July 20, 1948. C. R. LONG 2,445,443

MEANS FOR DRYING EXTENDED LENGTHS OF THREAD WITH INFRA-RED LAMPS

Filed Feb. 10, 1942 2 Sheets-Sheet 1

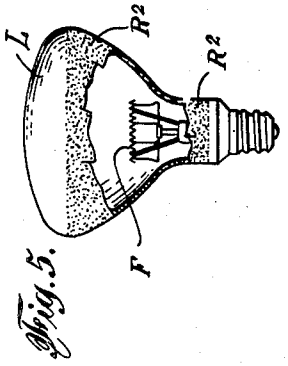


Fig. 5.

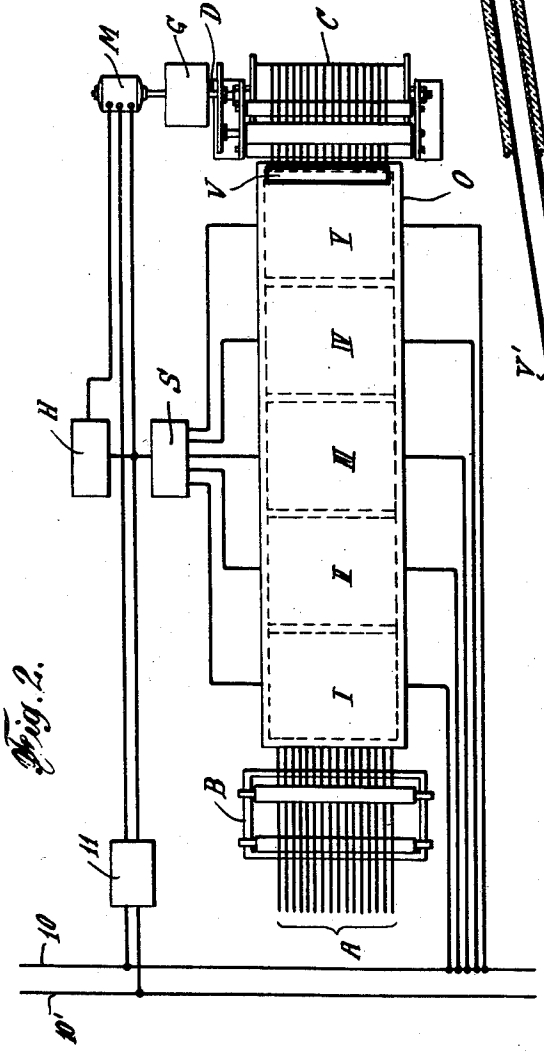


Fig. 2.

