

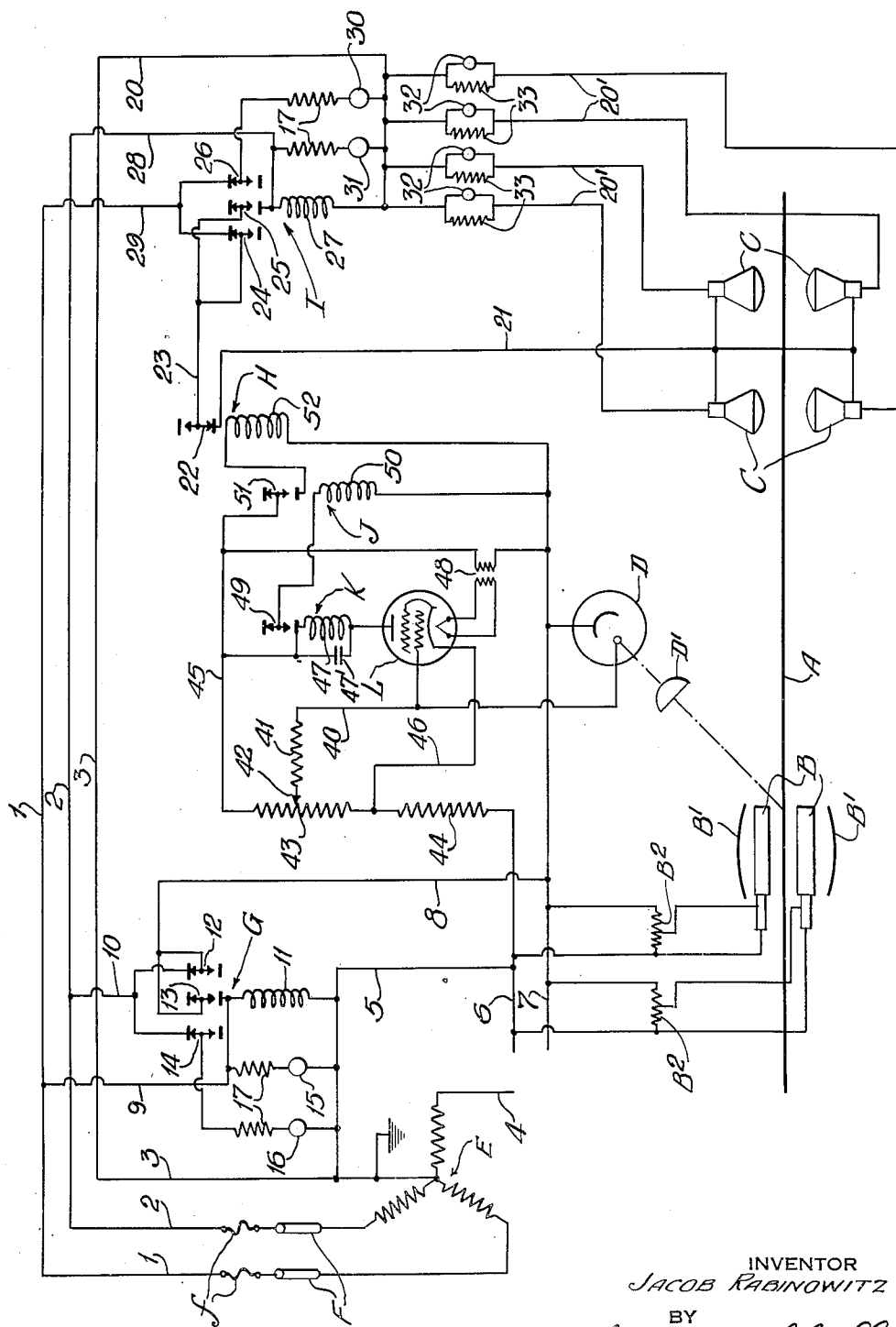
May 23, 1950

J. RABINOWITZ

2,508,928

REEXPOSURE APPARATUS

Filed April 12, 1946



INVENTOR
JACOB RABINOWITZ

BY
John E. Hubbard
ATTORNEY

UNITED STATES PATENT OFFICE

2,508,928

REEXPOSURE APPARATUS

Jacob Rabinowitz, Brooklyn, N. Y., assignor to
Pavelle Color Incorporated, New York, N. Y., a
corporation of Delaware

