DEVICE FOR THE FEEDING AND CYCLIC TREATMENT OF A BODY WITH SYNCHRONIZING OF TREATMENT DEVICE AND FEED DEVICE

Filed Dec. 1, 1969 4 Sheets-Sheet 1

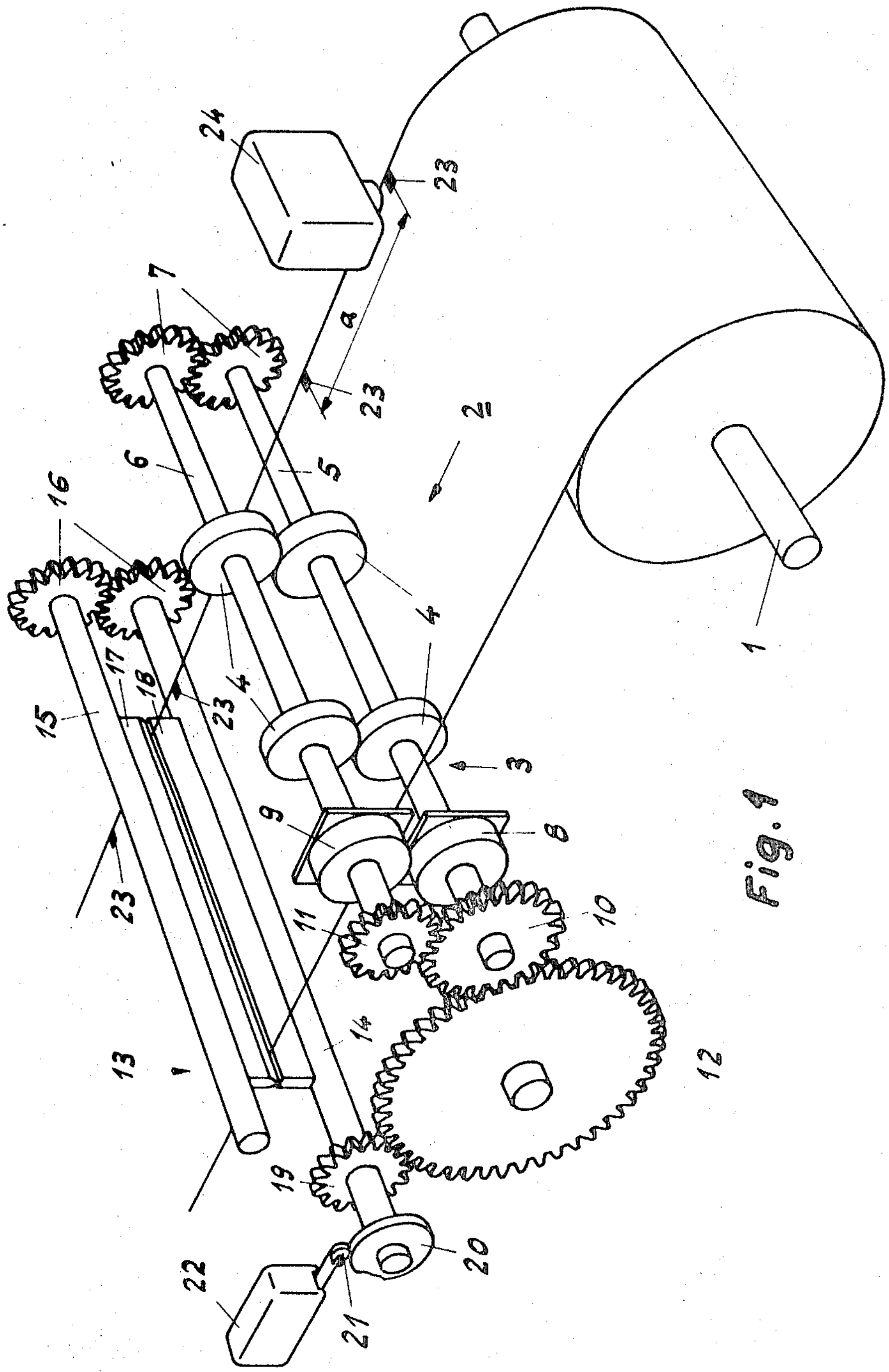

Fig. 1

DEVICE FOR THE FEEDING AND CYCLIC TREATMENT OF A BODY WITH SYNCHRONIZING OF TREATMENT DEVICE AND FEED DEVICE

