RADIATION EXPOSURE UNIT

Filed Feb. 19, 1957 2 Sheets-Sheet 1

FIG. 1

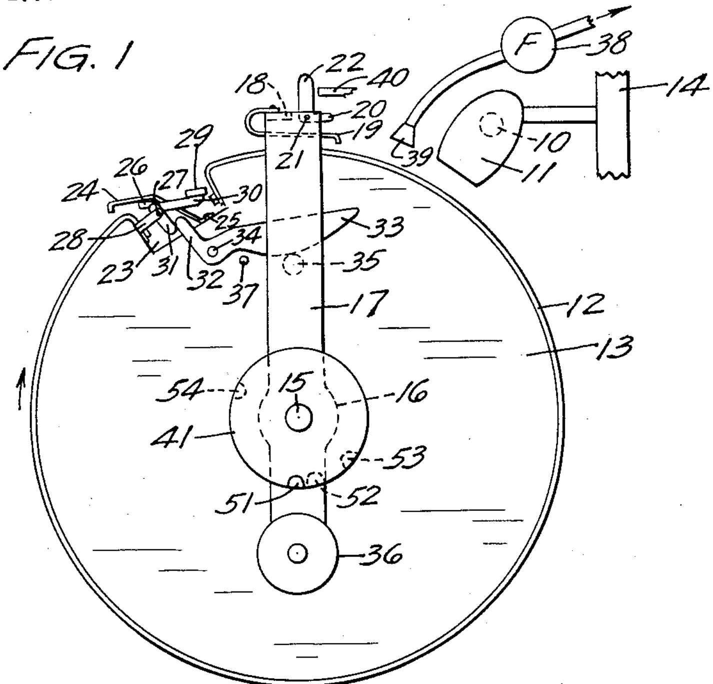

FIG. 2

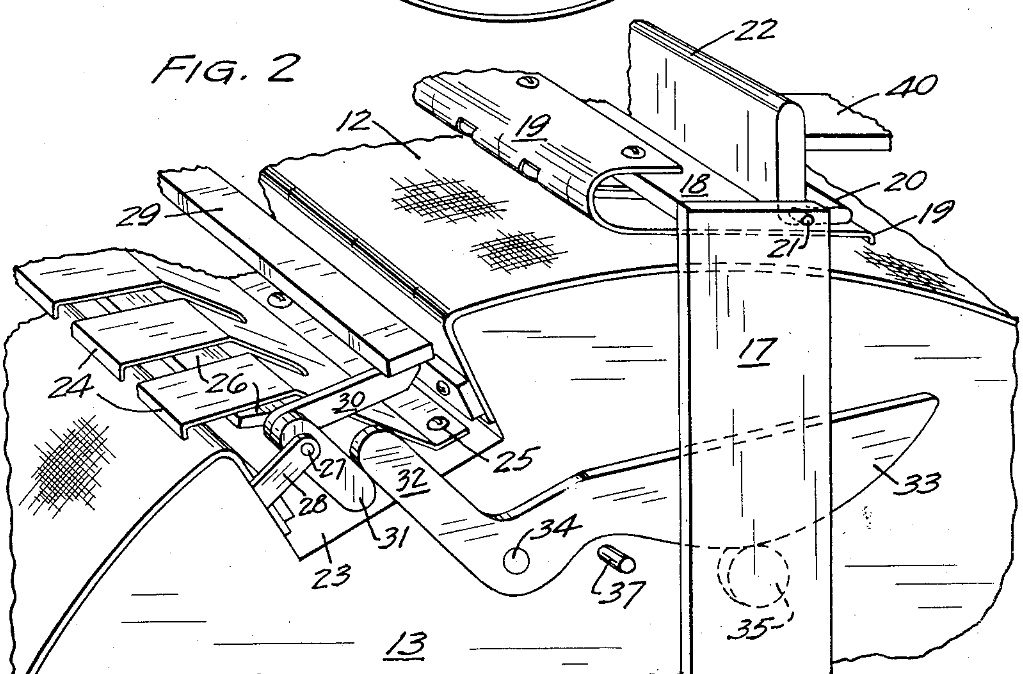

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FIG. 3

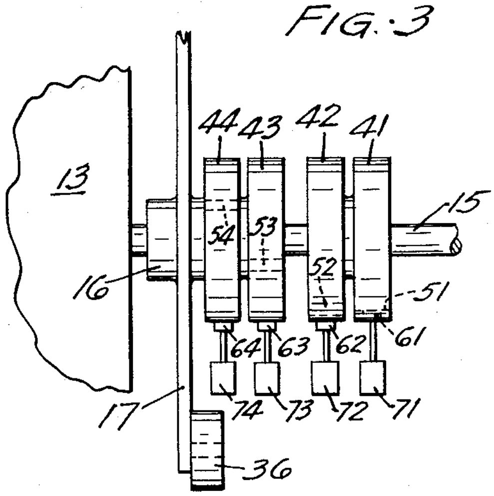
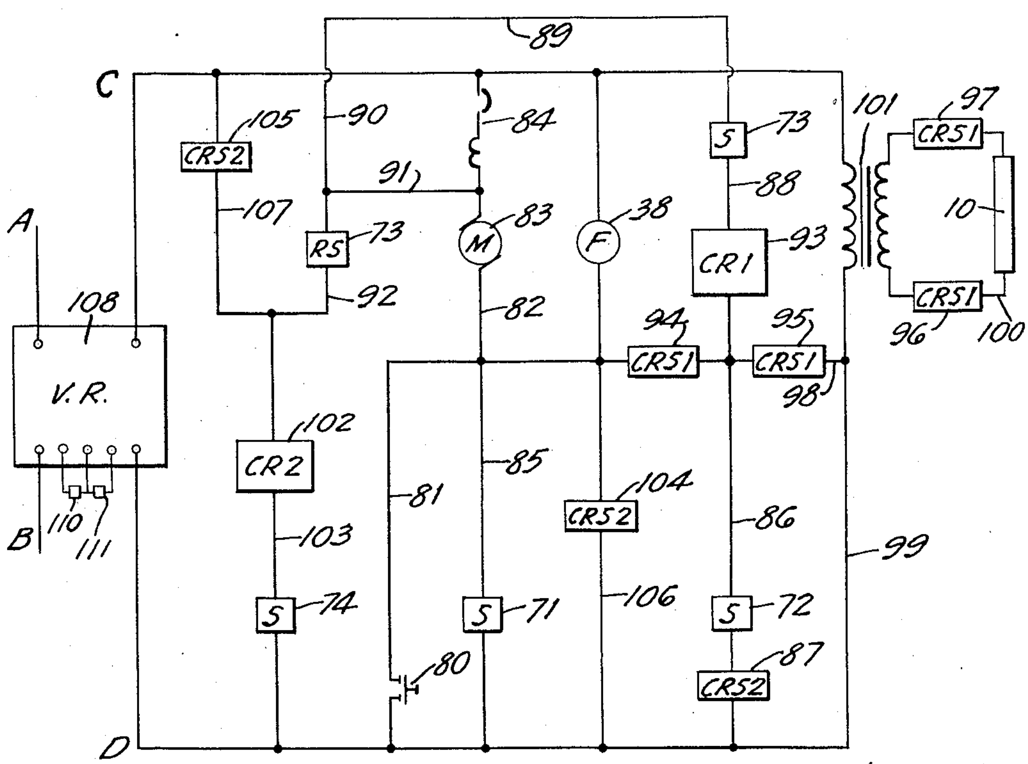


FIG. 4



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RADIATION EXPOSURE UNIT

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Application February 19, 1957, Serial No. 641,006

10 Claims. (Cl. 219—19)

This application is a continuation-in-part of my application, Serial No. 569,993, filed March 7, 1956, now abandoned.

This invention relates to apparatus for exposing sheet materials to intense radiation.

The apparatus of this invention is useful in processes requiring the treatment of sheet materials with any desired type of intense radiant energy. One example of such a process is in the fusion of a rough thermoplastic coating into a smooth, uniform and continuous layer. The apparatus is particularly useful in processes for treating previously printed or inked heat-expandable sheet materials with intense radiant energy to gain high, graduated relief patterns in the sheet materials. These latter sheet materials generally have a backing member and a layer of a heat-softenable resinous material with a heat-sensitive blowing agent distributed therethrough. The inked pattern absorbs radiant energy, resulting in localized increases in temperature, which in turn causes the blowing agent to generate gas and the resinous material to soften and expand, providing a permanent increase in thickness at the areas affected, to a degree commensurate with the energy absorbed.

The apparatus provided by this invention holds sheet materials of the foregoing type in position for exposure to intense radiation without pressure over areas undergoing exposure, thus permitting such areas to rearrange themselves or change in thickness under the effects of radiation, as desired.