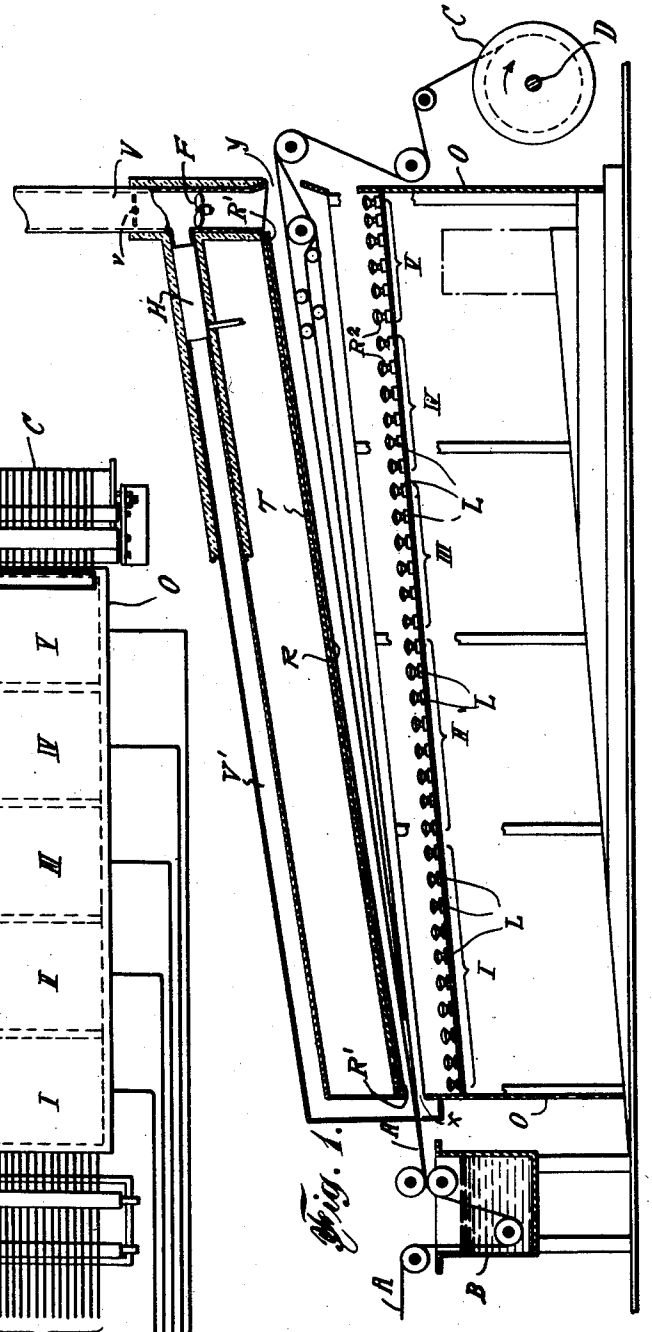


Fig. 1.

INVENTOR
C. R. LONG
BY
ATTORNEY

July 20, 1948. C. R. LONG 2,445,443

MEANS FOR DRYING EXTENDED LENGTHS OF THREAD WITH INFRA-RED LAMPS

Filed Feb. 10, 1942 2 Sheets-Sheet 2

Fig. 3.

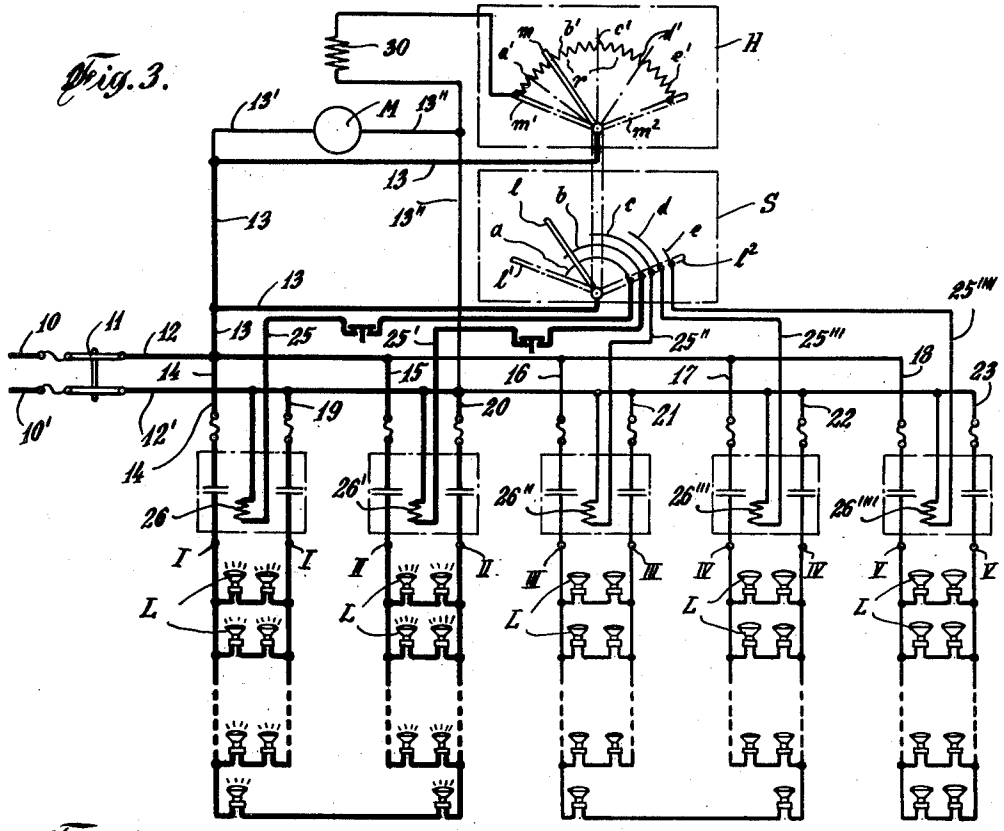
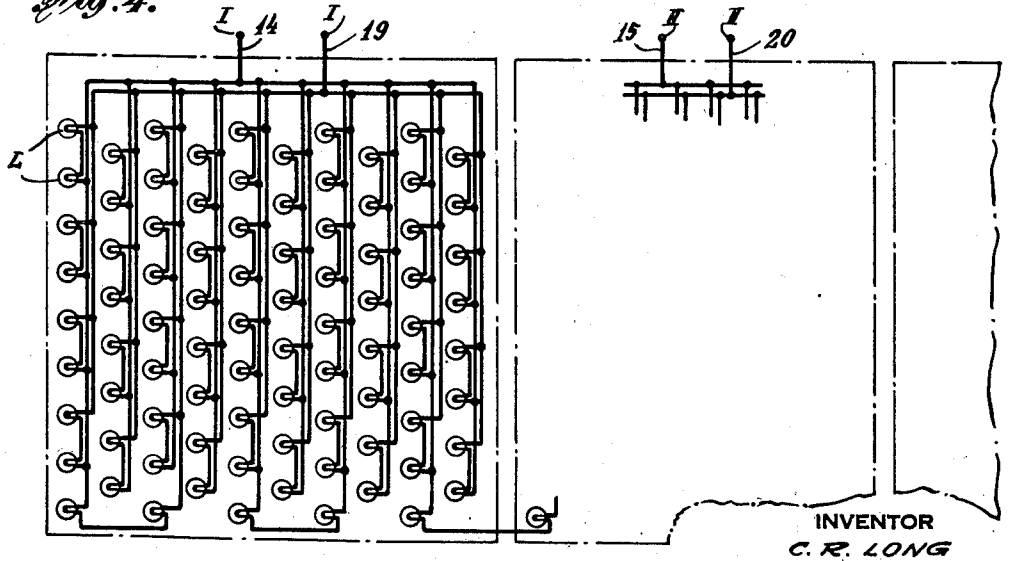


