United States Patent

[11] 3,623,808

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[21] Appl. No. **31,653**
[22] Filed **Apr. 24, 1970**
[45] Patented **Nov. 30, 1971**

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[32] Priority **Apr. 25, 1969**
[33] **Germany**
[31] **P 19 21 281.8**

[54] **PHOTOGRAPHIC-COPYING APPARATUS**
10 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **355/40,**
226/33, 340/174.1, 355/50, 355/64
[51] **Int. Cl.** **G03b 27/46**
[50] **Field of Search** 355/28, 29,
40, 50, 51, 54, 64, 65, 96; 226/33; 340/174.1 C,
174.1 H

[56] **References Cited**
UNITED STATES PATENTS

3,209,644	10/1965	Simmon et al.	355/64
3,246,817	4/1966	Floden	226/33
3,387,548	6/1968	Funk	355/29
3,394,853	7/1968	Foley et al.	226/33 X
3,426,336	2/1969	Gabor	340/174.1
3,493,301	2/1970	Sable et al.	355/64

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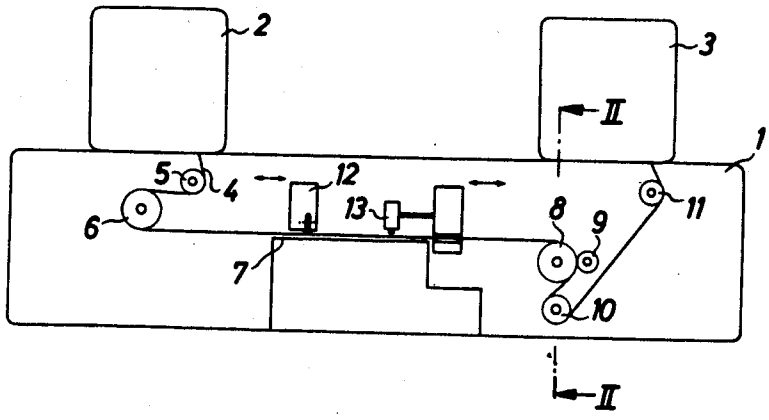
ABSTRACT: A photographic copying apparatus wherein a web of photosensitive material is moved stepwise to place successive increments into registry with a printing station. The web is driven by a roller which can be suddenly arrested in response to detection of bits of information encoded on a carrier which travels in synchronism with the web or forms an integral part of the web. The shaft of the roller is rotated by the driven element of a clutch and carries a gear whose teeth are engaged by a pawl which is controlled by a device serving to detect successive bits on the carrier whereby the pawl holds the roller against rotation during intervals which are required for exposure of photosensitive material to printing light.



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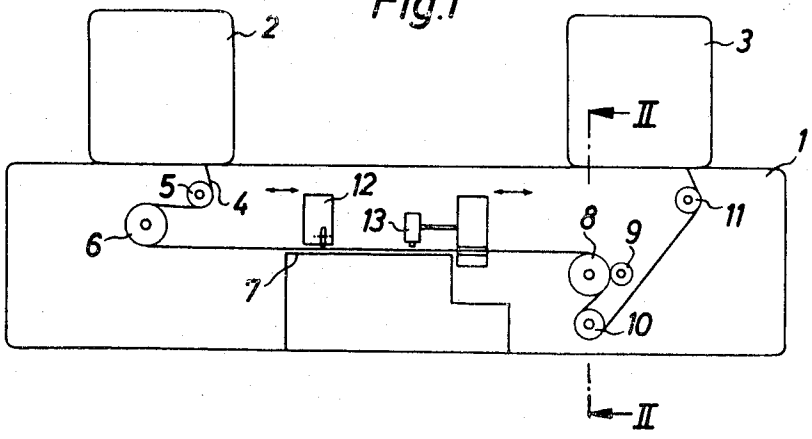
SHEET 1 OF 2