Additionally, this invention provides apparatus which is simple to operate and in which required functions are so controlled that intense and uniform radiation of a sheet material may be accomplished in a substantially automatic manner.

The invention will now be described with respect to illustrative drawings in which:

Figure 1 is a schematic end view of the apparatus showing the relationship of structural elements;

Figure 2 is a fragmentary perspective detailed view of gripping fingers and related elements of the apparatus;

Figure 3 is a front view of control elements on the drum shaft of the apparatus; and

Figure 4 is a schematic diagram of a suitable electrical control circuit.

As shown in Figure 1, the apparatus includes a tubular or elongated radiation source **10** mounted at the internal focal axis of an elliptical reflector **11**, with the external focal axis of the reflector in the open and located immediately adjacent padded surface **12** of rotatable cylindrical drum **13**. The axis of the tubular radiation source, the externally focused rays, and the drum are parallel. Any fumes generated during radiation are removed through an exhaust manifold **39**, extending adjacent reflector **11**, by exhaust fan **38**. Elliptical reflector **11** is suitably mounted on frame **14**, as is also fan **38**, exhaust manifold **39**, and each end of shaft **15** holding drum **13**.

About shaft **15** is bushing **16** (Figure 3) to which

cams **43** and **44**, as well as arm **17**, and counterbalance weight **36**, are all rigidly affixed. Arm **17**, and a similar arm fixed to a bushing at the other end of shaft **15**, extend to a point just past the periphery of the drum, and are joined by bar **18** extending the length of the drum. Attached along the length of bar **18** are gripping fingers **19**, suitably of resilient leaf spring. These gripping fingers in normal condition are free of drum **13** and any padding thereon. Cam **20**, extending above gripping fingers **19** along the length of bar **18**, is pivotally mounted at **21** in each arm **17**. Whenever handle lever **22** is pulled away from stop **40** (an action which causes the upper end of arm **17** and associated elements to rotate slightly in a counterclockwise direction as seen in Figure 1) and manually pressed downward, in a clockwise direction as seen in Figure 1, cam **20**, which is integral with lever **22**, presses upon the upper surface of gripping fingers **19** forcing them into engagement with the peripheral surface of drum **13**.

In drum recess **23** extending the length of drum **13**, and parallel with the axis thereof, is an assembly of another group of resilient gripping fingers **24**, extending the length of the drum and affixed in the drum recess at **25**. Beneath all gripping fingers **24** extends flat eccentric cam **26** affixed to an extending shaft **27** at each end thereof. Shaft **27** is journaled in brace **28** mounted in the drum recess. To each end of shaft **27** is rigidly affixed handle bar **29** through arm **30**, so that hand pressure on bar **29** will cause cam **26** to abut against the under surface of fingers **24** and hold them in the raised position illustrated in the drawings, i.e., out of engagement with the surface covering of the drum.

Likewise rigidly affixed to shaft **27** is cam arm **31** against which cam follower arm **32** abuts. Cam follower arm **32** is integral with cam arm **33**, and pivots on shaft **34**, which latter is affixed to drum **13**. On the inside of axially rotatable arm **17** is affixed cam follower **35**, which, under conditions as will be explained, follows the curvature of cam arm **33** pivoting it upwardly and forcing cam follower arm **32** into displacing engagement with cam arm **31**, whereby eccentric cam **26** raises gripping fingers **24** into the position illustrated in the drawings. When free of pressure from cam **26**, fingers **24** grip the surface of drum **13**.

As illustrated most clearly in Figure 3, control cams **41** and **42** are affixed to drum shaft **15** and rotate therewith. Control cams **43** and **44** are affixed to bushing **16**, to which is affixed arm **17**, and these elements are all axially adjustable about the drum, being rotatable as a unit. In the periphery of each control cam is a small transverse recess **51**, **52**, **53** and **54** adapted respectively to receive control cam followers **61**, **62**, **63** and **64**. The control cam followers trigger various switches in the circuit.

Before describing the circuit illustrated in Figure 4, it may be well to briefly describe the method of operation of my apparatus. In idle condition, resilient gripping fingers **19**, out of contact with drum **13**, are disposed along the top of the horizontally mounted drum by stop **40**, against which handle lever **22** abuts when in raised condition as illustrated in the drawings. Stop **40** is mounted on frame **14**. Also, in idle condition, cam arm **33** is forced upwardly by cam follower **35** as illustrated in Figures 1 and 2. This places transverse recesses **51**, **52**, **53** and **54** in each control cam in the respective positions illustrated in Figures 1 and 3.

