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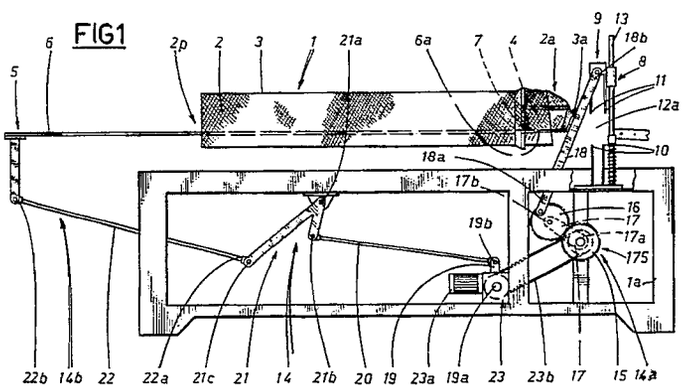
(54) A mechanical linkage providing simultaneous and synchronized operation of the feed device and netting station by which containers of fruit and vegetable produce are wrapped in automatic netpacking equipment.

(57) An automatic net packing equipment basically comprising a feed device (5) and a netting station (8), by which containers of fruit and vegetable produce are wrapped in tubular netting (3). The feed device comprises a longitudinal element (6) reciprocating in a tube (2) from a retracted limit position in front to an extended limit position beyond the netting station. The netting station is basically a guillotine (9) consisting of a fixed (10) and a moving (11) pair of elements disposed transversely to the feed direction of the containers (4). The moving elements are capable of a vertical movement in either direction between a raised position, in which the fixed and moving elements form an opening (12a) to allow the forward passage of the longitudinal element (6) with a single container (4) ensheathed by its net (3), and a lowered position in which the fixed and moving elements (10, 11) draw together the net (3) behind the container (4). The all-mechanical linkage (14) disclosed features an epicyclic rod-and-crank mechanism (14a) serving to operate the guillotine (9). The linkage comprises a rod (18) hinged at one end (18b) to the moving elements (11) and at the remaining end (18a) to the periphery of a planet disk (16), and a crank (175) by which the disk (16) is rotatably carried and subjected to a controlled rolling and rotary motion deriving from the crank action. The same linkage (14) further comprises means (14b) by which the operation of the rod-and-crank mechanism (14a) is synchronized with that of the feed device (5).

FIG1



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A MECHANICAL LINKAGE PROVIDING SIMULTANEOUS AND SYNCHRONIZED OPERATION OF THE FEED DEVICE AND NETTING STATION BY WHICH CONTAINERS OF FRUIT AND VEGETABLE PRODUCE ARE WRAPPED IN AUTOMATIC NET-PACKING EQUIPMENT

The present invention relates to an all-mechanical linkage providing for simultaneous and synchronized operation of the feed device and netting station in automatic equipment for net-packing containers of fruit and vegetable produce.

The prior art embraces automatic equipment by which fruit and vegetable produce packed in containers are wrapped in net, substantially comprising:

-an elongated tube enveloped externally by a long and tightly bunched tubular net serving ultimately to ensheath containers previously filled with fruit and/or vegetable produce, which are introduced into the tube at one end and fed toward the remaining forward end;

-a feed device comprising a longitudinal element guidedly reciprocated inside the ned feed tube and provided with at least one projection designed to register with the containers on one side and propel them toward a netting station located beyond the forwardmost end of the tube;

-a guillotine device installed at the netting station, incorporating a pair of fixed elements disposed transversely to the direction of movement of the containers, and a pair of moving elements positioned above and operating in conjunction with the fixed elements, capable of vertical motion in relation thereto between a raised first position, whereby an opening is afforded between the pairs of elements for the passage of the forward end of the longitudinal element, carrying a netted container, and a lowered second position in which the opening remains just sufficient to secure and position the stretch of net immediately to the rear of each container once the forward end of the longitudinal element has been retracted far enough from the netting station not to obstruct the trajectory of the moving elements;

-means by which the feed device, and in particular the longitudinal element, is operated synchronously with the moving elements of the guillotine device.

As a general rule, in equipment as described above, both the moving guillotine elements of the netting station and the longitudinal element of the feed device are set in motion by rod-and-crank type mechanism suitably synchronized one with the other in such a way as to avoid any mechanical contact between moving parts during those operating steps which involve a geometrical intersection of the relative trajectories.

In practice, from the constructional standpoint, the velocity of the longitudinal element of the feed device is conditioned by factors dependent on the characteristics of the produce being packed, for instance such as the greater or lesser degree to which containers are filled, hence the risk of losing produce, in particular due to inertia in the initial stages of the feed movement and in cases where the produce projects above the side of the container. For any given type of produce, moreover, there are additional factors combining to impose limitations on the rate of feed which cannot be exceeded.

