

Aug. 28, 1951

W. MESSINGER
RADIANT HEAT DRIER

2,565,570

Filed June 11, 1948

4 Sheets-Sheet 1

FIG. 2.

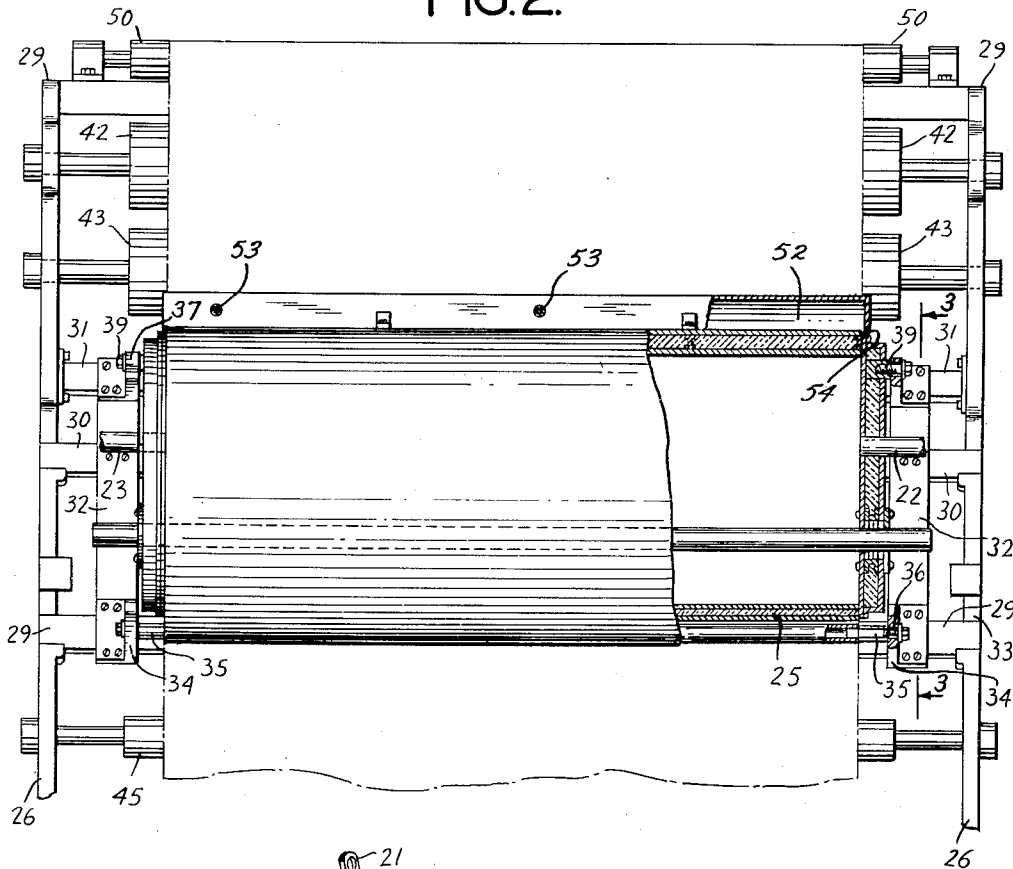
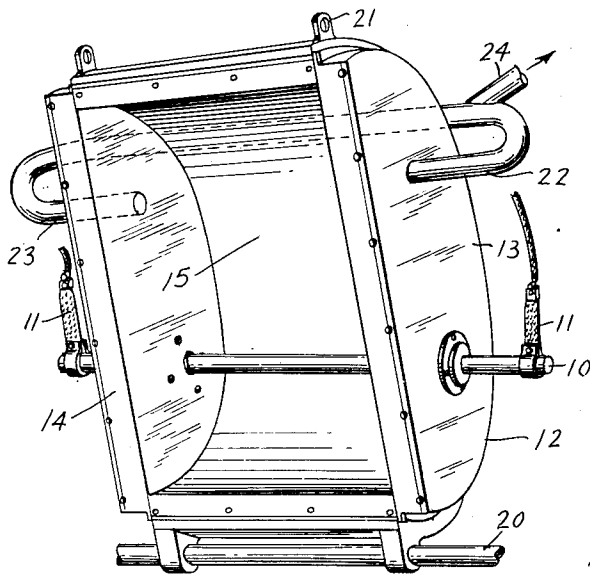


FIG. 1.



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FIG.3.

