Feb. 18, 1936. A. G. RAINEY 2,031,503

LIGHT-SENSITIVE CELL CONTROL MECHANISM

Filed May 17, 1930 2 Sheets-Sheet 1

Fig. 1.

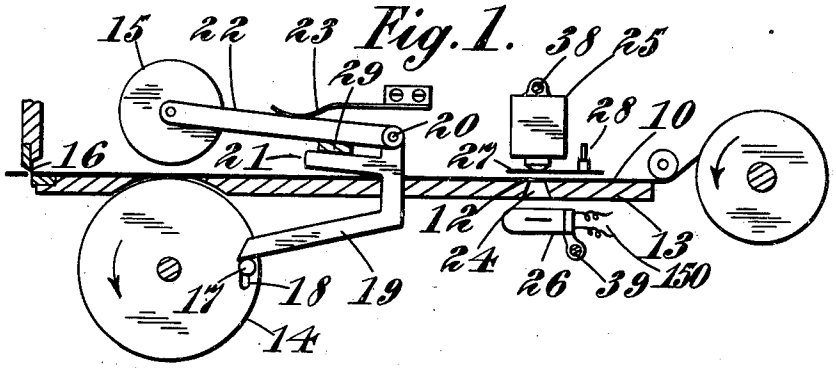


Fig. 2.

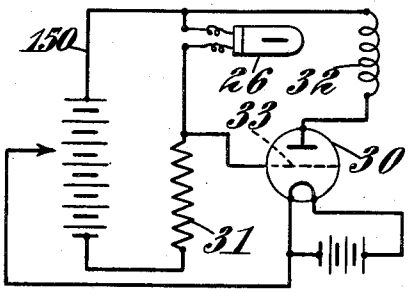


Fig. 3.

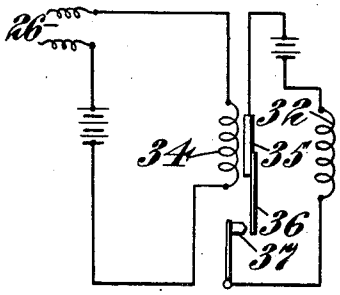


Fig. 4.

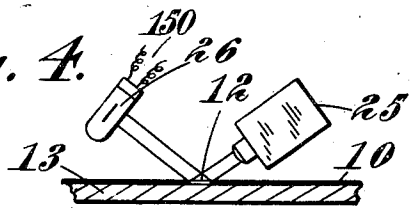
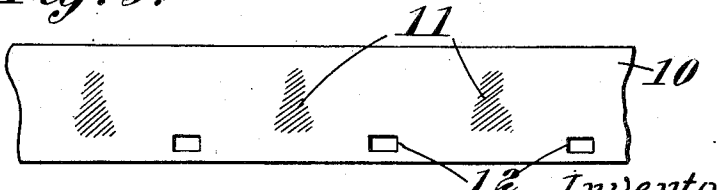


Fig. 5.



Inventor:
A. G. Rainey,
By
Byrnes, Stebbins Parmelee & Blenko atty.

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LIGHT-SENSITIVE CELL CONTROL MECHANISM

Filed May 17, 1930 2 Sheets-Sheet 2

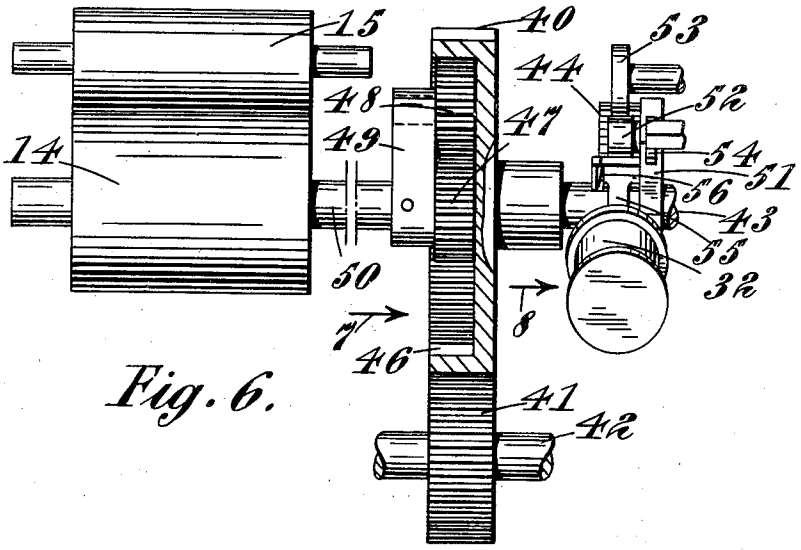


Fig. 6.

