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(54) Improvements in or relating to machine drive systems.

(57) A machine for forming synthetic plastics material bags from a web (14) of synthetic plastics material comprising a number of web treating stations and conveyor means (11, 29, 32) for conveying the web to be treated through those treating stations is equipped with an electric stepping motor (17, 27, 31, 33, 51) arranged to drive the conveyor means and an electronic micro-processor (40) arranged to supply pulses of electric power to the stepping motor in accordance with a predetermined programme for the movement of the web through the machine.

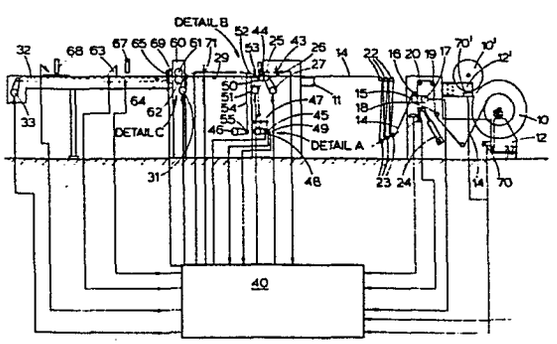

Fig .1

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This invention relates to a drive system which finds particular although not exclusive application in machines used for processing webs of material such as synthetic plastics material webs, paper webs or the like. The invention finds particular, although not exclusive application in a machine for forming synthetics plastics material bags from a web of such material.

In web processing machines, it is conventional for a web of the material to be carried through various conveyor and guide roller systems through various processing stages at which various operations are performed on the web to complete articles of manufacture. Such operations may be heat sealing of plastics web materials, cutting, perforating, printing or other finishing operations. Conventional machines for this purpose have been driven mechanically from electric motors and the control of the various indexing operations has involved elaborate sequencing systems with various electrical limits which are positioned on the machine to detect the operation and completion of various stages in the process, and an elaborate electrical control gear.

It is an object of the present invention to provide a drive system which is applicable to such machines which offers versatility in operation and enables simple resetting of the machine to perform its operative cycle on different products or different sized products.

Accordingly the present invention provides a drive system for a machine comprising an electric stepping motor in combination with an electronic micro-processor arranged to provide pulses of power to the stepping motor in accordance with a predetermined programme.

In a further aspect the present invention provides a web treating machine comprising means for conveying a web of material through the machine driven by such a stepping motor.

In a further aspect the invention provides a plastics material web treating machine comprising a number of web treating stations and conveyor means for carrying a web to be treated through those treating stations, an electric stepping motor arranged to drive the conveyor means, and an electronic micro-processor arranged to supply pulses of electric power to the stepping motor in accordance with a predetermined programme for the movement of the web through the machine.

In a further aspect the invention provides a machine for forming synthetic plastics material bags from a web of synthetic plastics material comprising a number of web treating stations and conveyor means for conveying a web to be treated through those treating stations, an electric stepping motor arranged to drive the conveyor means and an electronic micro-processor arranged to supply pulses of electric power to the stepping motor in accordance with a predetermined programme for the movement of the web through the machine.

In order to promote a fuller understanding of the above and other aspects of the present invention, an embodiment will now be described, by way of example only, with reference to the accompanying drawing which shows in schematic side elevation a plastic bag making machine embodying various aspects of the present invention.

The machine shown in the drawing is in general arrangement similar to known machines and comprises a conveyor system which takes a web of plastics material from a roll of such web indicated at 10, over a generally table-like conveyor indicated at 11 to carry the web successively past various operative stations which transform the web into a series of plastic bags.

The roll of web 10 is supported on a suitable shaft carried in known manner per se in trunnion bearings 12 on the base of the machine so that the web indicated at 14 may be drawn off by a capstan roller 15, a nip roller 16 being provided to maintain the web 14 in frictional engagement with capstan roller 15.

The capstan drive motor is an electric stepping motor 17 which is driven in a manner to be discussed below. The web 14 is drawn over guide rollers 18, 19 and 20 and continues to a dancing roll compensator mechanism indicated generally at 21. The mechanism 21 comprises a series of fixed rollers 22 and a series of movable rollers 23 which are biassed away from the rollers 22 by means of a pneumatic spring compensator device indicated at 24.