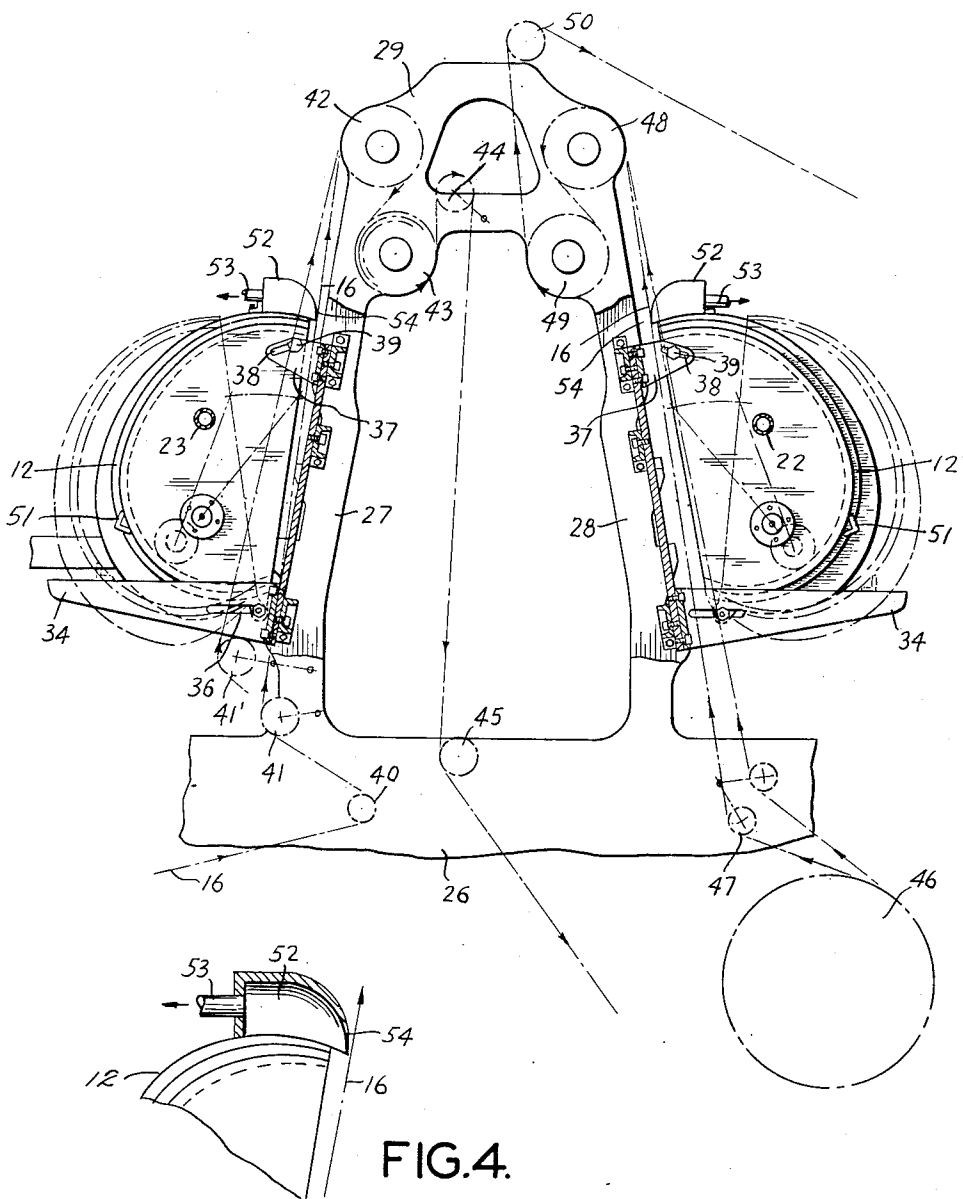


FIG.4.

