April 10, 1951 F. AUER 2,548,136

REGISTER CONTROL MEANS FOR CONTINUOUS AND INTERMITTENT WEB FEED MECHANISM

Filed June 22, 1946 5 Sheets-Sheet 1

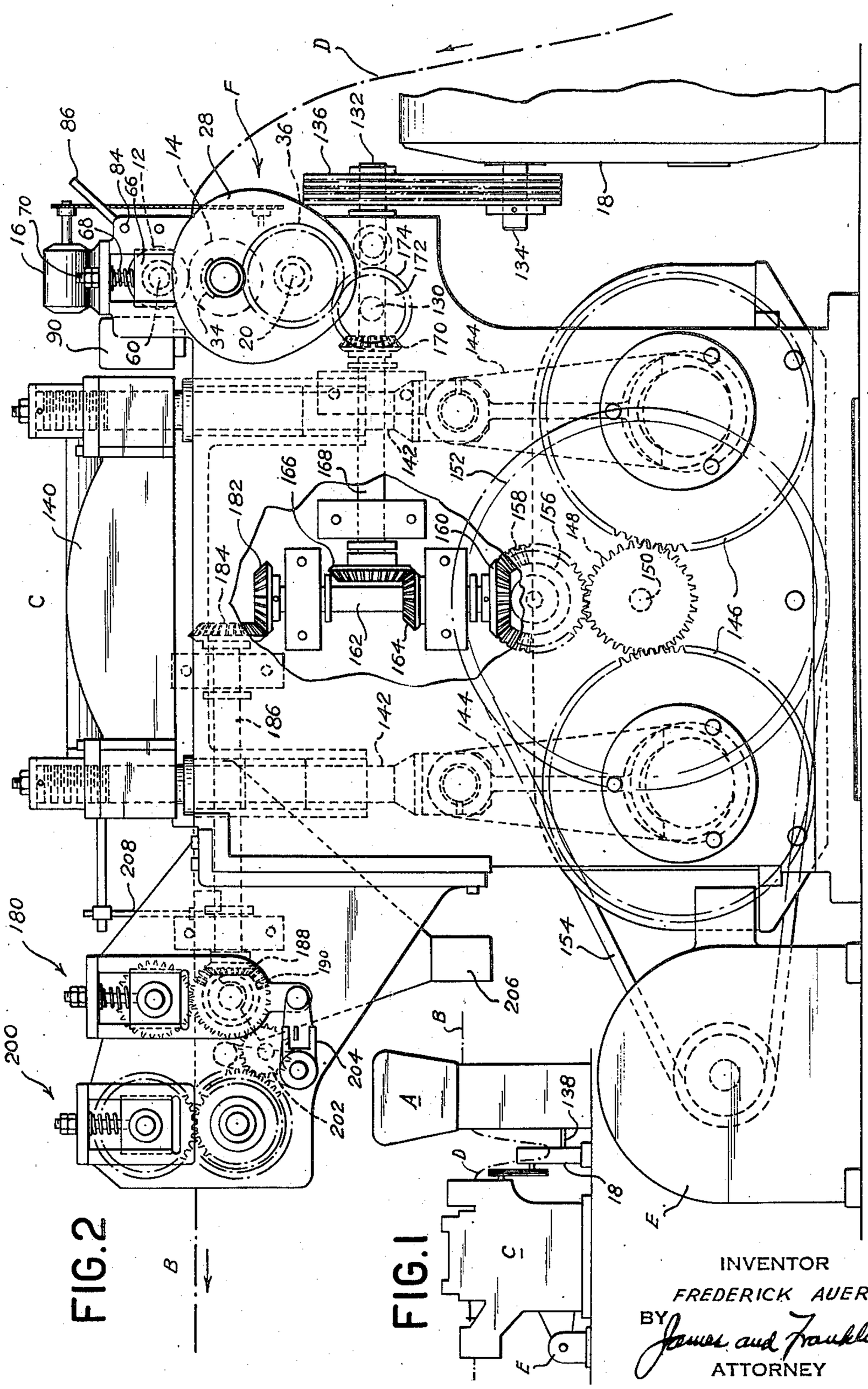

FIG. 2

FIG. 1

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FIG. 4

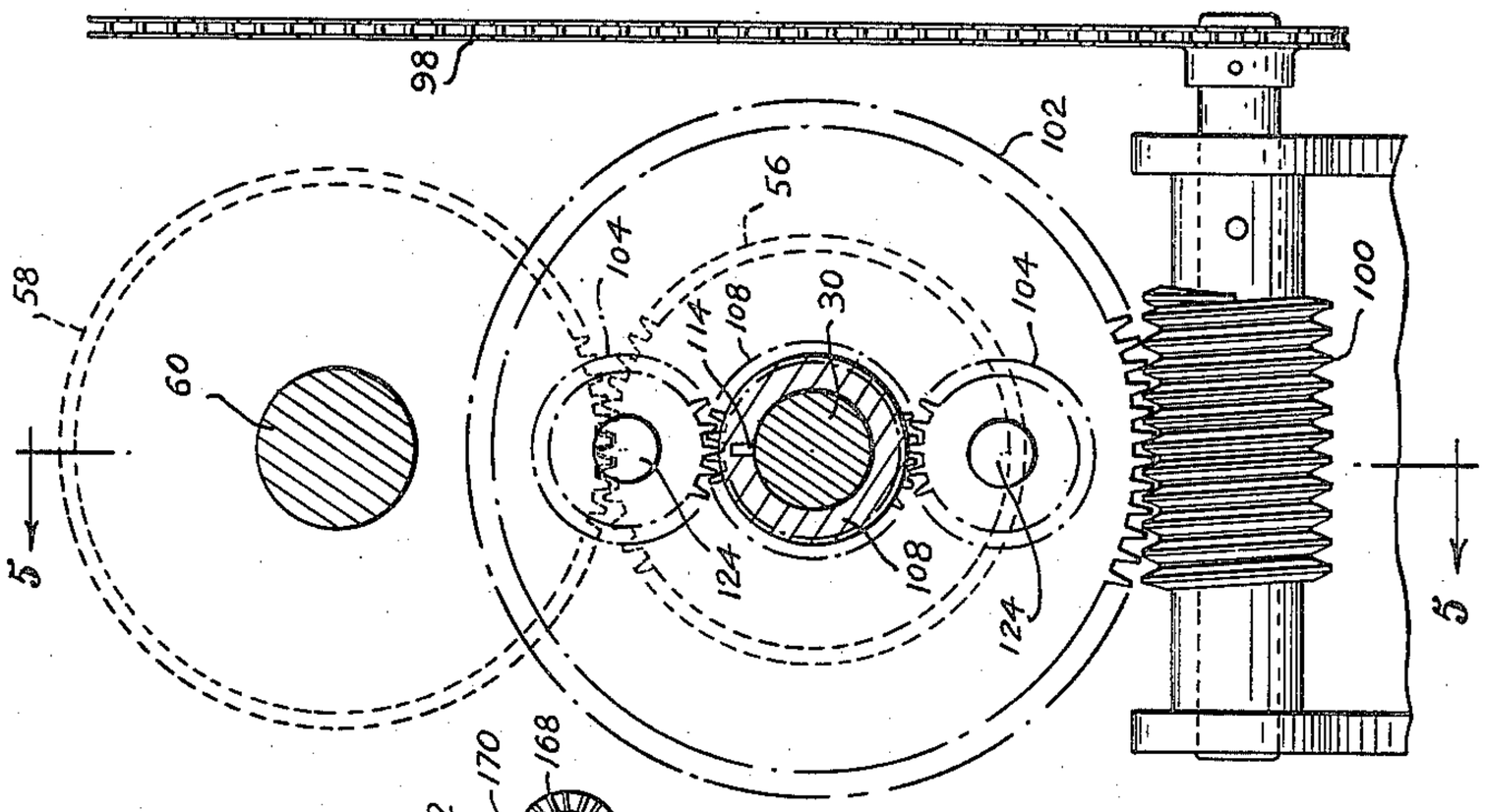
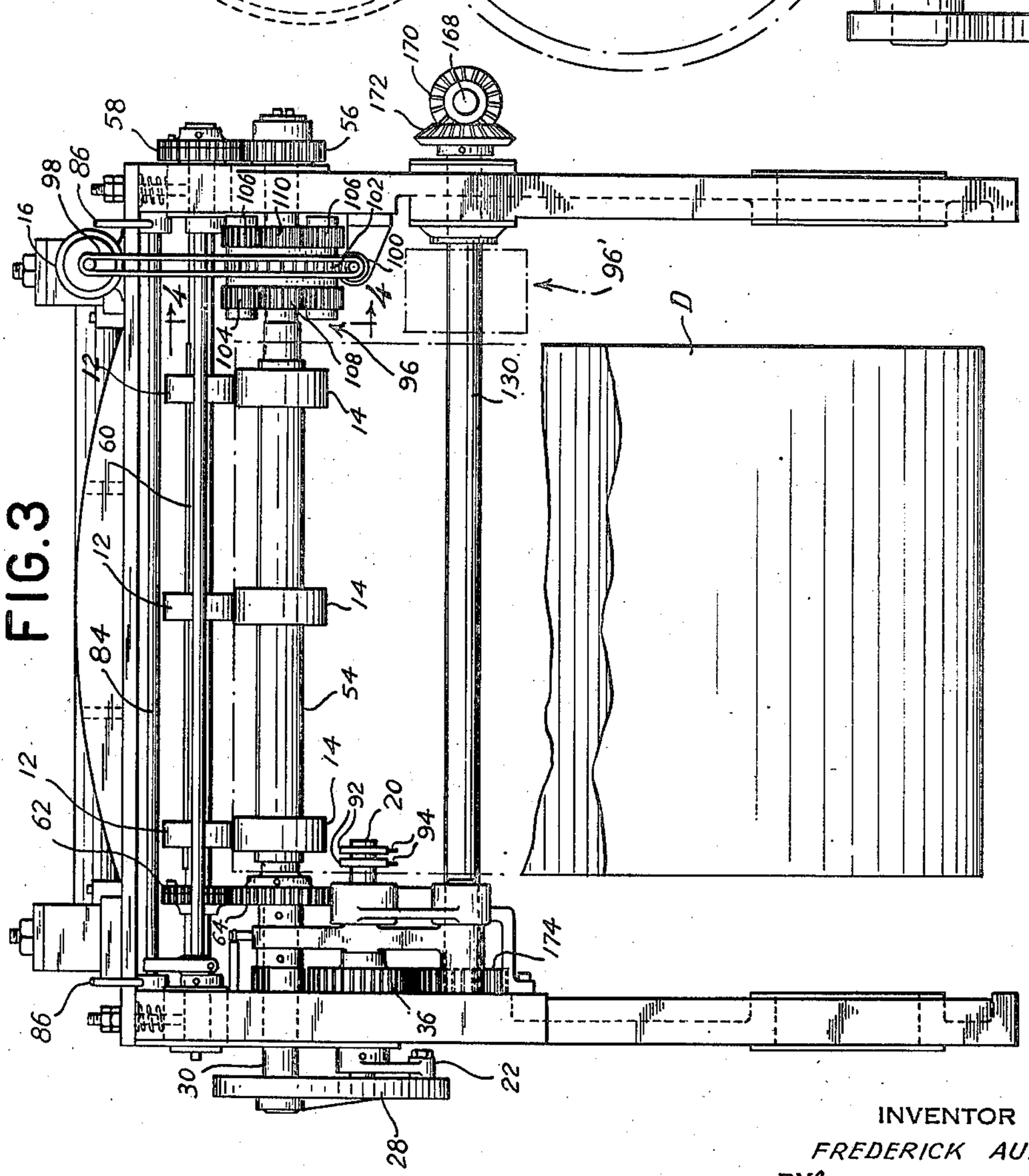