The web 14 continues through the machine through the nip between a pair of draw rollers 25 and 26. The draw roller 26 is driven by means of an electric stepping motor 27 which is controlled in a manner to be described below.

Downstream of the draw rollers 25 and 26 is a "hot knife" station indicated generally at 28 the arrangement and operation of which to produce individual bags from the web will be described below.

Downstream of the knife station is a main conveyor system indicated generally at 29 arranged to convey bags formed in the web at the hot knife station away from the hot knife station and feed them to a stacking arrangement indicated generally at 30. The conveyor system 29 is driven by an electric stepping motor 31, the control of which will be discussed below, and the stacking arrangement 30 includes an indexible conveyor system 32 which is provided with an electric stepping motor 33 to drive it, the control of which stepping motor will also be discussed below.

The general principle of operation of the machine is similar to known machines in so far as a web of plastics material is provided in the roll 10, either in the form of a tube, or in the form of a folded double thickness open at one edge, and this web is conveyed through the machine being slit and sealed in various configurations to form bags.

The general operation of the machine is under the control of an electronic micro-processor indicated at 40. The internal design and arrangement of the micro-processor 40 does not form part of the present invention or disclosure.

The micro-processor 40 is programmed and arranged to supply the capstan drive stepping motor 17 with a series of pulses of electrical current so that it is driven to drive the capstan roller 15 and draw web from the roll 10 on the trunnions 12. A transducer 41 is provided to give an electrical output indicative of the position of the rollers 23 in relation to the rollers 22 in the compensating device 21, and the micro-processor 40 is programmed to drive the motor 17 to maintain a given quantity of web in the compensator 21 in a stable fashion, thus to provide a reservoir of web for feed to the draw rollers 25 and 26. A limit transducer 42 is provided to sense the upper and lower positions of the rollers 23 and the output from the transducer 42 is fed to the micro-processor to provide a warning signal to an operator of the machine, or other control of the machine such as shut-down upon certain limits on the position of the rollers 23 being exceeded.

The stepping motor 17 is operated basically in a continuous mode so that the web 14 is moving continuously over the idler rollers 19 and 20 to the compensator device 21. Thus the portion of the web passed between the rollers 19 and 20 may be considered as a constant motion section in the web path and various attachments to the basic machine may be positioned to operate on the web between these two rollers.

In the drawing accompanying the specification, the rollers 19 and 20 are shown schematically and it will be appreciated that the space between them can be suitably extended and arranged to accommodate various attachments.

Examples of such attachments which are known per se, are items such as a sheet gussetter for forming gussets in the bags, a lip folder for folding lips in the web to form lips in bags eventually formed from the web, slit sealers to divide the web up into a series of tubes, trimming devices and devices for rewinding material trimmed from the web, and a perforator for perforating the web longitudinally so that various types of perforations may be finished in the finished bags. The micro-processor 40 may be provided with suitable outputs, and the programming of the micro-processor may be arranged so that such attachments may be controlled to perform their various functions as required.

The micro-processor 40 is further programmed and arranged to supply the draw roller stepping motor 27 with a series of pulses of electrical current so that it is driven to drive the draw rollers 25 and 26 thus to index the web through the hot knife station 28. The arrangement is such that the motor 27 is driven in a number of steps equivalent to the length of the pitches required between the operations of the hot knife station, these pitches being equivalent to the axial dimension of the bags that are required to be formed. Thus the length of a bag is controlled by a settable input to the micro-processor which may determine in accordance with the programme for the processor the number of steps that the motor 27 moves through in each cycle of operation of the machine.

If the web in use is a printed web to produce printed bags, it is necessary to bring the printing on the web into register with the operation of the hot knife section.

To achieve this a photo-electric detector device 43 is provided above the web at a position upstream of the draw rollers 25 and 26 and arranged to provide an electric signal to the micro-processor 40 on the passage of a pre-determined part of the material on the web. Means is provided to set into the micro-processor appropriate data so that it can supply the stepping motor 27 with the appropriate number of pulses to bring the web into correct register having regard to the printed material with the hot knife section on initial operation of the machine, whereafter correct indexing of the web in each cycle of the machine can be continued by the micro-processor.

