Feb. 11, 1958 G. E. FORD ET AL 2,823,029

STRIP FEEDING ARRANGEMENT

Filed Sept. 26, 1955 3 Sheets-Sheet 1

Fig. 1.

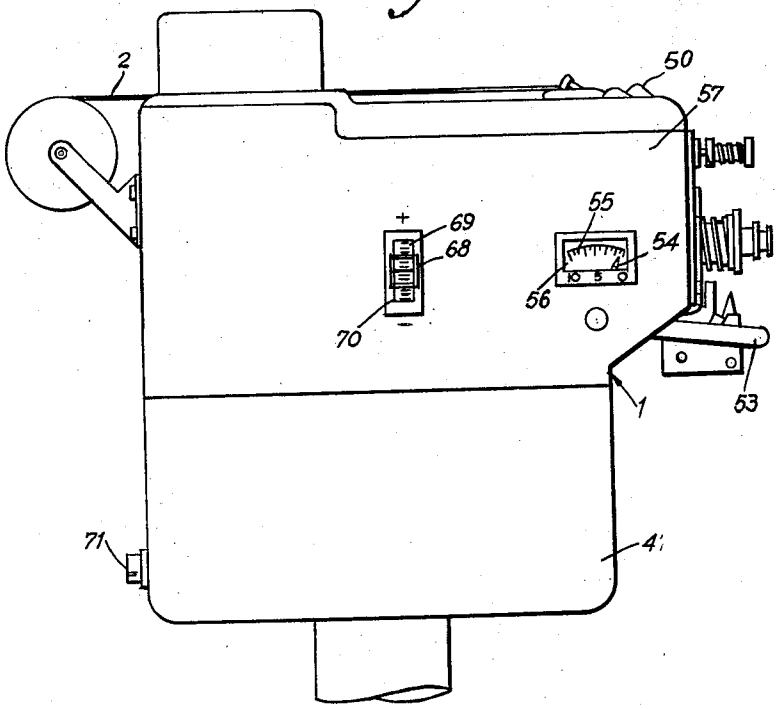
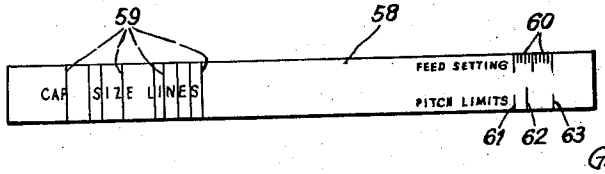


Fig. 4.



INVENTOR
Geoffrey E. Ford
Philip S. Waite
BY
Holcombe, Wetherill & Brisbois
ATTORNEY

