April 23, 1935. T. M. AVERY 1,999,164

REGISTRATION COMPENSATING MEANS

Filed Aug. 25, 1930 6 Sheets-Sheet 1

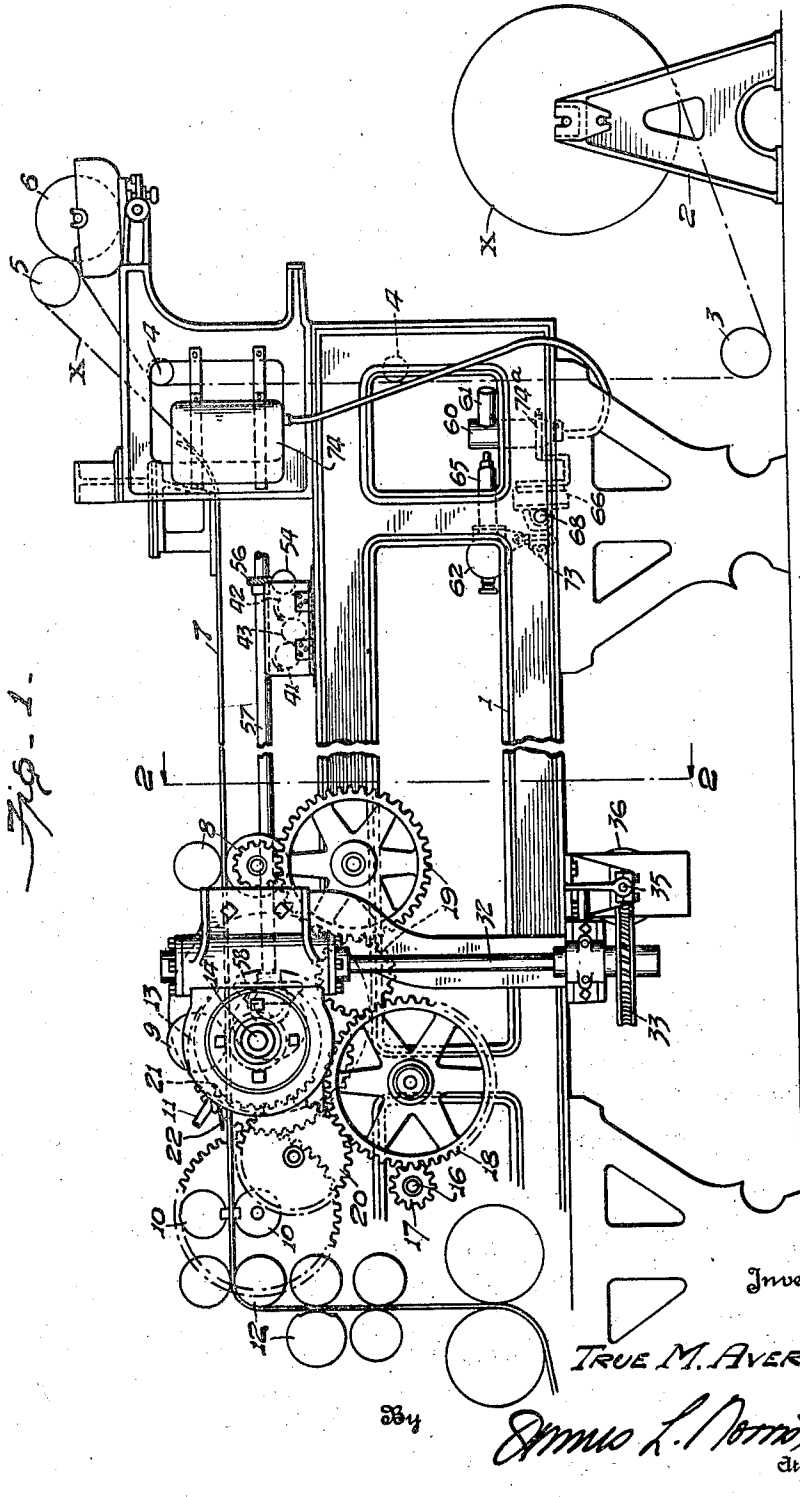


Fig. 1.

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REGISTRATION COMPENSATING MEANS

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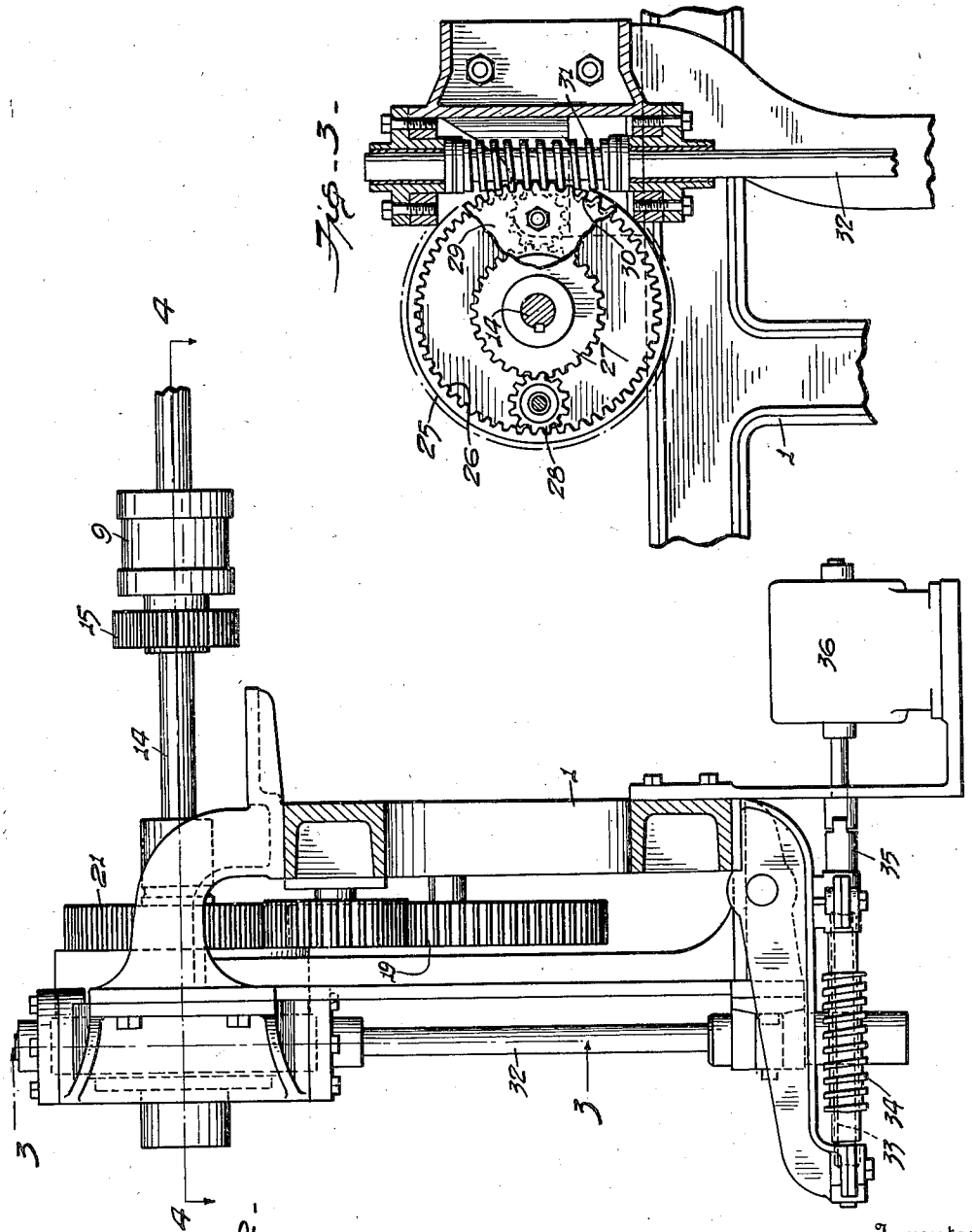


Fig. 2.