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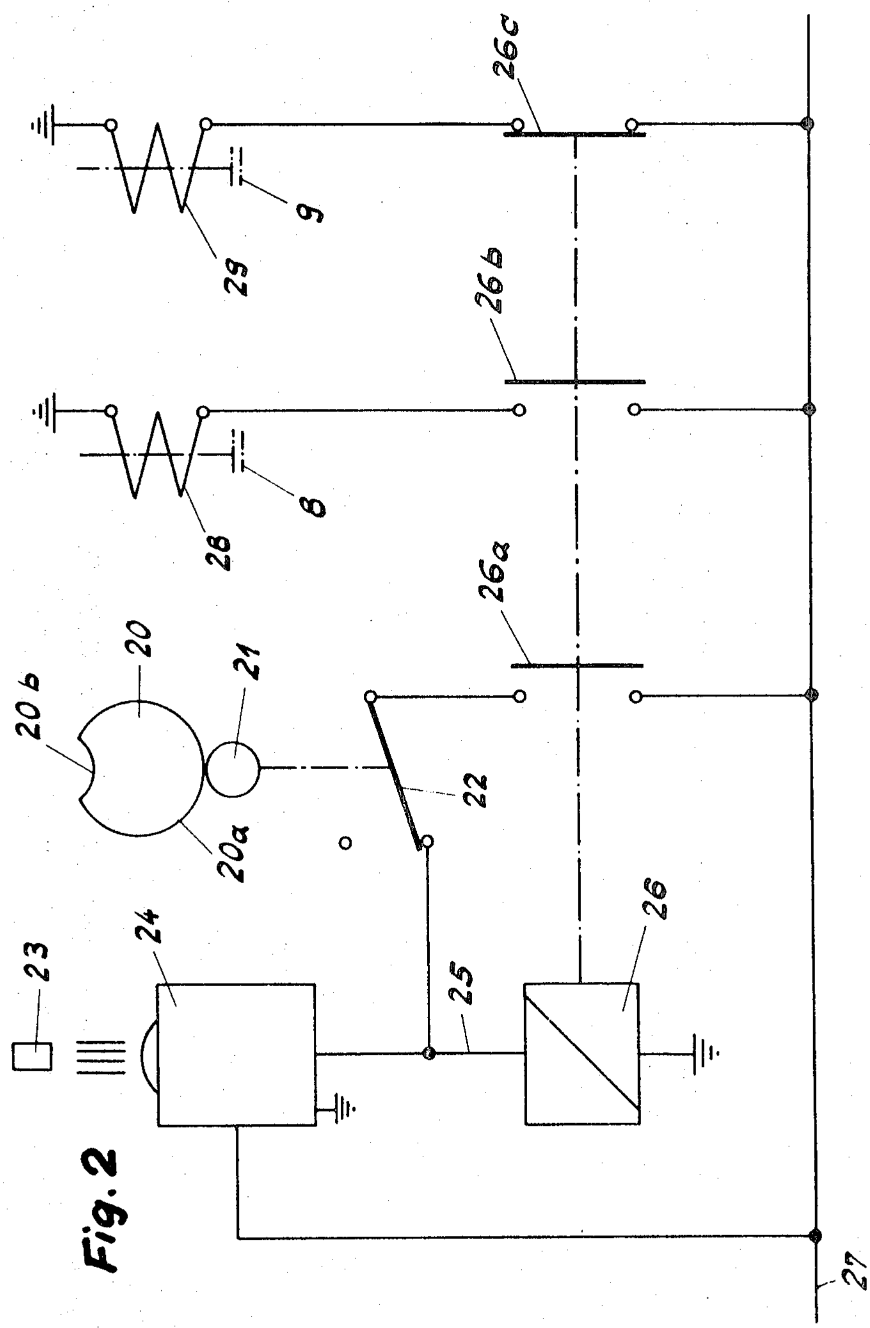

Fig. 2

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DEVICE FOR THE FEEDING AND CYCLIC TREATMENT OF A BODY WITH SYNCHRONIZING OF TREATMENT DEVICE AND FEED DEVICE