Feb. 11, 1958 G. E. FORD ET AL 2,823,029

STRIP FEEDING ARRANGEMENT

Filed Sept. 26, 1955 3 Sheets-Sheet 2

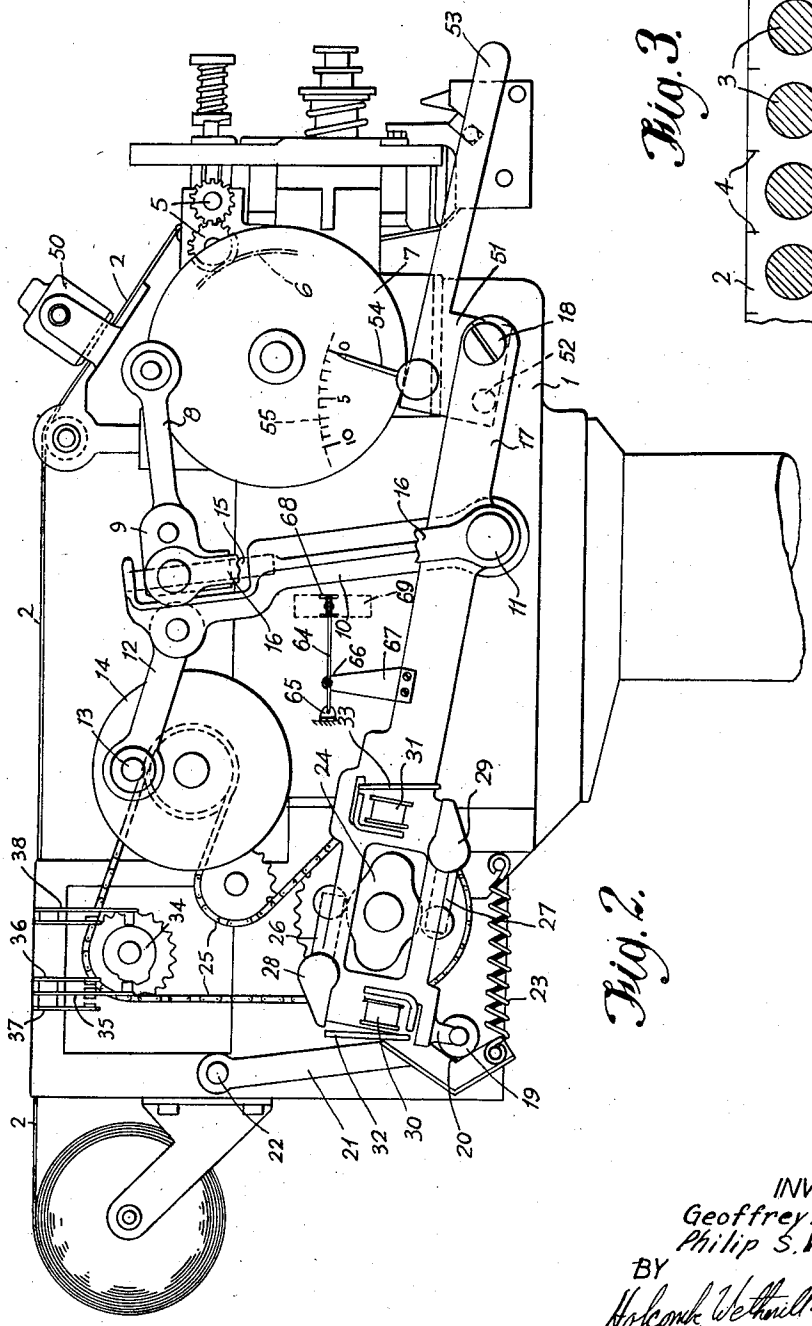


Fig. 2.

Fig. 3.

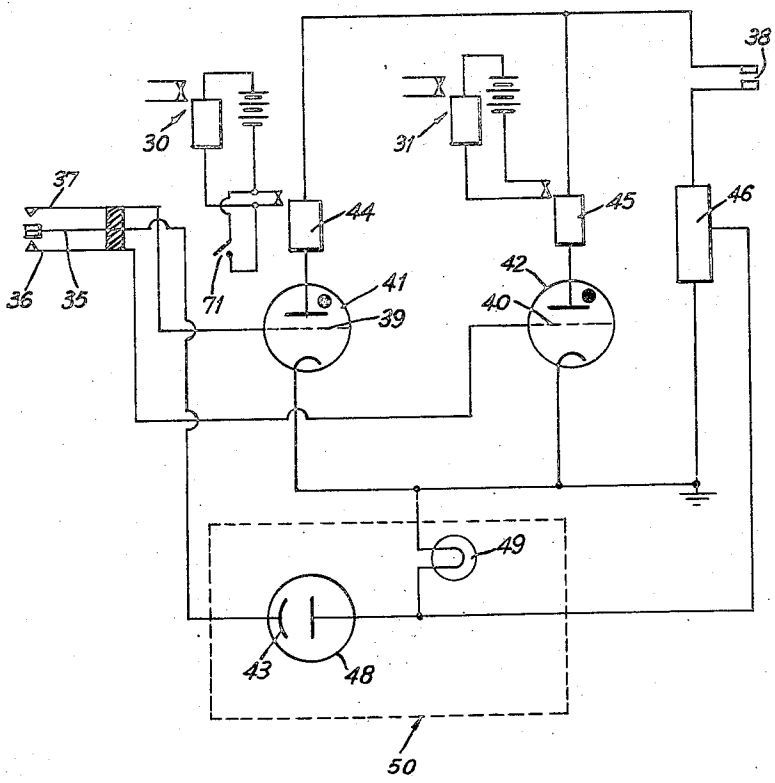
INVENTOR
Geoffrey E. Ford
Philip S. Waite
BY
Holcomb, Wetherill & Brisebois
ATTORNEY

