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- (54) Benævnelse: **Fremgangsmåde og maskine til robotindpakning af en palleteret last ved hjælp af et overtræk i fleksibelt plastmateriale**
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FR-A1- 2 478 578
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US-A- 3 897 674

Description

The invention relates to a method and device for forming and depositing a packaging cover on a palletized load, said cover being prepared from a sleeve made from flexible plastic material wound on at least one storage reel, a method consisting in:

- storing a predefined length of sleeve on a transfer and accumulation device to constitute a cover closed at one end,
- taking up the opposite open end, and moving the cover down around the load to be packaged, keeping the cover spread open via its four corners.

State of the art

Most known machines possess a sleeve opening device placed above the load to be packaged, during the covering operation, the load being input according to an automated sequential cycle into the machine by means of a roller or chain-driven conveyor and positioned with precision underneath the sleeve opening device.

In these machines, a sleeve storage reel is placed not far from the ground, and its axis extends parallel to or at another angle with the transfer conveyor of the load to be packaged.

In the version where the reel is parallel to the conveyor, the unwound sleeve moves up vertically along the machine to position its open end above the load to be packaged.

In the version where the axis of the reel is positioned at another angle not parallel to the conveyor, the unwound sleeve passes via an angle transmission device before or after moving up vertically along the machine to position its opening above the load to be packaged.

In both these cases, the transverse feed axis of the sleeve coincides with the transverse axis of the transfer and accumulation device, and the transverse axis of the load, and is fixed independently from the loads.

The documents EP1060988 and EP1574433B1 each describe a device for performing overpackaging of a palletized load by means of a cover prepared from a gusseted sleeve wound flat on a storage reel. A gripping robot comprises an accumulation system on which a part of the sleeve is accumulated, a transfer arm for transferring the roller to the covering station, and a mechanism for spreading the cover open during the downward movement around the load. The sleeve, previously heat-sealed in the transverse direction, is kept in the vertical position with the gussets forced to the open position by positioning means. The arm of the robot is animated with at least one horizontal translational movement towards the covering station which is executed perpendicularly to this covering station.

The document EP-A-395919 relates to a machine for packaging a palletized load by means of a heat-shrink film, comprising four vertical bars equipped with gripping members of the film able to move up and down in the frame. It further comprises an annular retraction furnace, a pair of horizontal cross-bars and two carriages able to move horizontally along the cross-bars. The bars move towards one another when the carriage moves towards the distribution section, and move away from one another when the carriage is above the load to be packaged. This mechanism also performs pallet covering. The movement of the carriage also takes place perpendicularly to the covering station.

In known systems of this type, the transverse axis of the covering station is compulsorily the same as the feed axis of the sleeve coming from the storage reel. This sometimes results in location constraints of the sleeve storage reel with respect to the position constraints of the feed conveyor of the load to be packaged.

In addition, the longitudinal axis of the load to be packaged is compulsorily fixed and corresponds by construction to the longitudinal axis of the transfer and accumulation device. This means that the load to be packaged in the

covering station has to be positioned with precision along the two axes. In most cases, a transverse and/or longitudinal load centring device is used in the covering station or up-line from the latter.

5 **Object of the invention**

A first object of the invention consists in improving the method for performing preparation and deposition of a cover on a load to be packaged, to limit the location constraints of the sleeve storage reel with respect to the constraints
10 on the position of the feed conveyor of the load to be packaged.

The packaging method according to the invention is characterized by the following intermediate steps:

- determining the position of the transverse mid-axis of the load to be
15 packaged with respect to the feed axis of the sleeve,
- moving the transfer and accumulation device of the cover above the load to be packaged, synchronizing the positioning control of said device with the position data of the load to be packaged.

20 The positioning of the load can be either measured to define said position of the transverse mid-axis or programmed in advance. The robot is thus positioned according to a specific measurement or parameter setting, and the load can be located anywhere on the conveyor.

25 During the positioning step of the load to be packaged, the position of the longitudinal axis of the load to be packaged is measured and/or programmed to enable longitudinal positioning of the transfer and accumulation device of the cover. This results in the possibility of eliminating the longitudinal centring device used in the prior art.

30 It is also possible to measure and/or program the position of the two transverse and longitudinal axes of the top plane of the load to be packaged.

The transfer and accumulation device of the cover can then be positioned according to these axes. This results in the possibility of using sleeves having a perimeter adjusted to the perimeter of the load to be packaged. In this version in fact, the perimeter of a sleeve is calculated according to a functional clearance necessary between the perimeter of the load to be packaged and that of the cover. In most cases, the loads to be packaged present a deformation which generally results from an offset of the top plane of the load with respect to the bottom plane. In order to preserve the film from the frictions on the load to be packaged, the perimeter of the sleeve is calculated according to the largest perimeter of the load (union of the projection on the ground of the different planes of the load to be packaged). The positioning of the transfer and accumulation device of the cover according to the axes of the top plane of the load enables the functional clearance to be balanced as best as possible during downward movement of the covering mechanism around the load. It also makes it possible to work with a sleeve having a perimeter that is adjusted to that of the load to be packaged thereby enabling the quantity of cover used to be reduced.

During the step in which the cover is taken up and spread open, the covering mechanism positions the take-up and spreading elements according to the position of the transfer and accumulation device of the cover.

During the step of moving downwards around the load, the covering mechanism controls the position of its take-up and spreading elements according to the position of the load to be packaged.

The load to be packaged may not be stopped on the covering area. Measurement of the position of the transverse axis of the load is performed while it is transported, so that the covering mechanism controls the position of its take-up and spreading elements of the cover so that they also follow the position of the load continually.

It is also possible to measure and/or program the angular position of the two transverse and longitudinal axes of the load to be packaged. During the transfer and take-up step of the cover by the covering mechanism, a rotation takes place with respect to a vertical axis by a suitable angle in order to ensure a good position with respect to the load.

This results in the possibility of positioning the cover in the best direction according to the load to be packaged, but also of adjusting to a feed axis of the load that is not perpendicular to the feed axis of the sleeve.

During the transfer and take-up step of the cover by the covering mechanism, the device can perform a rotation through a suitable angle with respect to a vertical axis in order to ensure correct insertion of the film on the take-up and spreading fingers. This results in the possibility of using a film suited to the load to be packaged limiting the impact of the dimensions of the take-up and spreading fingers.

During the transfer and take-up step of the cover by the covering mechanism, the device performs a combination of movements and rotations through a suitable angle with respect to a horizontal axis in order to ensure correct insertion of the film on the take-up and spreading fingers. This results in the possibility of using a film suited to the load to be packaged limiting the impact of the dimensions of the take-up and spreading fingers.