To the end of obtaining a higher hourly output of petted containers, escaping the limitations imposed by obtainable feed rates, equipment was developed in which the netting station could reciprocate in a direction coinciding with the trajectory of the longitudinal element.

This further movement, appropriately synchronized both with that of the moving guillotine elements and with that of the longitudinal feed element, is characterized by being continually contrary to the motion of the longitudinal element, with the clear end in view of increasing the effective velocity of the longitudinal element in relation to the moving parts of the netting station, and doing so without affecting the optimum absolute feed rate obtainable for the containers.

Nonetheless, reciprocating movement of the netting station requires a further crank mechanism of which the inclusion together with the existing mechanisms of the equipment occasions a number of drawbacks, namely:

-notable complexity in overall construction of the automated equipment;

-a certain difficulty in synchronizing the various mechanisms, not least by reason of the fact that such equipment will also incorporated other moving parts, not directly pertinent to the subject matter of the invention and therefore not described, but which must be operated in such a way as to ensure correct timing with the rod-and-crank mechanisms aforementioned;

-limited dependability of the equipment, stemming directly from its complex construction.

What is more, all of the drawbacks highlighted above will be accentuated further in the event that it is sought to adopt the commonplace industrial expedient of driving all the various rod-and-crank assemblies from a single motor.

According to current practice, these drawbacks can be overcome at least in part, with the particular end in view of rendering equipment constructionally less complex, by abandoning the notion of a single prime mover and driving the various rod-and-crank

mechanisms individually, also dispensing in certain instances with the reciprocating movement of the netting station. In the resulting embodiments of such equipment, operation of the single mechanisms becomes entirely independent from the mechanical standpoint, and to enable the equipment to function as a whole, the relative movements are synchronized through interaction with sensors (microswitches in most instances), positioned in such a manner that their interception by the pertinent moving parts of the various linkages will establish the timing and the ordered sequence of movements inherent in the operating cycle.

Whilst such an expedient has certainly reduced the constructional complexity of conventional packing equipment and eliminated certain negative factors, it nevertheless introduces a new type of drawback.

In effect, by rendering the assemblies mechanically independent of one another, not only is there the higher cost of separate drive systems to consider, but the dependability of the equipment as a whole is enormously reduced, as with its synchronization entrusted to microswitches, the malfunction of even one microswitch only (by no means improbable) can result in destructive malfunction as a consequence of moving parts entering into unwarrented contact one with the other.

Accordingly, the object of the present invention is to overcome the various drawbacks described above by the adoption of an entirely mechanical linkage as characterized in the appended claims, designed to ensure simultaneous and synchronized operation of the feed device and netting station by which containers filled with fruit and vegetable produce are wrapped in automatic net-packing equipment. In the mechanical linkage according to the present invention, the moving elements of the netting station are set in motion by a particular epicyclic type of rod and crank mechanism which, synchronized in operation with the transmission components of the feed device, invests the moving elements of the netting station and the longitudinal element of the feed device with movement at variable velocity along their relative trajectories in such a way as to obtain an optimum combination of the relative mutual velocities at each instant. In addition to favouring the passage of the forward end of the longitudinal element of the feed device through the netting station, this advantageous combination of operating velocities also permits of dispensing with reciprocation of the netting station along the trajectory of the longitudinal element.

The advantages afforded by the present invention are essentially those of:

-enabling the embodiment of automatic equipment in which all movement derives from an all-mechanical linkage, hence great reliability in terms of safety from any malfunction attributable to unwarranted contact between moving parts;

-obtaining equipment of simpler design, driven by a single prime mover and decidedly more competitive from the standpoint of economy;

-securing a more favourable interrelation between the velocities of the various moving parts, and by extension, particularly high hourly output rates.

The invention will now be described in detail, by way of example, with the aid of the accompanying drawings, in which:

-fig 1 is a general view of automatic net-packing equipment incorporating an all-mechanical linkage embodiment according to the invention, which is illustrated in a typical operation configuration;

-figs 2...5 are general views of the automatic equipment as in fig 1, showing certain of the more salient configurations assumed by the mechanical linkage according to the invention in the course of the operating cycle executed by the equipment.