Feb. 11, 1958 G. E. FORD ET AL 2,823,029

STRIP FEEDING ARRANGEMENT

Filed Sept. 26, 1955 3 Sheets-Sheet 3

Fig. 5.



INVENTOR
Geoffrey E. Ford
Philip S. Waite
BY
Holcombe, Wetherill & Brisebois
ATTORNEY

United States Patent Office

2,823,029

Patented Feb. 11, 1958

2,823,029

STRIP FEEDING ARRANGEMENT

Geoffrey Ewart Ford and Philip Sidney Waite, Bedford, England, assignors to Fords (Finsbury) Limited, Bedford, England, a British company

Application September 26, 1955, Serial No. 536,706

Claims priority, application Great Britain September 29, 1954

15 Claims. (Cl. 271—2.6)

In the manufacture of bottle caps having printing thereon, the printing is applied as a repeating pattern along a metal foil which is fed through the machine for making the caps, the machine cutting the foil or blanking and forming the foil to form the caps. It is necessary that the printing should accurately register with the final cap and, since the foil is liable to stretch and slippage may possibly occur during feeding, means must be provided for automatically controlling the feed to eliminate the errors which would otherwise result in the cap being formed with the printing out of register. Similar problems arise in feeding printed strips of paper or other material bearing printed or other markings which must be kept in register with a machine operation.

One object of the present invention is to provide a mechanism for adjusting the strip feed to maintain the required register.

It is another object of the invention, in a machine in which the strip is fed intermittently by means of a lever arm which is driven to oscillate or move about a pivot, said lever arm being connected at a point spaced from said pivot to a connecting rod which actuates the means for driving the strip, to provide means for adjusting the distance between the point of connection of the connecting rod to the oscillating arm and said pivot whereby to vary the strip feed produced by a stroke of the arm. It is another object of the invention, in a machine of this nature, to connect the connecting rod to a slide member which is slidable back and forth along the lever arm to adjust said distance.

It is a further object of the invention in apparatus for forming bottle caps from metal foil bearing a repeating printed pattern representing areas of the caps to be formed, in which the strip feed is effected by means of a lever arm which is driven to oscillate or swing about a pivot and is connected at a point spaced from said pivot to a connecting rod which actuates the means for driving the strip, to provide a detecting device for detecting any discrepancy in register in the forming of caps from the pre-printed cap areas on the foil and to adapt said detecting device to operate control means to control the feed of the strip so as to correct said discrepancy by effecting an adjustment of the distance between the point of connection of the connecting rod to the oscillating arm and said pivot whereby to vary the strip feed produced by a stroke of the arm.

According to yet another object of the invention, the connecting rod slide member is moved to advance or retard the feed during a stroke in dependence upon the response of the detecting device to synchronising marks, perforations or the like on the strip as it is advanced through the machine. It is another object of the invention to provide a detecting device for this purpose comprising a photocell adapted to respond to the spaced marks or perforations as it is advanced through the machine so that during each feed stroke a signal impulse will be produced, the timing of which is compared with

means such as a commutator device operating in timed relation with the machine. In this manner if the signal impulse occurs in any stroke in advance of the correct timing, it operates mechanism to move the connecting rod slide member closer to the oscillating pivot to retard the feed during that stroke, whereas if the signal impulse occurs late in the time cycle the mechanism is operated to move the connecting rod slide member away from the pivot to increase the feed during that stroke. The timing of the signal impulse thus controls the feed during the actual stroke in which it occurs.