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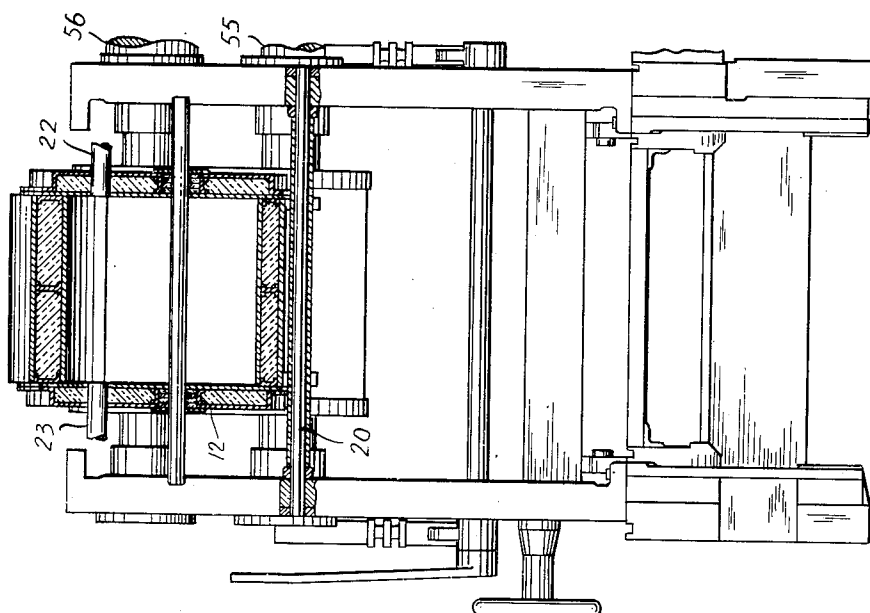
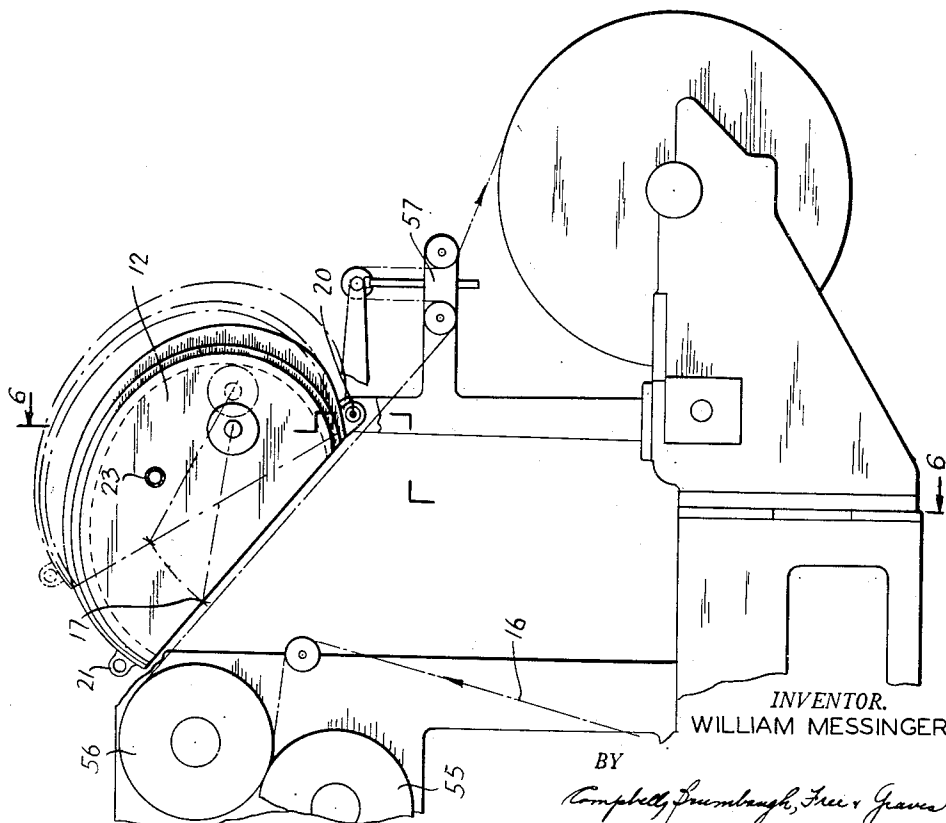


FIG. 5.



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FIG. 7.

