

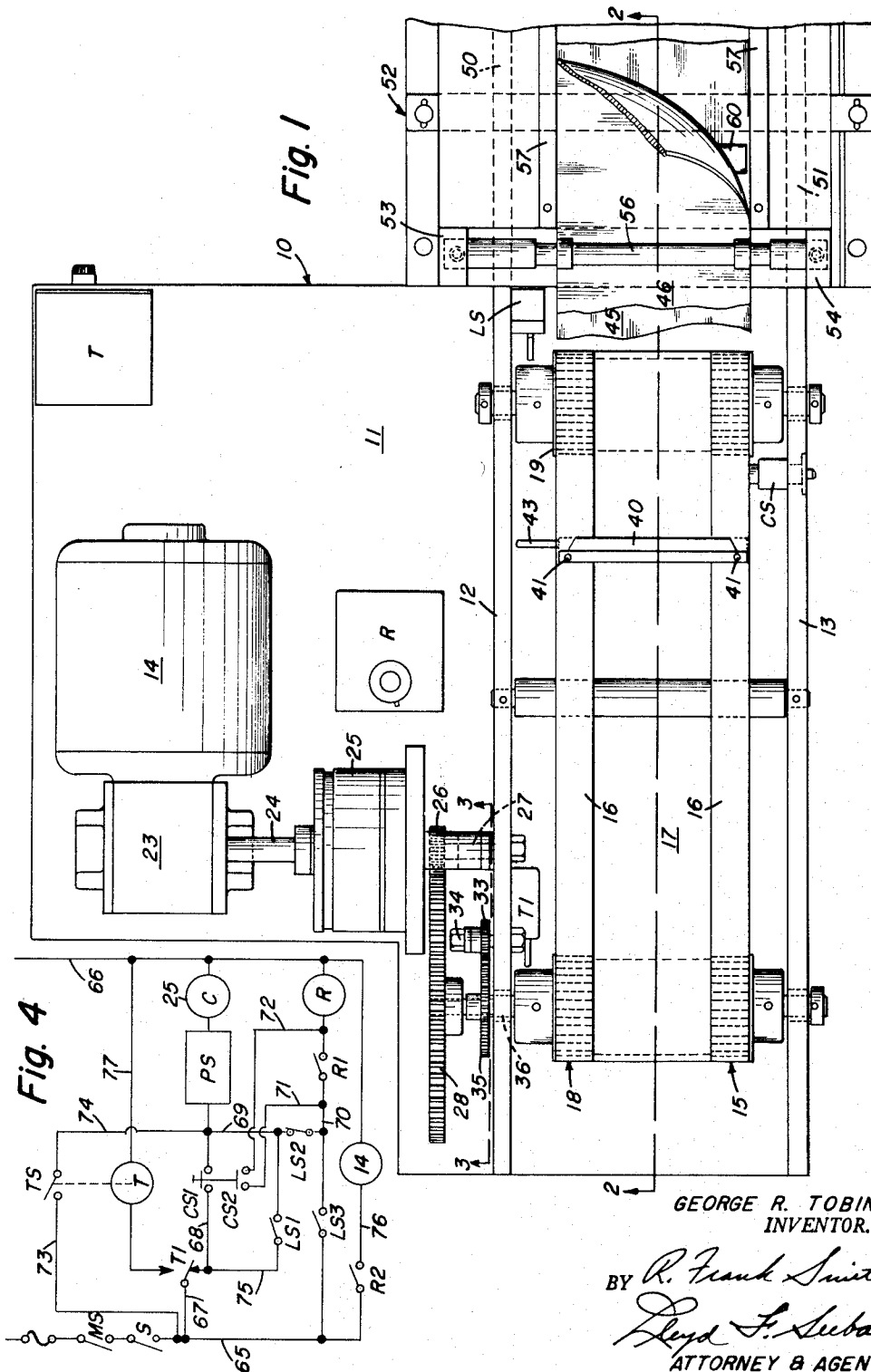
July 7, 1964

G. R. TOBIN, JR
DIFFUSION TRANSFER APPARATUS WITH A
COATING BELT TRANSFER SYSTEM

3,139,810

Filed May 14, 1962

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

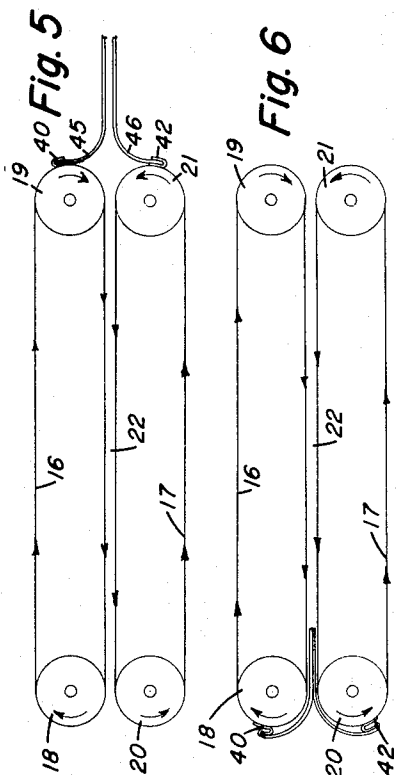
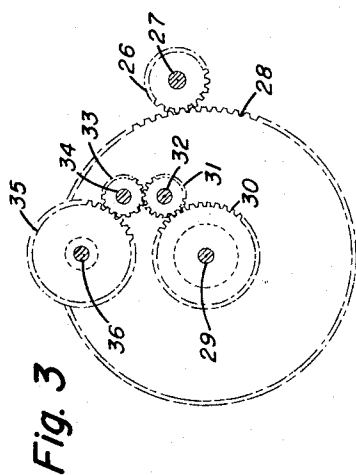
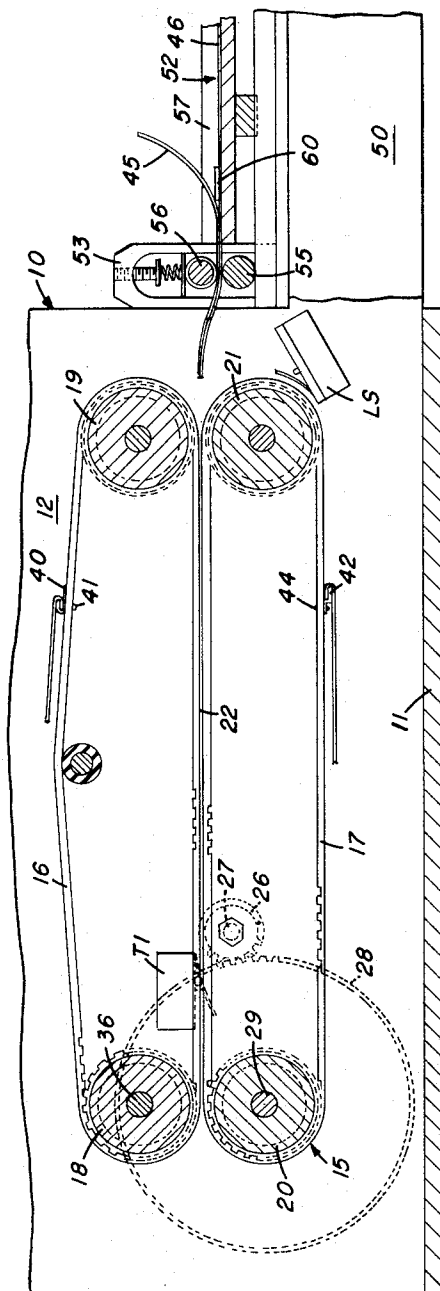


Fig. 2

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DIFFUSION TRANSFER APPARATUS WITH A COATING BELT TRANSFER SYSTEM

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9 Claims. (Cl. 95—89)

The present invention relates to photographic apparatus and more particularly to diffusion transfer apparatus for transferring an image from a negative sheet to a receiver sheet.

