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(54) Automatic sack filling machine.

(57) The sack filling machine comprises three working stations (S1, S2, S3) sequentially arranged after one another, and two pairs of grippers (P1, P2) to transfer each single sack (Z), by gripping it at its mouth portion, from a station to the successive station. Each gripper of the pairs of grippers (P1, P2) is mounted on a cradle member (14, 14') arranged at the respective side of the machine and articulated by its ends (15, 15') to pairs of parallel connecting rods (16, 16') directed upwardly and pivotably supported at their upper ends by the frame of the machine, the said cradle members (14, 14') being operatively connected by means of a respective tierod (18) to driving means (19, 20) which impart to said cradles a longitudinal alternating movement equal to the distance between two subsequent working stations (S1, S2, S3). Means are provided for lifting and lowering the grippers (P1, P2) in correct time relationship with the swinging movement of the cradles, for inserting and withdrawing the mouth of the sack respectively into and from the working station concerned.

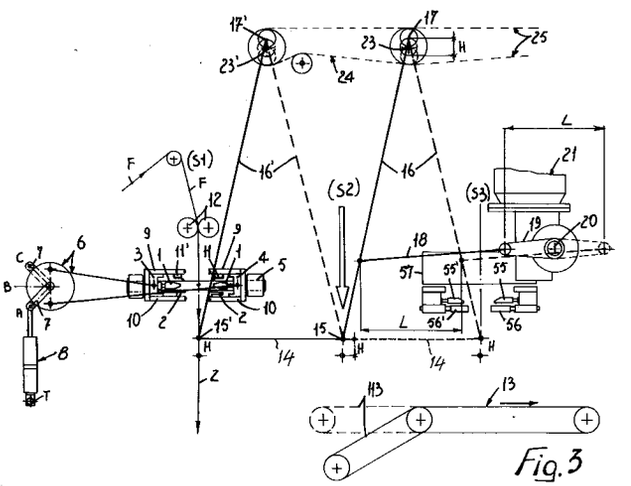

Fig. 3

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Sack filling machines are known, which comprise:

- a station for cyclically feeding a sack, provided preferably with means for cyclically forming a sack by sealing and cutting operations from a continuous tube of heat-sealable film, usually with bellows side folds;
- a station with means for opening the mouth of the sack;
- a station with means for filling the sack with a product;
- a station with means for closing the sack by a transverse heat-sealing operation;
- a station with means for cooling the transverse seal which has closed the sack.

Said stations are arranged after each other along a rectilinear path of travel, are equally spaced apart, and are provided with grippers mounted on a structure which is moved so that, after the operations at the various stations, the mouths of the sacks are simultaneously disengaged from the respective stations by means of a downward displacement, after which the said sacks are moved horizontally and are transferred to the successive station. The mouths of the sacks are then raised and inserted, simultaneously, into the above station so as to be retained thereby. The grippers which have transferred the sacks are then opened, are raised to move away from said sacks, and then are moved horizontally to be returned to the original stations where they are lowered to repeat the cycle described above.

A machine of this type is described, for example, in the Italian Patent No. 1.213.889 in the name of the same applicant.

According to the present invention, the sack filling machine comprises a particular rocking structure mounting the grippers designed to transfer the sacks to the various operating stations. The grippers have been reduced thanks to the omission of the sack-opening station, which has been incorporated in the sack-forming station. Moreover, the cooling station has been incorporated in the final sealing station. The operating stations arranged after each other are thus reduced to three and the transfer of sacks between them can be effected by only two pairs of grippers.

In the machine according to the invention, the means for opening the sack have been incorporated in the intermediate filling station, so that said sack can be transferred to said station while still in a flattened and closed condition as when formed, thus reducing the problems.

The grippers that transfer the sacks from the filling station to the final sealing and cooling station, are fixedly mounted on the rocking supporting structure, since this structure itself moves said grippers towards and away from each other to grip the opened mouth of the filled sacks and to preclose said mouth by a transverse stretching action, prior to its entrance into the sealing station. This solution has permitted the use of gripper displacing means very sturdy and powerful, capable of operating even with considerably heavy sacks without requiring any oversizing of the gripper-supporting structure. This solution has also permitted to reduce the transverse space requirement of the machine considerably.

Further characteristics of the machine according to the invention, and the advantages resulting therefrom will appear from the following description of a preferred embodiment thereof, shown merely by way of non-limiting example, in the attached drawings, in which:

Figure 1 is a perspective side view of the structure having a composite rocking movement, which supports the two pairs of grippers which transfer the sacks to the operating stations of the machine;

Figure 2 is an enlarged perspective view from below, of the lower side of the structure shown in Figure 1;

Figure 3 shows a kinematic diagram of one of the two articulated-parallelogram assemblies forming the rocking structure of the preceding Figures, as seen from one side;

Figure 4 is a front perspective view of the upper portion of the pair of levers of the rocking structure shown in the preceding Figures, with the grippers for transferring a sack from the opening/filling station to the final sealing station;

Figure 5 is a perspective view of the intermediate sack-opening/filling station in the rest condition;

Figures 6, 7 and 8 are perspective views of the lower portion of the station of Figure 5 during the successive working steps;

Figure 9 is a partly sectional view of one of the stationary grippers which operate at the intermediate sack opening/filling station;

Figures 10, 11, 12, 13, 14, 15 and 16 are diagrammatic top plan views of the intermediate sack opening/filling station, during successive working steps.

In the Figures 1, 2 and 3, to which reference is made first, S1 indicates the station at which a sack is formed cyclically by sealing and cutting operations by the action of opposite devices 1 and 2 which are mounted on parallel opposite carrier assemblies 3-4, movable on stationary guides 5 and connected to a self-centering actuating mechanism 6 of the crank/connecting rod type which, in turn, is connected by a crank 7 to a pair of fluid-operated double-acting jacks 8 by means of which said crank 7 can be moved selectively to the positions A-B-C.

Pairs of pressure bars 9 and 10 are mounted, with an intermediate springing system, on the assemblies 3-4, while cooling air dispensing bars 11-11' are arranged on the pressers 9 and directed towards the sealers 1.

In Figure 3, F indicates the tube of heat-sealable bellows-folded film coming from the powered feeding rollers 12 and inserted, under command, to a suitable extent between the sealing and cutting means 1-2 in the opened position thereof. On completion of the movement of the tube F the actuation is effected of the jacks 8 to move the crank 7 from the position A to the position C. The tube F is acted upon first by the pressure bars 9-10 and then by the sealers 1 and cutting means 2. During this step the sealing is effected of the bottom of a sack which will be completed during the successive working step and the severance is effected therefrom of a sack which has been formed during the preceding step. During this step, the cranks of the actuating mechanism 6 are slightly beyond their dead centers and maintain a controlled pre-established pressure against the tube to be sealed, thus granting the quality of the sealing effected by the devices 1.