FIG. 3



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REGISTER CONTROL MEANS FOR CONTINUOUS AND INTERMITTENT WEB FEED MECHANISM

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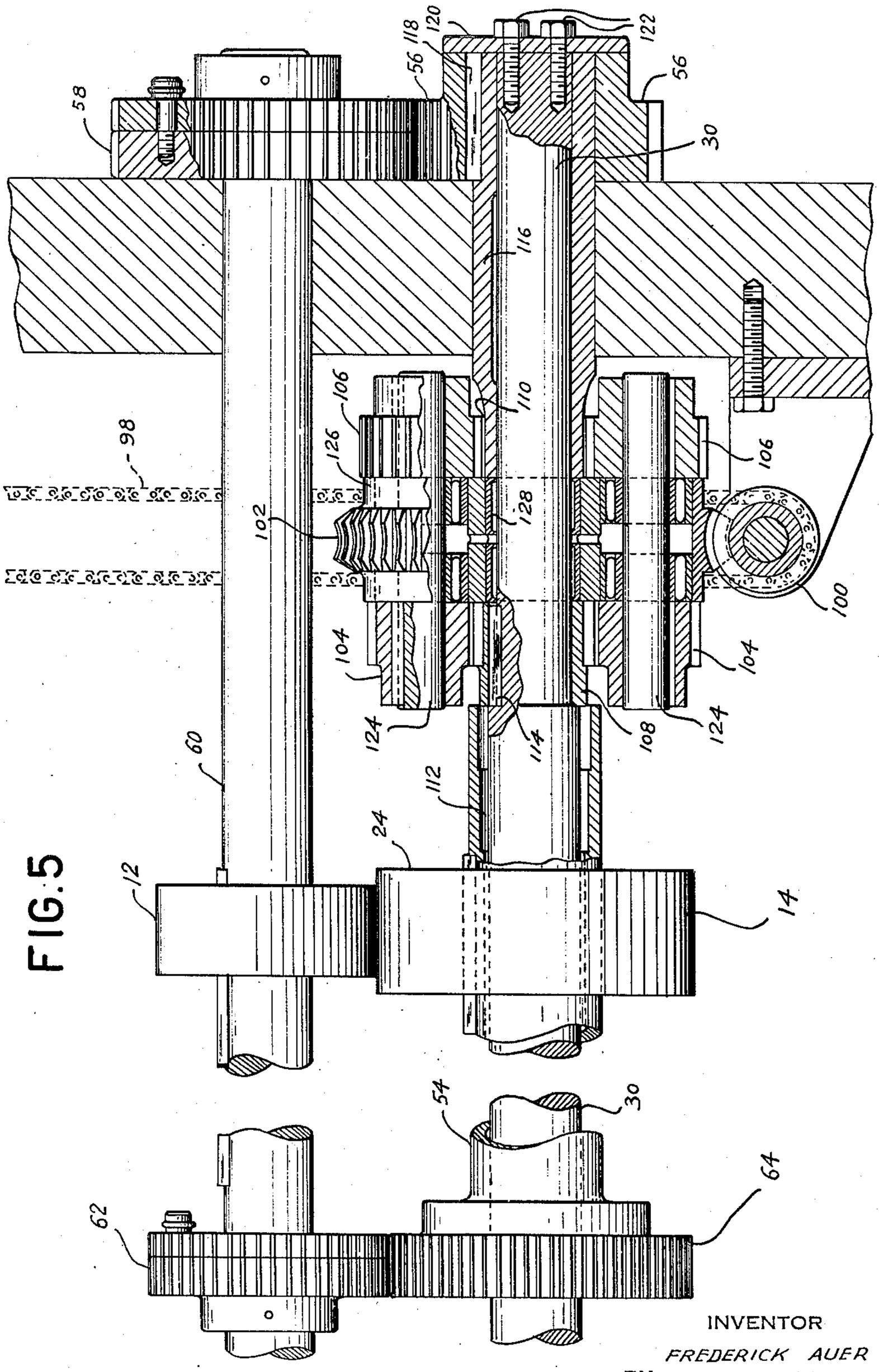
FIG.5



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REGISTER CONTROL MEANS FOR CONTINUOUS AND INTERMITTENT WEB FEED MECHANISM

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FIG. 7

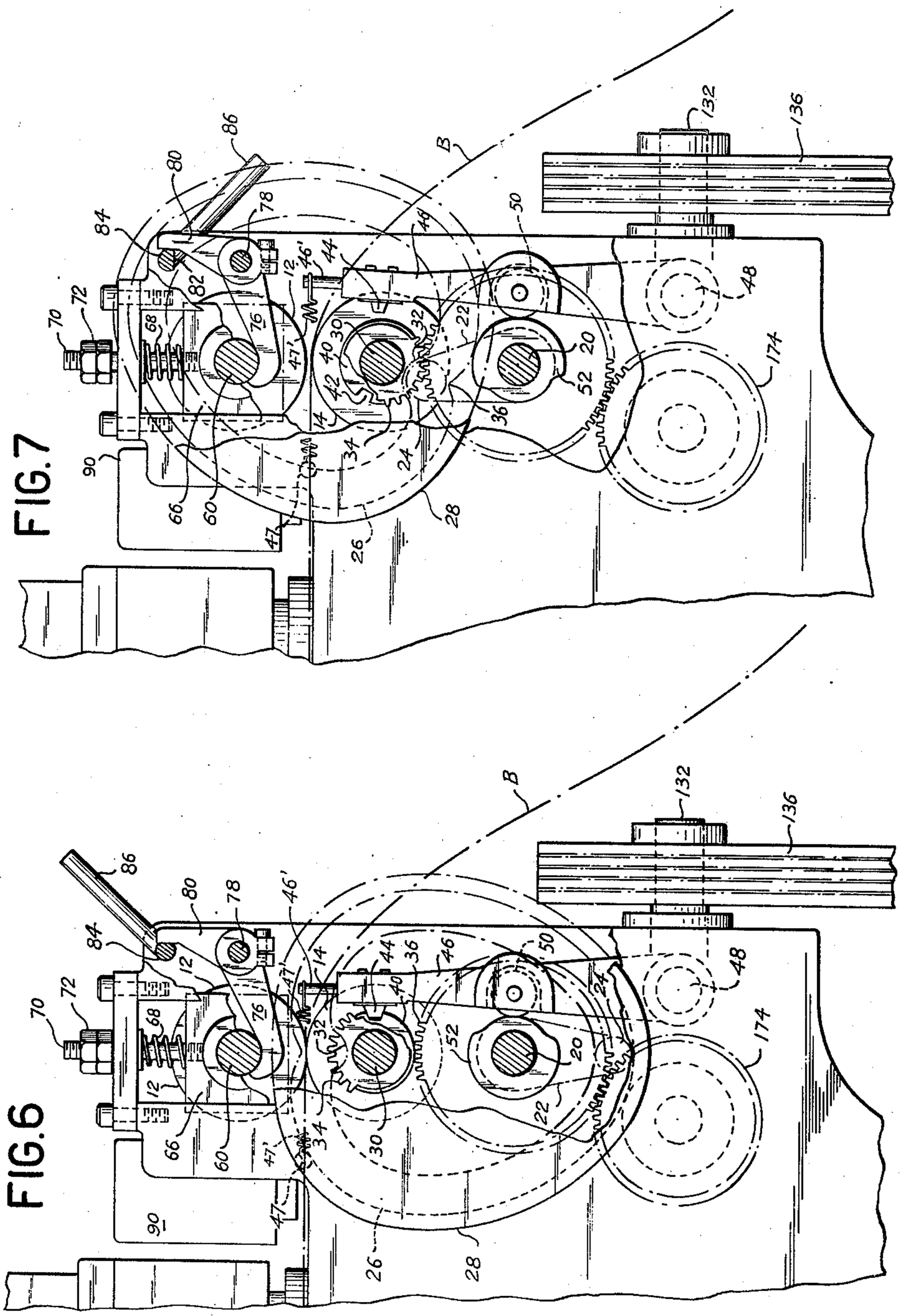

FIG. 6

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REGISTER CONTROL MEANS FOR CONTINUOUS AND INTERMITTENT WEB FEED MECHANISM