Fig. 3.

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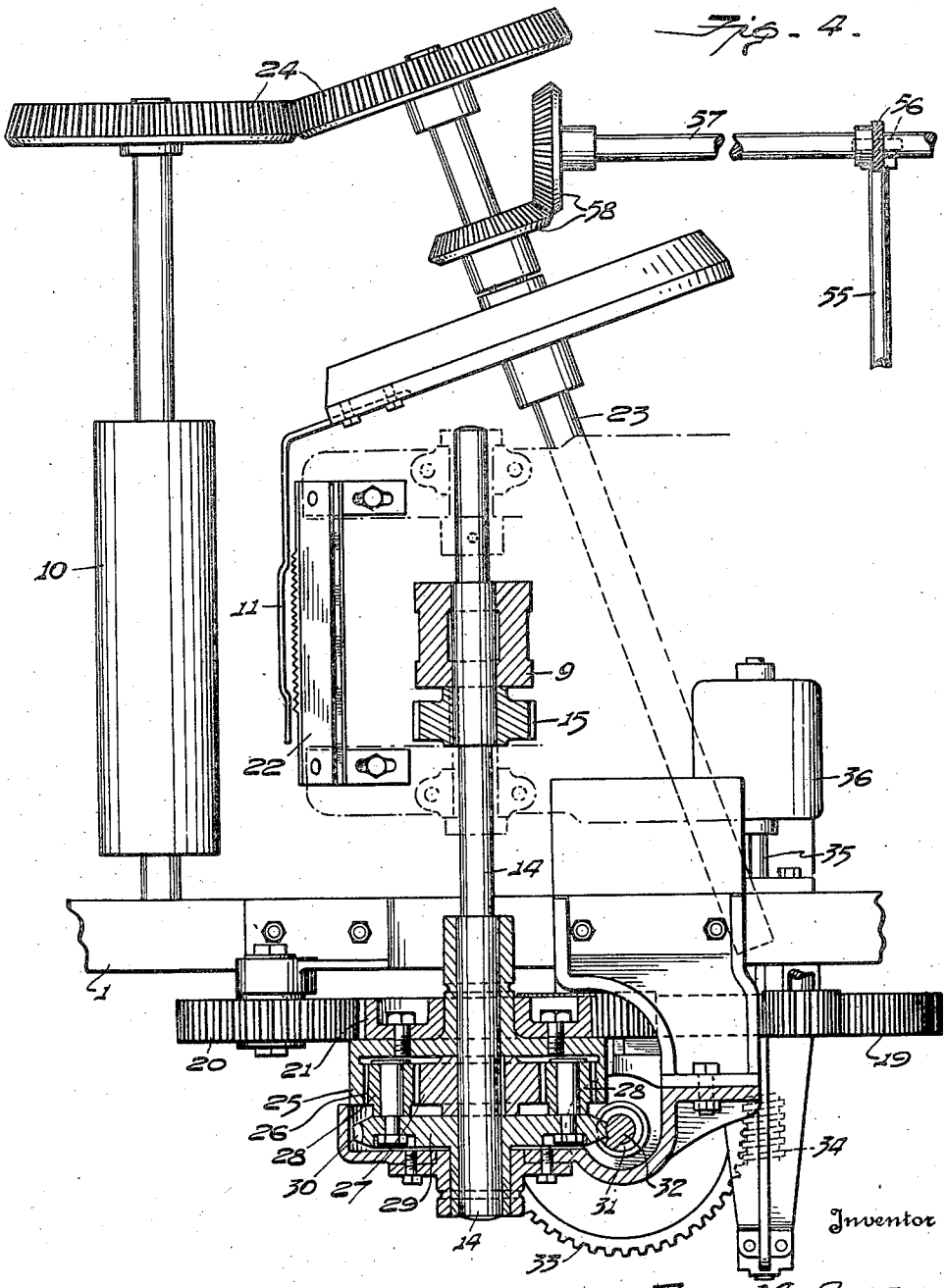
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April 23, 1935. T. M. AVERY 1,999,164

REGISTRATION COMPENSATING MEANS

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Fig. 4.



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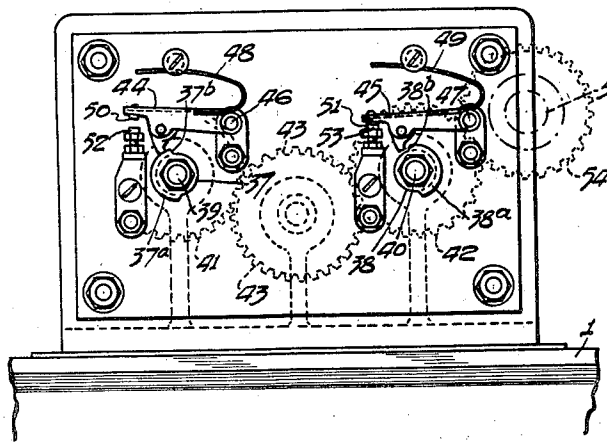
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REGISTRATION COMPENSATING MEANS

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Fig. 6.



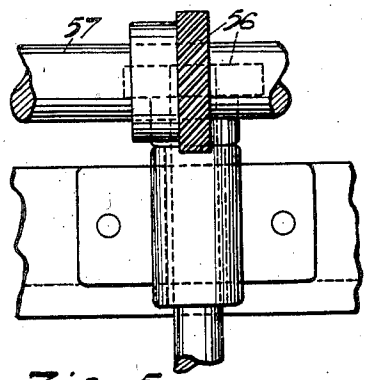


Fig. 5.

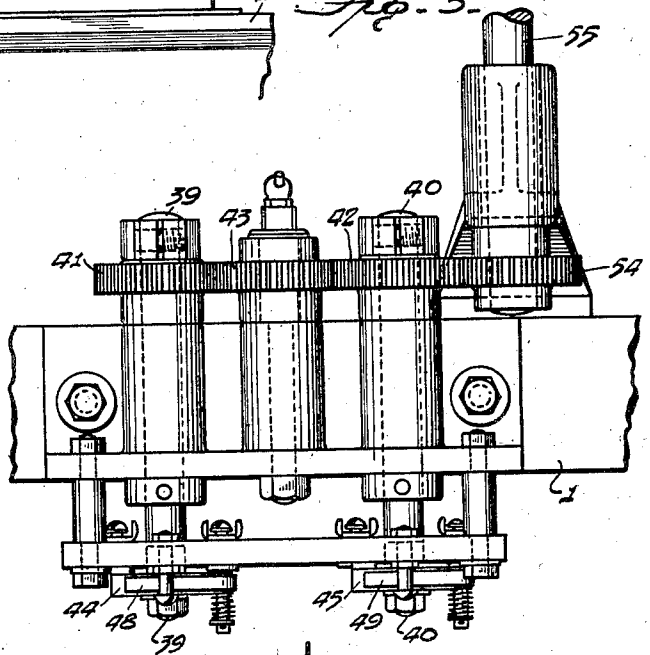
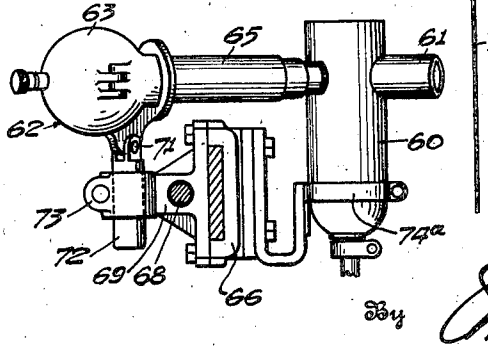


Fig. 9.