In the manufacture of photographic materials it is necessary to maintain a high degree of quality control in order to provide a paper of uniform and consistent photographic qualities. In the manufacture of such papers for a diffusion transfer process, such as is used in the well-known Polaroid camera, repeated tests of the paper are required to maintain uniform sensitometric values. It was previously necessary to maintain the negative sheet in intimate contact for a period of about one minute in order to effect transfer of the image from the negative sheet to the receiver sheet. However, with the development of photographic emulsions, designed for faster processing, the transfer period has been reduced from 60 seconds to 10 seconds.

When the slower developing emulsions were tested by an operator, the negative sheet and receiver sheet were placed in face-to-face contact with a developer pod between the sheets which were then drawn through a pair of rollers. After the necessary 60-second time interval, the sheets were separated and the image transferred to the receiver sheet was then evaluated for the necessary sensitometrical qualities. It can be readily appreciated that if the operator stripped the sheets either a second or two before or after the required time, this difference, which amounts to approximately 1 to 2% of the transfer time, produces very little, if any, difference in the sensitometric characteristics. However, if this same time differential of one or two seconds is applied to the faster developing emulsions, this differential then approaches a matter of 10–20% of the transfer time and produces undesirable variations in sensitometric characteristics. For this reason, it was essential that an apparatus be devised which would provide a high degree of reliability at the reduced transfer time and would not vary from one test to the next nor by operation from one operator to another.

The primary object of the invention therefore is to provide a device for repeatedly processing test samples by the same technique so as to obtain better quality control evaluation.

Another object of the invention is to provide a diffusion transfer apparatus in which, during a cycle of operation, the negative sheet and the receiver sheet are brought together by a conveyor system so as to effect transfer of the image while the sheets are in contact, the sheets then being moved to a station where they are stripped and separated.

Still another object of the invention is to provide a diffusion transfer apparatus in which the negative sheet and the receiver sheet can be placed on their respective conveyor at a reception station and moved in closed paths so as to be returned to the reception station, the image transfer being completed at an intermediate station between the reception and the stripping stations.

A further object of the invention is to provide a diffusion transfer apparatus in which separate conveyors are provided for the negative sheet and the receiver sheet, with the conveyors in close facing relation for a portion of the closed path so as to place the sheets one over the other and in contiguous relation to effect transfer of

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the image from the negative sheet to the receiver sheet during such relationship.

Still another object of the invention is to provide a diffusion transfer apparatus having means for establishing a cycle of operation and including means for controlling the conveyor system for the negative and receiver sheets as well as the requisite time for image transfer.

These and other objects and advantages will be apparent to those skilled in the art by the descriptions which follow.

Reference is now made to the accompanying drawings wherein like reference numerals and letters refer to like parts and wherein:

FIG. 1 is a plan view of the diffusion transfer apparatus showing the relationship of the drive means and the conveyor system to the reception and stripping stations for the negative and receiver sheets;

FIG. 2 is a vertical section taken along the line 2—2 in FIG. 1 and showing the closed path established by the conveyor system for the negative and receiver sheets;

FIG. 3 is an elevation view of a portion of the drive means interconnected to the conveyor system, as indicated by the line 3—3 in FIG. 1;

FIG. 4 is a schematic wiring diagram of the circuit used for controlling a cycle of operation; and

FIGS. 5 and 6 are diagrammatic views showing the manner in which the negative and receiver sheets are secured to their respective conveyors at the reception station at one end of the conveyor system and stripped from each other at the other end of the conveyor system.

