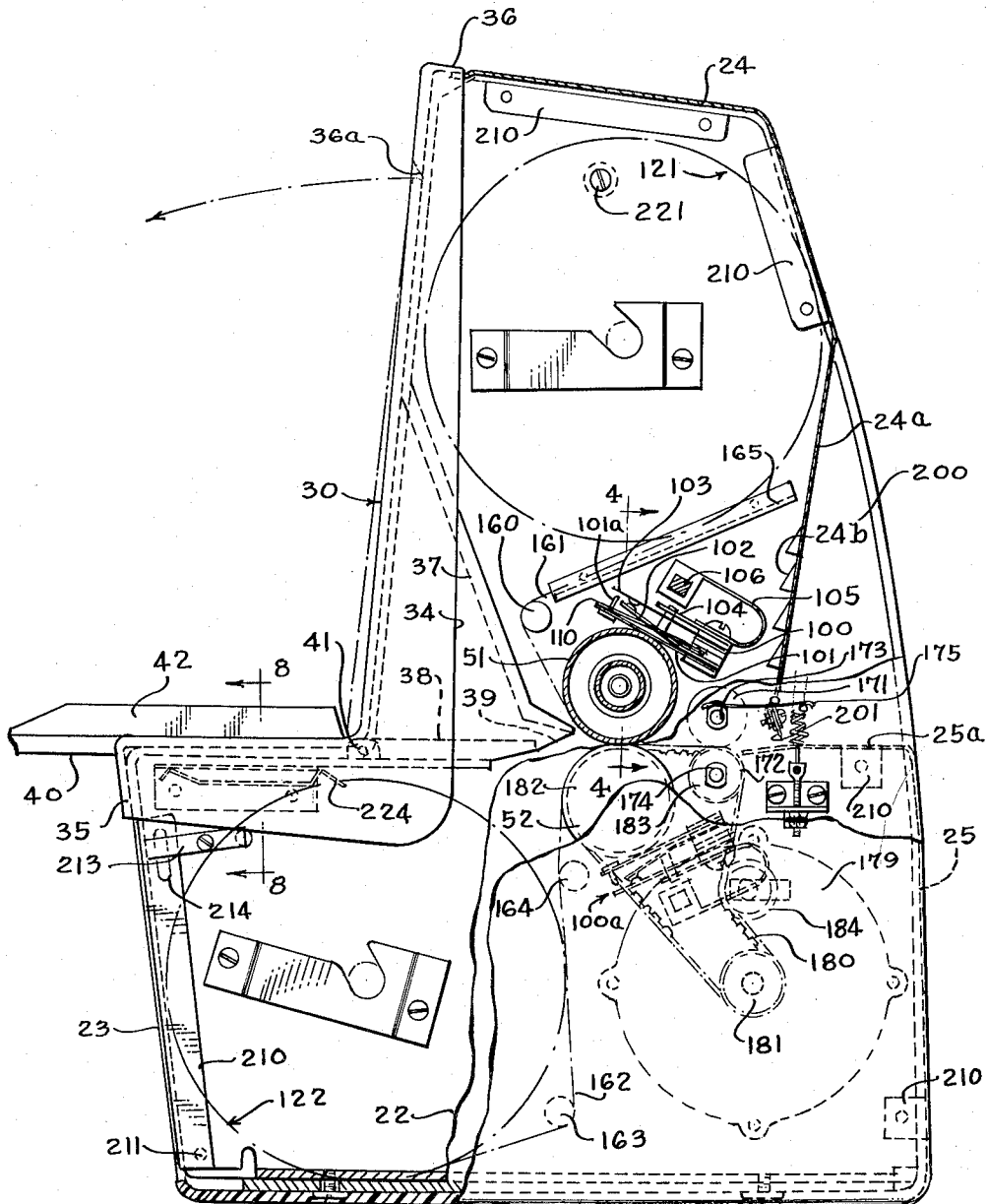


Fig. 3

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Fig. 4a

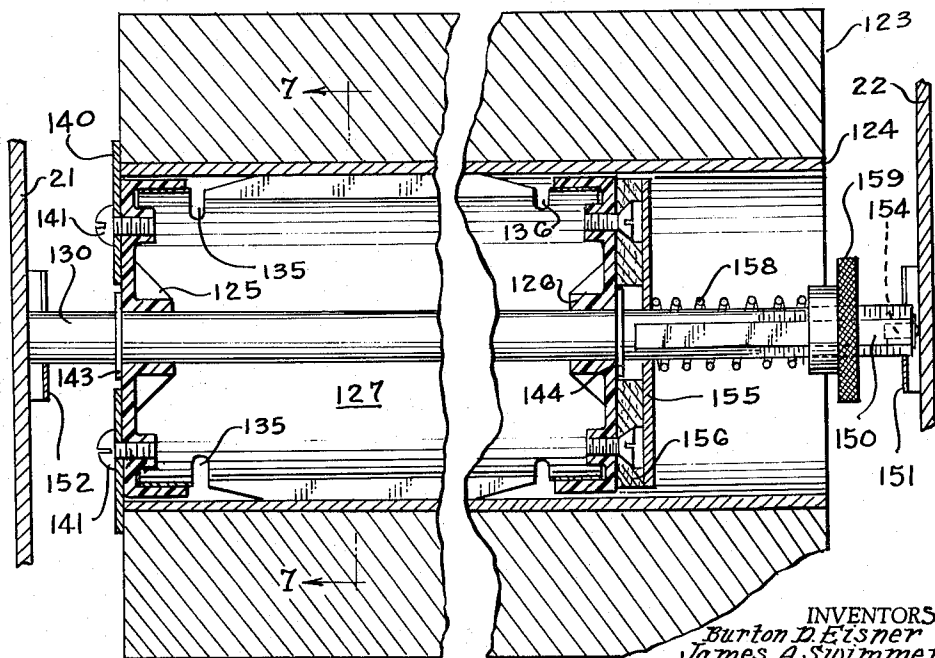
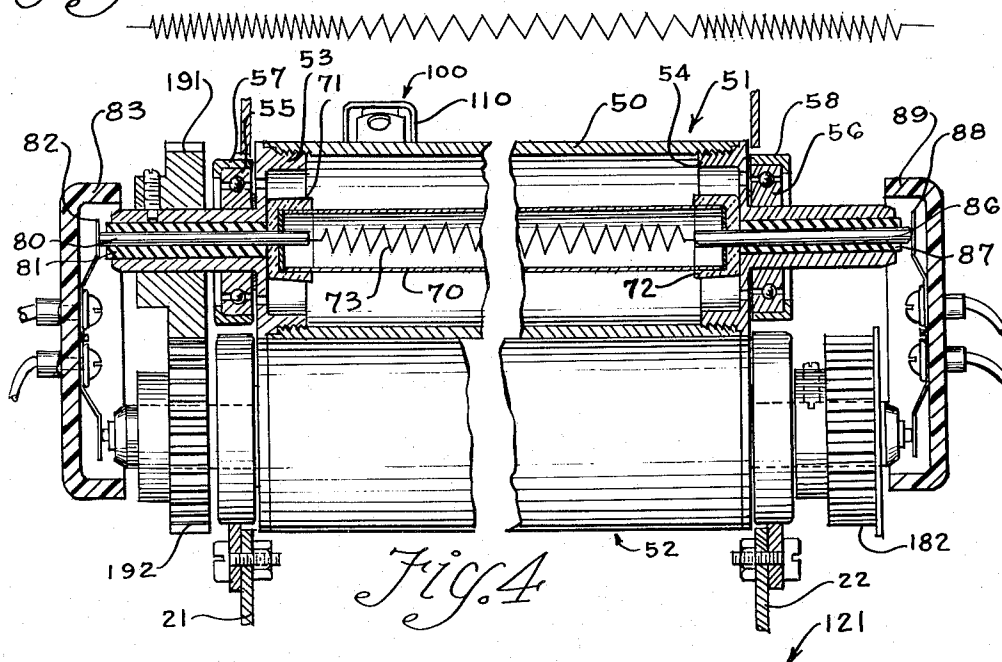


