United States Patent

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[54] **MACHINE FOR FILLING AND CLOSING OF COLLAPSIBLE TUBES, AMPOULES AND SIMILAR CONTAINERS**
5 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **318/138,** 318/18, 318/415
[51] **Int. Cl.** **H02k 37/00**
[50] **Field of Search** ..... 318/138, 254, 20.110, 415; 310/49; 141/31, (Inquired)

[56] **References Cited**

UNITED STATES PATENTS

2,833,941	5/1958	Rosenberg et al.	318/39X
3,109,974	11/1963	Hallmark	318/(20.110)
3,110,865	11/1963	Scuitto	318/(20.11)
3,374,410	3/1968	Cronquist et al.	318/254X
3,418,547	12/1968	Dudler	318/(20.110)
3,435,314	3/1969	Bradley et al.	318/(20.110)
3,443,181	5/1969	Kozol et al.	318/(20.110)

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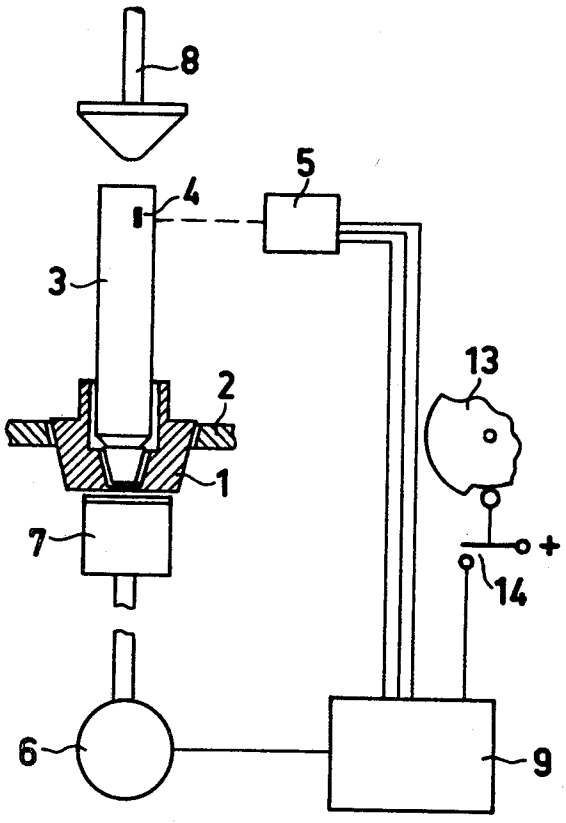
ABSTRACT: The invention relates to a device for rotating collapsible tubes or similar containers into a predetermined position for closing the open end of each tube. The device comprises a spindle driven by an electric multipolar electric step motor having a number of poles corresponding to the desired angular movement of each step. The motor is driven one step for each pulse in a pulse train from an oscillator with variable pulse frequency, said pulse train during a first time interval (t_1 to t_2) having a relatively low pulse frequency which during a second time interval (t_2 to t_3) is increased to a maximum value, said first time interval corresponding to the time consumed by the spindle cause it without any substantial slip relative the container to accelerate the same from zero to the predetermined rotational speed, which is determined by the frequency of the pulses emitted from the oscillator during said second time interval.