In fig. 1 of the drawings, 1 denotes automatic equipment for packing containers 4 of fruit and vegetable produce in a net covering, comprising:

-a tube 2, enveloped externally by a long and tightly bunched tubular net 3 of which the forward end 3a is sealed in readiness to ensheath and wrap single containers 4 filled previously with fruit or vegetable produce and fed along the inside of the tube 2 toward the forward end 3a of the net 3;

-a feed device 5 consisting substantially in a longitudinal element 6 designed to interact with a netting station 8 situated beyond the forwardmost end 2a of the tube 2, which is furnished at its forward end 6a with at least one spring-loaded projection 7 directed upwards and designed to register with the rear of the single containers 4, inserted into the tube 2 from the rear end 2p, and propel them forward together with the ensheathing stretch of net 3 toward the netting station 8. This same feed device 5 is also capable of guided reciprocating movement internally of the net feed tube 2 between a retracted limit position, in which the forward end 6a of the longitudinal element 6 is encompassed by the feed tube 2 and completely clear of the netting station 8, and an extended limit position in which the projection 7 carried by the forward end 6a of the longitudinal element 6 lies beyond the netting station 8.

The netting station 8 incorporates a guillotine device 9 comprising a pair of fixed elements 10 disposed transversely to the feed direction followed by the containers 4, parallel one with another and set apart at a distance such as will permit of interacting with a second, moving pair of elements 11; more exactly, these elements 11 are positioned above and operated in conjunction with the fixed

elements 10, moving in parallel planes marginally offset from those of the latter.

The moving elements 11 are slidably supported by upright columns 13 and capable thus of traversing vertically between a raised portion (see fig 1), in which the pairs of fixed and moving elements 10 and 11 afford an opening 12a that freely allows passage of the forward end 6a of the longitudinal element 6 of the feed device carrying a container 4 ensheathed by its net 3, and a lowered position (see fig 3) in which the opening 12b between the moving elements 11 and the fixed elements 10 is reduced in size, and just sufficient to ensure that the stretch 3a of net 3 immediately following the container 4 is retained, correctly positioned, once the forward end 6a of the longitudinal element 6 has been retracted from the netting station 8. Automatic net-packing equipment 1 according to the invention further comprises an entirely mechanical linkage 14, which in turn comprises a rod-and-crank mechanism 14a serving to bring about operation of the guillotine device 9, and means 14b by which the operation of the rod-and-crank mechanism 14a itself is synchronized with that of the feed device 5.

The mechanism denoted 14a comprises:
-a rod 18, connected pivotably at one end 18b with the moving elements 11 of the netting station 8; -a power driven rotating crank element 175 to which the rod 18 is rotatably coupled by its remaining end 18a in such a way that this same end 18a can be made to describe a controlled trajectory deriving from the rotation of the crank element.

In a preferred embodiment of the invention, the crank element 175 comprises:
-a fixed disk 15, rigidly associated with the main frame 1a of the automatic net-packing equipment 1;
-a moving disk 16, in peripheral contact with and exhibiting the same diameter as the fixed disk 15;
-a power driven revolving crank 17, of which one end 17a is coupled rotatably to the fixed disk 15 at its axis of symmetry, and the remaining end 17b to the axis of rotation of the moving disk 16, in such a way that the moving disk 16 can be made to roll around the fixed disk 15 and rotate about its own axis at one and the same time.

With the relative end 18a of the rod 18 connected rotatably to the moving disk 16 at a point near to its periphery, the end 18a in question is obliged to follow an epicyclic trajectory (or epitrochoid, in the particular instance illustrated) occurring simultaneously with and dictated by the orbit of the moving disk 16 around the fixed disk 15.

With opportunely selected construction parameters, the rod-and-crank mechanism 14a thus described permits of reciprocating the moving elements 11 of the netting station 8 along their columns 13 at a variable velocity, which, departing from the fully raised position of the elements 11 and approaching the fixed elements 10, decreases gradually from a maximum initial value to a minimum, reached around the middle of the relative approach trajectory, while at the same moment the longitudinal element 6 of the feed device retracts at maximum velocity through the netting station 8 and into the tube 2. In the successive final stage of the trajectory that brings the moving elements 11 toward the fixed elements 10, the velocity picks up and increases progressively. The elements 11 having duly reversed their direction of movement and begun the reascent to the initial raised position, the forward end 6a of the longitudinal element 6 will pass through the netting station B at maximum feed velocity carrying a further container for netting.

Means 14b by which the rod-and-crank mechanism 14a is synchronized with the feed device 5 comprise:
-a power driven revolving crank 19, of which one end 19a is anchored pivotably to the frame 1a of the automatic net-packing equipment 1;
-a first rod 20 coupled rotatably to the remaining end 19b of the revolving crank 19;
-an oscillating element 21 affording three ends denoted 21a, 21b and 21c, of which a first end 21a is pivotably anchored to the main frame 1a of the equipment 1 and a second end 21b pivotably coupled to the first rod 20, thereby enabling receipt of the motion required to produce oscillation about the pivot of the first end 21a;
-a second rod 22, of which one end 22a is coupled pivotably to the third end 21c of the oscillating element 21 and the remaining end 22b connected to the longitudinal element 6 of the feed device 5.