In the successive step, the crank 7 is moved to the position B to move the sealing/cutting means 1-2 away from F, while the pressure bars 9 and 10 are kept closed against the tube and against the sack obtained therefrom. A jet of cool air is issued from the bars 11-11' and is directed against the seal effected by the means 1 in order to cool it and assure the required mechanical strength.

Before the crank 7 moves to the position A to return the sealing/cutting assembly to the rest position, as from Figure 3, the sack Z which has been formed at the station S1 is gripped laterally at its upper portions by a pair of pneumatically operated grippers P1 (Figures 1-2) which afterwards will transfer it in its closed condition to the intermediate opening/filling station S2. During this step, a stronger pair of grippers P2 will seize the side upper portions of the sack that has been filled previously at the station S2 and will transfer it to the final station S3 which effects the top closing seal of the sack and which incorporates the means to cool said seal.

During the filling step at the station S2 and transferring step to the station S3, the sack is supported by an underlying conveyor 13 of a conventional type, which comprises an initial rocking portion 113 which at the beginning of each step is in its lower position, as shown with solid lines, and which is raised during the filling of a sack in order to better support said sack and ensure a uniform filling thereof. To this end, the initial portion 113 of the conveyor can, if desired, submit the sack, during the filling step, if desired, to a slight subsultory movement. The conveyor 13 is of suitable length for discharging the sack after the closing step at the final station S3 and is connected to an actuating unit (not shown).

It appears from Figures 1-2-3 that the grippers P1 and P2 are mounted on two horizontal, parallel cradles 14-14', arranged at the same level and directed longitudinally at the sides of the machine. The ends of said cradles are connected - by articulating them on horizontal shafts 15-15' perpendicular to said cradles - to the lower ends of respective pairs of parallel and equal connecting rods 16-16' which are directed upwards and are supported indirectly at their upper ends, so as to be swingable on axes 17-17' parallel to said lower shafts, by the frame T of the machine. The cradles 14-14' form the lower mobile side of two articulated parallelograms which are connected by means of links 18 to a pair of cranks 19 which are keyed on a synchronization shaft 20 which is actuated, for example, by a self-braking geared motor 21. The oscillatory movement of the connecting rods causes the longitudinal reciprocating movement of the cradles 14-14' to transfer the sacks from a station to the successive one and to return to the initial position.

Said axes 17-17' are the axes of respective parallel shafts 22 of the type shown in Figure 4, on which said connecting rods are mounted with the interposition of bushes and bearings. These shafts, in turn, are supported rotatably at the ends thereof by the frame T of the machine, with the interposition of cranks having the same characteristics and so timed whereby said shafts can rotate on respective axes 23-23' which are parallel to and equally spaced from the axes 17-17'.

The axes 23-23' are synchronized between each other by a positive drive 24 of any suitable type, e.g. a chain-and-sprocket drive or a toothed pulley and belt drive. One of the axes 23-23' is connected, in turn, by a rigid drive 25, to a self-braking geared motor, not shown. The intermittent rotation of the eccentrics 17-23 and 17'-23' causes the grippers mounted on the cradles 14-14' to move up and down as required for inserting and withdrawing the sacks, respectively, into and from said stations S1-S2-S3.

In the machine being described, it has been foreseen, for example, that the grippers P1-P2 reach the stations S1-S2 in the opened and raised condition. Here, the grippers will close to seize the sacks at their sides, and then they move down to withdraw the sacks from said stations and then they transfer said sacks from S1 to S2 and from S2 to S3. On completion of this transfer, the grippers move upwards to introduce the sacks into the stations they have reached and after introducing them they open and oscillate to repeat the cycle just

described. This succession of steps is ensured by suitable programming means, not shown, for actuating with suitable timing the geared motor 21 and the geared motor connected to the drive 25.

In Figure 3, H indicates the extent of the upwards and downwards displacement of the grippers, caused by the eccentrics 17-23 and 17'-23', and L indicates the extent of the backward and forward displacement of the assembly of grippers by the action of the cranks 19.

It appears from Figures 1 and 2 that the cradles 14-14' comprise an intermediate member 114-114' which is connected by means of cylindrical/vertical articulated joints 26-26' to the end portions 214-314 carrying the grippers P1-P2 and the pivots 15-15' to the connecting rods 16-16'. The cradles 14-14' are articulated since the grippers P2 are fixed to the ends 314 of the cradles and are moved towards and away from each other, as required to transfer a sack from the station S2 to the station S3, as a result of a proportional parallel displacement of the connecting rods 16 towards and away from each other, these connecting rods 16 being of sturdier construction than the connecting rods 16' because they must bear stronger stresses.

It will be noted in Figure 4 that the bushes 27, co-operatively associated with the connecting rods 16 for rotation on the shaft 22, can also move axially on said shaft 22, for example by means of ball-recirculation bearings. Mounted centrally on the shaft 22 and prevented from displacing axially, there is a body member 28 having affixed thereto the intermediate portion of a rod 29 which is parallel to the shaft 22 whose end portions slidably support bushes 30 which are secured to the bushes 27. In this manner the connecting rods 16 are made solidary with each other in oscillating on the shaft 22.

The body member 28 is provided with a depending projection 128 having secured thereto two opposite pneumatic jacks 31-31', of equal characteristics, connected to the connecting rods 16 by means of tierods 131-131'. By varying the length of said tierods, the maximum mutual approaching condition of the gripper P2 is adjusted to the dimensions of the sack to be gripped. Conversely, the maximum spaced apart condition of the grippers P2 is adjusted by means of nuts 132-132' screwed on members 32-32' secured to the body member 28, parallel to the shaft and traversing the abutments 33-33' secured to the bushes 27.

The grippers P2 reach the station S2 in the maximum mutually approached condition and in the opened condition. At this station they will be closed to grip the side portions of the sack, after which they will be lowered to withdraw the mouth of the sack from said station. While tranferring the sack from the station S2 to the station S3, the grippers P2 are moved away from each other by such an extent to stretch the mouth of the sack transversely, whereby said mouth will reach the station S3 in an almost closed condition, to be inserted suitably between the sealers at that station.

With reference to Figure 5, the intermediate station S2 will be now described. At this station there operates the stationary lower mouth 34 of the product-feeding station, which is closed in a conventional manner by a pair of valve-like doors 35-35' which are hinged to said mouth and which can be moved apart for opening the hopper under the action of pneumatic jacks (not shown).

