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(54) Automatic silo for automobiles.

(57) A computerized automatic multistory silo for automobiles comprises a plurality of parallelepipedal compartments (29) arranged superposed onto each other and opposite to each other at the two sides of one common service corridor (C) inside which an elevator (4-9) operates. Means are provided to bring the platform (3) of said elevator co-planarly in line with an entrance station (1) or an exit station (2) for the vehicles (A) and with the bottom of the selected compartment, the longer dimension of said compartments being parallel to the length of said corridor. The elevator platform (3) and the bottom of each compartment are provided, transversely to their longer dimension, with conveyors on which the wheels of the vehicle (A) will rest during the ensilage and de-ensilage steps, said conveyors (T,T1) being of the chain (13) type and being actuated at the same speed with reversible direction. The ends of the conveyors in the compartments facing the service corridor (C) and the ends of the conveyors of said platform are arranged so as to co-operate in comb-like fashion, whereby the transfer of a vehicle from the platform into a compartment and vice-versa may be effected quickly by activating said conveyors in the desired direction and under the control of sensors which de-activate said conveyors when the vehicle (A) has reached the desired position.

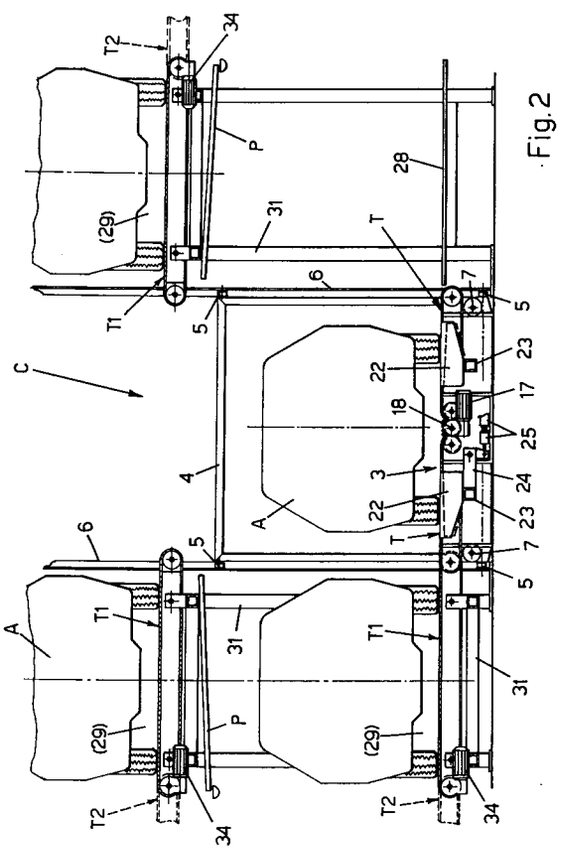

Fig.2

EP 0 504 750 A2

The invention relates to an automatic, computerized, multistory silo for automobiles.

Computerized silos for automobiles are known at present which comprise a parallelepipedal ensilage structure, made of steel framework and/or reinforced concrete, covered and protected on each side against weather, built up from ground level, or underground, or within floating structures, adapted to contain side-by-side compartments, superposed on each other in a multistory arrangement, preferably opposite to each other and open towards a service corridor provided with longitudinal rails on which a powered tower structure (transelevator) may run, said tower being as high as said ensilage structure and being provided with an elevator unit designed to pick up the vehicle to be parked and to ensile it automatically into one selected compartment, and designed to effect as well the contrary operation of withdrawing the vehicle from the selected compartment and returning it to the exit station. The longer dimension of said compartments is parallel to the longitudinal direction of the service corridor and the platform of the elevator is provided with telescopic structures which may be extended in cantilever fashion from any one of the sides of the elevator, to introduce the vehicles into and withdraw them from any one of the selected compartments, by translating said vehicles perpendicularly to their longitudinal axis and by supporting said vehicles by their wheels. The ensilage compartments, in turn, are provided at the bottom with combs the teeth of which are directed perpendicularly to the service corridor and, therefore, parallelly to the axes of the wheels of the vehicles which are disposed on said combs and which are thereafter picked up therefrom by a complementary comb-like structure which is associated telescopically with the elevator platform and which, as stated above, is adapted to be extended in cantilever fashion from any one of the sides of said elevator.

Such a silo for automobiles is described, for example, in the European Patent Publication EP-B1-0 275 004.