In operation, the movement of the means 14b thus embodies is synchronized with that of the feed device 5 in such a way that maximum velocity of the longitudinal element 6 is generated during passage of its forward end 6a through the netting station 8 in each direction. The passages in question are, respectively, that in which the single container 4 is carried forward by the longitudinal element 6 to be netted, and that in which the element 6 retracts into the feed tube 2 following separation from the container 4 beyond the netting station 8.

Both the rod-and-crank mechanism 14a and the feed synchronizing means 14b are set in motion by a single drive 23, which in the preferred embodiment illustrated in the drawings consists substantially in a geared motor 23a to which both the crank 19 of the synchronizing means 14b and the crank 17 of the guillotine mechanism 14a are coupled mechanically, in the latter instance by way of a conventional belt transmission 23b.

Accordingly, in the mechanical linkage 14 proposed, the rod-and-crank mechanism 14a and the means 14b by which synchronization with the feed device 5 is achieved are mutually and mechanically interlocked and interdependent, the movement of the one being dictated by that of the other.

The operation of the mechanical linkage 14 will be more fully appreciated by referring to the sequence of steps illustrated in figs 2, 3, 4 and 5.

Fig 2 illustrates a configuration of the linkage 14 in which the longitudinal element 6 of the feed device 5 is fully retracted in relation to the net feed tube 2.

In this position, the forward end 6a of the element is entirely encompassed by the forwardmost end 2a of the tube 2, carrying a container 4 engaged from the rear by the projection 7 and ready for transfer to the netting station 8. The guillotine device 9 is positioned with its moving elements 11 lowered against the fixed elements 10 and engaged currently in securing a stretch of net immediately to the rear of a container 4 already wrapped and moving away beyond the station 8.

In the successive step shown in fig 3, the moving elements 11 reascend to their raised position at progressively increasing velocity, and at the same time, the longitudinal element 6 advances toward the netting station, likewise at a progressively increasing velocity.

In fig 4, with the moving elements 11 completing their ascent to the raised position, an opening 12a is created of height sufficient to allow passage of a container 4 to the netting station 8, ensheathed in its net 3 and carried by the forward end 6a of the longitudinal element 6, which at this stage will be moving at maximum feed velocity.

In the following step of fig 5, the raised position has been reached and the moving elements 11 are seen descending toward the fixed elements 10 in the reverse direction, decelerating gradually from the velocity registering at the initial stage of the descent trajectory; in the particular instance of fig 5, the moving elements 11 are shown completing near to half the descent trajectory and approaching their minimum velocity. At this same juncture, the forward end 6a of the longitudinal element 6 will have reached its travel limit beyond the netting station 8 and now, moving in the reverse direction, retracts at increasing velocity toward the net feed tube 2 leaving the container 4 on the far side; maximum retraction velocity of the longitudinal element 6 is gained on passing through the netting station 8 at the moment in which the velocity of the moving elements 11 of the guillotine device 9 is at minimum.

Once the end 6a of the longitudinal element 6 has returned through and fully cleared the netting station 8 on the feed side, the moving elements 11 accelerate again toward the lowered position, fully down against the fixed elements 10. At this point, the longitudinal element 6 will be fully retracted into the net feed tube 2 and the configuration of the mechanical linkage 14 once again as illustrated in fig 2, whereupon the cycle repeats in the manner described above.

Claims

1) A mechanical linkage providing simultaneous and synchronized operation of the feed device and netting station by which containers of fruit and vegetable produce are wrapped in automatic net-packing equipment comprising:
-a feed device (5) consisting substantially in a longitudinal element (6) designed to interact with the successive netting station (8), which affords a projection (7) at its forward end (6a) positioned in such a way as to register with one side of the single containers (4) and is guidedly reciprocated internally of a net feed tube (2) between a first limit position in which the forward end (6a) is retracted and completely encompassed by the tube, clear of the netting station (8), and a second limit position in which the projection (7) afforded by its forward end (6a) is extended beyond the netting station (8);
-a guillotine device (9), constituting a part of the netting station (8) and consisting in a fixed first pair of elements (10) disposed transversely to the feed direction of the containers (4) and designed to operate in conjuction with a moving second pair of elements (11) located above the first and capable of vertical movement in either direction between a raised position, in which the pairs of fixed and moving elements (10, 11) afford an opening (12a) freely allowing passage of the longitudinal element (6) together with a single container (4) ensheathed by its net (3), and a lowered position in which the moving elements (11) combine with the fixed elements (10) to create a smaller opening (12b) just sufficient to secure and position the stretch of net (3) immediately to the rear of each container (4),
characterized
in that it comprises:
-a rod-and-crank mechanism (14a) serving to operate the guillotine device (9), consisting in a rod (18) of which one end (18b) is connected pivotably with the moving elements (11) of the netting station (8) and the remaining end (18a) connected pivotably and eccentrically to a moving disk (16), and a power driven revolving crank element (175), by which the moving disk (16) is carried rotatably and invested at each revolution with a controlled rotating and rolling motion in such a way as to reciprocate the moving elements (11) of the guillotine device (9) at variable velocity through a trajectory

