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2,113,770

METHOD AND APPARATUS FOR DRYING INKED IMPRESSIONS

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2 Sheets-Sheet 1

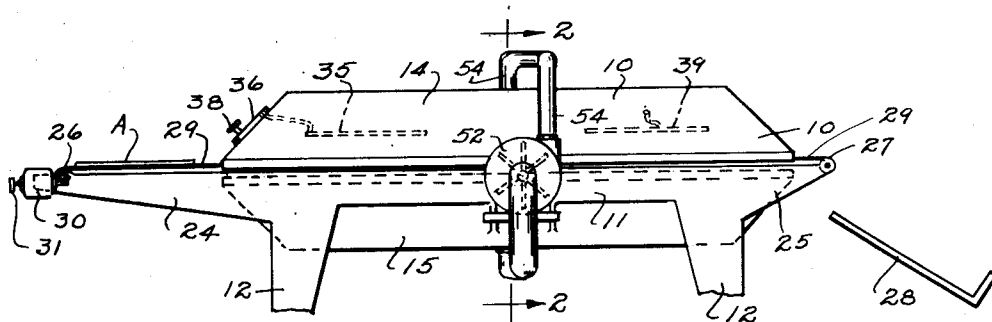


FIG. 1

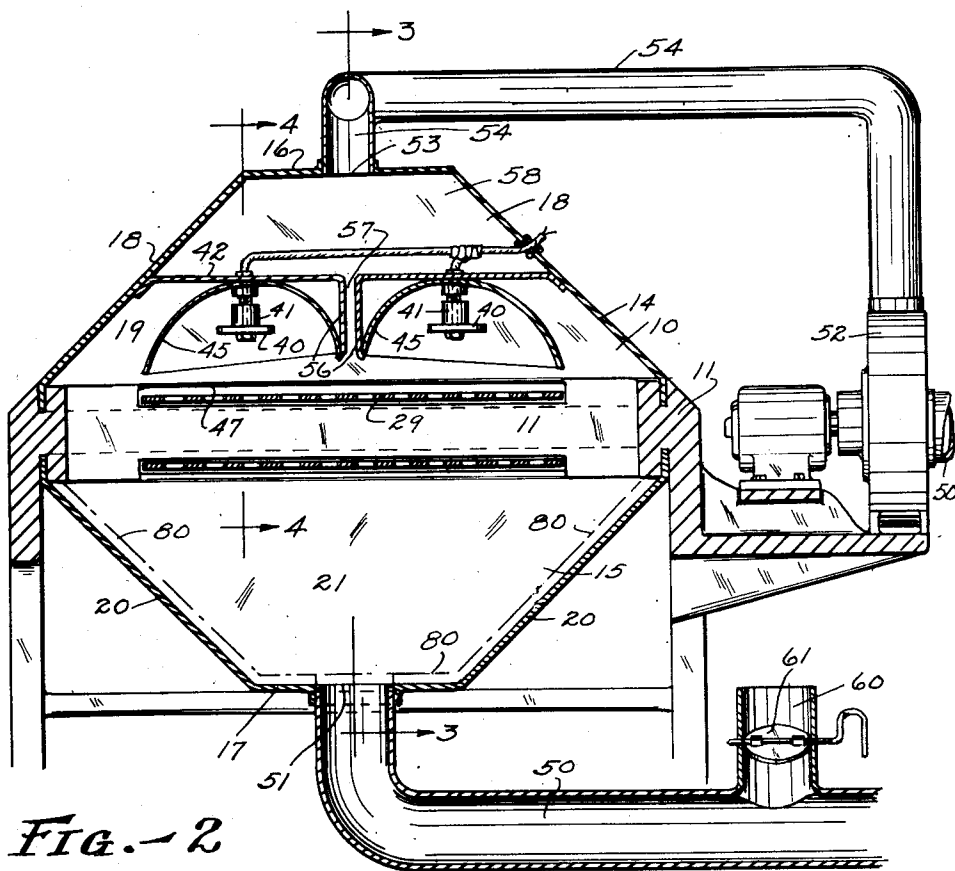


FIG. 2