Fig. 4.



INVENTOR
C. R. LONG
BY
ATTORNEY

Patented July 20, 1948

2,445,443

UNITED STATES PATENT OFFICE

2,445,443

MEANS FOR DRYING EXTENDED LENGTHS OF THREAD WITH INFRARED LAMPS

Charles R. Long, Fort Monroe, Va., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application February 10, 1942, Serial No. 430,226

4 Claims. (Cl. 34—60)

1

This invention relates to drying apparatus for textile thread and cord comprised of natural and/or artificial fibers, and more particularly to slasher-dryer apparatus for the drying of extended lengths of said thread.

In the textile industry "slashing" is a basic operation applied to substantially all textile threads, yarns and cords, and involves the two steps of impregnating the thread with some protecting and strengthening material in aqueous solution and drying the thread. Many different types of drying apparatus have been devised for use in the second step of this operation, but none so far developed have proven entirely satisfactory in either the quality of the dried product; the speed or productive capacity of the device; in the flexibility of the apparatus for use with a plurality of different thread sizes or thread compositions; or in the automatic regulation of the same to avoid the deleterious results of over-drying or under-drying.

One of the objects of the present invention is to provide an improved slasher-dryer device.

Another object is to provide an electrically heated and electrically controlled slasher-dryer device.

Still another object is to improve the operation of slasher-dryers and the quality of the dried thread.

Other objects and advantages will be apparent as the invention is more fully hereinafter disclosed.

In accordance with these objects I have devised the slasher-dryer apparatus illustrated in the accompanying drawings wherein the drying of the thread passing through the device is accomplished by radiant heat energy emitted by incandescent filament lamps of the type known in the art as infra-red radiation lamps, and wherein by the appropriate automatic regulation of the amount of electric current passing to the lamps relative to the rate of travel of the thread through the device, the dryer device, per se, may be adapted for use in the drying of a plurality of threads of different diameters and of different composition and for continuous operation on threads of indefinite lengths.

Referring to the drawings:

Fig. 1 is a sectional side elevational view of the slasher-dryer apparatus of the present invention;

Fig. 2 is a schematic plan view of the same;

Fig. 3 is a diagrammatic layout of the electrical control and lamp energizing circuit employed in combination with the apparatus of Fig. 1;

Fig. 4 is a schematic diagram illustrating the electrical characteristics of the radiant energy generating means of the present invention; and

Fig. 5 is a schematic view of a particular type of infra-red radiation generating means adapted for use in the present invention.

