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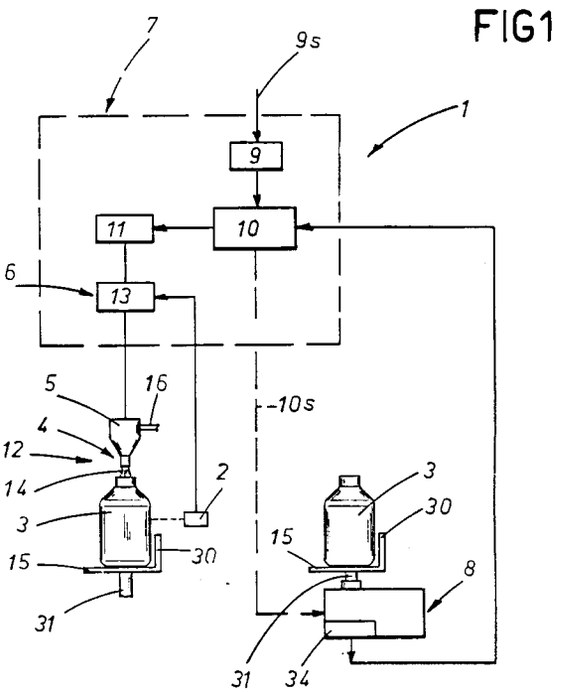
(54) Device for metering a product into respective containers, associable with automatic apparatuses or machines for filling the containers.

(57) Device, for metering a product into respective containers (3), associable with automatic apparatuses or machines for filling the containers (3), which operates in each filling station (12) of the filling machine, and includes at least one nozzle (4) for dispensing the product (14) with a constant flow-rate and a unit (5) for feeding the nozzle (4) which is activated so that it starts feeding the product (14) to the nozzle (4) by respective detectors (2) detecting the presence of a container (3) at the nozzle (4) and is actuated by a timer (13) which measures its activation time and can be adjusted according to the amount of product (14) to be fed to each container (3).

FIG1



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The present invention relates to a device for metering a product into respective containers, associable with automatic apparatuses or machines for filling said containers.

Automatic machines for filling containers with various products, usually liquid products but sometimes powder-like products, are known; they are provided with a filling apparatus, commonly termed "carousel", comprising a plurality of filling stations; a means for dispensing the product to the related container, for example a nozzle or a cock, operates in each station. The containers are taken from a conveyance line and fed to the carousel, and are respectively taken from the carousel and returned to the conveyance line, by means of two separate transfer apparatuses, better known as loading "star" conveyor and unloading "star" conveyor. In each filling station there is a seat for a respective container closed, in a downward region, by a pan for supporting said container and cooperates with related underlying weight measurement means, usually constituted by a load cell, i.e. by a dynamometer with electrical resistance strain-gauges.

In order to determine when a nozzle must start dispensing the product, i.e. when a container is below the nozzle, and when said nozzle must interrupt the feeding of product, i.e. when the preset amount of product has been dispensed, in each filling station there are means for detecting the presence of a container at the nozzle and means for measuring the weight of the entire container. The presence detection means cause the opening of an electric valve arranged along the nozzle feed duct, whereas the measurement means weigh the container continuously. Said presence detection means activate the electric valve not instantly, except for mechanical and/or electronic branches, but with a certain delay, in order to allow the measurement means to weigh, first of all, the tare of the container.

Said measurement means furthermore cooperate with comparison means adjustable according to the maximum weight of product to be dispensed; said comparison means continuously compare the weight of the container, minus its tare, with the preset adjustment value. When the preset maximum adjustment weight is reached, the comparison means act on the related electric valve and deactivate it, i.e. close it, thus interrupting the supply of product to the nozzle.