The cover opening and throughput device is positioned on a vertical plane at a height calculated according to several parameters, in particular the height of the load, in order to ensure correct guiding of the film:

- during the step of downward movement of the covering mechanism around the load for a first version. This results in better control of depositing of the cover in order to eliminate friction of the cover on the load to be packaged;

- during the pleating step of the cover on the fingers for another version. This results in better control of the friction on the pleating fingers.

A second object of the invention consists in providing a machine for forming and depositing a packaging cover on a palletized load, limiting the location constraints of the storage reel of the sleeve with respect to the positional constraints of the feed conveyor of the load to be packaged and being able to
5 indifferently use a sleeve with or without a gusset and made from plastic material or not.

The machine comprises a transfer and accumulation device comprising an
10 accumulator element on which a part of the sleeve is wound, and a mechanism for spreading the open end of the sleeve after transfer to the covering station. According to the invention, a control and/or measuring device of the position and the inclination angle of the feed axis of the load, by synchronizing control of positioning of the transfer device with the load
15 position measurement data, enables positioning of said transfer device to be performed, in space, according to the position of the load to be packaged.

Other features can be used in combination:

20 The transfer device can be configured to enable a new gusseted sleeve to be placed on the positioning means using a first reel whereas it continues to operate using the second reel.

The reels can be located in perfectly free manner as far as position is
25 concerned, but also along a parallel, perpendicular or indifferent axis with respect to the conveyor.

The gripping means can be positioned at a defined height level and in a space dedicated to maintenance enabling a good accessibility for
30 maintenance operations.

During the covering phase, the gripping means can prepare a new cover and anticipate feeding of other covering frames located in the accessible enclosure.

5 **Brief description of the drawings**

Other advantages and features will become more clearly apparent from the following description of an embodiment of the invention given for non-restrictive example purposes only and represented in the appended
10 drawings, in which:

- Figures 1 to 4 describe the packaging machine according to the invention with different operating cycles;
- Figure 5 represents a plane view of the robot and of the load position
15 control system;
- Figures 6 to 9 are plane views of the machine with different sleeve feed configurations with respect to the conveyor;
- Figures 10 and 11 show elevational and side views of the transfer and accumulation device with a deformed load to be packaged;
- 20 - Figures 12 and 13 represent views of the transfer and accumulation device positioned by the arm of the robot at two height levels.

Detailed description of the invention

25 In the figures, a packaging machine 10 of a palletized load CH is composed of a first preparation and forming station 11 of a cover 12 from a film made from flexible plastic material, of a second covering station 13 for depositing the cover 12 on the load CH, and of a transfer device 14 between the two stations 11, 13.

30

A conveyor 32 feeds loads CH to covering station 13 at a predefined rate.

Control of the transfer device 14 is performed by a robot 15 with a multidirectional actuating arm 16 of 4-axis or 5-axis type, for example a FANUC (registered trademark) robot, controlled by a control circuit with a programmable processor.

5

Packaging cover 12 is formed by a tubular sleeve formed by a film made from flexible plastic material, for example polyethylene or any other heat-shrink or stretchable flexible plastic material. The plastic sleeve comprises gussets in the form of a double V, and is folded flat after winding around one or two storage reels 17, 18 in first station 11. The sleeve is unwound from one of the reels 17 passing via rollers 19, and is kept in the vertical position in first station 11, with the gussets forced to the stretched position.

The gusseted film can also be replaced by a simple tubular sleeve without gussets, also folded flat on reels 17, 18.

In the two versions of packaging machines with a heat-shrink or cling film cover, the means of the first preparation station 11 are identical, only the fingers of the depositing arm being changed. In the case of a heat-shrink film, the depositing arm is provided with forming and pinching fingers. In the case of a cling film, the depositing arm comprises pleating and spreading fingers associated with motor-driven rollers to perform accordion pleating of the cover on the bottom part of the fingers.

A transfer and accumulation device DTA formed by an accumulator element 20 and a stretching mechanism 21 with four rocker arms 22 is fitted rotating on the actuating arm 16 of robot 15. The accumulator element 20 comprises for example a motor-driven rotary roller 31 on which a part of the sleeve is wound, which is secured by a securing grip integrated in roller 31. The four rocker arms 22 of stretching mechanism 21 are equipped with grips 23 to guide and seize cover 12. The sleeve is welded transversely to form a heat-

welded joint, and the accumulated element 20 is stored over a predefined length of sleeve to form cover 12.

5 Figures 1 to 4 illustrated several operating cycles when preparation, transfer of cover 12, and covering on load CH are performed. These figures concern for example a packaging machine with a cling film sleeve.

10 In figure 1, first preparation station 11 comprises two storage reels 17, 18, and robot 15 is placed on a support 24 between the two reels 17, 18 and facing second covering station 13. Actuating arm 16 of robot 15 is fitted with 360° rotation around a vertical axis 25 on a rotary base 26 of support 24. Actuating arm 16 can also swivel around a horizontal axis 27 to allow upward and downward movements. Multidirectional movement of actuating arm 16 is thus possible above the two stations 11, 13.

15 Figure 2 illustrates transfer of cover 12 wound on accumulator element 20 to second covering station 13. The four rocker arms 22 are actuated to the separated position to cause opening of the bottom free end of cover 12. Fingers 28 can separate horizontally along depositing arm 29 so as to place themselves underneath grips 23 of rocker arms 22. Depositng arm 29 is 20 movable in the upward and downward direction by means of a vertical translation control mechanism 30.

25 In figure 3, the end of cover 12 is taken up in second covering station 13 by fingers 28 of depositing arm 29. The latter is now ready to start its downward movement to progressively envelop load CH with cover 12.

30 Figure 4 shows the end of the covering operation, load CH being totally wrapped by cover 12. Depositng arm 29 is located in the down position, and robot 15 has moved accumulator element 20 to first preparation station to prepare a new cover.

In figure 5, load CH to be packaged is transported by the conveyor to the covering area. A control system 34 measures the position of load CH when it is stopped. Control system 34 is provided with several optoelectronic sensors 35 arranged according to a certain network layout covering a surface above that of the top of load CH. The different sensors 35 are electrically connected by connecting wires 36 to control circuit 33 of robot 15.

According to a variant, positioning of load CH can be programmed in advance after certain parameters have been stored in the control circuit. The load stops in a predefined position and the robot comes and places itself in a programmed position, without any previous measurement being required.