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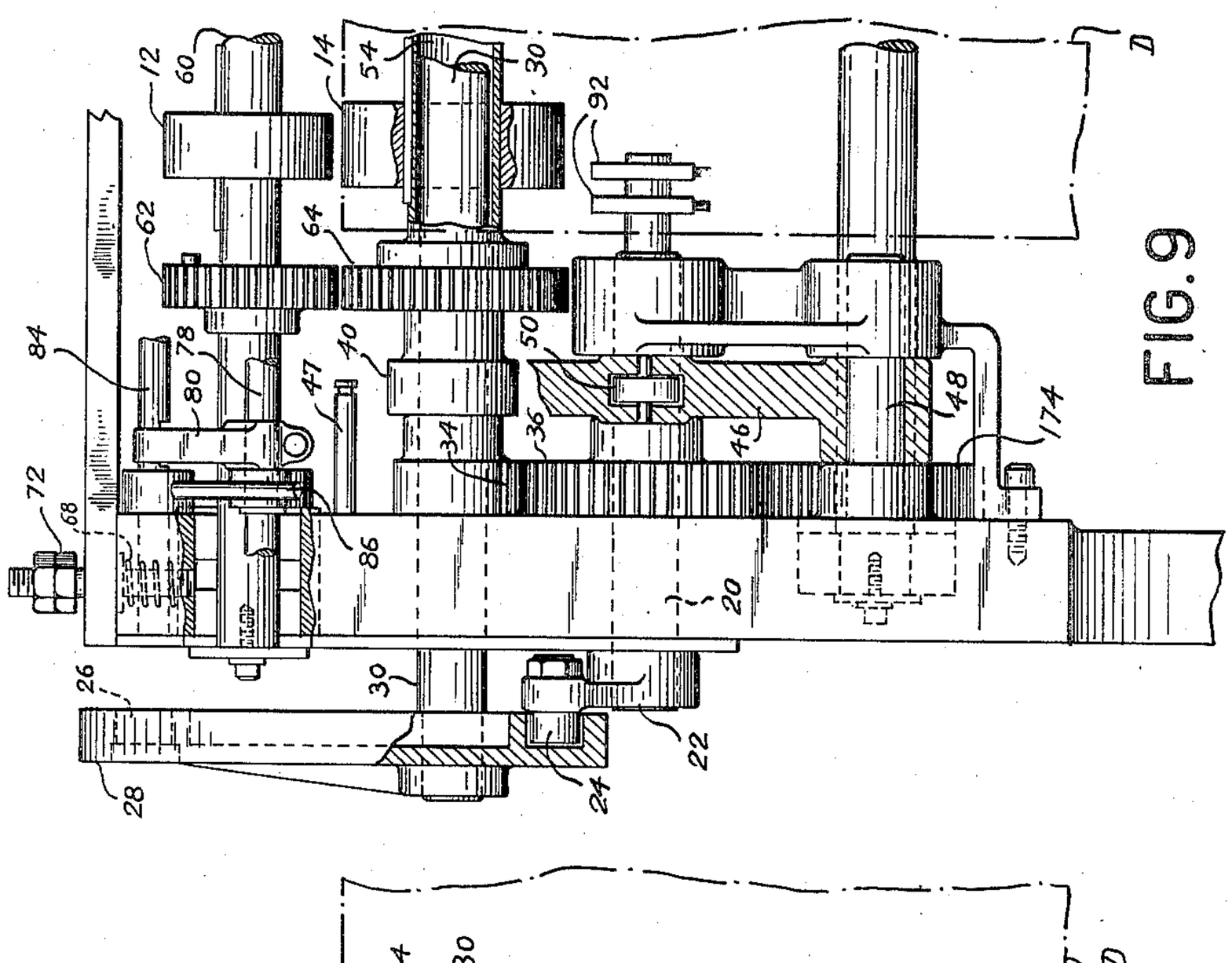

FIG. 9

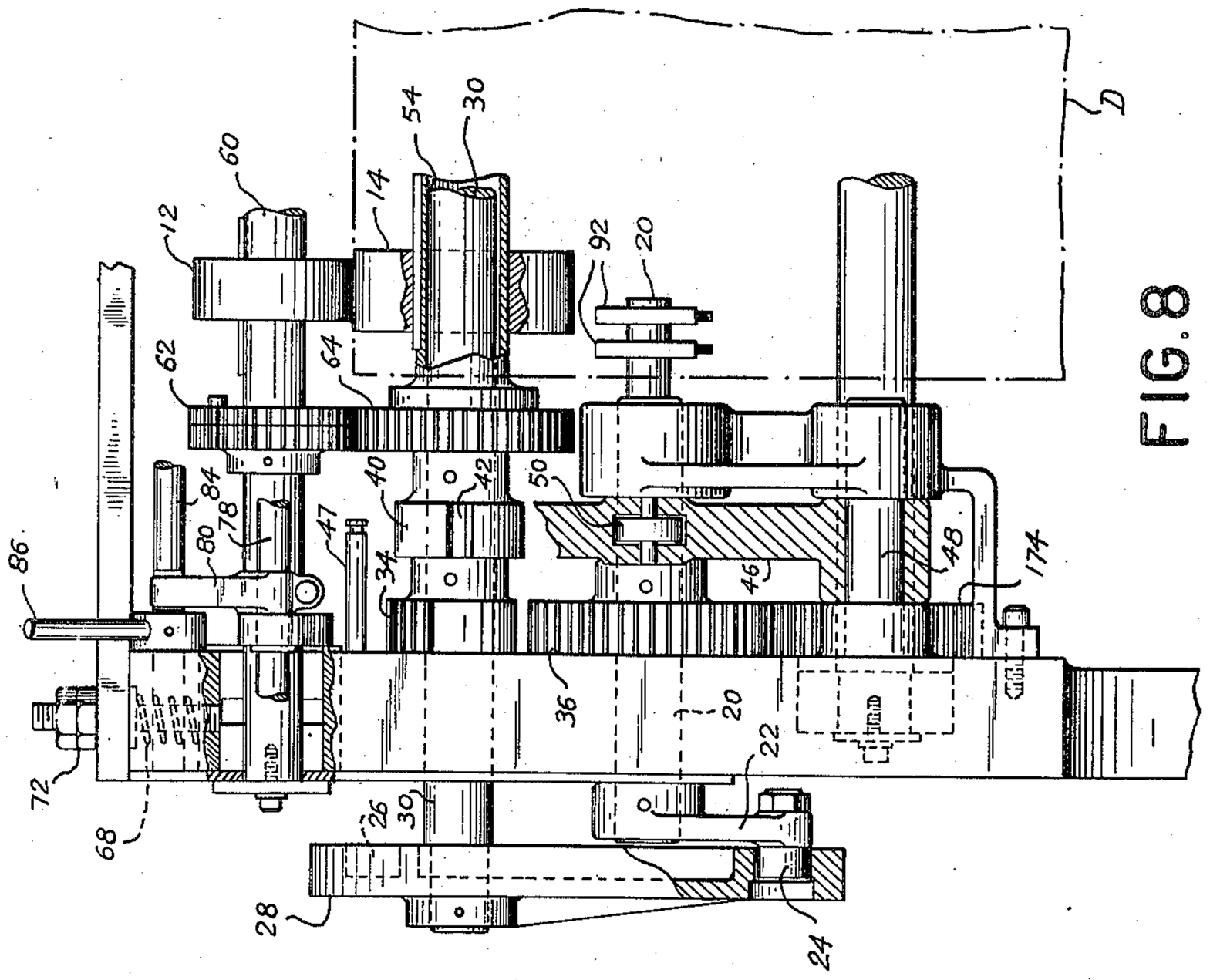

FIG. 8

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Patented Apr. 10, 1951

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UNITED STATES PATENT OFFICE

2,548,136

REGISTER CONTROL MEANS FOR CONTINUOUS AND INTERMITTENT WEB FEED MECHANISM

Frederick Auer, Teaneck, N. J., assignor to Champlain Company, Inc., Bloomfield, N. J., a corporation of New York

Application June 22, 1946, Serial No. 678,612

31 Claims. (Cl. 271—2.6)

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This invention relates to web feed mechanism, and more particularly to mechanism for intermittently feeding a web at high speed.

The primary object of the present invention is to generally improve such mechanisms. A more particular object is to improve such mechanisms intended to operate in synchronism with machines operating on a continuously moving web. A common example is the combination of printing machinery operating on a continuously moving web, with cutting, scoring, or punching machinery operating on the same web intermittently.