Although such a measurement system can be very valid and precise even if the tare of the containers varies considerably from one container to the next, it has the severe drawback of limiting the operating speed of the entire filling machine. The measurement means, as fast and simple as they may be, in fact require a given period of time to perform their measurement with the necessary precision, and this measurement can be biased by an excessive product flow-rate, since the kinetic energy accumulated by the product fed at an excessive flow-rate might be considered as an additional weight force by the measurement means.

In order to increase the operating speed of the machine it is thus currently necessary to reduce the time preset for the weighing operation, but this negatively affects precision.

The aim of the present invention is therefore to provide a weight control device which can obviate the drawbacks described above.

According to the present invention, a device for metering a product into respective containers is provided which is associable with automatic apparatuses or machines for filling said containers, said machines or apparatuses comprising at least one filling station in which a metering device operates, said metering device comprising means for dispensing the product to the containers and a respective unit for feeding the product to each of said dispensing means, said unit being activated so that it feeds the product to said dispensing means by means for detecting the presence of a container at the related dispensing means, characterized in that said dispensing means have a substantially constant flow-rate and in that said feed unit is controlled by means for measuring the activation time thereof.

The present invention is described in greater detail hereinafter, with the aid of the accompanying drawings, which illustrate a merely exemplifying and non-limitative embodiment thereof, wherein:

figure 1 is a block diagram of the device according to the present invention;

figure 2 is a schematic plan view, with some parts removed and others shown in cross-section in order to illustrate more clearly other parts, of a portion of an automatic filling machine with the device according to the present invention associated therewith; and

figure 3 is an elevation view, with some parts shown in cross-section in order to illustrate more clearly other parts, of weighing means which are part of the device according to the present invention.

With reference to the accompanying figures, the device according to the present invention can be used in automatic apparatuses or machines for filling containers 3 with a product 14 in fluid or power form.

A portion of a known filling machine is generally designated by the reference numeral 17 in figure 2 and comprises, in particular, an advancement line formed, in the following order, by a feeder conveyor 18, by a filling conveyor 19 and by an unloading conveyor 20. The three conveyors

18, 19 and 20 rotate about respective vertical axes and can move the containers 3 along circular paths which are substantially mutually tangent. The feeder conveyor 18 and the unloading conveyor 20 are individually substantially constituted by a rotating drum 21 and 22 which has a vertical axis, is rotated counterclockwise (as shown in figure 2) and is provided, on its peripheral region, with a plurality of receptacles 23 and 24 being mutually equidistant and individually suitable to accommodate an empty, and respectively full, container 3. A part of the rotating drums 21 and 22 is laterally delimited by respective fixed guides 25 and 26 having the purpose of keeping the containers 3 within the respective receptacles 23 and 24 during the movement of said rotating drums 21 and 22. Below said drums there are supporting means, not shown, having the purpose of supporting the containers 3 during their advancement produced by said rotating drums 21 and 22.

The filling conveyor 19 comprises a rotating disk 27 which has a vertical axis, is rotated clockwise (with respect to figure 2) and is provided, along its peripheral region, with a plurality of equidistant supporting surfaces or pans 15 which are provided with walls 30 forming an equal number of receptacles 28 suitable to receive the containers 3 during filling. The rotating drum 27 is peripherally delimited by a fixed curved guide 29 having the purpose of keeping the containers 3 within the respective receptacles 28 during the movement of the rotating drums 21 and 22.

Each of the supporting surfaces or pans 15 is fixed to the upper end of respective vertical supporting shafts 31 passing through the rotating disk 27 and constituting one side of an articulated parallelogram 32 the side whereof which is parallel to the supporting shaft 31 being constituted by a vertical bracket 33 fixed below the rotating disk 27 as shown in figure 3.

Above each supporting surface or pan 15, as shown in the schematic figure 1, there are means 4 for dispensing the product 14 to the containers 3; said means are hereinafter simply termed nozzles. In figure 1, each supporting surface or pan 15 constitutes, together with the respective nozzle 4, a filling station, designated by the reference numeral 12.