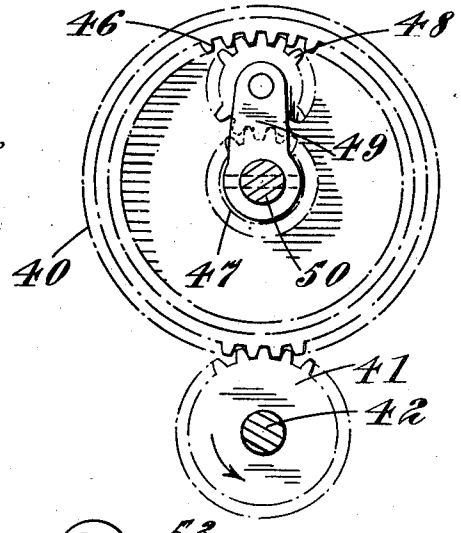


Fig. 7.

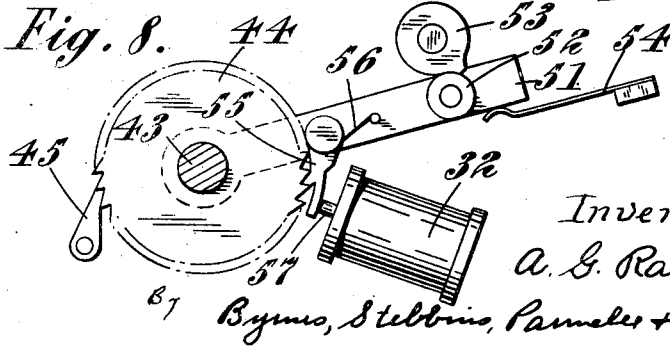


Fig. 8.

Inventor:
A. G. Rainey,
By Bynes, Stebbins, Parmelee & Blenko,
attys

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2,031,503

UNITED STATES PATENT OFFICE

2,031,503

LIGHT-SENSITIVE CELL CONTROL MECHANISM

Alexander Griffith Rainey, London, England

Application May 17, 1930, Serial No. 453,399
In Great Britain June 1, 1929

4 Claims. (Cl. 271—2.6)

This invention is for improvements in or relating to methods of, and apparatus for, coordinating the feed of a succession of sheets with operations repeated in respect of each.

The invention is based upon the use of "light-sensitive" devices. Such devices fall into two classes:—(1) Photo-emissive cells, that is to say cells which under the influence of radiant energy emit an electric current, and (2) photo-conductive cells, which under the influence of radiant energy alter their resistance to the passage of an electric current. Of this latter class the selenium cell or bridge is a typical example.

This invention provides a method of co-ordinating the feed of a succession of sheets with operations repeated in respect of each which comprises the employment of a "light-sensitive" device of the type described and associated energizing means, in combination with interference areas located at predetermined positions on the sheets for activation of the light-sensitive device.

An important application of this invention is to control the location of printed designs or the like upon sheet materials, for example to ensure that a web of paper, on which is a series of printed designs, may be cut up into separate sheets, the design on each sheet, being in its correct relation to the severance edge.

It has previously been proposed to control the location by means of apertures punched in a web of paper at spaced intervals along its length, such apertures being engaged by pegs. In other constructions the apertures have been utilized in conjunction with pneumatic apparatus, or with electric contacts. A sheet or web provided with such apertures may be utilized in the apparatus provided by the present invention, and the term "interference areas" is to be understood to include such apertures. No claim is made to such an apertured sheet, however.