Application April 12, 1946, Serial No. 661,552

5 Claims. (Cl. 250—41.5)

1

The present invention relates to lighting means used to furnish light for the re-exposure of a travelling sensitized material undergoing development in a known photographic process of producing pictures, and the general object of the present invention is to provide improved electric lighting means for such use. More specifically stated, the general object of the invention is to provide lighting means well adapted for the use stated, and characterized generally by its simplicity and effectiveness, and characterized in particular by its provisions for avoiding interruption of a desired illumination effect as a result of lamp failures, fuse blow-outs, and the like.

The invention was primarily devised for use in the continuous development of natural color pictures or photographs printed on a film by a well known process in which the film after being exposed in the picture printing operation is subjected to a first development treatment, and then without drying is re-exposed, and is thereafter subjected to a final development and finishing treatment. The complete development process involves the passage of the continuously moving film successively through numerous tanks holding developing, hardening, bleaching and fixing solutions, and wash water. In the continuous development of pictures in the manner described, the length of the travelling film strip undergoing treatment at any one instant may be of the order of 2500 feet, and the film may well travel at a speed of fifteen to twenty feet per minute.

Any interruption in the supply of light used in re-exposing the film necessarily involves a waste of film and treating chemicals which increases with the duration of the interruption period, and a specific object of the invention is to provide means for reducing the risk of interruption in the re-exposure light supply to a practical minimum, while at the same time maintaining a high overall efficiency in supply such light.

The best practical sources of re-exposure light now known to me are commercial mercury vapor lamps. Such lamps when operated at full capacity or brilliance give light of suitable chromatic values and are highly efficient. Their efficiency is practically important because of the substantial electric current saving made possible, and more importantly, because it avoids the undesirable film heating effect practically inevitable when less efficient lamps are used. The use of mercury vapor lamps for re-exposure is open to the objection that it requires several minutes to make such a lamp fully operative after it is con-

2

nected to a source of energizing current, not only when the lamp is first put into service, but also in re-starting the lamp following an interruption in current flow through the lamp even though that interruption is only momentary.

A major object of the present invention is to provide simple and effective means for substantially continuously maintaining the illumination of the re-exposure chamber, notwithstanding occasional interruptions in the operation of the mercury vapor lamps normally illuminating that chamber. To this end, I provide auxiliary or reserve lamps, such as tungsten filament electric lamps, which can be energized and brought to full brilliancy practically instantaneously, and also provide automatic control apparatus responsive to the light emitted by the mercury vapor lamps, for switching the reserve lamps into and out of service as the illumination furnished by the mercury vapor lamps falls below and rises to its normal value. The light emitted by such reserve lamps when operated to give a light color temperature of about 2950° Kelvin has suitable chromatic properties for use in illuminating the re-exposure chamber.

Another object of the present invention is to minimize the risk of interruption in the re-exposure chamber illumination as a result of fuse blowouts or other accidental interruptions in the supply of energizing current to the lamps. In practice, I attain this object by providing two separate lamp energizing circuits, each adapted to energize the re-exposure lamps, and only one of which is normally in use at any one time, and by also providing mechanism for automatically bringing the previously inactive lighting circuit into use, on a failure in the lighting circuit previously in use. In the preferred form of the invention, the mercury vapor lamps are normally connected in one of the two circuits and the reserve lamps are connected to the other circuit when brought into service, as this expedites the substitution of the reserve lamps for the mercury vapor lamps when the latter become inoperative as a result of a failure of their energizing circuit. My improved control system also operates to switch both sets of lamps to one circuit when the other circuit becomes inoperative.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages, and specific objects attained by its use, reference should be had to the accompanying

drawing and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

The one figure of the drawings is a circuit diagram.

