United States Patent [19]

Pray et al.

[11] **3,894,343**

[45] **July 15, 1975**

[54] **INK CURING AND DRYING APPARATUS**

[75] Inventors: **Robert W. Pray**, East Northport, N.Y.; **Ralph L. Foster**, Darien, Conn.

[73] Assignee: **Thermogenics of New York**, Byram, Conn.

[22] Filed: **Mar. 25, 1974**

[21] Appl. No.: **454,402**

Related U.S. Application Data

[62] Division of Ser. No. 263,250, June 15, 1972, Pat. No. 3,829,982.

[52] **U.S. Cl.** **34/4**; 34/1; 34/41; 34/49; 219/348

[51] **Int. Cl.** **F26b 3/30**

[58] **Field of Search** 34/1, 4, 39, 41, 43, 44, 34/48, 49, 151, 152; 219/348, 354, 388

[56] **References Cited**

UNITED STATES PATENTS

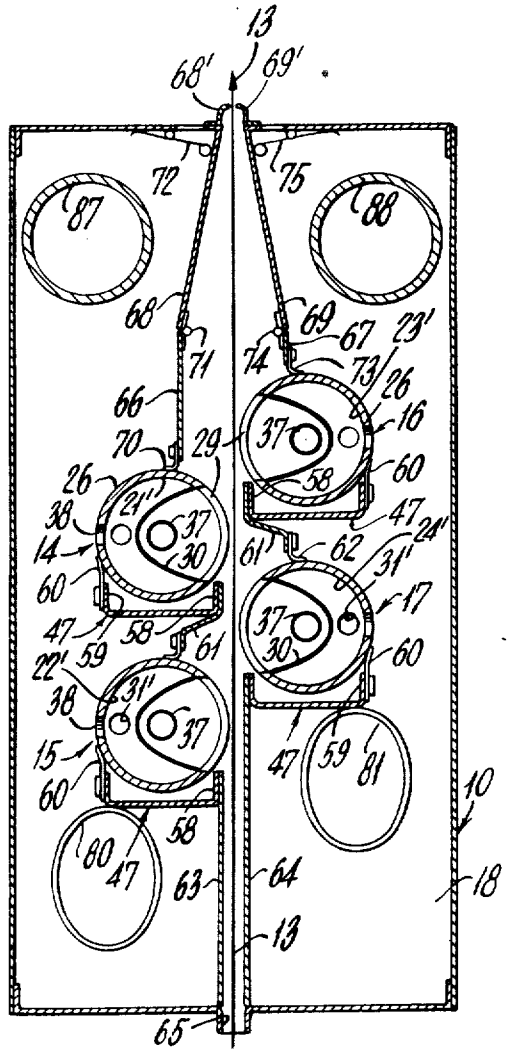
2,664,282	12/1953	Mann	34/87
3,052,037	9/1962	Miskella	219/354
3,637,983	1/1972	Nelson	34/49
3,733,709	5/1973	Bassemir	34/1

Primary Examiner—John J. Camby
Assistant Examiner—Larry I. Schwartz

[57] **ABSTRACT**

Curing and drying apparatus for printing inks which includes a housing having openings for passing a printed web therethrough and lamp assemblies each including a shell, a reflector, and an ultraviolet light lamp or radiator for focusing radiation onto said web. Blowers are coupled to said housing for feeding air about the back side of said reflectors and about the sockets for the lamps to remove excess heat and means are provided for protecting said lamps from said cooling air to prevent lowering the temperature and therefor the efficiency of the lamps. The lamp assemblies are rotatable to and from an operating position and when out of the operating position the radiation is directed into cooled radiation absorbing chambers which permit the lamps to remain energized without damaging the web should movement of the latter be temporarily stopped because of the need for stopping the associated printing press.