2

The slasher-dryer device of the present invention in its broadest aspect consists of an elongated oven O provided in the opposite ends thereof with inlet and outlet openings X and Y, respectively, for a plurality of threads A to be fed continuously therethrough and with means to project infra-red radiation onto the plurality of threads A as the threads pass through the oven O between the inlet and outlet openings thereof, with the amount of said radiation controlled with respect to the speed of the threads A in such a manner as to prevent over-drying and under-drying of the threads A.

There are many different ways in which this generic inventive idea may be employed. The arrangement illustrated in the drawings is one specific embodiment of the same. In the arrangement shown, the means to project infra-red radiation onto the threads A as they pass through the oven O comprise a plurality of infra-red radiation generating means, such as lamps L, disposed within oven O in predetermined horizontal spaced relation in a plane below that of the openings X and Y, the spacing therebetween being such as to provide for the projection of infra-red radiation over substantially the entire longitudinal cross-section of the oven O and means to confine the radiation within a predetermined space gap of a cross-sectional area and length enclosing the path of travel of the threads A within the oven O. Although shown below, I contemplate using arrangements in which said lamps are above, as well as in which some are above and some below. The last mentioned arrangement is preferred for materials which do not effectively transmit the radiations and, therefore, require radiant energy on both surfaces for rapid drying.

In the arrangement shown, concentration of the radiation is desirably obtained by providing an infra-red radiation reflector plate R on the inside face of top T of oven O, and by employing as infra-red radiation generating means a plurality of lamps L of the type heretofore known in the art, which are individually provided with reflecting surfaces R^2. The plate R desirably has a reflecting surface R^1 of aluminum, gold, or other material suitable for efficiently reflecting the generated radiations. By sustaining each lamp L with the reflecting surface R^2 in opposition to the reflector R^1 with the incandescent filament F therebetween, the plurality of lamps L in close spaced relation form effectively a continuous reflector R^2 in opposed relation to R^1 and with the reflectors R^1 and R^2 defining an area within which the infra-red radiation emitted by the lamps L is confined and through which threads A pass.

The means to regulate the amount of infra-red radiation emitted by lamps L with respect to the speed of threads A thereby to inhibit over-drying and under-drying of the threads A while passing through oven O may be widely varied without essential departure from the present invention, as one skilled in the art will perceive. This regulation is essential to adapt the dryer device, per se, to continuous and uninterrupted operation and to adapt it for wide use with threads of different diameters or different moisture content. For example, where threads A of substantially the same diameter but of different lengths are being passed through the dryer, it is frequently necessary to change winding and unwinding reels. To effect this change the speed of threads A must be decreased to a relatively slow rate for a time interval providing for the removal and replacement of a winding or unwinding reel, during which time interval, unless the heat energy generated within oven O is reduced accordingly, the thread A within oven O will be subjected to over-drying. Excessive heating bakes out some of the natural strength of animal or vegetable fibers, and in systems, heretofore employed, there is no rapid flexible heat control to compensate for any changes made in speed due to material defects, inspection, or warp changes.

I have provided for this contingency by arranging the plurality of lamps L in a plurality of lamp banks, numbered I to V inclusive, with the plurality of lamps L in each bank (I to V, inclusive) electrically connected to be energized separately and successively and with the total number of lamps L in each bank (I to V, inclusive) selected with respect to a plurality of selected speeds (I' to V', inclusive) so that with any given minimum speed I' of threads A (of any given diameter) the infra-red radiation of the plurality of lamps L in bank I is sufficient to effect the desired amount of drying in the threads A passing thereover and with any given maximum speed V' the total radiation of all the lamps L in the banks I to V inclusive is sufficient to effect the desired amount of drying in the threads A; the several intermediate speeds II', III' and IV' being selected with respect to the total radiation emitted by banks I—II, I—II—III, and I—II—III—IV respectively to accomplish substantially the same result.

With the plurality of lamps L thus arranged in a series of banks I to V, I provide a manually operative switch means S adapted to energize successively banks I; banks I—II; banks I—II—III; banks I—II—III—IV; and banks I—II—III—IV—V, and a manually operative rheostat means H adapted to energize motor M actuating drive shaft D in a plurality of speeds I' to V' inclusive, wherein speed I' is the desired minimum speed, speed V' the desired maximum speed, and speeds II' to IV' are desired intermediate speeds; and provide a mechanical interlock means whereby the switch S and rheostat H may be simultaneously actuated manually to positions 1 to 5 inclusive, corresponding to the same.