Operating below the mouth 34 of the hopper are opposite suction heads 36-36' mounted on slides 37-37' which slide on guides 38-38' which are secured to the sides of said mouth 34 and so directed as to permit the movements of the heads 36-36' to and from each other. These movements are effected in a self-centering manner by means of two vertical levers 39-39' which are connected to the slides 37-37' at their slotted lower ends and are interfulcrumed at 40-40' to respective supports secured to the hopper. By means of a tierod 41, said levers 39-39' are interconnected at 42-42' so as to obtain a self-centering movement, and one of said levers is connected to an oscillation control member comprising, for example, an angle lever 43 fulcrumed at 40 and connected at the opposite end at 44 to an actuating jack 45 and the slotted arm of which cooperates with a pin 46 at the end of the lever 39. It is now apparent that the upward and downward movements of the lever 43 will cause, respectively, the movements of the suction heads 36-36' away and towards each other.

The heads 36-36' are connected to a suction source through flexible hoses 47-47', while they are connected through additional conduits 48-48' to a safety circuit which controls the vacuum within said heads 36-36' as described below.

With reference also to Figure 10, it will be noted that mounted at the sides of the head of said hopper there are mounted respective grippers 49-49' which are directed downwards and such as to operate on the mouth of a sack that is inserted at the station S1. Arranged between said grippers and the hopper are stationary forks 50-50', also directed downwards and operating as explained below.

Upon the beginning of each working cycle, the grippers 49-49' are opened and the suction heads are spaced away and disactivated, as from Figure 5. It will be noted in Figure 10 that at due time the grippers P1 will position at the station S2 a sack Z coming from the station S1 and supported at the upper side portions thereof by said grippers P1 in

their lower position. At the station S2, said grippers P1 are raised to bring the sack to a short distance from the mouth of the hopper, inserting it partially in the forks 50-50'.

As appearing from the successione of Figures 11 and 12, the suction heads 36-36' are activated and moved towards each other to grip the sack at opposite side portions of its mouth (see also Figure 6), after which the grippers P1 will be opened and wait for the completion of work of the grippers P2 to repeat with them the working cycle.

During the step in which the suction heads 36-36' seize a sack, if one or both heads should not seize the corresponding portion of sack correctly, the irregularity is detected by sensors which are connected to the conduits 48-48' and which will act accordingly, for example, by controlling the heads to repeat the sack-seizing operation and by stopping the machine if the irregularity should persist.

In Figures 13 and 7 it will be seen that in subsequent steps the suction heads 36-36' are moved apart to open the mouth of the sack, while the portion of said mouth that is not covered by the overlying outline of the hopper is kept closed due to the co-operation with the forks 50-50'. This closed portion of the mouth of the sack will be acted upon at due time by the stationary grippers 49-49' of the station S2, while the mouth of the hopper will be opened, with the valve-like doors 35-35' pressing the interposed portions of the mouth of the sack against the suction heads 36-36' (see also Figure 8). The sack is thus firmly seized and suitably arranged for being filled at the station S2.

While the sack is being filled, the grippers P1 are returned to the station S1 and the grippers P2 are positioned at the station S2 in their opened and approached condition (Figure 14). At due time, the grippers P2 will close and grip the sack at side upper portions that are not engaged by the stationary grippers 49-49' which will be opened when the hopper 34 is closed (see Figure 15).

In the successive step, the grippers P2 are lowered to withdraw the sack from the filling station S2 while the suction heads 36-36' have been neutralized. As shown in Figure 16, while the grippers P1 insert a new sack Z to be filled into the station S2, the grippers P2 transfer the filled sack Z from the station S2 to the sealing station S3, and at due time they will be moved away from each other by the action of the means described with reference to Figure 4, to stretch the mouth of the sack and nearly close it, so as to ensure a correct insertion thereof into the sealing unit at the station S3.

It will be noted in Figure 9 that the grippers 49-49' at the station S2, preferably, are provided at their jaws with a shearing tip 51 and a cavity 52 in line with said tip, to partially shear at 53 the pinched flaps of the mouth of a sack, without removing any material therefrom, to obtain a fastening point for said flaps, which will be thus more suitably prepared for insertion into the final station S3.

With reference to Figures 8 and 14, it will be noted, finally, that in order to control any escape of air and powder from a sack while being filled at S2, the outer side portions of the door 35 at the hopper mouth may be provided with suction tubes 54-54' connected to a suction source, which will be introduced into the open regions of the mouth of a sack to subject the latter to a suitable de-pressurization.

In Figure 3 it can be seen that the station S3 comprises a pair of opposite sealers 55-55' which are mounted together with a pair of underlying opposite spring-loaded pressure bars 56-56', on a conventional structure having a self-centering action, shown diagrammatically at 57. On completion of the sealing, the sealers 55-55' are retracted and the sack will be further supported temporarily by the pressure bars 56-56', which are hollow, perforated and connected to a source (not shown) feeding cool air to the opposite faces of the sealed region so as to cool it. On completion of the cooling step, also the pressure bars 56-56' are opened so that the filled and sealed sack, no longer supported by the grippers P2, which have released it to effect a new working cycle, is discharged by the conveyor 13.

It is to be understood that the description relates to a preferred embodiment of the invention and that many changes and modifications, especially of constructional nature, may be made thereto. Said changes and modifications may relate, for example, to the fact that the two pairs of connecting rods 16-16' may be made independent in their oscillating and upward/downward movements, whereby the insertion of an empty sack into the station S2 and the filling of said sack may avail of a longer time than the sack-transfer step from the station S2 to the final sealing station S3, with the obvious advantages resulting from this condition.

Claims

1. A sack filling machine comprising a plurality of working stations (S1, S2, S3) sequentially arranged after one another, and pairs of grippers (P1, P2) to transfer each single sack (Z), by gripping it at its mouth portion, from a station to the successive station,
characterized by the fact that
each gripper of the pairs of grippers (P1, P2) is mounted on a cradle member (14, 14') arranged at the respective side of the machine and articulated by its ends (15, 15') to pairs of parallel connecting rods (16, 16') directed upwardly and pivotably supported at their upper

ends by the frame of the machine, the said cradle members (14, 14') being operatively connected by means of a respective tierod (18) to driving means (19, 20) which impart to said cradles a longitudinal alternating movement equal to the distance between two subsequent working stations (S1, S2, S3), and that means are provided for lifting and lowering the grippers (P1, P2) in correct time relationship with the swinging movement of the cradles, for inserting and withdrawing the mouth of the sack respectively into and from the working station concerned.

2. A sack filling machine according to claim 1, characterized by the fact of comprising only the following three working stations:

- a first working station (S1) at which a sack of thermoplastic material is formed;
- a second working station (S2) at which the mouth of the sack is opened and the sack is filled with the product;
- a third working station at which the filled sack is closed by heat sealing and the seal is suitably cooled.