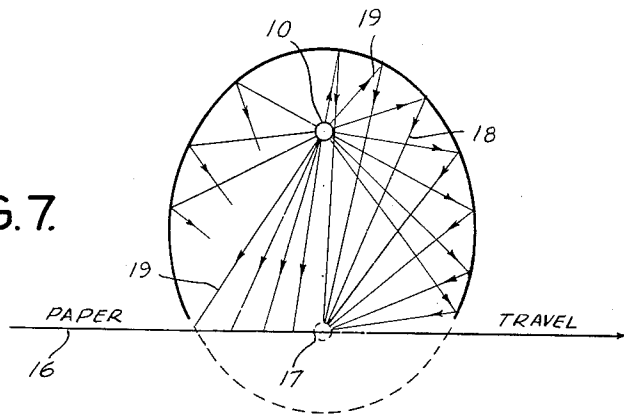
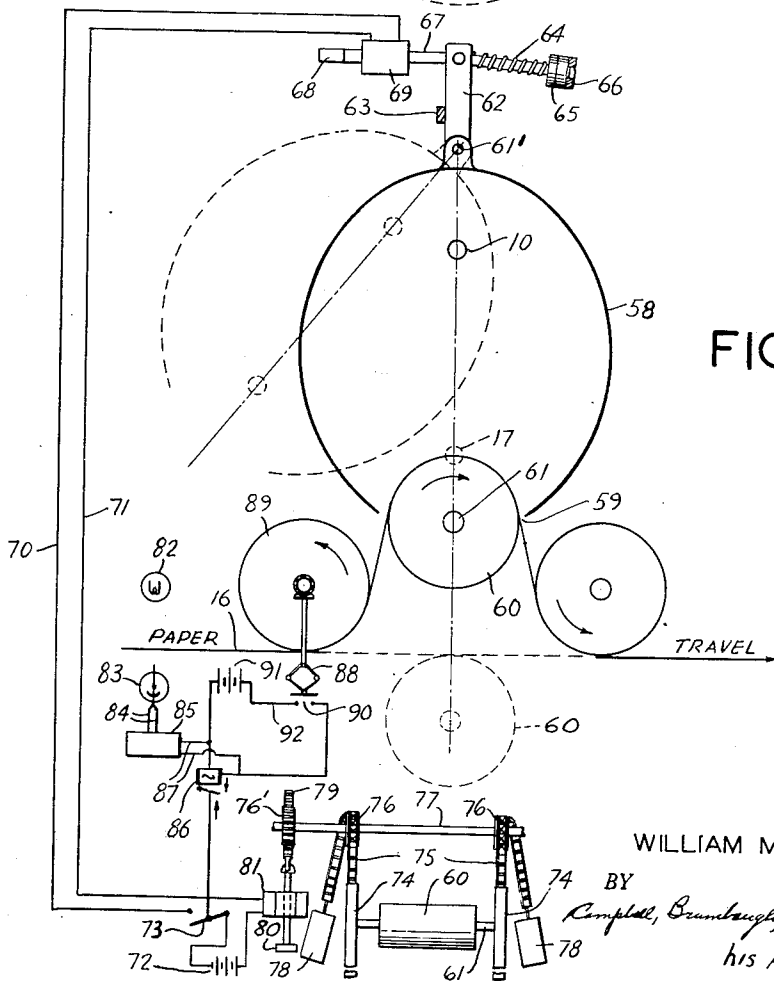


FIG. 8.



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UNITED STATES PATENT OFFICE

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RADIANT HEAT DRIER

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2 Claims. (Cl. 219—19)

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The present invention relates to methods and apparatus for heating or drying and has to do particularly with such methods and apparatus used in operations such as high speed printing where it is important to dry the ink that has been applied to a rapidly moving web of paper.

Although the invention is not alone applicable to the printing art, it has unique applicability thereto, particularly in view of the fact that the increased speeds at which many printing operations are now carried on has greatly emphasized the need for drying or setting the inks that are used in order to prevent offset thereof upon surfaces in contact with which the web moves subsequent to the printing operation. These subsequent surfaces include guide rollers over which the web is led through the printing machine as well as subsequent printing cylinders which apply additional printed impressions to the web as in multicolor printing.

In high speed printing operations now generally employed, the inks set by evaporation or by the application of heat or both. Great difficulty is frequently encountered in these operations by reason of the fact that interruptions in the printing operations require careful control of the drying mechanism to avoid damage to the web. A further difficulty is encountered because the drying operations have frequently had deleterious effects, not only upon the paper web, but upon the inks that are used, as a result of which the printed impression is impaired.

These existing drying operations are accomplished by the use of gas flames directed toward the rapidly moving web; by passing the paper over and in close proximity to highly heated porcelain elements; or by passing the web over heating drums that are heated, for example, by steam. In these operations considerable hazard exists because of the danger of fire, or the product is impaired or destroyed because the heat injures the web or destroys the luster of the pigment in the inks. Difficulties also arise because convection or conduction of heat to the web creates a blanket or layer of heated air that moves with the web and, becoming saturated with the volatile ink solvent, forms an insulating blanket that retards further desired evaporation of ink solvent. The inefficiency of these methods is particularly pronounced where drying is accomplished by the conduction of heat through steam drums where the conductivity is reduced by layers of moisture or scale within the steam drum as well as the relatively low conductivity of the web of paper which is frequently filled or coated with materials that retard the conduction of heat.