The hot knife station comprises a knife blade 44 which is arranged in known manner per se to be heated electrically and raised and lowered by means of a linkage connected to an eccentric mechanism 45 which in turn is driven by a stepping motor 47. The stepping motor 47 is provided with pulses of electric current at an appropriate point in the machine cycle by the micro-processor 40 in accordance with its programming so that the motor 47 causes the knife 44 to be lowered to engage the web and seal it in a fashion known per se to form bags in the web material, and to cut the web to separate the bags again in known manner per se. Sensing devices 48 and 49 are provided to indicate to the micro-processor when the hot knife 44 is raised and lowered respectively.

A sealing pressure roller 50 is provided immediately below the hot knife 44 to support the web while it is sealed by the hot knife. The sealing roller 50 is driven by means

of an electric stepping motor 51 which is supplied with pulses of electric current by the micro-processor in a manner discussed below.

As mentioned above, downstream of the hot knife section conveyor system 29 is arranged to take a finished bag away from the hot knife section. This is driven at an appropriate rate and in sequence with the operation of the machine by the micro-processor 40 supplying pulses of electric current to the stepping motor 31 provided to drive the conveyor. The sealing roller 50 is driven at an appropriate point in the cycle of the machine, that is to say after the operation of the knife 40, by the supply of electric pulses to it from the micro-processor 40 to advance the leading edge of the web formed by the cutting operation of the knife 44 onto the conveyor system 29. A pick off arm device 52 having a roller 53 at the end of a pivotally mounted arm is arranged above the conveyor 29 and is movable to nip the trailing edge of a bag (or bags) as it approaches the conveyor 29, by means of a linkage 54 driven by an eccentric mechanism 55 and an electric stepping motor 46. Lowering of the arm 52 by the motor 46 also under control of the micro-processor 40, causes the bag (or bags) to be engaged by the conveyor 29 and thus drawn away from the hot knife section at the appropriate point in the machine cycle as the web is advanced by the draw rollers 25 and 26 during the indexing out of a fresh bag length of the web 14.

Downstream of the conveyor 29 is a stacking wheel assembly indicated generally at 60. This assembly comprises two rolls 61 and 62 which are driven from the motor 31 and

which are arranged to intermesh so as to corrugate a web passing through the nip between them. The purpose of these rolls is to temporarily form corrugations along the length of the bags leaving the conveyor 29 to give them temporary longitudinal stiffness so that they can be readily shot from the end of the conveyor 29 onto the indexing conveyor system 32 to rest against a stacking gate indicated at 63. Thus the bags are shot from the stacking wheel assembly to form a stack of bags on the indexible conveyor 32. A bag retarder unit 62 is provided between the stacking wheel assembly 60 and the conveyor 32. The unit 64 comprises a pair of grippers 65 and 66 and mechanism not shown in detail is provided to be driven through an eccentric or cam mechanism by an electric stepping motor 69, so that the grippers are brought together to catch the tail end of a bag leaving the stacking wheel assembly to retard it so that it lies flat in the stack against the stacking gate 63.

The operation of the bag retarder unit is initiated in correct sequence in the operation cycle of the machine by the micro-processor 40. When a required number of bags has been provided in a stack against the stacking gate 63, this number being set into the micro-processor in setting up the machine, the micro-processor provides an electrical signal to initiate the raising of the stacking gate 63 by suitable means of known design per se, and supplies pulses of electrical current to the stepping motor 33 to drive the conveyor 32 to carry the stack beyond the stacking gate.

The stacking gate 63 is then lowered ready to form a fresh stack of bags while the previous stack is carried to the end of the conveyor 32.

Various types of units for treating a stack of bags in a known manner per se may be provided at various positions on the conveyor 32. Typical of these are a hotrod sealing unit indicated at 67 which under control from the micro-processor 40 may pierce a stack of bags with hot rods to seal them together, thus to retain them in a stack. A further typical such unit is that indicated at 68 in the form of a block sealing unit for sealing a block of bags in known manner per se again under the control of the micro-processor 40.

A photo-electric device 71 is provided over the conveyor 29 upstream of the stacking wheel assembly and arranged to give an electrical signal to the micro-processor 40 on the passage of the rear edge of a bag from the conveyor 29. This signal is used to initiate the operation of the bag retarder unit 64 by the micro-processor 40.