1 Claim, 6 Drawing Figures



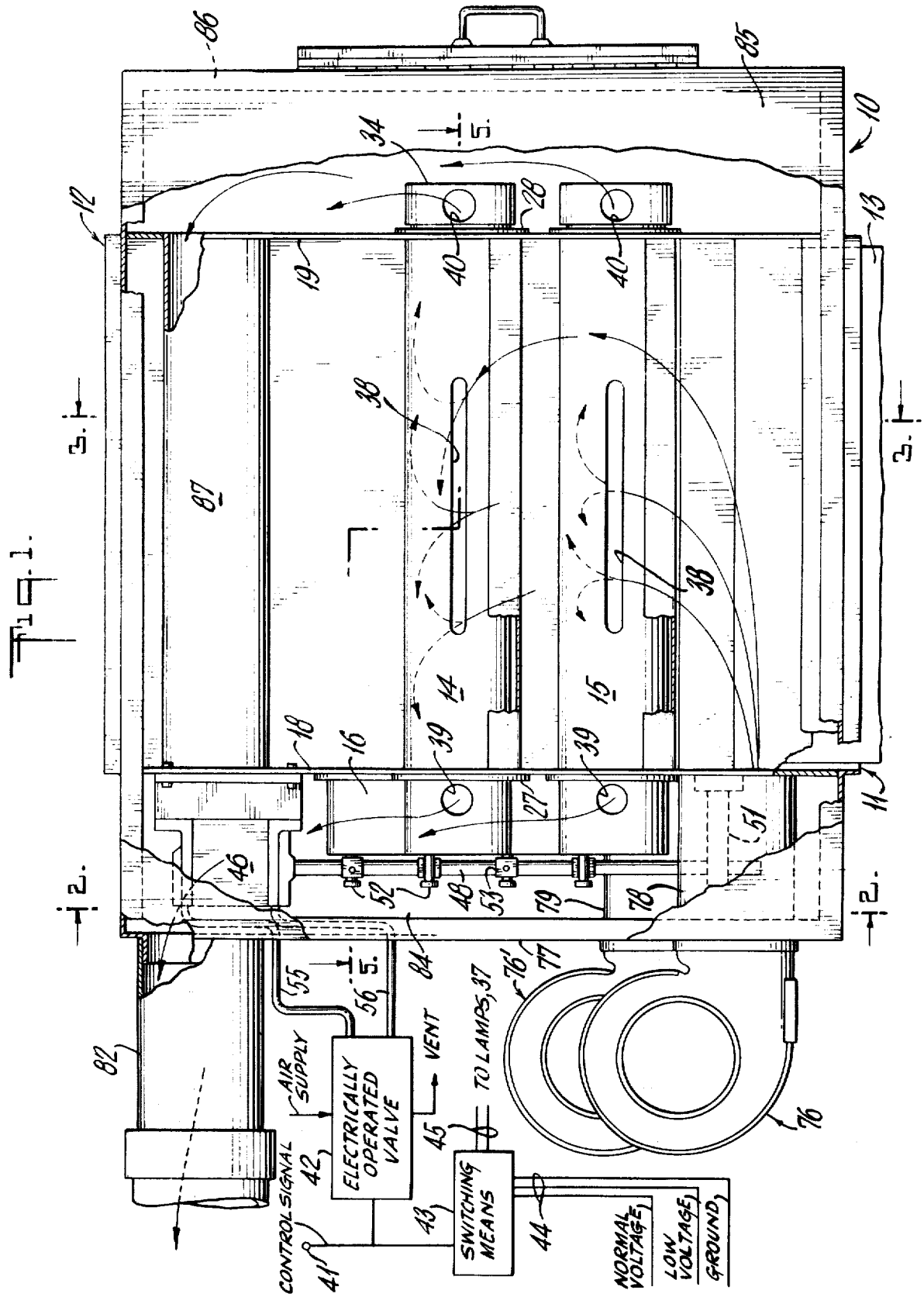

AIR SUPPLY
ELECTRICALLY OPERATED VALVE
VENT
TO LAMPS, 37
CONTROL SIGNAL
SWITCHING MEANS
NORMAL VOLTAGE
LOW VOLTAGE
GROUND

FIG. 1.

FIG. 2.