In the drawing I have diagrammatically illustrated the use of the present invention in controlling the illumination for re-exposure of a travelling film A on which pictures have been printed and which has been subjected to the preliminary development treatment of the above mentioned color photographic process. For use in re-exposing a film of a width not more than a foot, or so, and travelling at a speed of not more than twenty-five feet, or so, per minute, I ordinarily use one upper and one lower mercury vapor lamp B and two upper and two lower reserve lamps C. In practice, the mercury vapor lamp B may well be of the commercial type known as DH-1 lamps, each having a rated lamp wattage of 400, and emitting 16,000 lumens when in good condition. I may use other mercury vapor lamps, however, and in particular I may use the commercial lamp known as a Hanovia lamp and having about the characteristics as the DH-1 lamp. The reserve lamps C employed may well be Mazda incandescent PS-25 lamps, with a wattage of approximately 500 per lamp. While it is essential that the illumination of the re-exposure chamber should be adequate in amount, and should have suitable chromatic characteristics, an increase in the amount of re-exposure light above the minimum required is not injurious to the film. Reflectors B' are arranged to increase the amount of light passing to the film A from the lamps B.

In the system shown in Fig. 1, the energization and deenergization of the reserve lamps C is effected by relay mechanism automatically controlled by a photoelectric cell D which is so disposed as to be responsive to the intensity of the light which the film A receives from the lamps B. As diagrammatically shown, the lamp energizing current is supplied by a three phase alternating current supply source E. The latter, as conventionally illustrated, maintains voltages of different phases between each of three output or line conductors 1, 2 and 4, and a common conductor 3. The latter is connected to the neutral point of the three phase generator and customarily is grounded as indicated. As shown, each of the supply conductors 1 and 2 includes a switch F and a fuse f. The conductor 4 is not used for lamp energizing purposes. The fact that the current supplied by the two lamp energizing circuits differ in phase is not of direct significance for the purpose of the present invention. The lamps B are energized through distributing conductors 6 and 7, to which the two lamps B are separately connected, each through an individual auto transformer B². The conductor 6 is continuously connected by a conductor 5 to the supply conductor 3. The conductor 7 is connected by a conductor 8 to a relay G. The latter connects the conductor 8 either to a conductor 9 and thereby to the supply conductor 1, or to a conductor 10 and thereby to the supply conductor 2, accordingly as the winding 11 of the relay G is energized or deenergized. The winding 11 of relay G is connected between the conductors 9 and 5 and hence between the supply conductors 3 and 1, and is energized when, and only, when the energizing circuit including the conductors 1 and 3 is operative. When the relay winding 11 is energized, the conductor 8 is connected to the con-

ductor 9 through the movable relay contact 13, and when the winding 11 is deenergized the conductor 8 is connected to the conductor 10 through the movable contact 12 of relay G. The conventionally illustrated relay G and the other relays H, I, J and K, hereinafter mentioned, each include one or more movable contacts. Each of said movable contacts is movable between a stationary upper contact and a stationary lower contact. As shown one of the two stationary contacts associated with each movable contact is a dead contact, serving only as a stop to arrest movement of the associated movable contact in one direction. Each of the movable relay contacts is biased to its upper position.

A signal lamp 15 connected between the conductors 5 and 9, is illuminated when the lamp energizing circuit including the conductors 1 and 3 is operative, and when that circuit is not operative, a second signal lamp 16 is illuminated. The signal lamp 16 is connected between the conductor 5 and the movable contact 14 of the relay G, and through said movable contact is connected to the conductor 10 and supply conductor 2, when the relay is deenergized. The signal lamps 16 and 15, and other signal lamps hereinafter mentioned, may well be neon lamps, each connected in series with a suitable resistance 17 of 30,000 ohms or so.

The energization of the incandescent reserve lamps C is controlled by the photocell D through the relay H, which as hereinafter explained, is energized or deenergized accordingly as the mercury vapor lamps B do not or do, supply an adequate amount of light to the re-exposure chamber. When the relay H is energized, it cooperates with a relay I to connect the lamps C to the light energizing circuit including the supply conductors 2 and 3 if that circuit is then operative, and if not, the relays H and I cooperate to connect the lamps C to the lamp energizing circuit including the conductors 1 and 3. As shown the relay I is like the relay G in having three movable contacts, and in other respects.

The energizing connections to the lamps C include a conductor 20 connected to the supply conductor 3, conductors 20' through which the conductor 20 is individually connected to one terminal of each of the lamps C, a conductor 21 which connects the second terminal of each of the lamps C to the lower stationary contact of the relay H, the single movable contact 22 of the relay H, and a conductor 23 which connects the contact 22 to the movable contacts 24 and 25 of the relay I. When the relay I is energized, the movable contact 25 is connected to the supply conductor 2 through the conductor 28 and the stationary lower contact of the relay then engaged by the contact 25. When the relay I is deenergized, the conductor 23 is connected to the supply conductor 1 through the movable contact 24, the conductor 29 and the stationary upper relay contact then engaged by movable contact 24.