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April 23, 1935. T. M. AVERY 1,999,164

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Fig. 7.

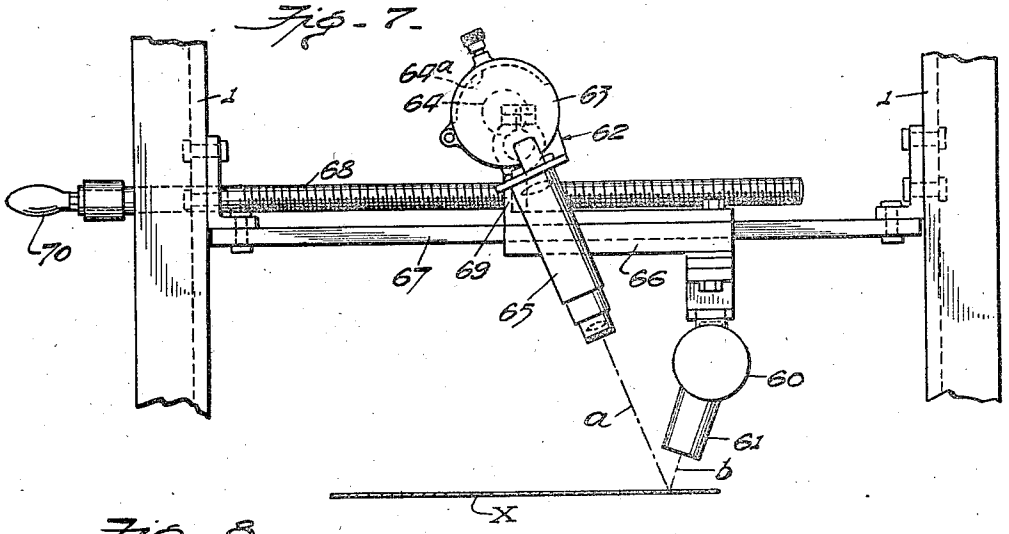
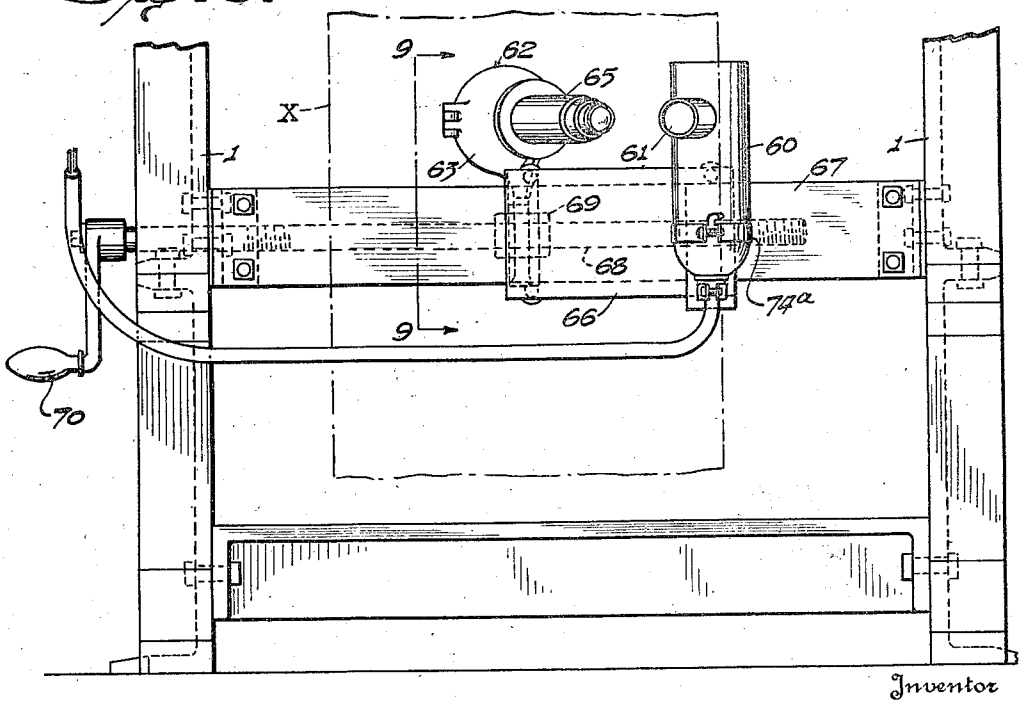


Fig. 8.



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April 23, 1935. T. M. AVERY 1,999,164

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Fig. 10.