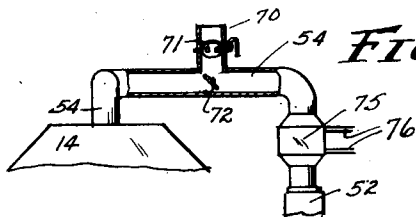


FIG. 5

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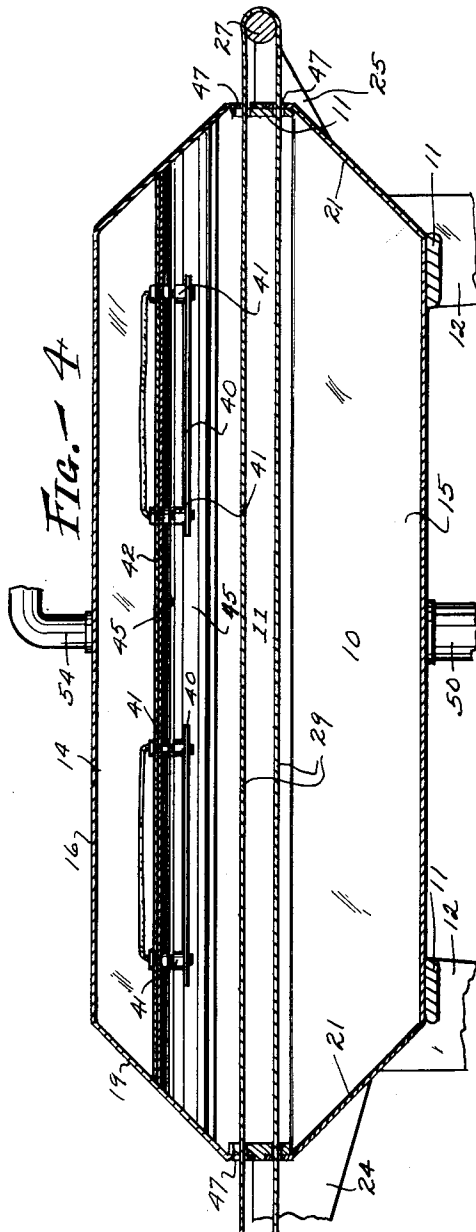
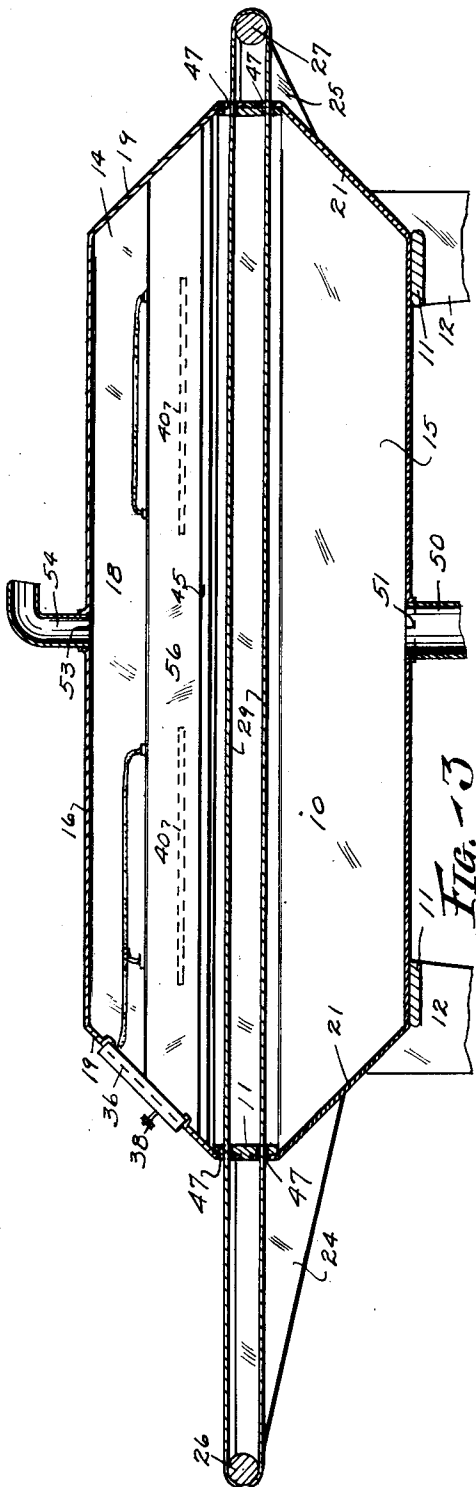
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METHOD AND APPARATUS FOR DRYING INKED IMPRESSIONS