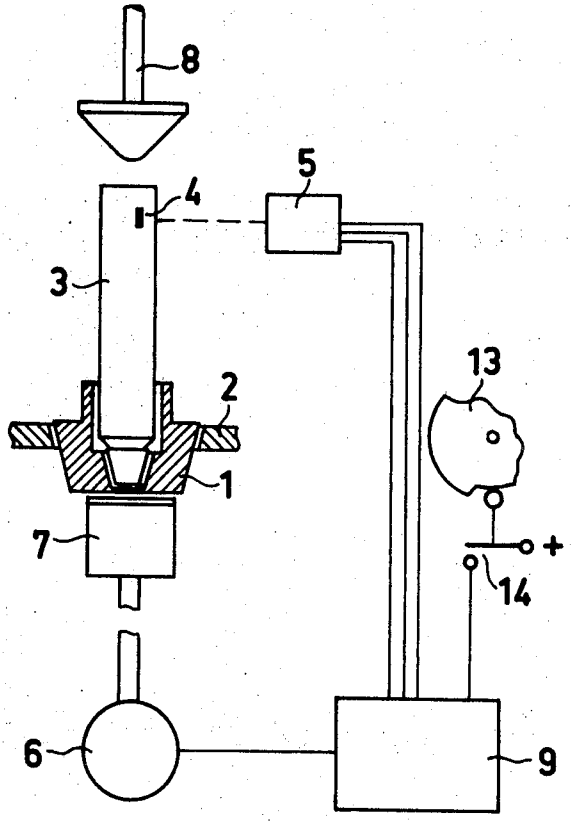


Fig 1

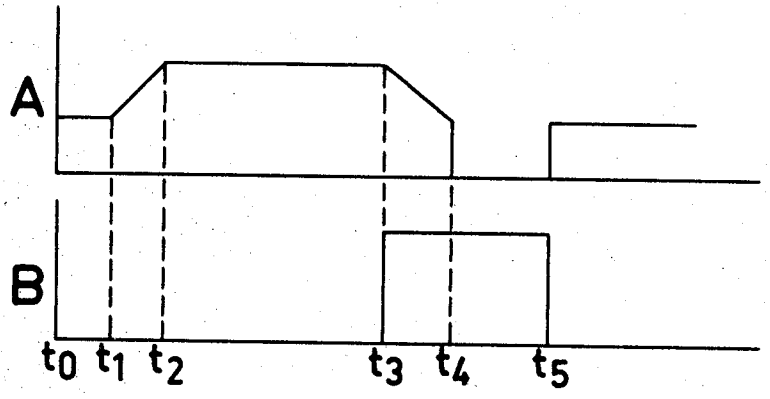


Fig 3

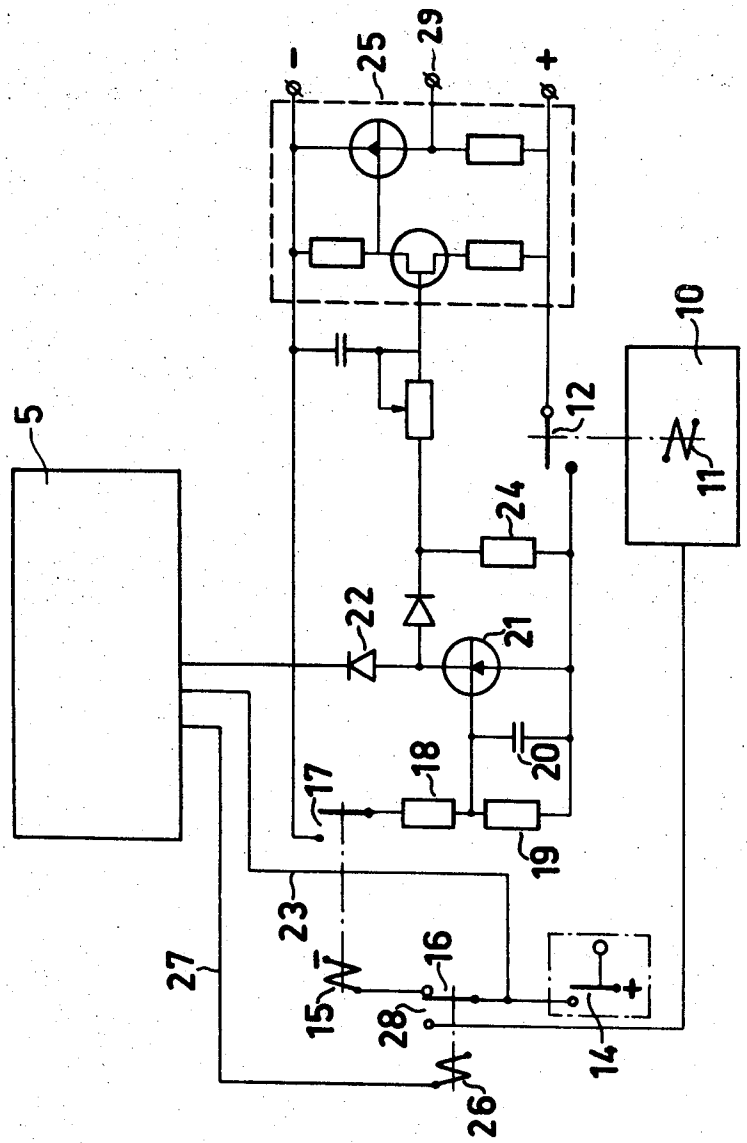


Fig 2

MACHINE FOR FILLING AND CLOSING OF COLLAPSIBLE TUBES, AMPOULES AND SIMILAR CONTAINERS

The invention relates to a device in a machine for filling and closing collapsible tubes and similar containers which during the closing cycle are intended to be rotated into a predetermined position in relation to a vertical axis in dependence of a readable marking provided on the container, said container being brought to rotational movement by means of a rotatable spindle driven by an electric motor and displaceable to frictional engagement with the bottom of the container or a retainer for said container, and rotated by said spindle into the predetermined position which is indicated by a photoelectric scanner when reading said marking.

Devices earlier known for driving the spindle which subjects the container to rotation, have normally been operative entirely dependent on the main shaft of the machine and thereby with a constant number of revolutions. To attain as rapid adjustment of the container as possible the spindle must work with the largest number of revolutions which is realizeable. This number of revolutions is substantially determined by the frictional force produced between the working surface of the spindle and the container or the collapsible tube, for example, and as slip or slide between the spindle and the container is to be avoided as much as possible, the number of revolutions of the spindle will become relatively low which results in a too long period of rotational adjustment of each container. A further drawback inherent to known devices of the kind in consideration consists in the difficulty rapidly to stop the tube or container when it has reached the predetermined position, i.e. when the photoelectric scanner reads the marking on the tube and emits a stop signal.