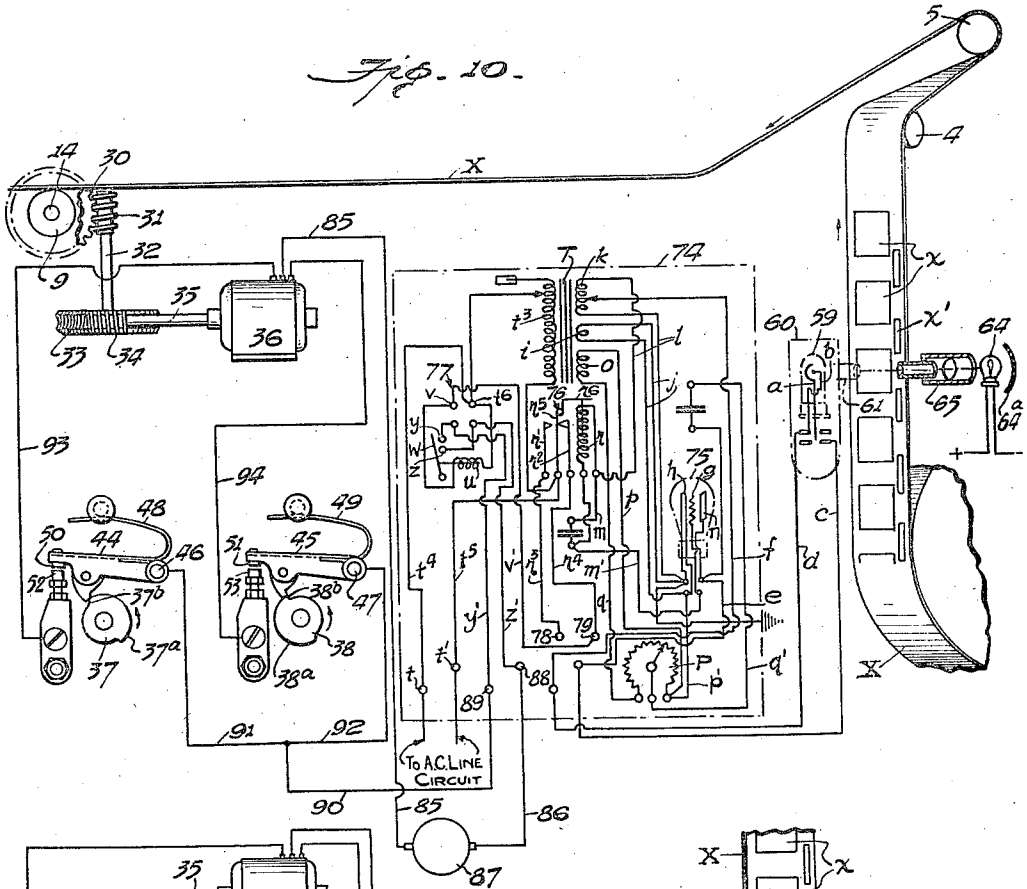
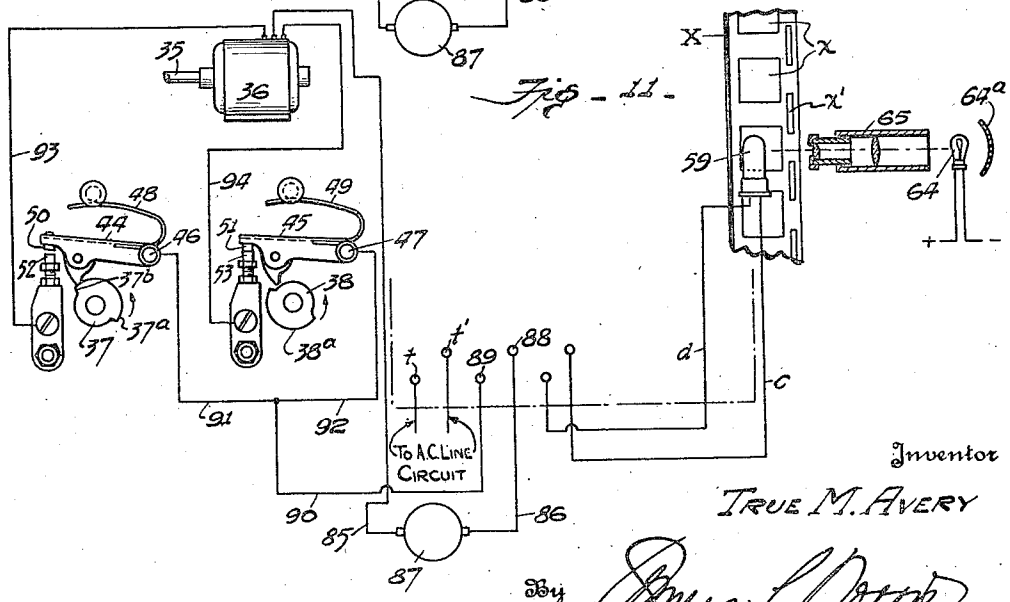


Fig. 11.



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Patented Apr. 23, 1935

1,999,164

UNITED STATES PATENT OFFICE

1,999,164

REGISTRATION COMPENSATING MEANS

True M. Avery, Glens Falls, N. Y., assignor to Union Bag & Paper Corporation, Hudson Falls, N. Y., a corporation of New Jersey

Application August 25, 1930, Serial No. 477,679

1 Claim. (Cl. 164—68)

The present invention relates to improvements in registration compensating mechanism of the class used for maintaining correct registration between a travelling web and an element or elements of a machine through which the web passes and operate at intervals thereon, and it relates more particularly to means for maintaining correct registration between the travelling paper strip or web and the operative elements of a bag making machine through which the web passes and which act on the paper strip or web at intervals in its length to form bags therefrom, mechanism of this class being shown and described in my prior Patent No. 1,517,099 granted Nov. 25, 1924 upon which the present invention is an improvement.

One of the primary objects of the present invention is to provide a novel and improved detector for governing the operation of the registration compensating mechanism which embodies a photo-electric cell which responds to the movement of printed sections of the web past it and governs the operation of registration restoring means according to the relationship of such sections of the web with the operative element or elements of the machine acting thereon.

Another object of the present invention is to provide means whereby the operation of registration restoring means may be governed by a detector which responds to the passage of the successive sections or bag lengths of the web without requiring the use of perforations in the web.

A further object of the invention is to provide a detector embodying a photo-electric cell which is adjustable to bring it into position to respond to the passage of any desired portions of the successive printed impressions or of special marks printed or otherwise applied to the web and thereby control the operation of the registration restoring means according to the relationship of such printed impressions or marks with the operative element or elements of the machine acting thereon.

To these and other ends, the invention consists in certain improvements and combinations and arrangements of parts all as will be hereinafter more fully described, the features of novelty being pointed out particularly in the claim at the end of the specification.

In the accompanying drawings:—

Fig. 1 is a side elevation of a paper bag making machine provided with web controlling means embodying the present invention;

Fig. 2 is a vertical section on an enlarged scale taken through a side of the machine on the line 2—2 of Fig. 1;

Fig. 3 is a detail vertical section taken on the line 3—3 of Fig. 2;

Fig. 4 is a horizontal section taken on the line 4—4 of Fig. 2;

Fig. 5 is a detail view in top plan and on an enlarged scale, of the timers of the detector mechanism;

Fig. 6 is a front elevation of the timers shown in Fig. 5;

Fig. 7 is a detail view in top plan of the detector which cooperates with the travelling web;

Fig. 8 is an elevation of the detector shown in Fig. 7;

Fig. 9 is a vertical section taken on the line 9—9 of Fig. 8;

Fig. 10 is a diagrammatic view showing the detector in cooperative relation with the travelling web, the timers connected to the detector, and the registration correcting means governed by the detector and timers, the parts being shown in the positions they occupy when the web is in correct registration with the operating element or elements of the machine; and

Fig. 11 is a view similar to Fig. 10 but showing the relationship between the web and detector and the timers when the web is out of registration with the operative element or elements of the machine.

Similar parts are designated by the same reference characters in the several figures.

Registration compensating mechanism embodying the present invention is applicable generally to all uses where it is desirable or necessary to maintain correct registration between a travelling web of paper or other material and a device or mechanism which operates on or cooperates with the web at certain intervals in its length, whereby registration may be correctly maintained between the travelling web and the device or mechanism which acts thereon. The invention is particularly useful in paper bag making machines for the purpose of maintaining correct registration between the continuously travelling web from which the bags are to be made, and which has been previously printed with advertising or other matter and the slitters, severing device or other parts of the machine which are intended to and should register very closely with the web in predetermined relationship with the printed impressions on the web, in order that the printed impressions will be at uniform height on all of the bags made on the machine.