It is a further object of the invention to provide manually-operable means in addition to the automatic means to enable the strip feed to be adjusted independently of said automatic adjustment. These additional means may be arranged to be operable whilst the machine is running. It is yet a further object of the invention to provide these manually-operable means with indicating and gauging means to allow a predetermined manual adjustment to be effected.

Advantageously, manually-operable means are additionally provided to enable the strip-feed to be adjusted independently of the automatic adjustment. These additional means may be arranged to be operable whilst the machine is running. Preferably the manually-operable means are provided with indicating and gauging means to allow a predetermined manual adjustment to be effected.

In order that the invention may be more readily understood, reference will now be made to the accompanying drawings, which show one specific embodiment thereof by way of example, and in which:

Fig. 1 shows a side exterior view of a cap-forming machine embodying a feed mechanism according to the invention.

Fig. 2 shows a side view of the machine of Fig. 1 with the exterior cover members removed, and to a larger scale.

Fig. 3 shows a portion of pre-printed strip of the kind fed by the feed mechanism of the invention.

Fig. 4 shows a feed-length gauging device, and

Fig. 5 shows a schematic circuit diagram of the electrical control means.

In the drawings, the cap blanking and forming machine **1** may generally be of the type described in the specification of copending application Serial No. 445,639 filed July 26, 1954, in the name of Goeffrey Ewart Ford, and is designed to blank and form bottle caps from a strip of aluminum foil **2**, which may be paper-backed, which is intermittently fed through the machine. The foil **2** is provided with printed areas **3** (Figure 3) at spaced intervals along its length where the foil is to be blanked and formed. Also printed at regularly spaced intervals along the side edges of the foil are synchronising marks **4**. These marks when fed past a photo-cell unit **50**, produce signal impulses which are used to control the feed of the strip and to maintain register between the printed areas **3** thereon and the blanking tool of the machine when the foil is stationary between successive strokes. Since the photo-cell unit per se forms no part of the present invention, and may take any desired form, there is no need more fully to describe it here. However, generally speaking, it will comprise a photo-cell **48** (Fig. 5) in a casing positioned so as to receive light reflected to it from the foil surface, the light being emitted by an electric lamp **49** located in the casing and passing through a slit in the casing onto the foil. The photo-cell is shielded from the direct light of the lamp. The foil is fed through the machine by the knurled rollers **5** which are driven by the gear wheel **6**. The gear wheel **6** is driven through a free-wheel or uni-directional drive of any convenient kind, for

example by a known wedging roller arrangement, from the disc 7 mounted coaxially with the gear wheel 6. It will be appreciated that the drive for the gear wheel 6 per se forms no part of the invention and is therefore not illustrated, in the interests of not confusing the reading of the drawings. The disc 7 is reciprocated, to produce the intermittent drive of the rollers 5, by a connecting rod 8, the opposite end of which is connected to a slide member 9 attached to an oscillating lever arm 10 which is pivoted to the machine frame at 11, the arm being oscillated by the connecting rod 12 which is driven by the crank pin 13 on the disc 14. The disc 14 is driven by the machine in timed relation with the blanking tool so that the strip 2 will be advanced during part of the machine cycle and will remain stationary during the actual blanking operation. The stroke of the crank pin may be adjustable for initial adjustment of the required foil feed.

The slide member 9 is movable towards and away from the pivot 11 on a rod 15 carried by the lever arm 10, and is moved by a link 16 pivotally connected at one end to the slide member 9 and at its other end to a control lever 17 pivoted either directly to the machine frame at 18 or to a subsidiary member as will hereinafter be explained. When the control lever 17 is in its neutral position, the slide member 9 will be at the centre of the rod 15 and the pivot between the link 16 and the control lever 17 will be in alignment with the pivot 11. By raising the left-hand end of the control lever 17 upwardly (referring to the drawing), the slide member 9 will be moved further away from the pivot 11 and thus the stroke of the connecting rod 8, and the feed of the rollers 5, will be increased, whereas by lowering the left-hand end of the control lever 17 the stroke will be reduced. The movement of the control lever may conveniently produce an increase or decrease of the strip feed of $\pm 1/32$ of an inch during one stroke.