With reference particularly to FIG. 1 the diffusion transfer apparatus, designated broadly by the numeral 10, comprises a bedplate 11 on which two spaced vertical plates 12 and 13 are secured by suitable bolts or by welding the plates in position thereon. The plate 11 also provides a support for the motor 14 which is interconnected in a manner to be described to the conveyor system designated broadly by the numeral 15. The conveyor system 15 comprises two endless flexible belts 16 and 17 which encircle pulleys 18 and 19 and 20 and 21, respectively, said pulleys being journaled in the plates 12 and 13. The aforementioned belts and pulleys are of the well-known type usually referred to as timing belts which are provided on their inner surface with transverse grooves for engaging corresponding recesses in the pulleys to obtain a positive driving connection. As shown in FIG. 2, the belt 16 and 17 have portions thereof which face each other and are also spaced slightly from each other in the order of at least twice the thickness of the sheets to be conveyed thereby. This facing portion of the belts 16 and 17 is designated by the numeral 22. Preferably the belt 17 is of a width at least the same as that of the negative and receiver sheets to be processed. The belt 16 can be of the same width, although preferably two belts should be utilized, as shown in FIG. 1, so that only the longitudinal marginal edges of the sheets will be engaged by these belts. Although the timing belts 16 and 17 are commercially available as steel-reinforced rubber belts, the belts can also be of leather, metal, plastic, or a composition and, if necessary, a chain and sprocket system can be utilized.

The drive means for the conveyor system comprises the motor 14 which has integral therewith a gear reduction unit 23, the output shaft 24 of which supports the driving portion of the electromagnetic clutch 25. The driven portion of clutch 25 is mounted on shaft 27 which is journaled in plate 12 and carries a gear 26. Gear 26 is freely rotatable on shaft 27 and is directly connected to the driven portion of clutch 25. The gear 26 meshes with a gear 28 fixed to the shaft 29 on which the pulley 20 is also mounted. The shaft 29 also carries a gear 30 which meshes with the gear 31 on stub shaft 32 journaled

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in plate 12, see FIG. 3. Gear 33 is mounted on a second stub shaft 34 journaled in plate 12, the gear 33 meshing with gear 31 and with gear 35 on shaft 36 which is journaled in plates 12 and 13 and to which pulley 18 is connected. Motor 14 with the gear drive just described provides the means for driving both the pulleys 18 and 20 with the clutch 25 interposed in this drive.

A formed clamping member 40 is secured to belt 16 in a transverse direction by means of rivets 41. A similar member 42 is secured to belt 17 in a transverse direction by rivets 44 and is provided with an extension 43 for a purpose to be described hereinafter. The clamp or receiving members normally assume a position, as shown in FIG. 5, immediately adjacent the reception station at which the end of the negative sheet 45 and the end of the receiver sheet 46 are inserted into their respective clamping member for movement through the facing portion of the conveyor system.

The plates 12 and 13 have extensions 50 and 51, respectively, which support a loading platform designated broadly by the numeral 52. This load platform at the end adjacent the pulleys 19 and 21 is provided with spaced bearings 53 and 54 in which a freely rotatable roller 55 and a spring biased roller 56 are mounted for rotation as sheets 45 and 46 are drawn therebetween. Guide strips 57 are provided on the loading platform for guiding the negative and receiver sheets between the rolls 55 and 56 and toward the reception station of the conveyor system.

With reference to FIGS. 4-6 a cycle of operation comprises securing the ends 45 and 46 of the sheets to their respective conveyor by means of clamping members 40 and 42 and then moving the strips toward the stripping station as determined by the pulleys 18 and 20. When the sheets are fully positioned between the pulleys 18 and 19, the conveyor system is stopped for an interval depending on the necessary image transfer time and, upon expiration of this interval, the conveyor system is again started for moving the sheets to the stripping station. Since the belts 16 and 17 are moved in opposite directions by pulleys 18 and 20, the sheets are stripped from one another and returned by their respective belts to the reception station at which they are then withdrawn.