Fig.1



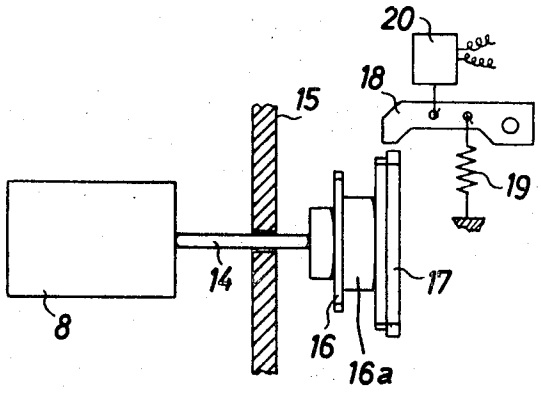


Fig.2

Fig.3

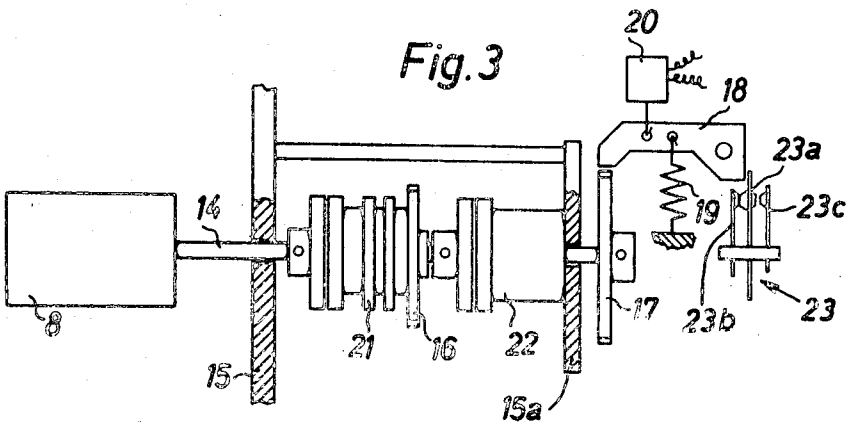


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Fig.4

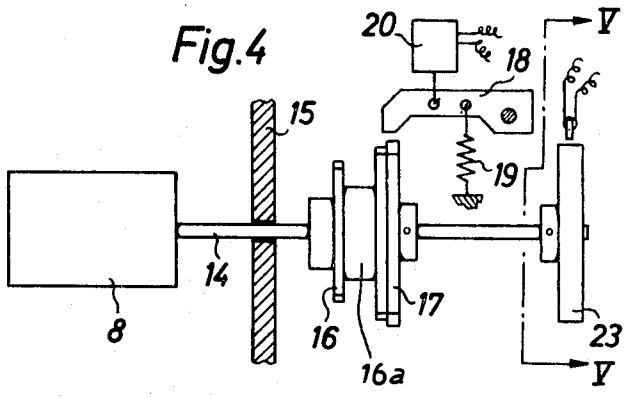
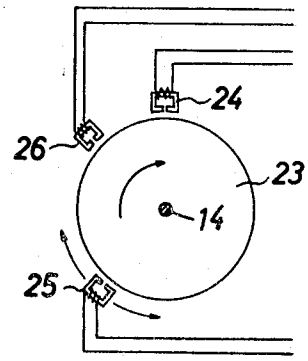


Fig.5



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PHOTOGRAPHIC-COPYING APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to photographic copying apparatus, and more particularly to improvements in those components or groups of components in a copying apparatus which serve to transport successive increments or frames of weblike photosensitive material into registry with a printing station where the frames are exposed to printing light.

It is already known to apply to the web of photosensitive material graphite marks or the like and to utilize such marks for initiating stoppage of an electric motor which causes the web to move lengthwise. The inertia of such drives is so high that is is practically impossible to arrest the web at the exact moment when a predetermined length of the web has been moved forwardly. It was found that the length of successively transported web portions cannot be predicted with a desired degree of accuracy, i.e., the unexposed margins or strips between successively exposed portions of the web are invariably of different width.

SUMMARY OF THE INVENTION

An object of the invention is to provide a photographic-copying apparatus wherein a web of photosensitive material can be transported at a high speed and can be intermittently arrested to place equidistant increments into accurate alignment with a printing station.

Another object of the invention is to provide a copying apparatus wherein the prime mover which operates the drive for the web need not be arrested when the web is brought to a halt prior to making of an exposure.

A further object of the invention is to provide a copying apparatus with novel, improved and relatively inexpensive means for effecting intermittent stoppage of photosensitive material.

An additional object of the invention is to provide a copying apparatus wherein the photosensitive material can be intermittently transported with such a high degree of accuracy that the width of unexposed strips between successively exposed frames is within a very narrow range so that the differences between the widths of such strips cannot be detected with the naked eye.