Each nozzle 4 receives the product 14 from a related feed unit 5 which is in turn fed by a duct 16 originating from a generic known tank which is not shown. The feed unit 5 is usually constituted by an electric valve and allows, or respectively prevents, the flow of product 14 between the duct 16 and the nozzle 4.

Means 2 for detecting the presence of a container 3 at a nozzle 4, schematically shown only in figure 1, are also part of each filling station 12 and are constituted by at least one detection device 2.

The detection device 2, instead of being located at the filling station 12, might be arranged upstream of it, in order to provide a signal indicating the presence or absence of the container 3, when the controlled receptacle is located below the nozzle 4.

The control device 1 according to the present invention comprises, for each filling station 12, flow-rate measurement means 6 capable of measuring the amount of product 14 fed to the container 3 which is in that filling station 12 at that moment. The measurement means 6 are connected, in output, to an input of the related electric valve 5 and are capable of closing it when a preset weight value of the product 14 contained in the respective container 3 is reached.

In the exemplifying embodiment of figure 1, timer means 13, or simply timers, are used as flow-rate measurement means 6; said timers are adjustable, in each instance, according to the weight of the preset amount of product 14 to be fed to each container 3. Use of the adjustable timers 13 is possible since one may assume that the mass flow-rate of the nozzles 4 is constant or, at least, scarcely variable within the time interval corresponding to a filling cycle and that the tare of the containers 3 is substantially constant, i.e. variable within a narrow tolerance range.

As regards the mass flow-rate of the nozzles 4, it should be noted that all of their physical characteristics, in terms both of dimensions and of load losses produced during the feeding of the product 14, are known.

The detection means 2, for example presence sensors, send an electrical or mechanical dispensing start signal to the timer means 13 which in practice resets them. The same signal reaches the respective electric valve 5, either directly or indirectly through the timers 13, as shown in figure 1; said electric valve 5 allows connection between the duct 16 and the respective nozzle 4. The dispensing end signal is sent to each electric valve 5 directly by the related timers 13 when the preset period of time expires; this period, multiplied by the mass flow-rate of the nozzle 4, corresponds to the preset weight value of the product 14 to be dispensed to each container 3.

Since many of the various physical parameters contributing to determine the flow-rate of the nozzles 4 can vary during the operation of the filling machine or apparatus (for example, the passage sections may decrease due to gradual obstructions), downstream of the filling stations 12 there are weighing means 8 weighing the already filled containers 3.

In figure 2, the weighing means 8 are shown schematically proximate to the transfer region be-

tween the filling conveyor 19 and the unloading conveyor 20, but they may be provided in any point of the machine, for example downstream of said unloading conveyor 20.

By observing figure 3, it can be noted that idle rollers 35 are fixed at the lower end of the supporting shafts 31 and slide over the weighing means 8, which comprise a per se known load cell 34. The weighing operation can occur by sampling, or all the containers 3 can be weighed. The load cell 34 is connected in output to an input of control and actuation means 7 of which the timers 13 are a part, as shown in figure 1. Correction means 11, one for each timer 13, comparison and actuation means 10 and electronic memory means 9, are also part of the control and actuation means 7. The electronic memory means 9 are capable of storing the various parameters, such as the weight of product 14 to be dispensed to each container 3, the tare of said containers and similar parameters, and are connected in output to an input of the comparison and actuation means 10; the output of the load cell 34 is connected to the other input of said means 10, with the signals related to the gross weights of the various containers 3, where the term "gross weight" designates the actual weights of the containers 3 filled with product 14. The correction means 11 are input-connected to respective outputs of the comparison and actuation means 10 and are output-connected to the adjustment input of the timers 13.

Figure 1 also illustrates two signals: one signal, designated by the reference numeral 9s, is in input to the electronic memory means 9; the other signal, designated by the reference numeral 10s, is between the comparison and actuation means 10 and the load cell 34. The signal 9s indicates that the data stored in the means 9 can be modified according to the operating conditions, such as the relative density and the type of product 14 to be dispensed to the containers 3, which can have a role in determining the flow-rate of the nozzles 4. The signal 10s, instead shown with a dashed line, indicates a possible signal which the comparison and actuation means 10 send to the load cell 34 to inhibit its operation in case of sampled weighing.