A silo of this type, basically, has the following disadvantages:

- the operation requires long idle-time periods, required to withdraw the extendable comb structure of the elevator from the comb of the compartments of the ensilage structure or from the loading/unloading platform, during the ensilage and de-ensilage steps of a parked vehicle. Similar idle-time periods are required in the de-ensilage step of a vehicle from the parking compartments or from the loading/unloading platform, for extending the extendable structure of the elevator;
- the extendable structure of the elevator, designed to effect the introduction and withdrawal of vehicles into and from the parking compartments, as well as into and from the loading/unloading platform, must be constructed so as to withstand considerable bending strains when in the completely extended condition supporting the burden of a vehicle being parked or being returned. This fact leads to architectural problems in the construction of the elevator and transelevator and a considerably higher weight of these components;
- the problems mentioned above are even more serious if the depth of the compartments is such as to accommodate more than one vehicle, this condition being extremely desirable to increase the capacity of a silo while limiting its total volume. The inner portion of a compartment will accommodate vehicles with longer and uninterrupted parking periods, while the outer portion of said compartment (nearer the corridor of the transelevator) will accommodate vehicles with shorter parking periods.

The invention aims to overcome these and other disadvantages and limitations, by providing the following solution.

The bottom of the parking compartments is provided with powered conveyors, for example chain conveyors, which are independent of each other. A compartment may be constructed with such a depth as to accommodate more than one vehicle. In this case, each compartment section capable of accommodating one vehicle comprises its own bottom-powered conveyor, which is interlinked in comb-like fashion with the powered conveyor of the adjacent compartment section.

The platform of the elevator on which the vehicle to be parked rests, comprises powered conveyors similar to those in said compartments and adapted to co-operate therewith in comb-like fashion.

When the elevator platform becomes aligned and co-planar with the selected compartment, the conveyors of the platform and the compartments are activated automatically, whereby the vehicle is quickly transferred from the platform into the compartment. As soon as the vehicle has been introduced into the compartment, the elevator platform may be moved away from said compartment because it has no comb-like structures to be withdrawn from said compartment, as occurring in the known art.

If the compartment has such as depth as to accommodate a plurality of vehicles, the vehicle in the outer portion of the compartment may be then trasferred into the inner section of the same compartment by activating the bottom conveyor of said

compartment, and all the above regardless of the presence of the elevator.

The de-ensilage step of a vehicle is similarly quick and simple. When the elevator platform becomes aligned with the selected compartment, the conveyors of said platform and compartment are activated automatically and simultaneously, and the vehicle is transferred immediately from the compartment to the elevator.

Further characteristics of the invention, and the advantages resulting therefrom, will become apparent from the following description of some preferred embodiments thereof, shown as a non-limiting examples in the attached drawings, in which:

Figure 1 is a top plan view of the elevator platform and the bottom of one compartment of the silo;

Figure 2 is a cross sectional view on the line II-II of Figure 1;

Figure 3 is a cross sectional view on the line III-III of Figure 1, showing a detail of the device for locking and centering the front wheels of a vehicle to be parked when it reaches the elevator platform;

Figures 4 and 5 show as many details of the conveyors on the elevator platform and on the bottom of a compartment, as seen from lines IV-IV and V-V of Figure 1, respectively;

Figure 6 is a perspective view of an active stretch of one of the chain conveyors of Figures 4 and 5;

Figure 7 is a diagrammatic perspective view of a parking silo on the ground, of a simplified type, in which the entrance and exit for the vehicles are at the opposite sides of said silo;

Figure 8 is a diagrammatic front elevational view of a parking silo with compartments having such a depth as to accommodate a plurality of side-by-side vehicles.

Figures 1, 2 and 7 show a simplified parking silo 31, built up on the ground and comprising a plurality of compartments 29 superposed on each other in a multistory arrangement and opposite to each other so as to constitute two towers separated by a corridor C having in plan view the same dimensions as one of said compartments. Operating in said corridor C there is an elevator 4 which, when in its lowermost position, has its horizontal loading platform 3 flush with an entrance ramp 1 and an exit ramp 2 for the automobiles, arranged at the opposite ends of the corridor C.

By means of the rollers 5, the elevator 4 moves along vertical fixed guides 6, and by means of grooved pulleys 7 and hoisting ropes 8 said elevator co-operates with a capstan 9 arranged, for example, in the upper portion of the corridor C.