The invention is embodied in a photographic copying apparatus wherein an elongated web travels along a predetermined path to place successive equidistant increments or frames of its photosensitive material into registry with a printing station. The copying apparatus comprises a carrier (which may but need not form an integral part of the web) arranged to travel in synchronism with the web, coding means arranged to encode on the carrier bits of detectable information whenever one of the increments registers with the printing station, rotary advancing means arranged to transport the web lengthwise, drive means including a driven first rotary element and a second rotary element connected to the advancing means and normally receiving torque from the first element, and interrupter means for abruptly arresting the advancing means and for temporarily holding such advancing means against rotation while an unexposed frame of the web registers with the printing station. The interrupting means comprises a toothed gear rigid with the advancing means and with the second element of the drive means, a pawl or analogous arresting means movable into and from engagement with the teeth of the gear, and detector means arranged to effect abrupt movement of the arresting means into engagement with the gear in response to detection of successive bits on the carrier.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved copying apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic side elevational view of a photographic copying apparatus which embodies one form of the invention;

FIG. 2 is an enlarged fragmentary sectional view substantially as seen in the direction of arrows from the line II—II of FIG. 1;

FIG. 3 is a similar sectional view but showing a portion of a second copying apparatus;

FIG. 4 is a similar sectional view but showing a portion of a third printing apparatus; and

FIG. 5 is a sectional view as seen in the direction of arrows from the line V—V of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIGS. 1 and 2, the numeral 1 denotes a crosshead which forms part of a frame in a photographic roll copying apparatus. The crosshead 1 supports a magazine 2 for unexposed photosensitve material, here shown as an elongated web 4, and a magazine 3 which collects exposed material and can be transported into a developing machine, not shown. The web 4 is trained over guide rolls 5, 6 and thereupon travels along an elongated path extending past a stationary printing or exposing station 7. An advancing roller 8 cooperates with a spring-biased idler roller 9 to transport the web 4 stepwise so as to place successive increments of the web into registry with the printing station 7. Additional guide rolls 10, 11 are provided to guide the exposed increments of the web 4 toward the mouth of the magazine 3.

The printing station 7 is provided with a customary window (not shown) which admits printing light to successive frames of the web 4. Such light passes through or is reflected on originals whose images are to be reproduced on the web 4. Furthermore, the station 7 accommodates a coding device 12, e.g. a graphite marker, which applies to the rear side of the web 4 bits of information whenever the web is brought to a halt prior to or during the making of an exposure. The bits applied by the device 12 can be in the form of lines or other readily detectable information. An electrical or photoelectric decoding device or detector 13 is adjacent to the path of the web 4 downstream of the printing station 7 and is provided with one or more conventional detecting elements which scan the rear side of the web 4 and produce signals in response to detection of successive bits. The device 12 and/or 13 is adjustable lengthwise of the path of the web 4; for example, the adjustable device can be attached to the movable mask for the window at the printing station 7. The adjustability of the devices 12 and 13 is indicated by double-headed arrows.

FIG. 2 shows a wall 15 which forms part of the crosshead 1 and serves as a bearing for the shaft 14 of the advancing roller 8. This roller is rotated intermittently by a drive which includes a constantly driven rotary clutch element 16 here shown as a sprocket wheel and a second clutch element 16*a* which is in frictional engagement with the sprocket wheel 16 and is rigid with the shaft 14. The element 16, 16*a* form a simple friction clutch and the element 16 can rotate with reference to the shaft 14 and roller 8 when the clutch element 16*a* is held against rotation by a novel interrupting device which includes the aforementioned detector 13, a gear 17, an arresting pawl 18, a spring 19 which tends to move the pallet of the pawl 18 into engagement with the teeth of the gear 17, and an electromagnet 20 which is controlled by the detector 13 and is energizable or energizable in response to detection of bits to release the pawl 18 to the action of the spring 19. The clutch element 16 is constantly driven by a chain, not shown, which receives motion from an electric motor or another suitable prime mover. In the embodiment of FIG. 2, the gear 17 is a ratchet wheel and the circular pitch of teeth on this ratchet wheel is selected in such a way that the angular distance which the advancing roller 8 covers in order to transport a fresh increment of the web 4 into registry with the window at the printing station 7 is a whole multiple of the circular pitch. The operative connection between the detector 13 and

the electromagnet **20** preferably includes a suitable amplifier, not shown. That portion of the web **4** which receives bits of information applied by the coding device **12** constitutes a carrier of information and thus travels in synchronism with those increments or frames of the web which are exposed to printing light while they dwell at the station **7**. The coding device **12** may include a graphite wheel which is pressed against and rolls along the rear side of the web **4** when the latter is temporarily arrested while one of its frames registers with the window. The bits of information applied by the roller of the coding device **12** can be detected by a photosensitive detecting element of the detector **13** and/or by an element which can detect differences between the conductivity of the web material and the graphite marks.