In practice, the leading edge of a square piece of sheet material to be treated with radiation is inserted beneath gripping fingers **24** and a foot switch depressed to start fan **38** and a motor, geared through any suitable linkage to shaft **15**, which causes slow clockwise rotation (see Figure 1) of drum **13**. As drum **13** rotates, control cam follower 61, which in idle condition rests in transverse recess 51 in control cam 41, is formed downwardly and rides the periphery of control cam 41. As soon as this happens, current to the motor is supplied by the connection made by control cam follower 61, and pressure on the foot switch can be removed.

As the foregoing takes place, cam arm 33 slides over cam follower 35, which action relieves pressure exerted by eccentric cam 26 under gripping fingers 24. Gripping fingers 24 then resiliently press down upon the leading edge of the sheet material and hold it on drum 13. In accomplishing this, cam arm 31 and handle bar 29 rotate slightly in a counter-clockwise direction and cam follower arm 32 rotates slightly in a clockwise direction. Stop spindle 37 affixed to drum 13 keeps cam arm 33 in position for sliding contact with cam follower 35 at the end of the cycle of operation.

Slight further rotation of drum 13 causes control cam follower 62 to fall into the transverse recess 52 in control cam 42. This energizes the tubular source 10 of radiant energy, and removes control of the cycle of operation, i.e., operation of the motor, from control cam 41. It will be evident that rotation of drum 13 draws the sheet material through the line, or narrow band, of focused intense radiant energy from tubular source 10.

While the foregoing takes place, an operator will use one hand to smooth the sheet material over the surface of the revolving drum, and his other hand to hold handle bar 22. When the trailing edge of the sheet material is properly smoothed over the surface of the drum, handle lever 22 is pulled away from stop 40 and fingers 19 are positioned properly with respect to the trailing edge of the sheet material. When this is accomplished, handle lever 22 is manually depressed in a clockwise direction. This causes cam 20 to force gripping fingers 19 over the trailing edge of the sheet material and hold the same against drum 13. With gripping fingers 19 in gripping position, bar 18 through arm 17 causes bushing 16 and affixed elements to rotate with drum 13.

Just after the clamped trailing edge of the sheet material passes through focused radiation from tubular source 10, transverse recess 53 on control cam 43 is in position to receive control cam follower 63. When control cam follower 63 passes into recess 53, power to the source of radiation is cut off and the element de-energized. In addition, control of the energization of tubular source 10 is removed from control cam 42.

Further rotation of drum 13 with the clamped sheet material thereon will place transverse recess 54 in control cam 44 in position to receive control cam follower 64. When this happens, control of the cycle of operation, i.e., current to the motor, is restored to control cam 41. Additionally, control of the energization of tubular source 10 is restored to control cam 42. After control cam 44 has acted, control cam 41 operates effectively to stop rotation of drum 13 as soon as control cam follower 61 slides into transverse recess 51. However, control cam 44 must act in sequence after control cam 43 has acted in order for control cam 41 to be effective to stop the motor and consequently stop rotation of drum 13.

As soon as the leading edge of the sheet material reappears in front of the operator during the cycle of operation here described, (i.e., after it has been exposed to radiant energy and completed approximately one revolution on the drum) it will be released and removed from the drum by the operator by pressing handle bar 29, which raises gripping fingers 24. When the trailing edge of the sheet material appears in front of the operator, it also is released simply by raising handle lever 22, which releases gripping fingers 19. Handle lever 22 and affixed elements are then moved into the position illustrated in Figure 1, either manually or by allowing frictional forces between shaft 15 and bushing 16 to rotate the assembly on bushing 16 with the rotation of shaft 15 until raised handle lever 22 abuts against stop 40. The drum will continue to rotate after the operator has removed the sheet material until control cam follower 61 passes into transverse recess 51, which cuts off current to the motor, as well as to fan 38. The elements of the apparatus will then be in the relationship illustrated in the drawings and another cycle of operation can be started.

The following description of the circuit illustrated in Figure 4, read in the light of the foregoing, will further illustrate the relationship of elements and the operation of my apparatus. Current from standard commercial 220–240 volt range input lines A and B is fed into a standard voltage regulator 108 so that variations in input voltage can be corrected and a stable 240-volt output maintained in main lines C and D, except as such voltage output is further modified as hereinafter explained.