The arrangement provided is most simply illustrated in the schematic diagram of Fig. 3. The switch means S comprises substantially a plurality of arcuate electrically conductive sections *a* to *e* inclusive disposed concentrically about a common axis in a position to be successively contacted by said lever on rotation of lever *l* from dotted line position *l'* to dotted line position l^2.

The rheostat H comprises essentially a resistance *r* and a moving member *m* adapted to make

sliding contact with the resistance *r* over substantially the entire length thereof from dotted position *m'* to dotted position m^2, giving thereby a succession of positions *a'* to *e'* at which speeds I' to V' inclusive may be obtained in motor M.

The two movable elements, lever *l* and member *m* of switch S and rheostat H respectively, may be keyed to a rotatable shaft provided with a manually operative rotating means (not shown), such as a wheel, in such manner as to be shifted simultaneously to positions *a*—*a'* to *e*—*e'*, respectively, or to intermediate positions *b*—*b'*, *c*—*c'*, *d*—*d'* as desired, the specific arrangement employed being generally old in the art, and adapted to be widely modified without essential departure from the present invention.

As indicated in the drawings, Fig. 3, the speed of motor M is controlled by rheostat H and the successive energization of the plurality of lamp banks I to V inclusive is controlled by switch means S, manually operative means *l*—*m*, respectively, in a manner well known in the art. Successive energization of the lamp banks I to V is obtained as follows:

Electric current from supply lines **10**—**10'** is carried through switch **11** to load circuit lead wires **12**—**12'**. One lead wire **12** is connected through conductors **13**—**13'** to lever arm *l* of switch S and to member *m* of the rheostat H and by conductor **13'** to one side of the armature of motor M, the other side of the armature of motor M being connected back through conductor **13''** and motor field coil **30** through rheostat H to lead wire **12'**, substantially as indicated. Conductors **14**, **15**, **16**, **17** and **18** electrically connect lead wire **12** to one side of each of the banks I to V inclusive of lamps L. The other lead wire **12'** is connected by conductors **19**, **20**, **21**, and **22** to the opposite side of each of the banks I to V, inclusive, of lamps L.

To regulate and control the successive energization of the several banks of lamps I to V, inclusive, switch means S is provided with a plurality of electrically conducting arcuate sections (*a* to *e* inclusive), one for each of the banks I to V, inclusive, arranged substantially as indicated to become successively energized upon the rotation of lever *e* from the dotted position (*l'*) to dotted line position (l^2).

Upon the simultaneous rotation of lever *l* and member *m* from circuit open position (*l'*—*m'*) to first circuit closing position (*a*—*a'*) by any desired manually operative means (not shown), motor M is energized to a speed I' and the electric current passing through arcuate section *a* passes through conductor **25** to solenoid actuated switch means **26**, operative to close the electrical circuit connecting bank I to load circuit lead wires **12**—**12'**, through conductors **14** and **19**, thereby energizing lamps L of the bank I, the remaining banks II to V, inclusive, remaining de-energized.

When the speed of motor M is increased as by moving member *m* to position *b'*, to reduce the field current by increasing the field resistance, lever *l* is simultaneously moved to a position engaging arcuate section *b* whereupon, as may be seen from the electrical connections shown, lamp bank II also is energized in substantially the same way as heretofore described for bank I. Further movement of lever arms *l* and member *m* to the relative positions indicated at *c*—*c'*, *d*—*d'* and *e*—*e'*, results in the successive energization of banks III, IV and V in a manner similar to that hereinabove described for banks I and II. It is

believed apparent that by an appropriate selection of the points *a'* to *e'* on resistance *r* of rheostat H any desired speed of motor M may be obtained and any desired rate of travel of threads A through oven O also may be obtained at each of the positions *a*—*a'* to *e*—*e'* inclusive shown in the drawings and that the total number of lamps L in each of the banks I to V inclusive may be adjusted with respect to the rate of travel of threads A to provide the desired amount of infra-red radiation to effect the drying of the threads A at the determined rate of travel at each position *a*—*a'* to *e*—*e'* inclusive.