In addition to its movable contacts 24 and 25, the relay I comprises a movable contact 26 and an energizing winding 27. The movable contact 26 is connected to the conductor 20 and thereby to the supply conductor 3 through a signal lamp 30 and resistance 17. The lamp 30 is energized, therefore, when the relay I is deenergized and movable contact 26 engages the cooperating stationary contact which is connected to the conductor 29 and thereby to the supply conductor 1. The energizing winding 27 of the relay I is connected at one end to the conductor 20 and there-

by to the supply conductor 3, and has its other end connected to the conductor 28 and thereby to the supply conductor 2. A signal lamp 31 connected in series with a resistance 17 between the conductors 20 and 28, is illuminated during the periods in which the winding 27 is energized. As shown, a separate signal lamp 32 and a small resistance 33 in parallel therewith is connected between each conductor 20' and the conductor 20.

The control circuit arrangement through which the photocell D controls the energization of the relay H and thereby controls the energization and deenergization of the reserve lamps C, is energized by the distributing conductors 6 and 7. As shown, the cathode of the photocell D is directly connected to the conductor 7. The anode of the cell is connected by a conductor 40 and resistance 41 to a slider contact 42 engaging a potentiometer resistance 43. The latter has one terminal connected by a resistance 44 to the distributing conductor 6, and has its other terminal connected by a conductor 45 to the distributing conductor 7. The conductor 40 is connected to the control grid of an electronic amplifier L. The latter as shown is a tetrode which may be of the commercial type and form known as a 2050 tube. The cathode of the amplifier L is connected by conductor 46 to the connected ends of the resistances 43 and 44. The anode of the valve L is connected by the energizing winding 47 of the relay K and by-pass condenser 47' to the conductor 45 and thereby the conductor 7. As shown, the conductor 45 is connected to the distributing conductor 7 through the primary of a small transformer 48, the secondary of which supplies heating current to the cathode heating filament of the tube L.

In normal operation, with the film A adequately illuminated by the lamps B, the current flow through the cell D is large enough to maintain the valve L non-conductive as a result of the potential drop then occurring in the resistance 41. When the amount of light supplied to the film by lamp B unduly diminishes, the resultant decrease in the current flow through the tube D, reduces the potential drop in the resistance 41. In consequence, the control grid of the valve L becomes sufficiently less negative relative to the cathode of the valve L to make the latter conductive. Thereupon the plate current of valve L energizes the winding 47 of the relay K. When the relay K is thus energized its movable contact 49 is moved out of engagement with its associated dead stationary upper contact, and into engagement with its associated stationary lower contact which is connected to conductor 46.

When the light output of the lamps B is insufficient, the relay H is energized as a result of the energization of the relay K and the intermediate relay J, and when said light output is sufficient, the relays K, H and J are all deenergized. The relay H is provided because the current flow through the lamps C is too heavy for direct control by a relay energized by the plate current of the valve L, and the use of the intermediate relay J as well as the relay H is practically desirable even though not essential. The energization of the relay K energizes the relay J since the winding 50 of relay J has one end connected to the conductor 7 and has its other end connected to the movable contact 49 of relay K, and the contact 49 is connected to the conductor 45 when the relay K is energized. The energization of the relay J energizes the relay H in consequence of the fact that the movable con-

tact 51 of the relay J is connected to the conductor 45, and the further fact that one terminal of the energizing winding 52 of the relay H is connected to the stationary lower contact of the relay J which is engaged by the contact 51 when the relay J is energized. The second terminal of the energizing winding 50 of the relay H is connected to the conductor 7.