In the case where test evaluations are to be made of the sensitive portion which has been coated on the receiver sheet, the negative sheet is first exposed to a sensitometric scale and a sample piece of the receiver sheet is then used for transfer of the sensitometric pattern for evaluation of the emulsion being applied. The sample strip of the receiver sheet 46 is positioned with the sensitive side up between the guide strips 57 and the exposed negative sheet 45 is placed over the receiver sheet with its exposed surface facing the reactive surface of the receiver sheet. The ends of the sheets adjacent the rolls 55 and 56 are then threaded between these rolls, as shown in FIG. 2, and the end of the negative sheet is inserted under the clamp 40 on belt 16, and the end of the receiver sheet is inserted under clamp 42 on belt 17, as shown in FIG. 5. The negative sheet is then raised and a developer pod 60 is placed between the sheets and to the right of rolls 55 and 56, as shown in FIGS. 1 and 2. The end of the negative sheet is then replaced over the receiver sheet and a cycle of operation can then be started.

With particular reference to FIG. 4, which discloses the circuitry for controlling a cycle of operation, the master switch MS in the line 65 is first closed, lines 65 and 66 being connected to a source of electric power. In the embodiment shown in FIG. 2, a cover can be provided for enclosing the mechanism arranged between plates 12 and 13 and when this cover is positioned over the plates a switch S in line 65 is then closed. With the negative and receiver sheets secured to belts 16 and 17, as described above, the cycling switch CS is then momentarily actuated by the operator and a circuit is completed via line 67, switch T1, line 68 and the contacts CS1 of the switch CS to a direct current power supply

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PS which provides D.C. voltage for the clutch 25 to actuate it to an engaged position. With the closing of switch CS, a circuit is also provided via line 69, switch LS2, line 70, line 71, the other set of contacts CS2 of switch CS, line 72, and relay R to line 66. This circuit causes energization of relay R and when this occurs contact R1 of the relay is closed as well as the contact R2. The contact R1 serves to hold in relay R via line 70 and contact R2 in line 76 completes the circuit for motor 14 across lines 65 and 66. With the motor 14 energized and clutch 25 engaged, the drive through the gear train 26, 28, 30, 31 and 33 and 35 causes the pulleys 18 and 20 to be rotated, respectively, in a clockwise and counterclockwise direction. When this occurs, the clamps 40 and 42 are moved toward the facing portion 22 of the belts 16 and 17 and the ends of the negative and receiver sheets are folded over and drawn between belts 16 and 17 at the junction of pulleys 19 and 21. As the sheets are moved to the left and into the facing portion 22, the sheets are drawn through rolls 55 and 56 with the result that pod 60 is broken and the chemical solution therein is spread between the sheets in a well-known manner. As the sheets continue to be moved through the facing portion of the belts, or other means for holding the sample, the belts serve to hold the sheets in contiguous relation for transfer of the image from the negative sheet to the receiver sheet.

As belts 16 and 17 start to move, extension 43 on clamping member 42 is removed from the three-position stop switch LS. When this occurs LS1 closes, LS2 opens and LS3 closes. The circuit for the power supply PS and clutch 25 is maintained by switch T1, line 75, contact LS1 and line 69 to line 68, the switch CS returning to its normally open position upon release by the operator. With LS2 open and LS3 closed, the circuit for relay R is maintained by contacts LS3 and R1 in line 70, and motor 14 in line 76 is maintained in an energized state by contact R2.

Switch T1 is positioned adjacent the pulley 18, see FIG. 2, and arranged so as to be actuated by the extension 43 on the clamp 40. When switch T1 is actuated, the sheets are fully within the facing portion 22 of belts 16 and 17 and the circuit to the power supply PS and clutch 25 is broken so that movement of the sheets is stopped, clutch 25 moving to its disengaged position. When switch T1 is actuated to its other contact, a circuit is completed through lines 67, switch T1 and timer T in line 77 to line 66, thereby energizing the timer and starting a preset time interval. This interval is commensurate with the emulsion being tested and timer T can be set for any interval between 0 and 60 seconds or longer. When timer T completes the preset interval, its switch TS is closed and a circuit is completed from line 65 via line 73, switch TS and line 74 to line 68 for again completing a circuit through the power supply PS for moving clutch 25 into its engaging position. Switch TS therefore over-rides switch T1 and the sheets are moved toward the stripping station at the junction of pulleys 18 and 20. When belts 16 and 17 start to move, extension 43 releases switch T1 which then reverts to its original position and switch TS moves to its normally open position.