3. A sack filling machine according to claim 2 characterized by the fact that there are provided only two pairs of grippers, of which the first pair of grippers (P1) transfers the sack (Z) from the first working station (S1) at which the sack is formed to the second intermediate working station (S2) at which the sack is opened and filled, while the second pair of grippers (P2) transfers the filled sack from the said second intermediate working station (S2) to the third and final working station (S3) at which the sack is closed by heat sealing.

4. A machine according to claim 1, characterized by the fact that the connecting rods (16, 16') present their upper ends which are swingably mounted onto lifting and lowering means (17, 22, 23 - 17', 22', 23').

5. A machine according to claim 4, characterized by the fact that the upper ends of the connecting rods (16, 16') are carried by excentric shafts synchronized with each other by a rigid drive (24) which is connected to a driving unit actuated in correct time relationship with the driving unit (21) which drives the tierods (18) imparting to the cradles (14, 14') the longitudinal alternating movement (L).

6. A machine according to claim 1, characterized by the fact that the grippers mounted on the oscillating cradles (14-14') are actuated in a self-centering pneumatic manner and are arranged horizontally to act on opposite side top portions of a sack.

7. A machine according to claim 5, characterized by the fact that the cradles (14-14') comprise an intermediate portion (114) which is pivoted at its ends on vertical axes (26-26') and the connecting rods (16) that are near to the grippers seizing a filled sack are mounted on the respective oscillating and raising/lowering eccentric shaft (22) with interposed axially sliding means (27) and are controlled by displacing means (31-31') which under command move them towards and away from each other to give said grippers (P2) the required movement to seize an opened sack at the filling station (S2) and then to stretch the mouth of said sack during the transfer towards the final sealing station (S3), in order to close said mouth which is thus disposed correctly between the operating components of the said final station.

8. A machine according to claim 7, characterized by the fact that intermediately of the eccentric shaft (22) supporting the connecting rods (16) for the grippers (P2) for handling a filled sack there is mounted in a rotatable but axially-locked manner a member (28) which carries the intermediate portion of a rod (29) which is parallel to said shaft and which slides within bushes (30) which are secured to the end bushes (27) of said connecting rods, in order to synchronize the latter in their oscillatory movement, said member (28) having secured thereto fluid-operated jacks (31-31') for moving said connecting rods towards and away from each other and having secured thereto means (32-32'-132-132'-33-33') for controlling the stroke of said jacks.

9. A machine according to any one of the preceding claims characterized by the fact that said grippers (P1-P2) are mounted on respective pairs of oscillating connecting rods (16-16'), suitably constructed as an articulated parallelogram to maintain said grippers in a horizontal position, means being provided whereby said pairs of connecting rods are actuated independently of each other.

10. A machine according to claim 2 characterized by the fact that the first working station (S1) comprises means (12) for feeding a tube (F) of thermoplastic material between a pair of opposite heat sealers (1) mounted on carrier assemblies (3-4) which move with a self-centering movement to cause said sealers to move

toward and away from each other and having arranged thereon, below said sealers, means (2) for cutting the sack-forming tube (F) transversely, said assemblies having mounted thereon, at their top and bottom, pairs of pressure bars (9-10) acting on the tube which is inserted cyclically into the station at intervals of pre-established length, at least one pair of said pressure bars having secured longitudinally thereon air-dispensing bars (11-11') to cool the seal effected by the sealers, the actuation of said self-centering mechanisms being effected, for example, by means of connecting rods and cranks (6) keyed on a shaft which is moved by means of a crank (7) driven by fluid-operated jacks (8).

11. A machine according to claim 2, characterized by the fact that the final station (S3) comprises a pair of opposite sealers (55-55') mounted on a self-centering carrier assembly (57) having also mounted thereon, below said sealers, pressure bars (56-56') provided with means which, under command, dispense cool air, further means being provided whereby the opening movement of said mechanism will occur in two steps, with a suitable dwell period in the position when the sealers (55-55') are spaced from each other and the filled sack is retained by the lower pressure bars (56-56') which blow cooling air.

12. A machine according to claim 2, characterized by the fact that the second intermediate sack filling station (S2) comprises:

- a hopper (34, 35) for feeding the product into the opened sack (Z);
- suction tubes (54, 54') associated to the outlet of said hopper, to suck air and powder from the sack being filled;
- suction heads (36, 36') acting to open the mouth of the sack;
- fork members (50, 50') for delimiting the portion of the mouth of the sack to be openend by the said suction heads (36, 36') and for leaving in closed condition the end portions of the said mouth of the sack;
- a pair of downwardly directed grippers (49, 49') arranged sidewise of the said hopper (34, 35) and of the said fork members (50, 50') to grip the end portions of the mouth of the sack in order to support it during the filling step.