The platform 3 comprises two transverse, aligned and opposite rows of chain conveyors T formed by tubular beams 10, (see also Figure 6) presenting on their upper and lower portion longitudinal guides 11 for rolling engagement with the rollers 12 of chains 13 passed around sprockets 15, 16 arranged at the ends of said beams. The outer sprockets 16 are freely rotatable, while the inner ones 15 are keyed on shafts 19 which are supported on bearings 20 and are connected through a drive 18 to a reversible geared motor 17.

The solution described above permits the geared motor 17 to be positioned at the center of the platform 3 and to leave free the ends of the conveyors T, but it is to be understood that other suitable solutions may be used for the same purpose.

The chains 13 are of the bridge type (Figure 6) with externally knurled shoes 14 on which the tires of the vehicles will rest (see below).

Provided between the two rows of chain conveyors T of the platform 3, there is a section R of freely rotating rollers having the function of forming a connection bridge between the upper stretches of said conveyors.

Each row of chain conveyors of the platform 3, in turn, is divided into two suitably spaced apart groups. A group of conveyors supports the front wheels of a vehicle and comprises a centering device (see below) for fixedly positioning said wheels. The other group of chain conveyors has a larger extension than the former to match every wheel base of the vehicles to be parked.

In order to attenuate the jolts of vehicles while entering and exiting the platform 3, running boards 21 of ridged plate are arranged between the groups of chain conveyors, and parallel and co-planar between said conveyors there are provided tubular bars 22 which are connected to each other by beams 23 (Figures 1, 2, 3, 4) which, in turn, are connected to rocking arms 24 which are actuated by hydraulic cylinders 25, whereby said bars 22 can be selectively lowered below said chain conveyors (see below).

It is to be noted from Figures 1 and 3 that the centering of the front wheels on the front chain-conveyor groups of the platform 3, is ensured by two rocking stops 26-126 actuated by hydraulic cylinders 27-127.

In Figures 1 and 2, it can be seen that when the loading platform 3 is at the ground floor, a free compartment is provided beside it and comprises a stationary platform 28 for entrance and exit of the driver. On the other side of the platform 3 at the ground floor there is provided a compartment 29 adapted for parking a vehicle.

Figures 1, 2, 5 show that each compartment 29 comprises at the bottom a row of chain conveyors T1 similar to the conveyors T of the platform 3, directed in the same direction and staggered for

co-operating therewith in comb-like fashion. The chain conveyors in the compartments are also provided with tubular bars 30 on which said chains 13 can slide, said bars being connected to a fixed structure 31 by means of spacing and supporting members 32 and respective tierods 33. The chains 13 in the compartments are also powered, through sprokets 15, by a geared motor 34 and a shaft 35 resting on supports 36. The chain conveyors in a compartment constitute the supporting base for the automobiles being parked. In order to protect the automobiles parked therebelow from any dripping of oil, mud, water, each compartment is provided with shields P with respective drains.

The described silo for automobiles operates as follows. An automobile A, with only the driver therein, after passing beyond conventional electronic checks ascertaining its weight and dimensions (not shown), proceeds onto the platform 3 via the ramp 1 (Figure 1) until its front wheels abut against the stops 26, moved to their top position by the respective cylinder 127 (Figure 3). The abutment of the wheels against the stops 26 causes, by means of a signal processed by a sensor (not shown), the rear stops 126 to be raised by the cylinder 27. Thus, the automobile is centered and suitably locked on the platform 3 of the elevator. Now, the driver switches off the automobile, engages a gear, activates the hand-brake and steps down onto the side platform 28, closes a safety gate and inserts a card into a suitable terminal, thus starting the following operations. The computer which manages the automatic operation of the silo selects the compartment at which the automobile shall be parked and activates the capstan 9. The platform 3 is lifted and is positioned with its chain conveyors T into co-planar, comb-like relation with respect to the similar chain conveyors T1 of the selected compartment. As soon as the platform is aligned with the compartment, the transfer of the vehicle is started. The bars 22 which were in their lifted position upon the access of the vehicle onto the platform 3, will be lowered so that the tires of said vehicle will rest only on the chains 13 of the conveyors of the platform. In the successive step, the geared motors 17 and 34 are activated simultaneously, in the same direction and at the same speed. The vehicle will be transferred from the chain conveyors T of the loading platform to those T1 of the selected compartment, with no jolts, thanks to the comb-like penetration of the consecutive ends of said conveyors. A sensor of any suitable type will stop said geared motors when the vehicle A has been suitably arranged in the compartment.

The platform 3 is now ready for a successive operation and will be lowered to ground floor to pick up a new vehicle, or else it may be given a different command if in the meantime the computer has been instructed to discharge a vehicle.