In one construction, this invention provides control mechanism comprising in combination a "light sensitive" device, a source of radiant energy associated therewith and so arranged that the incidence of its rays on the said device may be modified by the introduction into their path of an interference-area upon the sheet (for example paper), and feeding and associated mechanism (e. g. cutting, printing or embossing) for the said sheet actuated or controlled by the modulations of an electric current which are induced in the said device as before described.

Conveniently, the light-sensitive device and the energizing means may be located upon opposite sides of the sheet and the said control area act to obstruct or facilitate passage of rays from one side to the other of the sheet. In another construction they may be placed both upon the same side of the sheet, and the rays from the source of radiant energy diverted from their path and directed upon the light-sensitive device by the control area. This control area may be constituted by the printed design or the like, whose location on the sheet it is desired to control, or it may be separate from the printed design and located at a station offset therefrom.

According to a further feature of this invention, the modulations induced in the electric current as above described are utilized to control an electric relay, which in turn controls or operates the feeding mechanism.

If desired, the feed mechanism may be arranged to move the sheet or web intermittently and to give a cumulative error in the position of the interference areas at each cessation of feed, and the light-sensitive device may be operable upon the cumulative error reaching a predetermined degree to correct the positioning of the succeeding sheets. In such a construction at some period during the feed of the web each interference area will pass through the zone of the rays from the source of radiant energy, but as it is desired to operate the light-sensitive device only by the misplacement of an interference area within that zone at the cessation of feed, it has been found advantageous to provide means (e. g. an obturator which is interposed between the source of radiant energy and the light-sensitive device) operable to permit rays to pass from the source to the light-sensitive device only at or about that period during which an interference area is in its operative position, it being understood that in the case of the construction outlined above an interference area is only in an operative position at the cessation of feed. In general, however, the term "operative position" indicates that position in which an interference area modifies the incidence of the rays upon the light-sensitive device to cause the latter to effect or control an operation. The provision of such means controlling the passage of the rays has the further advantage that fatigue of the light-sensitive device is obviated.

The present invention also embraces the provision of a sheet or web of paper having a plurality of printed designs, legends, or the like spaced apart along its length and a plurality of interference areas, one in spaced relation to each design and located at a station which is offset there-

from, the transparency or the reflective properties of which areas are substantially different from the contiguous portions of the sheet.

It is also within the scope of this invention to make the position of the source of energy, or the light-sensitive device, or both, adjustable in relation to the feeding mechanism or other mechanism associated therewith, for the purpose hereafter specified.

The light-sensitive device may be such that it will respond to infra-red (or invisible) rays.

Various constructions according to this invention will now be decribed in detail by way of example with reference to the accompanying diagrammatic drawings, in which

Figure 1 is a section showing the arrangement of paper feed, light sensitive device, knife and associated parts;

Figure 2 is an electric relay circuit of known type;

Figure 3 is an alternative relay;

Figure 4 is a diagram showing an alternative arrangement of lamp and light-sensitive device to that shown in Figure 1 and

Figure 5 shows a strip of paper suitable for use with the control mechanism described herein;

Figure 6 shows an alternative method of correcting the paper feed;

Figure 7 is a feature looking in the direction of the arrow 7 in Figure 6 and

Figure 8 is a feature looking in the direction of the arrow 8 in Figure 6.

Throughout this decription like reference numerals indicate like parts.