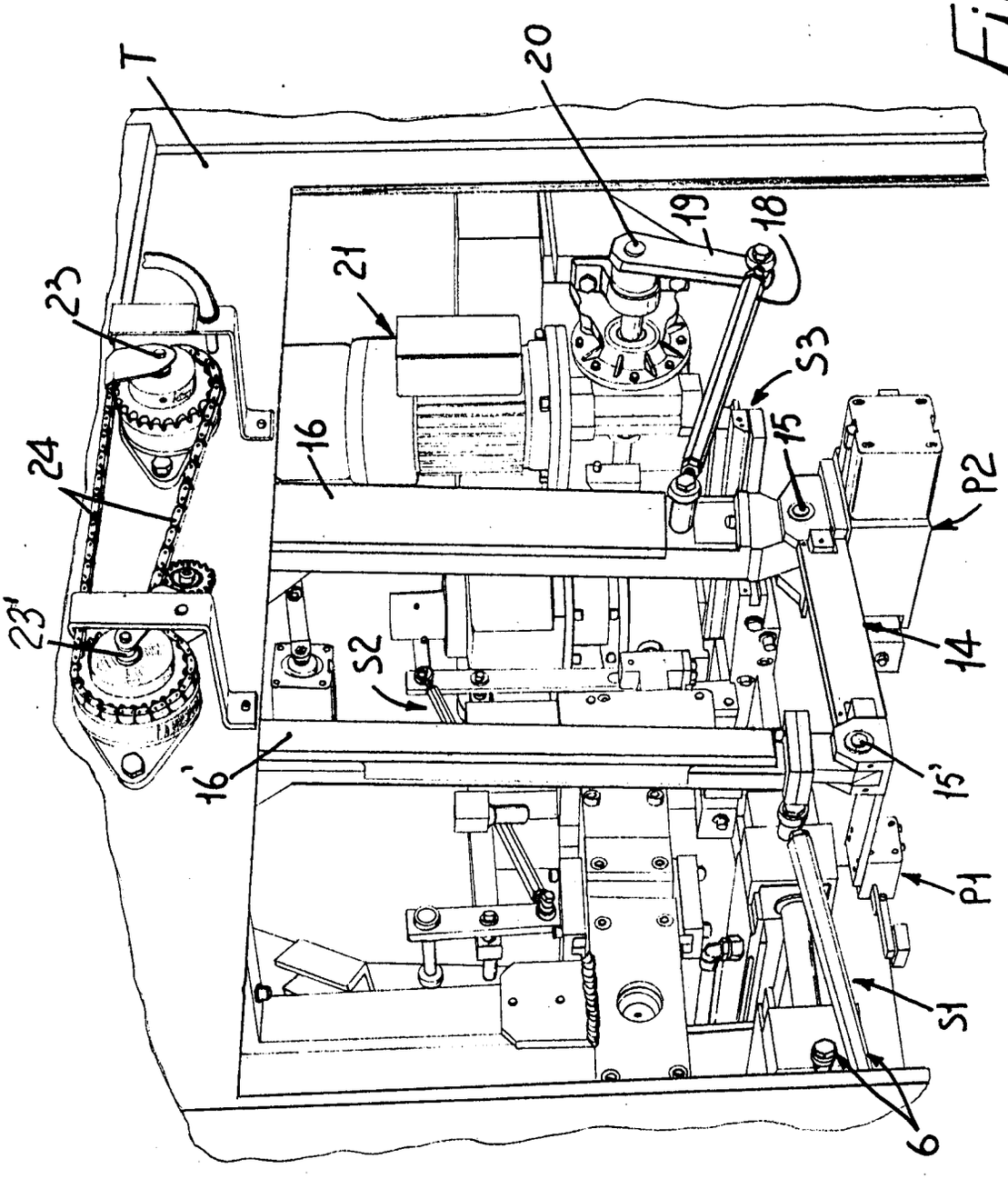

Fig. 1

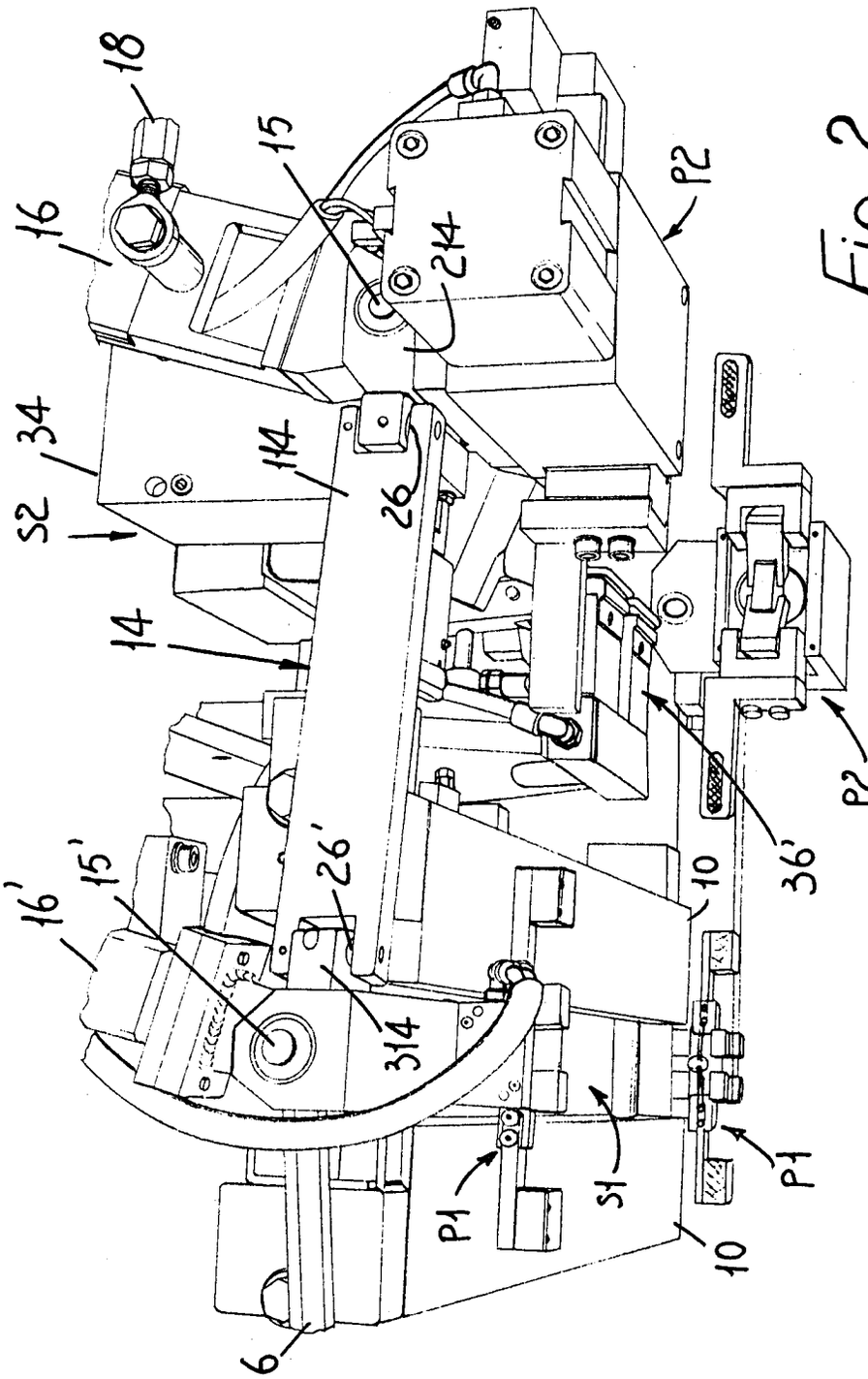

Fig. 2

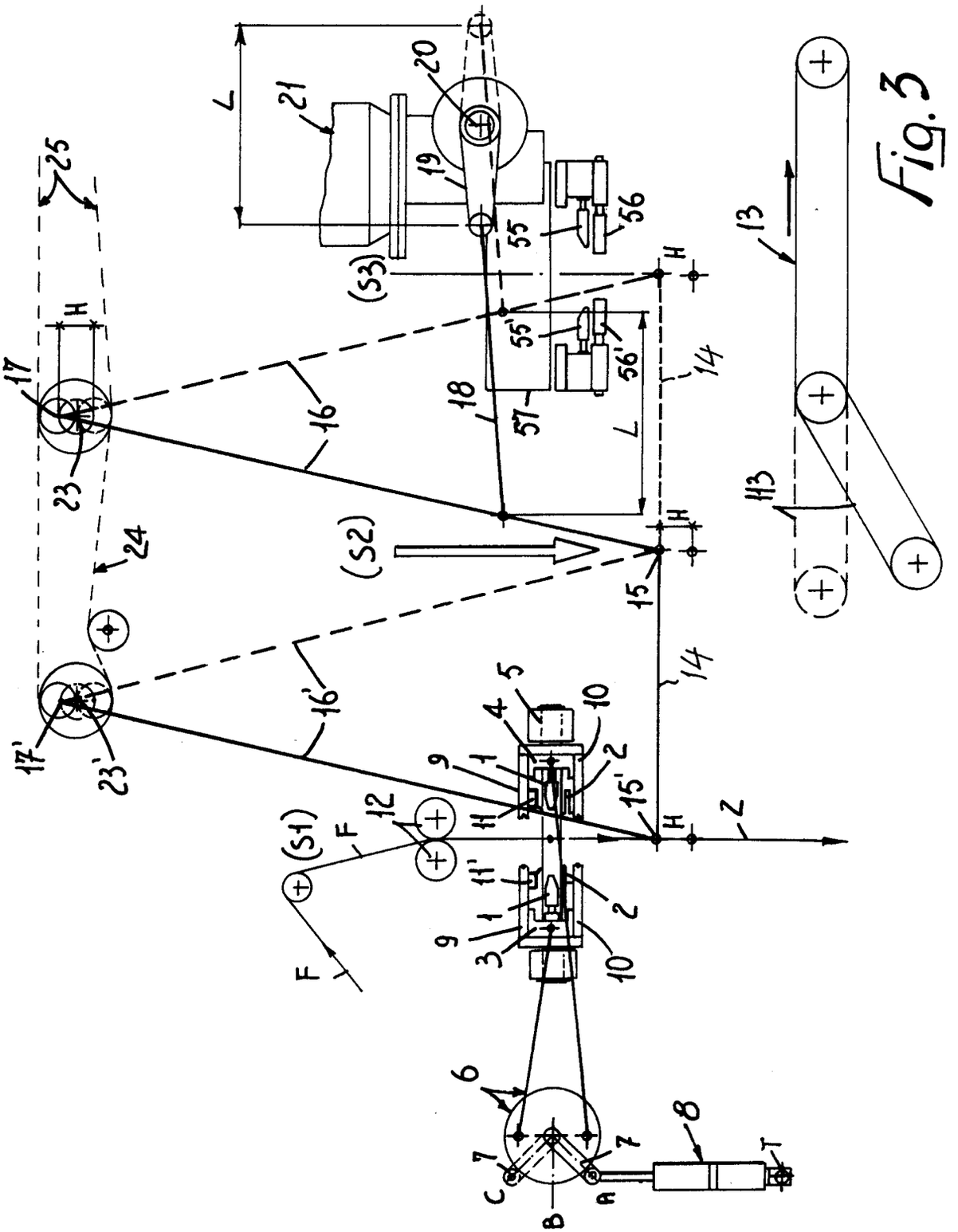