The de-ensilage of a vehicle is effected with a contrary procedure. Depending upon the arrangement of the silo, which may be built up on the ground, or underground, or within a floating structure, the vehicle to be returned may have of a through-exit, i.e. opposite to the entrance as shown on the drawings, or else the exit may be effected by driving in reverse over the same entrance ramp, or by other solutions.

Alternately, the silo may be provided with a plurality of stacked compartments arranged longitudinally on each side of the corridor C, and in this case the loading platform 3 shall be mounted on a powered tower capable of being displaced along said corridor to bring the platform in line with the selected column of compartments. In this case the chain conveyors T of the platform are constructed so as to be able to effect a small retraction and extension movement longitudinally at their free ends.

Unlike what has been shown, the conveyors in the compartments may not be provided with an actuation geared motor and may be actuated by the geared motor of the conveyors of the elevator platform 3, through a suitable plug-and-socket power takeoff system of the automatic quick-coupling and uncoupling type.

As shown in Figures 1, 2, 7 and 8 the compartments may present such a depth as to contain more than one vehicle A and each compartment section 29-129 capable of containing more than one vehicle will be provided with its own bottom chain conveyors T1, T2 provided with their respective actuating means and inter-engaged in comb-like fashion. The compartment sections 129 which are farther from the service corridor C will accommodate the vehicles with longer parking periods. In order to effect the de-ensilage of these vehicles, the computer will actuate the loading platform 3 so as to remove any obstructing vehicle by transferring it into a free compartment and by storing the transfer into memory.

It is to be understood that the description is referred to a preferred embodiment of the invention, omitting the details concerning the electric and hydraulic circuits, as they may be easily conceived and constructed by those skilled in the art. It is also to be understood that many changes and modifications, especially of constructional nature, may be made to the invention.

Claims

1. A computerized automatic multistory silo for automobiles, comprising a plurality of parallelepipedal compartments (29) arranged super-

posed onto each other and opposite to each other at the two sides of at least one common service corridor (C) inside which an elevator (4-9) operates, means being provided to bring the platform (3) of said elevator co-planarly in line with an entrance station (1) or an exit station (2) for the vehicles (A) and with the bottom of the selected compartment, the longer dimension of said compartments being parallel to the length of said corridor, characterized in that the elevator platform (3) and the bottom of each compartment are provided, transversely to their longer dimension, with conveyors on which the wheels of the vehicle (A) will rest during the ensilage and de-ensilage steps, said conveyors (T, T1) being of the chain (13) type and being actuated at the same speed with reversible direction, the arrangement being such that the ends of the conveyors in the compartments facing the service corridor (C) and the ends of the conveyors of said platform are arranged so as to cooperate in comb-like fashion, whereby the transfer of a vehicle from the platform into a compartment and vice-versa may be effected quickly by activating said conveyors in the desired direction and under the control of sensors which de-activate said conveyors when the vehicle (A) has reached the desired position.

2. A silo according to claim 1, characterized in that the elevator platform (3) is provided with pairs of stops (26-126) which are retractable below said platform and which are actuated by suitable independent actuating means, so as to lock the front wheels of a vehicle (A) admitted onto the platform to be ensiled.

3. A silo according to claim 1, characterized in that the elevator platform (3) comprises, parallelly between the conveyors (T) of said platform and co-planarly with the upper stretch of said conveyors, bridging bars (22) connected to lowering and lifting means (24, 25), for the purpose of preventing any jolting of a vehicle (A) during its travel on the platform and for permitting the wheels of the vehicle to rest only on said conveyors during the ensiling and de-ensiling steps of said vehicle.

4. A silo according to claim 1, characterized in that each compartment (29) may have such a depth as to accommodate more than one vehicle (A), each compartment section (29-129) being provided with its own bottom conveyors (T1-72) which compenetrate in comb-like fashion and which are actuated by respective driving means.

5. A silo according to claim 1, characterized in that the elevator platform (3) is mounted on a transelevation tower which is movable along the corridor (C) of said silo in order to permit said platform to move along rectangular coordinates, the ends of the chain conveyors (T) being adapted to effect small retraction and extension movements, so as to avoid interfering with the chain conveyors (T1) of the compartments (29) during the transelevation movement and to be able to co-operate in comb-like fashion therewith in the vehicle transfer phase.

6. A silo according to the preceding claims, characterized in that the conveyors (T1-T2) in the compartments are not actuated by respective gearmotors, but are each provided of a respective power take-off which is arranged with suitable direction along the corridor (C) and is adapted to be activated by a respective activating plug arranged on the elevator platform and connected to the geared motor which actuates the conveyors (T) of said platform.