that comprises departure from the raised position toward the fixed elements (10), with the velocity of the moving elements (11) decreasing progressively from a maximum initial value to a minimum value reached substantially in mid-descent, at which juncture the forward end (6a) of the longitudinal element (6) passes through the netting station (8) retracting at maximum velocity toward the net feed tube (2), followed by continuation through the final stage of the approach toward the fixed elements (10) at increasing velocity, whereupon the direction of movement is reversed and the moving elements (11) reascend at progressively increasing velocity toward the raised position, at which juncture the forward end (6a) of the longitudinal element (6) passes through the netting station (8) at maximum feed velocity carrying a further container (4) for netting: and

-means (14b) by which the operation of the rod-and-crank mechanism (14a) is synchronized with that of the feed device (5).

2) A linkage as in claim 1, wherein means (14b) by which the operation of the rod-and-crank mechanism (14a) is synchronized with that of the feed device (5) comprise:

-a power driven revolving crank (19), of which one end (19a) is anchored pivotably to the frame (1a) of the automatic equipment (1);

-a first rod (20) coupled rotatably to the opposite end (19b) of the revolving crank (19);

-an oscillating element (21) affording three ends (21a, 21b, 21c) of which a first end (21a) is pivotably anchored to the main frame (1a) of the automatic equipment (1) and a second end (21b) pivotably coupled to the first rod (20) in such a way as to receive the motion required to produce oscillation about the pivot of the first end (21a);

-a second rod (22), of which one end (22a) is coupled pivotably to the third end (21c) of the oscillating element (21) and the remaining end (22b) hinged to the longitudinal element (6) of the feed device, in such a way that the longitudinal element (6) is invested with maximum velocity during the states in which its forward end (6a) passes through the netting station (8).

3) A linkage as in claim 1, wherein the crank, element (175) comprises:

-a fixed disk (15), rigidly associated with the frame (1a) of the automatic equipment (1);

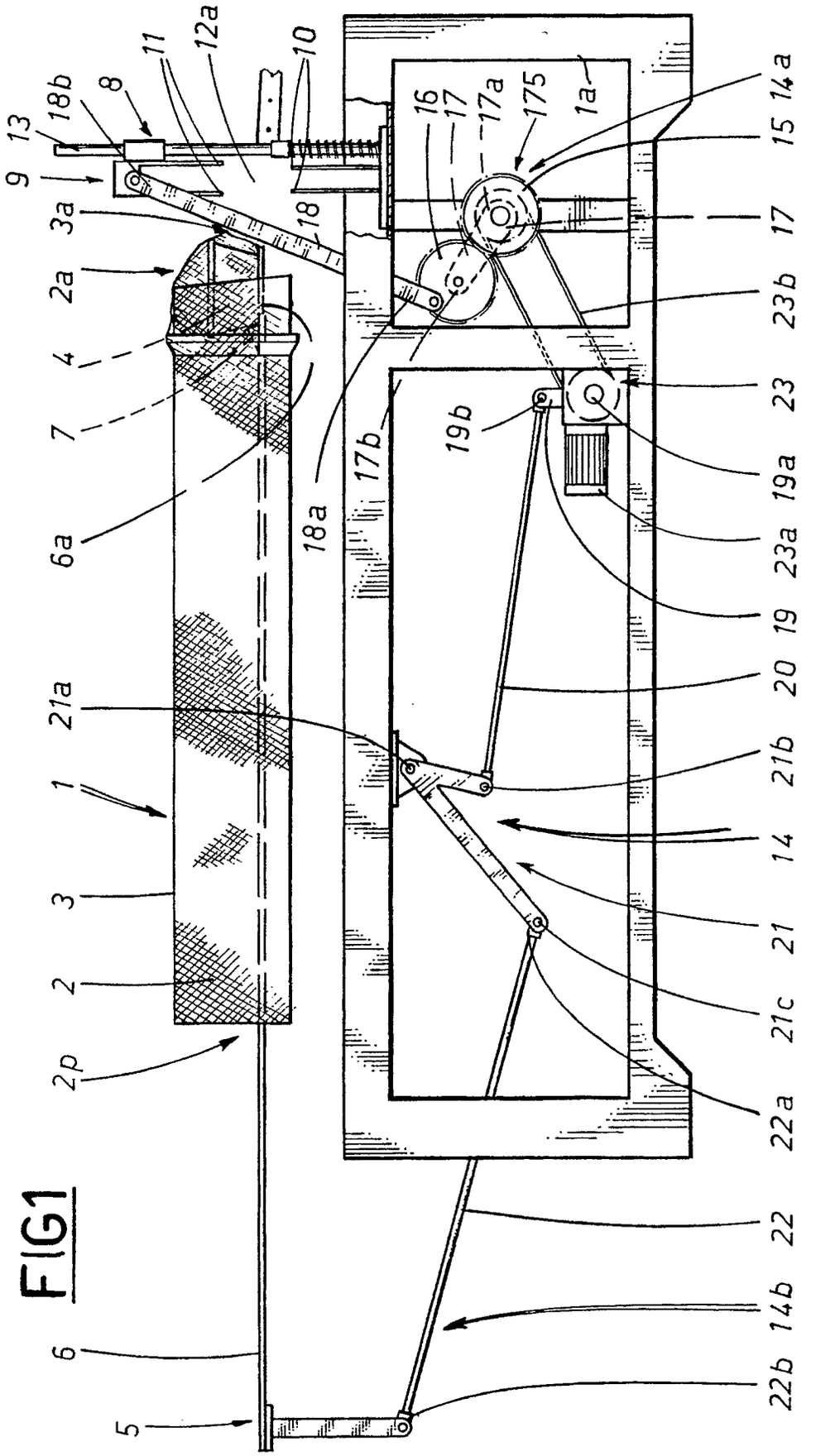
-a power driven revolving crank arm (17), of which one end (17a) is coupled rotatably to the fixed disk (15) at its axis of symmetry and the remaining end (17b) to the axis of rotation of the moving disk (16), in such a way that the moving disk (16) is made by the crank (17) to roll around the fixed disk (15) and rotate about its own axis at one and the same time.