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2 Sheets-Sheet 2



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METHOD AND APPARATUS FOR DRYING
INKED IMPRESSIONS

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4 Claims. (Cl. 34—12)

This invention relates to a method and apparatus for rapidly drying inked impressions on paper, cardboard or similar materials. More particularly, the invention concerns an apparatus for drying impressions made from steel engravings on mechanically operated steel die embossing or plate presses.

At the present time practically all drying of impressions, made by steel die presses, is accomplished by lengthy exposure of the imprinted paper sheets to the influence of the atmosphere in the printing or engraving shop. Each piece of imprinted paper, after being removed from the press by the press operator, is individually laid upon drying racks or trays by another operator. The sheets remain on these trays untouched until the ink is completely dried by the influence of the atmosphere. This natural drying process requires from three to twenty-four hours depending on the amount and grade of ink used, the grade and surface characteristics of the paper, and the humidity and temperature of the atmosphere in the shop. When the ink has dried, the sheets none of which were superimposed upon the other, are manually gathered from the trays and boxed for shipment, or in case of two or more color work, the sheets are returned to the press for the second color and the drying process again repeated before the final boxing and shipment can be accomplished.

While the impressed sheets are drying, they remain unstacked on the trays, as no stacking, even that of placing a single sheet on top of another, can be done until the ink is thoroughly dry, otherwise the wet impression will offset on the back of the superimposed sheet. Likewise, in the case of two, (or more), color work, the sheets cannot be subjected to a second impression until the previously imprinted ink is dry, as the impression will smear on contact with the die, or during the handling of the sheet. In either of these instances, that is, when the ink either offsets or smears, the sheet or sheets are marred and become unfit for presentation to, or acceptance by the customer.

The natural drying process heretofore described, requires large expenditures for equipment such as racks and trays, as well as the use of considerable floor space for the storage of sheets during the drying process, and for the storage of trays. Likewise the time required for such method of drying is at least seventy-five per cent of the total time required to complete the work, and due to the manual labor required, represents a considerable part of the ultimate

cost of the product. Nevertheless this natural drying method has been, since the conception of the art of steel engraved printing, practically the only successful method of accomplishing this essential operation.

There are several requisites for the successful drying of inked impressions such as those made by the steel engraving or similar processes. Among these is the requirement for virtually complete hardening of the ink or pigment to prevent offsetting or smearing. This requirement alone eliminates, for all practical purposes the use of heaters and the like as are commonly used in ordinary printing processes. This is due to the fact that the amount of ink used in the process of steel engraving leaves an impression of considerable weight and thickness as distinguished from the comparative thin film of ink deposited by ordinary printing presses. Hence to complete the hardening of the ink or pigment is an object of the present invention.

Another requirement, that must be met to successfully dry these particular types of inked impressions, is that of avoiding microscopic or macroscopic changes in the physical structure of the paper on which the impressions are made. The structure of the papers, upon which steel engraving is done, is generally of such delicate nature that exceedingly slight changes in its composition, such as occur when the moisture, within the paper itself, is removed rapidly or unevenly, cause the paper to curl, buckle over its entire width or length, or produce numerous small waves in the surface of the sheet. The latter is an effect known in the trade as "cockling". An object of the present invention is, therefore, to overcome such difficulties and yet provide a method and apparatus for quickly drying the inked impressions.