The left-hand end of the control lever 17 is normally retained in its neutral position by a roller 19 thereon engaging in a V-notch 20 on an arm 21 pivoted to the machine frame at 22 and urged towards the rod by a spring 23.

Raising or lowering of the control lever 17 is effected by a double-armed cam 24 which is driven by a chain 25 from the shaft of the disc 14 at half the speed of the disc 14. The cam lobes are adapted to engage with the ends of fingers 26, 27 pivoted respectively to the control lever 17 at 28 and 29 and normally urged by light springs or gravity to the positions shown in the figure. The control lever 17, also carries two relays 30, 31 of which the armatures 32, 33 respectively are adapted, when the relays are energised, to engage beneath the outer ends of the fingers 26, 27 and prevent turning thereof about their pivots 28, 29. When the relays are de-energised, the armatures are clear of the ends of the fingers so that as the cam 24 rotates the lobes thereon can move the fingers 26, 27 without actuating the control arm 17. As soon as one relay is energised, however, for example the relay 30, the armature 32 is attracted to lock the finger 26 so that the cam lobe will then cause the control lever 17 to be raised as the lobe moves past the finger 26. Conversely, if the relay 31 is energised, the cam 24 will cause the control lever 17 to be depressed. Movement of the control lever causes the roller 19 to move away from the bottom of the V-notch 20 and thus tension the spring 23; the control lever 17 will be restored by the spring 23 and notch 20 to its neutral position as soon as the cam lobe disengages from the finger 26 or 27 as the case may be.

Also driven by the chain 25 and at the same speed as the disc 14 is a cam 34 which is arranged to move a central contact 35 from engagement with one spring contact 36, against which it normally rests, into engagement with another spring contact 37 on the opposite side thereof. As shown schematically in Fig. 5, the contacts 36, 37 are connected respectively to the control electrodes 39, 40 of two thyratrons 41, 42 in an electronic control equipment and the central contact 35 is connected to the output electrode 42 of the photo-cell 48. If the synchronizing signal impulse from the photo-cell 48 occurs at the same instant as the central contact 35 lies between and is not in engagement with either of the side contacts 36, 37 neither thyratron will be fired, but if the signal impulse occurs sooner or later in the machine cycle, then it will be passed through either contact 36 or 37 to fire the corresponding thyratron. The thyratrons, when energized, actuate relays 44, 45 in their respective anode circuits which, in turn, respectively control the relays 30 and 31 on the control lever 17. The cam 34, during its cycle, subsequently actuates a further switch contact 38 which opens the anode current supply to the thyratrons 41, 42 at each cycle, so that, at the appropriate instant in each cycle, a thyratron which has previously been fired during that same cycle will be extinguished and the control lever 17 will not operate during the next machine cycle unless one or other of the thyratrons has again fired.

The thyratrons are fed from a suitable power source schematically indicated at 46 which is also arranged to feed the photo-cell 48 and its associated lamp 49. It will be understood that the circuit arrangement shown in Fig. 5 is a skeleton arrangement and purely illustrative of many possible conventional arrangements. In practice many other components may be used, depending upon the operating characteristics of the thyratrons and relays selected at the discretion of the user.

The thyratrons and associated equipment may be housed in a casing 47 beneath the machine 1 as shown in Fig. 1 but this casing has been omitted from Fig. 2 as being unnecessary for a proper understanding of the invention. The location and mounting of the equipment within the casing 47 has also not been shown in Fig. 2 as it may follow conventional practice. Moreover, the electrical leads from the photo-cell unit 50, cams 35, 36, 37 and 38 and the relays 30 and 31 have also been omitted in the interests of clarification of the drawings.