Fig. 3

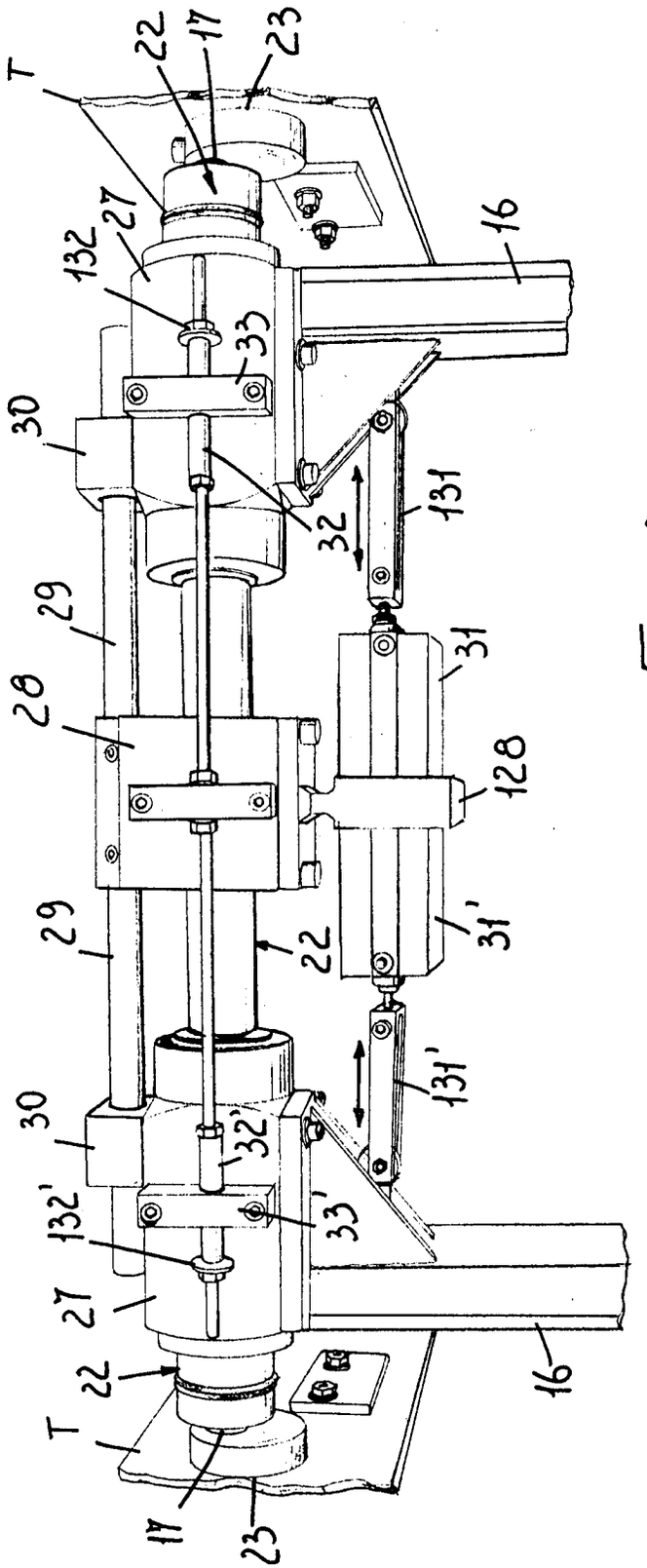
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Fig. 4