Some paper stocks, notably the heavier ones and/or those of high rag content, are more susceptible to curling, while the lighter bonds and/or low rag content papers are more susceptible to cockling. I have found that curling is largely caused by differences in the temperature of the atmosphere surrounding the sheet. This difference in temperature causes the fibers, on one side of the sheet, to elongate, or contract to a greater extent than the fibers on the other side of such sheet. An object of the present invention, therefore, is to control the temperature of the atmosphere surrounding the sheet during the drying operation, so as to eliminate this unequal elongation and contraction of the fibrous structure.

I have also found that cockling, to a great de-

gree, is caused by much the same differences in temperatures as causes curling. However cockling is also caused by the uneven application of heat over the surface of the sheet, and by the
 5 unequal removal of moisture due to variations in the density of the sheet. Thus when moisture is removed from the paper, the loss of weight varies from point to point of the sheet and the effect on the sheet is mottling or cockling. I
 10 have found that cockling may be avoided, for all practical purposes, if the drying medium is maintained at a low temperature. This therefore is an object of the present invention.

Another object of the present invention is to
 15 overcome the difficulties heretofore mentioned by providing an apparatus and method for rapidly drying steel die embossed impressions, at the lowest possible temperature of the air in an oven through which the embossed sheets pass, equalizing such temperature and evenly applying, to the
 20 paper and to the impression, auxiliary drying agency while minimizing the length of time of the exposure of the sheets to the drying medium.

Other objects of this invention will become
 25 more apparent from the following description, in which reference is had to a preferred form of apparatus for drying steel die engraved or similar impressions and the essential characteristics of the invention will be set forth in the claims.

30 Referring now to the drawings;

Fig. 1 is a side elevation of my improved drying apparatus;

Fig. 2 is a vertical transverse section, on an enlarged scale, the plane of the section being indicated by the lines 2—2 on Fig. 1;

Figs. 3 and 4 are longitudinal sections, on a slightly smaller scale than Fig. 2 and the plane of the sections being indicated by the lines 3—3 and 4—4 respectively on Fig. 2.

40 Fig. 5 is a detail partially in section illustrating a modified form of air circulating duct.

My improved method comprises subjecting the impressed sheet first to a tempering agency in the form of radiant heat waves, and subsequently
 45 to a drying agency in the form of radiant heat waves, while maintaining the atmospheric temperature surrounding the sheet substantially even by constantly circulating such atmosphere in a substantially closed circuit, and directing such circulating medium toward the sheet and between
 50 the sheet and the source of radiant heating energy.

Referring again to the drawings, I have illustrated a preferred form of apparatus for carrying out my improved method. As shown I have provided a longitudinally extending ovenlike structure 10 carried by a suitable frame 11 having supporting legs 12. The oven, as shown, comprises a pair of longitudinally extending casings 14 and 15, provided respectively with a top and bottom wall
 60 16 and 17. The upper casing 14 has downwardly and outwardly extending side and end walls 18 and 19, while the lower casing 15 is provided with upwardly and outwardly extending side and end walls 20 and 21 respectively. The side walls of
 65 both casings may be joined to, or supported by the frame 11 in any well known manner, suffice it to say that the casing 14 is superimposed upon the casing 15 to form an ovenlike structure 10, completely closed at its sides and having comparatively small horizontally extending slotted
 70 openings 22 in its end walls to permit the passage of the embossed sheets into and out of the oven.

The impressed sheets are removed from the
 75 steel die press, and placed one at a time on a

suitable conveyor which progresses the sheets through the oven. In the drawings, the frame 11 has rearwardly and forwardly extending arms 24 and 25 which support rollers 26 and 27 respectively. The roller 24 lies rearwardly from the oven 10 a distance slightly greater than the length of the longest sheet desired to be dried. The roller 25 lies forwardly of the oven a distance sufficient to permit the discharge of the sheet into a suitable bin or stacker mechanism generally indicated in Fig. 1 at 28. A suitable flexible continuous belt 29 is carried by the rollers 26 and 27, and serves to support and progress the sheets through the drying oven 10 with the inked impression uppermost. The belt 29 is preferably
 15 made of a comparatively light flexible fabric or metal which will not collect or retain heat to any great extent and therefore will not interfere with the maintenance of an even temperature in the oven. Likewise, for this reason the belt is preferably perforated.