The invention is shown in the present instance

applied to a paper bag making machine of the kind used in making paper bags of the so-called self-opening or automatic type, the machine being similar to that shown and described in my prior patent hereinbefore referred to, it comprising a main frame 1 which supports the operating mechanism of the machine, a rack 2 which may be arranged at one end of the machine to support a roll of paper X in the form of a continuous strip which has been previously printed with advertisements or other imprints *x* at intervals in its length, the strip of paper being fed past a guide roller 3 into one end of the machine past a pair of guide rollers 4 and thence around a guide roller 5 which is arranged opposite to a gum or adhesive applying roller 6 which applies adhesive along an edge of the paper strip, the latter then passing beneath a former 7 which forms the paper strip into a tube in the manner usual in bag making machines of this class, the tube then passing between slitters 8 which operate on the web at intervals in its length and in definite relation with the imprints thereon to form tabs or flaps which serve to secure the bottoms of the completed bags. A pair of draw rolls 9 are provided beyond the slitters to cooperate with the bag tube and thereby draw the same through the machine, and a pair of pinch rolls 10 are provided beyond the draw rolls between which the tube passes, these pinch rolls acting on the paper tube to hold it while a breaker 11 strikes the paper tube about midway between the draw rolls 9 and the pinch rolls 10 and severs the tube into bag lengths, the lines of severance being in definite relation with the printed impressions on the tube. Folding and cooperative bag forming mechanism 12, the construction of which is well understood in the art is arranged beyond the pinch rolls 10 and cooperates with the severed bag sections to complete the formation of the bags. The pair of draw rolls 9 are mounted on shafts 13 and 14 respectively, these shafts being connected usually by gearing 15 to insure rotation of the two draw rolls at equal speed, the draw rolls gripping the paper tube between them and thus insuring advance of the web at a speed determined by the speed of the draw rolls, and the draw rolls and also the slitters 8 and pinch rolls 10 are driven from a main drive shaft 16 through a gear 17 thereon which meshes with a gear 18, the latter being connected through the gears 19 to one of the slitter rolls 8, and the gear 18 meshing with a gear 20 which in turn meshes with a drive gear 21 for the draw rolls and also driving the pinch rolls 10 through suitable gearing as usual in bag making machines of this type. The breaker 11, which cooperates with the usual severing knife 22, is carried by a shaft 23 which is connected by gearing 24 to be driven from the shaft of one of the pinch rolls 10.

It will be understood that the slitters 8, pinch rolls 10 and breaker 11 are all driven from and at a definite speed in relation to that of the main drive shaft 16, but the draw rolls 9 which serve to advance the paper tube or web in relation to these elements of the machine are driven through a variable speed device so that the paper tube or web may be driven at an increased or a diminished speed and thereby reestablish correct registration between it and the elements of the machine acting thereon whenever the paper tube or web is out of register with such elements of the machine. The variable speed device for driving the draw rolls shown in the present instance is like that shown and described in my prior patent hereinbefore referred to, its construction being briefly as follows:

The driving gear for the draw rolls is fixed to a member 25 which is loosely mounted on the draw roll shaft 14 and is formed with an internal gear 26, and a spur gear 27 is keyed or otherwise fixed to the draw roll shaft 14, pinions 28 being interposed between the gear 27 and the internal gear 26 and meshing therewith, these pinions being carried by a member 29 which is mounted loosely on the shaft 14 so that the axes of the pinions may be rotated about the center of the shaft 14 as an axis, in one direction or the other, thereby increasing or diminishing the ratio of speed transmission between the gear 21 and the draw rolls. The periphery of the pinion carrying member 29 is formed with worm wheel teeth 30 with which a worm 31 meshes, this worm being fixed on a shaft 32 which latter is provided with a worm wheel 33 which is fixed thereto, and a worm 34 meshes with the worm wheel 33, the worm 34 being fixed on a shaft 35 which is coupled or otherwise connected to the shaft by a reversible electric motor 36. By this arrangement, when the electric motor 36 is energized to revolve in one direction it will operate through the worm gearing described to rotate the pinion carrying member 29 to carry the axes of the pinions 28 in one direction around the axis of the shaft 14 as a center to increase the ratio of speed transmission from the gear 21 to the shaft 14 relatively to the speed of operation of the slitters, pinch rolls and breaker and when the electric motor is energized to revolve it in the opposite direction it will operate through the worm gearing described to rotate the pinion carrying member 29 in the opposite direction to carry the axes of the pinions 28 in the opposite direction about the axis of the shaft 14 as a center and thereby reduce or diminish the ratio of speed transmission from the gear 21 to the shaft 14 in relation to the speed at which the slitters, pinch rolls and breaker are driven, it being understood that the speed of the draw rolls and hence of the paper tube or web acted on thereby will be thus increased or diminished while the slitters, pinch rolls and breaker continue to operate at a constant or invariable speed and that while the electric motor is idle or stationary, the pinion carrying member 29 will be held from rotation and the ratio of speed transmission from the gear 21 through the pinions 28 and gear 27 to the draw roll shaft 14 will correspond with that of the drive for the slitters, pinch rolls and breaker, so that the draw rolls will then advance the paper tube or web at a speed corresponding with the speed of operation of these elements of the machine.

The present invention provides novel and improved means for detecting any variation that might exist between the printed impressions on the continuously travelling paper web and the slitters or breaker bar or other element of the machine acting at intervals on the web and for automatically varying the relative speed of operation of the travelling web and such element or elements of the machine, as by governing the operation of the reversible electric motor 36, as may be required, to restore correct registration between the web and said element or elements of the machine. Such means comprises timing

means connected to be driven in synchronism with the slitters and breaker or other element of the machine which acts at definite intervals on the web and a cooperating device which responds to the passage of each printed impression on the web or of each of a series of special marks or impressions printed or otherwise applied to the web in definite relation with such printed impressions, said device cooperating with the timing means to detect a lack of registration between the printed impressions upon the web and the slitters, breaker or other element of the machine and to vary the relative speed of operation of the web and such element of the machine accordingly, as by governing the operation of the electric motor, to restore registration.

The timing means comprises preferably a pair of timing cams 37 and 38 fixed on shafts 39 and 40 respectively, these shafts having gears 41 and 42 of equal diameter fixed thereon and said gears being connected by an intermediate gear 43 which causes the shafts 39 and 40 to revolve at equal speed. The cams 37 and 38 each have a high or raised portion 37^a or 38^a extending around a part of its circumference, and the leading end 37^b of the raised portion of the cam 37 and the rear or trailing end 38^b of the raised portion of the cam 38 are located in approximately the same angular positions around the shafts 39 and 40 respectively. Contact arms 44 and 45 are pivotally mounted at 46 and 47 and cooperate with the respective cams, they being held in contact therewith by the springs 48 and 49 respectively, and the contact arms 44 and 45 carry electrical contacts 50 and 51 respectively which are arranged to engage relatively stationary contacts 52 and 53 respectively when the contact arms rest on the relatively low parts of the respective cams as shown at the right hand side of Fig. 6 and to disengage from said stationary contacts when the contact arms engage the relatively raised or high portions of the cams, as shown at the left hand side of Fig. 6. The shafts 39 and 40, connected by the gearing described, are driven in exact synchronism with the slitters or breaker or other element of the machine which acts on the web at intervals in its length, these shafts being driven in the present instance by a gear 54 which meshes with the gear 42 on one of the cam shafts, this gear being fixed to a shaft 55 and the latter is connected by spiral or other gearing 56 to a shaft 57, the latter shaft being driven in definite timed relation with one of the elements in the machine which acts on the web at intervals in its length, it being shown in the present instance connected by bevel gearing 58 to the breaker shaft 23. The duration of the period during which the contacts are closed depends upon the circumferential length of the raised portions of these cams. As shown the raised portion of each cam extends through approximately one-half its circumference so that the contacts controlled by each cam will be closed during approximately one-half a revolution of the cam, but by lengthening or shortening the circumferential length of the raised part of the cam, the period during which the contacts are engaged will be reduced or increased relatively to the period of rotation of the cam. The relationship of the high and low portions of the cams is such however that at the moment the slitters, breaker or other element of the machine is ready to act on the paper tube or web, one contact arm is about to ride from the raised to the lower portion of its cam while at the same time the other contact arm has just reached the raised or high part of its cam as shown diagrammatically in Fig. 10, and when the slitters, breaker or other operative element of the machine is in advance or behind such a position, one of the contact arms will rest on the raised part of its cam while the other contact arm will rest on the lower part of its cam as is shown for example in Figure 11.

