



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 1 270 488 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.01.2003 Bulletin 2003/01

(51) Int Cl.7: **B66B 11/04**, B66B 11/00

(21) Application number: **02013883.0**

(22) Date of filing: **24.06.2002**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**
Designated Extension States:
AL LT LV MK RO SI

(71) Applicant: **INVENTIO AG**
CH-6052 Hergiswil (CH)

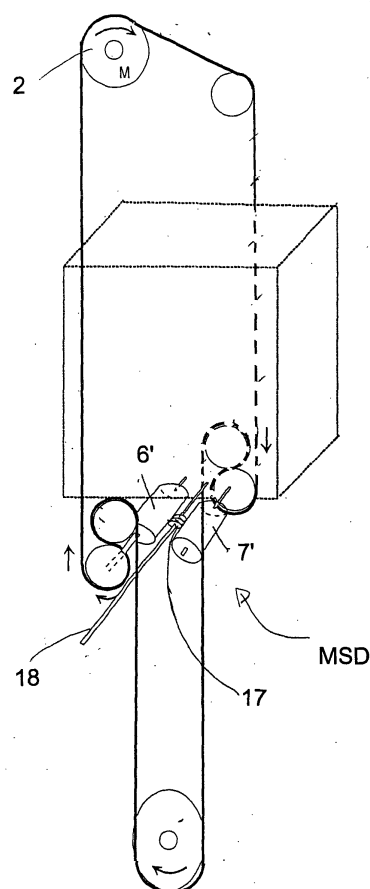
(72) Inventors:
• **Rossignol, Eric**
6648 Minusio (CH)
• **Angst, Philipp**
6300 Zug (CH)

(30) Priority: **28.06.2001 EP 01810627**

(54) Elevator driving means

(57) The invention concerns an elevator installation with a car (8), which is moved by a motor by means of a closed rope (1) running on an upper pulley (2) and on a lower pulley (3), whereby the closed rope (1) comprises a first rope portion (9) and a second rope portion (10), wherein a gear box (GB) interacting with the first rope portion (9) and with the second rope portion (10) is arranged on the car (8). A car speed control independently from the motor speed is achieved on the car itself.

Fig. 5



EP 1 270 488 A2

Description

[0001] The present invention relates to an elevator installation.

[0002] The Swiss patent CH-252872 describes an elevator installation with a closed rope running on six pulleys. The closed rope is driven by a motor, which drives in the same direction two pulleys with different diameters arranged on the motor shaft. As the motor runs with constant speed, the rotation speed of these pulleys is different. The speed of the car is therefore independent from the motor speed. So a gear mechanism with a speed reduction factor is achieved. A problem of this solution is that the speed reduction factor is achieved by pulleys with different diameter, which are arranged directly on the motor. The gear ratio is fix and can be varied only by changing the two pulleys on the motor shaft. Further another problem is the use of several pulleys arranged fixed in the hoistway. This solution brings therefore to a complex elevator installation with high costs for the realization and for the maintenance. Moreover a counterweight is absolutely necessary to balance the whole elevator installation.

[0003] The present invention as defined in claim 1, claim 15 and claim 18 proposes an elevator installation that solves all the above-cited problems and provides an elevator installation with simple construction, by which the number of the elevator components arranged in the hoistway can be reduced, whereby alternative solutions permitting in a simple way to vary the direction and the speed of the car independently from the speed of the motor are given.

[0004] The object of the present invention is solved by the invention characterised in the claims 1, 15 and 18.

[0005] The elevator installation according to claim 1 has in respect to the state of the art the advantages, that the variation of direction and the speed of the movable element can be made directly on the car and independently from the motor speed. Further no counterweight is absolutely necessary. The elevator components arranged in the shaft are reduced.

[0006] The elevator installation according to claim 15 has in respect to the state of the art the advantages, that the variation of direction and the speed of the movable element can be made exclusively by varying the speed difference between the two motors. No counterweight is required.

[0007] The elevator installation according to claim 18 has in respect to the state of the art the advantages, that the number of the elevator components fixed in the shaft, as for example pulleys, can be reduced.

[0008] Advantageous developments and improvements are specified in the dependent claims.

[0009] The invention is described in the following by the aid of a few embodiments by referring to the attached schematic drawings, which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

Fig. 1 illustrates conceptually and theoretically an embodiment according to the present invention,

Fig. 2 illustrates another embodiment of the present invention,

Fig. 3 illustrates still another embodiment of the present invention,

Fig. 4 illustrates a mechanical speed deviator in an embodiment of the invention,

Fig. 5 illustrates an elevator installation with a mechanical speed deviator,

Fig. 6 illustrates a mechanical positioning system using the speed deviator,

Fig. 7 illustrates an embodiment of the invention with another kind of gearbox,

Fig. 8 illustrates an elevator installation with two motors,

Fig. 9 illustrates an embodiment of the invention with a counterweight,

Fig. 10 illustrates an embodiment of the invention with two counterweights and a flywheel,

Fig. 11 illustrates an embodiment of the invention with a counterweight and a reversal box.

[0010] Figure 1 illustrates the basic concept of the invention by describing an embodiment where no slip and no friction are considered. For better clarity the other usual elevators components are not shown.

[0011] The rope 1 is a closed rope 1, which can be a belt, running on a upper pulley 2 and on a lower pulley 3 arranged in an elevator hoistway H. The upper pulley 2 is actuated by a motor M, and the lower pulley 3 is a passive pulley. The motor M can be for example directly coupled to the upper pulley 2 so that the upper pulley 2 can be also named traction pulley 2. The lower pulley can also be named diverting pulley 3. A first friction pulley 4 and a second friction pulley 5 are arranged on a movable element 8. The movable element is in this case the elevator car 8. In this example the first friction pulley 4 is linked together to the second friction pulley 5 by means of a double pulley system DPS comprising a first transmission pulley 6 and a second transmission pulley 7, which have different diameters. The car 8 is linked to the rope 1 by means of the first friction pulley 4 and the second friction pulley 5. The first friction pulley 4 interacts with a first rope portion 9 corresponding to the left rope portion in figure 1 and the second friction pulley 5 interacts with a second rope portion 10 corresponding to the right rope portion in figure 1. The first rope portion

9 is therefore linked to the second rope portion 10 by means of a power transmission mechanism PTM comprising in this embodiment the double pulley system DPS. In this configuration, when the motor is not running, the car 8 cannot move. The car 8 is standstill with half of its load hanging on each rope portion 9, 10 and the system is perfectly balanced. Because the first transmission pulley 6 and the second transmission pulley 7 have different diameter, when the first friction pulley 4 will turn, the second friction pulley will turn at a different speed. The relation is given by:

$$w_2 = D_1/D_2 \cdot D_3/D_4 \cdot w_1$$

where

w₁ : rotation speed of the first friction pulley 4
w₂ : rotation speed of the second friction pulley 5
D₁ : diameter of the the first friction pulley 4
D₂ : diameter of the the second friction pulley 5
D₃ : diameter of the first transmission pulley 6
D₄ : diameter of the second transmission pulley 7

[0012] When the motor causes the upper pulley 2 to run clockwise, the second friction pulley 5 will turn faster than the first friction pulley 4, as a result the second friction pulley 5 is going up faster on the rope going down than the first friction pulley 4 is going down on the rope going up. The result is that the car 8 will move up.