The belt 29 is driven to progress the sheets A by a suitable motor 30. As some inked impressions require a longer exposure to the drying mediums than others, the motor is preferably of one of the well known variable speed types, the speed of which is manually controlled by a knob or lever 31 carried by the motor. While the motor 30 may be drivingly attached to either the roller 26 or the roller 27, I find it more convenient to connect the motor to the roller 26, at the charging end of the oven. In this manner the speed of the belt may readily be adjusted by the press operator without any undue loss of time.

The heating of the oven is preferably accomplished and maintained by two groups of electric heating elements. The first group 35 is in the rearmost, or charging, end of the oven 10, and is chiefly used for supplementarily heating the oven and tempering the paper as it enters the oven. The amount of electrical energy delivered to this group of elements is controlled by a thermal switch 36 of any well known type, which acts automatically to energize or deenergize this group, consequent upon a change in temperature within the oven. The switch 36 is provided with a knob 38 by means of which the temperature of the oven may be varied by the operator to provide for different types of paper and/or ink.

The second group of heating elements 39 are in the rear or discharge end of the oven. This group of heating elements comprise the chief source of heat for the oven and also supplies the supplemental radiation required for drying the inked impression. This supplemental drying
 55 agency is chiefly in the form of radiant energy, for the emission of which the elements are kept at a predetermined temperature. This is in contrast to the first group of elements which are, automatically energized and deenergized to maintain an even temperature in the oven. For the bulk of steel engraved work I have found that the proper temperature for the heating elements in group 39, that is the second group, is approximately 600 degrees Fahrenheit. Whereas the preferable oven
 65 temperature varies from 100 to 250 degrees Fahrenheit. The latter variation being accomplished solely by adjustment of the switch 36 which automatically controls the first group 35 of heating elements.

The drying operation is accomplished mainly by radiant energy from the second group of elements. It is well known that the absorption of heat rays will vary with the substance and color of the material exposed to the rays. The ink or other
 75

material of the impression being in dark colors, generally black, the rate of absorption of the rays by the ink is much more rapid than the absorption of the rays by the paper itself which is generally white, or of a comparatively light color. Consequently the use of radiant energy saves the paper stock from excessive heat absorption and aids materially in eliminating the curling and cockling effects, previously described.

Each heating element comprises an elongated flat metallic bar 40, of the usual type, and is preferably adjustably supported at its ends by suitable posts 41 which are carried by plate like supporting members 42 mounted in the casing 14 and which extend the entire length of the oven some distance above the upper stretch of the sheet feeding belt 29. It will be noted that each heater extends parallel with the direction of travel of the paper, as this aids in maintaining an even temperature over the sheets.

Even distribution of the auxiliary drying agency, since the latter is in the form of radiant heat waves, is partially accomplished as heretofore mentioned by the positioning of the elements 40 with relation to the paper and the impression. However the distribution of the heat waves is balanced to a great degree by suitable reflectors which are constructed with a high degree of mathematical precision. The reflectors are shown at 45 in the drawings and comprise inverted, polished or semi-polished metal troughs which extend longitudinally from one end to the other of the oven casing 14. The reflectors extend parallel to the belts 29 and their lowermost edges extend some distance below the bottom of the heating elements 40 heretofore mentioned. As shown there are two longitudinal rows of heating elements 40 and therefore a reflector 45 is provided for each row, such reflectors being mounted on the supporting plates 42 heretofore mentioned.

One of the essential requisites for the successful drying of steel engraved work is the maintenance of an even temperature on all sides of the sheets. This is partially accomplished by the oven like structure in which the drying takes place. However I find that keeping the air in the oven constantly circulating, for all practical purposes, enables the maintaining of a completely even temperature on all sides of the sheet.

