April 7, 1964 H. GERSTER 3,128,157

ARRANGEMENT FOR HEATING DRYING DRUMS OF DRYING MACHINES

Filed Feb. 15, 1961

2 Sheets-Sheet 1

FIG. 1

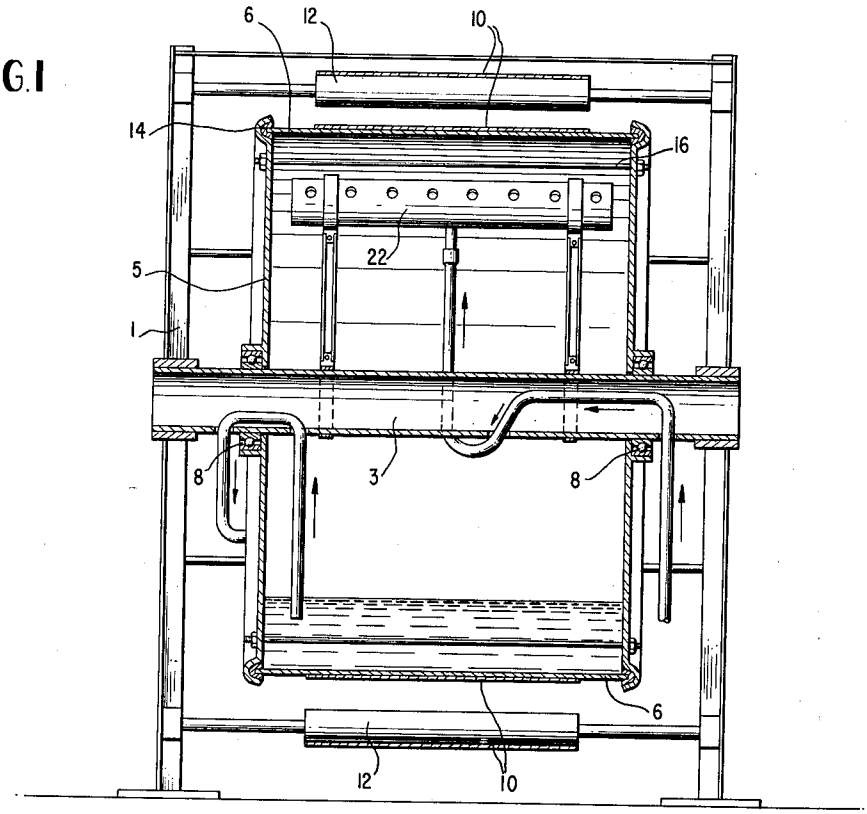
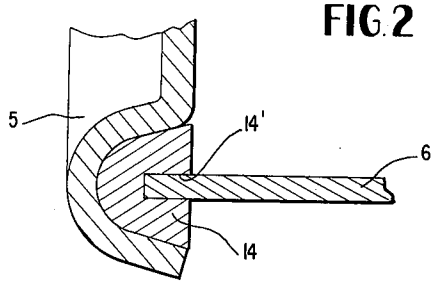