In the preferred arrangement, in order to enable the strip-feed to be manually adjusted in addition to the automatic adjustment, means are provided for shifting the pivoting point of the control lever 17. Such a manual control is extremely useful in setting up the machine initially. Instead of pivoting the lever 17 directly on the machine, the pivot point 18 is transferred to a plate 51 (Fig. 2) pivoted to the machine at 52 and the plate 51 is provided with a control handle 53 projecting away from the machine. The plate 51 also carries an indicating pointer 54 which travels over a scale 55 as handle 53 is moved. The scale 55 may be engraved on a window 56 (Fig. 1) provided in a casing 57 of the upper part of the machine. Its spacial relationship to pointer 54 is also indicated on Fig. 2. The pivot 18 is in the form of a clamping screw.

To assist in the manual adjustment of the feed, a gauge is provided, which is shown in Fig. 4. This gauge is in the form of a measuring rule 58 of transparent material at one end of which is a plurality of "cap size" lines 59 and at the other a scale 60 of numbered registration marks corresponding to the markings of scale 55. The distance between that one of the lines 59 selected for the cap size in use and one of the scale marks 60 represents a gauge length corresponding to a multiple of e. g. five times the diameter of the cap to be made by the machine. Using a multiple gauge length gives greater accuracy.

To use the gauge for the prevention of any misregister of the printing areas 3, a length of the printed foil 2 is placed, printed side uppermost, on a flat surface and the gauge 58 is laid over the foil with the line 59 representing the selected cap size placed against one edge of one of the registration marks 4 on the foil 2. Five "pitches" or registration marks 4, representing the

multiple gauge length are then counted towards the other end of the gauge and the position of the fifth registration mark in relation to the three lines **61, 62, 63** is noted. The long line **62** indicates the recommended length of the foil, whilst the short lines **61** and **63** on either side thereof denote the maximum and minimum "five cap diameters" which the machine can successfully accommodate. Provided the said fifth registration mark on the foil lies between the upper and lower limits represented by lines **61** and **63**, the foil will be satisfactory for obtaining registration. If not, the foil should be rejected as non-standard.

The gauge **58** is then moved across the width of the foil **2** so that the registration marks **4** lie under the opposite edge of the gauge, still keeping the selected "cap size" line on one edge of the registration mark: five cap "pitches" or diameters are then counted down the gauge towards the scale **60** and the division under which the fifth registration mark falls is noted.

The handle **53** is then released by undoing pivot clamping screw **18** and moved until the pointer **54** is brought opposite the similarly numbered division on scale **55** and the screw **18** tightened.

In this way the normal uncorrected length of foil fed by the machine for each cap will be exactly the same as that required by the printing of the caps on the foil and any small variations due to printing errors or stretch of the foil during its manufacture will be automatically corrected by the automatic registration control mechanism.

In using the gauge **58** it is important to take the measurement from the same side of a registration mark **4** at each end of the gauge otherwise the thickness of the registration mark will cause an error in measurement.

It is advisable to check each reel of foil from any one particular consignment until it is reasonably certain that all the reels are consistent.

A visual indication of the running characteristics is also provided. This comprises a pointer **64** pivotally secured to the machine at **65** (Fig. 2) and at **66** to a lever arm **67** which is secured to the control lever **17**. A cursor **68** is pivoted to the free end of the pointer **64** so that during movement of control lever **17** the pointer tip moves in an arcuate path and the cursor travels up and down a scale **69** provided on a second window **70** in the casing **57**. The spacial relationship of cursor **68** to scale **69** is also indicated in Fig. 2. The cursor **68** and scale **69** thus give an indication of the corrections that are automatically being given to the feed by the control mechanism. When the cursor moves in an upward direaction a small increase of feed takes place and vice versa. If the cursor moves predominantly in one direction rather than the other, then a small adjustment should be made by the handle **53** whilst the machine is running in order to obtain a more balanced action, i. e. as few corrections as possible, some in the "increase" position and some in the "decrease" direction.