As heretofore described the oven 10 is a substantially enclosed structure, being open only at its opposite ends, where slotted openings 47 are of only sufficient size to permit the passage of the belt 29 and the sheets which are to be dried. To circulate the air in this ovenlike structure, I prefer to provide a duct or conduit 50, one end of which is in communication with the intake of a suitable motor driven fan 52. The exhaust of this fan is connected with an opening 53 in the top wall of the oven by a suitable conduit or duct 54. In this way a constant circulation of the air within the oven is accomplished.

A more even circulation is accomplished and a greater efficiency of the radiant heat units is provided for, by the controlling of the direction of flow of the current of circulating air. I find it preferable to so control this circulation that the air is forced downwardly through a longitudinally extending opening toward the longitudinal center of the paper and then outwardly toward the side edges of the paper and between the heaters 40 and the surface of the sheet carrying the impression to be dried, without permitting such

circulating currents to come in contact with the heating elements.

As shown in the drawings, the plate like members 42 which carry the heating elements 40 and the reflectors 45 extend longitudinally from end to end of the upper oven casing member 14. Each member or wall 42 is connected to the adjacent sloping side wall 18 of the oven and extends therefrom horizontally inward to a point adjacent the longitudinal center of the oven, where each plate is bent downwardly forming spaced vertically extending walls 56 which extend downwardly to a point substantially midway between the level of the elements 40 and the belt 29. The walls 56 form a downwardly opening restricted passageway 57 which extends from end to end of the oven. The upper end of this passageway 57 is in communication with a chamber 58 which in turn is in communication with the fan 52 as heretofore described. Thus the circulating air is directed in a smooth flowing current evenly over the embossed sheets.

While the circulating system is substantially closed nevertheless a certain amount of air escapes and is replenished through the slotted openings 47 heretofore described. I find however that this change of air is slight and serves a valuable purpose, namely that of assisting in the control of the humidity of the circulating air. However as the moisture content of this circulating air increases beyond a useful point I find it advantageous to admit air from the exterior to lessen the humidity of the air within the oven. This is readily accomplished by means of a vent 60 in the duct 50 which leads from the bottom of the oven to the intake side of the fan. This vent is normally closed by a suitable valve, such as is indicated at 61, but which may be adjustably opened to change the humidity of the circulating air.

As above mentioned I believe the moisture content of the circulating air to be valuable. As, when the air has slightly more moisture in it than the paper has, substantially no moisture will be removed from the paper. The ink, however, containing much more moisture than either the circulating air or the paper, will give up its moisture under the influence of the radiant heat waves and the circulating atmosphere.

In Fig. 5 I have illustrated a modified form of air circulating system. This form of the invention is especially well adapted when very heavy dies, slow drying inks and other similar conditions are present, any or all of which require the operation of the forward heating elements at full temperature. The circulating atmosphere may then become too hot to accomplish the drying of the ink without detriment to the paper heretofore pointed out. This form of the invention therefore provides a mechanism to lower the atmospheric temperature of the circulating air. The temperature of such circulating air is lowered materially by the opening of the valve 61 heretofore mentioned and at the same time increasing the speed of the blower fan 52. This obviously increases the amount of cool air which is drawn into the system by the fan 52. Likewise by partially closing a suitable valve in the conduit 50, the amount of heated air, in proportion to the amount of cool air, is decreased. This however requires the operation of the fan at a comparatively high rate of speed, which in turn passes the air thru the oven at such speed that the sheets, being dried, are apt to be blown to such

an extent as to be detrimental to the drying of the printed inks.

The use of the duct arrangement as shown in Fig. 5 eliminates any blowing of the paper due to the increase in velocity of the circulating air, by by-passing an amount of the circulating air sufficient to reduce the velocity of the air in the oven to normal. As shown in Fig. 5 I have provided the duct 54 which forms the passageway for the circulating air between the fan 52 and the top of the oven, with a vent tube 70 communicating with the air in the room. The duct 54 is as shown, also provided with a valve or diverter plate 72 which may be adjustably positioned to divert a sufficient quantity of air from the fan out of the passageway 70 to reduce the velocity of the circulating air in the oven to normal.

When the system is used with average drying inks and/or under average conditions the valve or diverter 72 is opened to permit an unobstructed passage of the circulating air through the passageway or duct 54 and the duct 70 is closed by a suitable valve member 71.