The device which responds to the passage of the printed impressions on the paper strip or web consists, according to the present invention, of a photo-electric cell or tube which may be of the type now in common use employing electrodes having a potential difference between them and the current flow through which is varied by variations in the amount of light to which the tube or cell is exposed. The photo-electric tube or cell, designated 59, according to the present invention, is so placed relatively to the travelling paper strip or web X that it will receive alternately varying amounts of light transmitted successively from the printed and intervening unprinted portions thereof, the printed portions of the web, especially when printed in dark or black ink, transmitting less light than the plain or unprinted portions thereof. In the preferred embodiment of the invention shown, the photo-electric cell or tube is so placed relatively to the travelling paper strip or web and a source of light that it will successively receive light transmitted by reflection from the printed and intervening unprinted portions of the surface of the travelling paper strip or web, the light being reflected either from portions of the printed impressions x on the web and the unprinted or plain intervening portions of the web or from specially provided marks or spots x' printed in dark or black ink or otherwise applied to the paper strip or web in definite relationship with the printed impressions thereon and the clear portions of the paper strip or web intervening such marks or spots. Preferably, the photo-electric cell or tube is mounted in a light tight hood 60 which serves to exclude stray light from extraneous sources, it having an aperture 61 for admitting a beam of light thereto and to the photo-electric cell or tube therein from the particular part of the web used to control its operation, this aperture being located at a suitable angle of reflection in relation to the printed side of the paper strip or web X, and a source of light preferably in the form of a light projector 62 is mounted also at the printed side of the paper strip or web X and is set at an angle corresponding to the angle of the aperture of the photo-electric tube so that the light projector will focus a highly condensed beam of light therefrom along the line a upon a given point in the plane of the printed face of the travelling paper strip or web, and the light beam will be reflected from such point, by the surface of the travelling paper strip or web, along the line b into the aperture of the hood enclosing the photo-electric cell or tube. Any source of highly condensed and focussed light of sufficient intensity may be used, the light projector 62 shown comprising a casing or lamp house 63 to contain an electric light bulb 64 having a reflector 64^a behind it and a tube 65 through which light from the light bulb and reflector is projected onto the paper strip or web, this tube containing a suitable light condenser and focussing and projecting lenses such as those commonly used in light projecting apparatus.

In some instances it may be desirable to locate

the light projector and photo-electric cell or tube in such position in relation to the width of the travelling paper strip or web X as to cause transmission or reflection of light from the printed impressions x on the web and the intervening plain or unprinted portions thereof while in other instances, as for example, where there is insufficient contrast between the light transmitting or reflecting properties of the printed impressions and the intervening unprinted portions of the paper strip or web, special marks or spots x' having less light transmitting or reflecting properties may be printed in black or dark ink or otherwise applied alongside the row of printed impressions and at intervals in the length of the web in definite relationship with the printed impressions x thereon, and the light projector and photo-electric cell may be adjusted transversely of the web to cause them to cooperate with such specially provided marks or spots. For this purpose, the photo-electric cell or tube and light projector may be mounted on a slide 66 which is movable on a guide bar 67 which is fixed at its ends to the sides of the machine and extends transversely thereof in a position opposite to the printed side of the travelling paper strip or web so that by adjusting the slide 66 along the guide bar, the light projector and the photo-electric cell or tube may be brought into cooperation with different portions of the paper strip or web in the direction of the width thereof. The slide 66 may be readily adjusted along the guide bar 67 by a screw 68 journalled in the front of the machine frame and cooperating with a nut 69 on the slide 63, this screw having a handle 70 arranged at the front of the machine for operation thereof. To facilitate focussing the beam of light a onto the desired area of the strip or web and insure reflection thereof along the line b into the aperture of the photo-electric cell housing, the light projector is pivotally mounted by a horizontal pivot 71 on the upper end of a vertical swivel pin 72 which is rotatable about a vertical axis in a clamp 73 attached to the slide 66 the light projector being thus mounted for universal adjustment or adjustment angularly both longitudinally and transversely of the paper strip X and being held in adjusted position by tightening of the clamp 73, and the hood 60 containing the photo-electric cell is preferably rotatable horizontally and adjustable vertically in a clamping band 74^a attached to the slide 66 so that the aperture 61 may be adjusted vertically and angularly in a direction transversely of the paper strip X to properly receive the beam of light b reflected from the surface of the paper strip or web. By mounting both the light projector and the photo-electric cell on the slide, they may be readily adjusted to bring them into cooperation with any desired area in the width of the paper strip or web without disturbing the operative relationship between the light projector and the photo-electric cell.

The photo-electric cell 59 is provided with a suitable amplifying relay 74 whereby the variations in the flow of the electric current through the photo-electric cell produced by the passage of the relatively dark printed impressions or the specially provided spots or marks and the intervening clear or unprinted areas of the paper strip or web may be utilized to control the circuits of the reversible electric motor 36 to cause operation thereof in the proper direction to restore registration between the travelling paper strip or web and the elements in the machine acting thereon when the web is out of register therewith. The amplifying relay shown in the present instance is of a well known kind, it embodying a vacuum tube or thermionic device 75, a sensitive relay 76 and a contactor 77.

The photo-electric cell 59 has its anode a and cathode b connected by the wires c, d and e, f to the grid g and filament or cathode h of the vacuum tube or thermionic amplifying device 75, the latter being supplied with current for its operation by a transformer T, the primary terminals t and t' of which are adapted to be connected to an ordinary alternating current lighting circuit, the transformer having a secondary winding i connected by the conductors j to the terminals of the filament or cathode h for heating it and having a secondary winding k which is connected by the conductors l, m and m' to the filament h and the anode or plate n of the amplifying tube 75 to provide a suitably energized anode circuit therefor, a portion of the winding k being also connected in the circuit of the photo-electric cell to provide a potential difference between its electrodes. The transformer T also has a secondary winding o for supplying a biasing potential for the grid g of the amplifying tube 75, it being connected by the conductors p, p' and q, q' to the cathode h and the grid g respectively of the amplifying tube 75, a potentiometer P being bridged across the conductors p and q and having its movable resistance-varying element connected to the conductor q' whereby the potential of the grid g may be varied to adjust the sensitivity of the relay.

The sensitive relay 76 embodies an electro-magnet r the winding of which is connected in the output circuit of the amplifying tube 75 which includes the conductors l, m and m', this relay comprising a pair of oppositely arranged contact members r' and r^2 which are connected to terminals 78 and 79 by the conductors r^3 and r^4 respectively, a switch tongue r^5 being pivoted or otherwise movably mounted to engage one or the other of the contacts r' and r^2 under the control of an armature r^6 which is actuated by the electro-magnet r, the switch r^5 normally engaging the contact r^2 but disengaging therefrom and engaging the contact r' when the electro-magnet r is energized.