FIG. 2



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FIG. 3

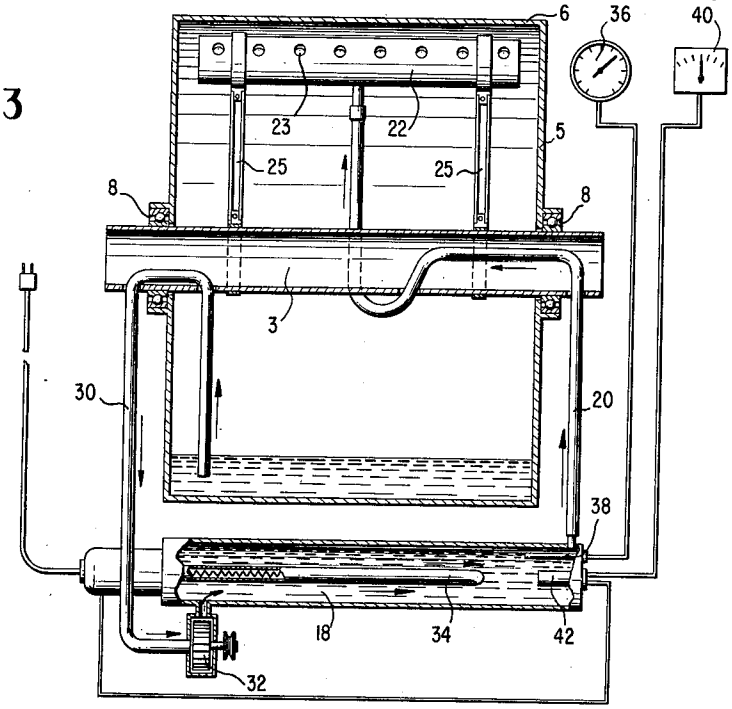
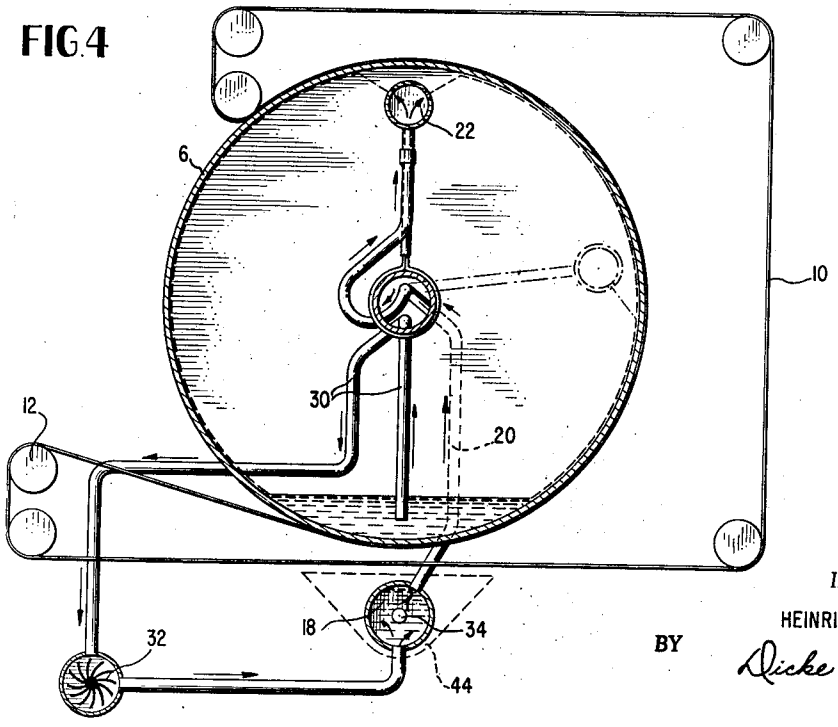


FIG. 4



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ARRANGEMENT FOR HEATING DRYING DRUMS OF DRYING MACHINES

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4 Claims. (Cl. 34—48)

The present invention relates to an arrangement for heating the drying drum of a drying machine used for drying photographic prints which drum is rotatably supported on an essentially horizontal shaft and against which abuts over a peripheral section thereof a drying cloth moved in the same direction as the drum which drying cloth is in the form of an endless band or belt.

The drying drums of the known prior art drying machines are heated by the supply of warm air to the drum inside. By reason of the relatively slight heating capacity of the air, the sections of the drum serving for purposes of drying which consist of relatively thin steel sheet metal parts, are cooled off relatively very rapidly and are not brought back, by means of the warm air, sufficiently rapidly to the temperature required for drying. The warm or heated air serving for purposes of heating also should not exceed a predetermined temperature as with the use of excessively high temperatures, there exists the danger of uneven heating with the consequence of uneven drying and local overheating of the drum. Accordingly, the heating of the drying drum with warm air leads to frequent, unpleasant and annoying occurrences of defective operation as regards the dried prints and therewith involves additional expenses.

It has already been attempted in the prior art to achieve a better heat conduction and heat distribution by an internal layer or coating of a material offering good heat conducting characteristics, for example, by plating the inner side of the drum with copper or the like. Such measure, however, does not entail the expected advantages and, under certain circumstances, causes the contrary effect, for example, in case of a plating which is not completely satisfactory. This is so as in those places in which the material applied to the base material does not abut thereagainst closely to form good contact therewith, heat-insulating air gaps result therefrom by means of which the heat transfer is additionally deteriorated.

Drum heating devices are also known in the prior art in which the annular space of a double-walled drum is filled with liquid and is electrically heated. However, the prior art realization of such construction is very complicated and involves very high manufacturing costs. Additionally, the circulation of the liquid can be attained only with great difficulties and often times is the cause of breakdowns or troubles in the operation thereof.

The present invention is based on the aim to create an installation in which the sections of the drying drum, intended for the drying of the photographic prints, can be heated, during rotation thereof, sufficiently and evenly without great expenditures. This aim and resulting problems are solved in accordance with the present invention by a drying drum, constructed in a fluid-tight manner, which is provided on the inside space thereof with spray installations by means of which a section of the drum casing is adapted to be sprayed by means of a liquid heat carrier or heating medium maintained at a predetermined temperature. With the use of a heat carrier or heating medium of large heating capacity, such as, for example, water, a relatively slight amount of the heating carrier is sufficient for the attainment of the intended purpose and, as a result thereof, the supply lines or conduits for the heat carrier may be kept relatively small. Moreover, for example, only a single spraying installation may be

sufficient if the heat carrier has sufficient heat capacity and the drum diameter does not exceed a predetermined dimension so that a sufficiently large section of the drying drum is heated thereby.