Heretofore, one method was to provide between the machines a slack loop having slack corresponding to the length of a single blank being operated upon. Feed rollers at the punch press would attempt to feed the web too fast, and would take up the loop. The loop was completely taken up at the time of the punching step, and stop fingers would at this time hold the web against the pull of the feed rollers. The web had to be taut at the time of descent of the stop fingers, because the distance between the printing press and the punch press with a tight web is what determined the registration of the printing and punching operations. As the stop fingers came down the pressure of the feed rollers was relieved, and often difficulty arose because of momentary loss of control of the web during the changeover from the feed rollers to the stop fingers.

Such an arrangement, while satisfactory at slow operating speeds, was not satisfactory at high speeds. Under high speed operation the slack would be taken up sharply, causing flutter and possible shortening of the sheet, with consequent poor registration, or slight errors in the length of the blank. There was also the annoyance of a rapidly repeated noisy snap as the loop was repeatedly pulled from slack to taut. When dealing with a long blank, the slack loop became quite deep, and taking out the slack at high speed would generate a wind resistance which would also affect the accuracy of registration.

In another development the web was moved continuously through the punch press as well as the printing press, the punch press being so designed that the cutting dies moved along with the web. However, such an arrangement was also unsatisfactory for high speed operation because of the very large masses associated with the dies which have to be moved back and forth in the direction of the web at high speed.

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General objects of the present invention are to overcome the foregoing difficulties, and to provide an improved web feed mechanism for intermittently feeding a web at high speed, and to keep positive control of the web at all times. For this purpose I employ feed wheels which engage the web tightly at all times, and which are rotated intermittently a predetermined amount to measure out or "meter" blanks of proper length and proper registration.

A more specific object of the present invention is to provide feed wheels which are accelerated, then rotated at uniform speed, then decelerated, and then remain stationary or dwell for the cutting operation. In accordance with the present invention, cam and cam roller mechanism is provided for accelerating and decelerating the feed wheels, and a gear segment is provided for uniform speed rotation of the feed wheels. In accordance with another feature and object of the invention, the stop position of the feed wheels is accurately predetermined as, for example, by providing a pilot wheel and a pilot which engages an opening in the pilot wheel during the dwell period. The pilot is cam controlled for high speed operation.

Still another object is to facilitate changing the length of feed, as when a new size blank is to be made. There are top and bottom feed wheels, and in accordance with the invention the top or more accessible feed wheels are driven, and may be removed and replaced by feed wheels of different diameter, thus changing the feed without changing the relative division of the periods for acceleration, uniform movement, deceleration, and dwell of the web.

Any error in feed is cumulative, and even if only a few thousandths of an inch will in the course of a thousand sheets amount to a few inches. This will spoil registration, and if continued would soon use up the slack loop between the machines, or increase the slack loop until it drags on the floor. Still another object of the present invention is to ensure registration of the printing and cutting operations, and to maintain the slack loop. For this purpose, either or both of two registration systems may be employed. In one of these systems a photoelectric cell is used in cooperation with a mark or target on the web, and a slight corrective increment of movement is fed into the feed wheels to make up for any loss of registration. In the other system, a positive infinite variable drive or so-called P. I. V. drive of the Link Belt Company or equivalent Reeves drive or Llewellyn drive is employed be-

tween the two machines and is so adjusted, either manually or automatically, as to keep the slack loop between the two machines constant in dimension.

To accomplish the foregoing objects, and other more specific objects which will hereinafter appear, my invention resides in the press and feed elements, and their relation one to the other as are hereinafter more particularly described in the following specification. The specification is accompanied by drawings, in which:

Fig. 1 is a small view schematically showing one use of the invention;

Fig. 2 is a side elevation of a press with feed mechanism embodying features of the invention;

Fig. 3 is an end elevation of the press looking toward the feed mechanism;

Fig. 4 is an enlarged section taken approximately in the plane of the line 4—4 of Fig. 3;

Fig. 5 is a partially sectioned view drawn to enlarged scale and explanatory of a part of the feed mechanism;

Fig. 6 is an end elevation of the feed mechanism with part of the cam broken away;

Fig. 7 is a similar view showing the parts in a different position;

Fig. 8 shows the mechanism of Fig. 6 in elevation; and

Fig. 9 is a similar partially sectioned elevation but showing the parts in the position of Fig. 7.

Referring to the drawing, and more particularly to Fig. 1, the apparatus comprises a first machine A which operates on a continuously moving web B, and a second machine C which operates on the same web with the web moved only intermittently, there being a slack loop D of the web between the two machines. The motor E runs continuously and drives the machines A and C, the machine C including means to move the web intermittently.

In the present case the machine A is a printing press, (it being understood that there may be a bank of printing presses for multi-colored printing, instead of a single press as shown) and the machine C is a punch press which may be used for scoring or cutting the web. A typical problem may be to make blanks for milk containers, in which case the web is scored to mark the fold lines, and is cut to mark the outlines of the blank.

Referring now to Fig. 2 of the drawing, the punch press C receives web B as fed to it by intermittently driven top and bottom feed wheels 12 and 14, these being intermittently driven by "speed-up" mechanism generally designated F. To maintain registration and to guard against cumulative change in the size of the slack loop of web, compensating mechanism may be provided, such as the motor 16 which supplies corrective movement to the feed wheels through differential gearing, later described, or by means of a positive infinite variable drive indicated at 18, this being disposed between the machines C and A, as is perhaps better shown in Fig. 1.

The speed-up mechanism F is best shown in Figs. 6 through 9, and referring thereto the shaft 20 carries a cam roller arm 22 with a cam roller 24. The latter runs in the cam groove 26 of a somewhat heart-shape cam 28, the latter being carried on a cam shaft 30. The shaft 20 turns continuously, but the cam shaft 30 turns only intermittently, and drives the feed wheels. The cam motion provides acceleration, deceleration,

and a dwell period. Figs. 6 and 8 show the parts at the dwell period, the cam roller 24 moving on a radius corresponding substantially to the curvature of the cam groove at the apex of the heart-shaped cam. The sides of the cam groove correspond to the acceleration and deceleration periods. In the present case, the cam is so shaped as to provide a uniform acceleration and a uniform deceleration, but it is not essential they be uniform.

In the illustrated machine I provide a period of uniform velocity feed between the acceleration and deceleration periods. This corresponds to the top of the heart-shaped cam, and Figs. 7 and 9 show the parts during this uniform velocity period. The cam roller 24 engages and moves with the recess 32 of the cam groove, much in the nature of a gear tooth. However, the cam mechanism is not relied upon for the uniform velocity drive, and is supplemented by gear teeth. In Fig. 6 a gear segment 34 is shown in its upper or inactive position, and mating gear 36 turns freely relative to the gear segment 34. This is essential during the dwell period shown. In Fig. 7 gear segment 34 is in mesh with gear 36, as it should be during the uniform velocity period.

In the particular drive here shown, the rotation of the driven shaft 30 is divided into four periods, corresponding to rotation of the driving shaft 20, as follows: acceleration for 108°, uniform velocity for 90°, deceleration for 108°, and dwell for 58°. These values are solely by way of example, and not in limitation of the invention.

To guard against overtravel and to accurately fix the position of the driven shaft 30 during the dwell period, I prefer to employ pilot means. In the present case, this comprises a pilot wheel 40 having a pilot opening 42, best shown in Fig. 7, and a pilot pin 44 for engaging pilot opening 42 during the dwell period, as is best shown in Fig. 6. The pilot pin 44 is carried on a lever 46 fulcrumed at 48 and carrying a cam roller 50 bearing against a cam 52. A spring part shown at 47', anchored on post 47 in Figs. 8 and 9, urges the roller against the cam. The cam is carried on the driving shaft 20 previously referred to, and controls the operation of the pilot pin. Such cam control of the pilot pin makes it possible to operate the apparatus without loss of speed to accommodate the pilot operation.

As so far described, the intermittently driven shaft 30 might run directly to the feed wheels, and in fact, in looking at Fig. 3 of the drawing, one might assume that the bottom feed wheels 14 are carried directly by the shaft 30. In the particular machine here illustrated, however, shaft 30 extends axially through a hollow shaft or sleeve 54 which turns freely about shaft 30, and which carries the feed wheels 14. The shaft 30, by means of gears 56 and 58, drives the shaft 60 of the top feed wheels 12. The shaft 60 drives the sleeve 54 and bottom wheels 14, by means of gears 62 and 64. It is convenient to drive through the top feed wheels, in order to facilitate changing the length of feed. It will be understood that each rotation of the cam shaft 30 corresponds to the feed of one blank. The gears 56 and 58 may be of such diameter that each rotation of top feed wheels 12 also corresponds to one blank. This is convenient but not essential. The pitch diameter of gear 62 corresponds to the diameter of feed wheels 12, and the pitch diameter of gear 64 corresponds to the diameter of feed wheels 14, hence the feed wheels 12 and 14 turn at equal linear speed, as

they should, although they may turn at different rotative speeds.