In figure 6, it can be noted that the transverse mid-axis a1 of load CH is perpendicular to the longitudinal axis a2 of conveyor 32, and is separated by a distance D1 from the feed access a3 of the sleeve coming from reel 17. The latter is placed in parallel manner to the direction of movement of conveyor 32. In this case, sensors 35 measure the position of the transverse mid-axis a1 of the load to be packaged with respect to the feed axis a2 of the sleeve. Control circuit 33 of robot 15 causes movement of the transfer and accumulation device DTA of the cover to a position above the load CH, synchronizing control of positioning of said device with the measurement data of the position of the load to be packaged.

In figure 7, reel 17 is moved through 90° extending in parallel manner to conveyor 32. An angle transmission 37 redirects the sleeve to preparation station 38, and the direction of the feed axis a3 of the sleeve is identical to figure 6.

In figure 8, the longitudinal mid-axis a4 of load CH is different from the longitudinal axis a2 of conveyor 32. Control system 34 measures the position of longitudinal mid-axis a4 of the load CH to be packaged to enable longitudinal positioning of the transfer and accumulation device DTA of cover

12. This results in the possibility of eliminating the longitudinal centring device used in the prior art.

5 In figure 9, the longitudinal axis a2 of conveyor 32 forms an angle A different by 90° from feed axis a3 of the sleeve. During the control and/or measurement step of the position of the load CH to be packaged, sensors 35 then perform measurement of the angular position of the two axes a1 and a2 of the load CH to enable a rotation of the transfer and accumulation device DTA to be made with respect to a vertical axis by a suitable angle.

10 This results in the possibility of positioning cover 12 in the best direction according to the load CH to be packaged, but also of adjusting to a feed axis of the load that is not perpendicular to the feed axis of the sleeve.

15 Fingers 10 and 11 show a load CH presenting a deformation that generally results from an offset of the top plane of the load with respect to the bottom plane. Control system 34 performs measurement of the position of the two (transverse and longitudinal) axes of the top plane of the load CH. The transfer and accumulation device DTA of the cover 12 can then be positioned according to these axes, and it enables the functional clearance to be
20 balanced as best as possible during downward movement of the covering mechanism around the load. It also makes it possible to work with a sleeve having a parameter that is adjusted to that of the load to be packaged and therefore to reduce the quantity of cover used.

25 In figures 12 and 13, the transfer and accumulation device DTA can be positioned by arm 16 of robot 15 at a defined height level and in a space dedicated to maintenance enabling a good accessibility for maintenance operations.

30

P a t e n t k r a v

1. Fremgangsmåde til formgivning og afsætning af et indpakningsovertræk (12) på en palletteret last (CH), hvor overtrækket fremstilles fra et hylster af fleksibelt plastmateriale, der er viklet på mindst én opbevaringsspole (17, 18), hvor fremgangsmåden består i at:

- opbevare en forudbestemt hylsterlængde på en transport- og opsamlingsindretning (DTA) for at danne et overtræk (12), der er lukket ved en ende,
- optage den modstående åbne ende, og nedsænke overtrækket (12) omkring den last (CH), der skal indpakkes, ved at holde den udbredt med de fire hjørner deraf,

kendetegnet ved de følgende mellemtrin:

- bestemme positionen af den midterste tværaksel (a1) af lasten (CH) i forhold til tilførsaksen (a3) af hylsteret,
- og flytte transport- og opsamlingsindretningen (DTA) af overtrækket (12) over lasten (CH), ved at synkronisere styringen af transport- og opsamlingsindretningen (DTA) med data for positionen af lasten (CH).

2. Fremgangsmåde ifølge krav 1, **kendetegnet ved, at** anbringelsen af lasten (CH) udføres med en måling af positionen af den midterste tværakse (a1).

3. Fremgangsmåde ifølge krav 1, **kendetegnet ved, at** anbringelsen af lasten (CH) er programmeret til at anbringe robotten i en forudbestemt position.

4. Fremgangsmåde ifølge krav 1, **kendetegnet ved, at** positionen af den midterste længdeakse (a4) af lasten (CH) måles og/eller programmeres til at tilpasse en langsgående anbringelse af transport- og opsamlingsindretningen (DTA) af betrækket (12).

5. Fremgangsmåde ifølge krav 4, **kendetegnet ved, at** positionen af den midterste tværakse (a1) og den midterste længdeakse (a4) af det øvre plan af lasten (CH) måles og/eller programmeres til at tilpasse positionen af transport- og opsamlingsindretningen (DTA) af betrækket (12).

6. Fremgangsmåde ifølge krav 4, **kendetegnet ved** en måling og/eller en programmering af vinkelpositionen af tværaksen (a1) og længdeaksen (a4) af den last (CH), der skal indpakkes.
- 5 7. Fremgangsmåde ifølge et af de foregående krav, **kendetegnet ved, at** overtrækningsmekanismen tilpasser fingrene (28) af afsætningsarmen (29) til transportpositionen af transport- og opsamlingsindretningen (DTA) og positionen af lasten (CH).
- 10 8. Indpakningsmaskine, som styres af en robot (15) og omfatter:
- en transport- og opsamlingsindretning (DTA), på hvilken der vikles et overtræk (12),
- en mekanisme (21) til fjernelse af den åbne ende af overtrækket (12) efter transport mod en overtrækningsstation (13),
- 15 **kendetegnet ved, at** den omfatter et system til styring (34) med sensorer (35), som er beregnet til at måle positionen og hældningsvinklen af tilføringsaksen af lasten ved at synkronisere styringen af anbringelse af transport- og opsamlingsindretningen (DTA) med data for målingen af positionen af lasten (CH).
- 20 9. Indpakningsmaskine ifølge krav 8, **kendetegnet ved, at** transport- og opsamlingsindretningen (DTA) udfører en kombination af bevægelser og drejninger i forhold til en vandret akse om en vinkel, der er tilpasset til at sikre den rette indføring af filmen over gribe- og spredefingrene (28).