It will be appreciated that the detectors 43 and 69 may be adjusted over their respective conveyors to suit particular bag configurations.

Again while the above description has been with reference to a single web machine, it will be appreciated that a dual machine is possible, again in known manner per se, where the various drive elements are shared between two web paths. A second reel of web may be provided as indicated at 10' in trunnions 12'.

Sensors indicated at 70 and 70' may be provided to give an electrical signal to the micro-processor 40 when the reel of web 10 or 10' reaches a given minimum diameter indicating that the web is virtually consumed.

Thus it can be seen that by providing the various stepping motor drives at various points in the machine, under the control of the micro-processor 40, the various feed rates and feed distances of the web through the machine, particularly through the stages of the machine associated with forming the bags in the web and stacking the finished bags into stacks may be controlled by the programming of the micro-processor 40. The processor can be provided with various settable inputs so that these parameters of the machine operation may be simply set without further mechanical adjustment of the machine. This provides for extreme versatility in operation and ease of setting of the machine from making one size and type of bag to another.

By use of the micro-processor 40, not only is versatility of setting achieved, but a great deal of electrical control equipment which would otherwise be needed for processing the machine and sequencing the various operations may be eliminated.

The stepping motor drives are preferably fed with pulses in such a manner so that the acceleration and deceleration pattern of the web 14 follows a simple harmonic type of motion. This is the preferred wave form for the motion since it minimises the stress in the web for high speed operation and thus enables the highest feed rates to be achieved.

While the application of stepping motor drives under the control of the micro-processor has been described above particularly with reference to a plastic bag making machine, it will be appreciated that the drive system is applicable to other web processing machines such as printing machines or the like, and indeed it is applicable to other types of machine where a given feed of a material at a given feed rate is a requirement in the operative cycle of the machine.

CLAIMS :

1. A drive system for a machine comprising an electric stepping motor in combination with an electronic micro-processor arranged to provide pulses of electric power to the stepping motor in accordance with a predetermined programme.

2. A web treating machine having conveyor means for carrying a web to be treated through the machine and a drive system as claimed in Claim 1 for the conveyor means.

3. A plastics material web treating machine comprising a number of web treating stations and conveyor means for carrying a web to be treated through those treating stations, an electric stepping motor arranged to drive the conveyor means, and an electronic micro-processor arranged to supply pulses of electric power to the stepping motor in accordance with a predetermined programme for the movement of the web through the machine.

4. A machine as claimed in Claim 3 for forming synthetic plastics material bags from a web of synthetic plastics material comprising a number of web treating stations and conveyor means for conveying a web to be treated through those treating stations, an electric stepping motor arranged to drive the conveyor means and an electronic micro-processor arranged to supply pulses of electric power to the stepping motor in accordance with a predetermined programme for the movement of the web through the machine.

5. A machine as claimed in Claim 4 comprising means for feeding plastics web from a supply of such web; a draw roller, means for engaging the web on the draw roller and an electric stepping motor arranged to drive the draw roller; a hot knife device disposed downstream of the draw roller, and an electric motor arranged to operate the knife device to bring it into contact with the web to seal and cut it into separated bags; and a conveyor means disposed downstream of the hot knife device provided with an electric stepping motor arranged to drive it, the conveyor means being arranged to receive and convey said separated bags; in which said stepping motors are supplied with pulses of electric current under the control of said micro-processor to operate the machine.

6. A machine as claimed in Claim 5, in which said knife device motor is an electric stepping motor supplied with pulses of electric current under the control of said micro-processor.

7. A machine as claimed in Claim 5 or 6, comprising an indexible conveyor means disposed downstream of said conveyor means having a movable stacking gate disposed thereover to receive and stack said separated bags into stacks, and comprising an electric stepping motor supplied with pulses of electric current under the control of said micro-processor, arranged to index the indexible conveyor after the gate has been moved to carry away a stack of said bags.

8. A machine as claimed in Claim 7, comprising a bag stack treating device such as a punch sealing device operably disposed above said indexible conveyor upstream of said stacking gate and controlled by said micro-processor

9. A machine as claimed in Claim 7 or 8, comprising a bag stack treating device such as a block sealing device operably disposed above said indexible conveyor downstream of said stacking gate and controlled by said micro-processor.