Motor 83, powering drum shaft 15, is started by pressing foot switch 80, which closes line 81 and provides a complete circuit between main lines C and D through lines 81, 82, motor 83 and overload 84. Motor 83 causes rotation of drum 13 on shaft 15 in a clockwise direction, as described above. Slight rotation of drum shaft 15 causes control cam follower 61 to be depressed and ride the periphery of control cam 41 (see Figures 1 and 3). This closes switch 71 and current is sent through line 85 for the motor. Foot switch 80 is now released, cutting line 81. Exhaust fan 38 is in parallel with motor 83 and operates on the same cycle as motor 83.

Next in the rotation of shaft 15, control cam follower 62 slips momentarily into transverse recess 52 in control cam 42, which closes switch 72 in line 86. At the beginning of the cycle of rotation now described, control relay switch 87 in line 86 is closed. Also switch 73 in line 88 is closed, i.e., switch 73 in line 88 is held closed at this point in operation by control cam follower 63 resting on the periphery of control cam 43. When switch 72 is closed at this early point in the rotation of shaft 15, a circuit between main lines C and D is completed through lines 86, 88, 89, 90, 91, and overload 84. (It may be well to note that switch 73 in line 92 is the reverse of switch 73 in line 88, and that, at this point in operation, switch 73 in line 92 is open. Switch 73, as evident from the foregoing, is a double switch, one side functioning in line 92 and the other side in line 88.) The circuit completed by switch 72 energizes control relay 93 in line 88 which closes control relay switches 94, 95, 96 and 97.

Control relay switch 95 in line 98 closes a circuit through lines 99, 98, 88, 89, 90, 91, and overload 84, thus maintaining control relay 93 in energized condition—and control relay switches 94, 95, 96 and 97 closed—even after switch 72 is opened by the action of control cam follower 62 slipping out of transverse recess 52 during the rotation of shaft 15. Control relay switch 94 held closed by control relay 93 provides another line for motor current. Control relay switches 96 and 97 in circuit 100 are now closed and tubular source 10 of radiation is energized. Transformer 101 is used to build up the voltage in circuit 100 to 480 volts.

The next control switch to function is switch 73 in both lines 88 and 92. It is actuated by control cam 43, the respective position of the latter being set by the operator when he clamps the trailing edge of the sheet material with fingers 19. When control cam follower 63 slides into transverse recess 53 in control cam 43, switch 73 in line 88 is broken causing control relay 93 to be de-energized and control relay switches 94, 95, 96 and 97 to be broken. This cuts off power to the source 10 of radiation, and breaks current to the motor which was supplied through line 98.

Simultaneously, switch 73 in line 92, which functions the reverse of switch 73 in line 88, is closed, i.e., when control cam follower 63 is in transverse groove 53, switch 73 in line 92 is closed. When this happens control relay 102 in line 103 is energized. (The position of switch 74 in line 103 is controlled by control cam 44 and this switch remains closed except when control cam follower 64 is in transverse recess 54, which does not occur until after switch 73 has acted in the cycle.) Energization of control relay 102 by switch 73 in line 92 causes control relay switch 87 in line 86 to open, and control relay switches 104 and 105 to close. When control relay switch 104 in line 106 is closed, a new line of current for motor 83 is established to maintain continuous rotation of drum 13. Control relay switch 105 in line 107 completes a circuit through lines 103 and 107 to now maintain control relay 102 energized, regardless of the position of switch 73 in line 92.

Slight further rotation of shaft 15 will force control cam follower 63 out of transverse recess 53 closing switch 73 in line 88 and opening reverse switch 73 in line 92. Control relay 93 in line 88 would, at this point, be ready for energization by switch 72 except that line 86 is broken by control relay switch 87 now held open by control relay 102 which is in energized condition.

On further rotation of shaft 15, switch 74 is opened by the action of control cam follower 64 sliding into transverse recess 54 in control cam 44. This de-energizes control relay 102, which in turn causes control relay switch 87 to close, thus restoring control of the energization of control relay 93 to switch 72 actuated by control cam 42. De-energization of control relay 102 also causes control relay switches 104 and 105 to open. The sliding of control cam follower 64 out of transverse recess 54 will close switch 74 but such action does not effect any result in the circuit.

After switch 74 has acted, the only source of current to the motor is through line 85 controlled by switch 71. When control cam follower 61 falls into transverse recess 51, the motor stops and the cycle is completed. It will be apparent from the foregoing that the device is restored to its initial condition ready for another complete cycle of operation.