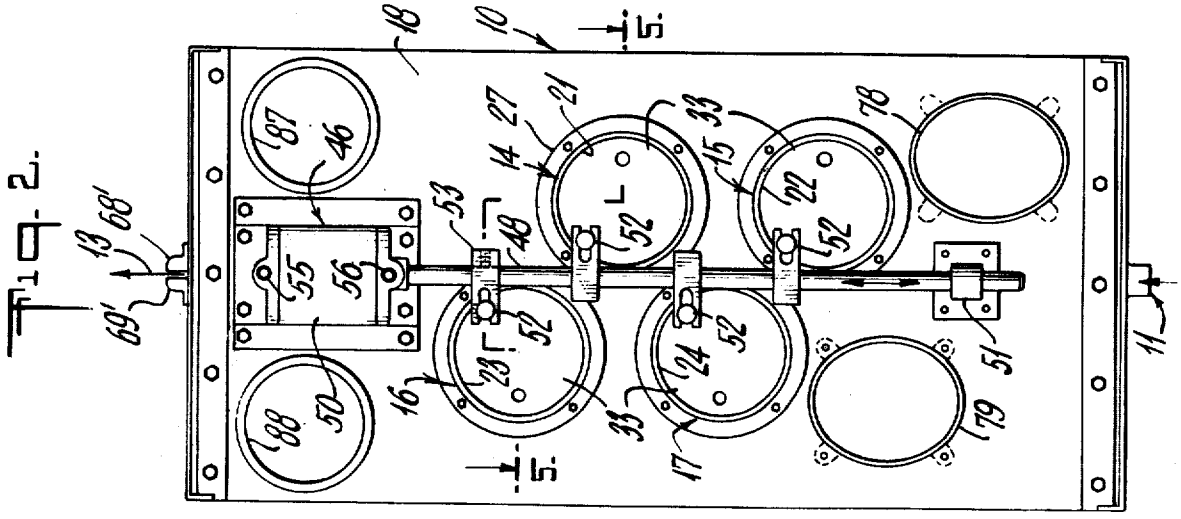


FIG. 3.

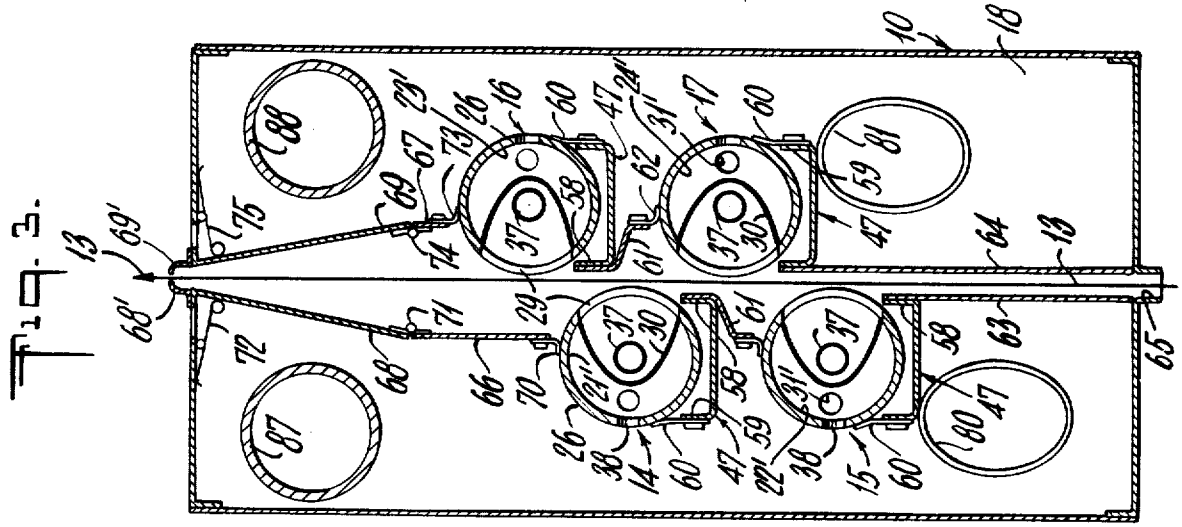


FIG. 4.

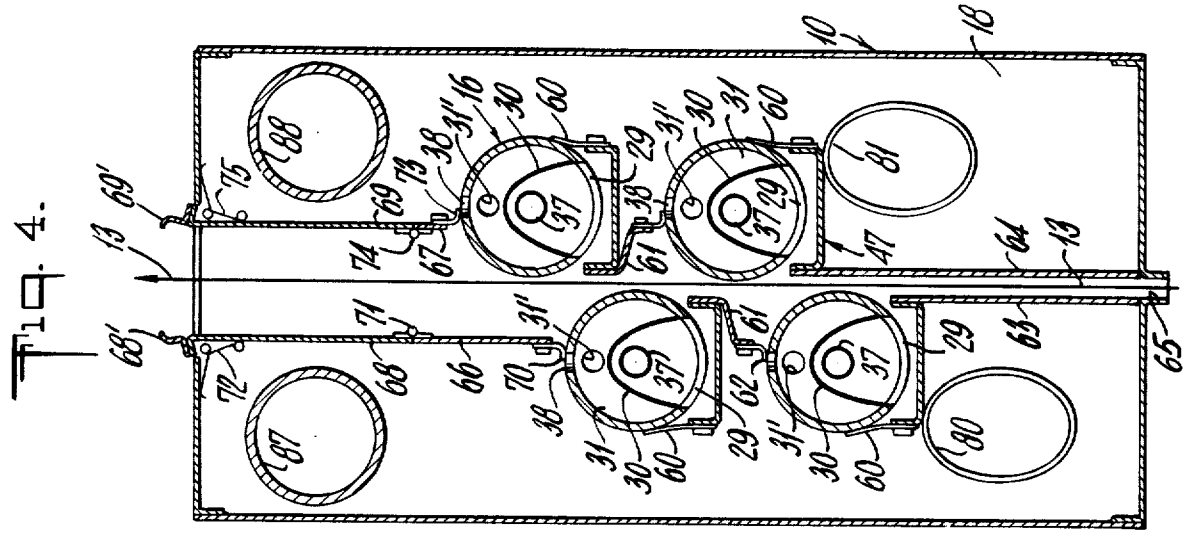


Fig. 5.