[0013] The speed of the car V_c is given by the following relations:

$$\pi \cdot w_1 \cdot D_2 = \pi \cdot w_M \cdot D_M - V_c$$

$$\pi \cdot w_2 \cdot D_2 = \pi \cdot w_M \cdot D_M + V_c$$

$$w_2 \cdot D_2 \cdot D_4 = w_1 \cdot D_1 \cdot D_3$$

$$\Rightarrow V_c = \pi \cdot w_M \cdot D_M \cdot (D_3 - D_4) / (D_3 + D_4)$$

where

w_M : rotation speed of the upper pulley 2
D_M : diameter of the upper pulley 2

[0014] In this relation when D₃ = D₄, the speed of the car is null whatever is the speed of the motor w_M.

[0015] The car 8 is moving with the speed of the ropes (π · w_M · D_M) multiplied by a factor (D₃ - D₄) / (D₃ + D₄) depending on the diameter of the two transmission pulleys 6 and 7. This factor can be very small, by choosing the two diameters D₃ and D₄ almost equal. This means that these two transmission pulleys 6 and 7 constitute a gear box GB with a very high speed reduction factor. This gear box GB is arranged on the car 8 away from the motor. The direction and speed of the car 8 is set

directly on the car, by means of the gear box GB, the gear ratio thereof is given by the difference of the diameters D₃, D₄. The direction and the speed of the car can be therefore varied and controlled independently from the motor speed respectively from the rope speed.

[0016] As example hereafter a numerical application:

[0017] Let's take

$$D_M = 0.5m$$

$$w_M = 1000 \text{ tr/min} = 16.67 \text{ tr/s}$$

$$V_c = 1 \text{ m/s}$$

[0018] We must design the pulley such as D₃ = 1.076 · D₄.

[0019] With this system following advantages are reached:

- Always balanced load on the upper pulley 2
As the diameter of first transmission pulley 6 and the second transmission pulley 7 are almost the same, the system is symmetrical and therefore the load on each side of the motor pulley are equal, the system is self balanced.
- No need for counterweight
As a consequence of the previous point, the system needs no counterweight
- No need for gear box on the motor
The speed reduction is made on the car by the first transmission pulley 6 and the second transmission pulley 7, therefore the motor can be linked directly on the upper pulley 2 without reduction.
- Very simple gear box on the car
The gear box with a very high speed reduction factor is composed only by 2 pulley of almost the same size. This means low friction and low cost.
- Reduced static load on the ropes
The rope portions need to support only half of the car load. As no counterweight is needed, the static load on the ropes is less than half of the load of a system with counterweight.
- Dynamic traction forces in the ropes are highly reduced
The dynamic forces in the ropes, due to acceleration, are highly reduced, as the speed of the ropes is higher.
The reduction factor is given by the speed reduction factor (D₃ - D₄) / (D₃ + D₄)

[0020] Figure 2 illustrates another embodiment, where a better friction between the closed rope 1 and the first friction pulley 4 respectively the second friction pulley 5 is achieved. The friction pulleys 4, 5 are coupled with additional pulleys 11, 12 on the car 8 to increase the contact between the rope 1 and the friction pulleys

4, 5. The double pulley system DPS has the same function as in figure 1.

[0021] The figure 3 illustrates an embodiment, where the stability of elevator installation is increased. In this figure the first rope portion 9 runs substantially parallel to a first side 13 of the car 8 and the second rope portion 10 substantially parallel to a second side 14 of the car 8. So the load is equilibrate, and the friction on the not shown guide rail can be reduced. For this purpose an additional upper pulley 15 arranged in the hoistway is required. Further a reversal pulley 16 is needed between the first transmission pulley 6 and the second transmission pulley 7 in order to reverse the rotation direction of the first transmission pulley 6 in respect to the second transmission pulley 7.

[0022] As illustrated the balanced lift system is based on a small difference between the diameter D3 of the first transmission pulley 6 and the diameter D4 of the second transmission pulley 7 (for instance about 8%). If we build a system that can make variable the rapport of the above-mentioned diameters D3 and D4 of a few percent, we could change the speed of the car 8 while the speed of the motor remaining constant. For example if we vary the diameter D3 between 0 and 8%, we can vary the speed of the car between 0 and 1m/s.

[0023] In figure 4 is given an example of a mechanical system, which is able to vary continuously or for example step by step the gear ratio of the gear box GB of a few percent. This mechanical system will be called mechanical speed deviator MSD in the following. The disc-shaped first transmission pulley 6 and the disc-shaped second transmission pulley 7 of the above-mentioned embodiments, are in the embodiment of figure 4 replaced by a first conic-shaped transmission pulley 6' and a second conic-shaped transmission pulley 7'. A side of each of the conic-shaped transmission pulleys 6', 7' has a diameter D3', the other side a diameter D4', whereby the diameters D3' and D4' differ of a few percent (for example 4 %). The first conic-shaped transmission pulley 6' is positioned in the reverse position as the second conic-shaped transmission pulley 7' and they are linked together by a mobile pulley 17, that is movable on its axe 18. The axe 18, also called control axe of the mechanical speed deviator MSD, can move substantially parallel to the axes 19, 20 of the two conic-shaped transmission pulleys 6', 7'. When the mobile pulley 17 is in the center (point C in figure 4) both conic-shaped transmission pulleys 6', 7' turn exactly at the same speed because the diameter at this point is $(D3'+D4')/2$. When the mobile pulley 17 is moving until the side of the second conic-shaped transmission pulley 7' with diameter D3' is reached (point A in figure 4), the first conic-shaped transmission pulley 6' will turn faster than the second conic-shaped transmission pulley 7' because $D3' > D4'$. If, for example, D3' is 4% bigger than D4', the first conic-shaped transmission pulley 6' will turn 8% faster. When the mobile pulley 17 is moving until the side of the second conic-shaped transmission pulley 7' with

diameter D4' is reached (point B in figure 4), we have the opposite situation. To make the link between the conic-shaped transmission pulleys 6', 7' the use of a linking belt 21 is preferable.