Now if the length of the blank being operated on is changed, the feed wheels 12 are changed in diameter, and the gear 62 is correspondingly changed to a gear having the new pitch diameter. The shaft 60 assumes a new height, depending on the change in diameter of the feed wheels, and the shaft bearings are accordingly made slidable in ways to accommodate this change. The gears 56 and 58 are changed to another pair of gears which will provide the proper new center-to-center spacing between the shafts 30 and 60. Here again it is convenient but not essential to keep the same gear ratio. If not, the new ratio must be considered together with the top feed wheel diameter, to determine the feed length. In some rare cases it may be possible to change to a new desired feed length by changing the gear ratio of gears 56 and 58 without changing the feed wheels and gear 62. However, the more usual procedure is to turn the top feed wheels once for each blank, and to make the circumference of the feed wheels equal to the desired length of blank. In usual practice, shaft 60, feed wheels 12, and gears 58 and 62 may all be provided as a unit which may be bodily removed from or added to the machine. In this way the only other change needed is to change the gear 56.

Figs. 2, 6 and 7 show how shaft 60 is carried in bearings 66 which are slidable in ways and which are urged downwardly both gravitationally and by means of springs 68. The screws 70 hold the springs in position. The nuts 72 may be adjusted to limit the downward movement of the bearings when dealing with a thick cardboard web, but with a thin web, may be backed off enough to apply full spring pressure, When the height of shaft 60 is changed substantially, different springs may be used, or the spring pressure may be limited by nuts 72. A more elaborate spring mounting may be provided in which an adjusting screw bears on top of the spring, and compensates for change of shaft height, so that the same spring pressure may be applied by the same spring for any shaft height.

The feed wheels are preferably arranged for quick release in the event it is desired to stop movement of the web. For this purpose, lift arms 76 (Figs. 6 and 7) are provided, the ends of which underlie the shaft 60. The arms 76 are secured to a rod 78 which has an upwardly extending arm 80 which rests against a cam or "flat" 82 formed on a rod 84, the ends of which carry handles 86. In Fig. 6, the handles 86 are shown in normal or raised position, thus permitting the feed wheels 12 to bear down tightly against the feed wheels 14. In Fig. 7, the handles 86 have been pulled down to release position, thereby oscillating the rod 78 and arms 76 slightly in clockwise direction, and thus raising the shaft 60 and with it the upper feed wheels 12. The web B then rests loosely between the feed wheels and is no longer moved thereby.

Reference has already been made to motor 16 shown in Figs. 2 and 3. In Fig. 2, attention is also directed to the photoelectric unit 90 which scans the web and responds to an appropriate mark or target printed on the web, corresponding to each blank. Various units have already been developed and are known for this purpose, the electrical impulse resulting from passage of the target being compared with a suitable standard, most conveniently a segment on a commutator on

a one-to-one rotation shaft in the machine. In the present case, the shaft 20 (Fig. 3) is selected for the purpose, it having rings 92 engaged by brushes 94 connected in an electrical circuit, not shown, this circuit cooperating with the photoelectric scanning device 90 (Fig. 2) in such a way that a loss of registration is revealed and energizes the motor 16. The motor then feeds a slight compensatory feed movement in a direction which helps restore the proper registration.

For this purpose differential gearing may be employed, and is generally indicated at 96 in Fig. 3. The motor 16, through a suitable belt or chain 98, drives a worm 100 meshing with a worm wheel or ring gear 102, carrying planet gears 104 and 106 which in turn mesh with sun gears 108 and 110. Sun gear 108 is carried by the cam shaft 30 previously referred to, and sun gear 110 is connected to the gear 56. It will be understood that with such an arrangement, the motion of cam shaft 30 is applied directly to the gear 56 when the motor 16, worm 100 and planet gears are stationary, and that a slight additional movement is supplied to the gear 56 when the motor 16 is energized.

As will be understood by those skilled in the art, the differential gearing may be of the bevel type using equal sun gears, or may be of the spur gear type using meshing pairs of spur planets to produce a reversal in direction equivalent to the use of bevel planets, in which case also the sun gears may be equal, or as in the particular case here illustrated, spur planets may be employed without extra spur planets for reversal of direction, and instead, the arrangement is made unsymmetrical, the sun gear 108 differing somewhat in number of teeth from the sun gear 110, and the planet gears 104 and 106 differing correspondingly in inverse direction. In the specific case here shown, gear 108 has twenty teeth, gear 104 has sixteen teeth, gear 106 has eighteen teeth, and gear 110 has eighteen teeth. (These figures are given by way of example and not in limitation of the invention.) This causes the gear 56 to turn in five to four ratio with the cam shaft 30 when motor 16 is stationary. The ratio of gears 56 and 58 is accordingly made four to five, so that feed wheel shaft 60 turns one to one with the cam shaft 30 and cam roller shaft 20.

The differential gear and feed wheel arrangement is shown in greater detail in Fig. 5, referring to which it will be seen that the cam shaft 30 extends coaxially through the hollow shaft or sleeve 54 carrying the feed wheels 14 and the gear 64. They are spaced apart by appropriate bushings, preferably commercial "Oilite" bushings 112. The sun gear 108 is keyed to cam shaft 30, as indicated at 114. The sun gear 110 is formed integrally with a sleeve 116, and it is this sleeve which carries the gear 56, the latter being keyed to the sleeve at 118. The end plate 120 is bolted at 122 to shaft 30, but both the end plate 120 and shaft 30 turn freely relative to the gear 56 and sleeve 116. The planet gears 104 and 106 are keyed to a common shaft 124 which passes through roller bearings carried in ring 126, which in turn carries a worm wheel 102 meshing with worm 100, as previously described. The ring 126 turns on shaft 30 with a suitable bearing bushing 128 therebetween.

The photoelectric cell control circuits are of two types, either of which may be employed here. In one type the feed is intentionally made slightly wrong in one sense or the other, for example, slightly too small. The compensating motor 16

would in such case be a unidirectional motor operating in a direction to increase the feed. Any loss of registration picked up by the photoelectric cell energizes the motor. In the other type, the photoelectric cell arrangement is more elaborate, and discriminates between a gain or loss of feed. The motor is a reversing motor, and is run in one direction or the other depending on whether the feed must be increased or decreased. In this case, the feed wheels are dimensioned for the correct feed, as closely as possible, instead of intentionally providing for a slight loss of feed.

In Fig. 5, it will be noted that the gears **58** and **62** are split gears of the anti-backlash type, i. e., there are two sections in face-to-face relation, one of which is keyed to the shaft, and the other of which is displaced by appropriate springs, so that any backlash between gears will be taken up at all times in one direction.

It may be well to clarify the fact that it is not essential to the invention that the cam shaft **30** pass coaxially through the bottom feed wheels **14**. It is merely a structural convenience, because with this construction a relatively light sleeve carrying the feed wheels **14** is stiffened against bending by the cam shaft running therethrough, and the latter is stiffened by the sleeve. A single set of frame bearings supports the shaft, sleeve, and differential. The arrangement also makes for compactness. Moreover, coaxial shafts are anyway wanted for the differential gearing.

It would also be well to clarify the fact that the differential gearing need not be connected in cam shaft **30**. It may be inserted anywhere between the common drive for the several machines and the present machine. It may be applied to a continuously rotating shaft instead of an intermittently moved shaft, a possible location being in the shaft **130** in Fig. 3, in which case the differential gearing would be located as indicated by the dotted rectangle **96'**. In pure theory there would be an advantage in locating the differential gearing in a continuously rather than intermittently rotated shaft, for that would avoid movement of the web during the dwell or stationary period. As a practical matter, this is ignorable when, as in the present case, it is contemplated that the feed be so accurate that the compensation is very slight in amount, say, one or a few thousandths of an inch.

It has already been mentioned in connection with Fig. 1 that the drive between the machines A and C may include a positive infinite variable or so-called "P. I. V." drive **18**. In Fig. 2, the drive shaft **132** is connected to shaft **134** of the P. I. V. drive by means of a silent gear chain **136**. The output shaft **138** of the drive **18** is not shown in Fig. 2, but is indicated in Fig. 1. This drive would be essential in the absence of the photoelectric cell compensating means previously described, the reason being that any slight error in feed would, with the passage of thousands of sheets, cumulatively decrease or increase the size of the slack loop D between the machines, thus interfering with practical operation as well as registration. By adjusting the P. I. V. drive either manually or by means of automatic controls responsive to any change in the size of the slack loop, the slack loop may be kept constant in length, and this at the same time will ensure maintenance of registration, provided registration is made correct to begin with.

The drive **18** may be used along with the photoelectric cell registering means, but is not essential because the latter, in correcting any loss of registration as to the successive blanks, automatically corrects for improper length of feed and inherently maintains the slack loop at the proper size. For example, if the slack loop contains, say, seven blanks, it will be maintained seven blanks in length regardless of any slight expansion or shrinkage in the web, or deviation in feed at the punch press.

The punch press shown in Fig. 2 may be of conventional construction, it comprising a bolster or platen **140** reciprocated by four corner rods **142** connected to links **144** operated by eccentrics driven by bull gears **146**. These mesh with gears **148** carried by a drive shaft **150** also carrying suitable pulleys **152** receiving belts **154** connected to the main drive motor E.

To drive the feed mechanism and also the printing press, power is taken off from shaft **150** by means of gear **156** which drives bevel gears **158** and **160**, the latter turning shaft **162** and bevel gears **164** and **166**. Gear **166** turns a shaft **168** located at the side of the machine, as is best shown in Fig. 3. It carries a bevel gear **170** meshing with a bevel gear **172** on the end of shaft **130** previously referred to. At its opposite end, shaft **130** carries a spur gear **174** meshing with the spur gear **36** on the cam roller shaft **20** previously referred to. This completes the drive from the motor to the speed-up mechanism of the feed wheels.