The particular manner in which lamps L are electrically connected in each bank I to V inclusive may be widely varied without departure from the present invention. In Figs. 3 and 4 I have shown one way to connect the lamps L in the circuit, which briefly stated is a series-parallel arrangement, wherein two lamps L of the plurality of lamps in each group of lamps comprising banks I to V inclusive are electrically connected in series and each pair of series connected lamps L are connected in parallel across the lead wires conducting the supply current to each bank of lamps I to V inclusive. In this manner, the total number of lamps in each bank I to V inclusive may be readily regulated by cutting in and out the total number of pairs of series-connected lamps to obtain the desired heat energy in each bank of lamps. Many alternative ways of obtaining the same desired result are available in the art.

In addition to the mechanical convenience of a continuously operating drying means, relatively high rates of production and an improved product with a substantially consistent and controlled final moisture content, the dried thread product or other material of the present invention is characterized, if thread, by a substantially uniform cross-sectional area and rounded contour which differentiates the same from the product of prior art drying processes, particularly those employing rotating steam-heated drums for drying the thread.

The specific structure of oven O may be varied widely without departure from the present invention, as may also the particular mechanism by which the plurality of threads A from unwinding reels (not shown) through the fortifying bath B and through the oven O onto winding reels C, and the specific means for spacing and holding apart the said threads A in transit through the oven O, and the various specific means provided to facilitate the mounting and demounting of the winding and unwinding reels, per se, form no part of the present invention. In general, these several means are actuated by a common driving means, such as motor M through gear reduction means G driving a drive shaft D to which the winding reels C are operatively connected to be forwardly driven. It is also preferably to provide a ventilating flue V in the top of oven O to carry away the moisture laden atmosphere from the oven interior. Flue V may be located at either the entrance or exit end and may, if desired, be provided with fan exhaust means (not shown) where the flue draft is insufficient for ventilation.

I consider it desirable from a standpoint of efficiency to dehumidify and recirculate the air in the oven O, as by causing a fan F in the flue V to return the drying air to the oven entrance R', as through an insulated flue V', after passing through a dehumidifier H. In this way the air,

laden with moisture from the wet material A, may be dried, while the heat contained therein is reclaimed and used, to at least some extent, by recirculating the heated air rather than allowing it to escape. The proportion of reclaimed air employed may be controlled by a valve *v* in flue V. Thus the lamps L would operate in air at a higher temperature and only enough would be needed to replace the losses of conducted and convected heat, making it possible to keep the room in which the equipment is located at a cooler temperature due to the desired insulation which would be employed outside of said air duct V'.

Although I have indicated the drying of the material in one plane, it will be understood that I do not wish to be limited to this, as floor space may in some instances be conserved, where it is not undesirable to bend the material being dried, by running said material diagonally up and down in a generally inverted V or M shaped oven. Thus the necessary length of drying space may be secured without the use of a corresponding length of floor space.

It will be understood that although I have disclosed manual means for controlling the operation of the motor and lamps, yet I contemplate the use of automatic means similar to the Taylor moisture analyzers. Such a moisture controller would operate directly on the yarn or other material being dried, making the machine fully automatic and very sensitive to variations, thereby vastly improving quality and tending to reduce breakage.

It is believed apparent that the slasher-dryer device of the present invention may be widely varied without essential departure therefrom and all such modifications and departures thereof are contemplated as may fall within the scope of the appended claims.

I claim:

1. Apparatus for drying thread and continuous material of a similar nature comprising an oven, inlet and outlet openings in the respective end walls of said oven and adjacent the top thereof, a plurality of infra-red radiation generating lamps disposed in predetermined spaced relation in a plane below said openings, the total number thereof being at least sufficient to provide for the projection of infra-red radiation throughout substantially the entire horizontal cross-section area of the oven, reflector means above the level of said inlet and outlet openings and cooperating with said individual lamps to confine the radiations substantially within the space gap therebetween, an insulated flue connecting the inlet and outlet ends of said oven, a dehumidifier in said flue, means for recirculating the moisture-laden air passing from said oven outlet through said flue and dehumidifier and returning it to the oven inlet, to thereby reclaim some of the heat of said oven, means to feed extended lengths of said continuous material through said oven, means to vary the rate of travel of said material through said oven, and means movable therewith to directly increase or decrease the amount of infra-red radiations generated by said lamps, as the rate of travel of said material through the oven is increased or decreased.