10. A machine as claimed in any one of Claims 7, 8 or 9, including a pair of bag corrugating rolls disposed between said conveyor means and said indexible conveyor means the corrugating rolls being drivably connected to said conveyor means.

11. A machine as claimed in any one of Claims 7, 8, 9 or 10, including bag retarting means arranged to retard bags as they reach the indexible conveyor.

12. A machine as claimed in Claim 11, in which said bag retarding means comprises a pair of grippers arranged so that the bags pass between them to the indexible conveyor, and electric stepping motor driven means arranged to close the gap between the grippers to grip and slow down a bag under the control of the micro-processor.

13. A machine as claimed in Claim 11 or 12, including detector means adjacent said conveyor means and arranged to initiate operation of the retarding means on

detecting the passage of the trailing edge of a bag.

14. A machine as claimed in any one of Claims 4 to 13, in which said conveyor means includes a pick-off arm pivotally mounted above the conveyor means, a pick-off roller rotatably mounted on the arm, and electric stepping motor means arranged to pivot the arm to cause the roller to grip bags leaving the knife device on the conveyor means under the control of the micro-processor.

15. A machine as claimed in any one of Claims 5 to 14, in which the hot knife device includes a pressure roller disposed to co-operate with the knife device, and an electric stepping motor drive means arranged to drive the pressure roller to move the leading edge of the web to said conveyor means after operation of the knife device, under the control of the micro-processor.

16. A machine as claimed in any one of Claims 5 to 15, in which said feeding means comprises means for supporting a roll of web material, and a pair of feed rolls having a nip between them through which the web passes, one of the rolls having an electric stepping motor drive means supplied with pulses of electric current under the control of the micro-processor to draw web from the roll at a substantially constant rate.

17. A machine as claimed in Claim 16, in which said feed means comprises compensator means arranged between said feed rolls and the conveyor means, arranged to com-

pensate between intermittent motion of the conveyor means and continuous motion of the feed rolls.

18. A machine as claimed in Claim 17, in which said compensator means includes a plurality of fixed rollers and a movable member having a plurality of movable rollers arranged so that the web passes alternately over fixed and movable rollers with the position of the movable member determining the length of web in the compensator means at any given time, and control means arranged to move the movable member under the control of the micro-processor.

19. A machine as claimed in any one of Claims 5 to 18, including detector means disposed over said conveyor means arranged to detect the passage of printed marking on the web and supply a control signal to the micro-processor whereby to synchronise the drive of said draw roll with such printing.

20. A drive system for a machine substantially as herein described with reference to the accompanying drawing.

21. A machine for making synthetic plastics material bags substantially as herein described with reference to the accompanying drawings.

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Chartered Patent Agents
Agents for the Applicants