A web of paper 10 upon which are located a plurality of printed designs 11 of any desired character, and interference areas 12, is fed over a feed table 13 by means of rolls 14 and 15 towards a knife 16 which is operable to sever the web into successive sheets. The feed roll 14 upon which the paper is pressed by weight of the roll 15 (assisted by a spring 23), is intermittently operable and during each stationary period of this roll the knife 16 is actuated. The roll 14 carries a pin 17 which is adjustable circumferentially in a slot 18, and at the end of each period of intermittent movement the pin 17 is in contact with a lever 19 pivoted to the frame of the machine at 20. The lever 19 carries a projecting arm 21 which at the commencement of each movement of the roll 14 is moved up towards a second lever 22 upon which the roll 15 is mounted. The lever 22 is pressed downwardly by a leaf spring 23. The intermittent movements of the roll 14 are so arranged that the web of paper 10 is fed towards the knife 16 rather more rapidly than is required so that there is a cumulative error in the location of each severance edge in relation to the designs 11 and the interference areas 12. The feed table 13 is pierced with an aperture 24 above which is located a lamp 25, and below it a selenium cell 26. The aperture 24 is so located that during the feed of the paper web the control areas 12 pass over it and arrive approximately in that position at the termination of each intermittent feed movement. A shutter comprising an apertured disc 27 secured to a shaft 28 is arranged to uncover the lamp 25 at the termination of each intermittent feed, so that rays are projected on to the paper. It will be appreciated that owing to the setting of the feed roller 14 above mentioned, each interference area 12 (which may be considered to be opaque, although a modified form of apparatus will operate with transparent areas), allocated to each successive design 11 will, at the moment that the feed is interrupted, lie slightly nearer to the knife 16 than did the preceding control area, and at each successive cessation of feed a greater portion of the aperture 24 is left uncovered by the interference area. When, for example, half the aperture 24 in the feed table 13 is uncovered at the moment of interruption of paper feed sufficient light will pass through the paper 10 and the aperture on to the selenium cell 26 and the resistance of the latter decreases to an extent sufficient to send a surge of current through a solenoid coil (described below) and by this means a tongue 29 is inserted between the arm 21 on the lever 19 and the lever 22. Thus at the commencement of the next movement of the roller 14 a mechanical connection is established between the levers 19 and 22, and the roller 15 is momentarily lifted clear of the paper and the forward advance of the latter towards the knife is delayed, thus a correction is made in the length of the next following sheet.

It will be appreciated that the difference in current flowing when the selenium cell is exposed to light and when it is not so exposed, is insufficient by itself to perform operations of any magnitude. Hence a relay is used.

Figure 2 shows a known relay 150 in which by means of a thermionic valve 30 the modulations in current through the selenium cell 26 are amplified to a magnitude sufficient to operate the solenoid 32. 31 is a resistance of approximately the same value as that of the selenium cell 26, and it will be seen that any variation in the resistance of this cell will cause a variation in the potential of the grid 33.

Figure 3 illustrates an alternative method of operating the solenoid 32. A decrease in the resistance of the selenium cell 26 causes a surge of current through the windings 34 of an electromagnet which attracts an armature 35 and closes contacts 36 and 37, thus completing a circuit through the solenoid 32 which operates the tongue 29. Figure 4 shows an arrangement in which the lamp 25 and the selenium cell 26 are both located upon the same side of the paper web 10. It will be appreciated that the presence or otherwise of an interference area 12 will cause a variation in the intensity of light reflected from the surface of the paper on to the selenium cell. It is also within the scope of this invention that the interference area 12 shall be constituted by a perforation in the paper web (or a notch or recess in its edge). In the case of the apparatus shown in Figure 1 such a perforation or notch would permit the free passage of the rays through the aperture 24 on to the selenium cell 26, and in the case of the apparatus shown in Figure 4 such a perforation or notch would expose a reflecting surface beneath the paper (which reflecting surface may be constituted by the surface of the feed table 13) to the rays from the lamp 25.

The lamp 25 may be replaced by a source of infra-red, or invisible rays, to which the selenium cell is sensitive.

In a further construction, which is particularly applicable to the case in which the interference area is constituted by the design, or the like, the location of which upon the sheet (e. g. in relation to a severance edge) it is desired to control, instead of the aperture 24, a slot may be formed running diagonally across the table, and the lamp 25 and the selenium cell 26 may be slidably mounted on diagonal rods 38 and 39, so that their position with relation to the feed rolls 14 and 15 and the knife 16 may be adjusted to regulate the position of the printed design.