The metering device 1 according to the present invention operates as follows: assuming that the various operating parameters required to determine the mass flow-rate (of product) of the nozzles 4 and the weight of product 14 to be fed to each container 3 have been stored in the memory means 9, a container 3 arrives at a nozzle 4, and its presence is detected by the related sensor 2, which resets the related timer 13 and activates the related electric valve 5; said electric valve starts dispensing the product 14 into the container 3 through the nozzle 4. As soon as the preset period of time corresponding to a filling cycle has elapsed, the timer 13 closes the electric valve 5 and waits for the subsequent empty container 3 to restart a filling cycle. Downstream of the filling stations 12, the load cell 34 weighs the gross weight of the containers 3 according to a certain continuity or sampling criterion stored in the means 9. The load cell 34 then sends a signal, which corresponds to the measured weight, to the comparison and actuation means 10, which compare this signal with a signal, stored in the means 9, corresponding to the weight of the product 14 to be contained in the container 3. Since the load cell 34 measures the gross weight of the containers 3, obviously either the comparison and actuation means 10 or the means 9 take into account the tare of the containers 3 to make an exact comparison between the measured weight and the preset weight of the product 14. If the comparison and actuation means 10 detect a positive or negative deviation, above a preset maximum value stored in the means 9, said comparison and actuation means 10 send a corresponding signal to the correction means 11 related to the nozzle 4 which has fed the container 3 for which a weight different from the preset one has been detected. The comparison and actuation means 10 then correct the opening time of the nozzle 4 by virtue of the correction means 11 and according to a mathematical algorithm such as, for example, a simple algebraic proportion given by the formula:

$$dt_{i+1} = dt_i \, (P_p/P_m)$$

where dt_{i+1} is the correct opening time, dt_i is the opening time which caused the error, P_p is the preset weight and P_m is the measured weight. If another error is detected during the subsequent weight checking operation, the opening time of the related nozzle 4 is corrected again.

Obviously, the opening time of the nozzle 4 is corrected if the detected error is contained within a certain limit which is preset and stored in the means 9: if the error exceeds this limit, said comparison and actuation means 10 reject, and thus the container 3 having an incorrect weight is removed from the production line.

It is thus evident that the combination of the weighing means 8 functionally (electrically) connected to the comparison and actuation means 10 constitutes, when said means are activated by the signal 10s, a "feedback control" of the filling of the containers 3.

Various modifications and variations may be made with regard to the foregoing detailed description without departing from the inventive concept.

Where technical features mentioned in any claim are followed by reference signs, those refer-

ence signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. Device for metering a product into respective containers, associable with automatic apparatuses or machines for filling said containers, said machines or apparatuses comprising at least one filling station (12) in which a metering device (1) operates, said metering device comprising dispensing means (4) for dispensing the product (14) to the containers (3) and a respective feed unit (5) for feeding the product to each of said dispensing means (4), said feed unit (5) being activated for feeding the product to said dispensing means (4) by detecting means (2) for detecting the presence of a container (3) at related dispensing means (4), characterized in that said dispensing means (4) have a substantially constant flowrate and in that said feed unit (5) is controlled by measurement means (6) for measuring the activation time thereof.

2. Device according to claim 1, characterized in that said measurement means (6) are timer means (13) which are adjustable according to the amount of product (14) to be fed to each container (3); said timer means (13), being reset and activated by said related detection means (2), actuates the deactivation of the related dispensing unit (5) at the end of a preset period of time required by said dispensing means (4) to deliver the preset amount of product (14).