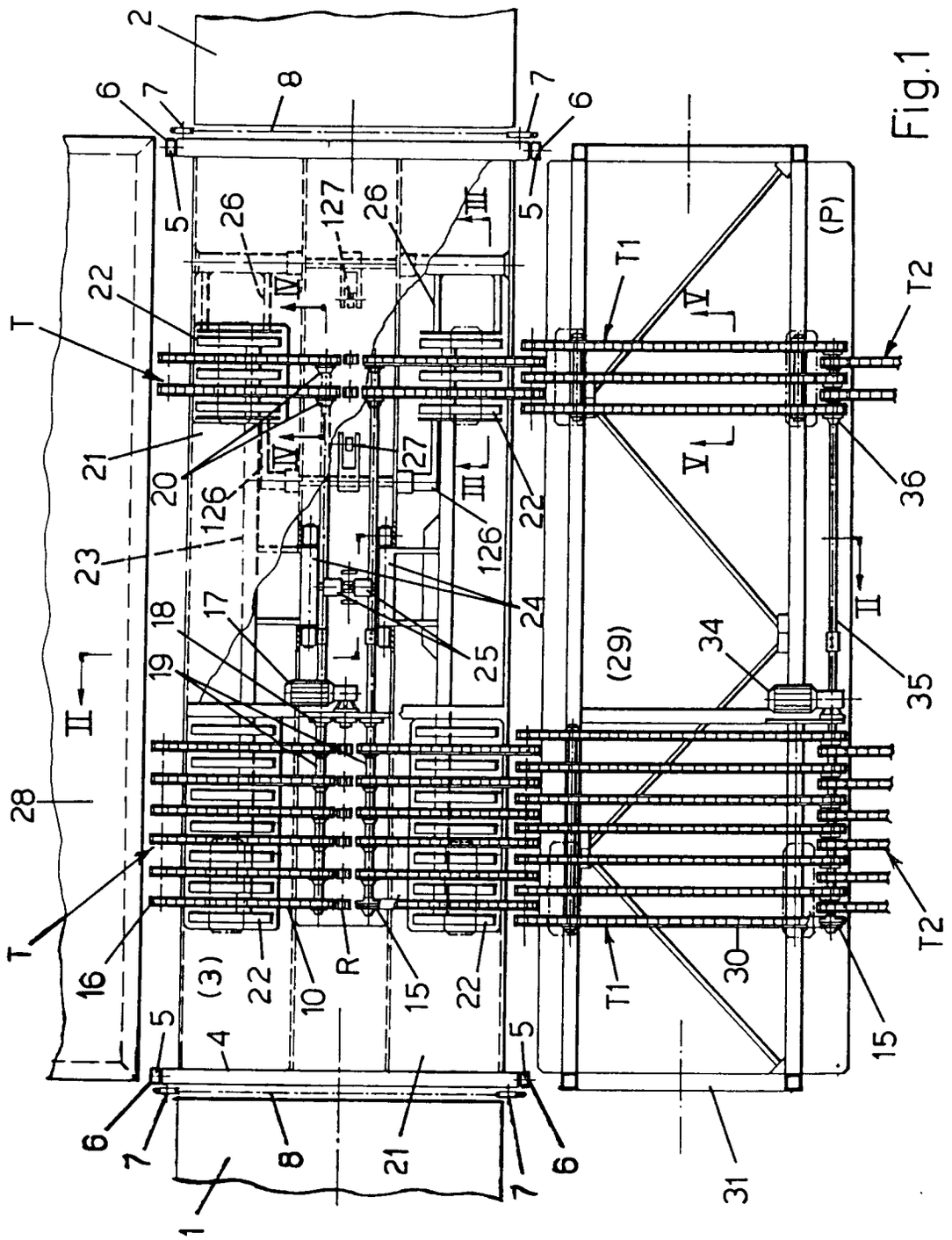
1
2
3
4
5
6
7
8
10
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
34
35
36
126
127
R
T
T1
T2
(P)
(29)
(3)
I
II
III
IV
V
VI
L