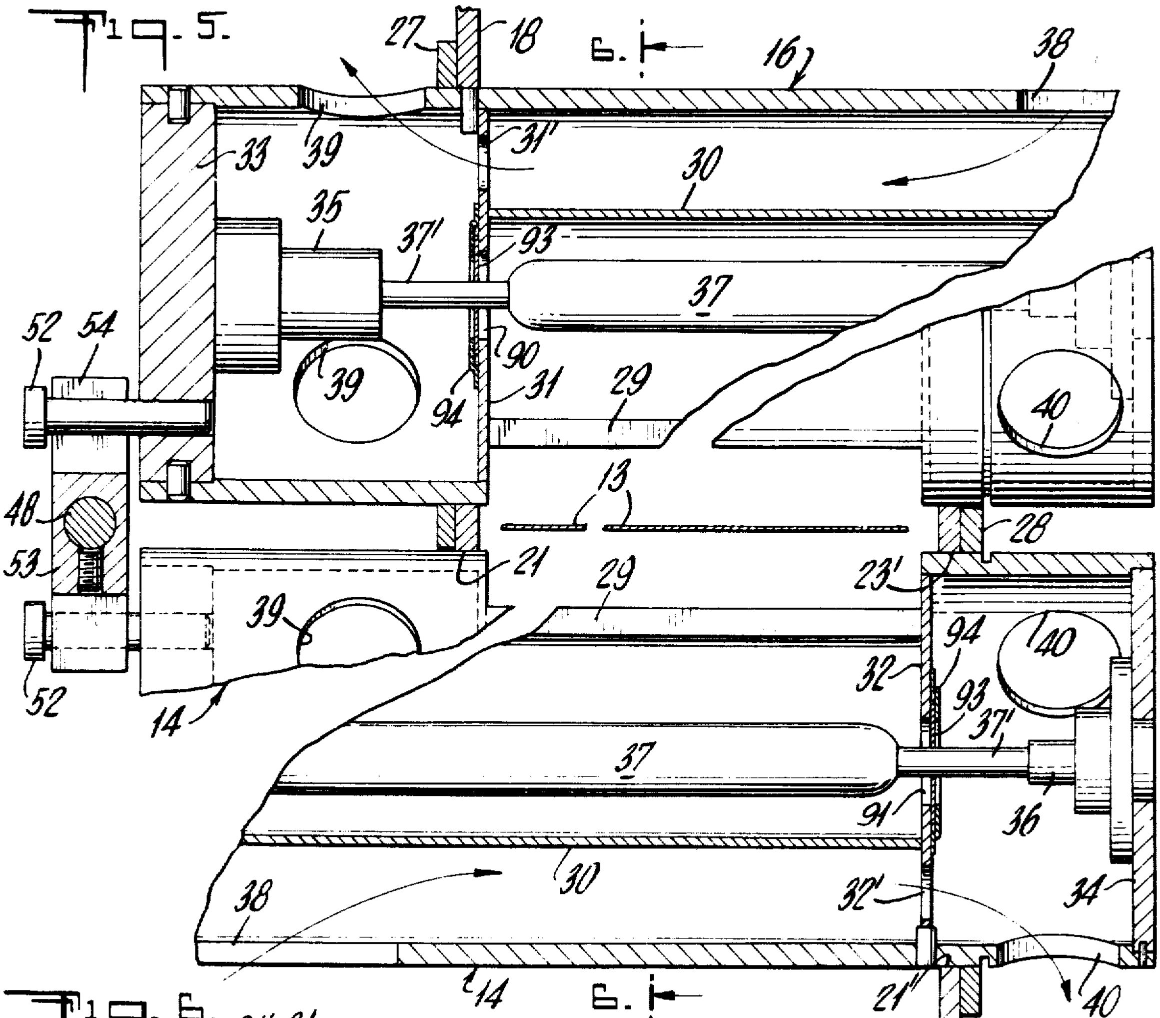
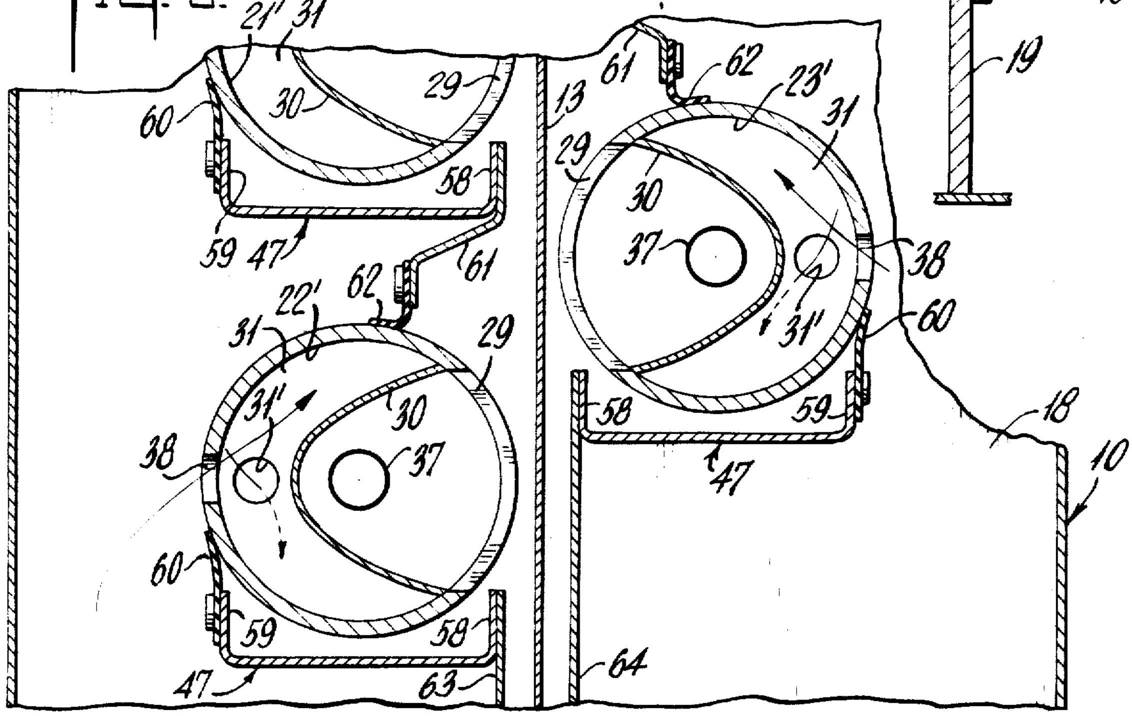