Fig. 5

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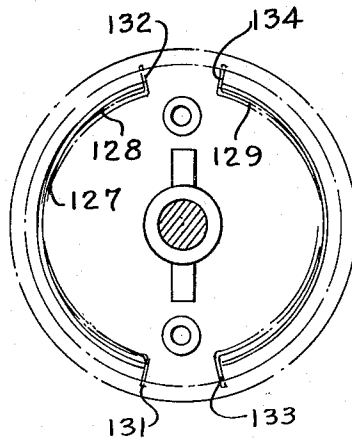
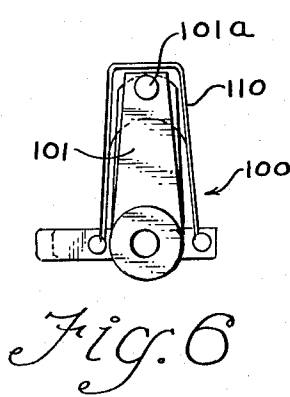


Fig. 7

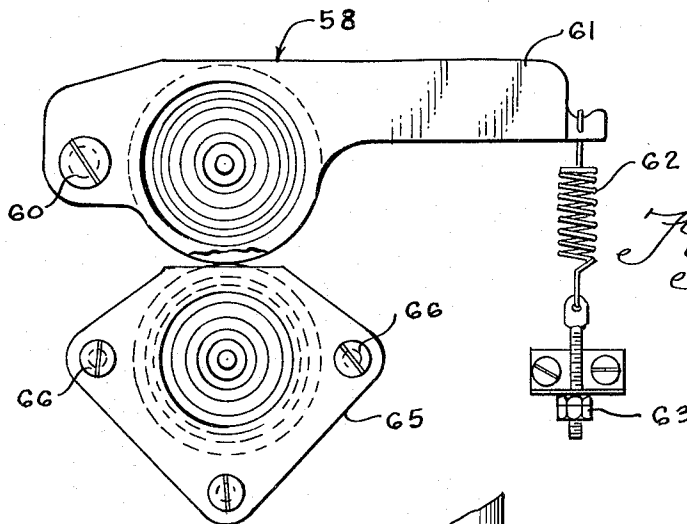


Fig. 3a

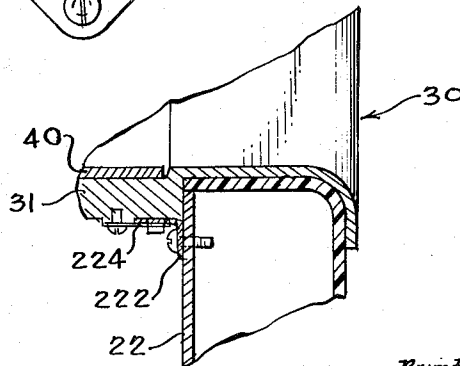


Fig. 8

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5 Sheets-Sheet 5

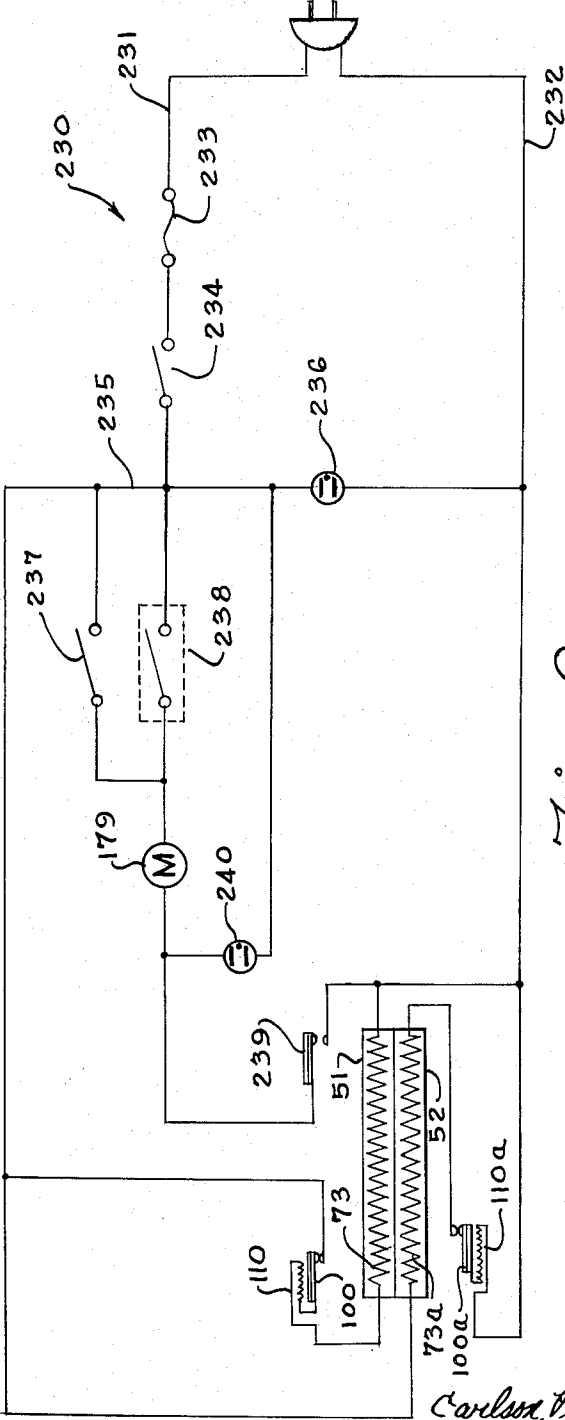


Fig. 9

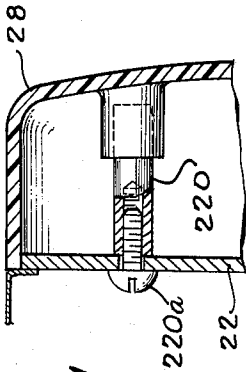


Fig. 11

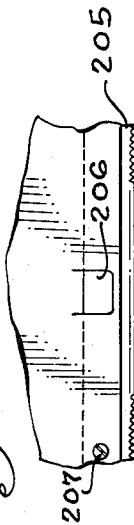


Fig. 10

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OFFICE LAMINATING MACHINE

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Filed Aug. 28, 1958, Ser. No. 757,779
16 Claims. (Cl. 156—359)

The present invention relates to machines for laminating documents between sheets of transparent plastic.