Fig.1

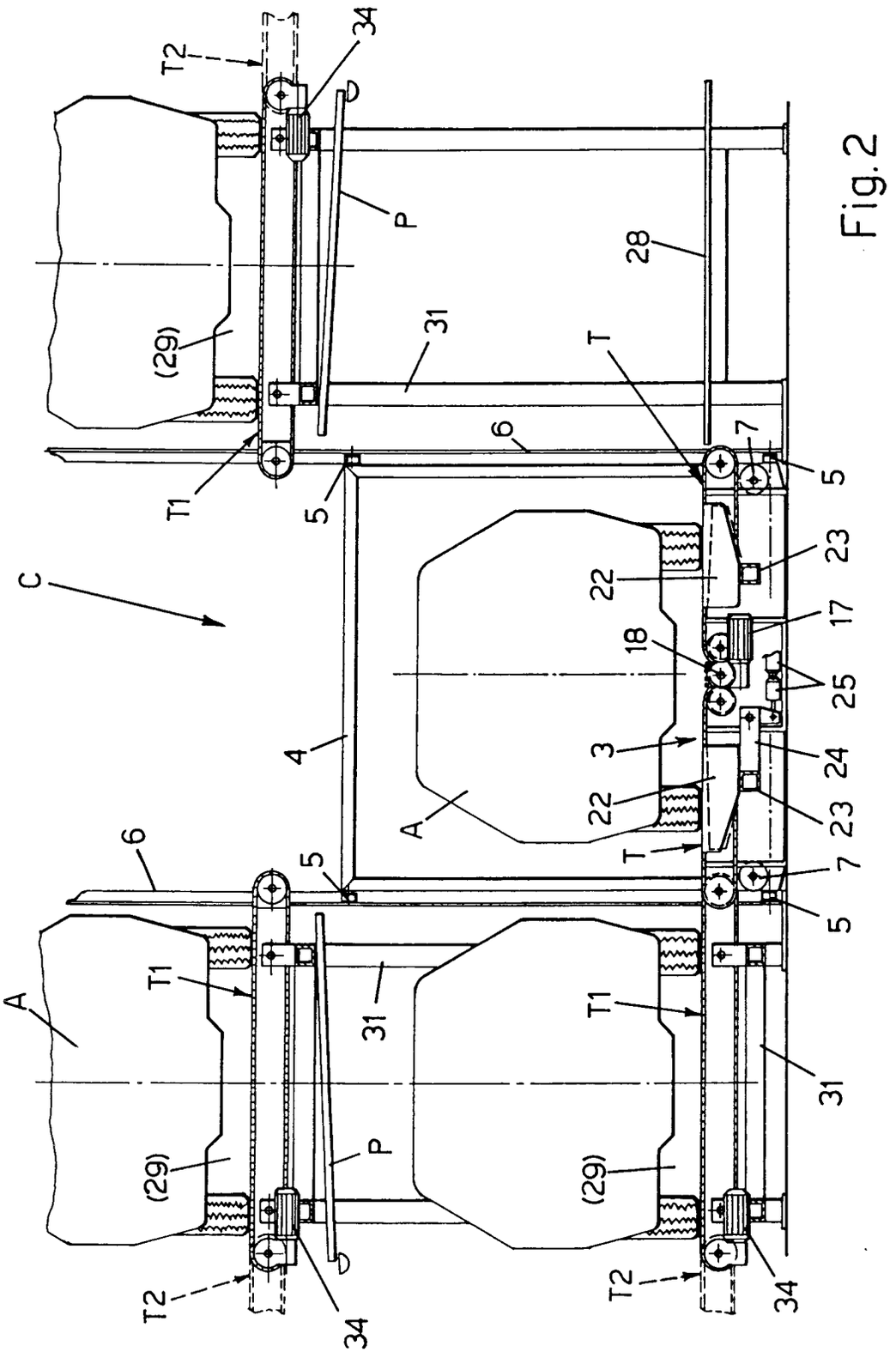
T2
34
P
28
(29)
31
T
T1
6
7
5
C
22
23
17
18
25
4
3
24
A
22
23
T
7
6
5
T1
31
T1
31
(29)
P
(29)
T2
34
T2
34