[0024] Figure 5 illustrates an elevator installation similar to figure 3, whereby the mechanical speed deviator MSD is used. The control axe 18 of the mechanical speed deviator MSD can be actuated by an electromagnet or a motor. The power needed is low. By actuating the control axe 18 it is possible to generate an acceleration ramp or a deceleration ramp without any Alternating Current Variable Frequency (ACVF), the speed of the motor running the upper pulley 2 remaining constant. The speed variation is achieved therefore only by means of the mechanical speed deviator MSD. Another advantage can be seen in the fact that the start of the trip can be made with the motor at full speed, which brings to a reduction of the motor size. The car can be stopped while the motor is running, an abrupt acceleration and the deceleration can therefore be avoided.

[0025] The mechanical speed deviator MSD can be used also to mechanically recognize the position of the elevator car 8 in the hoistway H. This is illustrated in the figure 6. The control axe 18 of the mechanical speed deviator MSD is activated by cams arranged in the hoistway as for example: a lowest cam S1, an intermediate cam S2 and a highest cam S3. These cams S1, S2 and S3 are used for the deceleration of the car 8. Acceleration can be done with an electromagnet or a small motor actuating the same control axe 18.

[0026] The functioning principle looks as follows: When the car 8 arrives at a floor, the mechanical speed deviator MSD is actuated by the corresponding cam S1 S2, S3, that presses the control axe 18 until it reach the central position of the conic-shaped transmission pulleys 6', 7', where the speed of the car will be null. The shape of the cam S1, S2, S3 defines completely the deceleration ramp. An important characteristic is that the point where the car 8 will stop, is mechanically defined by the shape of the cam and is independent of the car load, rope flexibility, car speed and so on. So we can expect with this system a very high precision in positioning.

In the figure 6 the lowest cam S1 at the lowest floor and the highest cam S3 at the highest floor are fixed, the intermediate cam S2 at intermediate floor will be linked to the control axe 18 only if the car has to stop on that floor (activation on the control axe 18 by an electromagnet for example). The high precision of positioning is therefore independent of the car load, car speed and rope flexibility. A very simple mechanical shaft information, without need of electronic is therefore achieved.

[0027] The figure 7 illustrates an elevator installation, where the first rope portion 9 and the second rope portion 10 are linked by means of an usual gear box GB arranged on the car 8. The first rope portion 9 and the second rope portion 10 run each additionally on three little pulleys 22 arranged near the gear box GB. These

three little pulleys 22 have the purpose to increase the friction of each of the first and second rope portion 9, 10. The car 8 is hanging between the upper pulley 2 and the lower pulley 3 fixed in the hoistway headroom and respectively in the pit. This has the advantage that the car's vertical movement is reduced while loading/unloading, the stiffness of the rope system is increased. Accelerations of the car of more than 1g are possible upwards as well downwards. In this case the motor is on the upper pulley 2. Coaxial to the lower pulley 3 a flywheel 23 can be used to accumulate/store kinetic energy, which can be by necessity reused. Also in this embodiment no counterweight is needed. As before also here the gear ratio of the gear box GB determines the direction and the speed of the car independently from the motor speed. The motor may turn with constant speed.

[0028] In figure 8 is shown a closed rope elevator installation, whereby a first motor M1 and a second motor M2 are used. The car 8 is supported by a first closed rope 24 and a second closed rope 25, actuated by the first motor M1 respectively by the second motor M2. The first closed rope 24 runs on a first lateral side 13' of the car 8. The second closed rope 25 runs on a second lateral side 14' of the car 8 opposite to the first lateral side 13'. The first closed rope 24 runs further on a first set 26 of four little friction pulleys and the second closed rope 25 in the same manner with a second set 26' of four little friction pulleys. The first set 26 and the second set 26' of little friction pulleys are linked together by a linking mechanism 27 on the car 8. If the first and second motor M1, M2 are not running, the car 8 cannot move. If they are running exactly at the same speed, the car 8 stays standstill. If there is a small difference between the two motor speeds, the car 8 will move with speed

$$V_c = \pi \cdot (w_{M2} - w_{M1}) \cdot DM.$$

[0029] Where

w_{M1}, w_{M2} : speed of motor M1 respectively motor M2

DM : diameter of traction pulleys moved by motor M1 and motor M2; in this case the two traction pulleys have the same diameter.

[0030] The following figure 9, figure 10 and figure 11 illustrate three possibilities to use one or more additional movable elements 28 in this case counterweights 28 with the above described elevator installation.

[0031] In figure 9 as traction pulley is used the lower pulley 3 arranged in the pit and as diverting pulley the upper pulley 2 arranged in the hoistway headroom. The gear box GB and the closed rope 1 are arranged essentially as in figure 7. A counterweight 28 is linked to the car 8 with a separate rope 29, which runs on an addi-

tional diverting pulley 30 fix in the hoistway headroom.

[0032] In figure 10 is shown an elevator installation, where both the motor M and the gear box GB are positioned on the car 8. In the pit the lower pulley 3 has the flywheel 27 having the same function as in figure 7. In this case two counterweights 28 are linked to the car 8 by means of two separate ropes 29.

[0033] In figure 11 we have an elevator installation, where the counterweight 28 and the car 8 are hanging on the same closed rope 1. Basically it is the same principle used in figure 1, but with a counterweight. The upper pulley 2 is on the counterweight 28 and the lower pulley 3 is on the car 8. The first and the second transmission pulleys 6, 7 of the double pulley system DPS are fixed on the top hoistway and turn in reversal direction by means of a reversal box RB arranged between them. If they turn at the same speed, the car 8 will not move, if they turn at different speed the car 8 will move with the following speed:

$$V_c = \pi \cdot (w_3 - w_4) \cdot DM$$

[0034] Where

w_3, w_4 are the rotation speeds of the first and the second transmission pulleys 6, 7

[0035] Different configurations are possible:

[0036] The motor M can be put not only, as shown in figure 11, on the counterweight (directly or indirectly on the upper pulley 2, the motor can be the pulley itself) but also on the top hoistway (directly or indirectly by one of the transmission pulleys 6 or 7) or on the car (directly or indirectly by the lower pulley 3).