Appropriately, the heat carrier or heating medium is circulated within a circulatory system which consists of a temperature control vessel or container, arranged externally of the drum, for the heat carrier or heating medium with installations for the selective control of a predetermined temperature and of a circulating pump for drawing in the liquid heat carrier or heating medium from the drying drum and/or forcing the heat carrier into the drying drum.

In one advantageous arrangement of the installation according to the present invention, the drum axle is constructed as a stationary hollow shaft with externally arranged roller bearings for the drum, and the pressure line as well as the suction line leading to the lowest point of the drum are extended through the hollow shaft and are connected externally thereof with the temperature control vessel and the circulating pump. Appropriately, the pressure line and the suction line are constructed as flexible pressure hoses adapted to be detachably secured to pipe connections or nipples at the temperature control vessel or container and the suction pump, and the pressure line is extended to the spray installation out of the hollow shaft through an aperture provided therein.

However, it is also understood that the hollow shaft, if constructed so as to be closed on all sides thereof to be fluid-tight, may be constructed itself also as pressure line from which a stationary pipe leads to the spray installation whereas the suction line is extended, in a fluid-tight manner, through the hollow shaft out of the drum inner space toward the outside thereof. The use of only a single spray installation may be sufficient if the spray installation, according to a further feature of the present invention, is arranged below the upper apex or top point of the drum and is so constructed that the heat carrier or heating medium is adapted to be sprayed, from both sides thereof, toward the drum casing. The spray installation is thereby secured with the aid of appropriate securing members on the hollow shaft. With a sufficient speed of the sprayed or discharged heat carrier, the latter runs off along the inner walls of the drum casing and forms in the lower part of the drum a heat carrier sump.

In case a single spray installation is not sufficient, additional spray installations, for example, with relatively larger drums, may be arranged, distributed over the section of the drum to be heated.

It is of particular advantage with the drum heating system in accordance with the present invention that the heat carrier sump which is formed in the lower portion of the drum area, represents the relatively coolest place of the system from which the temperature gradually increases along the drum walls in the upward direction up to the point of impingement of the spray jets. This is so as it has been found advantageous to treat the photographic prints to be dried initially at relatively lower temperatures and to increase the temperature gradually. Since the heat carrier sump is located in proximity to the place of input, i.e., to the place where the prints initially come into contact with the drum, whereas the place of impingement of the heat carrier is located near the outlet of the prints, i.e., near the place where the prints are removed from operative engagement with the drum, there is achieved additionally a favorable temperature distribution over the drum surface by the installation according to the present invention.

The temperature distribution over the drum surface can be additionally controlled and regulated by the provision of two or more separate heat carrier circulatory systems, each provided with a temperature control vessel, a

circulating pump and a spray pipe whereby the zones of highest temperature are to be located in the upper drum area.

Accordingly, it is an object of the present invention to provide a heating installation for drying machines, especially drying apparatus for drying photographic prints which eliminates the inadequacies and shortcomings of the prior art installations.

It is another object of the present invention to provide a heating system for heating the wall surfaces of a drying drum which is simple in construction, inexpensive in manufacture as well as in operation and completely satisfactory for the intended purposes.

Still a further object of the present invention resides in the provision of a heating system that permits the utilization of a heat carrier or heating medium of large thermal capacity for effectively heating, in a predetermined manner, a section of a drying drum forming part of a drying machine.

Still another object of the present invention resides in the provision of heating means for the drum walls of a drying apparatus, especially for drying photographic prints which permits the realization of a predetermined temperature gradient in a simple and efficient manner.

These and further objects, features and advantages of the present invention will become more obvious from the following description when taken in connection with the accompanying drawing which shows, for purposes of illustration only, one embodiment in accordance with the present invention, and wherein

FIGURE 1 is a longitudinal cross sectional view through the drying drum provided with parts of the heating installation according to the present invention,

FIGURE 2 is a cross sectional view, on an enlarged scale, of a detail relating to the seal used in the drying machine according to the preesnt invention,

FIGURE 3 is a somewhat schematic longitudinal cross sectional view, on an enlarged scale, through the drying drum illustrated in FIGURE 1, and

FIGURE 4 is a somewhat schematic side elevational view of the drying drum illustrated in FIGURE 3, but additionally showing a further spray means with its circulatory connections together with a heat reflector.