One main object of the invention is to provide a device in which these drawbacks are eliminated at least to a substantial extend and which thus is capable of accelerating the tube or container from a condition of rest to full turning speed which turning speed exceeds speeds obtained earlier and which in addition is capable of causing the tube to take position of standstill with great exactness.

According to a main feature of the invention the spindle of the device is coupled to a multipolar electric step motor having a number of poles corresponding to the desired angular turn per step and devised to be driven one step for each pulse in a pulse train from an oscillator having a varying pulse frequency, said pulse train during a first time interval having relatively low pulse frequency which during a second time interval is increased to a maximum value, said first time interval corresponding to the time consumed by the spindle to cause it without any substantial slip relative the container to accelerate the same from zero to the predetermined rotational speed which is determined by the frequency of the pulses emitted from the oscillator during said second time interval. According to a further development of the invention the oscillator is devised during a third predetermined time interval to generate pulses having low frequency in comparison to the maximum frequency in order thereby to cause such retardation of the container that the danger of slip or sliding relative to the driving spindle is eliminated when the motor is being braked.

Further objects and advantages of the invention will become apparent from the following description of a preferred embodiment of the invention considered in connection with the accompanying drawings, which form part of this specification and of which:

FIG. 1 shows the more important parts necessary for the understanding of the invention of a machine for rotation of collapsible tubes, the electric equipment being shown in block form,

FIG. 2 shows the oscillator and the circuits cooperating therewith, and

FIG. 3 shows diagrammatically some steps of operation during rotation of a tube.