[0037] The variation of the car speed by the embodiment of figure 11 can be done in the following way:

A) Fix ratio of the speed between the transmission pulleys 6, 7 by using two pulley of different diameter (for example $D_3 = 0.9 D_4$), and use of an ACVF on the motor.

B) Fix ratio on the speed between the transmission pulleys 6, 7 by using a reversal box RB with a speed ratio (for example 0.9), and use an ACVF on the motor.

C) Constant speed of the motor (nominal speed) and use of a mechanical speed deviator MSD (as on Figure 6) between the transmission pulleys 6, 7.

[0038] This system has therefore following advantages:

- Load compensation by means of the counterweight => reduction of the motor power for very big cars.
- Space saving with the motor on the counterweight (for the of the above-mentioned configurations).
- Speed variation without ACVF, by means of the me-

chanical speed deviator (for configuration C).

- Start of the trip with the motor at nominal speed => reduction of the motor size (for configuration C)

[0039] In general following further considerations can be done about the present invention:

[0040] The use of a gear box GB on the car, interacting with both the first and the second rope portions 9, 10 causes the reduction of the drive torque and of the braking torque and therefore a simpler design of the motor and the brake is possible. The closed rope can run faster than the car.

[0041] The closed rope can be also designed as a belt or as a vee-belt (V-belt) or as band or as chain or as other equivalent cables attending the same function. Naturally more than one rope can be used.

[0042] The motor can be arranged everywhere in the hoistway or on the movable element.

[0043] The movable element 8 or the additional movable element 28 can be an elevator car or a counterweight.

[0044] The gear box GB can be steplessly adjustable or having predetermined steps or having a constant gear ratio or other configurations.

[0045] By varying the gear ratio of the gear box the direction and the speed of the car can be varied, by maintaining and the motor turning at optimal constant speed during the trip of the car. On the other hand a steplessly variable gear box on the car permits the car to travel with a constant speed, even when the motor does not run at constant speed.

[0046] The invention allows an elevator design without counterweight and therefore a lightweight car. The load on the ropes is the weight of the car plus passengers.

If a separate counterweight is added, the whole weight of the car and maybe the weight of some passengers can be equalized by this counterweight, thus reducing the load of the ropes (not ropes of counterweight).

[0047] The flywheel 23 can be arranged coaxially or not coaxially to the upper pulley or to the lower pulley. A gear mechanism can eventually be put between the flywheel and the upper pulley respectively the lower pulley.

[0048] If the controlling of the speed and direction of a car is done on the car while the belt is turning at more or less constant speed, the use of several cars per hoistway is possible (multicar elevator installation).

Bezugszeichenliste

[0049]

- | | |
|---|-----------------------|
| 1 | Closed rope |
| 2 | Upper pulley |
| 3 | Lower pulley |
| 4 | First friction pulley |

- | | |
|--------|---|
| 5 | Second friction pulley |
| 6 | First transmission pulley |
| 6' | First conic-shaped transmission pulley |
| 7 | Second transmission pulley |
| 5 7' | Second conic-shaped transmission pulley |
| 8 | Movable element / car / counterweight |
| 9 | First rope portion |
| 10 | Second rope portion |
| 11 | Additional pulley |
| 10 12 | Additional pulley |
| 13 | First side |
| 13' | First lateral side |
| 14 | Second side |
| 14' | Second lateral side |
| 15 15 | Additional upper pulley |
| 16 | Reversal pulley |
| 17 | Mobile pulley |
| 18 | Axe of mobile pulley / control axe |
| 19 | Axe first conic-shaped transmission pulley |
| 20 20 | Axe second conic-shaped transmission pulley |
| 21 | Linking belt |
| 22 | Little pulleys |
| 23 | Flywheel |
| 24 | First closed rope |
| 25 25 | Second closed rope |
| 26 | First set of little friction pulleys |
| 26' | Second set of little friction pulleys |
| 27 | Linking mechanism |
| 28 | Additional movable element |
| 30 29 | Separate rope |
| 30 | Additional diverting pulley |
| CA | Central axe |
| DPS | Double pulley system |
| GB | Gear box |
| 35 H | Hoistway |
| M | Motor |
| M1 | First motor |
| M2 | Second motor |
| MSD | Mechanical speed deviator |
| 40 PTM | Power transmission means |
| RB | Reversal box |
| S1 | lowest cam |
| S2 | intermediate cam |
| S3 | highest cam |

Claims

1. Elevator installation with a movable element (8), which is moved by a motor by means of a closed rope (1) running on an upper pulley (2) and on a lower pulley (3), whereby the closed rope (1) comprises a first rope portion (9) and a second rope portion (10), wherein a power transmission means (PTM) interacting with the first rope portion (9) and with the second rope portion (10) is arranged on the movable element (8).