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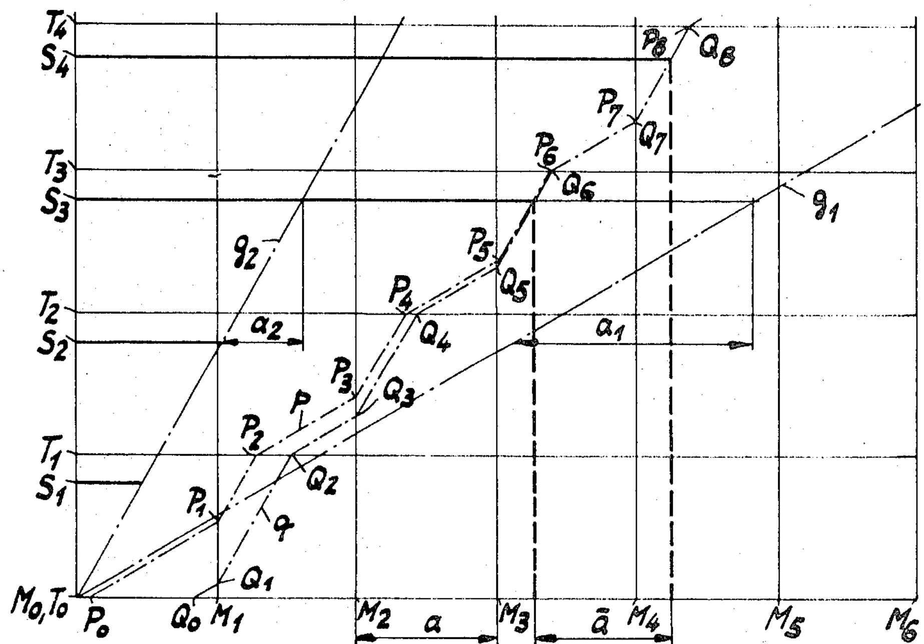