It is an object of the invention to provide a laminating machine which is particularly well-suited for office use and which is capable of applying an adherent layer of plastic to both sides of a document or other sheet material to be protected. It is a related object to provide a protective coating which is permanently bonded, which is impervious to water, ink and other liquids, which is wear resistant, and which imparts a clear, bright, glossy appearance. In the latter connection, it is an object to provide a machine for protecting and beautifying descriptive literature, drawings, photographs and the like used for sales and display purposes. It is also an object to provide a machine which not only preserves documents subjected to repeated handling, such as blue prints, price lists and the like, but also precludes the possibility of tampering.

It is another object to provide a laminating machine which is capable of applying uniform heat and pressure to the laminate for fusing of the adhesive thereon, and in which the same temperature and pressure is applied over the entire width of the document insuring an overall bond as well as reliable sealing at the edges. It is a further object to provide a laminating machine which comes up to operating temperature promptly and maintains the proper temperature for all conditions of loading from maximum load to the idle or stand-by condition.

It is a further object to provide a novel machine of the above type which is extremely rapid, producing a laminated document in a matter of seconds, and which is capable of operating at a high speed on a continuous feed basis. In this connection, it is an object to provide a machine which accommodates large capacity rolls of plastic laminating material, requiring only infrequent replenishment and which turns out documents in the form of a continuous strip capable of being cut off individually right in the machine if desired. The laminated documents thus produced may vary in size from the maximum throat width of the machine to the size of file cards or even smaller.

In one of the aspects of the invention, it is an object to provide a machine employing sheet material having a thermoplastic adhesive coating which is fused at the region of contact with the document but which is protected against premature fusion or sticking. It is a specific object to provide a novel heated roller arrangement in which the temperature at the surface is thermostatically maintained within desired limits but which cycles at a rate which assures long contact life.

In another aspect of the invention, it is an object to provide a laminating machine having novel provision for controlling tension in the plastic material both before and after the laminating process. It is a related and more general object to provide a tension control means which insures that the plastic material is applied smoothly, free of any bubbles, wrinkles or the like, and which insures that the laminated documents will lie flat, free of any tendency to curl in one direction or the other.

It is another object of the invention to provide a machine which is convenient to use, which has simple

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semi-automatic controls, and which may be used successfully by an unskilled operator without any special training or experience. It is a correlative object to provide a laminating machine which is light and portable and which may be easily carried from desk to desk enabling a single machine to accommodate a number of users in the same office.

It is still another object of the invention to provide a machine which has a convenient and extensive feed table which may be swung from working position to an out of the way position for transport and storage, protecting the mechanism against the entry of dust or foreign objects. It is another object related to the foregoing to provide a novel housing in a machine of the above type which permits ready removal of the front plate or bezel for service and replenishment of the rolls of laminating material, but in which all screws and fastening devices are hidden from view and which has an attractive functional appearance. In this connection, it is an object to provide a laminating machine which requires a minimum of servicing which consists of a minimum number of parts, and which may be economically constructed and maintained.

Other objects and advantages of the invention will become apparent upon reading the attached detailed description and upon reference to the drawings in which:
FIG. 1 is a perspective showing the external appearance of a machine constructed in accordance with the present invention under operating conditions.

FIG. 2 is an exploded view showing the removal of the front bezel in the machine of FIG. 1.

FIG. 3 is a right hand end view of the machine with portions of the end plate and end bell removed to show the details of the internal construction.

FIG. 3a is a detail showing the resilient mounting of the upper heated roller.

FIG. 4 shows the heated rollers with the upper heated roller in transverse section taken along the line 4—4 in FIG. 3.

FIG. 4a shows the preferred distribution of the convolutions of the coiled heating element.

FIG. 5 is a transverse sectional view of a supply roller inserted in the upper roller position.

FIG. 6 is a bottom view of the thermostat shown in FIG. 3.

FIG. 7 is a section of the supply roller mandrel taken along the line 7—7 in FIG. 5.

FIG. 8 is a fragment showing the bezel retaining means taken along the line 8—8 in FIG. 3.

FIG. 9 is a schematic diagram of the electrical circuit.

FIG. 10 is a fragment showing the cutting means incorporated in the back of the housing.

FIG. 11 is a fragment illustrating the manner in which the end bells are secured to the end plates.

While the invention has been described herein in terms of a preferred embodiment, it will be understood that we do not intend to limit ourselves to such embodiment but intend to cover the various alternative and equivalent constructions which may be included within the spirit and scope of the claims appended hereto.

Turning now to the drawings, and particularly to FIGS. 1-3 thereof, a laminating machine 20 is shown which is capable of receiving documents fed in at the front and for discharging the laminated documents at the rear, with the documents being sandwiched between two sheets of tightly bonded plastic film. The machine includes a frame having two end plates 21, 22 which are laterally spaced from one another and which support the various rollers included within the machine. In the present embodiment, the end plates 21, 22 are of forwardly-facing L shape having a horizontal portion 21a, 22a and a vertical portion 21b, 22b. Bridging the two end plates is

a front member 23, a top member 24, and a back member 25 (FIG. 3). For enclosing the end plates 21, 22 end bells 27, 28 are provided which conform in profile to the end plates and which are secured to the latter. The means employed for fastening the various members together will be described in detail at a later point.

It will be apparent that the structure as thus far described leaves open the front of the machine except for that portion covered by the front plate 23. Consequently, for enclosing the front of the machine and for supporting and guiding documents into the machine a bezel 30 is provided which is L shaped in cross section having a horizontal portion 31 and a generally vertical portion 32 for mating with the horizontal and vertical portions respectively of the side plates 21, 22. In the present instance the bezel carries side flanges 33, 34 which are dimensioned to telescope snugly over the end bells 27, 28 when the bezel is assembled in operating position. The bezel is also provided with a lower flange 35 or skirt and an upper flange 36 which extend over the edges of the front and top members 23, 24 respectively to produce a neat finished appearance.

In accordance with one of the aspects of the invention, the front surface 32 of the bezel is recessed as indicated at 36a, with a guiding wall 37 which tapers inwardly and downwardly. The horizontal portion 31 of the bezel is, moreover, extended inwardly to form a feed surface or table 38, the junction of the members 37, 38 serving to define an opening or slot 39 between them into which the documents are fed when the machine is in operation.