4) A linkage as in claim 3, wherein the moving disk (16) and the fixed disk (15) of the crank element (175) are of identical diameter.

5) A linkage as in claim 1, wherein the end (18a) of the rod (18) is connected to the moving disk (16) at a point close to its periphery in such a way as to describe a substantially epicyclic trajectory during passage of the moving disk (16) around the fixed disk (15).

6) A linkage as in claim 1 or 2, wherein the means (14b) by which operation of the rod-and-crank mechanism (14a) is synchronized with that of the feed device (5) are operated from a single prime mover (23a) driving the entire linkage (14).

7) A linkage as in claim 1, wherein the rod-and-crank mechanism (14a) and the means (14b) by which its operation is synchronized with that of the feed device (5) are interlocked mechanically in such a way that the movement of the one is dictated exclusively by that of the other.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18b
8
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12a
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17a
175
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15
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7
6a
18a
17b
19b
23b
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2p
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21c
22a
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FIG1

FIG2

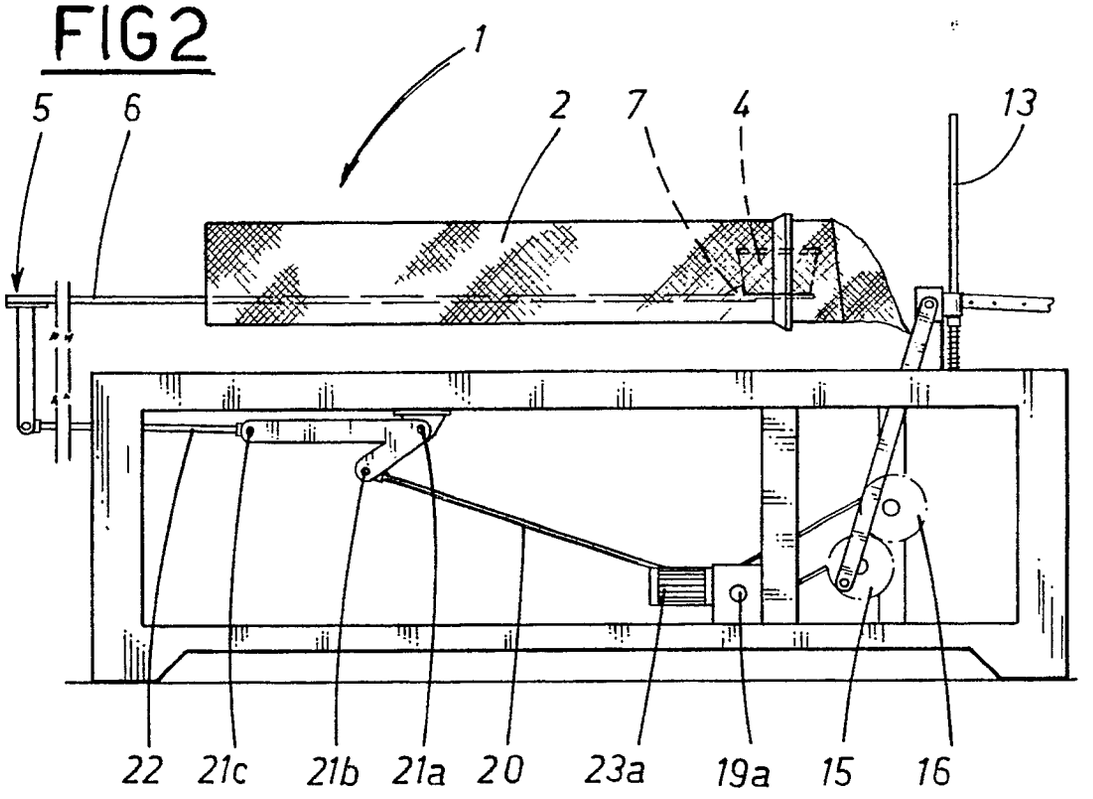
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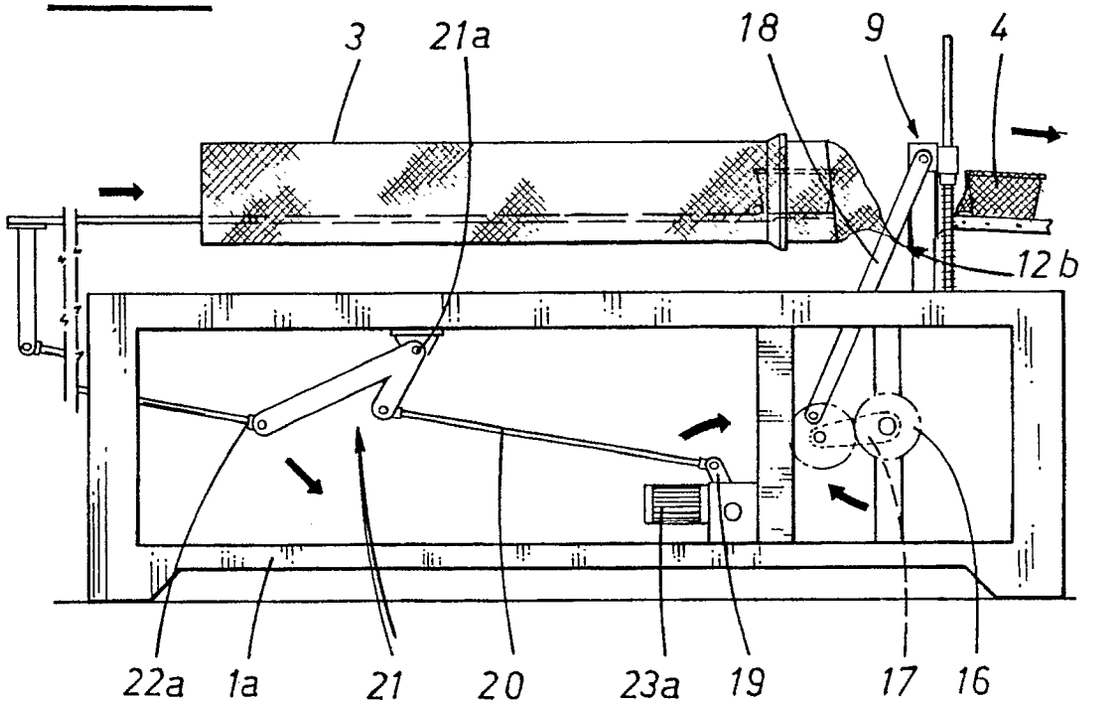
FIG3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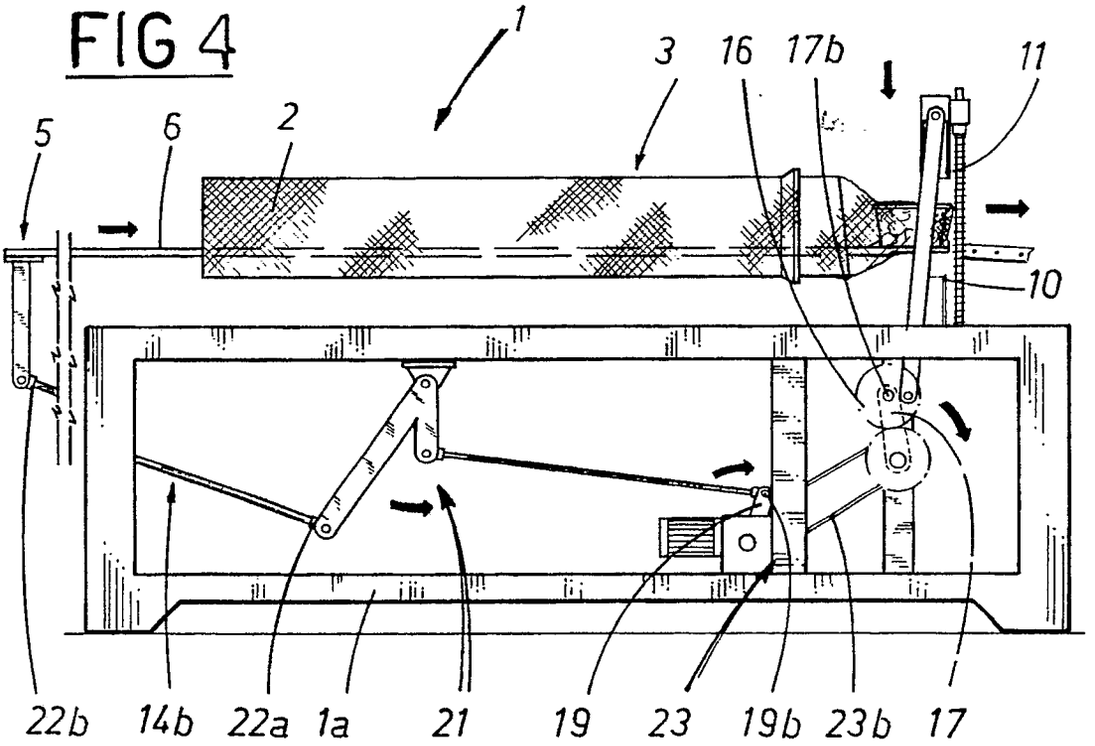
16