Fig. 3

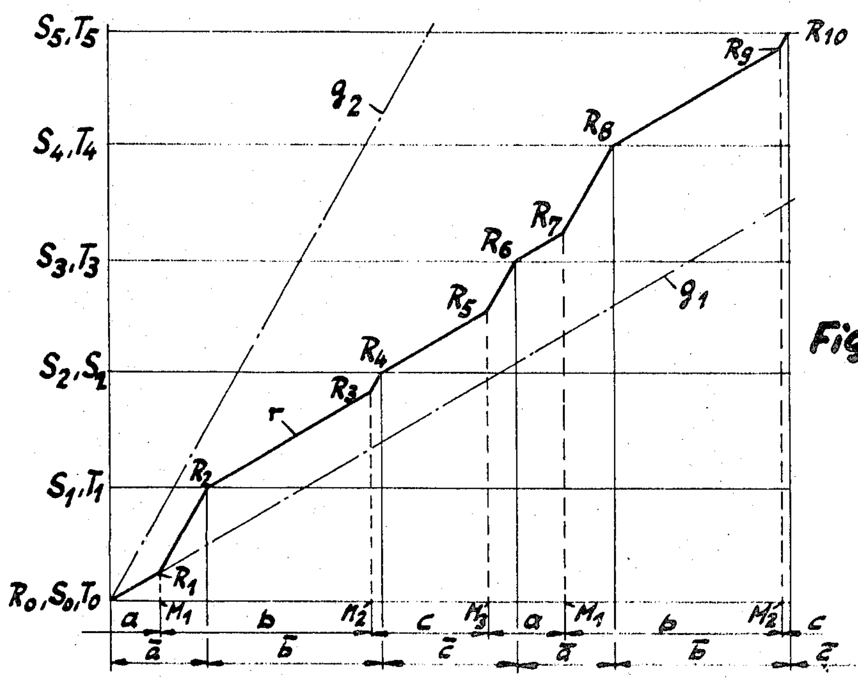


Fig. 4

Fig. 5

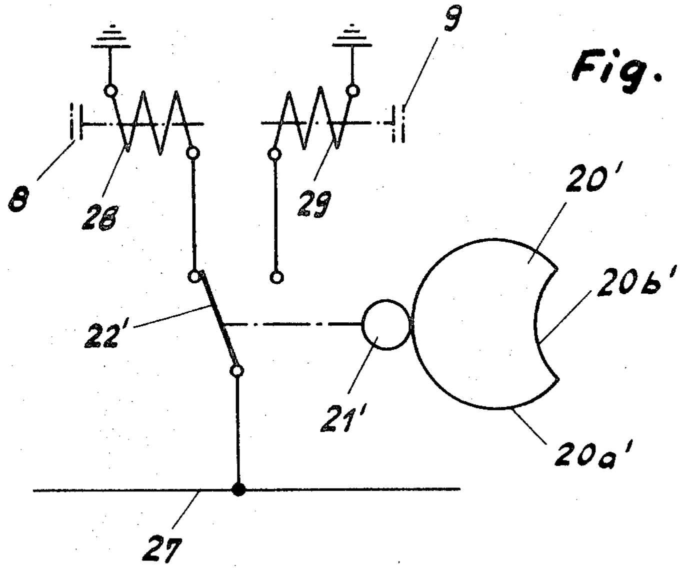


Fig. 7

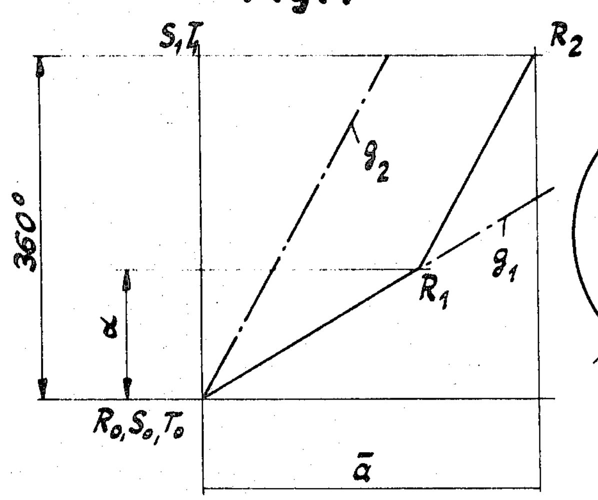
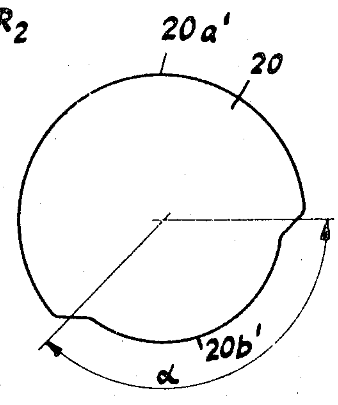


Fig. 6



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DEVICE FOR THE FEEDING AND CYCLIC TREATMENT OF A BODY WITH SYNCHRONIZING OF TREATMENT DEVICE AND FEED DEVICE

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Int. Cl. B23d *25/12*

U.S. Cl. 83—74 8 Claims

ABSTRACT OF THE DISCLOSURE

A device for feeding and cyclically processing a longitudinal body, for instance, a web of sheet material which is withdrawn from a supply roll and is to be cut into individual pieces of the desired length. A feeding device provided with rollers on at least one shaft is rotated during the operation of a processing device, such as a cutter when a web is to be cut, alternately with a high speed and a lower speed. The processing device also has at least one shaft which is rotated always with the same speed. For synchronizing the feeding device and the processing device a photoelectric scanning head is provided which scans marks arranged in lengthwise spaced relation on the longitudinal body and operates a relay which latter controls electro-magnetic clutches in the feeding device and a control cam for effecting a speed control of said feeding device in such manner that after a few initial uneven feed operations the longitudinal body is advanced with uniform speed in relation to the processing device.

The invention relates to a device for feeding and cyclically processing a body with synchronization of the processing device and the feed device, in such manner, that the body is fed between the treatments following one another consecutively, each by a predetermined amount. The body may, for example, consist of a paper web which is drawn from a supply roll and the treatment may consist in the cutting off of pieces of predetermined length from this web. Previously, with such devices the paper web is mainly fed a predetermined amount and the cutting performed at a standstill of the web; with such a stepwise feed of the web, however, the speed of operation is relatively low and the adjusting work required for the changing of the length drawn off the drum is considerable.

In order to eliminate this disadvantage, the device according to the invention is distinguished in this, that a first one of the mentioned devices has at least one shaft, which during each operating cycle of the processing device rotates alternately with a greater and with a lower speed, while the second device has at least one shaft which always rotates with the same speed, and that for the synchronization of the two devices, means are provided which reverse the first device according to the prerequisite amount alternately from the greater to the lower speed, and vice versa.

It is frequently desired to cut a paper web at specific predetermined points. This causes difficulties because already quite minor deviations from the desired length of the pieces during the course of the treatment constitute a substantial amount. In a preferred embodiment of the device in accordance with the invention, this difficulty is also eliminated.

The predetermined amount, by which the body is fed between two operative cycles must not necessarily be the same; it may rather have in consecutive operating cycles different lengths (cut-off lengths).

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The invention will now be explained with reference to the accompanying drawing, which by way of example illustrates a few embodiments.

In the drawings:

FIG. 1 is a perspective illustration of a device for the feeding and cutting of a paper web;

FIG. 2 is an electric diagram of FIG. 1;

FIG. 3 is a diagram explaining the operation of the device according to FIG. 1;

FIG. 4 is a further diagram explaining a particular application of the device according to FIG. 1;

FIG. 5 is an electric diagram for a modification of the device according to FIG. 1;

FIG. 6 illustrates the profile of a control cam provided in FIG. 5, and

FIG. 7 is an explanatory diagram of FIG. 5.