In accordance with another aspect of the invention, the bezel includes a hinged feed table or platen 40 which is pivoted along its rear edge at a pivot 41 (FIG. 3) and which is swingable between a horizontal working position and an upraised storage or transport position. When the feed table 40 is in its horizontal position, it is supported by the horizontal portion 31 of the bezel and forms a smooth continuation of the feed surface 38 so that documents may be smoothly guided from the forward edge of the table 40 across the surface 38 and into the slot 39. When the table 40 is swung upwardly the upper portion thereof nests in the recess 36a as shown by the dot-dash outline in FIG. 3, preventing entry of dirt or other foreign material into the document receiving slot 39.

To facilitate guiding documents into the machine, a guide 42 is provided at the left hand side of the table 40, such guide being contoured so that it registers with the sloping surface 37 when the table is in its upwardly-swung, enclosing position.

For the purpose of applying heat and pressure during the process of lamination, a pair of vertically arranged heated rollers 51, 52 are provided having a nip aligned with the feed table 38, the ends of the rollers being journaled in the respective side plates 21, 22. In order to understand the mounting and construction of these rollers, the roller 51, which is typical, is shown in transverse section in FIG. 4 to which reference is made. Here it will be noted that the roller is of hollow construction comprising a metal cylinder 50 having good thermal conduction properties and end members or trunnions 53, 54 which are telescoped into the ends of the cylinder. Preferably the end member 53, 54 are threaded into the member 50 as shown to provide a unitary construction rigid in the face of the applied pressures which may, nevertheless, be disassembled.

For journalling the roller 51 in the side plates, ball bearings 55, 56 are provided mounted in pivoted carriers 57, 58 to permit bodily movement of the roller. The carrier 57 which is associated with the ball bearing 55 is shown in detail in FIG. 3a. Here it will be noted that it includes a stationary pivot 60 anchored in the side plate and an arm 61 which is pulled downward by a coil spring 62 having an adjustable anchor 63. An identical arrangement is provided at the other end of the roller 51, and it will be understood that the springs are adjusted

to provide equal biasing forces, causing the roller 51 to bear with equal pressure along its entire length. The mounting arrangement for the roller 52 differs from that of the roller 51 in that the roller 52 is supported by stationary carriers at each end. As shown in FIG. 3a the roller 52 is supported at its right hand end by a bearing carrier 65 which is anchored to the adjacent end plate 22 by means of screws 66.

In accordance with the present invention a radiant heater is located at the axis of each of the rollers 51, 52, the heater element including a radiation-transparent tube made of quartz or the like having contained therein a longitudinally extending coil of resistance wire 73. The quartz tube indicated at 70 is mounted in cup-shaped supports 71, 72 which are preferably made of ceramic material with the joint being sealed by suitable high-temperature cement. The coil of heating wire 73 is axially arranged within the tube 70 and, in accordance with one of the more detailed aspects of the invention, the convolutions are more closely spaced at the ends of the heating element (FIG. 4a) to make up for leakage of heat at the ends of the tube. The exact spacing between the turns at each point along the element may be adjusted by one skilled in this art.

In order to provide electrical connection to the ends of the heating element, rod-like terminals anchored to the ends of the tube are telescoped through the roller trunnions. Thus, at the left hand end of roller 51, the heating element is connected to a terminal 80 which is insulated from the trunnion member 53 by a sleeve 81 of insulating material. Since the insulating sleeves provide thermal insulation as well as electrical insulation, heat loss at the ends of the element is much less than in conventional constructions. For the purpose of making connections to the outer end of terminal 80, a wiper 82 is provided mounted in a stationary support 83 formed of insulating material and secured to the associated end plate. A similar construction is utilized at the right hand end (FIG. 4), with a terminal 86 being brought out through an insulating sleeve 87 and contacting a wiper 88 which is mounted in an insulating supporting member 89. It will be apparent that this novel construction avoids the use of sliding contacts with their attendant difficulties and provide a reliable path for current flow into the rotating cylinder. Moreover, the heating element including the tube 70 with its attached terminals is readily replaceable simply by removing the roller and unscrewing one of its ends.

It is found that the arrangement just described provides even, radiant heating of the inner wall of the roller 51 distinguished by quick response and therefore close following of the thermostatic control switch to be described. To facilitate heat absorption, the inner wall may be colored black. The wire 73 of the heating element is preferably formed of an alloy which is resistant to oxidation when operated at radiant temperatures. We prefer to use an aluminum iron alloy. Experience has indicated that it is not necessary to have a hermetic seal between the mounts 71, 72 and the quartz tube 70, the mounts being preferably formed of ceramic material which has a certain amount of porosity. It would appear, however, that with the members 71, 72 cemented in place, only a limited amount of oxygen is admitted to the inside of the tube thus limiting the rate at which oxidation can take place. It will be apparent that other well-known alloys may be used; for example, alloys comprised of nickel, iron, chromium and generally referred to as "Nichrome."

In carrying out the invention a resiliently mounted, stationary thermostat is provided having a sensitive element which bears directly against the outer surface of the heated roller 51 and which has contacts connected in series with the heater 73. The construction of the thermostat 100 engaging the roller 51 may be understood from inspection of FIG. 3. It includes bimetallic strip 101 which

rides directly on the outer surface of the roller and includes a stationary contact arm 102 and a movable contact arm 103. An adjustable stop 104 determines the normal position of the fixed contact arm 102. At the tip of the bimetallic element 101 is a projecting pin 101a which engages the movable contact arm 103 thereby opening and closing the contacts in accordance with the flexure of the bimetallic element 101.

In order to insure maintenance of physical contact between the bimetallic element and the roller, the entire thermostat 100 is mounted at the end of a light leaf spring 105 which is anchored with respect to the end plates by a square rod 106. The spring 105 is preferably much lighter than the bimetallic strip so that the latter may flex in response to temperature changes independently of the flow-up action of the spring. In short the bimetal constantly follows the temperature of the moving roller. It will be apparent that where it is desired to change the amount of force between the thermostat assembly and the roller 51, this may be accomplished simply by rotating the supporting bar 106 through a small angle in one direction or the other. The construction of the thermostat 100a associated with the heated roller 52 need not be described in detail since it corresponds exactly to that previously set forth.

Thus, the temperature of the heated rollers 51, 52 is subject to independent automatic control, the upper thermostat preferably being adjusted at the factory to a slightly lower control point than the lower to compensate for the upwardly convected heat.