2. Apparatus for drying thread and continuous material of a similar nature comprising an oven, inlet and outlet openings in the respective end walls of said oven and adjacent the top thereof, lamps generating infra-red radiations in said

oven, an insulated flue connecting the inlet and outlet ends of said oven, a dehumidifier in said flue, means for recirculating moisture-laden air passing from said oven outlet through said flue and dehumidifier and returning it to the oven inlet, to thereby reclaim some of the heat of said oven, means to feed extended lengths of said continuous material through said oven, means to vary the rate of travel of said material through said oven, and means movable therewith to directly increase or decrease the amount of infra-red radiations generated by said lamps, as the rate of travel of said material through the oven is increased or decreased.

3. Apparatus for drying threads and continuous material of a similar nature including a supporting frame, a pair of rollers at the entering end of the frame between which the threads pass, a drum at the opposite end of the frame on which the threads are wound, electric power means for rotating said drum, banks of drying lamps supported on said frame, located between said rollers and said drum, and positioned adjacent the threads for drying the same, said lamps being individually provided with reflecting surfaces and disposed in predetermined spaced relation in a plane below said threads, the total number of said lamps being at least sufficient to project infra-red radiations throughout substantially the entire horizontal cross-section area of the apparatus, and reflector means above said threads and cooperating with the individual lamp reflecting surfaces to confine the radiation substantially within the space gap therebetween, means to vary the speed of rotation of said drum, and means interlocked therewith to automatically make the amount of infra-red radiations generated by said lamps also vary substantially directly proportional to the rate of travel of the threads to obtain the desired drying effect.

4. Apparatus for drying threads and continuous material of a similar nature including a supporting frame, a pair of rollers at the entering end of the frame between which the threads pass, a drum at the opposite end of the frame on which the threads are wound, an electric motor for rotating said drum, banks of drying lamps supported on said frame, located between said rollers and said drum, and positioned adjacent the threads for drying the same, said lamps being individually provided with reflecting surfaces and disposed in predetermined spaced relation in a plane below said threads, the total number of said lamps being at least sufficient to project infra-red radiations throughout substantially the entire horizontal cross-section area of the apparatus, and reflector means above said threads

and cooperating with the individual lamp reflecting surfaces to confine the radiation substantially within the space gap therebetween, and means comprising a manually-controlled rheostat in the circuit to the field coil of said motor to control the motor speed and a switch connected to the manual control of said rheostat for simultaneously increasing or decreasing the number of lamps energized as the motor speed is increased or decreased by correspondingly changing the amount of resistance of said rheostat in circuit with said field coil, whereby upon increasing the motor speed the number of lamps which are energized is simultaneously increased, to thereby directly compensate for said increased speed and avoid under-drying, and upon decreasing the motor speed the number of lamps which are energized is simultaneously decreased, to thereby avoid over-drying.

CHARLES R. LONG.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,023,316	Hurwitz	Apr. 16, 1912
1,228,225	Lynoh	May 29, 1917
1,432,729	Pinder	Oct. 17, 1922
1,463,923	Nelson	Aug. 7, 1923
1,571,282	Leculier	Feb. 2, 1926
1,683,833	Maneschi	Sept. 11, 1928
1,802,407	Danninger et al.	Apr. 28, 1931
1,956,737	Walker et al.	May 1, 1934
2,034,270	Reading	Mar. 17, 1936
2,057,776	Groven	Oct. 20, 1936
2,065,070	Hanson	Dec. 22, 1936
2,156,352	Peterson	May 2, 1939
2,186,067	Groven	Jan. 9, 1940
2,204,603	Kline et al.	June 18, 1940
2,220,928	Kienle et al.	Nov. 12, 1940
2,236,754	Gurwick	Apr. 1, 1941
2,268,986	Hess et al.	Jan. 6, 1942
2,269,236	Wellmar	Jan. 6, 1942
2,281,184	Dykstra et al.	Apr. 28, 1942
2,308,239	Bell	Jan. 12, 1943
2,355,391	Nelson et al.	Aug. 8, 1944
2,420,399	New	May 13, 1947

OTHER REFERENCES

"Quicker Drying with Lamps," Beggs, pages 88, 89 in "Factory Management and Maintenance," July 1939 issue.

"Infra-Red Does the Trick," pages 124 to 127 in "Scientific American," Sept. 1941 issue.