6
6
13
14
14
16
18
19
21
21'
23'
27
28
29
30
31
31'
32
32'
33
34
35
36
37
37'
38
39
40
48
52
53
54
90
91
93
94

Fig. 6.


10
13
18
21'
22'
23'
29
30
31
31'
37
38
47
58
59
60
61
62
63
64

INK CURING AND DRYING APPARATUS

This application is a division of Ser. No. 263,250 filed June 15, 1972, now U.S. Pat. No. 3,829,982.

This invention relates to ink drying and curing apparatus for printing presses and more specifically to a novel and improved ultraviolet ink drying system useful among other things for offset presses of both single color and multi-color types.

With the development of printing inks and other coatings which may be rapidly cured and dried by relatively high intensity ultraviolet radiation, apparatus for the production of high intensity ultraviolet radiation has been suggested utilizing, among other devices, high intensity mercury lamps. While mercury lamps which utilize a high intensity arc to evaporate mercury within a sealed envelope have been found most effective for generating ultraviolet light, they present certain problems, particularly when used in connection with printing presses. One of the basic difficulties is encountered in stopping a press since the ultraviolet radiation will immediately burn the web which is normally paper or other similar material that is readily damaged by excessive radiation. While the use of shutters and partitions have been suggested, they have not been found particularly effective to prevent damage to the printed web since the lamps must continue to be energized at least to 50 percent of their intensity if the web is to be halted only momentarily. This is necessary since five to ten minutes are required to restart a lamp once the arc has been extinguished. Furthermore, shutters and partitions will absorb substantial energy so that the time during which the shutters would be effective before re-radiating heat of sufficient magnitude to burn the printed web is materially limited.

This invention overcomes the difficulties heretofore encountered and provides a novel and improved device particularly adaptable for use in rapidly curing and drying printing inks and wherein the printed web may be stopped for an indefinite period while the ultraviolet lamps are energized and without adversely affecting the lamps or web in any way.

Another object of the invention resides in the provision of novel and improved curing and drying apparatus for continuously moving printed and coated webs embodying means for irradiating the web and for rapidly terminating the irradiation should the web be stopped without deenergizing the source of radiation.