Referring now to the drawing wherein like reference numerals are used throughout the various views to designate like parts, and more particularly to FIGURE 1, reference numeral 1 designates therein a frame of any suitable construction to which is secured, in a non-rotatable manner, a hollow shaft 3. The drying drum essentially consisting of the two end walls 5 and the outer cylinder casing 6 which is finished to a high polish and surface-protected, is rotatably supported on the shaft 3 by means of roller bearings 8. A drying cloth 10 or the like of any suitable material which is constructed as endless band abuts against a relatively large portion of the periphery of the drum casing 6. The drying cloth 10, constructed as endless band is returned upon itself by means of rollers 12 supported within the frame 1 over the section thereof resting against the drum casing 6, as is clearly shown in FIGURE 4 of the drawing. The drum assembly 5, 6 is supported on shaft 3 in a freely rotatable manner whereas the drying cloth 10 is driven with the aid of any suitable motor, not illustrated herein so that the drum is effectively taken along in the rotary movements thereof by the movement of the belt-type cloth 10.

An inwardly open, annular trough or stiffening corrugation is provided along the outer circumference of each end wall 5 which serves for the accommodation of a sealing ring 14 made of flexible or yielding material and having an essentially U-shaped cross section. The cross section of the U-shaped sealing ring 14 is provided with a gap 14' intermediate the leg portions thereof as illustrated on a larger scale in FIGURE 2. The lateral rim portions of the cylinder casing 6 are inserted during assembly of the drum into the open gap 14' of the annular sealing ring 14 so that they do not come in direct contact with the end walls 5. The drying drum is kept together in a fluid-tight manner by several tie-rods or tensioning rods 16 extending through the end walls 5.

A water tank or reservoir 18 (FIGURES 3 and 4) is disposed below the drying drum 5, 6 within the contours of the frame 1. A line 20, extending through the hollow shaft 3, leads from tank 18 to a spray pipe 22 which is provided on two sides thereof with spray nozzles 23 directed upwardly obliquely toward the cylinder casing 6. The spray pipe 22 is so arranged below the top point or apex of the drying drum 5, 6 that the connecting rods 16 may pass over the spray pipe 22 during rotation of the drum. The spray pipe 22 is secured on the hollow shaft 3 with the aid of two securing members 25. The securing members 25 are thereby provided at the two ends thereof with clamps for the support of the spray pipe 22 and for the securing thereof on the hollow shaft 3.

A suction line 30, passing through the hollow shaft 3, is extended within the drum inner space 5, 6 to the lowest point of the drum 5, 6. The suction line 30 is operatively connected outside of the drum 5, 6 with a pump 32 of any suitable construction which is driven in any suitable manner, for example, from a motor (not illustrated). The pressure side of the pump 32 is operatively connected with the temperature control vessel or container 18. A heating rod 34 or equivalent heating means, operatively connected with the electric power line is located with the temperature control tank or vessel 18. The temperature of the water within the tank or vessel 18 is indicated by a thermometer 36 (FIGURE 3) the sensing element 38 of which is arranged within the temperature regulating vessel 18. A thermostat 40, the sensing element 42 of which is also disposed within the temperature control vessel 18, controls, in a manner known per se, the supply of electric current to the heating rod 34.

Possibly, a heat reflector 44 for purposes of accelerating the drying of the drying cloth 10 may be arranged about the heating vessel 18 which during operation, heats the returning portion of the drying cloth 10. Of course, any suitable additional drying means for drying the cloth 10 may also be used. In case a single spray pipe 22 is not sufficient for heating the drum casing 6, a further spray pipe, shown in dash lines in FIGURE 4, may be provided. The heating of the section of the drum casing 6 with which the drying cloth 10 is not in contact is not desirable as it is appropriate if the photographic prints to be dried which are placed thereagainst do not encounter immediately the fully heated drum casing 6.

Operation

The operation of the heating system for the drying drum of a drying apparatus in accordance with the present invention is as follows:

The water is drawn in by the pump 32 from the water sump in the lowest part of the drum 5, 6, in proximity of the lower apex or lowest point thereof, and is forced into the temperature control vessel or container 18 where it is heated by the heating rod 34 to the adjusted temperature. The thermostat 40 assures the maintenance of an even temperature of the water at the desired temperature. The heated water is supplied through the pressure line 20 to the spray pipe 22, leaves the spray pipe 22 through the spray nozzles 23 in the manner indicated in FIGURE 4 and impinges against the inside walls of the cylinder casing 6. With a sufficient speed of the water, the latter runs off along the casing 6 into the sump located within the lower region of the drum. The water thereby gives off its heat to the drum casing 6.