The primary winding t^3 of the transformer is connected to the line terminals t and t' by the conductors t^4 and t^5, the conductor t^4 being connected to a terminal t^6 of the contactor 77 and the conductor t^5 being connected to the movable switch member r^5 of the sensitive relay 76. The contactor 77 comprises an electro-magnet u the winding of which is connected to the terminal t^6 and the terminal v of the contactor, the terminal v being connected by a flexible conductor v' to the terminal 79. The electro-magnet u of the contactor cooperates with a pivoted or movable armature w arranged to cooperate with a pair of contacts y and z, the contacts y being connected by a conductor y' to the motor circuit terminal 89 and the contact z being connected by a conductor z' to the motor circuit terminal 88. With the conductor v' connected to the terminal 79 as shown, the armature w of the electro-magnet u will be normally attracted and will bridge the terminals y and z and thereby close the part of the motor circuit between the terminals 88 and 89, since the winding of the electro-magnet u is bridged across the line conductors t^4 and t^5 and the contact member r^2 and switch member r^5 connected in the circuit of said winding will be

engaged, the electro-magnet r of the sensitive relay being assumed to be de-energized, but when the electro-magnet r is energized, the switch member r^5 is disengaged from the contact member r^2, the circuit of the electro-magnet u will be broken and the armature w will be retracted, thus breaking the circuit between the terminals y and z and thereby opening the motor circuit through the terminals 88 and 89.

The operation of the amplifying relay is briefly as follows:—An increase in the amount of light to which the electrodes of the light sensitive photo-electric cell 59 are subjected will cause an increase in current flow through the conductors c, d and e, f. Since the electrodes of the photo-electric cell are connected to the grid g and filament h of the amplifying tube 75 and assuming the biasing potential of the grid g to be suitably adjusted, such increased current flow through the photo-electric cell will produce an increased flow of current of amplified strength through the amplifying tube 75, causing the electro-magnet r of the relay 76 connected in the plate or output circuit of the tube 75 to be energized, thereby attracting the armature r^6 and swinging the switch member r^5 out of contact with the contact member r^2 and into contact with the contact member r', and when the flexible conductor v' is connected to the terminal 79 as shown, the normally closed line circuit through the terminals t and t' and the electro-magnet u of the contactor 77 will be broken, thereby causing the armature w of the contactor to be retracted, thereby breaking the part of the motor circuit formed by the terminals y and z and 88 and 89 and the connecting conductors y' and z'. When the amount of light to which the electrodes of the light sensitive photo-electric cell is sufficiently reduced, the current flow in the circuit thereof connected to the amplifying tube 75 is reduced, thus reducing the current flow through the amplifying tube, in consequence of which the electro-magnet r of the sensitive relay 76 is sufficiently de-energized to allow the switch member r^5 to move into engagement with the contact member r^2, due to retraction of the armature r^6, thereby closing the energizing circuit of the electro-magnet u of the contactor 77 so that the electro-magnet u of the contactor will be energized by line current through conductor t^4, terminals t^6 and v of the electro-magnet, conductors v' and r^4, contact member r^2, switch member r^5 and conductor t^5, thereby causing the electro-magnet u of the conductor to attract its armature w, causing it to bridge the contacts y and z and thereby close the motor circuit through the conductors y' and z' and across the terminals 88 and 89.

While the amplifying relay as just described is arranged to open the part of the motor circuit between the terminals 88 and 89 when the photo-electric cell is exposed to an increase in light and to close the motor circuit when the amount of light reaching the photo-electric cell is sufficiently reduced, the amplifying relay may be readily changed to operate in the reverse manner, that is, to close the electric motor circuit when the photo-electric cell is exposed to an increased amount of light and to break the motor circuit when the amount of light reaching the photo-electric cell is sufficiently reduced. This change requires merely the connecting of the conductor v' to the terminal 78 instead of to the terminal 79 as shown. When thus changed, it will be seen that when the electro-magnet r of the sensitive relay 76 is energized by an increased current output from the amplifying tube 75 resulting from an increased flow of current through the photo-electric cell due to the exposure thereof to an increased amount of light, the circuit of the electro-magnet u of the contactor, which will then be normally open between the contact member r' and the switch member r^5, will be closed by the swinging of the switch member r^5 into engagement with the contact member r' by the attraction of the armature r^6 of the sensitive relay, and the electro-magnet u of the contactor will then attract its armature w, closing the motor circuit through the conductors y' and z' and across the terminals y and z and 88 and 89, and when the electro-magnet r is de-energized by a reduced current output from the amplifying tube 75 resulting from a diminished or interrupted flow of current through the photo-electric cell due to the exposure thereof to a reduced amount of light the circuit of the electro-magnet u of the contactor will be opened by the disengagement of the switch member r^5 from the contact member r', due to retraction of the armature r^6 of the sensitive relay, and the armature w of the contactor will then become retracted, it disengaging from the contacts y and z and thus breaking the motor circuit between the terminals 88 and 89.

Using the amplifying relay as shown, the current flow through the photo-electric cell 59 will be reduced each time a printed area x or one of the specially provided printed marks or spots x' is opposite to the aperture of the photo-electric cell, thereby causing closing of the part of the circuit of the electric motor 36 between the terminals 88 and 89, and an increased current flow through the photo-electric cell, which takes place when the intervening blank or unprinted areas of the surface of the web are opposite to the aperture of the photo-electric cell, will cause opening of this part of the circuit of the motor 36, the variation in the amount of light reaching the photo-electric cell to cause its operation being produced by the difference in the light-transmitting or reflecting properties of the printed areas or marks or spots on the web and the intervening blank or unprinted portions of the web, the light-transmitting or reflecting power of the printed areas or marks or spots on the web, especially when printed in black or dark ink, being much less than that of the blank or unprinted portions of the web.

The electric circuit connections between the various elements are as follows:—85 and 86 are conductors for supplying the operating current for the motor 36, these conductors being connected to any suitable source of current of proper voltage as for example an electric generator 87. The conductor 85 is connected directly to one terminal of the motor 36 and the conductor 86 is connected to the terminal 88 of the contactor 77 of the amplifying relay. The other terminal 89 of the contactor 77 is connected by a conductor 90 and its branches 91 and 92 to the contact arms 44 and 45 respectively. The stationary contacts 52 and 53 are connected by conductors 93 and 94 to the remaining terminals of the reversible motor 36, it being understood that the motor is of the reversible type and will revolve in one direction when energized by current supplied by the conductor 85 and the conductor 93 and will revolve in the opposite or reverse direction when energized by current supplied by the conductor 85 and the conductor 94.