Certain of these difficulties in existing methods and apparatus were attempted to be overcome by the use of such means as cooling drums, but without marked success due to the fact that the

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expansion and contraction resulting from these variations in heat cause the paper to cockle, and thereafter it will not lie flat or pile compactly upon being cut into sheets.

An object of this invention is to provide a heating or drying method and apparatus by means of which radiant heat may be more effectively applied at high intensity over a relatively limited area of a desired object.

A further object of the invention is to provide a heating or drying method and apparatus by means of which the heating or drying of the ink on the surface of a rapidly moving web may be accomplished effectively.

In accordance with the present invention, radiant heat is utilized in a unique fashion to accomplish the drying or setting of the ink effectively without injuring the web of paper upon which the ink has been applied. The manner in which the foregoing objects and advantages are accomplished will be apparent from the accompanying drawings, wherein:

Figure 1 is a perspective view of a heating element constructed in accordance with the present invention;

Figure 2 is a view in side elevation of a printing press upon which the heating unit has been mounted, the view being broken away and in section to show in greater detail the structure of the heating element;

Figure 3 is a view in end elevation, partly in section on lines 3—3 of Figure 2, showing the structure of Figure 2;

Figure 4 is a partial detail view, enlarged and illustrating mechanism for withdrawing a film of gas from adjacent the web as it emerges from beneath the dryer as illustrated in Figure 3;

Figure 5 is a partial view, similar to Figure 3, illustrating a modified form of the invention;

Figure 6 is a view in side elevation, partly in section on line 6—6 of Figure 5, and showing the device of Figure 5;

Figure 7 is a diagrammatic illustration of a form of heating unit constructed in accordance with the present invention and illustrating the manner in which radiant energy is applied to the web; and

Figure 8 is a view similar to Figure 7, showing a modified form of the invention.

In accordance with the present invention, it is proposed to utilize radiant heat to dry or set the ink that has been applied to the web. In order that this may be done effectively and efficiently, open glow infrared heating units are utilized in the form of glow bars. Heating units of this character are now of standard form and readily available on the market (see INCO Magazine, vol. 21, No. 1, by The International Nickel Company, Inc.) and form no part of the present invention. For example, a suitable refractory

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core may be provided with a nickel chromium alloy wire as the heater element, and in the accompanying drawings, the glow bar is simply shown as a tube without any further detailed structure.

In these heating elements, radiant heat is generated as incandescence is approached, the temperature at which incandescence is attained for electric resistance alloys beginning at 1650° F. with a fairly substantial incandescence existing at 1800° F., and true incandescence at 2200° F., at which temperature fully 95% of the electrical energy appears as radiant heat.

In order that this heat may be utilized effectively for the purposes herein described, the heating element or bar is utilized in connection with a novel form of reflector which serves to concentrate the radiant heat along a line extending transversely of the moving web. For example, in Figure 1, the glow bar is illustrated at 10 and is provided with electrical current through lead-in wires and connections 11 at opposite ends thereof. The glow bar is mounted with its axis at one focus of an ellipse, the locus of the ellipse being formed by the reflecting surface of a reflector 12. In Figure 1, the reflector is formed with end walls 13 and 14 between which a reflecting surface 15 is mounted, the reflecting surface 15 lying in the locus of the ellipse, one focus of which is coaxial with the glow bar 10. The reflector is so formed that the other locus of the ellipse lies in the plane through which the web travels as it moves beneath the reflector. For example, in Figure 7, the web of paper is illustrated at 16, and the second focus of the ellipse is illustrated in dotted lines at 17.

It will be understood that the shape of the reflecting surface in Figure 7 does not correspond precisely to the reflecting surface 15 in Figure 1, although in each figure the locus of the reflecting surface corresponds to that of an ellipse, the foci of which contain the glow bar 10 and the transverse line or area 17 over which the web of paper 16 passes. In Figure 7, the paths of reflected light are illustrated by the several lines 18, whereas the direct emanations from the glow bar 10 are illustrated by the lines 19.