A suitable elongated source 10 for very intense infrared radiation is a tungsten filament, quartz envelope, gas-filled lamp having a lighted length of 25 inches and a wattage of 2500 giving theoretically a watt density of 100 watts per inch of filament length when operated at 480 volts. The filament under such conditios has an apparent color temperature in excess of 2400° K. when measured by an optical pyrometer. I have found that areas intermediate ends of this lamp, i.e. center areas, are preferably masked slightly in order to equalize the intensity of radiation of such areas to that intensity emitted near end areas of the lamp. Thus, the intense radiation concentrated in a narrow band on the drum surface is of substantially uniform intensity at all points along the length thereof. If desired, equalization of the intensity of radiation along the length of its band may be accomplished by slotting reflector 11 with a thin line slot intermediate its ends so as to decrease the reflective efficiency of it in the center portion. Drum 13 preferably should have a length approximately the same as the tubular source of radiation employed.

The surface of drum 13 is desirably padded with an insulating blanket 12 of any suitable material to maintain essentially uniform the inevitable slow loss of heat energy from areas of a sheet material treated by heat during exposure. As desired, an insulating blanket prevents extremely rapid dissipation of heat energy into the drum from a sheet article being treated. A preferred type of insulating blanket is a piled glass fabric, i.e., a glass fabric having glass pile tufts anchored therein, but other insulating layers have been found to function satisfactorily. In the case of exposing sheet articles as aforedscribed to intense radiant energy to gain high graduated reliefs according to the degree of radiant energy absorbed by selected areas of the sheet material, an insulating blanket facilitates desired high build-ups of heat in localized areas of the sheet material and thereby improves the accuracy of expanded relief patterns. Excellent results are obtainable using my apparatus to process sheet articles designed to rearrange in a manner commensurate with the temperature level attained in localized areas thereof.

Preferably, the rate of rotation for my drum is slow so as to provide sufficient time for absorption of radiant energy by an article being treated, but is not so slow as to allow time for complete dissipation and accumulation of a high level of heat energy throughout all areas of an inked sheet such as aforedescribed. A suitable rate of rotation is on the order of approximately 20 surface feet per minute past the tubular source of radiation.

The exposure of some sheet materials to intense radiation is desirably conducted in such a manner as to maintain, throughout the exposure cycle, an essentially constant energy level of treatment in all portions of such sheet materials where radiation-absorptive properties are equal. Assuming a theoretically constant voltage output in main lines C and D (see Figure 4), the energy from source 10, directed in a thin line on a sheet material wrapped on drum 13, will gradually increase as focusing reflector 11 and source 10 becomes hotter and therefore more efficient during an operating cycle. Additionally, peripheral areas of drum 13 tend to gradually increase in temperature during an operating cycle. Successive use of the apparatus in exposing sheet materials also gradually causes heat buildups in the apparatus. These increases in temperature of parts of the apparatus tend to reduce requirements for additional heat from source 10 as focused by reflector 11 during exposure treatment.

In order to correct for such changing conditions, and to provide for essentially uniform or constant energy levels of treatment during any one exposure cycle, as well as during successive exposure cycles, heat compensating means to adjust the intensity of radiation source 10 may advantageously be added to my apparatus. Suitable heat compensating means may comprise a circuit, as illustrated in Figure 4, connected to voltage regulator 108 so as to cause a lowering of the voltage output in main lines C and D to a degree approximately commensurate with heat build-ups in areas of the apparatus subjected to the effects of radiant energy. Such a lowering of voltage output in main lines C and D in turn causes a proportionate lowering of the level of radiation emitted from source 10 in reflector 11, as desired.

In the illustrated heat compensating circuit, a thermal sensing element 110 (i.e., a "thermister") is used to cause, in its line of the circuit, a variation of resistance responsive to variations of the temperature of reflector 11, and a cam operated rheostat 111 is used, in its line of the circuit, to vary resistance according to the relative position of drum 13 in an operating cycle. Thermal sensing element 110 is positioned adjacent reflector 11 (a relationship not illustrated in the drawings) and causes a lowering of resistance in its circuit as the temperature of reflector 11 rises. A rheostat control cam (not shown in the drawings) on drum shaft 15 operates rheostat 111 and causes a decrease in the resistance of rheostat 111 in a programmed fashion as peripheral areas of drum 13 move past source 10. At the beginning of each cycle of drum 13, the rheostat control cam causes rheostat 111 to assume a position of greatest resistance; and then as the drum rotates through one complete cycle, this control cam causes rheostat 111 to assume positions of gradually decreased resistance. The heat compensating circuit, wherein thermal sensing element 110 and cam operated rheostat 111 operate, feeds into a conventional voltage sensing diode filament element (illustrated in Figure 4 as being part of voltage regulator 108), which in turn causes a lowering of voltage output from voltage regulator 108 to main lines C and D to a degree approximately commensurate with decreases in resistance in the heat compensating circuit. In this manner, the heat energy level of treatment for sheet materials may be maintained at an essentially uniform level throughout the length of a single sheet being treated, as well as for various sheet materials treated in sequence.