To produce a certain amount of "anticipation" and thereby minimize any tendency for the temperature to overshoot, particularly when the heating elements are first turned on, the thermostat 100 is provided with an auxiliary heating element 110 of hairpin shape which is outwardly spaced from the periphery of the bimetal 101 (see FIGS. 3 and 6). This auxiliary heater is arranged in series with the electrical contacts so that when current is first applied (the contacts being initially closed) the bimetallic element receives a portion of its heat from the auxiliary heater. Thus, the contacts tend to be opened slightly in advance of the control point with little or no overshoot of the temperature existing at the roller surface. In a practical case, the heating element may have a rating of 280 watts with a light running cycle of 3 seconds "on" and 30 seconds "off" and a load cycle of about 3 seconds "on" and 15 seconds "off." The relatively long "off" portion of the cycle even under load is explained by the fact that the thermal capacity of the film and paper is low so that it takes very little heat to bring the film and paper up to the operating temperature. It has been found that a temperature of 230° F. may be maintained plus or minus about 10°. This is well within the limit temperatures of 210° F. to about 260° F. for practical adhesives.

Having understood the construction of the heated rollers 51, 52 and the means employed for heating such rollers, attention may next be given to the supply rollers which supply films of the transparent plastic laminating material. An upper supply roller 121 serves to supply plastic film to the heated roller 51 while a lower supply roller 122 serves as the source of film for the heated roller 52. The supply roller 121 will be taken as representative, corresponding numerals being applied to the supply roller 122 with the addition of subscript "a." The details of construction will be apparent upon reference to FIGS. 5 and 7, FIG. 5 being a transverse fragmentary section with a roll of laminating material in place. Such material, indicated at 123, is wound about a hollow core 124 formed of cardboard or the like. For supporting the core 124 in tight frictional engagement, a mandrel is used having end pieces 125, 126 and a resilient shell 127, all rotatably mounted on a shaft 130. As shown in FIG. 7, the resilient shell 127 has two semi-cylindrical sections 128, 129 having sharp edges 131, 132, 133 and 134 which

extend radially outward. The edges 131—134 occupy only the central portion of the mandrel and relief is provided as at 135, 136 so that all of the sharp edges are individually sprung in the outward direction. Thus, when a roll of laminating material is forced onto the mandrel, the edges 131—134 are depressed inwardly as shown by the dot-dash outline in FIG. 7 and tend to bite into the relatively softer cardboard core. Even though the force required to assemble the roll in place may be relatively light, rotation between the roll and mandrel is effectively prevented.

In order to insure that the supply roll is seated in aligned position, a roll stop 140 in the form of an annular disk is secured to the end member 125 by screws 141. And to insure that the mandrel itself is properly located with respect to the frame of the machine, retaining washers 143, 144 are employed which may be of the snap-spring type, engaging suitably spaced annular grooves in the shaft 130.

In accordance with one of the aspects of the invention, the shaft 130 is locked against rotation and serves to support a brake disk for application of predetermined drag upon the rotation of the mandrel with provision for precise adjustment of the braking force. To prevent rotation, the shaft 130 is "flatted" as indicated at 150 and the right hand end (FIGS. 3 and 5) is received in a close fitting, slotted bracket or clip 151 which is secured to the frame plate 22. At its other end, the shaft 130 is received in a bracket 152 secured to the frame plate 21. End-play between the plates 21, 22 is taken up by a "bullet catch" 154 which is received in the right hand end of the shaft and which presses against the plate 22. Keyed to the flats on the shaft 150, and thus non-rotatable, is a brake disk 155 which cooperates with a second brake disk 156 of brake lining material screwed or otherwise secured to the end member 126 of the mandrel. Predetermined braking force between the disks is obtained by a coil spring 158 which presses against the disk 155 and which is backed up by an adjustable thumb screw 159 threaded on the shaft 130. It will be apparent that as the plastic film is drawn from the supply roll relative rotation will take place between the two brake disks resulting in a drag which depends upon the adjustment of the screw 159. With the screw properly adjusted, the film is tensioned and drawn perfectly straight over the guide bar, thus avoiding any wrinkles, bubbles or the like in the final product. The adjustment of the two supply rollers 121, 122 is preferably such as to produce equal tension in the film being fed to the heated rollers, thereby to reduce any tendency toward curling of the laminate.

For the purpose of guiding the films from the supply roll and for causing the same to be trained or wrapped about the heated rollers over a predetermined arc, transverse polished guide bars rigidly secured to the end plates are employed. Thus, referring to the upper supply roll, the film 161 therefrom passes about a guide bar 160 which is so arranged that the film is in contact with the heated roller 51 through an arc of about 80°. Since the guide bar 160 contacts the back or non-adhesive side of the film, there is no tendency for the film to stick to the bar even though the bar is located in a heated environment. Referring to the lower supply roll 122, the film 162 therefrom is passed about a first transverse guide bar 163 and thence about a second guide bar 164. While the guide bar 163 is in contact with the adhesive side of the film, nevertheless it will be noted that such bar is located at the very bottom, i.e., the coolest part, of the housing and no tendency for softening or sticking of the adhesive is noted, even when the machine is operated for long periods of time. Nor has any tendency been noted for the accumulated heat to cause sticking of the film in either supply roll. By way of insurance, a layer of insulation

165 is used extending the width of the roll 121 between it and the heated rollers.

For the purpose of receiving and tensioning the laminate from the heated rollers 51, 52, and for discharging it from the machine, vertically arranged pull rollers 171, 172 are provided closely adjacent the heated rollers and having a nip aligned with the nip of the heated rollers. The pull rollers are mounted on shafts 173, 174, and the driving means is so arranged that the surface speed of the pull rollers is slightly greater than the surface speed of the heated rollers 51, 52. The pull rollers are preferably made of rubber or the like and are biased together by a leaf spring 175 at each end of the shaft 173, the frame end members being slotted to accommodate floating movement of the shaft in response to the spring pressure. For driving the rollers at proper relative speeds, a positive type belt drive is employed using a belt 180 driven by a motor 179 suitably secured to the frame plate 22. The belt 180 is trained about a motor pulley 181, a heated roller drive pulley 182 and a pull roller drive pulley 183, the diameters of the rollers being such that the "overdrive" of the pull rollers is in the order of one percent. Slack in the belt 180 is taken up by an idler pulley 184. For positive driving of the upper heated roller 51 end gears are used, located at the opposite end of the machine from that visible in FIG. 3. Thus as shown in FIG. 4 the heated roller 52 is provided with an end gear 192 and the cooperating roller 51 is provided with an end gear 191, with such gears being in mesh with one another and having the same pitch diameter as the diameter of the heated rollers. End gears are not provided for the upper pull roller 171 since friction driving has been found to be adequate; however, end gears may be used if desired.

It is found that the "over driven" pull rollers perform a number of important functions. In the first place, since they are aligned with the heated rollers, they provide a straight pull upon the bonded laminate during the critical cooling phase just after the laminate leaves the surface of the heated rollers. This balances any residual strains in the laminate so that the final product lies perfectly flat. It is also found that the pull rollers tend to complete the laminating operation, ironing out any wrinkles or bubbles which may "get by" the heated rollers. This ironing effect may be due to the relative slippage which must necessarily take place because of the over-driving. In any event, the quality of the final product including freedom from bubbles and irregularities is believed to result from the combined action of the two sets of rollers, constructed and driven as described above.