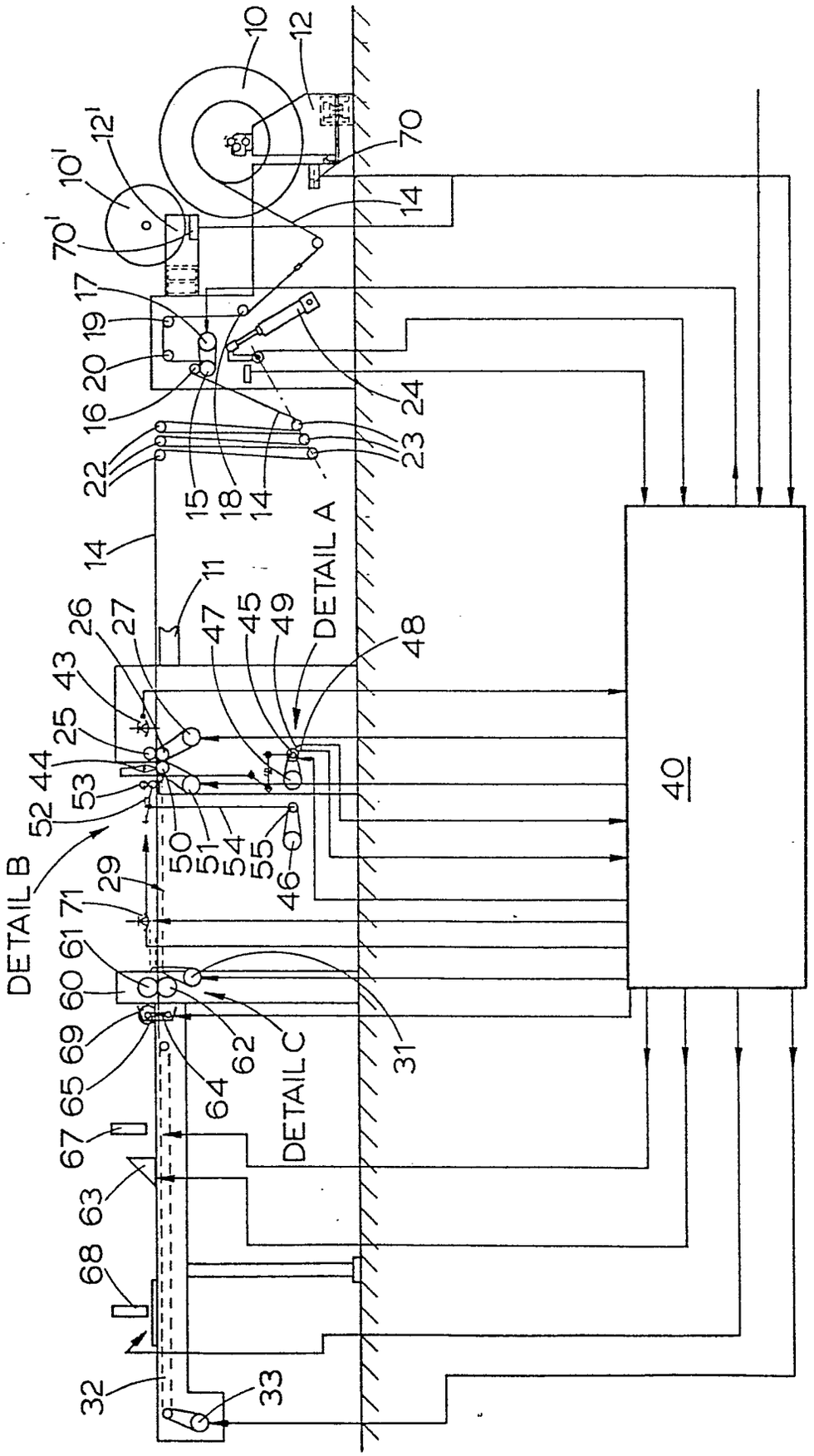
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Fig . 1