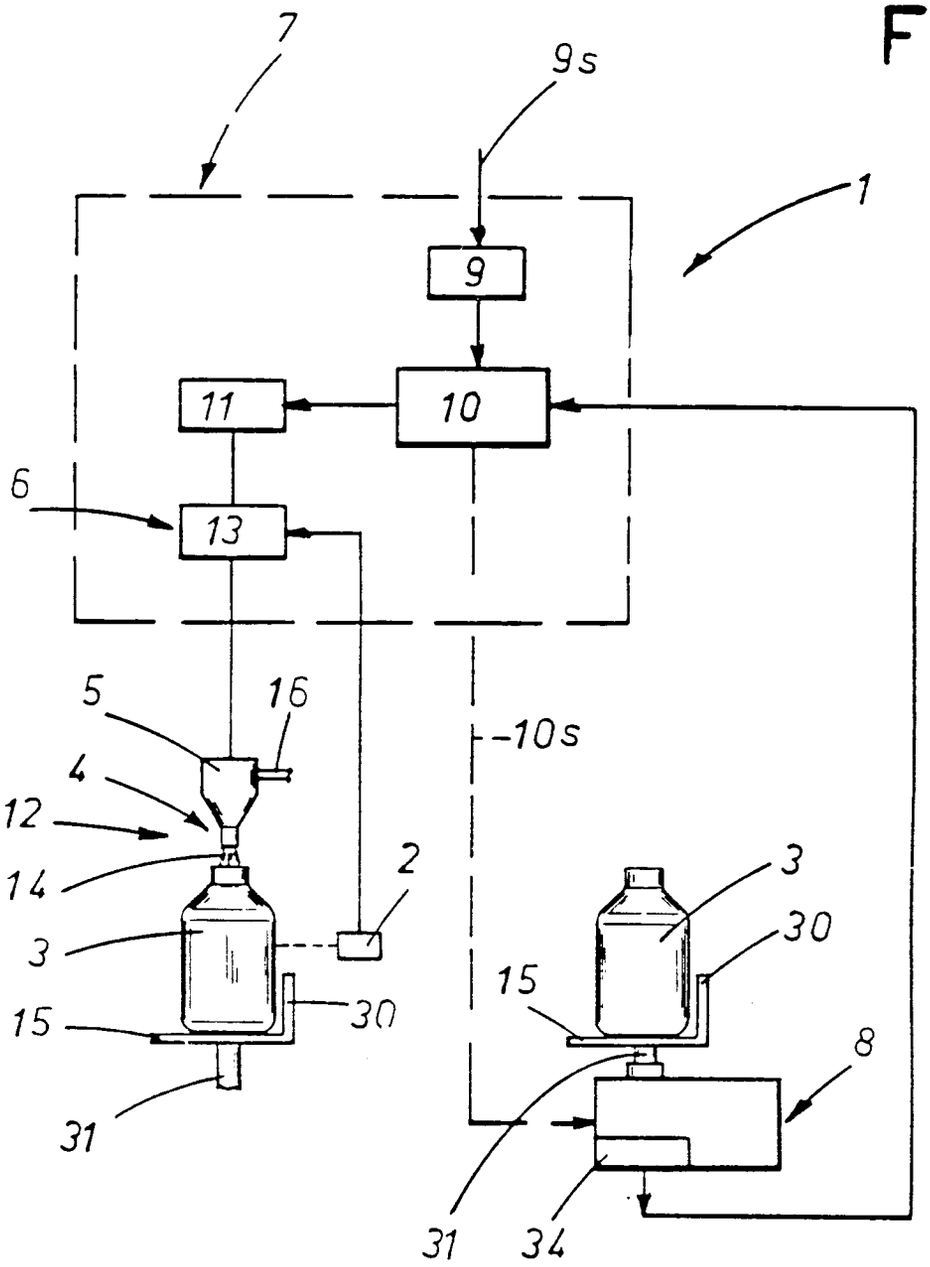
3. Device according to claim 2, characterized in that said timer means (13) are part of control and actuation means (7) to which weighing means (8) are connected in input, said weighing means (8) being arranged downstream of said filling station (12) to measure the gross weight of the filled containers (3); said control and actuation means (7) comprising electronic means (9) for storing a preset value of the weight of the product (14) to be dispensed to each one of said containers (3), electronic comparison means (10) for comparing said preset weight value stored in said electronic memory means (9) with the weight actually detected by said weighing means (8), and electronic correction means (11) being input-connected to a respective output of said electronic comparison means (10) and output-connected to an adjustment input of said timer means (13), said correction means (11) being adapted for correcting the intervention time period of said timer means (13) according to any deviation between said preset weight value stored in said electronic memory means (9) and the actual weight of a container (3) measured by said weighing means (8).