As another feature of the present device, a serrated edge is provided immediately adjacent to the discharge side of the pull rollers 171, 172 to facilitate the cutting off of individual laminated documents. In the present instance this edge occupies a recess 200 in the back of the cabinet, the recess being defined by bending the top member 24 inwardly to form a forwardly inclined portion 24a and the back member 25 forwardly to form a discharge shelf 25a (FIG. 3). Between them, the two members 24a, 25a, define a discharge slot or outlet 201. Mounted along the lower edge of the portion 24a of the top member is a serrated blade 205 which is held in place by struck out metal clips 206 (FIG. 10) and by screws 207. It is one of the features of the present construction that the lower edge of the member 24a carrying the blade is flared outwardly so that the advancing edge of the laminate is sure to be guided through the discharge opening 201 and not "hung up" within the machine. In using the severing means described above, a document is fed into the receiving slot 39 at the front of the machine and, as soon as the document emerges from the outlet slot 201, the motor is stopped. Force is then applied upwardly to one edge of the laminate, causing the laminate to be impaled on the serrated edge

of the blade and resulting in a clean tear across the width of the laminate. Since the serrated tearing edge is located immediately adjacent to the pull rollers, waste or "idle" laminating material is reduced to an absolute minimum. It should be mentioned in any discussion of the top panel 24 that the portion 24a thereof is louvered as shown at 24b to provide a large ventilating area thereby to keep the temperature of the machine at a safely low level.

It is one of the features of the device contributing to attractive appearance that while the housing consists of a number of pieces, the fastening means for anchoring these pieces together is not readily visible. This is accomplished in part by providing inwardly turned anchoring flanges on the front, top and back members 23, 24 and 25, indicated by the general numeral 210, and anchored by screws or the like to the end members 21, 22 of the frame. In the case of the front panel 23, the flanges thereon are pivoted along the lower edge as indicated at 211 and a spring clip and detent 213, 214 is provided at the upper edge of the panel to keep the same in place except when it is desired to replenish the lower supply roll 122. For the purpose of enclosing the end plates and thereby hiding and protecting the mechanism secured thereto, the hollow end bells 27, 28 are provided having threaded posts at spaced points engageable by screws passing through holes in the end plates. Thus referring to FIG. 11 which is typical, it will be noted that the end bell 28 is provided with a post 220 which is threaded for reception of a fastening screw 220a extending through a hole in the adjacent end plate 22. The screws 220a are so positioned as to be readily accessible when the bezel 30 and supply rolls 121, 122 are removed. To insure that the bezel 30 remains in place, while permitting ready removal by a simple forward pull, guide rails 221, 222 are secured to the inside surfaces of the end plates 21, 22. The horizontal portion of the bezel 30 rests upon such guide rails and is retained in contact therewith by spring clips, for example, as indicated at 224 in FIGS. 3 and 8. The spring clips are sufficiently strong so that the bezel cannot slip forwardly except with intentional effort.

Prior to mentioning certain advantageous features which are inherent in the above construction, attention may be directed to the control circuit shown in FIG. 9. The circuit indicated generally at 230 has input lines 231, 232 protected by a fuse 233. In series with the line 231 is a master switch 234 which supplies current to a bus 235. To indicate that the master switch 234 is closed, a pilot light 236 of the gaseous discharge type is employed.

For supplying current to the motor 179, two switches, arranged in parallel, are used. The first is a switch 237 located right at the front of the machine and the second is a foot switch 238 which is connected into the circuit by an appropriate line and connector.

In accordance with one of the aspects of the invention, means are provided for disabling the motor circuit until the device comes up to temperature. This is accomplished by an auxiliary thermostat 239 of the normally open type which is arranged within the machine in a heat-responsive position preferably in riding contact with one of the heated rollers, and adjusted to close once the desired threshold temperature is reached, remaining closed for all subsequent operation. In a practical construction the auxiliary thermostat may be mounted adjacent the control thermostat on the lower heated roller. To inform the operator when the machine is in readiness, a ready light 240 of the gaseous discharge type is employed bridging the motor and motor switch circuit. Upon closure of the thermostat 239, the ready light 240 is energized, informing the operator that the machine may be used. Upon closure of either of the motor control switches 237, 238 the ready light 240 remains lighted since the voltage drop through the motor is always greater than the striking point of the gaseous discharge lamp. The thermostats 100, 100a continuously maintain the heated rollers 51, 52 at

operating temperature as previously described, whenever the master switch 234 is closed. It will be apparent to one skilled in the art that the above described circuit positively insures that the machine will be operated only when at operating temperature and consequently there are no precautions to be kept in mind on the part of the operator, enabling the machine to be operated successfully by inexperienced office personnel.

With regard to the choice of laminating material, a polyester resin is preferred since it is distinguished by strength and long life. Such material may be coated with a suitable transparent adhesive, capable of bonding to all types of paper within the temperature range set forth above. Selection of an appropriate adhesive is a matter well within the skill of the art.

As will be apparent to one skilled in the art one of the features of the above-described construction is that the documents pass in a straight line from inlet to outlet, the feed table 38, 40 being located at the same level as the junction between the heated rollers 51, 52. While the machine is compact, with the supply rollers being located close to the heated rollers, premature fusion or sticking of the laminated material is, nevertheless, avoided. Note that the lower supply roller utilizes the space under the feed table in the forward portion of the L, a location which is inherently cool so that there is no danger the adhesive will stick to the guide rod 163. Care need not be exercised in the insertion of documents since the surfaces 37, 38 form a funnel for guidance of the document into the inlet opening or throat 39 where immediate engagement takes place with the advancing films. And, since both the front bezel and back panel are recessed inwardly toward the rollers, the total traverse within the machine, i.e., from the inlet of the heated rollers to the outlet of the pull rollers is only a matter of a few inches, a distance which is a small fraction of the total thickness of the housing for minimizing waste in the laminating of single documents.

Because of the simplicity and low cost of the present machine, it may be used universally in business offices for the enhancement and protection of documents and, where desired, for protectively laminating sheet materials other than paper.

While the invention has been described in accordance with a preferred embodiment in which an adherent film is applied to both sides of a single sheet, it will be apparent that the invention is not limited thereto but may be employed for covering only the face of a sheet. This is accomplished by feeding in two sheets back-to-back with subsequent separation by trimming the edges. Consequently the term document as used in the claims shall be understood to cover a single sheet or two sheets back-to-back.

Finally, while the disclosed machine is primarily intended for applying transparent plastic films, it will be understood that it is applicable, in addition, to non-transparent, i.e., translucent, materials and to films made of material other than plastic.

What is claimed is:

1. In an office laminating machine, the combination of means providing an opening for receiving a document, a pair of heated rollers biased together and arranged adjacent said opening means for driving said heated rollers, a pair of supply rolls each supplying a film of transparent laminating material having a thermoplastic surface for training about said heated rollers so that a document fed into said opening is bonded between two layers of film by the action of heat and pressure, means for equally tensioning the films of transparent laminating material as they approach the heated rollers, and means including a pair of pull rollers having a nip aligned with the nip of the heated rollers and defining a straight run of bonded laminate for tensioning the bonded laminate as it leaves the heated rollers.