Reverting to Fig. 2, the discharge side of the press is provided with a pull unit generally designated **180**. This includes rollers which turn continuously but which are adjusted to only lightly touch the web, and to slip readily when the web is stopped by stoppage of the true feed wheels **12** and **14** which meter out blanks of proper length. The pull unit is provided because the feed wheels **12** and **14** push the web, and any slight resistance in the press might cause the web to buckle or kink. This is prevented by the pull unit which keeps the web smooth and taut over the base of the die. (The die may be of the chase type, and is omitted in the drawing.) The drive for the pull unit **180** will be evident from inspection of Fig. 2, the shaft **162** driving mitre gears **182** and **184**, shaft **186**, bevel gears **188** and **190**, and the bottom feed rollers. The top feed rollers are driven by the bottom rollers through spur gears, as shown.

The unit **200** is a so-called "tab-breaker" which separates the blanks from one another. The particular machine here shown is being used to make blanks for milk containers, and these are not fully severed in the punch press. Instead, the cutting knives have notches at intervals which provide tiny connecting tabs between the blanks. The complete tab breaker includes fingers which clamp the web and hold it tight, and friction wheels having sufficient friction to break the tabs and so separate the blanks. The drive of the tab breaker unit is evident from the drawing, it being driven by the pull unit through an idler gear **202**.

The mechanism shown at **204** guides marginal waste or trim from the side edges of the web down into a chute **206**. This chute also receives small pieces of scrap which are pushed out of the web by fingers such as are indicated at **208** and which are connected to and moved by the bolster or platen **140** of the press. The holding fingers previously referred to which cooperate

with the friction wheels of the tab breaker, may also be connected to the press as shown at 208.

It is believed that the construction and operation of my improved web feed mechanism, as well as the advantages thereof, will be apparent from the foregoing detailed description. The feed wheels grip the web tightly at all times and maintain positive control of the web. The web is accelerated, moved at high speed, decelerated, and then dwells in a manner which utilizes the available time, most efficiently. A combination of cam drive and gear segment provides the desired motion, and a pilot arrangement insures accurate stop position of the web during the dwell period. The feed rolls feed the web accurately, and may be thought of as metering rolls. The drive is applied to the top feed wheels, and the entire top feed wheel shaft is readily removable and replaceable to accommodate changes in size of blank. This shaft also is arranged with a quick-release mechanism to stop feed of the web. A differential mechanism under photoelectric control may be employed to automatically insure registration of the different operations on the same web. A variable speed drive between machines may also be provided, although not essential when the photoelectric control is used.

The pilot mechanism (wheel 40 and pin 44) may be located elsewhere than shown, as for example, after the differential gearing. The nearer it is to the feed rolls, the less concern there is about backlash in the gearing.

A machine using intermittent feed might precede instead of follow a machine using continuous feed. The cam and roller speed-up mechanism may employ a cam driving a roller instead of vice-versa.

It will be understood that while I have shown and described my invention in preferred forms, changes may be made in the structures disclosed, without departing from the spirit of the invention, as sought to be defined in the following claims.

I claim:

1. Apparatus comprising a machine for operating on an intermittently moving continuous web, feed wheels continuously engaging said web, a continuous power source for driving said feed wheels, and means operatively connecting said power source and said feed wheels to drive said feed wheels intermittently, said means including two shafts one of which is driven by the power source and rotates uniformly and drives the other non-uniformly, one of said shafts having a single short arm carrying a cam roller engaging a single large cam on the other shaft, said cam having a continuous cam groove for positive control and drive of the roller, and being approximately heart-shaped so that the driven shaft is accelerated, decelerated, and then dwells during each rotation, the dwell period being only a fraction of the feed period.

2. Apparatus comprising a machine for operating on an intermittently moving continuous web, feed wheels continuously engaging said web, a continuous power source for driving said feed wheels, and means operatively connecting said power source and said feed wheels to drive said feed wheels intermittently, said means including two shafts one of which is driven by the power source and rotates uniformly and drives the other non-uniformly, one of said shafts having a single short arm carrying a single large cam roller engaging a cam on the other shaft, said

cam having a continuous cam groove for positive control and drive of the roller, and being approximately heart-shaped so that the driven shaft is accelerated, then driven at uniform speed, then decelerated, and then dwells during each rotation, one of said shafts having a gear segment and the other having gear teeth meshing with said gear segment during the period of uniform speed.

3. Apparatus comprising a machine for operating on an intermittently moving continuous web, feed wheels continuously engaging said web, a continuous power source for driving said feed wheels, and means operatively connecting said power source and said feed wheels to drive said feed wheels intermittently, said means including two shafts one of which is driven by the power source and rotates uniformly and drives the other non-uniformly, one of said shafts having a single short arm carrying a cam roller engaging a single large cam on the other shaft, said cam having a continuous cam groove for positive control and drive of the roller, and being approximately heart-shaped so that the driven shaft is accelerated, decelerated, and then dwells during each rotation, the latter shaft having a pilot wheel, and a pilot mating with a pilot opening in said wheel during the dwell period.

4. Apparatus comprising a machine for operating on an intermittently moving continuous web, feed wheels continuously engaging said web, a continuous power source for driving said feed wheels, and means operatively connecting said power source and said feed wheels to drive said feed wheels intermittently, said means including two shafts one of which is driven by the power source and rotates uniformly and drives the other non-uniformly, one of said shafts having a single short arm carrying a cam roller driving a single large cam on the driven shaft which in turn drives the feed rollers, said cam having a continuous cam groove for positive control and drive of the roller, and being approximately heart-shaped so that the cam shaft is accelerated, then driven at uniform speed, then decelerated, and then dwells during each rotation, one of said shafts having a gear segment and the other having gear teeth meshing with said gear segment during the period of uniform speed, said cam shaft having a pilot wheel, and a pilot mating with a pilot opening in said wheel during the dwell period.

5. Apparatus comprising a machine for operating on an intermittently moving web, top and bottom feed wheels continuously engaging said web, a top shaft carrying said top feed wheels, a power source for driving said feed wheels, and means between said power source and said feed wheels to drive said feed wheels intermittently, the intermittent drive from said power source and the aforesaid means being applied to the top shaft, said top shaft being removably mounted in the machine with bearings adjustable to receive top feed wheels of different diameter.

6. Apparatus comprising a machine for operating on an intermittently moving web, top and bottom feed wheels continuously engaging said web, a power source for driving said feed wheels, and means between said power source and said feed wheels to drive said feed wheels intermittently, the bottom feed wheels being mounted on a shaft having a gear the pitch diameter of which corresponds to the diameter of the bottom feed wheels, the top feed wheels being mounted on a shaft having a gear the pitch diameter of which

corresponds to the diameter of the top feed wheels, the intermittent drive from said power source and the aforesaid means being applied to the top shaft, said top shaft being removably mounted in the machine with bearings adjustable to receive top feed wheels of different diameter.

7. Apparatus comprising a machine for operating on an intermittently moving web, top and bottom feed wheels continuously engaging said web, a top shaft carrying said top feed wheels, a power source for driving said feed wheels, and means between said power source and said feed wheels to drive said feed wheels intermittently, the intermittent drive from said power source and the aforesaid means being applied to the top shaft, said top shaft being removably mounted in the machine with bearings adjustable to receive top feed wheels of different diameter, and a quick release lever for lifting the top shaft and feed wheels in order to release the pressure on the web and thereby interrupt the feed of the web.

8. Apparatus comprising a machine operating on a continuously moving web, a machine operating on an intermittently moving web, said web having a slack loop between said machines, top and bottom feed wheels at the second named machine continuously engaging said web, a top shaft carrying said top feed wheels, a common power source for driving said machines and said feed wheels, and means between said power source and said feed wheels to drive said feed wheels intermittently, the intermittent drive from said power source and the aforesaid means being applied to the top shaft, said top shaft being removably mounted in the machine with bearings adjustable to receive top feed wheels of different diameter depending on the length of the blank being operated on.

9. Apparatus comprising a machine operating on a continuously moving web, a machine operating on an intermittently moving web, said web having a slack loop between said machines, top and bottom feed wheels at the second named machine continuously engaging said web, a common power source for driving said machines and said feed wheels, and means between said power source and said feed wheels to drive said feed wheels intermittently, the bottom feed wheels being mounted on a shaft having a gear the pitch diameter of which corresponds to the diameter of the bottom feed wheels, the top feed wheels being mounted on a shaft having a gear the pitch diameter of which corresponds to the diameter of the top feed wheels, the intermittent drive from said power source and the aforesaid means being applied to the top shaft, said top shaft being removably mounted in the machine with bearings adjustable to receive top feed wheels of different diameter depending on the length of the blank being operated on.

10. Apparatus comprising a machine feeding and operating on a continuously moving web, a machine operating on an intermittently moving web, said web having a slack loop between said machines, top and bottom feed wheels at the second named machine continuously engaging said web, a top shaft carrying said top feed wheels, a common power source for driving said machines and said feed wheels, and means between said power source and said feed wheels to drive said feed wheels intermittently, the intermittent drive from said power source and the aforesaid means being applied to the top feed wheel shaft, said top shaft being removably mounted in the machine with bearings adjustable to receive top feed wheels of different diameter, said means between said power source and said feed wheels including two shafts one of which rotates uniformly and drives the other non-uniformly, one of said shafts having an arm carrying a cam roller engaging a cam on the other shaft, said cam being so shaped that the driven shaft is accelerated, decelerated, and then dwells during each rotation, and means to change the feed of the web in one of said machines relative to the feed of the web in the other of said machines in order to compensate for any error in the feed which might otherwise cause a gradual cumulative change in the slack loop between the machines.