4. Device according to claim 3, characterized in that the values stored in said memory means (9) can be modified according to the physical-chemical characteristics of the product (14) to be fed, according to physical characteristics of said dispensing means (4) and according to the amount of product to be fed to each container (3).

5. Device according to claim 3, characterized in that said control and actuation means (7) are adapted for storing which of said dispensing means (4) has fed the container (3) being weighed and are adapted for acting on respective timer means (13) by means of the respective correction means (11) to change their activation time.

6. Device according to claim 3, characterized in that said control and actuation means (7) actuate said weighing means (8) for weighing the containers (3) by sampling, said weighing means weighing a container (3) every preset number of non-weighed containers (3).

FIG1



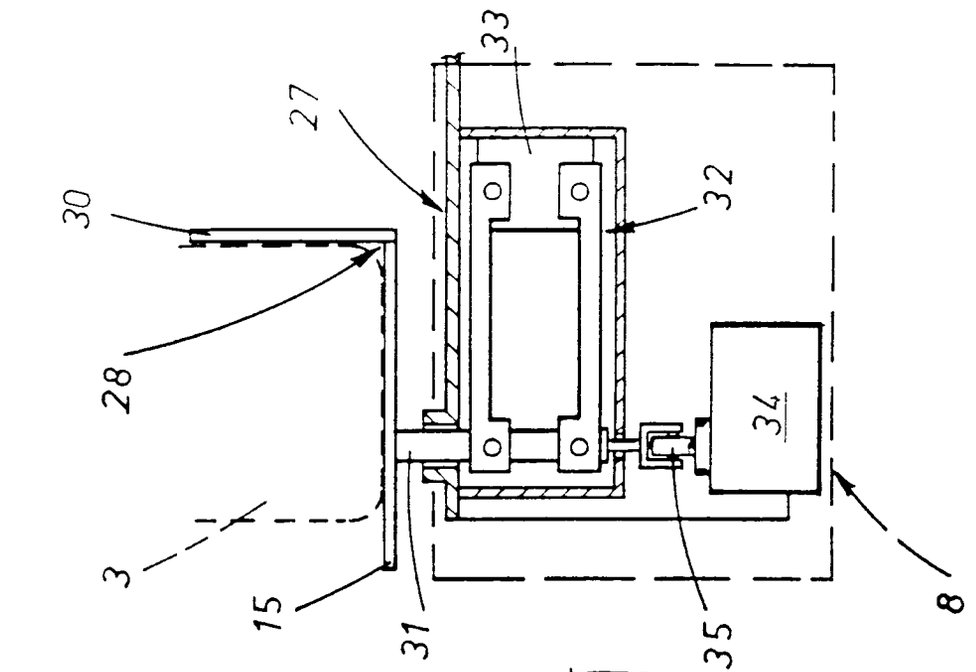

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FIG 3

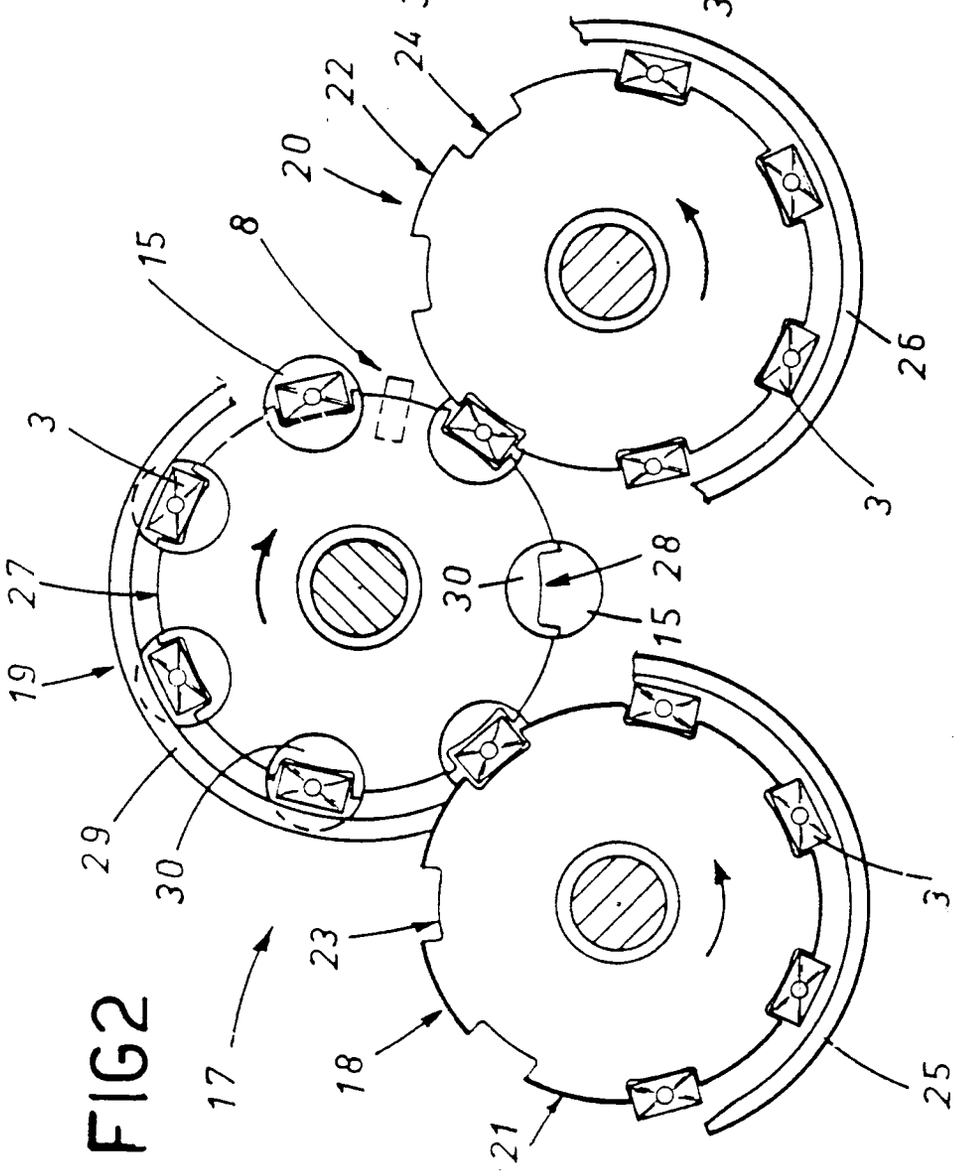
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FIG 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 93 11 0017

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X Y	US-A-3 032 005 (GARRISON) * the whole document * ---	1 2,3	B65B3/36 B65B57/06
Y	EP-A-0 406 558 (SCHMACHTEL) * column 3, line 39 - column 4, line 23; figure 2 * ---	2	
Y	EP-A-0 430 897 (FARMOMAC) * column 5, line 37 - column 7, line 57; figure 1 * ---	3	
A	EP-A-0 086 098 (MERCK) * claim 1; figure 1 * -----	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B65B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	05 OCTOBER 1993	CLAEYS H.C.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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