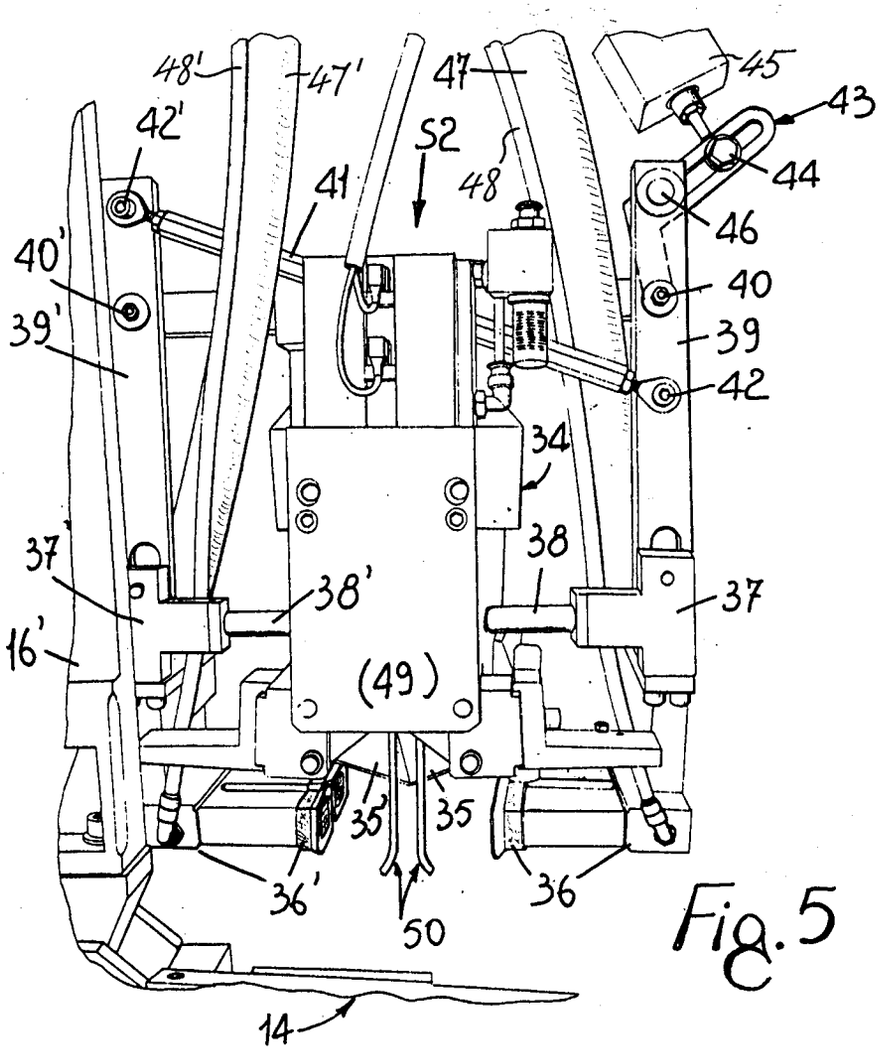
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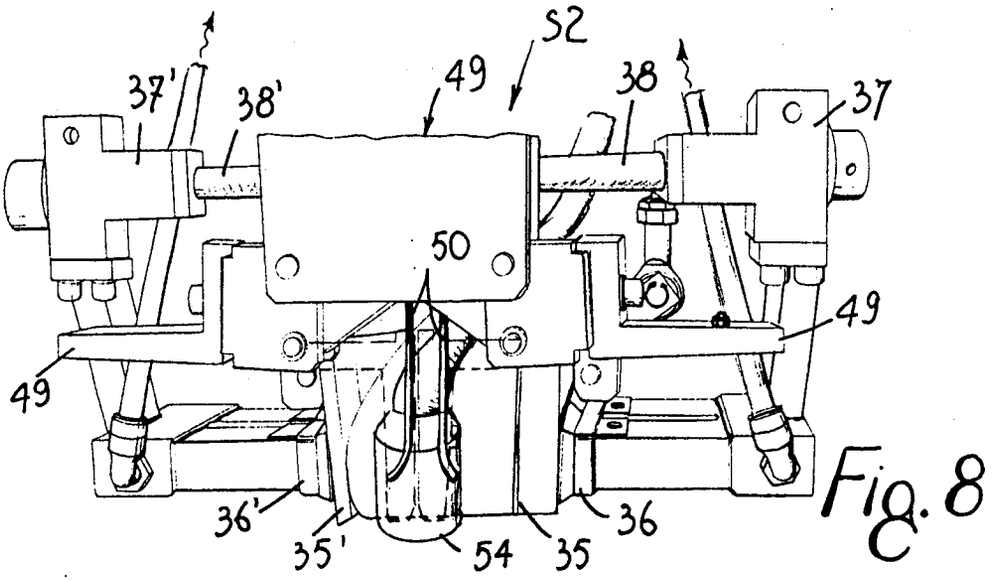
Fig. 5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36

Fig. 8

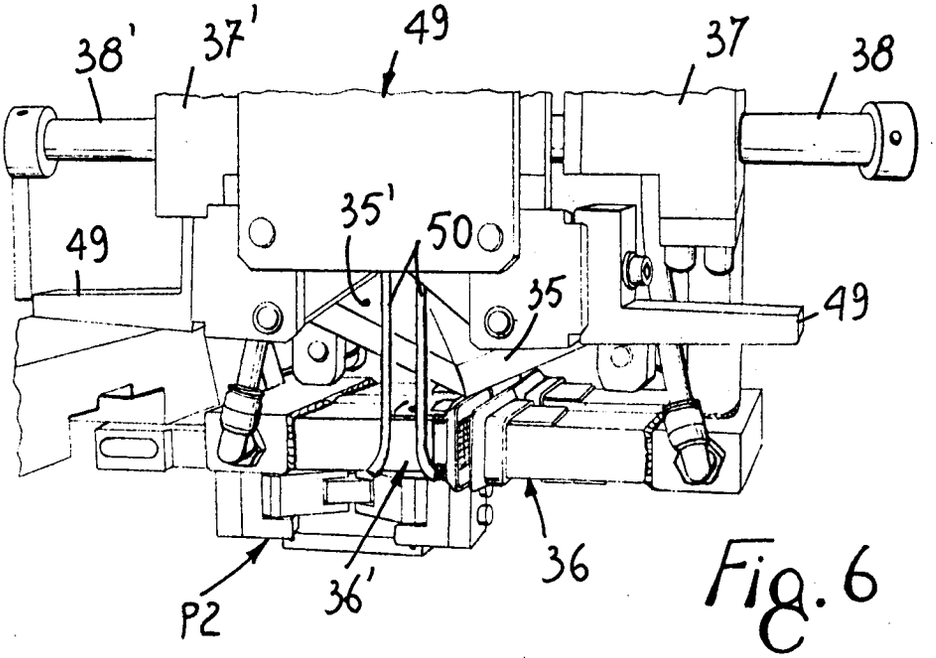
38'
37'
49
37
38
35'
50
49
35
49
36
36'
P2