11. Apparatus comprising a machine feeding and operating on a continuously moving web, a machine operating on an intermittently moving web, said web having a slack loop between said machines, top and bottom feed wheels at the second named machine continuously engaging said web, a common power source for driving said machines and said feed wheels, and means between said power source and said feed wheels to drive said feed wheels intermittently, the bottom feed wheels being mounted on a shaft having a gear the pitch diameter of which corresponds to the diameter of the bottom feed wheels, the top feed wheels being mounted on a shaft having a gear the pitch diameter of which corresponds to the diameter of the top feed wheels, the intermittent drive from said power source and the aforesaid means being applied to the top shaft, said top shaft being removably mounted in the machine with bearings adjustable to receive top feed wheels of different diameter, said means between said power source and said feed wheels including two shafts one of which rotates uniformly and drives the other non-uniformly, one of said shafts having an arm carrying a cam roller engaging a cam on the other shaft, said cam being so shaped that the driven shaft is accelerated, decelerated, and then dwells during each rotation, said shaft having a pilot wheel, and a pilot movable into and out of the pilot opening in said pilot wheel during the dwell period, and means to change the feed of the web in one of said machines relative to the feed of the web in the other of said machines in order to compensate for any error in the feed which might otherwise cause a gradual cumulative change in the slack loop between the machines.

12. Apparatus comprising a machine feeding and operating on a continuously moving web, a machine operating on an intermittently moving web, said web having a slack loop between said machines, top and bottom feed wheels at the second named machine continuously engaging said web, a common power source for driving said machines and said feed wheels, and means between said power source and said feed wheels to drive said feed wheels intermittently, additional means to change the feed of the web in one of said machines relative to the feed of the web in the other of said machines in order to compensate for any error in the feed of the feed wheels which might otherwise cause a gradual cumulative change in the slack loop between the machines, the bottom feed wheels being mounted on a shaft having a gear the pitch diameter of which corresponds to the diameter of the bottom feed wheels, the top feed wheels being mounted on a shaft having a gear the pitch diameter of which corresponds to the diameter of the top feed

wheels, the intermittent drive from said power source and the aforesaid means being applied to the top shaft, said top shaft being removably mounted in the machine with bearings adjustable to receive top feed wheels of different diameter, said means between said power source and said feed wheels including two shafts one of which rotates uniformly and drives the other non-uniformly, one of said shafts having an arm carrying a cam roller engaging a cam on the other shaft, said cam being so shaped that the driven shaft is accelerated, then driven at uniform speed, then decelerated, and then dwells during each rotation, one of said shafts having a gear segment and the other having gear teeth for meshing with said gear segment during the period of uniform speed, the intermittently rotating shaft having a pilot wheel, and a pilot mating with a pilot opening in said pilot wheel during the dwell period.

13. Apparatus for operating on a web, said apparatus including top and bottom feed wheels, a top shaft for the top feed wheels, a hollow shaft or sleeve for the bottom feed wheels, a gear on said sleeve, a gear on said top shaft meshing with said sleeve gear, a coaxial shaft passing through said sleeve and geared to said top shaft, and means to drive the coaxial shaft in order to drive the feed wheels, said top shaft and top feed wheels being removable and changeable in order to change the feed, said bottom feed wheels and sleeve remaining in position on the coaxial shaft.

14. Apparatus for operating on a web, said apparatus including top and bottom feed wheels, a top shaft for the top feed wheels, a hollow shaft or sleeve for the bottom feed wheels, a gear on said sleeve, a gear on said top shaft meshing with said sleeve gear, a coaxial shaft passing through said sleeve and geared to said top shaft, and means to intermittently drive the coaxial shaft in order to intermittently drive the feed wheels, said top shaft and top feed wheels being removable and changeable in order to change the feed, said bottom feed wheels and sleeve remaining in position on the coaxial shaft.

15. Apparatus for operating on a web, said apparatus including top and bottom feed wheels, a top shaft for the top feed wheels, a hollow shaft or sleeve for the bottom feed wheels, a gear on said sleeve, a gear on said top shaft meshing with said sleeve gear, a coaxial shaft passing through said sleeve and geared to said top shaft, said gearing including differential gearing, registration compensating means including an intermittently operable motor connected to a part of said differential gearing for occasionally feeding in an extra compensation movement, and means to drive the coaxial shaft in order to drive the feed wheels, said top shaft and top feed wheels being removable and changeable in order to change the feed, said bottom feed wheels and sleeve remaining in position on the coaxial shaft.

16. Apparatus for operating on a web, said apparatus including top and bottom feed wheels, a top shaft for the top feed wheels, a hollow shaft or sleeve for the bottom feed wheels, a gear on said sleeve, a gear on said top shaft meshing with said sleeve gear, a power source, and means connecting the source to the top shaft, said means including differential gearing with sun gears and planet gears and a ring gear carrying said planet gears, registration compensating means including an intermittently operable motor connected to said ring gear, and a coaxial

shaft passing through and rotatable in said sleeve, said top shaft and top feed wheels being removable and changeable in order to change the feed, said bottom feed wheels and sleeve remaining in position on the coaxial shaft.

17. Apparatus comprising a machine operating on a continuously moving web, a machine operating on an intermittently moving web, said web having a slack loop between said machines, top and bottom feed wheels at the second named machine continuously engaging said web, a common power source for driving said machines and said feed wheels, a top shaft for the top feed wheels, a hollow shaft or sleeve for the bottom feed wheels, a gear on said sleeve, a gear on said top shaft meshing with said sleeve gear, and means connecting said power source to said feed wheels, said means including differential gearing, registration compensating means including a motor connected to a part of said differential gearing for occasionally feeding in an extra compensation movement, a coaxial shaft passing through the sleeve and geared to the top shaft, and means driven by said power source to intermittently drive the coaxial shaft in order to intermittently drive the feed wheels.

18. Apparatus comprising a machine operating on a continuously moving web, a machine operating on an intermittently moving web, said web having a slack loop between said machines, top and bottom feed wheels at the second named machine continuously engaging said web, a common power source for driving said machines and said feed wheels, a top shaft for the top feed wheels, a hollow shaft or sleeve for the bottom feed wheels, a gear on said sleeve, a gear on said top shaft meshing with said sleeve gear, a coaxial shaft passing through said sleeve and geared to said top shaft, said gearing including differential gearing with sun gears and planet gears and a ring gear carrying said planet gears, registration compensating means including an intermittently operable motor connected to said ring gear, and means driven by said power source to intermittently drive the coaxial shaft in order to intermittently drive the feed wheels, said top shaft and top feed wheels being removable and changeable in order to change the feed, said bottom feed wheels and sleeve remaining in position on the coaxial shaft.

19. Apparatus comprising a machine operating on a continuously moving web, a machine operating on an intermittently moving web, said web having a slack loop between said machines, top and bottom feed wheels at the second named machine continuously engaging said web, a common power source for driving said machines and said feed wheels, means between said power source and said feed wheels to drive said feed wheels intermittently, said means between said power source and said feed wheels including two shafts one of which rotates uniformly and drives the other non-uniformly, one of said shafts having an arm carrying a cam roller engaging a cam on the other shaft, said cam being so shaped that the driven shaft is accelerated, decelerated, and dwells during each rotation, whereby its rotation is intermittent, a top shaft for the top feed wheels, a hollow shaft or sleeve for the bottom feed wheels, a gear on said sleeve, a gear on said top shaft meshing with said sleeve gear, the aforesaid intermittently rotated shaft passing through said sleeve and geared to said top shaft, said gearing including registration compensating means including differential gearing

and an intermittently operable motor connected to a part of said differential gearing for occasionally feeding in an extra compensation movement.

20. Apparatus comprising a machine operating on a continuously moving web, a machine operating on an intermittently moving web, said web having a slack loop between said machines, top and bottom feed wheels at the second named machine continuously engaging said web, a common power source for driving said machines and said feed wheels, means between said power source and said feed wheels to drive said feed wheels intermittently, said means between said power source and said feed wheels including two shafts one of which rotates uniformly and drives the other non-uniformly, one of said shafts having an arm carrying a cam roller engaging a cam on the other shaft, said cam being so shaped that the driven shaft is accelerated, then driven at uniform speed, then decelerated, and then dwells during each rotation, whereby its rotation is intermittent one of said shafts having a gear segment and the other having gear teeth meshing with said gear segment during the period of uniform speed, a top shaft for the top feed wheels, a hollow shaft or sleeve for the bottom feed wheels, a gear on said sleeve, a gear on said top shaft meshing with said sleeve gear, the aforesaid intermittently rotated shaft passing through said sleeve and geared to said top shaft, said gearing including registration compensating means including differential gearing and an intermittently operable motor connected to a part of said differential gearing for occasionally feeding in an extra compensation movement.