The photographic prints to be dried are placed with the emulsion side of the film facing upwardly on the lower input section of the drying cloth 10 and are taken along between the drying cloth 10 and the cylinder casing 6 whereby the photographic prints give off the stored

dampness. The prints emerge at the upper deflecting place of the drying cloth 10 and either drop off by themselves since they have been dried in the meantime or are taken off by a suitable deflector guide or the like.

While I have shown and described one embodiment in accordance with the present invention, it is understood that the same is not limited thereto but is susceptible of many changes and modifications within the spirit and scope of the present invention and I, therefore, do not wish to be limited to the details shown and described herein but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

I claim:

1. An installation for heating the drying drum of a drying apparatus for photographic prints, comprising drum means, a relatively fixed shaft, means for rotatably supporting said drum means about said shaft, drying cloth means in the form of an endless band abutting against said drum means over a section of the periphery thereof to press the prints against said drum means, said band having a portion forming an angle with the lowermost portion of said section, said drying cloth means and said drum means moving in the same direction, said drum means being constructed in a liquid-tight manner, means for heating said drum means in a manner such that the temperature of said drum means increases in directions upwardly from said lowermost portion to the uppermost portion of said section, spray means disposed on the inside of said drum means for covering a predetermined section of the drum casing with a spray of a liquid heat carrier maintained at essentially a predetermined temperature, said spray means being disposed below and adjacent the top point of said drum means and comprising a spray pipe extending substantially parallel to the longitudinal axis of said drum means, said spray pipe being provided on two sides thereof with nozzle means for angularly discharging said liquid heat carrier on peripherally spaced portions of the inner periphery of said drum means, and securing means for securing said spray means on said shaft.

2. An installation for heating the drying drum of a drying apparatus for photographic prints, comprising drum means, an essentially horizontal hollow stationary shaft, bearing means for rotatably supporting said drum means about said hollow shaft, drying cloth means in the form of an endless band abutting against said drum means over a section of the periphery thereof to press the prints against said drum means, said drying cloth means normally moving in the same direction as said drum means, said band having a portion forming an angle with the lowermost portion of said section, said drum means being constructed in a liquid-tight manner, means for heating said drum means in a manner such that the temperature of said section is lowest in the lowermost portion of said section and varies in directions upwardly from said lowermost portion to the uppermost portion of said section, a plurality of spaced spray means disposed on the inside of said drum means for spraying a plurality of sections of the drum casing with a liquid heat carrier maintained at essentially a predetermined temperature, each of said spray means comprising a spray pipe extending substantially parallel to the longitudinal axis of said drum means, said spray pipe being provided on two sides thereof with nozzle means for angularly discharging said liquid heat carrier or peripherally spaced portions of the inner periphery of said drum means, a circulatory system for each spray means for circulating said heat carrier including suction line means common to both spray means and pressure line means including a separate pressure line to each spray means, temperature-controlling means for said heat carrier located externally of said drum means and provided with temperature regulating means for selectively adjusting the temperature at which said heat carrier is maintained, and circulating pump means for drawing said heat carrier out of said drum means and for forcing the same back into said drum means, said suction line means extending near the lowest point of said drum means, and said suction and pressure line means extending through said hollow shaft and being connected externally of said drum means with said temperature control means and with said pump means, said suction and pressure line means being constructed as readily detachable, flexible hoses adapted to be connected in a readily detachable manner to pipe connections, and each said separate pressure line extending through an aperture in said hollow shaft toward said spray means.

3. An installation for heating the driving drum of a drying apparatus for photographic color prints, comprising an essentially horizontal, stationary, hollow shaft, bearing means rotatably supporting said drum on said shaft, an endless drying belt drivingly engaging said drum, said belt having a portion adapted to receive said prints and forming an angle with the lowermost portion of said drum means for heating said drum in such a manner that the temperature of said drum increases in directions upwardly from the said lowermost portion to the uppermost portion of said drum, said means for heating comprising spray means disposed within said drum for spraying the inner periphery of said uppermost portion of said drum with a liquid heat carrier, said spray means comprising a spray pipe having nozzles closely adjacent said inner periphery of said uppermost portion of said drum, each of said nozzles being effective to direct a spray of said liquid heat carrier in a direction forming an acute angle with said inner periphery and substantially opposite to the direction of rotation of said drum, and a heating means and a circulating system for said liquid heat carrier operatively connected to said spray means.

4. An installation according to claim 3, wherein said spray pipe is provided with further nozzles directing sprays substantially in the direction of rotation of said drum.

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