The reflector of Figure 1 may be hingedly mounted upon a supporting bar 20 and the position of the reflector controlled by means of apertured ears 21 at the other end of the reflector remote from the hinge mounting 20 through any suitable mechanism, not illustrated. Exhaust ducts 22 and 23 communicate with the interior of the reflector through the end walls 13 and 14, respectively, the ducts 22 and 23 being connected to an exhaust duct 24 in order that gas may be removed from the interior of the reflector during the drying or setting operation. The reflector walls, both at the ends of the reflector and over the reflector surface may be insulated as illustrated at 25 in Figure 2 by any suitable insulating means.

The reflector shown in Figure 1 may be utilized in connection with the drying or setting of the ink on a printed web of paper as illustrated in Figures 2 and 3. In these figures, a supporting frame 26 is provided with upwardly extending arms 27 and 28 (Figure 3) connected at the top by a head member 29.

A radiant heating unit or reflector 12 similar to that shown in Figure 1 is mounted upon each of the arms 27 and 28. This may be accomplished by providing supporting arms 29, 30, and 31 at each end of the heating unit, these arms

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being mounted upon plates 32 and supported in suitable notches 33 formed in the arms 27 and 28, respectively. At the lower end of the plates 32 brackets 34 are mounted, the lower ends of the reflectors 12 having pins 35 formed thereon, which pins are received in slots 36 formed in the brackets 34, respectively. The pins 35 and slots 36 thus provide means for adjusting the axis of the hinged support for the reflectors 12. Upper brackets 37 are formed on the plates 32 and have slots 38 through which studs 39 extend in order that the reflector may be secured with its upper portion in proper position with respect to the frame and the web to be presently described.

The lead of the paper through the drying element is illustrated in the dot-and-dash lines of Figure 3, the web 16 issuing from a printing unit and passing over a guide roller 40 and a second guide roller 41, the position of which may be adjusted between the lower right-hand position of Figure 3 and the second position 41' of Figure 3.

With the dryer in the position illustrated in solid lines in Figure 3, the guide roller 41 is in the lower right-hand position of Figure 3, and from this guide roller the web is led beneath the drying unit and over a guide roller 42 journaled in the head member 29. The web then passes over guide rollers 43 and 44 and a final guide roller 45 journaled in the frame 26.

From the guide roller 45 the web may travel to a second printing unit, a part of which is indicated at 46 from which printing unit the web travels over a guide roller 47 journaled in the frame 26 and past a second dryer unit 12' illustrated on the right-hand side of Figure 3 and supported by the vertical arm 28. After passing beneath the dryer 12', the web passes over guide rollers 48, 49, and 50 and then on to a suitable receiving mechanism, not illustrated.

Each of the dryers 12 and 12' is provided with outwardly extending angle bars 51 which, when the dryers are moved to their retracted positions illustrated in dot-and-dash lines in Figure 3, rest upon the brackets 34 in order that the drying units may be suitably supported in their inoperative positions.

As illustrated in Figure 4, it may be desirable to remove a substantial portion of the film of air and ink solvent that travels with the web as it issues from beneath the dryer units. In order that this may be accomplished, the trailing edge of the dryer units may be provided with a manifold 52 which communicates through a conduit 53 with a suction mechanism (not shown), the manifold terminating in a scoop-forming edge 54, the position of which lies closely adjacent the web 16. The manifold 52, together with its edge 54, thus serves to remove a substantial portion of the film of gas that normally travels with the web as it leaves the drying unit, and complete evaporation of the ink on the web is thus greatly facilitated.

In the form of the invention illustrated in Figures 5 and 6, the glow bar is mounted in the reflector in such fashion that the paper web reaches the heat converging focus 17 adjacent the entering edge of the reflector, whereas in the form illustrated in Figures 2 and 3, this focus was positioned adjacent the trailing or exit edge of the reflector. The precise details of the reflector in the form of the invention shown in Figures 5 and 6 conform to the structure illus-

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trated in Figure 1, although the physical principle of operation of both forms of the device is the same. In Figure 5, the printing unit is shown as a printing cylinder 55 which applies the printed impressions to the web 16 as it passes over the back-up or impression roller 56. The drying unit 12 thus acts upon the web immediately after it passes from the cylinder 56 and conditions it so that it may be operated upon by any suitable receiving mechanism illustrated at 57.