Referring to FIG. 1 the device has a shaft **1** carrying a supply roll of paper web **2** which is to be unwound. For this purpose the web **2** travels through a feed device **3** with two pairs of feed rolls **4** provided each with a rubber coating, which are mounted in spaced relation on two vertically spaced shafts **5** or **6**, extending perpendicularly to the direction of feed of the web **2**. The web **2** is assumed in the drawing for reasons of illustration to be transparent. The shafts **5** and **6** are coupled with one another at one of their ends by means of two similar gear wheels **7** meshing with one another. At the other end, the shafts **5** and **6** are connected with each other by electromagnetic couplings **8** or **9**, respectively, with two interengaging gear wheels **10**, or **11**, respectively, of which the gear wheel **10** has more teeth than the gear wheel **11**. The gear wheel **10** also meshes with a gear wheel **12**, which is driven by a prime mover not shown.

The gear wheel **12** serves also as a drive for a cutting device **13**, which has two shafts **14** and **15** provided on opposite sides of the web and extending perpendicularly to the feed direction of the web **2**, said shafts being coupled with each other at one of their ends two similar gear wheels **16** meshing with one another. The shaft **15** carries a knife **17**, which cooperates with a counter-blade **18** disposed on the shaft **14**, and is shown in that position in which it cuts through the web **2**. On the shaft **14** is also arranged a gear wheel **19** which is driven by the gear wheel **12**, and also carries a reversing cam **20**, which is engaged by the actuating member **21** of a switch **22**.

The paper web **2** is provided along one of its edges with marks (centering marks) **23**, which are arranged at equal distances from one another. A photoelectric scanning head **24**, which is used for scanning the marks, is arranged to be slidably adjustable along the path of the web **2** in any type of known manner.

In accordance with FIG. 2, an output conductor **25** of the scanning head **24** leads to a relay **26** the other conductor of which is grounded. This relay **26** has three contacts **26***a*, **26***b* and **26***c*. A conductor **27** energizes the scanning head **24** and serves for the energization of the control windings **28** and **29** of the electromagnetic couplings **8** or **9**, respectively.

By means of the described device, in the manner described more in detail in the following, the cutting device **13** cuts from the paper web **2** individual pieces having the length *a*, when the web **2** is fed continuously, namely, alternately with two speeds different from one another, and dependent on the transmission ratio of the gear wheels **10** and **11**.

In FIG. 2 it is assumed that a mark **23** is about to be moved in front of the scanning head **24**, and that the actuating member **21** of the switch **22** is located on a high peripheral portion **20***a* of the reversing cam **20**, and thereby holds the switch **22** closed. As long as the relay is found in the position of rest as shown, the winding **29** is energized by the rest-current contact **26***c* and accordingly the coupling **9** is closed, while the circuit of the winding **28** is interrupted by means of the operating contact **26***b* and accordingly the coupling **8** is open. The feed shaft **5** is driven by the gear wheels **12**, **10**, **11**, the coupling **9**, the shaft **6** and the gear wheels **7** with a number of revolutions u_1, which corresponds to a feeding speed v_1 of the web **2**.

When now the mark **23** is moved directly below the scanning head **24**, an output voltage is supplied to the relay **26**, so that the same responds and thereby the winding **29** becomes deenergized and the winding **28** becomes energized. At the same time, the holding contact **26***a* closes a holding circuit **27**, **26***a*, **22**, **25**, **26** to ground, so that the relay **26** even after the mark **23** has moved past the scanning head **24**, remains energized. The shaft **5** is now driven by the gear wheels **12** and **10** and the coupling **8**, and drives by means of the gear wheels **7** the shaft **6** with a speed of rotation u_2, which corresponds to a feed speed v_2, while the gear wheel **11** rotates idly because the coupling **9** is open. The speed of rotation u_2 or the speed v_2, respectively, is smaller than the speed of rotation u_1 or the speed v_1, because the gear wheel **11** has less teeth than the gear wheel **10**.

The shafts **5** and **6** or the feed rolls **4**, respectively, rotate for as long with the speed of rotation u_2 until the actuating member **21** reaches a low peripheral portion, **20***b* of the reversing cam **20**, and thereby opens the switch **22**, so that the holding circuit is interrupted and the relay **26** drops off. Thereby the coupling **9** is again closed and the coupling **8** is opened, whereupon the described operative cycle is repeated. As apparent from FIG. 3, with each operating cycle, by means of the cutting device **13***a* piece is cut off from the paper web **2**, whose length at the start of the operation of the device is at first different from the distance *a* between the marks **23**, but after a few cycles, however, will be equal to this distance.