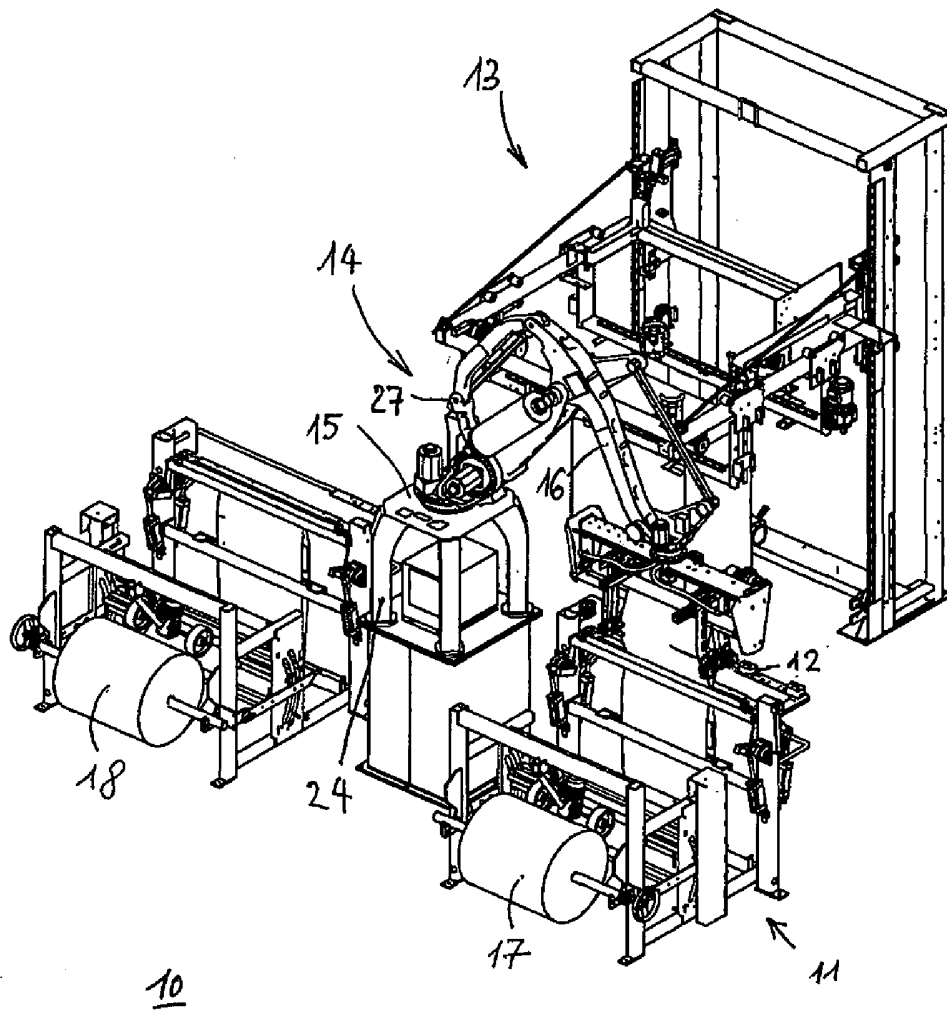


FIG 1.