When clamps 40 and 42 with the ends of their respective sheets attached thereto arrive at the point between pulleys 18 and 20 at which the belts move in opposite directions, the sheets are separated or stripped from one another and carried by the clamps toward the station at which the ends were first attached to their respective clamp. As the clamps approach the rolls 19 and 21, the extension 43 actuates the three-contact switch LS. The positions of these contacts are then changed and are held in this position by the extension 43 until another cycle of operation is initiated. The contacts LS1 and LS3 are therefore opened and contact LS2 is closed. With the opening of LS1 and LS3, the circuit to relay R is broken as well as the circuits for clutch 25 and motor 14. As

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a result, the movement of the sheets comes to a halt at the reception station and, upon lifting of the cover, the sheets can then be removed from their respective clamps and another set of test sheets then affixed thereto.

While the embodiment of the invention described hereinabove discloses returning the negative and receiver sheets to the reception station, it is within the scope of the invention to remove the sheets at any point along the belts 16 and 17 once the sheets have been separated. It can be readily appreciated therefore that the paths of the belts 16 and 17 can take many other configurations aside from that disclosed in FIG. 2. Also, various changes can be made in the control circuitry for producing a cycle of operation which will be equivalent to that described in connection with the preferred embodiment of the invention.

Since many other modifications and changes in the disclosed embodiment of the invention can be made by those skilled in the art, the invention is not to be limited to the embodiment disclosed but is of a scope as defined by the appended claims.

Having now particularly described my invention, what I desire to secure by Letters Patent of the United States and what I claim is:

1. In a diffusion transfer apparatus including drive means and a normally disengaged clutch, the combination comprising:

- (a) conveyor means moved by said drive means, upon engagement of said clutch, and including two endless, flexible belts arranged with portions thereof in facing relation for supporting and moving (1) a negative sheet having a photosensitive surface and (2) a receiver sheet having an image receptive surface in closed paths from a reception station at which said sheets are attached to and removed from said belts and through a stripping station, said stations being at opposite extremities of said facing portions,
- (b) means mounted on each of said belts and adapted to be cyclically positioned at said reception station for receiving one of the ends of said negative sheet and of said receiver sheet with the sensitive surfaces thereof facing each other,
- (c) means for initiating a cycle of operation by rendering said drive means operative and for engaging said clutch so said sheets are moved into contiguous relation by the facing portions of said belts and toward said stripping station,
- (d) timer means adapted to be preset for establishing an interval of time for image transfer from said negative sheet to said receiver sheet and, upon expiration of said interval, for engaging said clutch for moving said sheets to said stripping station where said sheets are separated by the movement of said belts in different directions,
- (e) first means responsive to one of said receiving means upon movement thereof to a position between said reception station and said stripping station for disengaging said clutch and for initiating operation of said timing means, and
- (f) second means responsive to one of said receiving means upon movement thereof to said reception station for disengaging said clutch whereby each sheet can be removed from its respective belt.

2. In a diffusion transfer apparatus as defined by claim 1 wherein one of said endless belts is of a width at least equal to the width of said negative sheet and the other of said endless belts engages only the marginal longitudinal portions of said negative sheet.

3. In a diffusion transfer apparatus as defined by claim 1 wherein said timer means includes a member operatively connected to said clutch and adapted to be actuated upon expiration of said interval for over-riding said first actuating means for engaging said clutch.