2. Elevator installation according to claim 1, wherein the first rope portion (9) runs in the opposite direction as the direction of the second rope portion (10).
3. Elevator installation according to claim 1 or 2, wherein the power transmission means (PTM) includes a friction pulley (4, 5, 11, 12), whereby the closed rope (1) runs on the friction pulley (4, 5, 11, 12) arranged on the movable element (8).
4. Elevator installation according to any preceding claim, wherein the first portion rope (9) runs on a first side (13) of the movable element (8) and the second rope portion (10) runs on a second side (14) of the movable element (8), whereby the first side (13) and the second side (4) are arranged symmetrically in respect to the central axe (CA) of the movable element (8).
5. Elevator installation according to any preceding claim, wherein the power transmission means (PTM) comprises a gear box (GB) having a constant gear ratio.
6. Elevator installation according to claim 5, wherein the gear box (GB) comprises a first transmission pulley (6) interacting with a second transmission pulley (7), whereby the first transmission pulley (6) and the second transmission pulley (7) have different diameters (D3, D4) determining a speed reduction factor between the first transmission pulley (6) and the second transmission pulley (7).
7. Elevator installation according to any preceding claim 1 to 4, wherein the power transmission means (PTM) comprises a gear box (GB) having a variable gear ratio.
8. Elevator installation according to claim 7, wherein the gear box (GB) comprises a mechanical speed deviator (MSD) comprising a first conic-shaped transmission pulley (6') having a first longitudinal axe (19) and a second conic-shaped transmission pulley (7') having a second longitudinal axe (20), whereby the first conic-shaped transmission pulley (6') interacts with the second conic-shaped transmission pulley (7') by means of a mobile pulley (17), which is movable substantially parallel to the first and second longitudinal axes (19, 20) by means of a control axe (18) arranged on the mobile pulley (17).
9. Elevator installation according to claim 8, wherein the control axe (18) of the mobile pulley (17) is activated by means of a motor or an electromagnet.
10. Elevator installation according to claim 8, wherein the control axe (18) of the mobile pulley (17) is activated by means of a cam (S1 S2, S3) arranged in the hoistway (H) of the elevator installation.
11. Elevator installation according to any preceding claim, wherein a flywheel (23) is interacting with the upper pulley (2) or with the lower pulley (3) in order to store energy.
12. Elevator installation according to any preceding claim, including a hoistway (H) wherein the movable element (8) and a second equal movable element (8) are moving in the same hoistway (H).
13. Elevator installation according to any preceding claim, wherein an additional movable element (28) is attached to the movable element (8) by means of a separate rope (29) running over an additional upper pulley (30).
14. Elevator installation according to any preceding claim, wherein the movable element (8) or the additional movable element (28) is an elevator car or a counterweight.
15. Elevator installation with a movable element (8), which is moved by means of a first closed rope (24) and a second closed rope (25), whereby the first closed rope (24) is actuated by a first motor (M1) and the second closed rope (25) is actuated by a second motor (M2).
16. Elevator installation according to claim 15, wherein the first closed rope (24) and the second closed rope (25) run on two opposite sides of the movable element (8).
17. Elevator installation according to claim 15 or 16, wherein the first closed rope (24) interacts with the second closed rope (25) by means of a linking mechanism (27) arranged on the movable element (8).
18. Elevator installation with a movable element (8), which is moved by a motor by means of a closed rope (1) running on a first transmission pulley (6) and on a second transmission pulley (7), whereby the first transmission pulley (6) is linked to the second transmission pulley (7) by means of a power transmission means (PTM) enabling one of the first transmission pulley (6) and the second transmission pulley (7) to rotate in the reverse direction in respect to the rotation of the other one of the first transmission pulley (6) and the second transmission pulley (7).
19. Elevator installation according to the claim 18, wherein the power transmission means (PTM) comprises a reversal box (RB).

20. Elevator installation according to the claim 18 or 19, wherein the first transmission pulley (6) and the second transmission pulley (7) have different diameters.