The operation:

The length of intervals during which the pallet of the pawl **18** engages the adjacent teeth of the gear **17** is selected with a view to provide ample time for the exposure of that frame of the web **4** which registers with the window at the printing station **7**. The electromagnet **20** is thereupon energized and disengages the pawl **18** from the gear **17** so that the clutch element **16***a* can rotate with the clutch element **16** and drives the shaft **14**, roller **8** and gear **17**. The roller **8** advances the web **4** lengthwise whereby a bit which was applied by the coding device **12** reaches the detector **13** so that the latter produces a signal which is amplified and transmitted to the electromagnet **20**. The latter then permits the spring **19** to rapidly move the pallet of the pawl **18** into engagement with the adjacent teeth of the gear **17**. This automatically and abruptly terminates the transport of the web **4** because the gear **17** is rigid with the clutch element **16***a*, shaft **14** and advancing roller **8**. The clutch element **16** then continues to rotate but it turns relative to the arrested clutch element **16***a*. As stated before, the angular distance which the roller **8** must cover in order to place a fresh frame of the web **4** into registry with the window at the printing station **7** is a whole multiple of the circular pitch of the gear **17**. This insures that the pallet of the pawl **18** can engage and arrest the gear **17** at a time when the next unexposed frame of the web **4** is in exact registry with the window and when such unexposed frame is separated from the preceding (last exposed) frame by a strip of predetermined width. The angular displacement of the roller **8** between successive stoppages can be varied by appropriate adjustment of the detector **13** in or counter to the direction of travel of the web **4**.

The electromagnet **20** is thereupon energized with a predetermined delay which suffices to complete the exposure of that frame which registers with the window at the station **7**; the shaft **14** is again rotated by the clutch element **16** and the roller **8** begins to move the next unexposed frame into registry with the window. The same procedure is repeated again and again whereby the magazine **3** collects the exposed frames of the web **4**.

FIG. **3** illustrates a portion of a second copying apparatus which comprises a modified interrupting device for effecting intermittent stoppage of the advancing roller **8**. The driving and driven elements **16**, **21** form an electromagnetic clutch which is operatively connected with the detector **13** (not shown in FIG. **3**) to be disengaged in automatic response to deenergization of the electromagnet **20**, i.e., in response to engagement between the pallet of the arresting pawl **18** and the adjacent teeth of the gear **17**. In addition, the structure of FIG. **3** comprises a brake **22** which is operated to brake the shaft **14** (and hence the gear **17** and roller **8**) when the gear **17** is engaged by the pawl **18**. The stationary part of the brake **22** is mounted on a wall **15***a* of the frame. As shown, the pawl **18** serves as a trip or actuator for an electric switch **23** whose contacts **23***a*, **23***b* normally complete the circuit of the electromagnetic clutch **16**, **21** and whose contacts **23***a*, **23***c* can complete the circuit of the brake **22**. The contact **23***a* is disengaged from the contact **23***b* to thereby deenergize the clutch **16**, **21** when the pallet of the pawl **18** engages and arrests the gear **17**, and the contact **23***a* simultaneously engages the contact **23***c* to actuate the brake **22**. The clutch **16**, **21** is rendered operative and the brake **22** is disengaged in automatic response to energization of the electromagnet **20**. The action of the brake **22** can be readily selected in such a way that the shaft **14** is arrested when the oncoming space between two teeth of the gear **17** registers with the pallet of the pawl **18** to insure that the roller **8** is arrested when a predetermined unexposed portion of the web **4** registers accurately with the window at the printing station **7**. Furthermore, such adjustment in the action of the brake **22** reduces the likelihood of excessive tensioning of the web **4** prior to stoppage. Such tensioning could develop if the pallet of the pawl **18** were to strike against the top land of a tooth on the gear **17** prior to entering the next-following tooth space.

FIGS. **4** and **5** illustrate a portion of a third copying apparatus. The shaft **14** of the advancing roller **8** is rigid with the clutch element **16***a*, with the gear **17** and with a drum-shaped carrier **23** which thus rotates in synchronism with lengthwise movement of the web **4** (not shown). The carrier **23** has a magnetic peripheral surface which travels along a recording head **24**, thereupon past a reproducing head **25** and an erasing head **26**. At least one of the heads **24**, **25** is adjustable in the circumferential direction of the carrier **23**.

The operation:

The recording head **24** replaces the coding device **12**; it records on the surface of the carrier **23** a bit of information whenever the web **4** comes to a stop. Such bits are detected by the reproducing head **25** which replaces the detector **13** and causes the electromagnet **20** to effect movement of the pawl **18** into engagement with the gear **17**, i.e., to arrest the advancing roller **8**. The bits are erased at **26** before they reach the recording head **24**. The electrical connection between the reproducing head **25** and the electromagnet **20** comprises suitable amplifier means, not shown. The angular distances which the roller **8** covers between successive stoppages can be varied by adjusting the reproducing head **25** (as indicated by the arrows shown in FIG. **5**).