For example, if the cursor **68** moves predominantly upwards then the manual feed adjustment handle **53** should be moved upwards by a small amount at a time (say half a division on the scale **55**) until the cursor **66** moves occasionally in both directions.

This final adjustment of the machine although not strictly necessary will certainly prolong its life by reducing the amount of work which the automatic correcting mechanism has to perform.

Since, on initiating operation of the machine with a new spool of foil, it will generally happen that the printed areas **3** are not placed in any definite position when threading the foil through the machine, it is very possible, even likely, that the registration of the printing on the cap will be incorrect. Although the machine will correct this automatically, a number of caps would be wastefully made before correct registration occurs. This can

be avoided by speeding up the foil feed. One way of effecting such speeding up is schematically illustrated in Fig. 5. A switch **71** is provided for manual operation to energise the "increase feed" relay **30** independently of energisation by relay **44**. Thus, the switch button may be depressed until correctly registered caps are made. Preferably an automatic cut-out is provided to allow the impulses from the photo-cell unit **50** to supersede the switch **71** when the caps are being made correctly in register. Such a cut-out may follow conventional practice and therefore has not been illustrated here.

Whilst a particular embodiment has been described, it will be understood that various modifications may be made without departing from the scope of the invention. Thus, for example, other means may be provided for making a semi-permanent adjustment of the strip feed to compensate for a detected synchronising error. For example, the detection of a synchronising error may be arranged to shift the pivot **18** slightly in one direction or another through a high reduction gear so as to effect a slight shift of the neutral position of the slide member **9** relative to the arm **10**. The reduction gear may drive a screw which slightly raises or lowers the pivot **18**. The screw may be actuated either by each synchronising error detected or after a predetermined number of errors in the same direction have been occurred. This latter result may be achieved by driving the screw through a lost-motion connection. In this way any repetitive lack of synchronising in the same direction will produce semi-permanent compensation.

We claim:

1. Apparatus for forming bottle caps from metal foil bearing a repeating printed pattern representing areas of the caps to be formed, comprising a strip-feed-controlling lever arm, means for driving said lever arm to cause it to oscillate about a pivot, a strip-driving means, a connecting rod for actuation of said strip-driving means, a detecting device for detecting any discrepancy in register in the forming of caps from the printed cap areas on the foil, a slide member slidable back and forth along said lever arm and connected to said connecting rod, and control means under control of said detecting device to effect adjustment of said slide member on said lever arm to vary the strip feed produced by a stroke of the arm.

2. Apparatus as claimed in claim 1, in which said detecting device comprises a photo-cell arranged to respond to spaced marks along the length of the strip to produce signal impulses during each feed stroke, and means for comparing the timing of said impulses with means operating in timed relation with the machine.

3. Apparatus as claimed in claim 1, and further comprising manually-operable means for adjusting the strip feed.

4. Apparatus as claimed in claim 3, comprising indicating and gauging means on said manually-operable means to allow a predetermined manual adjustment to be effected.

5. Apparatus for forming bottle caps from metal foil bearing a repeating printed pattern representing areas of the caps to be formed, comprising knurled rollers to feed the foil through the machine, a gear-wheel mounted to drive said rollers, a unidirectional drive including a disc mounted coaxially with and for driving said gear-wheel, a connecting rod, one end of which reciprocates said disc to produce intermittent drive of the knurled rollers, a slide member connected to the opposite end of said connecting rod, said slide member also being attached to an oscillating lever arm which is pivoted to a mounting frame for the apparatus, a second connecting rod connected to said lever arm for oscillation thereof, a crank pin located on a second driving disc and operatively connected to said second connecting rod to drive same, and means for driving said second driving disc in timed rela-

tion with cap blanking tools operating on said strip so that the said strip will be advanced during part of the machine cycle and will remain stationary during the said operation.