5

10

15

20

25

30

35

40

45

50

55

Fig. 1

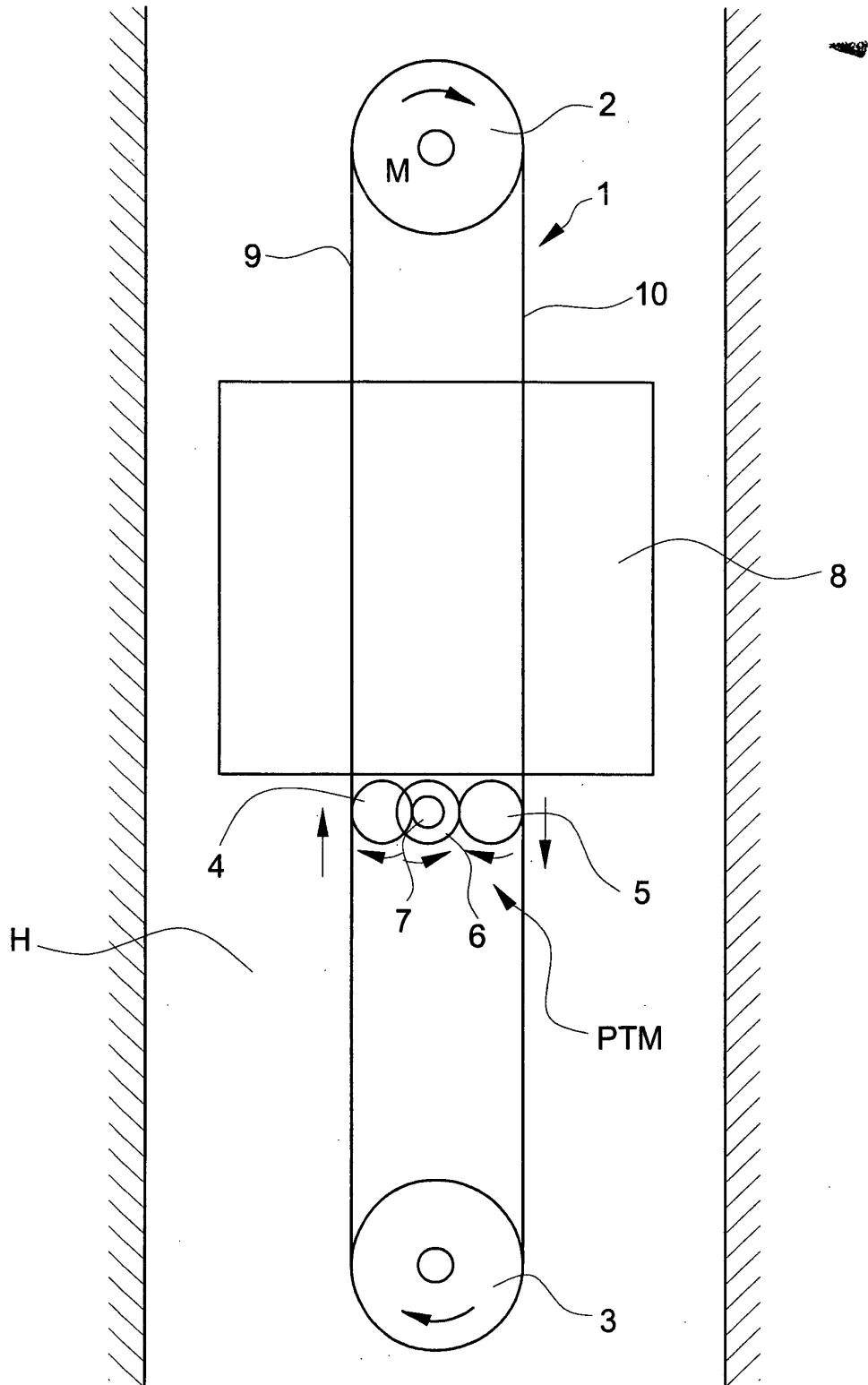


Fig. 2

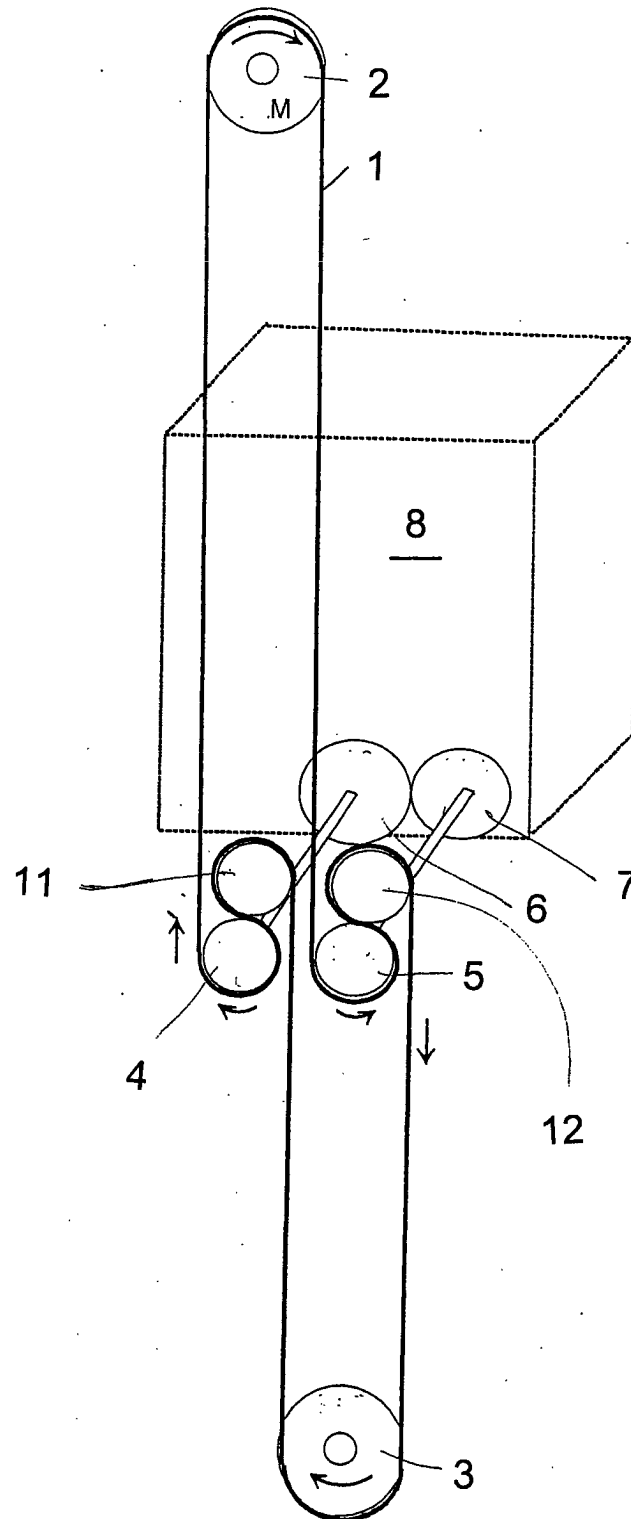