4. In a diffusion transfer apparatus as defined by claim 1 wherein said second means responsive to one of said

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receiving means terminates the cycle of operation by disengaging said clutch and by rendering said drive means inoperative.

5. In a diffusion transfer apparatus including drive means, and a normally disengaged electromagnetic clutch, the combination comprising:

- (a) conveyor means moved by said drive means, upon engagement of said clutch, and including two endless, flexible belts arranged with portions thereof in facing relation for supporting and moving (1) a negative sheet having a photosensitive surface and (2) a receiver sheet having an image receptive surface in closed paths from a reception station at which said sheets are attached to and removed from said belts and through a stripping station, said stations being at opposite extremities of said facing portions,
- (b) means mounted on each of said belts and adapted to be cyclically positioned at said reception station for receiving one of the ends of said negative sheet and of said receiver sheet with the sensitive surfaces thereof facing each other,
- (c) circuit means for controlling a cycle of operation and including a manually operable switch means for initiating said cycle of operation by rendering said drive means operative and for engaging said clutch so said sheets are moved into contiguous relation by the facing portions of said belts and toward said stripping station,
- (d) a timer switch adapted to be preset for establishing an interval of time for image transfer from said negative sheet to said receiver sheet and upon expiration of said interval for engaging said clutch for moving said sheets to said stripping station where said sheets are separated by the movement of said belts in different directions,
- (e) a first switch means arranged between said reception station and said stripping station and actuated by one of said receiving means for disengaging said clutch and for initiating operation of said timer switch, and
- (f) a second switch means arranged adjacent said reception station and actuated by one of said receiving means for terminating said cycle of operation and for disengaging said clutch and rendering said drive means inoperative whereby each sheet can be removed from its respective belt.

6. In a diffusion transfer apparatus as defined by claim 5 wherein said timer switch over-rides said first switch means upon termination of said interval for engaging said clutch.

7. In a diffusion transfer apparatus as defined by claim 5 wherein said second switch means includes a switch in series with one of the contacts of said first switch means, a second switch in series with one of the contacts of said timer switch, and a third switch in series with a holding relay for said drive means, said switches being actuated as a unit by one of said receiving means.

8. In a diffusion transfer apparatus including drive means and a normally disengaged clutch, the combination comprising:

- (a) conveyor means moved by said drive means upon engagement of said clutch, for supporting and moving (1) a negative sheet having a photosensitive surface and (2) a receiver sheet having an image receptive surface, from a reception station to a stripping station,
- (b) means mounted on and movable with said conveyor means for receiving at said reception station one of the ends of each of said sheets with the photosensitive and image receptive surfaces thereof facing each other,
- (c) timer means adapted to be preset for establishing a predetermined interval of time for image transfer from said negative sheet to said receiver sheet and,

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for engaging said clutch at the expiration of said predetermined interval of time, and

- (d) transfer control means operable in response to movement of said receiving means, to a position between said reception station and said stripping station, for disengaging said clutch and for initiating operation of said timer means. 5

9. In a diffusion transfer apparatus including drive means and a normally disengaged clutch, the combination comprising: 10

- (a) conveyor means moved by said drive means, upon engagement of said clutch, and including two endless, flexible belts arranged with portions thereof in facing relationship for supporting and moving (1) a negative sheet having a photosensitive surface and (2) a receiver sheet having an image receptive surface from a reception station to a stripping station, said stations being at opposite extremities of said facing portions, 15

- (b) means mounted on each of said belts at said reception stations for receiving one of the ends of 20

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said negative sheet and of said receiver sheet with the photosensitive and image receptive surfaces thereof facing each other,

- (c) timer means adapted to be preset for establishing a predetermined interval of time for image transfer from said negative sheet to said receiver sheet and for engaging said clutch at the expiration of said predetermined interval of time, and

- (d) transfer control means operable in response to said receiving means, upon movement thereof to a position between said reception station and said stripping station, for disengaging said clutch and for initiating operation of said timer means.

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