FIG 4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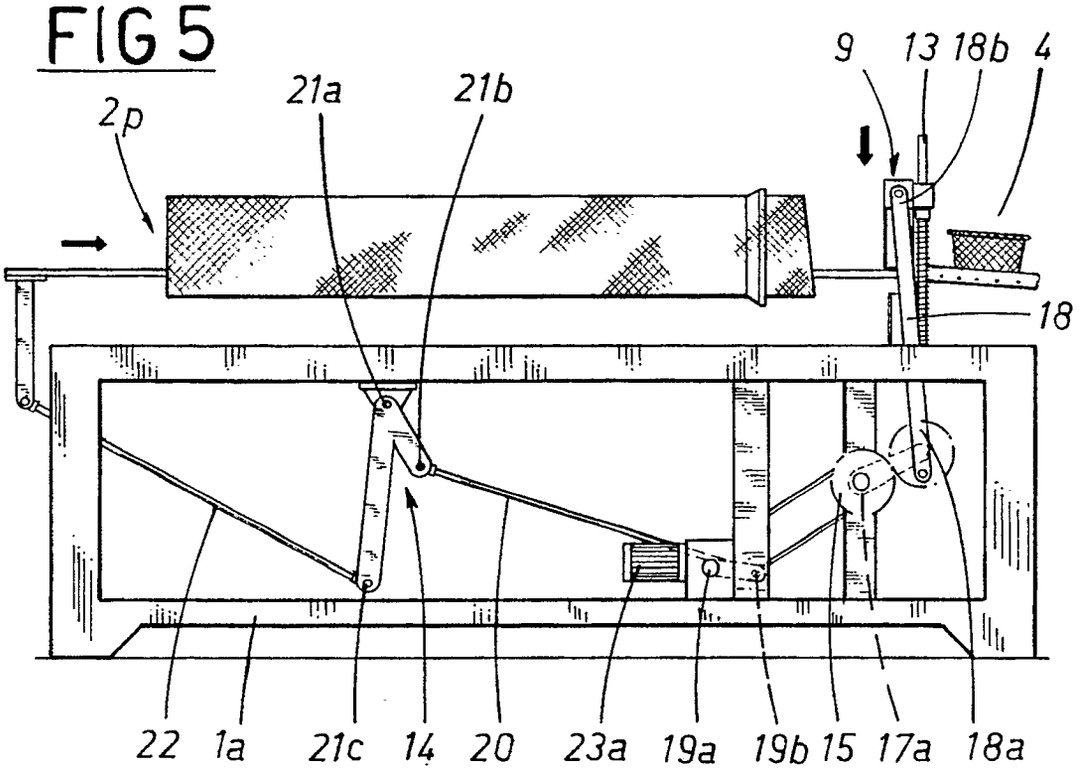
19b
23b
17

FIG 5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18a

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 83 0388

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)
A	EP-A-0 123 655 (SORMA) * Page 5, line 15 - page 10, line 15; figure 3 *	1	B 65 B 9/15

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 65 B
B 26 D

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	14 January 91	SMOLDERS R.C.H.

CATEGORY OF CITED DOCUMENTS

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