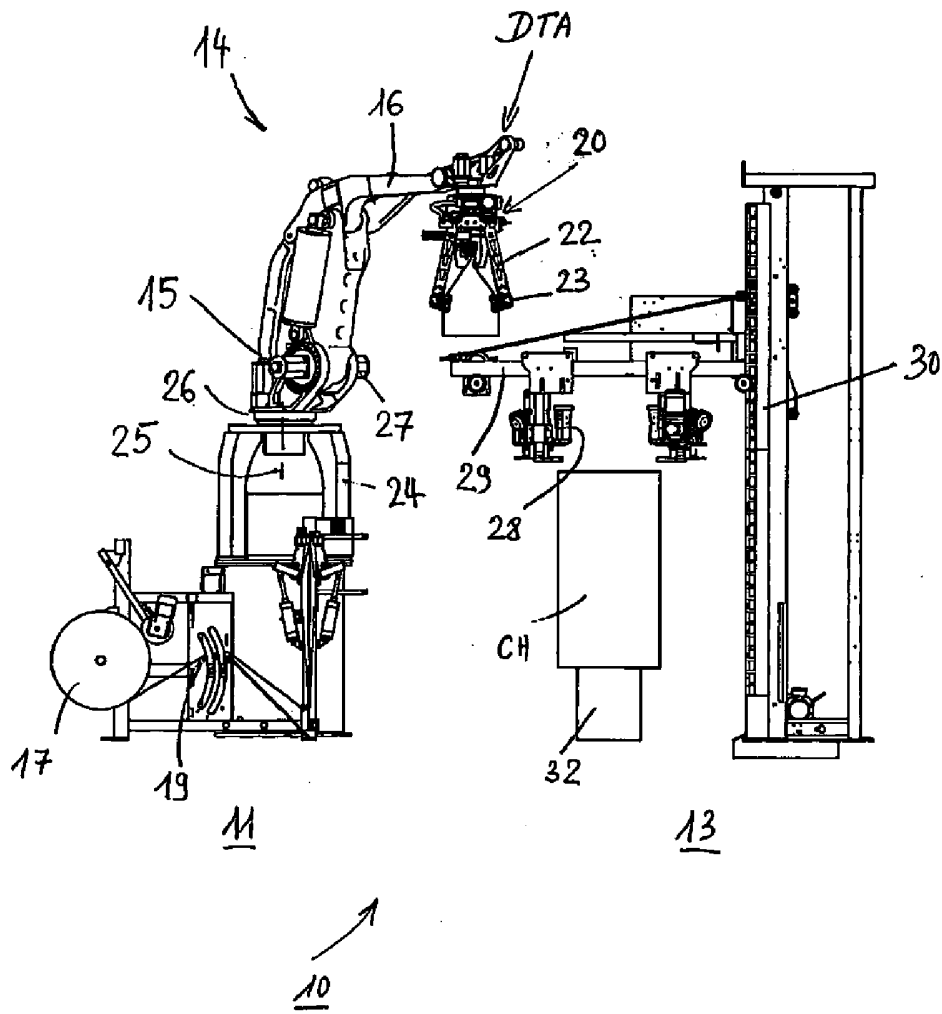


FIG 2

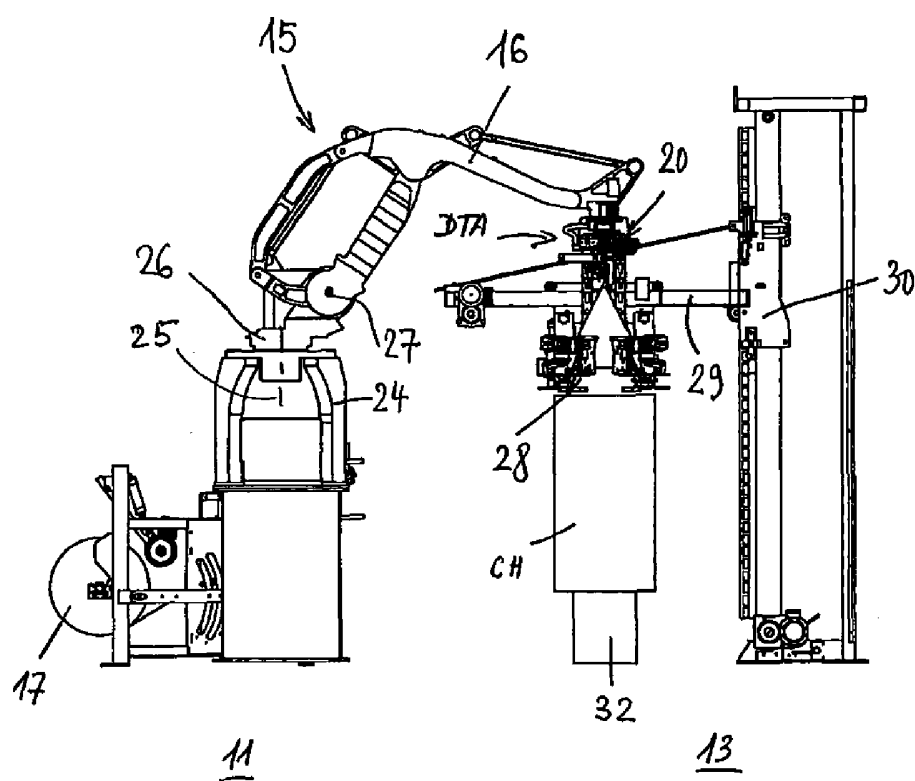


FIG. 3

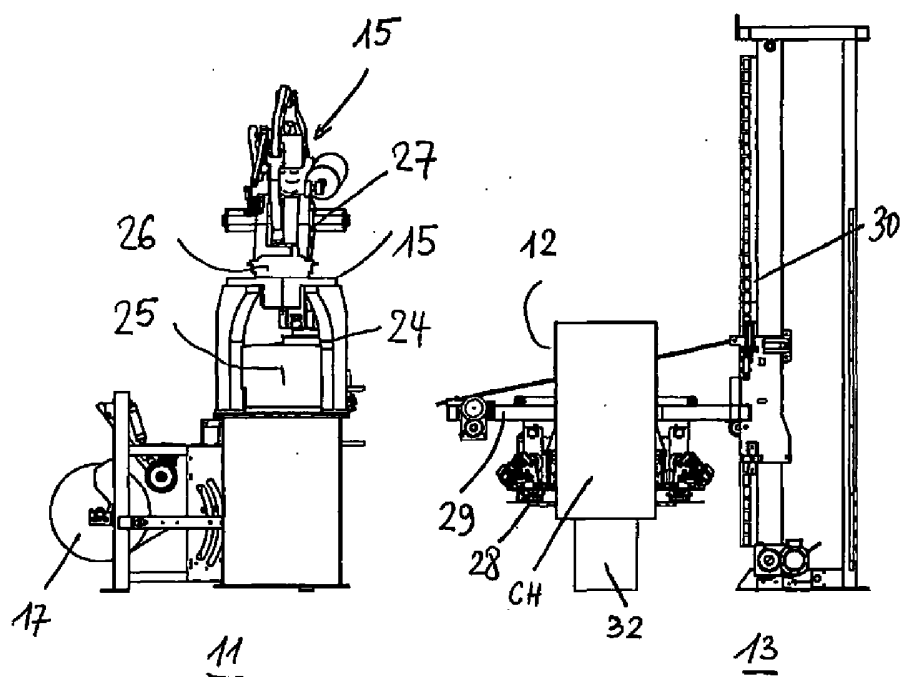