In Figure 8, a further modified form of the invention is illustrated by means of which reflected heat may be utilized more fully to accomplish the drying or setting operation. In this form of the invention the reflector is illustrated at 58 as being of almost complete elliptical form save at the interrupted opening 59. The glow bar 10 is mounted at the upper focus of the ellipse, the lower focus 17 coinciding with the upper periphery of a back-up roll 60 which is mounted upon a shaft 61 and received within the opening 59 of the reflector. The reflector 58 is hinged upon an axis 61' and is provided with an arm 62 which normally rests against a stationary abutment 63. A spring 64 seated upon a stationary abutment 65 urges the arm 62 into its normal position illustrated in Figure 8, the spring being coiled about a guide rod 66.

The arm 62 has pivotally connected thereto an operating arm 67, the outer end of which carries the core 68 of a solenoid 69. This solenoid is connected to wires 70 and 71 which are adapted to be connected to a source of electricity 72 by means of a switch 73.

The shaft 61 of roller 60 may be maintained in the position illustrated in Figure 8 by means of a suitable supporting mechanism comprising guides 74 which are constrained to movement in a vertical plane and suspended by chains 75 that engage over sprocket wheels 76 carried on shaft 77. Counterweights 78 (shown out of vertical position in the interest of clarity) are provided on the other ends of chains 75 to maintain normally the back-up roll 60 in the position illustrated in solid lines in Figure 8. A rack 79 engages a third sprocket wheel 76' and is provided with an armature 80 that is actuated by an electromagnet 81 connected in the circuit formed by wires 70 and 71. The foregoing mechanism, it is understood, is simply for purposes of illustration and is not intended to show a commercial form of the device.

The switch 73 is made responsive to web breaks by suitable photoelectric mechanism illustrated diagrammatically as including a lamp 82 mounted upon one side of the web and a photoelectric cell 83 mounted upon the opposite side of the web. Upon a web break, light from the lamp 82 energizes the photoelectric cell 83, which is connected through wires 84 to a suitable amplifying device 85 which is adapted to actuate an electrical relay 86 through wires 87. Upon actuation of the relay 86, the switch 73 is closed, energizing solenoids 69 and 81. The back-up roll 60 is dropped to the position shown in dotted lines in Figure 8, and the reflector 58 is simultaneously moved into the position illustrated in dotted lines.

If desired, the reflector and back-up roll may also be controlled so that they are moved into the inoperative positions shown in dotted lines in Figure 8 upon a reduction in speed of the web beneath a predetermined minimum speed. This may be accomplished by a suitable speed responsive mechanism such as a fly-ball governor 88,

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which is driven by a power take-off mechanism from the web guide roll 89, the speed responsive mechanism 88 serving to close a switch 90 when the speed of the web falls below a predetermined minimum. The switch 90 is connected to a source of electricity 91 and to the relay 86 by wires 92.

It is to be understood that the above described mechanism for controlling the positions of the reflector and back-up roll are merely intended to be conventional and diagrammatic representations of the manner in which the actuation of these elements may be accomplished.

The operation of the drying mechanism above described is such that an extremely intense heat is applied in a line transversely of the rapidly moving web. The high speed of the web is such as to cause the duration of the application of the radiant heat to be of only a very limited time and, in this fashion, the ink on the web is effectively set or dried to prevent subsequent offsetting when it moves into contact with receiving elements such as rollers or subsequent printing cylinders. Inasmuch as the heat utilized is in the form of radiant energy, the surface of the web which is not covered by the ink reflects the heat and thus is not deleteriously affected during the short interval of time that the web is passing through the zone of intense heat.

I claim:

1. Radiant heating apparatus comprising means including a roll for supporting a web moving at high speed, an elongated elliptical reflector having spaced apart first and second focal lines and an opening for receiving the roll to position the first focal line at the periphery of the roll, an elongated radiant heating element substantially coaxial with the second focal line for radiating heat for concentration by the reflector at the first focal line at the periphery of the roll, means supporting the roll for movement toward and away from the reflector, speed responsive means movable in response to movement of the web, a motor for moving the roll toward and away from the reflector, and means controlled by the speed responsive means to actuate the motor and move the roll away from the reflector when the speed of the web decreases below a predetermined value.

2. The radiant heating apparatus set forth in claim 1 including means supporting the reflector pivotally to move the first focal line toward and away from the periphery of the roll, and means controlled by the speed responsive means to move the reflector and displace its first focal line away from the periphery of the roll when the speed of the web decreases below a predetermined value.

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