Still another object of the invention resides in the provision of novel and improved irradiating apparatus utilizing high intensity lamps for curing and drying printed and coated surfaces and which includes energy absorbing chambers for receiving and dissipating radiant energy of said lamps when it is desired to terminate irradiation of the printed or coated surfaces without deenergizing the lamps.

A further object of the invention resides in the provision of novel and improved ink drying and curing apparatus embodying high intensity ultraviolet lamps and reflectors and air cooling means for cooling both the reflectors and the electrical connectors for the lamps without permitting circulation of air over the lamp envelopes.

A still further object of the invention resides in the provision of a novel and improved ultraviolet radiator for drying and curing printing inks and coatings.

The objects of the invention are attained by the provision of a housing having elongated cylindrical tubes or shells rotatably disposed therein. A longitudinal portion of each tube is open to receive a reflector and an ultraviolet energy source and the housing has openings to permit a web to be treated to pass therethrough. The cylindrical tubes are rotatable from one position to direct radiation onto the web and to another position wherein the open portion of each tube is closed by an energy absorbing chamber. The housing and tubes have openings for the circulation of air through the housing, through the tubes and about the reflectors, and about the energy absorbing chambers to cool the housing, tubes, chambers and lamp terminals while, at the same time, permitting the energy sources to remain at a normal operating temperature.

The above and other objects and advantages of the invention will be more clearly understood from the following description and accompanying drawings forming part of this application.

In the Drawings:

FIG. **1** is a side elevational view with parts broken away of one embodiment of drying and curing apparatus in accordance with the invention,

FIGS. **2** and **3** are cross-sectional views of FIG. **1** taken along the lines **2—2** and **3—3** thereof,

FIG. **4** is a view similar to FIG. **3** with the cylindrical tubes or shells rotated away from the web being treated,

FIG. **5** is a cross-sectional view of FIG. **1** taken along the line **5—5** thereof and with parts broken away, and

FIG. **6** is a cross-sectional view of FIG. **5** taken along the line **6—6** thereof.

Referring now to the drawings, the drying apparatus is enclosed within a housing generally denoted by the numeral **10** having a web inlet **11** and a web outlet **12.** The web is denoted by the numeral **13** and moves vertically through the housing. As will become apparent, the housing **10** may be positioned so that the web traverses the housing horizontally or at any angle of inclination.

In the instant embodiment of the invention, four ultraviolet lamp assemblies generally denoted by the numerals **14, 15, 16** and **17** are utilized for simultaneously curing ink on each side of the web though it is evident that any desired number of lamps on one or both sides may be employed depending on the speed of the web and whether one or both sides are to be treated.

The lamp assemblies **14** through **17** are supported by transverse partitions **18** and **19** disposed within the housing **10** and spaced apart a distance slightly greater than the width of the web. The partitions **18** and **19** each include four openings, **21** through **25** in partition **18** and **21'** through **25'** in partition **19,** for rotatably supporting the lamp assemblies on each side of the web **13.** More specifically, the lamp assemblies which are generally of tubular configuration are arranged with the assemblies **14** and **15** on the left side of the web **13** is viewed in FIGS. **3** and **4,** while the assemblies **16** and **17** are on the right side of the web and displaced upwardly therefrom so that radiation from two opposing lamp assemblies is not directed simultaneously on the same portion of the web. Inasmuch as the four lamp assemblies are identical in structure and mounted in a similar manner, only one lamp assembly will be described.

The lamp assembly **14** includes a tubular shell **26** which extends through the openings **21** and **21'** in the partitions **18** and **19** respectively. The shell is rotatably sealed in the openings by light-tight rings **27** and **28** of a suitable high temperature plastic or metal. As will be described, each lamp assembly is rotatable through an angle of 90° and, accordingly, suitable means are provided to limit rotation as well as longitudinal displacement. The shell **26** has a longitudinal opening **29** of substantial arcuate width and a length slightly greater than the width of the web. A curved reflector **30** of suitable hypobolic or other curvature is disposed within the shell **26** and with the edges of the reflector coincident with the edges of the longitudinal opening **29.** The ends of the reflector are closed by annular plates **31** and **32** having openings **31'** and **32'** respectively communicating with the back side of the reflector.

The ends of the shell **26** are closed by plates **33** and **34** each of which carry electrical sockets **35** and **36** respectively for the ultraviolet radiation lamp **37.** The sockets are positioned in such a manner that the lamp **37** will be disposed in proper relationship to the reflector in order to focus the radiation on the web with a beam width at the point of impingement preferably being of the order of one quarter inch. The shell is further provided with an elongated opening **38** and the ends of the shells which extend through the partitions **18** and **19** are provided with openings **19** and **40.** The plates **33** and **34** on the ends of the shells **26** are removably secured in position to facilitate servicing and maintenance.