In FIG. 3 are entered on the abscissae axis the length of the paper web **2** and on the ordinal axis the revolutions following consecutively of the shafts **14** and **15** of the cutting device **13**. The points M_0, M_1, M_2, M_3 to M_6 of the abscissae axis correspond to consecutive marks **23** at a predetermined distance *a*. The points T_0, T_1, T_2, T_3, and T_4 of the ordinal axis correspond to consecutive reversing points of the cam **20** after each full revolution of the shafts **14** and **15**, whereby during these revolutions, the knife **17** at the points S_1, S_2, S_3, and S_4 indicated on the ordinal axis encounters the counterblade **18** and cuts the web **2**. The straight line g_1 extending from the zero point M_0, T_0 corresponds to a condition at which the web **2** would be continuously moved with greater speed v_1 and the steeper straight line g_2 to a condition, at which the web would be constantly moved with the smaller speed v_2; since the cutting device **13** is driven by the gear wheels **12**, **19** with constant speed, the piece of web a_1 cut off at the greater speed v_1 would be longer than the piece of web a_2 cut off at the lower speed v_2. As during one revolution of the shafts **14** and **15** of the cutting device **13**, or of the reversing cam **20**, respectively, the feed of the web **2** takes place partially with the greater and partially with the lower speed v_1 or v_2, respectively, for the length $\overline{a}$ (cut-off length) of the actually cut piece of the web, the Equation $a_1>\overline{a}>a_2$ holds good, and it is found that at a desired starting position of the marks **23** with reference to the knife **17**, already after a few reversing cycles $\overline{a}$ will become equal to *a*.

In FIG. 3 are indicated two broken lines *p* and *q* which illustrate the function of the device for two very different starting conditions. In both cases, indeed, at the beginning of the rotation T_0–T_1, the web **2** moves with the greater speed v_1; for the line *p* or *q*, respectively, however, the point P_1 or Q_1 in which through the appearance of the mark M_1 under the scanning head **24** the control winding **28** of the coupling **8** is connected and the control winding **29** of the coupling **9** is disconnected, lies at a very great or at a very short distance from the starting point P_0 or Q_0, respectively of this line *p* or *q*, respectively. From P_0 or Q_0, respectively up to the reversing point P_1 or Q_1, respectively, the lines *p* and *q* extend parallel to g_1, from P_1 or Q_1, respectively, to the contrary, parallel to g_2 and indeed up to the points P_2 or Q_2, respectively, in which the reversing cam **20** again reverses the couplings **8** and **9** to the greater speed v_1. It is apparent that the lines *p* and *q* converge very rapidly on one another, so that their points P_6, P_7, P_8 etc. and Q_6, Q_7, Q_8 etc. coincide and already for the cutting length $\overline{a}$ corresponding to the cutting points S_3 and S_4, the Equation $\overline{a}=a$ is met.

If with the same device a paper web is used, whose marks **23** have any other distance *a* from one another than that distance assumed in FIG. 3, then still the cutting length $\overline{a}$ will always be similar to this other distance *a*, with the prerequisite that the distance *a* between the marks between the limit values a_{max} and a_{min}. In this connection, the maximum or the minimum mark distance a_{max} or a_{min} respectively, is equal to the cutting lengths a_1 or a_2, respectively, at the greater or the lower speed v_1 or v_2, respectively. With the dimensioning of the feed device **3** and the cutting device **13**, particularly the selection of the transmission ratio of the gear wheels **10** and **11**, it is accordingly to be noted in what area of cutting length the device is to operate, without having to be altered. That a change of this area by an exchange of gear wheels is possible without difficulty, is obvious. It is further easy to understand that the lines *p* and *q* converge the more rapidly, the greater the difference is between a_{max} and a_{min}. The gear wheels of the feed- and of the cutting-device may obviously also be connected with one another by means of endless chains. If the gear wheel **10** is selected smaller than the gear wheel **11**, then obviously the greater feeding speed v_1 occurs with a closed coupling **8** and the lower feeding speed v_2 with a closed coupling **9**.

Normally the paper web is not cut in or at the marking points M themselves. If this is desired, then it is sufficient to slide the scanning head **24** along the web **2** by the amount by which the cuts deviate from the marks. The distance between scanning head **24** and cutting device **13** will then amount to a complete multiple of $\overline{a}$. It is obviously a coincidence dependent upon the introduction of the beginning of the web **2** between the feed rolls **4**, if a mark **23** is located then directly under the scanning head **24**, when the reversing cam **20** is positioned at the opening point of the switch **22**, as is assumed in FIG. 3 at the zero point M_0, T_0, this assumption, however, playing no part in the construction and convergence of the lines *p* and *q*.