Fig.2

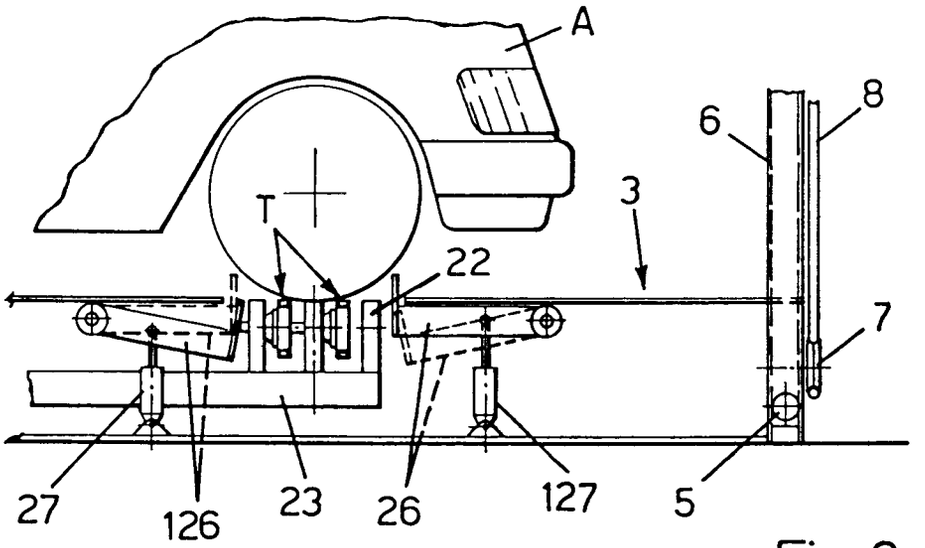

Fig.3

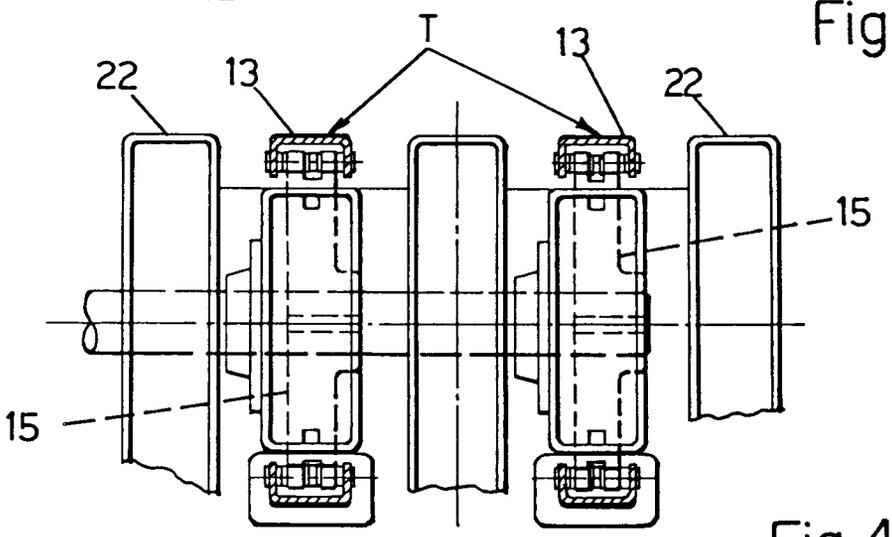

Fig.4

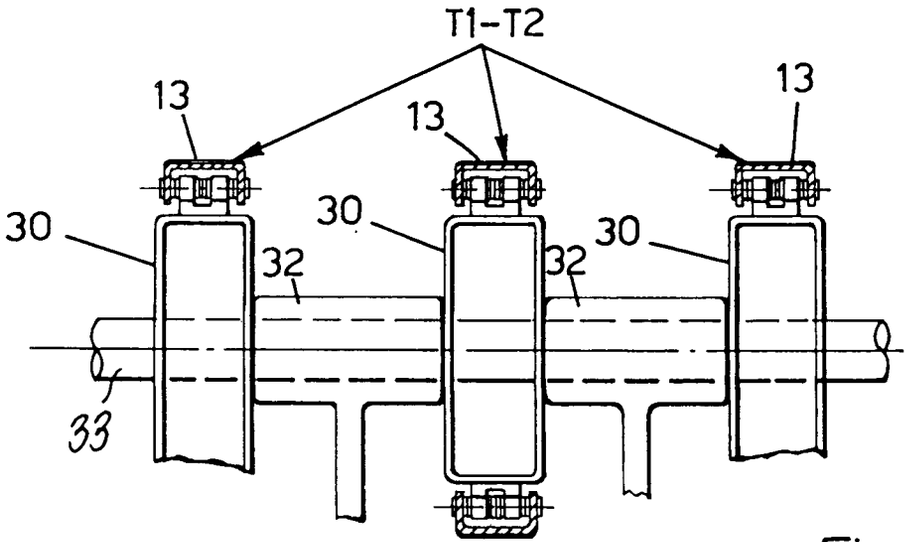