That which is claimed is:

1. A machine for exposing a sheet material to intense radiation, said machine comprising, in combination: a source energizable to provide intense radiation, a support member adapted to support a sheet material in a manner for receiving radiation from said energized source, releasable gripping means to hold the leading edge of a sheet material on said support member, releasable gripping means for holding the trailing edge of said sheet material on said support member, said two last named gripping means serving to hold said sheet material on said support member without applied pressure over areas exposed to radiation, means to energize said source for the exposure of said sheet material to intense radiation and means to de-energize said source after said sheet material has been exposed to intense radiation.

2. A machine for exposing a sheet material to intense radiation, said machine comprising, in combination: a source energizable to provide intense radiation, a support member movable with respect to said source and adapted to support a sheet material in a manner for receiving radiation from said energized source, releasable gripping means on said support member to hold the leading edge of a sheet material thereon, releasable gripping means adjustable with respect to said support member for holding the trailing edge of said sheet material thereon, said two last named gripping means serving to hold said sheet material on said support member without applied pressure over areas exposed to radiation, automatic means controlled by the relative movement between said support member and said source to energize said source before the leading edge of said sheet material moves past the same, means to de-energize said source after the trailing edge of said sheet material moves past the same, said last named means being actuated by the position of elements connected with said gripping means for holding the trailing edge of said sheet material, and means to terminate relative movement between said support member and said source after said sheet material has been exposed to intense radiation.

3. A machine for exposing a sheet material to intense radiation comprising, in combination: a rotatable drum adapted to receive a sheet material on the peripheral surface thereof, a source energizable to provide intense radiation on the peripheral surface of said drum, releasable means to hold the leading edge of a sheet material on said drum, releasable means to hold the trailing edge of said sheet material on said drum, said two last named releasable holding means serving to hold said sheet material on said drum without applied pressure over areas exposed to radiation, means to energize said source of radiation before the leading edge of said sheet material moves past the same, and means to de-energize said source of radiation after the trailing edge of said sheet material moves past the same.

4. A machine for exposing a sheet material to intense radiation comprising, in combination: a source energizable to provide intense radiation, a rotatable drum adapted to receive a sheet material on the peripheral surface thereof, means to concentrate radiation from said source onto the peripheral surface of said drum in a band substantially parallel to the axis of rotation thereof, means to hold the leading edge of a sheet material on said drum, means to hold the trailing edge of said sheet material on said drum, means actuated by rotation of said drum to energize said source of radiation before the leading edge of said sheet material moves past the same, and means to de-energize said source of radiation after the trailing edge of said sheet material moves past the same, said last named means being actuated by elements connected with said means to hold the trailing edge of said sheet material.

5. A machine for exposing a sheet material to intense radiation comprising, in combination: a source energizable to provide intense radiation, a rotatable drum adapted to receive a sheet material on the peripheral surface thereof, means to concentrate radiation from said source onto the peripheral surface of said drum in a band substantially parallel to the axis of rotation thereof, means to hold the leading edge of a sheet material on said drum, means to hold the trailing edge of said sheet material on said drum, means actuated by rotation of said drum to energize said source of radiation before the leading edge of said sheet material moves past the same, means to reduce the intensity of radiation from said source to a degree sufficient to approximately compensate for heat build-ups in said machine during exposure treatments, and means to de-energize said source of radiation after the trailing edge of said sheet material moves past the same, said last named means being actuated by elements connected with said means to hold the trailing edge of said sheet material.