FIG 4

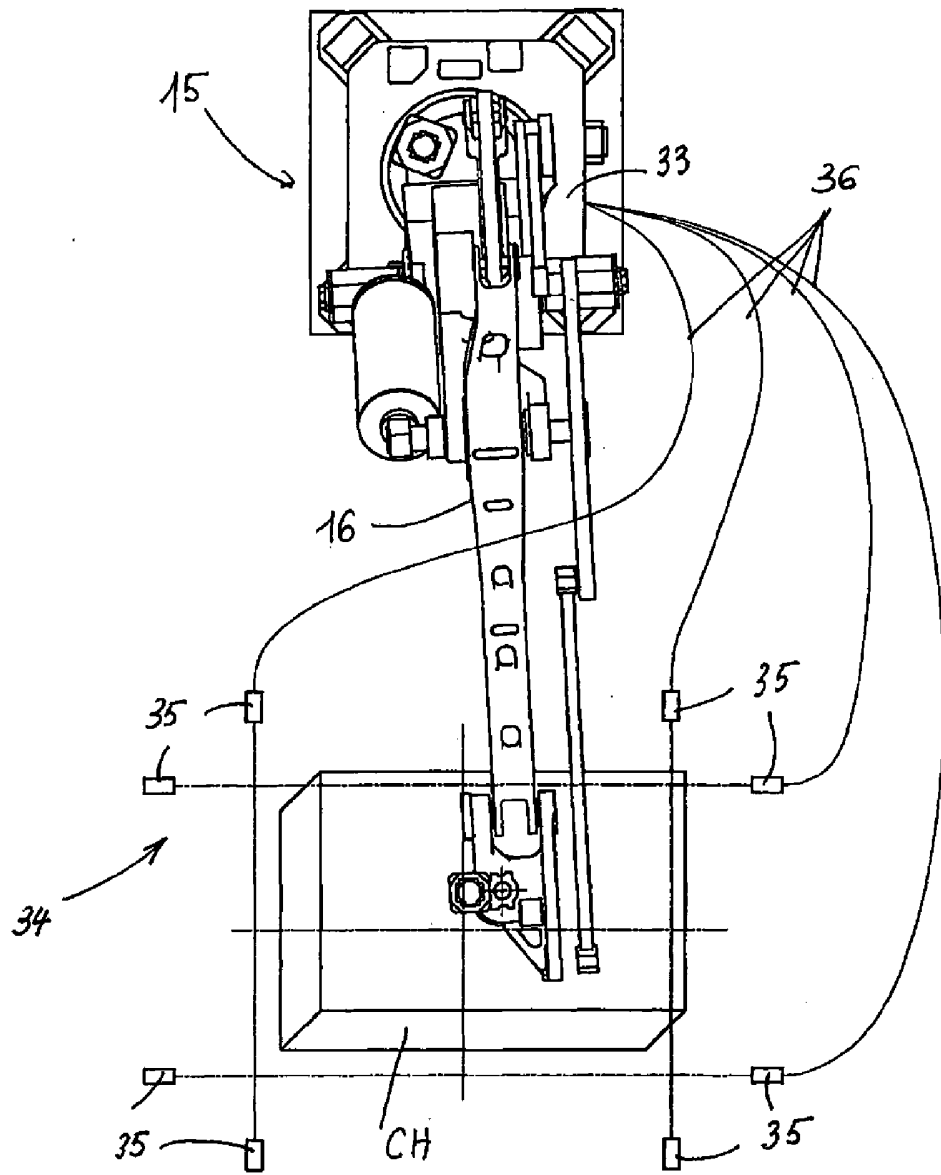


FIG 5

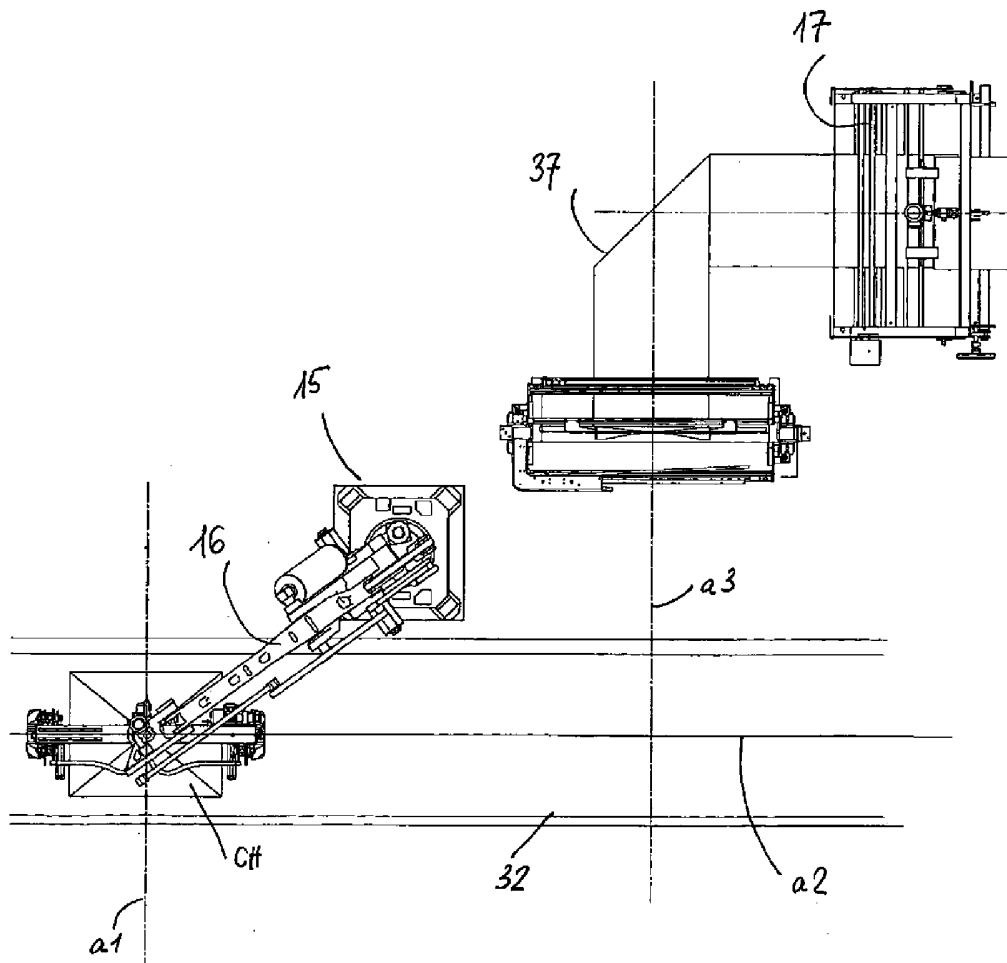


FIG 7