Fig. 6

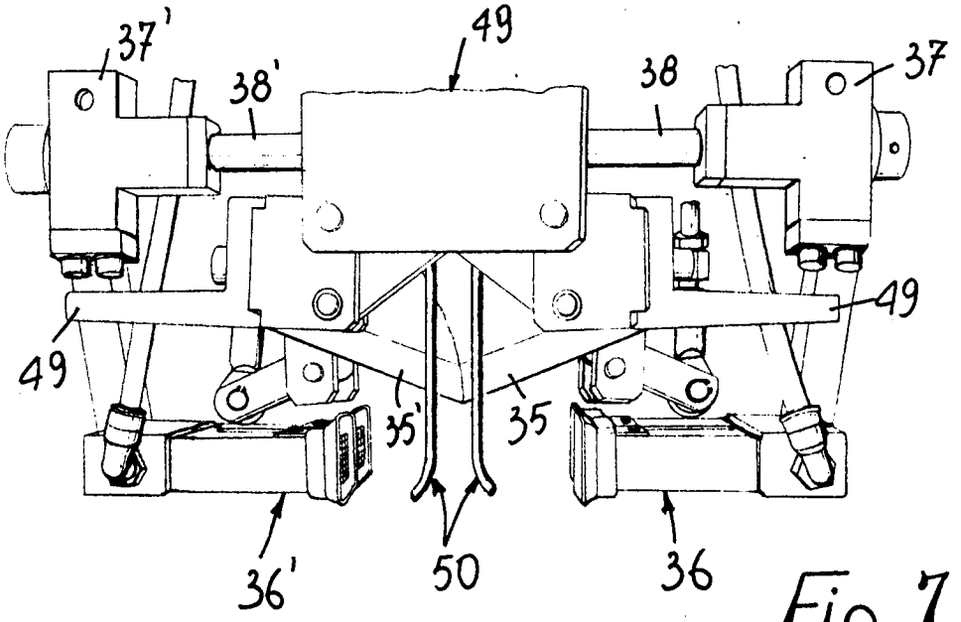
37'
49
38'
38
37
49
49
35'
35
36'
50
36

Fig. 7

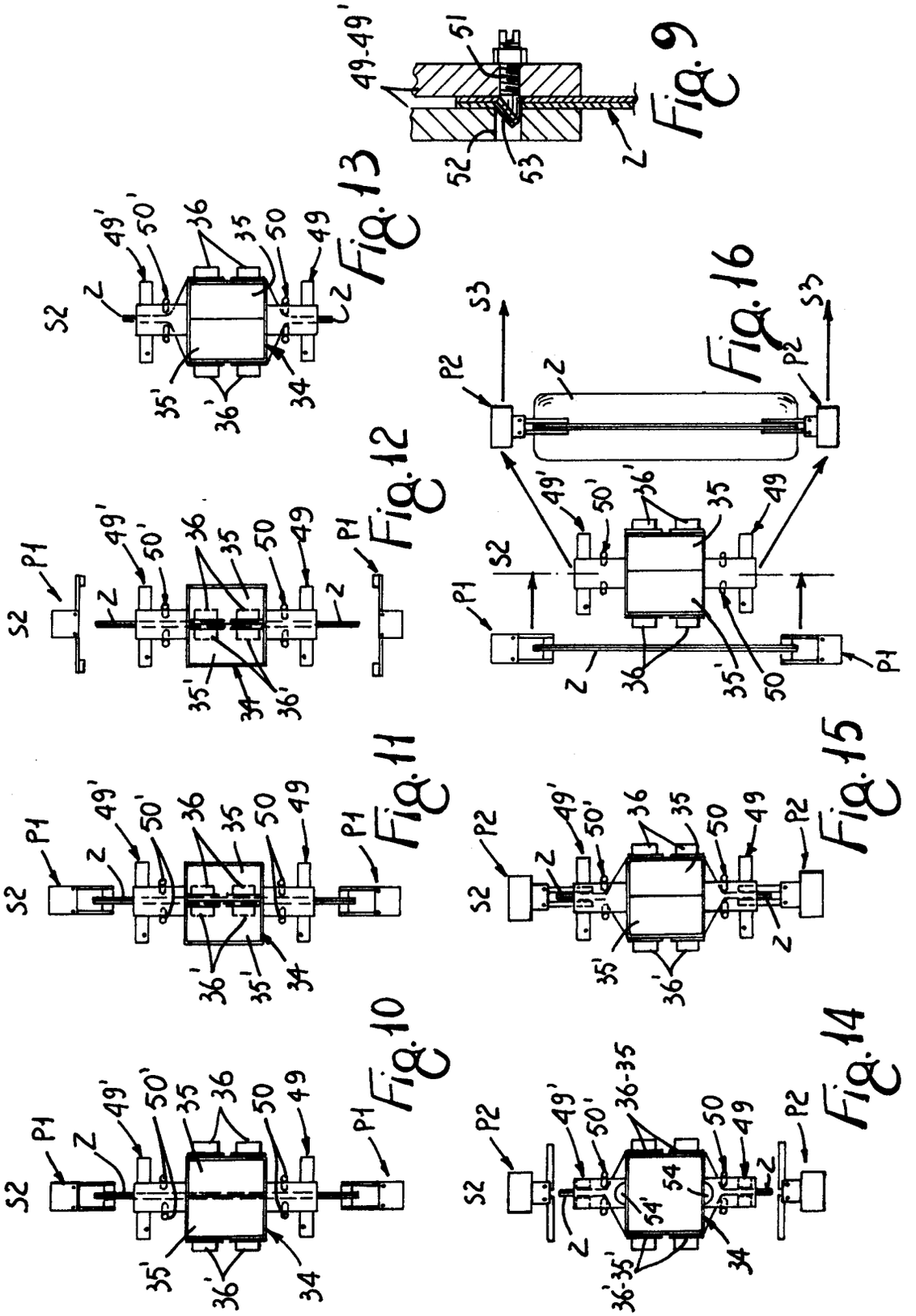

Fig.9 Fig.10 Fig.11 Fig.12 Fig.13 Fig.14 Fig.15 Fig.16

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EUROPEAN SEARCH REPORT

Application Number

EP 91 11 2104

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	DE-A-2 634 754 (ERWIN BEHN VERPACKUNGSBEDARF) * the whole document *	1	B 65 B 43/46
A	FR-A-2 324 514 (OPTYNO-KONSTRUKTORSCOE ET AL.) * the whole document *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 65 B

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	15 October 91	NGO SI XUYEN G.

CATEGORY OF CITED DOCUMENTS

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