6. Apparatus as claimed in claim 5, in which said slide member is mounted for movement towards and away from said pivot on the apparatus frame on a rod carried by the said lever arm and is moved by a link pivotally connected at one end to the said slide member and at its other end to a control lever mounted for pivotal movement with respect to said apparatus frame.

7. Apparatus for forming bottle caps from metal foil bearing a repeating printed pattern representing areas of the caps to be formed, comprising a strip-feed-controlling lever arm, means for driving said lever arm to cause it to oscillate about a pivot, a strip-driving means, a connecting rod for actuation of said strip-driving means, a detecting device for detecting any discrepancy in register in the forming of caps from the printed cap areas on the foil, a rod carried by said lever arm, a slide member carried by said rod, a link pivotally connected at one end to said slide member and at its other end to a control lever mounted for pivotal movement with respect to said apparatus frame, and control means under control of said detecting device to effect adjustment of said slide member on said rod, to vary the strip feed produced by a stroke of the arm.

8. Apparatus as claimed in claim 7, and further comprising a double-armed cam, means for driving said cam at half the speed of the apparatus drive, lobes on said cam located to engage with the ends of fingers pivoted to the said control lever, two relays carried by said control lever, the armatures of said relays being located for engagement beneath the outer ends of the said fingers when said relays are energized.

9. Apparatus as claimed in claim 8, comprising a second cam, means for driving said second cam from the apparatus drive, a central contact, and a spring contact on either side of said control contact, said control normally resting in engagement with one of said spring contacts, and said second cam being operative to move said control contact from said contact in engagement with which it normally rests to the other spring contact.

10. Apparatus as claimed in claim 9, in which said spring contacts are connected respectively to electrical control circuits controlling the operation of said relays, a photo-cell arranged to respond to spaced marks along the length of the strip to produce signal impulses during each feed stroke, means for comparing the timing of said impulses with means operating in timed relation with the machine, an output electrode on said photo-cell, said central contact being connected to said output electrode whereby if a synchronising signal impulse from the photo-cell occurs at the same instant as the central contact lies between and is not in engagement with either of said spring contacts, neither of the control circuits will be energized but whereby if a signal impulse occurs sooner or later in the apparatus cycle, then it will be passed through either of said spring contacts to energize the corresponding electric control circuit.

11. Apparatus as claimed in claim 10, in which the said second cam during its cycle subsequently actuates a further switch contact, which opens a current supply to said electrical control circuits at each cycle so that at the appropriate instant in each cycle, a control circuit which has previously been operated during that same cycle will be cut off and the control lever will not operate during the next cycle unless one or other of the control circuits has again been energized.

12. Apparatus for forming bottle caps from metal foil bearing a repeating printed pattern representing areas of the caps to be formed, comprising a support member, a lever mechanism mounted on said support member for intermittently feeding said foil between a pair of blanking tools mounted for mutual reciprocation on said support, a deflecting device mounted on said support for detecting errors in register between said printed areas and said blanking tools, drive means mounted on said support and controlled by said detecting device to synchronise operation of said blanking tools with said printed areas in register, said controlled means including a control lever, a plate member pivoted to said support member, pivot means pivoting said control lever to said plate member, and a control handle projecting from said plate member.

13. Apparatus as claimed in claim 12, in which said plate member also is provided with a pointer arranged to move over a scale as the control handle is moved.

14. Apparatus as claimed in claim 13, in which indicating means are provided to give an indication of the operating characteristics of the apparatus and comprising a pointer pivotally mounted on the machine and to a point fixed in relation to said control lever whereby movements of the control lever cause the free end of the pointer to move in an arcuate path.

15. Apparatus as claimed in claim 14, in which the free end of said pointer is provided with a cursor pivoted thereto which cursor is arranged to move along a scale as the pointer is moved.

References Cited in the file of this patent

UNITED STATES PATENTS

1,474,748	White	Nov. 20, 1923
1,968,030	De Filippis	July 31, 1934
2,541,737	Bardsley et al.	Feb. 13, 1951