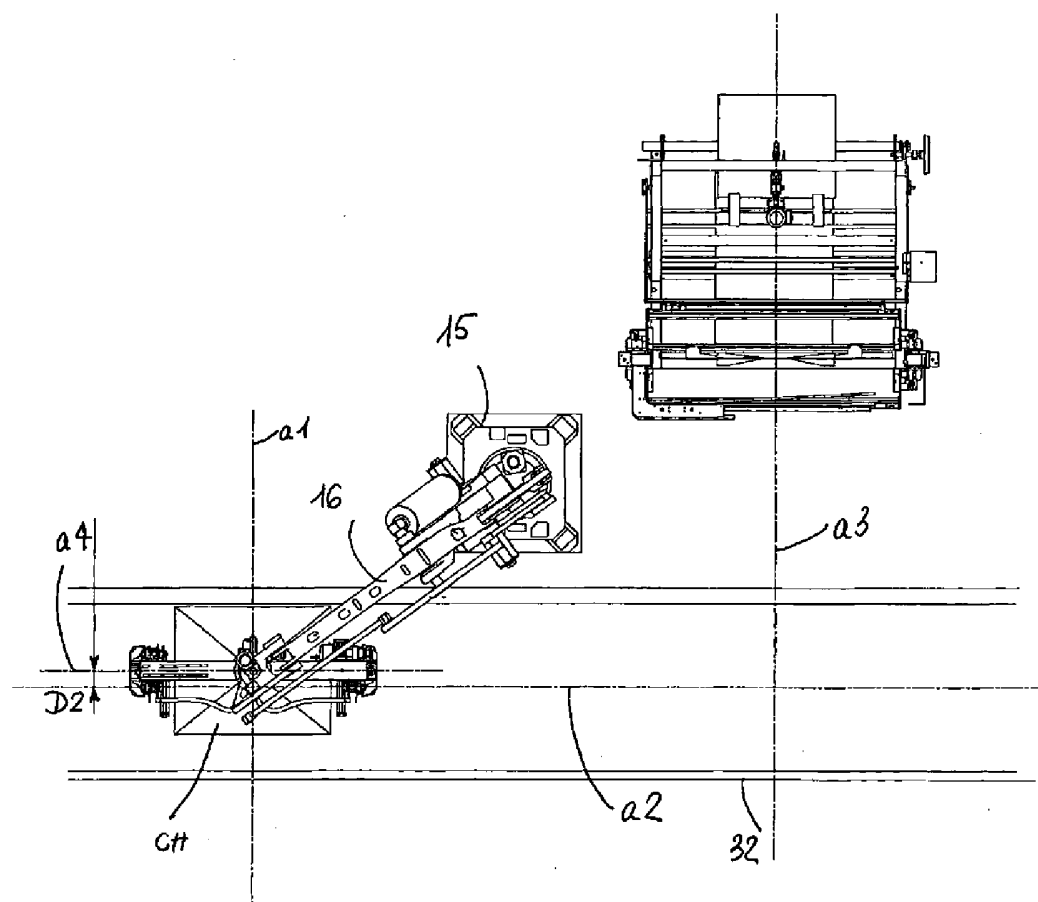


FIG 8

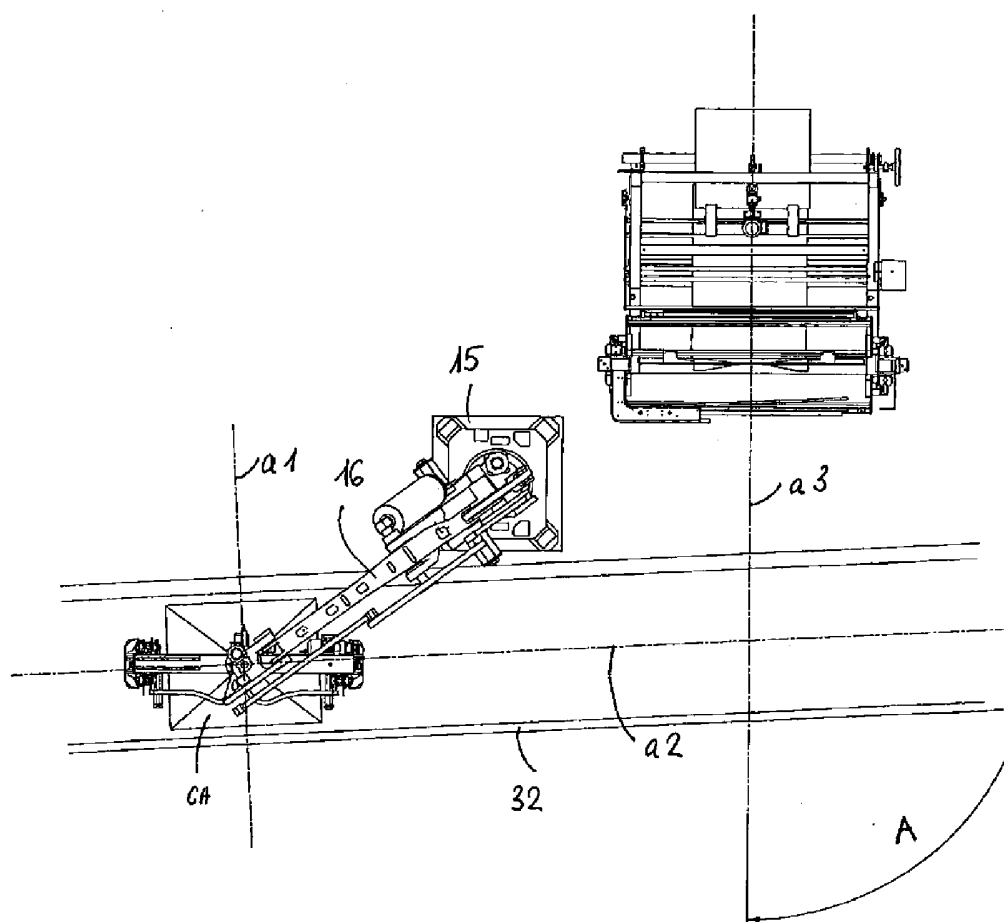


FIG 9

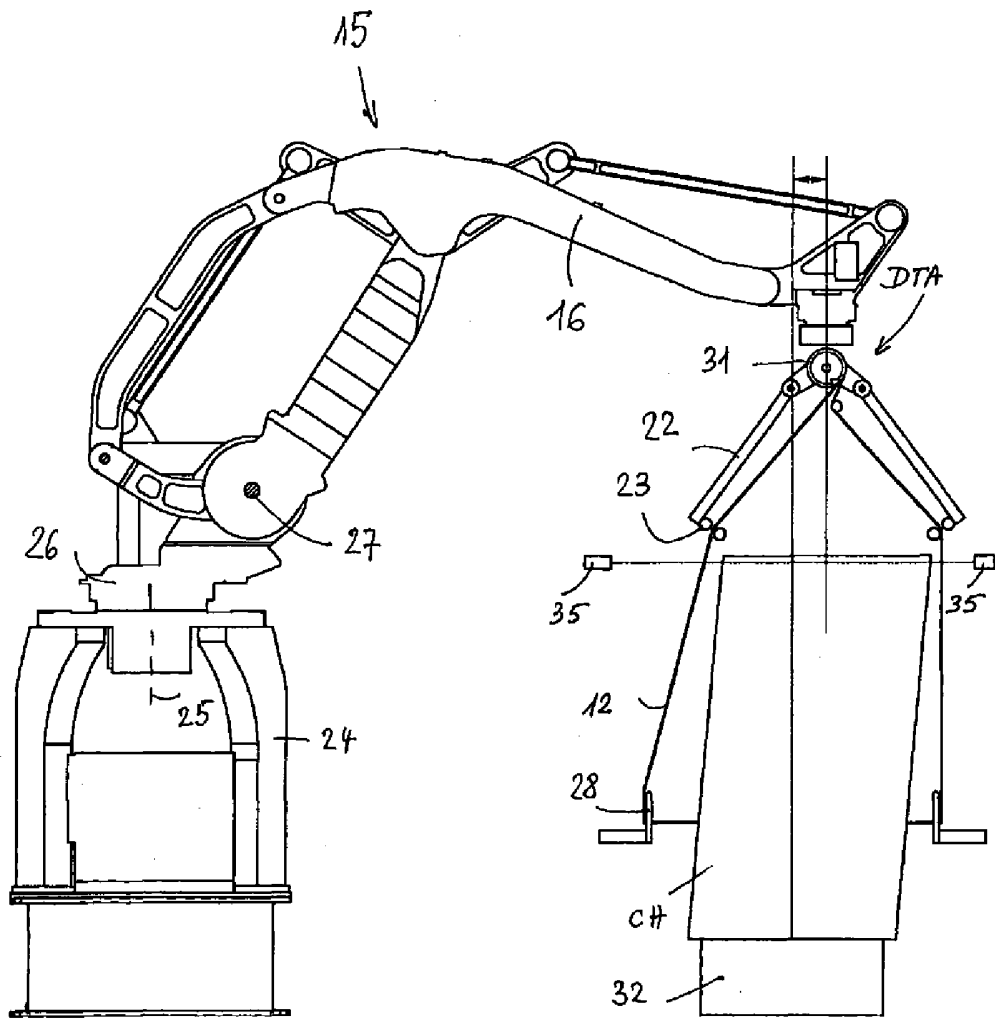