Fig. 3

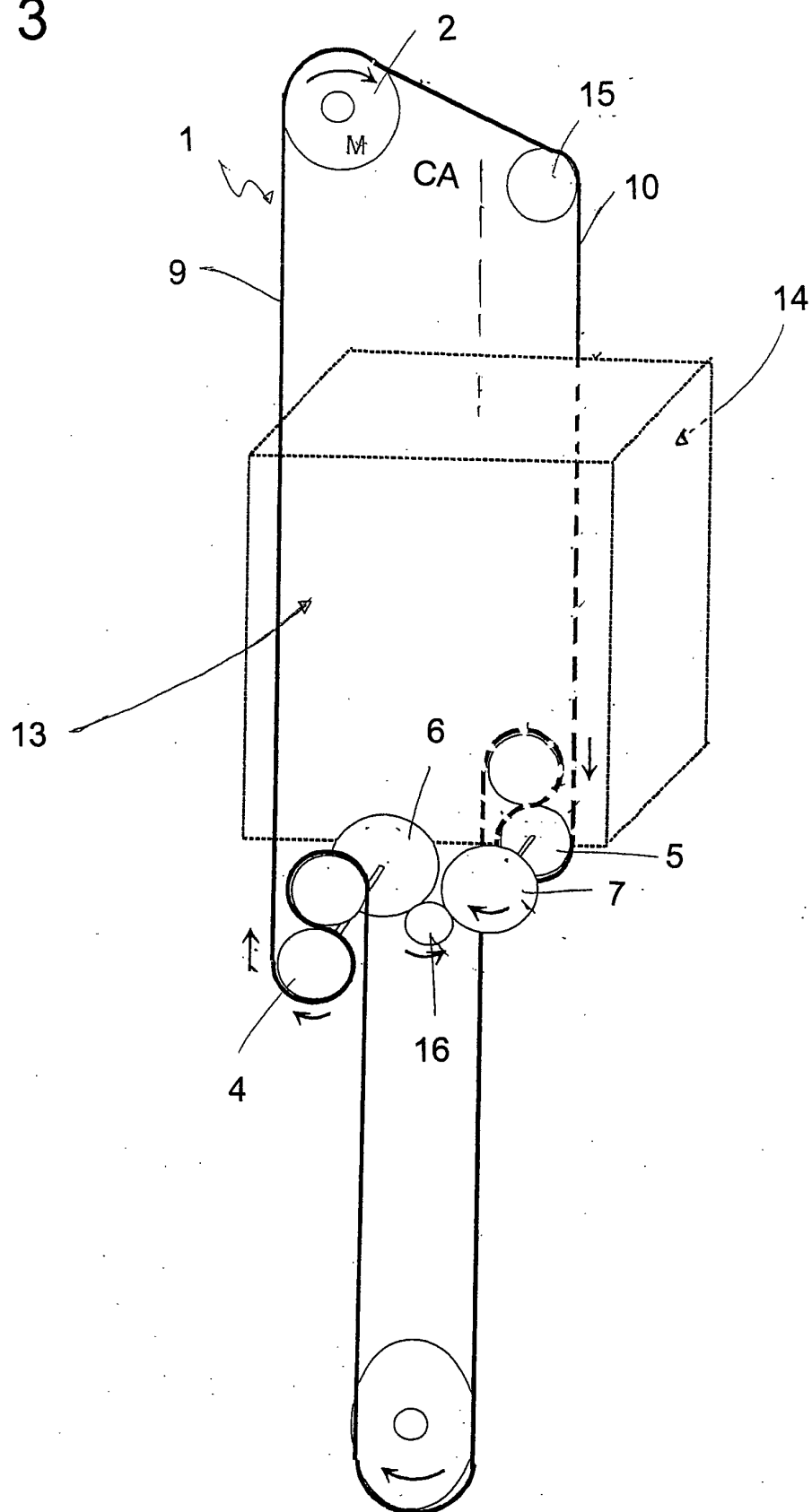


Fig. 4

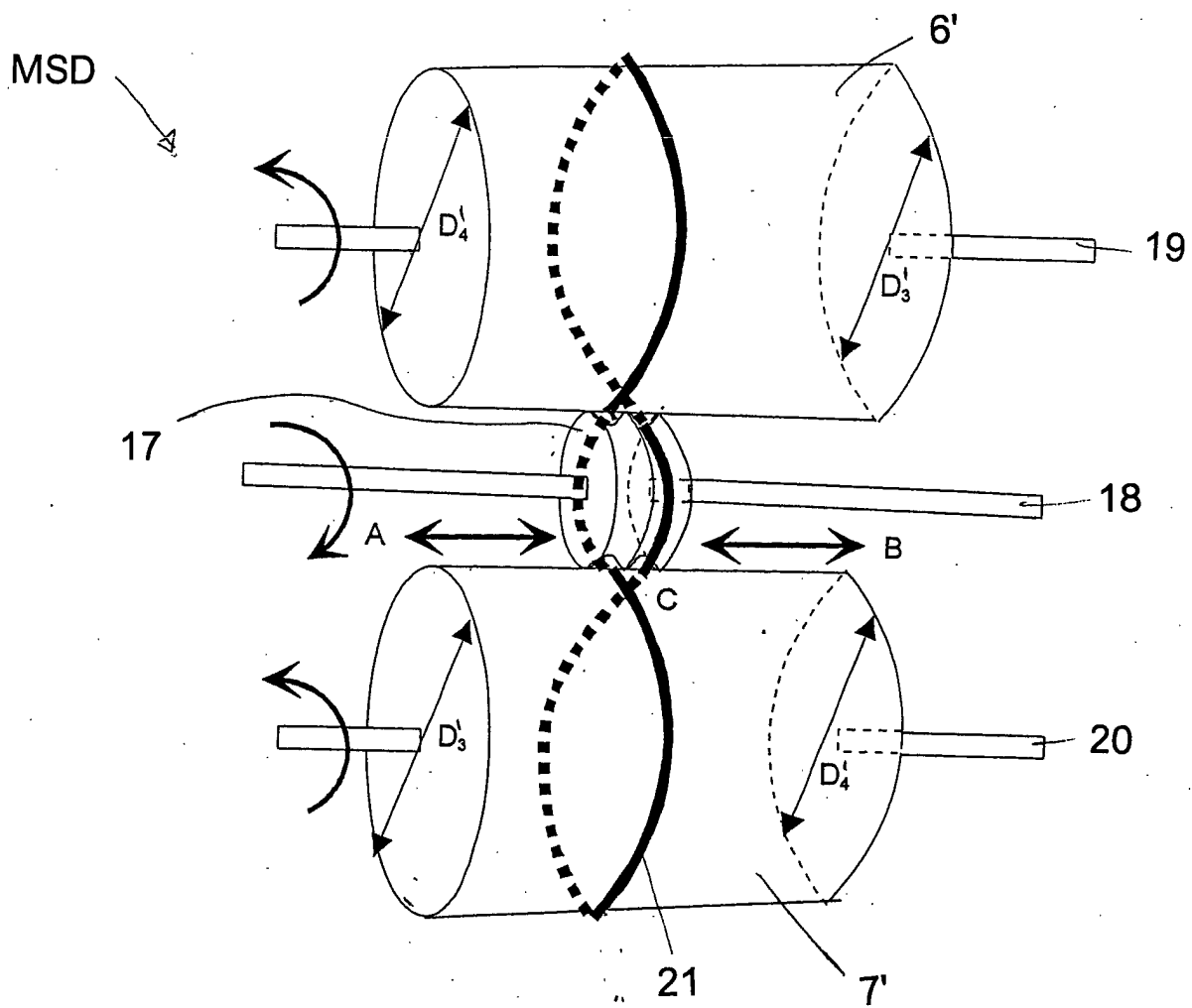


Fig. 5