21. Apparatus comprising a machine operating on a continuously moving web, a machine operating on an intermittently moving web, said web having a slack loop between said machines, top and bottom feed wheels at the second named machine continuously engaging said web, a common power source for driving said machines and said feed wheels, means between said power source and said feed wheels to drive said feed wheels intermittently, said means between said power source and said feed wheels including two shafts one of which rotates uniformly and drives the other non-uniformly, one of said shafts having an arm carrying a cam roller driving a cam on the driven shaft, said cam being so shaped that the cam shaft is accelerated, then driven at uniform speed, then decelerated, and then dwells during each rotation, one of said shafts having a gear segment and the other having gear teeth meshing with said gear segment during the period of uniform speed, said cam shaft having a pilot wheel, a pilot mating with a pilot opening in said pilot wheel during the dwell period, a top shaft for the top feed wheels, a hollow shaft or sleeve for the bottom feed wheels, a gear on said sleeve, a gear on said top shaft meshing with said sleeve gear, the aforesaid cam shaft passing through said sleeve and geared to said top shaft, said gearing including registration compensating means including differential gearing and an intermittently operable motor connected to a part of said differential gearing for occasionally feeding in an extra compensation movement, said top shaft and top feed wheels being removable and changeable in order to change the feed, said bottom feed wheels and sleeve remaining in position on the cam shaft.

22. Apparatus comprising a machine feeding and operating on a continuously moving web, a machine operating on the same web intermittently moved, said web having a slack loop between said machines, feed wheels continuously engaging said web at the second named machine, a common power source for driving said machines and said feed wheels, means operatively connecting said power source and said feed wheels to drive said feed wheels intermittently, said means including two shafts one of which rotates uniformly and drives the other non-uniformly, one of said shafts having an arm carrying a cam roller engaging a cam on the other shaft, said cam being so shaped that the driven shaft is accelerated, decelerated, and then dwells during each rotation, the dwell period being only a fraction of the feed period, and means to change the feed of the web in one of said machines relative to the feed of the web in the other of said machines in order to compensate for any error in the feed which might otherwise cause a gradual cumulative change in the slack loop between the machines.

23. Apparatus comprising a machine feeding and operating on a continuously moving web, a machine operating on the same web intermittently moved, said web having a slack loop between said machines, feed wheels continuously engaging said web at the second named machine, a common power source for driving said machines and said feed wheels, means operatively connecting said power source and said feed wheels to drive said feed wheels intermittently, said means including two shafts one of which rotates uniformly and drives the other non-uniformly, one of said shafts having an arm carrying a cam roller engaging a cam on the other shaft, said cam being so shaped that the driven shaft is uniformly accelerated, uniformly decelerated and then dwells during each rotation, the dwell period being only a fraction of the feed period, and means to change the feed of the web in one of said machines relative to the feed of the web in the other of said machines in order to compensate for any error in the feed which might otherwise cause a gradual cumulative change in the slack loop between the machines.

24. Apparatus comprising a machine feeding and operating on a continuously moving web, a machine operating on the same web intermittently moved, said web having a slack loop between said machines, feed wheels continuously engaging said web at the second named machine, a common power source for driving said machines and said feed wheels, means operatively connecting said power source and said feed wheels to drive said feed wheels intermittently, said means including two shafts one of which rotates uniformly and drives the other non-uniformly, one of said shafts having an arm carrying a cam roller engaging a cam on the other shaft, said cam being so shaped that the driven shaft is accelerated, then driven at uniform speed, then decelerated, and then dwells during each rotation, one of said shafts having a gear segment and the other having gear teeth meshing with said gear segment during the period of uniform speed, and means to change the feed of the web in one of said machines relative to the feed of the web in the other of said machines in order to compensate for any error in the feed which might otherwise cause a gradual cumulative change in the slack loop between the machines.

25. Apparatus comprising a machine feeding and operating on a continuously moving web, a machine operating on the same web intermit-

tently moved, said web having a slack loop between said machines, feed wheels continuously engaging said web at the second named machine, a common power source for driving said machines and said feed wheels, means operatively connecting said power source and said feed wheels to drive said feed wheels intermittently, said means including two shafts one of which rotates uniformly and drives the other non-uniformly, one of said shafts having an arm carrying a cam roller engaging a cam on the other shaft, said cam being so shaped that the driven shaft is accelerated, then decelerated, and then dwells during each rotation, the latter shaft having a pilot wheel, and a pilot mating with a pilot opening in said wheel during the dwell period, and means to change the feed of the web in one of said machines relative to the feed of the web in the other of said machines in order to compensate for any error in the feed which might otherwise cause a gradual cumulative change in the slack loop between the machines.

26. Apparatus comprising a machine feeding and operating on a continuously moving web, a machine operating on the same web intermittently moved, said web having a slack loop between said machines, feed wheels continuously engaging said web at the second named machine, a common power source for driving said machines and said feed wheels, means operatively connecting said power source and said feed wheels to drive said feed wheels intermittently, said means including two shafts one of which rotates uniformly and drives the other non-uniformly, one of said shafts having an arm carrying a cam roller engaging a cam on the other shaft, said cam being so shaped that the driven shaft is accelerated, then driven at uniform speed, then decelerated, and then dwells during each rotation, one of said shafts having a gear segment and the other having gear teeth meshing with said gear segment during the period of uniform speed, the driven shaft having a pilot wheel, and a pilot mating with a pilot opening in said wheel during the dwell period, and means to change the feed of the web in one of said machines relative to the feed of the web in the other of said machines in order to compensate for any error in the feed which might otherwise cause a gradual cumulative change in the slack loop between the machines.

27. Apparatus comprising a machine for operating on an intermittently moving web, top and bottom feed wheels continuously engaging said web, a top feed wheel shaft, a power source for driving said feed wheels, and means between said power solurce and said feed wheels to drive said feed wheels intermittently, the intermittent drive from the power source being applied to the top feed wheel shaft, said top shaft being removably mounted in the machine with bearings adjustable to receive top feed wheels of different diameter, depending on the length of the blank being operated on.

28. Apparatus comprising a machine for operating on an intermittently moving web, top and bottom feed wheels continuously engaging said web, a power source for driving said feed wheels, and means between said power source and said feed wheels to drive said feed wheels intermittently, the bottom feed wheels being mounted on a shaft having a gear the pitch diameter of which corresponds to the diameter of the bottom feed wheels, the top feed wheels being mounted on a shaft having a gear the pitch diameter of

which corresponds to the diameter of the top feed wheels, the intermittent drive from the power source being applied to the top shaft, said top shaft being removably mounted in the machine with bearings adjustable to receive top feed wheels of different diameter, depending on the length of the blank being operated on.

29. Apparatus comprising a machine for operating on an intermittently moving web, top and bottom feed wheels continuously engaging said web, a top feed wheel shaft, a power source for driving said feed wheels, and means between said power source and said feed wheels to drive said feed wheels intermittently, the intermittent drive from the power source being applied to the top feed wheel shaft, said top shaft being removably mounted in the machine with bearings adjustable to receive top feed wheels of different diameter, said means between said power source and said feed wheels including two shafts one of which rotates uniformly and drives the other non-uniformly, one of said shafts having an arm carrying a cam roller engaging a cam on the other shaft, said cam being so shaped that the driven shaft is accelerated, decelerated, and then dwells during each rotation.

30. Apparatus comprising a machine for operating on an intermittently moving web, top and bottom feed wheels continuously engaging said web, a power source for driving said feed wheels, and means between said power source and said feed wheels to drive said feed wheels intermittently, the bottom feed wheels being mounted on a shaft having a gear the pitch diameter of which corresponds to the diameter of the bottom feed wheels, the top feed wheels being mounted on a shaft having a gear the pitch diameter of which corresponds to the diameter of the top feed wheels, the intermittent drive from the power source being applied to the top shaft, said top shaft being removably mounted in the machine with bearings adjustable to receive top feed wheels of different diameter, said means between said power source and said feed wheels including two shafts one of which rotates uniformly and drives the other non-uniformly, one of said shafts having an arm carrying a cam roller engaging a cam on the other shaft, said cam being so shaped that the driven shaft is accelerated, decelerated, and then dwells during each rotation, said driven shaft having a pilot wheel, and a pilot mating with a pilot opening in said pilot wheel during the dwell period.

31. Apparatus comprising a machine for operating on an intermittently moving web, top and bottom feed wheels continuously engaging said web, a power source for driving said feed wheels, and means between said power source and said feed wheels to drive said feed wheels intermittently, the bottom feed wheels being mounted on a shaft having a gear the pitch diameter of which corresponds to the diameter of the bottom feed wheels, the top feed wheels being mounted on a shaft having a gear the pitch diameter of which corresponds to the diameter of the top feed wheels, the intermittent drive from the power source being applied to the top shaft, said top shaft being removably mounted in the machine with bearings adjustable to receive top feed wheels of different diameter, said means between said power source and said feed wheels including two shafts one of which rotates uniformly and drives the other non-uniformly, one of said shafts having an arm carrying a cam roller engaging a cam on the other shaft, said cam

being so shaped that the driven shaft is accelerated, then driven at uniform speed, then decelerated, and then dwells during each rotation, one of said shafts having a gear segment and the other having gear teeth for meshing with said gear segment during the period of uniform speed, the intermittently rotating shaft having a pilot wheel, and a pilot mating with a pilot opening in said pilot wheel during the dwell period.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
830,751	Turck	Sept. 11, 1906
846,945	Pierce	Mar. 12, 1907
958,661	Meisel	May 17, 1910
1,030,183	Inman	June 18, 1912
1,124,516	Provandie et al.	Jan. 12, 1915
1,858,763	Chase	May 17, 1932
1,870,197	Sibley	Aug. 2, 1932
1,975,126	Scholin	Oct. 2, 1934
2,047,221	Pechy	July 14, 1936
2,051,491	Lockett et al.	Aug. 18, 1936
2,192,908	Harrold et al.	Mar. 12, 1940