The operation of the registration compensat-

ing mechanism constructed as hereinbefore described is as follows:—

Assuming the invention is applied for example to a paper bag making machine and that the paper strip or web X from which the bags are to be made is printed with advertising matter or other printed impressions *x* arranged successively in the direction of its length, either with or without the special marks or spots *x'*, and that the paper strip or web is fed continuously through the machine by the draw rolls 9, and the photo-electric cell 59 and the cooperating light projector 62 are arranged to cooperate with the printed impressions *x* on the web or with the specially provided marks or spots *x'* thereon, the running of the machine will cause the cams 37 and 38 to operate in synchronism with the slitters 8, breaker 11 and other elements of the machine which act at intervals on the paper strip or web, and as the raised part of each cam reaches the respective contact arm, the latter will be raised, disengaging the contact 50 or 51 thereon from the respective stationary contact 52 or 53, and when the low part of each cam reaches the cooperating contact arm, the latter will be lowered thereby engaging the contact thereon with the respective stationary contact. The cams 37 and 38 are so set relatively to the cut off operation of the breaker on the web and the contacts 52 and 53 are so adjusted that while the printed bag sections of the travelling paper strip or web are in correct register with the slitters, breaker or other elements of the machine, the raised portion of one cam will have just raised one of the contact arms while the raised portion of the other cam will still hold the respective contact arm in raised position, at the moment one of the printed impressions *x* on the paper strip X is opposite to the aperture 61 of the photo-electric cell, assuming that the photo-electric cell 59 and the light projector 62 are adjusted to cooperate with the printed impressions *x* on the paper strip. Assuming the amplifying relay 74 to be connected so that the photo-electric cell will then close the circuit through the contactor terminals 88 and 89, the conductors 85 and 90, 91 and 92 will then be connected to the source of electric current supply for the motor 36 but the motor circuit will not be completed through either of the conductors 91 and 92 since the contacts 50 and 52 and 51 and 53 will be open as shown in Fig. 10 and hence the electric motor 36 will be idle or motionless and the draw rolls 9 will operate to draw the paper strip or web through the machine without variation in their speed relatively to the slitters 8, breaker 11 or the other operative elements of the machine, the paper strip or web being then in proper register with the slitters, breaker and other element of the machine so that these elements of the machine will operate on the paper strip or web in proper longitudinal relationship with the printed impressions *x* thereon. While the paper strip or web is thus in proper registration with the operative elements of the machine acting upon it, the electric motor 36 and the variable speed driving means for the draw rolls will remain idle, the electric motor circuit being opened by both contact arms 44 and 45 each time a printed impression *x* comes opposite to the aperture of the photo-electric cell. However, should the paper strip lag or become advanced relatively to the slitters, breaker or other operative elements of the machine so that these elements of the machine would not operate on the paper strip in proper longitudinal relationship with the printed impressions thereon, one or the other of the contact arms 44 and 45 will be in position to engage the electrical contacts controlled by it at the moment a printed impression on the paper strip is opposite to the aperture of the photo-electric cell and the resultant closing of the motor circuit through the contactor terminals 88 and 89 and the contacts engaged by the respective contact arm will cause operation of the motor 36 in a direction to increase or diminish the speed of operation of the draw rolls through the variable speed driving mechanism therefor, thereby restoring registration between the printed impressions on the travelling paper strip and the elements of the machine which operate thereon. For example, in Fig. 11, the paper strip or web X is shown in lagging relation to the cams 37 and 38 which are synchronized with the slitters, breaker and other elements of the machine which act on the paper strip, the contact arm 45 being opposite to the low part of the cam 38 so that it is lowered and its contacts 51 and 53 are in engagement at the time a printed impression *x* on the paper strip is opposite to the aperture of the photo-electric cell, and since the motor circuit through the contactor terminals 88 and 89 will be closed under these conditions, current will be supplied to the electric motor 36 through the conductors 85 and 94 to cause operation of the motor in a direction to cause the variable speed driving mechanism for the draw rolls to operate the draw rolls at an increased speed relatively to the speed of operation of the slitters, breaker and other operative elements of the machine, and this operation will take place at each revolution of the cams 37 and 38 until the travelling paper strip has been brought into registration with the slitters, breaker and other elements of the machine as represented in Fig. 10, whereupon the motor 36 will become idle. If the paper strip or web becomes advanced or runs ahead of the slitters, breaker or other operative elements of the machine, the contact arm 44 instead of the contact arm 45 will be in its lowered position so that its contacts 50 and 52 will be closed at the moment a printed impression *x* is opposite to the aperture of the photo-electric cell, and the electric motor 36 will then be caused to operate in the opposite direction through current supplied through the conductor 93 and the variable speed driving mechanism for the draw rolls will then operate in a direction to advance the paper strip or web at a reduced speed relatively to the speed of operation of the slitters, breaker or other elements of the machine, and this operation will take place at each revolution of the cams until registration is restored between the printed impressions on the paper strip or web and the slitters, breaker or other elements of the machine, whereupon the motor 36 will again become idle.

The operation may be the same when the row of marks or spots *x'* are printed or otherwise applied to the paper strip in definite relationship with the printed impressions thereon, these specially provided marks or spots being used advantageously when the contrast between the light reflecting properties of the printed impressions on the paper strip and the intervening clear or unprinted areas thereof is insufficient to effect the requisite variation in the amount of light received by the photo-electric cell to insure its

proper or efficient functioning. It will be understood that while the amplifying relay **74** may be adjusted so as to close the electric motor circuit across the terminals **88** and **89** of the contactor **77** when a printed impression *x* or a mark or spot *x'* on the paper strip is opposite to the photo-electric cell, the amplifying relay may be adjusted to close the motor circuit through the contactor terminals when a clear or unprinted area of the paper strip or web is opposite to the photo-electric cell and the latter may be positioned accordingly to maintain registration between the paper strip and the slitters, breaker or other elements of the machine in cooperation with the timing cams in the manner hereinbefore described.

It will be understood that while the registration restoring operation is taking place involving either an increased or reduced speed of operation of the draw rolls, the motor **36** will operate to effect such result during each revolution of the cams **37** and **38** and the motor will operate each time for the period of time the contact arm **44** or **45**, as the case may be, is in its lowered position as permitted by its engagement with the low portion of its respective cam, and by extending the high or raised portions of the cams around their circumferences for a greater or less extent, the duration of the registration restoring operation of the motor **36** during each revolution of the cam may be reduced or increased, if desired, since the lengthening or shortening of the raised portions of the cams at the ends thereof opposite the leading end **37**[b] of the cam **37** and the rear or trailing end **38**[b] of the cam **38** will, in effect, alter correspondingly the lengths of the low portions of the cams.

While it is generally preferable to employ the contactor of the amplifying relay and the cam controlled contact arms to directly control the operating circuit for the motor **36**, as shown and described, obviously a relay like that shown for example in my prior patent hereinbefore referred to and governed by the contactor of the amplifying relay and cam-controlled contact arms, may be employed to control the circuit of the motor.

The invention is shown in the present instance applied to a paper bag making machine of the kind used for making bags of the so-called self-opening or automatic type, but it is obvious that the invention is also applicable to machines for making bags of the flat, square or satchel bottom and all other types.

By employng a photo-electric cell to respond to the passage of the printed impressions or the marks or spots printed or otherwise applied to the paper strip or web in conjunction with the timing cams synchronized with the slitters, breaker or other elements of the machine which are intended to act on the paper strip in definite relationship with the printed impressions thereon, for detectng any lack of registration between the paper strip and such elements of the machine and for controlling the operation of means for restoring such registration, proper registration may be maintained between the paper strip and the machine in a more simple and efficient manner than heretofore and it affords the further advantage that it renders it unnecessary to provide perforations in the paper strip as has been heretofore required.

I claim as my invention:—

In means for maintaining registration between a travelling web having longitudinally spaced areas of relatively different light reflecting powers on a surface thereof and an element of a machine acting on said web, means for guiding the travelling web, a photo-electric cell and a light projector mounted opposite to said surface of the web in angular relation therewith to cause a light beam to be projected onto said surface of the web and reflected by said surface to the photo-electric cell, and a slide adjustably supporting the photo-electric cell and light projector in variable angular relations and movable to bring them bodily into cooperation with different portions of the width of the web.

TRUE M. AVERY.