2. In an office laminating machine, the combination

of means providing an opening for receiving a document, a pair of heated rollers biased together and arranged adjacent said opening, means for driving said heated rollers, a pair of supply rolls each supplying a film of transparent adhesive coated laminating material to said heated rollers so that a document fed into said opening is bonded between two layers of film by the action of heat and pressure, each of said heated rollers being of hollow construction having a radiant heating element located on its axis and having a stationary thermostat riding on its surface and in intimate heat transfer relation therewith for controlling the energization of said element, and means for lightly biasing the thermostats against said heated rollers.

3. In an office laminating machine, the combination of means providing an opening for receiving a document, a pair of heated rollers biased together and arranged adjacent said opening, means for driving said heated rollers, a pair of supply rolls each supplying a film of transparent plastic laminating material to said heated rollers so that a document fed into said receiving means is bonded between two layers of film by the action of heat and pressure, at least one of said heated rollers being of hollow construction having a radiant heating element located on its axis and having a thermostat including a bimetallic element riding on its surface for controlling the energization of the associated heating element, said bimetallic thermostat having a relatively light mounting spring so that the bimetallic element is maintained in intimate contact with surface of said roller regardless of the condition of flexure of such element.

4. In an office laminating machine, the combination of means providing an opening for receiving a document, a pair of heated rollers biased together and arranged adjacent said opening, means for driving said heated rollers, a pair of supply rolls each supplying a film of transparent plastic laminating material to said heated rollers so that a document fed into said opening is bonded between two layers of film by the action of heat and pressure, each of said heated rollers being of hollow thin-walled construction having low heat capacity and having a radiant heating element located at its axis for direct radiation of the inside surface of the roller, said heating element comprising a radiation-transparent tube having a radiant resistor therein.

5. In an office laminating machine, the combination of a frame providing an opening for receiving documents, a pair of heated rollers biased together and arranged adjacent said opening, means on said frame for driving said heated rollers, a pair of supply rolls each supplying a film of transparent plastic laminating material to said heated rollers so that a document fed into said opening is sandwiched between two layers of film and bonded together by the action of heat and pressure, each of said heated rollers comprising a hollow metal cylinder having hollow trunnions at its ends and having a tubular heating element located at its axis, said heating elements being formed of a radiation-transparent tube having a radiant coil longitudinally arranged therein and connected to terminal rods projecting from the ends of the tube, said terminal rods being telescoped into said hollow trunnions and insulated therefrom, and wipers mounted on said frame for contacting the ends of the terminal rods.

6. In an office laminating machine, the combination of a frame providing an opening for receiving documents, a pair of heated rollers biased together and arranged adjacent said opening, means on said frame for driving said heated rollers, a pair of supply rolls each supplying a film of transparent plastic laminating material to said heated rollers so that a document fed into said opening is sandwiched between two layers of film and bonded together by the action of heat and pressure, each of said heated rollers comprising a hollow metal cylinder of low

heat capacity having hollow trunnions at its ends and having a tubular heating element located at its axis, said heating elements being formed of a radiation-transparent tube having a radiant coil longitudinally arranged therein and connected to terminal rods projecting from the ends of the tube, said terminal rods being telescoped into said hollow trunnions and insulated therefrom, wipers mounted on said frame for contacting the ends of the terminal rods and thermostats mounted on said frame and riding on said heated rollers respectively for sensing the temperature thereof and thereby controlling the energization of the respective heating elements.

7. In an office laminating machine, the combination comprising a frame including a pair of end plates laterally spaced from one another, a pair of heated rollers journaled in said end plates and biased toward one another, a pair of supply rolls journaled in said end plates for feeding respective films of plastic between said heated rollers, a pair of pull rollers at the output of said heated rollers, means on at least one of said end plates for driving said heated rollers and pull rollers, hollow end bells on said end plates respectively conforming in outline thereto and covering said driving means, a front bezel shaped to overlie the front of the machines and having side flanges snugly telescoped over said end bells, said front bezel providing document receiving means in the form of a slot immediately in front of said heated rollers for the feeding of documents between said films of plastic material.

8. In an office laminating machine the combination comprising a frame including a pair of L-shaped end plates defining a forwardly facing step having a horizontal portion and a vertical portion, a pair of heated rollers journaled in said end plates and biased toward one another, said rollers being arranged one above the other and having a nip substantially aligned with the horizontal portion of said step, an upper supply roll journaled in said end plates at the upper portion of said frame, a lower supply roll journaled in said end plates below the horizontal portion of said step, means for guiding films of plastic laminating material from said supply rolls about adjacent ones of said heated rollers, a pair of pull rollers journaled in said end plates, said pull rollers being arranged one above the other immediately behind said heated rollers, and having a nip aligned with the nip of the heated rollers for defining a straight run of bonded laminate, means for driving said heated rollers and pull rollers, said supply rolls having constantly energized adjustable brakes respectively for applying predetermined and substantially equal tension to the films fed therefrom.

9. In an office laminating machine, the combination comprising a frame including a pair of end plates laterally spaced from one another with a document-receiving slot extending between them, a pair of heated rollers journaled in said end plates and biased toward one another, said rollers being arranged one above the other and having a junction substantially aligned with said slot, an upper supply roll journaled in said end plates in the upper portion of said frame, a lower supply roll journaled in said end plates in the lower portion of said frame, smooth surfaced guide rods secured to said end plates for guiding respective films of plastic laminating material from said supply rolls about adjacent ones of said heated rollers, a pair of pull rollers journaled in said end plates immediately behind said heated rollers and centered with respect to the latter, means for driving said heated rollers and pull rollers, said supply rolls having brakes integral therewith for constantly tensioning the film as it passes over said guide rods.

10. In an office laminating machine a combination comprising a frame including a pair of L-shaped end plates defining a step having a horizontal portion and a vertical portion, a pair of heated rollers journaled in said end plates and biased toward one another, said heated

rollers being arranged one above the other and having a junction substantially coinciding with the horizontal portion of said step, supply rolls associated with said heated rollers, means including film guides so that film from said supply rolls is trained about said heated rollers, means for driving said heated rollers, a front bezel member having a vertical portion and a horizontal portion for nesting in the step formed in said end plates, the vertical portion of said bezel member being rearwardly recessed and with the horizontal portion of said bezel member being rearwardly extended to define a document receiving slot located immediately adjacent the input of said heated rollers, said bezel member having an auxiliary pivoted feed table hinged along its rear edge to said bezel and swingable between (a) a lowered position in which the feed table constitutes a forward extension of the horizontal portion of said bezel and (b) a vertical position in which said auxiliary feed table encloses the front of said bezel.