Referring to Figures 6, 7 and 8 the feed rolls 14 and 15 are driven through gearing 40, 41 from a lay-shaft 42. The gear 40 is freely supported upon a shaft 43 to which is attached a ratchet wheel 44, normally held stationary by a pawl 45. In the interior of the gear 40 is formed an internal gear 46, concentric with which is a sun-wheel 47 attached to the shaft 43. A planet-wheel 48, which is carried upon a crank 49 attached to that shaft 50 upon which the feed roll 14 is mounted, meshes both with the internal gear 46 and with the sun-wheel 47.

Freely pivoted upon the shaft 43 is an arm 51 which carries a roller 52 and is pressed upwards, so that the roller 52 is maintained in engagement with a cam 53, by a leaf-spring 54. The arm 51 carries in addition a pawl 55 which is normally held out of engagement with the ratchet wheel 44 by a light spring 56, but is coupled to the armature 57 of a solenoid 32.

The operation of the device is as follows:—

As in the previously described example the feed roll 14 is driven intermittently in such manner that the web of paper is fed through the nip between the two rollers rather more rapidly than is required so that there is a cumulative error in the location of each severance edge in relation to the designs and to the interference areas. The ratchet 44, and hence the sun-wheel 47, is held stationary by the pawl 45, and the gear 41 on the lay-shaft 42 drives the internal gear 46. As the sun-wheel 47 is held stationary the planet wheel 48 rolls round this sun-wheel carrying with it the crank 49. Thus the shaft 50 and the feed-roll 14 are rotated and the reaction of the drive is taken by the sun-wheel 47. At the moment that the feed roll 14 is brought to rest the cam 53 operates to depress the arm 51, and if the cumulative error in the location of the interference areas has reached the degree required to operate the selenium cell the pawl 55 is moved forward into engagement with the ratchet wheel 44 by the solenoid 32. By this means the sun-wheel 47 is rotated through a small angle and the feed roll 14 is turned backwards to make a correction in the length of the next following sheet.

The activation of the light-sensitive device by the interference areas may be according to any of the methods described with reference to Figures 1 to 4.

I claim:—

1. In sheet feeding mechanism the combination of feed rollers, a light-sensitive device and a lamp for projecting light on to it, an epicyclic train of gearing coupled to a feed roller, a ratchet wheel coupled to one member of said train, a co-operating pawl and means to oscillate it through a constant amplitude, and electromagnetic means in electrical connection with the light-sensitive device for controlling the engagement of the pawl with the ratchet wheel.

2. In mechanism the operation of which is controlled by a light-sensitive device, the combination with the device of a feed roller, a crank coupled to said roller, a planet wheel pivoted at the outer end of the crank, a sun-wheel meshing with the planet wheel, an internal gear meshing with the planet wheel and concentric with the sun-wheel, a ratchet wheel coupled to the sun-wheel and a pawl for preventing the rotation of said ratchet wheel in one direction, means for rotating the internal gear, an oscillating pawl arranged to co-operate with said ratchet wheel and means for oscillating it through a constant amplitude, and an electromagnet coupled electrically to the light-sensitive device for controlling the engagement of the oscillating pawl with the ratchet wheel.

3. In a mechanism for feeding intermittently a sheet upon which an operation is performed, the provision of feed rollers, means for intermittently rotating the feed rollers a constant amount, a light sensitive device and means for directing a beam of light upon it, a screen arranged to interrupt the beam during the feeding movement of the sheet, but not to interrupt the beam when the web is stationary, interference areas on the sheet arranged so that when the sheet is correctly placed at the end of a feeding movement the beam is interrupted, a relay actuated when a predetermined amount of light reaches the light sensitive device, and means controlled by said relay for imposing a predetermined feed correcting movement upon the feed rollers.

4. In control mechanism for the feed of a web upon which an operation is to be performed and which is provided with interference areas, the combination of means for intermittently feeding the web a constant amount and with a cumulative error, a light-sensitive device, the electrical characteristics of which vary according to the intensity of light falling on it, a source of illumination for directing a beam of light on to the web and thence on to the light-sensitive device, a screen arranged to intercept the beam of light during movement of the web but not to intercept said beam when the web is stationary, and means controlled by the variations in the aforesaid electrical characteristics for applying a constant predetermined correction to said intermittent feeding means.

ALEXANDER GRIFFITH RAINEY.