FIG 10

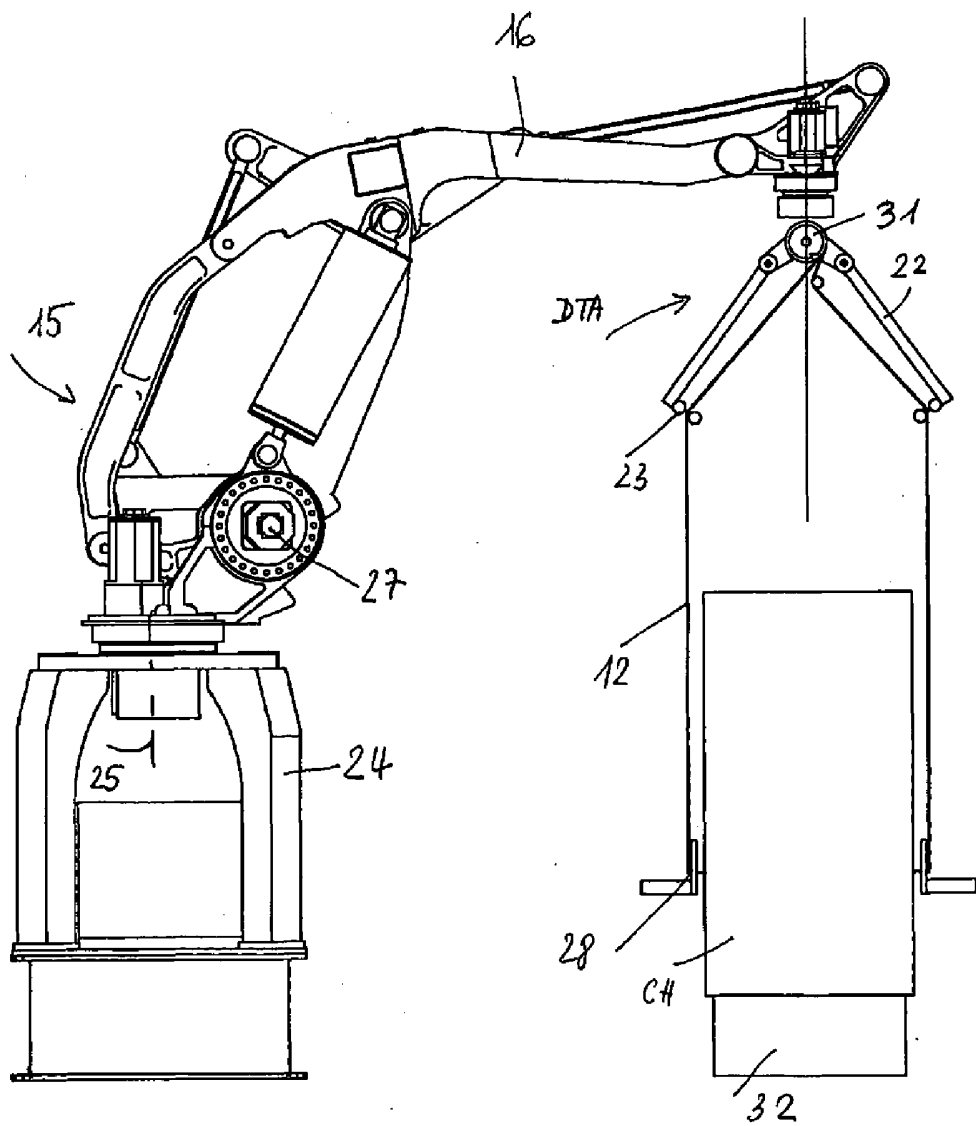


FIG 12

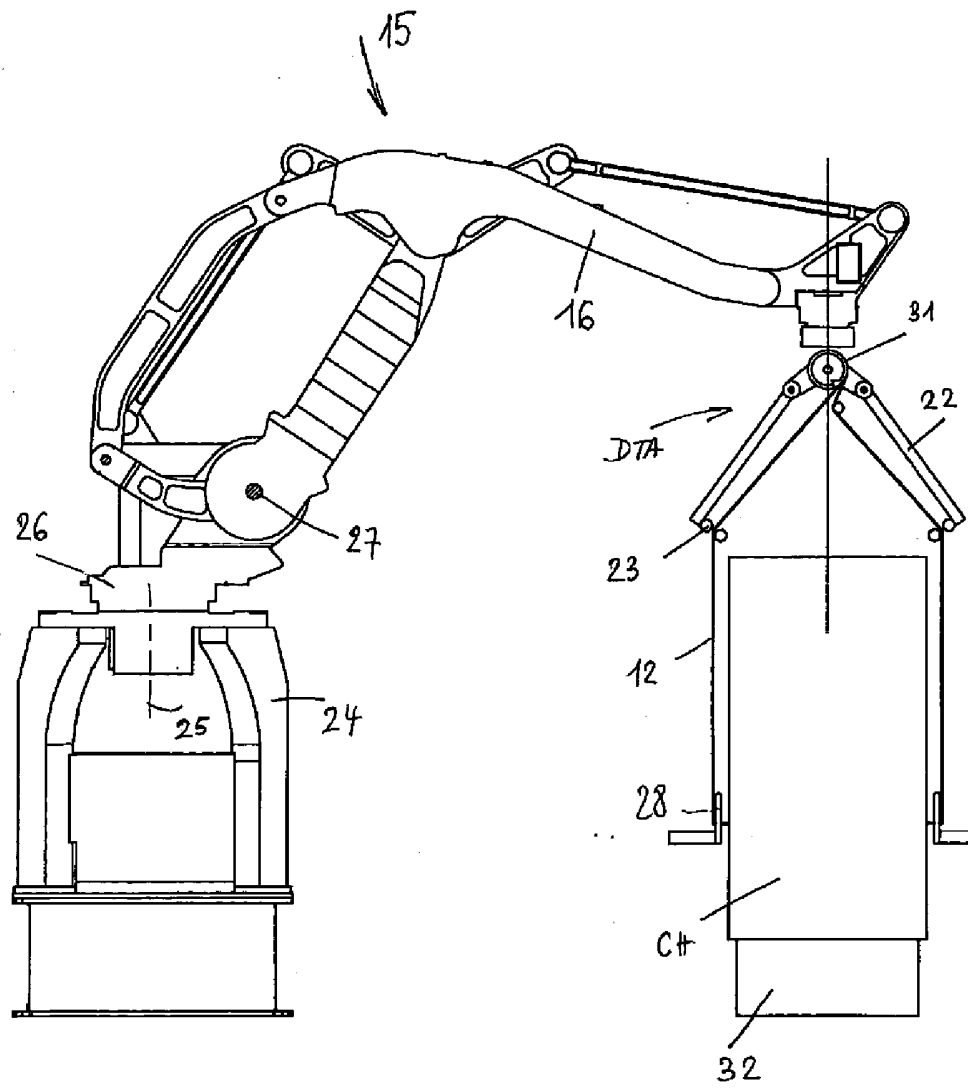


FIG 13