11. In an office laminating machine a combination comprising a frame including a pair of end plates laterally spaced from one another, a pair of heated rollers journaled in said end plates and biased toward one another, said heated rollers being arranged one above the other, supply rolls associated with said heated rollers, means for driving said heated rollers, a front bezel member spanning said end plates, said bezel member having a face which is angled rearwardly and downwardly and which terminates in a document receiving slot located immediately adjacent the input of said heated rollers, and a pivoted feed table hinged along its rear edge below said slot and swingable between a lowered horizontal position for feeding of documents into said slot and a vertical position which said feed table encloses the front of said bezel including said slot.

12. In an office laminating machine the combination comprising a frame including a pair of end plates laterally spaced from one another, a pair of heated rollers journaled in said end plates and arranged one above the other, means for supplying said heated rollers with films of transparent laminating material, a pair of pull rollers journaled in said end plates and arranged one above the other behind said heated rollers, means for driving said rollers with the pull rollers being driven at a surface speed slightly higher than that of the heated rollers so that a straight pull is applied to the laminate after the laminate leaves the heated rollers for equalization of strains set up in the laminate, a front bezel having a feed table, a rear panel having a discharge shelf, the feed table, the nips of the rollers and discharge shelf all being in substantial alignment with one another so that a document fed from said feed table proceeds in a straight line through the machine.

13. In an office laminating machine the combination comprising a frame including a pair of end plates laterally spaced from one another, a pair of heated rollers journaled in said end plates and arranged one above the other, means for supplying said heated rollers with films of transparent laminating material, a pair of pull rollers journaled in said end plates and arranged one above the other behind said heated rollers and centered with respect thereto, means for driving said rollers with the pull rollers being driven at a surface speed slightly higher than that of the heated rollers so that a straight pull is applied to the laminate after the laminate leaves the heated rollers for equalization of strains set up in the laminate, a front bezel having a feed slot aligned with the nip between said heated rollers for receiving a document, a rear panel having a discharge slot aligned with the nip between said pull rollers for receiving the bonded laminate discharged from the latter, the front bezel being recessed convergently inward toward the feed slot and the back panel being recessed to provide a flare so that the receiving and discharge slots are immediately adjacent

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said rollers thereby to provide a straight path of minimum length for said document.

14. In an office laminating machine the combination comprising a frame including a pair of end plates laterally spaced from one another, a pair of heated rollers journaled in said end plates and arranged one above the other, means for supplying said heated rollers with films of transparent laminating material, a pair of pull rollers journaled in said end plates and arranged one above the other behind said heated rollers and centered with respect thereto, means for driving said rollers, means behind said pull rollers defining a discharge opening aligned with the junction between said pull rollers for receiving the laminate discharged from the latter, a cutting blade on one side of said opening for severing the laminate upon applying relative movement between the laminate and the blade, said blade being mounted in angled position to provide a tapered surface for guiding the leading edge of the severed laminate through said discharge opening.

15. In an office laminating machine the combination comprising an upstanding housing, the front wall of said housing providing a receiving slot for receiving documents to be laminated, a pair of heated rollers positioned immediately behind said slot and vertically arranged to define a nip close to said slot and aligned therewith, said heated rollers being of hollow construction having radiant heating elements therein as well as thermostatic means responsive to the roller surface temperature for controlling energization of the heating elements so that the temperature at the surface is maintained within close limits, supply rolls arranged in said housing respectively above and below the heated rollers, said supply rolls each having a strip of transparent adhesive-coated laminating material, means for guiding the strips of laminating material from the supply rolls into arcuate contact with the respective heated rollers and into the nip thereof on opposite sides of a document fed into said receiving slot, a pair of pull rollers vertically arranged closely adjacent said heated rollers, means for positively rotating the heated rollers and pull rollers, the rear wall of said housing providing a discharge slot closely adjacent the pull rollers, means for establishing equal frictional drag upon the strips of laminating material so that the strips are tensioned equally as they are heated in contact with the heated rollers and said pull rollers having a nip which is symmetrically aligned with the nip of said heated rollers to provide a straight run of bonded laminate and having a surface speed which is just slightly greater than that of the heated rollers so that the tension is applied to the straight run of laminate as it cools and as it travels from the heated rollers to the pull rollers thereby to insure equalization of strains set up in the laminating material for production of a flat bonded laminate.

16. In an office laminating machine the combination comprising an upstanding housing having a work table extending horizontally along the front edge thereof, the front wall of said housing providing a receiving slot aligned with the top of the work table for receiving documents to be laminated, a pair of heated rollers positioned immediately

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behind said slot and arranged one above the other to define a nip horizontally aligned therewith, said heated rollers being of hollow construction having walls of low heat capacity and having heating elements therein arranged to supply heat directly to the walls as well as thermostatic means responsive to the roller surface temperature for controlling energization of the heating elements so that the temperature is maintained within close limits in spite of changes in loading, a first supply roll arranged above the heated rollers and a second supply roll arranged below the heated rollers and under said work table, said supply rolls each having a strip of transparent adhesive-coated laminating material, means for guiding the strips of laminating material from the supply rolls into arcuate contact with the respective heated rollers and into the nip thereof on opposite sides of a document fed into said receiving slot, a pair of pull rollers vertically arranged adjacent said heated rollers, means for positively rotating the heated rollers and pull rollers, the rear wall of said housing providing a discharge slot, means for establishing equal frictional drag upon the strips of laminating material so that the strips are tensioned equally as they are heated in contact with the heated rollers, and said pull rollers having a nip which is symmetrically aligned with the nip of said heated rollers to provide a straight run of bonded laminate and having a surface speed which is just slightly greater than that of the heated rollers so that tension is applied to the straight run of laminate as it cools and as it travels from the heated rollers to the pull rollers thereby to insure equalization of strains set up in the laminating material for production of a flat bonded laminate, the pull rollers being arranged closely adjacent the heated rollers and the front and rear walls of the housing being recessed inwardly so that the receiving and discharge slots formed therein are closely spaced with respect to the rollers and so that the document travels a straight path of minimum length within the machine.

References Cited in the file of this patent

UNITED STATES PATENTS

450,837	Kirby et al.	Apr. 21, 1891
1,514,288	Hynes	Nov. 4, 1924
1,596,181	Hills	Aug. 17, 1926
1,955,508	Lofman	Apr. 17, 1934
2,046,559	Javery et al.	July 7, 1936
2,171,259	Scott	Aug. 29, 1939
2,425,686	Porter	Aug. 12, 1947
2,499,961	Lennox	Mar. 7, 1950
2,621,423	Clark	Dec. 16, 1952
2,680,468	Lewis	June 8, 1954
2,750,310	Hodge	Mar. 29, 1955
2,814,328	Jess	Nov. 26, 1957
2,822,030	Pokras	Feb. 4, 1958
2,944,587	Newcomb	July 12, 1960

FOREIGN PATENTS

421,915	Great Britain	Jan. 2, 1935
122,807	Australia	Nov. 14, 1946