Fig.5

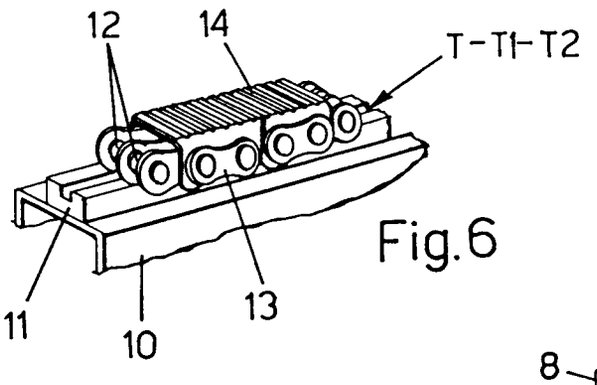

Fig.6

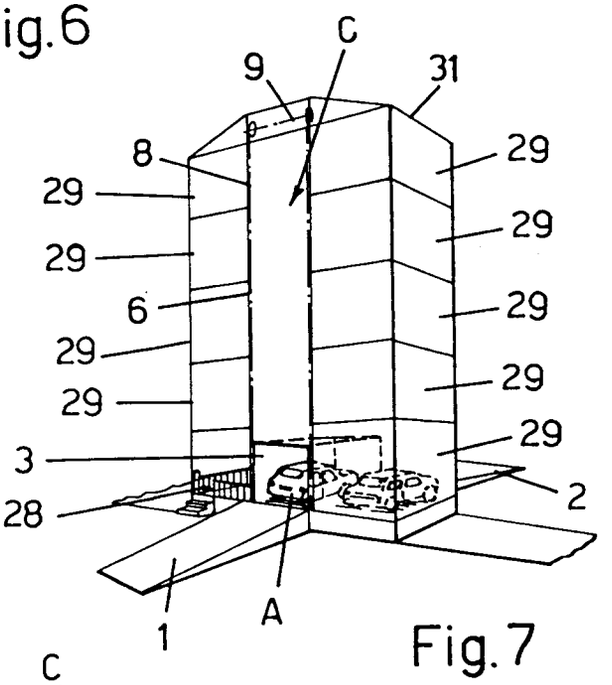

Fig.7

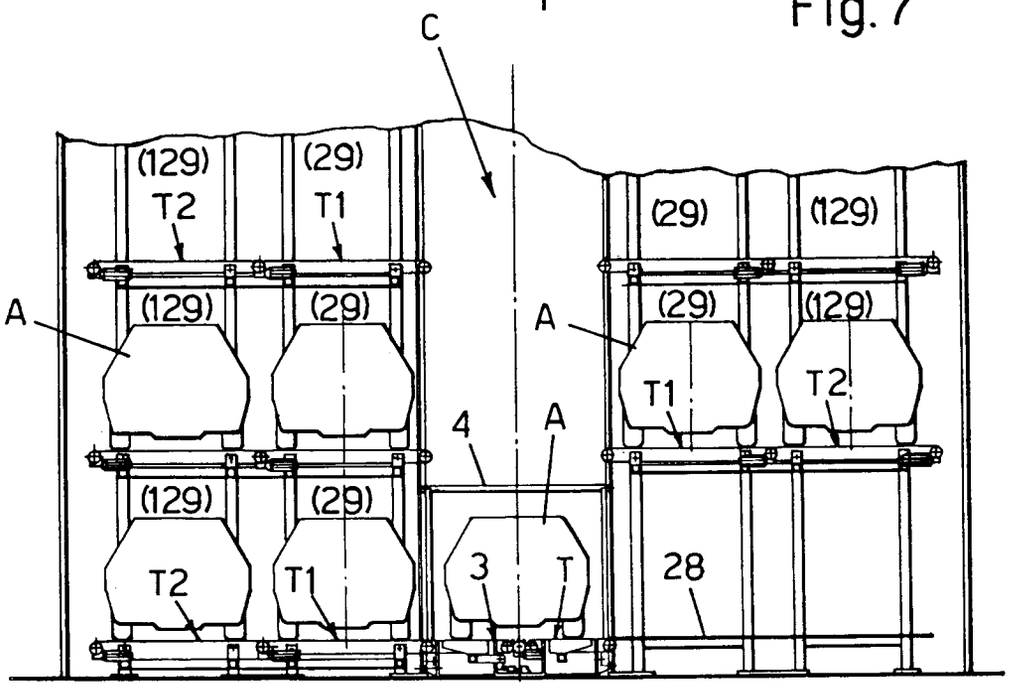

Fig.8