The apparatus shown diagrammatically in the drawing is comparatively simple in construction and operation, and well adapted for its intended purposes. As will be apparent, however, changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention, as set forth in the appended claims; and in some cases, moreover, use may advantageously be made of some features of the invention disclosed without a corresponding use of other features. In particular, it is to be noted that the automatic energization and deenergization of the lamps C, as the mercury vapor lamps B becomes inoperative and operative, respectively, is advantageous regardless of whether there are two lamp energizing circuits or only one. As is apparent, moreover, while the use of two phases of a multi-phase source of current in maintaining two lamp energizing circuits is convenient, when the multi-phase supply conductors are available, the two lamp energizing circuits may be entirely separate, and may or may not supply currents of the same phase.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. Apparatus for re-exposing a travelling sensitized photographic material undergoing development, comprising in combination a primary lighting unit including one or more mercury vapor lamps adapted to supply the illuminating effect required for the re-exposure of said material, a reserve lighting unit including one or more incandescent filament reserve lamps adapted to supply said required illuminating effect, photoelectric means responsive to the intensity of the illuminating effect of said mercury vapor lamps and lamp energizing means actuated by said photoelectric means to energize said lighting unit lamps when the illuminating effect of the mercury vapor lamps falls below a predetermined intensity.

2. Apparatus for re-exposing a travelling sensitized photographic material undergoing development, comprising in combination a primary lighting unit including one or more mercury vapor lamps adapted to supply the illuminating effect required for the re-exposure of said material, a reverse lighting unit including one or more incandescent filament reserve lamps adapted to supply said required illuminating effect, photoelectric means responsive to the intensity of the illuminating effect of said mercury vapor lamps and lamp energizing means actuated by said photoelectric means to energize and de-energize said reserve lighting unit lamps as the illuminating effect of the mercury vapor lamps falls below and rises to a predetermined intensity.

3. In apparatus for re-exposing a moving sensitized photographic material undergoing development, the combination of a primary lighting unit comprising one or more mercury vapor lamps and normally operative to supply the illuminating effect required for the re-exposure of said material, a reserve lighting unit comprising one or more incandescent filament lamps and adapted when energized to supply said required illuminat-

7

ing effect, photoelectric means responsive to the intensity of the illuminating effect of said primary unit, a first lamp energizing circuit normally energizing the primary unit lamps, a second lamp energizing circuit, a relay actuated by said photoelectric means when the illuminating effect of the primary unit lamps diminishes below a predetermined value, and a relay mechanism responsive to the condition of said second circuit and cooperating with the first mentioned relay on the actuation of the latter to connect said reserve unit lamps either to said second energizing circuit or to said first energizing circuit accordingly as said second circuit is then operative or inoperative.

4. In apparatus for re-exposing a moving film of photographic material undergoing development, the combination of a primary lighting unit comprising one or more mercury vapor lamps and normally operative to supply the film illuminating effect required for the re-exposure of said film, a reserve lighting unit comprising one or more incandescent filament lamps and adapted when energized to supply said required film illuminating effect, photoelectric means responsive to the intensity of the illuminating effect of said primary unit, a first lamp energizing circuit normally energizing the primary unit lamps, a second lamp energizing circuit, a relay actuated by said photoelectric means when the illuminating effect of the primary unit lamps diminishes below a predetermined value, a relay mechanism responsive to the condition of said second circuit and cooperating with the first mentioned relay on the actuation of the latter to connect said reserve unit lamps either to said second energizing circuit or to said first energizing circuit ac-

8

cordingly as said second circuit is then operative or inoperative, and a relay mechanism responsive to the condition of the first circuit and operative to disconnect the primary unit lamps from the first circuit and to connect them to the second circuit when the first circuit is inoperative.

5. In apparatus for re-exposing a moving film of photographic material undergoing development, the combination of a primary lighting unit comprising one or more mercury vapor lamps and normally operative to supply the film illuminating effect required for the re-exposure of said film, a reserve lighting unit comprising one or more incandescent filament lamps and adapted when energized to supply said required film illuminating effect, photoelectric means responsive to the intensity of the illuminating effect of said primary unit, a first lamp energizing circuit normally energizing the primary unit lamps, a second lamp energizing circuit, and a relay actuated by said photoelectric means, when said illuminating effect of the primary unit lamps diminishes below a predetermined value and normally operative when actuated to connect said reserve unit lamps to said second energizing circuit.

JACOB RABINOWITZ.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,944,751	Lyle	Jan. 23, 1934
1,973,469	Denis	Sept. 11, 1934
2,000,589	Fuller	May 7, 1935