6. An exposure unit for exposing a sheet material to intense radiation comprising, in combination: a source energizable to provide intense radiation, a rotatable cylindrical drum adapted to receive a sheet material on the peripheral surface thereof, means to concentrate radiation from said source onto the peripheral surface of said drum, means on the peripheral surface of said drum for clamping the leading edge of a sheet material thereto, means adjustable by axial rotation about said drum to clamp the trailing edge of said sheet material onto the peripheral surface of said drum, means to actuate rotation of said drum at a slow and uniform rate, means to energize said source of radiation before the leading edge of said sheet material moves past the same, means to de-energize said source of radiation after the trailing edge of said sheet material has passed the same, and means to terminate rotation of said drum after said sheet material has been subjected to radiation.

7. An exposure unit for exposing a sheet material to intense radiation comprising, in combination: an elongated source energizable to provide intense radiation, a rotatable cylindrical drum adapted to receive a sheet material on the peripheral surface thereof, the axis of said elongated source and said drum being substantially parallel, said source being located in a reflector adapted to concentrate radiation from said source onto the peripheral surface of said drum in a band substantially parallel to the axis of rotation thereof, means on the peripheral surface of said drum for clamping the leading edge of a sheet material thereto, said last named means being actuated within the first few moments after rotation of said drum is initiated, means adjustable by axial rotation about said drum to clamp the trailing edge of said sheet material onto the peripheral surface of said drum, means to actuate rotation of said drum at a slow and uniform rate, means actuated by the rotation of said drum to energize said source of radiation before the leading edge of said sheet material moves past the same, means to de-energize said source of radiation after the clamped trailing edge of said sheet material has passed the same, said last named means being actuated by the position of elements connected with the means to clamp the trailing edge of said sheet material, and automatic means to terminate rotation of said drum after said sheet material has been subjected to radiation.

8. An exposure unit for exposing a sheet material to intense radiation comprising, in combination: a source energizable to provide intense radiation, a rotatable cylindrical drum the peripheral surface of which is provided with an insulating layer, said drum being adapted to receive a sheet material on the peripheral surface thereof, means to concentrate radiation from said source onto the peripheral surface of said drum, means on the peripheral surface of said drum for clamping the leading edge of a sheet material thereto, means adjustable by

axial rotation about said drum to clamp the trailing edge of said sheet material onto the peripheral surface of said drum, means to actuate rotation of said drum at a slow and uniform rate, means to energize said source of radiation before the leading edge of said sheet material moves past the same, means to reduce the intensity of radiation from said source to a degree sufficient to approximately compensate for heat build-ups in said machine during exposure treatment, means to de-energize said source of radiation after the trailing edge of said sheet material has passed the same, and means to terminate rotation of said drum after said sheet material has been subjected to radiation.

9. An exposure unit for exposing a sheet material to intense radiation comprising, in combination: an elongated source energizable to provide intense radiation, a rotatable cylindrical drum the peripheral surface of which is provided with an insulating layer, said drum being adapted to receive a sheet material on the peripheral surface thereof, the axis of said elongated source and said drum being substantially parallel, said source being located in a reflector adapted to concentrate radiation from said source onto the peripheral surface of said drum in a band substantially parallel to the axis of rotation thereof, means on the peripheral surface of said drum for clamping the leading edge of a sheet material thereto, said last named means being actuated within the first few moments after rotation of said drum is initiated, means adjustable by axial rotation about said drum to clamp the trailing edge of said sheet material onto the peripheral surface of said drum, means to actuate rotation of said drum at a slow and uniform rate, means actuated by the rotation of said drum to energize said source of radiation before the leading edge of said sheet material moves past the same, means to reduce the intensity of radiation from said source to a degree sufficient to approximately compensate for heat build-ups in said machine during exposure treatment, means to remove any generated fumes from the area of said radiation exposure treatment in said machine, means to de-energize said source of radiation after the clamped trailing edge of said sheet material has passed the same, said last named means being actuated by the position of elements connected with the means to clamp the trailing edge of said sheet material, and automatic means to terminate rotation of said drum after said sheet material has been subjected to radiation.

10. A machine for exposing a sheet material to intense radiation comprising, in combination: a rotatable drum adapted to receive a sheet material on the peripheral surface thereof, a source energizable to provide intense radiation on the peripheral surface of said drum, means to concentrate radiation from said source onto the peripheral surface of said drum in a band substantially parallel to the axis of rotation thereof, releasable means to hold the leading edge of a sheet material on said drum, releasable means to hold the trailing edge of said sheet material on said drum, said two last named releasable holding means serving to hold said sheet material on said drum without applied pressure over areas exposed to radiation, means to energize said source of radiation before the leading edge of said sheet material moves past the same, and means to de-energize said source of radiation after the trailing edge of said sheet material moves past the same.

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