If marks are applied to the web, which alternatingly have a plurality, for example, three different distances *a*, *b* and *c* from one another, then with the described device alternatingly pieces with correspondingly many different cutting lengths $\overline{a}$, $\overline{b}$ and $\overline{c}$ may be cut off, whereby then $\overline{a}+\overline{b}+\overline{c}=a+b+c$. This will be explained more in detail with reference to FIG. 4. In FIG. 4 for the sake of clarity, it is assumed that as a result of a corresponding adjustment of the rotary position of the cam **20** on the shaft **14** the cutting points S_0, S_1, S_2, etc. indicated on the ordinal axis coincide with the reversal points T_0, T_1, T_2. On the axis of the abscissae there are indicated consecutively three groups of marks M_1, M_2, M_3, between which are present the distances *a*, *b*, *c*, and corresponding three groups of cutting lengths $\overline{a}$, $\overline{b}$, $\overline{c}$. The broken line *r* starting from the zero point $R_0S_0T_0$ coincides up to the point R_1 corresponding to the mark point M_1 with the straight line g_1, which corresponds to the greater feeding speed v_1. From the point R_1 on and up to the point R_2 corresponding to the cutting- and reversal-point S_1, T_1, the line *r* is parallel to the straight line g_2, which corresponds to the smaller feeding speed v_2, and to the now following points R_3, R_4, R_5 etc. the line *r* extends now alternately parallel to g_1 and g_2.

It is apparent that with the aforementioned cutting lengths $\bar{a}$, $\bar{b}$, $\bar{c}$, the distances *a*, *b*, *c* of the marks M_1, M_2, M_3 required on the paper web **2** may be determined in this manner, that one constructs a line *r* whose points R_0, R_2, R_4, R_6 etc. are determined by the end points of the cutting lengths $\bar{a}$, $\bar{b}$, $\bar{c}$ and the cutting-off points S, T. By drawing through the points R_2, R_4, R_6 etc. the parallel lines to g_1 and g_2, there are obtained the points R_1, R_3, R_5, R_7 etc. and accordingly the points M_1, M_2, M_3, M_1, etc. and accordingly the sought for distances *a*, *b*, *c*. If the cam **20** is adjusted otherwise on the shaft **14**, then the points **5** have a constant distance from the points T, which has no influence on the cutting lengths $\bar{a}$, $\bar{b}$, $\bar{c}$ and the corresponding marks distances *a*, *b*, *c*. It is furthermore obvious, that with another assumption for the starting point of the line **5** at the beginning the desired cutting lengths would still not be given exactly the desired lengths to be cut, but only after some operative cycles, as has been shown on the basis of FIG. 3, have been completed.

The device according to FIG. 1 may be altered in such manner that the gear wheel **19** and the cam **20** are secured to the shaft **5** of the feed device **3**, and that the gear wheels **10** and **11** are connected by the couplings **8** and **9** with the shafts **14** and **15** of the cutting device **13**. The web **2** is then continuously moved on with a constant speed, while a part of each rotation of the shafts **14** and **15** takes place with a greater and another part with a lower speed of rotation. This may be of advantage for the cooperation of the device with certain packing mechanisms.

If it is not of importance that the paper web **2** is cut at quite predetermined points, as is the case for printed packing webs, whose imprint must appear at a predetermined position on each packing, then one may dispense with the marks **23** and the scanning head **24**. In such a case, however, a suitable reversal cam **20'** is required, which also carries out the reversal which is effected in the case of FIGS. 1 and 2 by the scanning head **24**. This modification is shown in FIG. 5. It is apparent that as long as the actuating member **21'** of the reversing switch or change-over switch engages the high peripheral portion **20***a'* of the cam **20'**, the winding **28** of the coupling **8** is energized and accordingly the web **2** moves with the lower speed v_2. If the actuating member **21'**, however, engages the low peripheral portion **20***b'* of the cam **20'**, then the winding **29** of the coupling **9** is energized and the web **2** moves with the greater speed v_1, while the low peripheral portion **20***b* of the cam **20** corresponds solely to one switching point, the portion **20***b'* extends over a sector angle α, which together with the speeds v_1 and v_2 determines the cutting length $\bar{a}$. FIG. 6 shows the form of the cam **20'** more accurately. FIG. 7 shows how the angle α corresponding to a desired cutting length $\bar{a}$ may be determined, namely, in that a parallel line is drawn through R_2 to g_2, and thereby the second switching point R_1 is attained, which now, however, does not correspond to the mark M_1 as in FIG. 4, but corresponds to the end of the section **20***b'* with the sector angle α.