Because of the high intensity radiation emitted by the lamps **37** and the concentration of the radiation on an exceedingly narrow strip across the web, the web will be quickly burned should the press speed be materially decreased or the press be stopped for any reason whatsoever. While the lamps can be deenergized, even momentary deenergization would require at least 5 to 10 minutes for restarting with the result that substantial press-time would be lost. To avoid deenergization of the lamps **37** should the press speed be reduced, a suitable control signal is applied to the terminal **41** which is fed to an electrically operated valve **42** and to switching means **43.** The switching means **43** is supplied via conductors **44** with a normal operating voltage for the lamps **37** and a low operating voltage, and the conductors **45** are connected to the lamps **37.** The actual electrical connections have been omitted in order to avoid unnecessary complication of the drawings. When the press speed is reduced to approximately 25 percent of its normal speed, switching means **43** is actuated to switch the lamps **37** to the low voltage source which functions to operate the lamps at approximately one-half of the normal power output. Under these conditions, since the web **13** continues to move through the dryer **10,** the intensity of the radiation from the lamps **37** is insufficient to damage the web but will effect curing of the ink on the printed web.

If the printing press is completely stopped or its speed falls below 25 percent of its normal speed, the control signal **41** will operate the electrically operated valve **42** and thereby actuate a pneumatically operated control **46** which effects rotation of the shells **26** from the positions shown in FIG. **3** to the positions shown in FIG. **4** so that the radiation emitted by the lamps **37** is directed into energy absorbing chambers **47.** The pneumatically operated device **46** is carried by the partition **18** and has a shaft **48** pivoted at **49** to a piston disposed within the cylinder **50** and the lower end of the shaft **49** slidably engages a cooperating opening in a fixed support **51** also carried by the partition **18.** The end plates **33** of the shells **26** each carry a stud **52** fixedly secured thereto. Each stud **52** engages a bracket or dog **53** fixed to the shaft **48** and having a slot **54** slidably engaging pin **52.** With the piston in the retracted position as shown in FIG. **2,** the reflectors in the shells are directed toward the web **13** as shown in FIG. **3.** When air pressure is applied to the upper conduit **55** of the pneumatic device **46** and the lower conduit **56** is vented to the air by reason of the operation of the electrically operated valve **42,** the shaft **48** will move downwardly to rotate the shells **26** to the position shown in FIG. **4.** At the same time, the control **43** reduces the intensity of the lamps **37** to approximately 50 percent of their normal operating power. Immediately upon restarting the press and its attainment of a speed in excess of 25 percent of its normal speed, the shells **26** are rotated to the position shown in FIG. **3** and normal voltage is applied to the lamps.

The energy absorbing chambers **47** are generally identical in structure and extend between and are supported by the partitions **18** and **19.** Each chamber includes a bottom wall **57** and upwardly extending side walls **58** and **59.** The upper edges of the side walls **58** and **59** are positioned as close as possible to the associated shell **26** so that the light and air leakage from the chambers **47** will be maintained at a minimum. To further minimize the leakage of air from those portions of the housing **10** surrounding the lamp assemblies **14** through **17** into the space between the lamp assemblies and the web, each leg **59** carries an elongated strip of flexible material **60** which rides against the outer surface of the associated shell **26.** In addition, the legs **58** of the energy absorbing chambers **47** associated with the lamp assemblies **14** and **16** each carry a downwardly and outwardly extending bracket **61,** each of which carries a piece of flexible material **62** on the outer end thereof which bears against the surface of the underlying lamp assemblies **15** and **17,** as the case may be. The leg **58** of the energy absorbing chamber associated with the lamp assembly **15** has a downwardly extending wall **63** and the energy absorbing chamber **47** associated with the lamp assembly **17** has a similar wall **64** extending downwardly from the leg **58.** The walls **63** and **64** are in closely spaced relationship and provide just sufficient clearance for the web **13** so that the latter will not touch the partitions **63** and **64** during normal operation of the associated press. The lower edges of the walls **63** and **64** are coincident with an elongated opening **65** in the bottom end of the housing **10** through which the web **13** enters the housing.