As shown in Fig. 5 I may provide the passage 54 with an air conditioning unit of any of the well known types which will act to raise or lower the temperature of the circulating air as desired, such as for instance a radiator 76 through which the air is forced by the fan 52. Suitable conduits 76 communicate with the radiator and supply it with the desired cooling medium. The radiator may be of any well known type such as for instance one which will add moisture to the circulating air for the purposes heretofore mentioned.

From the foregoing description, it will be seen that I have provided a method and apparatus by means of which the drying of impressions made by steel die embossing and similar processes may be successfully accomplished in a short time interval. Experience demonstrating that in oven temperatures of 100 to 250 degrees Fahrenheit, and with a radiant drying element having a temperature of 600 degrees Fahrenheit, the drying is successfully accomplished in a time interval ranging from 20 to 60 seconds.

By accomplishing the drying in such a brief interval of time, at such comparatively low temperatures accurately controlled and evenly applied while maintaining a constant circulation of air, the humidity and temperature of which is controlled, steel die and similar process impressions have been dried without any detrimental effect upon the paper, either from discoloration, curling, cockling or other cause, and I therefore have provided an apparatus which greatly reduces the cost of this and similar types of printing and which apparatus has the added advantage of permitting the delivery of the completed work to the purchaser in a comparatively short time interval after the order for the work is given to the printer.

Likewise it is evident that by insulating the walls of the lower portion 15 of the oven and eliminating such insulation from the walls of the upper portion 14 of the oven, and passing the printed sheet through the oven substantially midway between the top and bottom walls thereof, I have increased the heat in the lower part of the oven and at the lower side of the sheet and slight-

ly decrease the heat in the upper part of the oven thereby bringing about a more even distribution of heat on both sides of the sheet. Such insulation preferably comprises slab like formations that cover the inner surfaces of the oven walls 15, 20 and 17 as indicated at 80 by dotted lines in Fig. 2.

I claim:

1. An apparatus of the class described, a supporting frame, an elongated ovenlike structure carried by said frame, means including a perforated flexible belt carried by said support to progress inked sheets through said structure from end to end, means to vary the speed of travel of said belt, heating means at the discharge end of said oven to heat the oven and comprising a plurality of longitudinally extending radiant heaters adapted to act on the inked impression and disposed to either side of the longitudinal center of the oven above said belt, a second group of heaters similar to the first named heaters at the charging end of the oven to supplementally heat said oven, thermal responsive means to control said last named heater to maintain a substantially constant temperature in said oven, reflectors mounted above said heaters, a power operated fan, a conduit from the intake of said fan to the bottom of the oven, and a second conduit from the exhaust of said fan to the top of said oven.

2. An apparatus of the class described comprising an oven like structure, means to progress freshly printed sheets through said oven substantially midway between its top and bottom walls, means to insulate the walls of said oven below said sheets to prevent the loss of heat through such walls, and wherein the walls of said oven above said sheets are uninsulated to permit the loss of heat and thereby equalize the temperature in the oven on either side of the sheets.

3. A mechanism for drying printed sheets including an elongated oven like structure having side, end, top and bottom walls, a conveyor passing longitudinally through said oven substantially midway its top and bottom walls, a pair of reflectors disposed above the conveyor and extending from end to end of the structure, heating elements in said reflectors, the sides of the reflectors extending downwardly beyond the bottommost edges of said elements, said reflectors being spaced apart thereby forming a longitudinally extending passageway therebetween whereby air may be forced toward the material to be dried on said conveyor.

4. In a device of the class described, the combination of an elongated oven, means to progress ink impressed sheets through said oven, said oven including a pair of side walls sloping upwardly and inwardly over the progressing means and having a pair of spaced vertical walls extending longitudinally above said progressing means, heaters mounted in the oven above the progressing means and between said vertical walls and said side walls, and laying above the lower edge of the vertical walls, and means to circulate a current of air downwardly between said vertical walls and outwardly between the progressing means and the heaters toward the side walls of the oven.

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