It is clear that the copying apparatus of FIGS. **4** and **5** can also employ an electromagnetic clutch (**16**,**21**) and a brake (**22**). The brake is then engaged when the clutch is disengaged and vice versa. The brake and the clutch can be controlled by the pawl **18** in the same way as shown in FIG. **3** or directly by the reproducing head **25**. An important advantage of the copying apparatus shown in FIGS. **4** and **5** is that its operation is not dependent on the quality of bits applied by a graphite wheel or the like, i.e., that the web **4** is more likely to be advanced through distances of optimum length.

It was found that the structures shown in FIGS. **2**, **3** and **4** are capable of effecting a much more predictable stepwise transport of photosensitive material than in presently known copying apparatus wherein the web is brought to a halt in response to stoppage of an electric motor or another prime mover. The angular distance which the roller **8** must cover between successive stoppages must equal the length of an exposed frame plus the width of the unexposed (white) strip or margin between two adjacent frames. The size of the exposed frame is determined by the mask which defines the window at the printing station **7**, i.e., differences between the lengths of successively advanced portions of the web **4** are reflected in the differences between the widths of strips or margins which separate successively exposed frames from each other. It is well known that the width of such strips should not exceed a predetermined value; as a rule, the width of such strips should be sufficiently uniform to prevent the detection of differences with the naked eye. Therefore, the tolerances in the width of unexposed strips should not exceed a small fraction of a millimeter. This cannot be readily achieved in presently known copying apparatus. The provision of an interrupting device which includes the gear **17**, the pawl **18** and the detecting unit including the electromagnet **20** and the detector **13** or the reproducing head **25** insures that the roller **8** can be arrested abruptly in immediate response to detection of a bit produced by the coding device **12** or **24**. It is immaterial whether the carrier of such bits is integral with the web **4** (FIGS. **1–3**) or is

a discrete part (drum **23**) which merely travels in synchronism with the web. By utilizing a precision-finished gear **17**, it is possible to practically eliminate the tolerances in the width of unexposed strips between successively exposed frames of the web **4**. The idler roller **9** is pressed toward the advancing roller **8** with a force which prevents slippage of the web **4** when the roller **8** is arrested by the pawl **18**. It is preferred to train the web **4** around a substantial part of the peripheral surface on the roller **8** to further reduce the likelihood of slippage when the roller **8** is arrested.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of our contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. In a photographic copying apparatus wherein an elongated web travels along a predetermined path to place successive equidistant increments thereof into registry with a printing station, a combination comprising a carrier arranged to travel in synchronism with the web; coding means arranged to encode on said carrier bits of detectable information whenever one of said increments registers with said station; rotary advancing means arranged to transport the web lengthwise; drive means including a driven first rotary element and a second rotary element connected to said advancing means and normally receiving torque from said first element; and interrupter means for abruptly arresting and temporarily holding said advancing means against rotation, including a gear rigid with said second element, arresting means movable into and from engagement with said gear, and detector means arranged to effect abrupt movement of said arresting means into engagement with said gear in immediate response to detection of successive bits on said carrier.

2. A combination as defined in claim **1**, wherein said arresting means comprises a pawl and wherein said gear comprises an annulus of teeth, the angular distance covered by said advancing means between successive stoppages thereof being a whole multiple of the circular pitch of said gear.

3. A combination as defined in claim **2**, further comprising brake means arranged to apply to said advancing means a braking force in response to movement of said arresting means into engagement with said gear.

4. A combination as defined in claim **2**, wherein said elements from part of an electromagnetic clutch which is deenergized in response to movement of said arresting means into engagement with said gear.

5. A combination as defined in claim **1**, wherein said detector means is adjustable in and counter to the direction of travel of said carrier.

6. A combination as defined in claim **1**, wherein said carrier forms part of the web.

7. A combination as defined in claim **1**, wherein said carrier is a rotary drum having an endless magnetic surface and wherein said coding means comprises a recording head adjacent to said surface, said detector means comprising a reproducing head adjacent to said surface and located past said recording head as considered in the direction of rotation of said drum.

8. A combination as defined in claim **7**, further comprising erasing means disposed past said reproducing head and arranged to erase said bits upstream of said recording head.

9. A combination as defined in claim **7**, wherein at least one of said heads is adjustable in the circumferential direction of said drum.

10. A combination as defined in claim **1**, wherein said advancing means comprises a roller and said elements form part of a friction clutch.

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