Light and air leakage above the lamp assemblies is prevented by walls or baffles **66, 67, 68** and **69.** The baffle **66** is supported between the partitions **18** and **19** and has a flexible strip **70** extending throughout its length and bearing against the shell **26** of the lamp assembly **14.** A wall or baffle **68** is hinged at **71** to the upper edge of the wall **66** and is movable from an operating position as shown in FIG. **3** to an open position as shown in FIG. **4.** The open and closed positions are controlled by a spring **72.** Similarly, the wall or baffle **67** also extends between the partitions **18** and **19** and has a flexible member **73** bearing against the outer surface of the shell **26** forming part of the lamp assembly

16. The wall or baffle 69 is pivoted at 74 to the upper edge of the wall 67 and is movable from an operating position as shown in FIG. 3 to an open position as shown in FIG. 4 under the control of a spring 75. The upper ends of the baffles 68 and 69 are curved inwardly at 68' and 69' respectively to form an exceedingly narrow gap through which the web 13 may emerge from the housing 10. This procedure greatly minimizes light leakage from the housing 10 and it is important that such leakage be minimized because the radiation is high tensity ultraviolet light which has serious adverse effects on the human eye. To facilitate threading of the web through the housing however, the baffles 68 and 69 can be moved to the open position shown in FIG. 4.

Inasmuch as substantial heat is developed within the housing 10, a novel and improved system is provided for both removing the heat from the housing and for cooling the reflectors 30. The cooling system includes a pair of centrifugal or other suitable motor operated blowers 76 and 76'. The blowers are secured to the rear wall 77 of the housing 10 and are coupled by conduits 78 and 79 to openings 80 and 81 so that air from the blowers 76 and 76' is discharged into the spaces surrounding the lamp assemblies and bounded by the partitions 18 and 19. Exhaust conduit 82 as shown in FIG. 1 is also secured to an aligned with a cooperating opening in the rear wall 77 of the housing 10. The conduit 82 therefore communicates with the space 84 between the housing end wall 77 and the partition 18. The space 84 and the space 85 in the forward end of the housing between the partition 19 and the housing front wall 86 are coupled by conduits 87 and 88 extending between and supported by partitions 18 and 19.

With the foregoing arrangement, air from the blowers 76 and 76' is fed through the conduits 78 and 79 into the spaces between the partitions 18 and 19 and the outer sides of the lamp assemblies 14 and 15 on one side of the web 13 and the outer sides of the lamp assemblies 16 and 17 on the other side of the web 13. In the case of the lamp assemblies 14 and 15, the air enters the slots or openings 38 as shown in FIG. 1 and travels in both directions over the back sides of the reflectors 30. Part of the air passes through the openings 31' in the plates 31 and is discharged through openings 39 and into the chamber 84. The remainder of the air flows through openings 32' in the plates 32 and is discharged through openings 40 into the chamber 85. The same air flow occurs in connection with the lamp assemblies 16 and 17. The air flowing into chamber 85 passes through conduits 87 and 88 into chamber 84 and all of the air in chamber 84 is exhausted through the conduit 82.

As pointed out above, it is important that the air does not contact and cool the envelopes of the lamps 37. This is accomplished by the structure previously described and shown in FIGS. 3 and 4. The air is directed through the openings 31' and 32' in plates 31 and 32 for the purpose of cooling the narrow neck portions 37' of the lamps 37 as well as the sockets 35 and 36 as may be observed more clearly in FIG. 5. Inasmuch as electrical connectors are secured to the neck portions 37', the openings 90 and 91 in the plates 31 and 32 must have a diameter larger than the electrical connectors which engage the sockets 35 and 36. To prevent air from flowing about the lamps 37, the opening 90 and 91 are closed by split rings 93 of a high temperature insulating material held in position by suitable brackets 94. In this way effective cooling of the lamp necks 37' and the sockets 35 and 36 is accomplished and the cooling air cannot flow over and about the lamps 37 which would adversely affect the operation thereof.

The split rings 93 as well as the sealing strips 60, 62, 70 and 73 are preferably formed of a flexible high temperature material. One such material that has been found effective for this purpose is asbestos impregnated with a tetrafluoroethylene resin generally known in the trade as Teflon. Other suitable materials may of course be employed provided however that they will enable the attainment of a good air seal.

While only one embodiment of the invention has been illustrated and described, it is understood that alterations, modifications and changes may be made without departing from the true scope and spirit thereof as defined by the appended claims.

What is claimed is:

1. Ink curing apparatus comprising a housing having openings for feeding a web therethrough, an ultraviolet lamp assembly rotatably supported within said housing and positioned transversely of said web, said assembly including an elongated shell having an opening extending longitudinally thereof, an elongated reflector and ultra-violet lamp within said shell, said lamp and reflector being positioned within said housing to direct radiation through said opening, said lamp being of cylindrical configuration having neck portions extending therefrom and terminals on said neck portions, sockets carried on each end of said assembly for engaging said terminals, transverse plates within said shell each having an opening therein, said plates being positioned with said necks extending through the plate openings and means carried by said plates and sealing said plate opening about said neck portions whereby said neck portions and sockets can be air cooled without cooling said lamps.

* * * * *