Referring to FIG. 1, reference numeral 1 denotes a tube retainer rotatably arranged in, for example, a feed chain or a turntable assembly 2 forming part of a tube filling and locking machine. The tube 3 is provided with a mark 4 which when the tube is being locked must have taken some predetermined position in relation to locking members not shown. The mark 4 is read in conventional manner by means of an electric photocell equipment 5 which controls a driving motor 6 which in a manner not shown here is coupled with a driving spindle 7 which spindle in the turning cycle is displaced to frictional engagement with the bottom of the tube retainer 1 shown or the hat or the bottom of the container proper to be turned to correct position for the closing operation. During the turning operation during which the tube retainer 1 is rotated by means of the spindle 7 until its mark 4 is scanned by the photocell equipment 5, a conical mandrel 8 is suitably kept pressed down against the upper open end of the tube.

The novel feature consists in the device to control the motor 6 and the driving spindle 7 so as to eliminate all slip or slide between the spindle 7 and the retainer 1 whereby the position of the mark upon being scanned becomes exactly determined or does not vary but within well tolerable limits. To this end the motor 6 is constituted by a multipolar synchron motor or step motor having 200 poles, for example, which is controlled by means of a pulse train from an oscillator 9. The number of poles is chosen in dependency of the exactitude with which a tube is to be rotated into the predetermined position. With 200 poles one obtains an angular turn for each pulse corresponding to 1.8°. The number of poles of the motor is preferably kept between 160 and 360 poles. The pulse frequency of the oscillator is here of such magnitude that it during the first time interval accelerates the tube retainer 1 from the number of revolutions zero to a maximum value. Depending on a signal from the photocell equipment 5 the pulse train from the oscillator 9 is then interrupted or the pulse train frequency is lowered continuously to a desired value prior to interruption of the pulse train in order to eliminate the risk that the tube 3 is rotated by its inherent force within the retainer 1 after that the motor has been stopped. This risk is, however, serious only if the pressure mandrel 8 is lacking and it is further reduced by increasing the load on the mandrel 8.

The oscillator shown in FIG. 2 includes a delay circuit. When the machine is operative, relay 11 is energized and contact 12 is closed. The components of the oscillator 9 are in the embodiment shown dimensioned so that a pulse train with low frequency is generated from output 29 of the oscillator to the motor 6 which thus rotates with low rotational speed as is indicated in the speed diagram A the motor, FIG. 3 (time t_0 to t_1). At the moment t_0 the spindle 7 begins to be lifted towards the bottom of the tube retainer and at the moment t_1 the spindle 7 has been lifted to bear against the tube retainer 1. The surface of spindle facing the retainer 1 is covered with rubber or some other friction generating material or, if desired, devised to establish direct engagement with the retainer in which latter case no sliding or slipping whatever can occur but between the tube and the retainer. Cam disc 13 shown in FIG. 1, which is driven by the main shaft of the machine, closes contact 14 at the moment t_1. *As will be seen from FIG. 2, this will cause current to be fed to relay 15 over the closed contact 16. Furthermore, positive potential is delivered from the contact 14 through conductor 23 to the photocell equipment 5 whereby this equipment is prepared for reading the mark 4 on the tube 3. The relay 15 closes its contact 17 and thereby a circuit is closed over resistors 18 and 19 and condenser 20 which begins to be charged. Transistor 21 which had been in nonconductive condition begins to conduct current and when full current passes through the transistor 21 a signal is sent through diode 22 to the photocell equipment 5 which together with the earlier signal from the conductor 23 renders the photocell equipment 5 ready for scanning. As will become evident from the voltage diagram B of FIG. 3 which illustrates the output voltage from the photocell equipment 5 the scanning is initiated at the moment t_3.* On increase of the current of the transistor 21 resistor 24 will be

bypassed and the impedance in the RC circuit for oscillator circuit **25** has been varied continuously from the moment t_1 to the moment t_2 in such a manner that the pulse frequency of the oscillator has been changed from 300 to 1,000 pulses per second, for example. There is no reason to describe the oscillator wiring more in detail, because it is trivial for an expert to indicate a plurality of circuits suitable for the purpose in consideration.