The modification according to FIG. 5, as compared with a device in which the feed rolls **4** can be rotated solely with a single speed, has the advantage, that the cutting lengths may be altered solely by means of interchanging of the cam **20'** by a cam of similar type, however, having another sector angle α, instead of for example interchanging a pair of gear wheels. The arrangement according to FIG. 5 may, however, obviously also be provided with a scanning head **24** as shown in FIG. 2, whereby one must take care solely by means of a corresponding circuit that either the one or the other circuit may be utilized. When the paper web **2** has no marks, for example is not printed or is provided with a so-called Spray-imprint, that is, with a printing design, which may appear on a packing at a desired position, then the same device may be utilized with the circuit according to FIG. 5 but shutting down the scanning head **24**. Without the circuit according to FIG. 5, the device is limited to the treatment of webs of paper provided with marks or other foil-shaped materials.

The invention is not limited to devices in which a web of paper or the like is to be cut into pieces of predetermined length. Similar devices may be provided for the carrying out of other work on bodies, for example, on tubings, cables. For example, tubing may be formed from a web of foil in known manner, whereby the tubing is welded together and cut at regular lengths, whereby the individual tubing sections in known manner may be filled with a material to be packed. With such a device, the feed device for the tubing may now be synchronized with the welding- and cutting-device, just as the device **3** is synchronized with the device **13** of FIG. 1. It is furthermore, for example, possible to press rings onto a cable at predetermined distances, for influencing its mechanical and/or electrical properties.

In order to insure a clean modus operandi, the speed of rotation of the operating tool during its working on the work-piece to be treated, must correspond approximately to the feeding speed of the latter. Referring to the device according to FIG. 1, this means:

The circumferential speed of the cutting device **13**, during the cutting operation must correspond at least approximately to the particular feeding speed v_1, or in any case v_2— (upon deviation, there must be counted on a bulging or tearing of the strip). By means of corresponding adjustment of the cam **20** relatively to the cutting device **13**, the cutting operation may be established in the area or range of the feeding speed v_1— or v_2, as the case may be.

What I claim is:

1. Device for feeding and cyclically processing a longitudinal body with synchronization of a processing device and a feeding device, in which the longitudinal body between successive processing operations is advanced a predetermined distance, comprising a feeding device having at least one shaft which during each operative cycle of the processing device rotates alternately with a greater and with a lower speed, said processing device having at least one shaft which constantly rotates with a uniform speed, and means for synchronizing the operations of said two devices, said means causing said feeding device to operate according to a predetermined amount alternatively with a greater speed and a lower speed, and vice versa, said feeding device being provided with two parallel shafts, drive members on said shafts and connected with each other for simultaneous rotation of said shafts, each of said shafts being connected each by a separate coupling with driven members which are driven by a a main drive member with different speeds, said separate couplings by changeover means are adapted to be separately opened and closed, said processing device being also provided with two parallel shafts, means for coupling said last mentioned parallel shafts with each other for simultaneous rotation, said means comprising driven members which are driven by a single driven member which is driven by said main drive member, and a reversal cam on one of said last mentioned parallel shafts for controlling a switch member which forms a part of said change-over means.

2. Device according to claim **1**, in which said couplings are electromagnetic, and an electric switch for controlling the circuit of control windings of said couplings.

3. Device according to claim **2**, including a photoelectric scanning head for scanning spaced marks provided lengthwise along said longitudinal body, said scanning head when scanning a mark on said body being effective to influence a relay which closes the circuit of the one control winding and opens the circuit of another control winding, and at the same time closes a holding circuit for the relay itself, which is first opened when an actuating member of said switch engages a predetermined point on the reversal cam.

4. Device according to claim **2**, including means forming an arrangement (FIG. 5) having a switch with an actuating member, said switch according to the position of its actuating member engaging one of two other portions of the reversal cam, said switch being arranged in the circuit of one of said two control windings of said couplings.

5. Device according to claim **3**, including means for making the device reversible from the one to the other of the mentioned arrangements (FIG. 2, FIG. 5), with interchange of the corresponding reversal cams (**20, 20′**).

6. Device according to claim **1**, including feed rolls on the two parallel shafts of the feeding device for advancing the longitudinal body comprising a length of sheet material, and that one of the two parallel shafts of the processing device carries a knife which is disposed opposite a counter blade on the other shaft.

7. Device according to claim **3**, in which the scanning head is slidably adjustably mounted along the path of the longitudinal body.

8. Device according to claim **6**, including means for causing the speed of the processing device during the engagement with the longitudinal body to be worked upon to correspond at least approximately to the feeding speed of said feeding device.

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JAMES M. MEISTER, Primary Examiner

U.S. Cl. X.R.

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