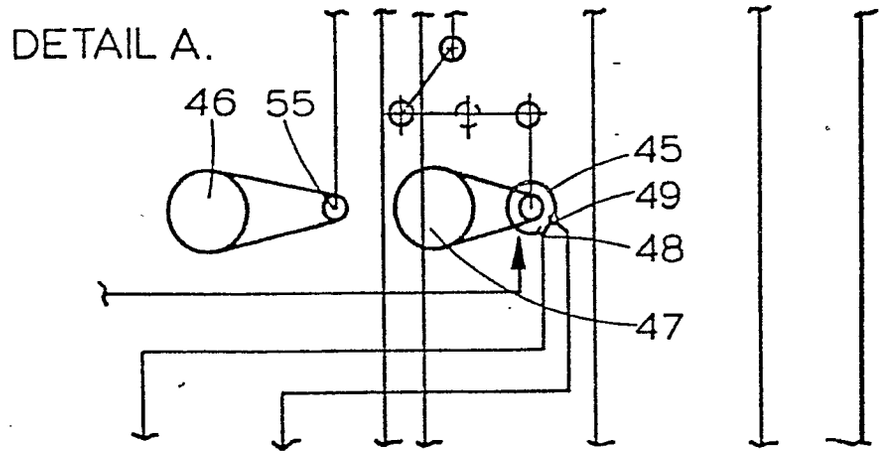

Fig. 1A

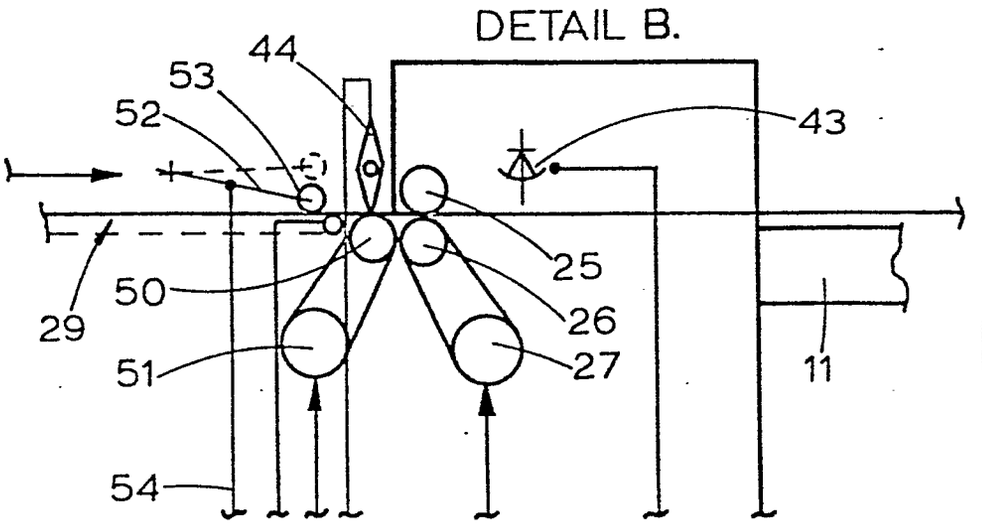

Fig. 1B

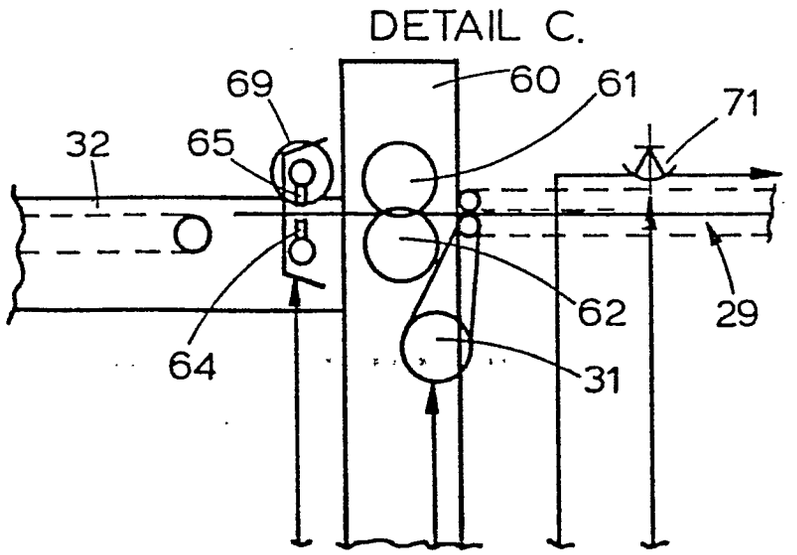

Fig. 1C

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 80 30 2368.8

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X	US - A - 4 156 170 (G.R. STRUNC) * column 2, lines 3 to 22 * --	1-4
	US - A - 4 061 260 (R.M. COPP) * claim 1 * --	1-4
	US - A - 4 006 395 (J. REESEN) * claim 1 * --	5
	DE - A - 1 942 410 (FMC CORP.) * page 13, lines 1 to 5 * --	7
A	GB - A - 2 005 593 (WINDMÖLLER & HÖLSCHER) * fig. 1 * --	
A	DE - A1 - 2 746 770 (FMC CORP.) * fig. 1 * --	
A	DE - A1 - 2 527 655 (PACKAGING INDUSTRIES INC.) * claim 1 * --	
A	DE - A - 2 305 719 (FMC CORP.) * claim 1 * -- ./..	

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

B 65 H 17/22
B 31 B 23/10
G 05 B 19/40

TECHNICAL FIELDS SEARCHED (Int.Cl.³)

B 29 C 24/00
B 31 B 1/10
B 31 B 23/00
B 31 B 37/00
B 65 B 57/00
B 65 H 17/22
G 05 B 19/00

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	23-10-1980	BITTNER

European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 80 30 2368.8

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	DE - A1 - 2 838 375 (SAPAL S.A. DES PLIEUSES AUTOMATIQUES) * claim 1 * ----		TECHNICAL FIELDS SEARCHED (Int. Cl.³)