After that the tube or container has reached its maximum number of revolutions and the photocell equipment has received the two starting signals, the tube is rotated until the light ray has hit the mark **4** whereby at the moment t_3 a signal is emitted to relay **26** through conductor **27**. This signal actuates the relay **26** and contact **28** is closed. Hereby positive potential is imposed on the continuously closed contact **14** over the contact **28** to the delay circuit **10** and the oscillator which delays the signal during a time interval t_3 to t_4. The relay **11** is deenergized at the moment t_4 and the contact **12** is opened. When the relay **26** was actuated at the moment t_3, the contact **16** was opened and the relay **15** deenergized at the moment t_3.

Upon deenergization of the relay **15** the contact **17** is opened and thereby discharge of the condenser is initiated until the transistor **21** returns to its nonconductive condition. During the time interval t_3 to t_4 the pulse frequency of the oscillator decreases continuously to the starting frequency. As already mentioned, the contact **12** is opened at the moment t_4 whereby the pulse train is interrupted and the motor is stopped in exact position. The delay circuit **10** keeps the contact **12** open until the moment t_5 at which moment the cam disc **13** again opens the contact **14**. A new rotating cycle can now be initiated.

As is easily understood an exact and unvariable location of the mark **4** and thereby the tube **3** in the predetermined position is obtained with the new device, as the motor is operating without retardation and is stopped in angular positions which are dependent only on the distribution of the poles and the working frequency which in turn can be kept very constant, while at the same time the various moments of the course of operations are entirely defined in an electronic way and thereby with great accuracy. By adjustment of the values for the resistors **18** and **19** a rapid and simple control of the acceleration cycle and the braking cycle can be brought about. Of course, the electromagnetic relays shown can be replaced by semiconductor circuits of known kind.

While one more or less specific embodiment of the invention has been shown and described, it is to be understood that this is for purpose of illustration only, and that the invention is not to be limited thereby, but its scope is to be determined by the appended claims.

I claim:

1 In a machine for filling and closing collapsible tube-shaped containers, each of the containers provided with a readable marking, an apparatus comprising: a rotatable support for holding the container in a vertical position, a rotatable spindle driven by an electric motor, means for engaging the spindle with the rotatable support thereby rotating the container, a photoelectric scanner means for scanning said container and for generating a signal when the marking is sensed, and means responsive to the signal for stopping the motor when the marking occupies a predetermined position, the motor being a multipolar electric step motor having a number of poles corresponding to a predetermined angular rotation of said spindle for each step of said motor, and a power source comprising an oscillator means for generating a varying pulse frequency pulse train to the motor and driving the motor through one step for each pulse of the pulse train, the pulse frequency of the pulse train during a first time interval having a relatively low pulse frequency and during a succeeding second time interval having a relatively high pulse frequency, the first time interval corresponding to the time during which the spindle engages the support without any substantial slip relative to the container or support and accelerates said container and support from zero to a predetermined rotational speed, the rotational speed being determined by the frequency of the pulses during the second time interval.

2. The device of claim **1** wherein the signal generated by the photoelectric scanner means occurs during a third predetermined time interval and wherein the means responsive to the signal for stopping said motor reduces the frequency of the pulses of the oscillator from the relatively relatively high pulse frequency to zero during the third time interval.

3. The device of claim **1** wherein the first time interval has a predetermined length.

4. The device of claim **1** further comprising means responsive to the contact of the spindle and the rotatable support, the means causing the pulse frequency of the oscillator to begin to vary upon the contact of the spindle and the rotatable support.

5. The device of claim **2** further comprising a delay circuit means responsive to the output of the photoelectric scanner means the delay circuit means preventing operation of the oscillator and thereby stopping the rotation of the spindle a predetermined time after the generation of a signal by the photoelectric scanner means.