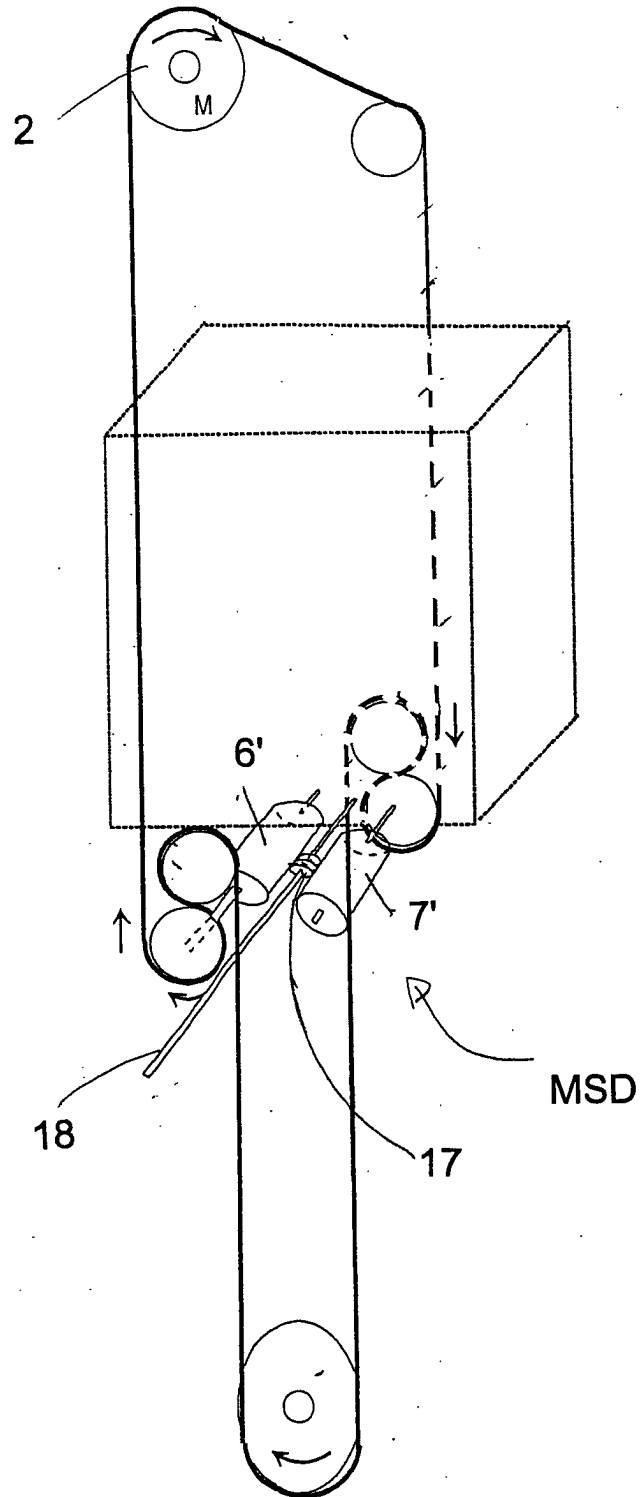


Fig. 6

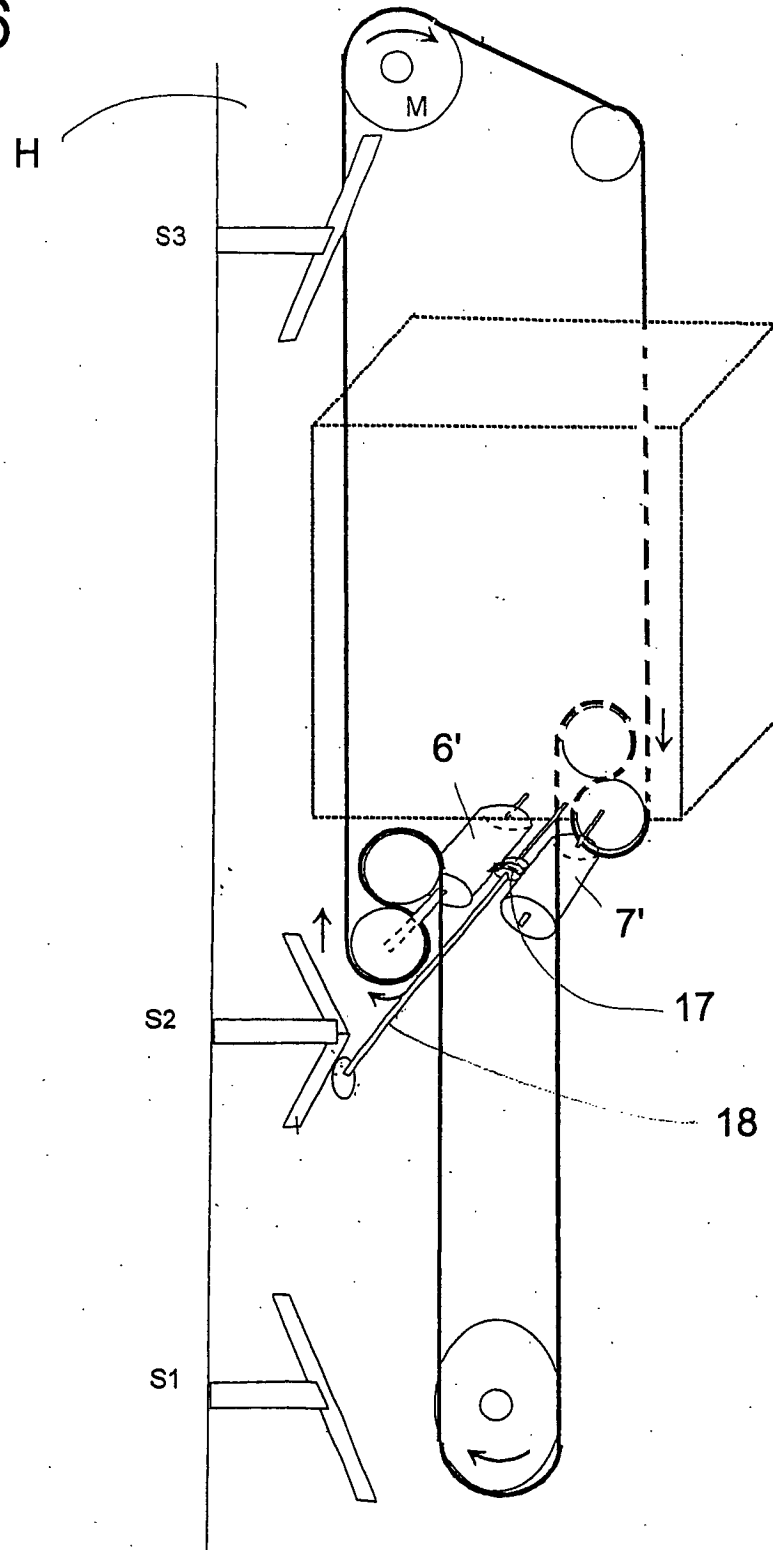


Fig. 7

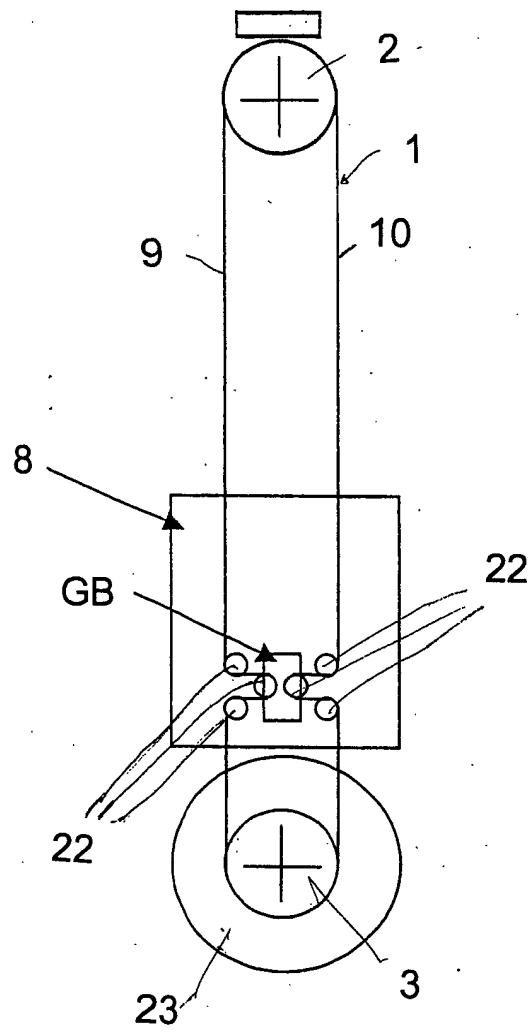


Fig. 8

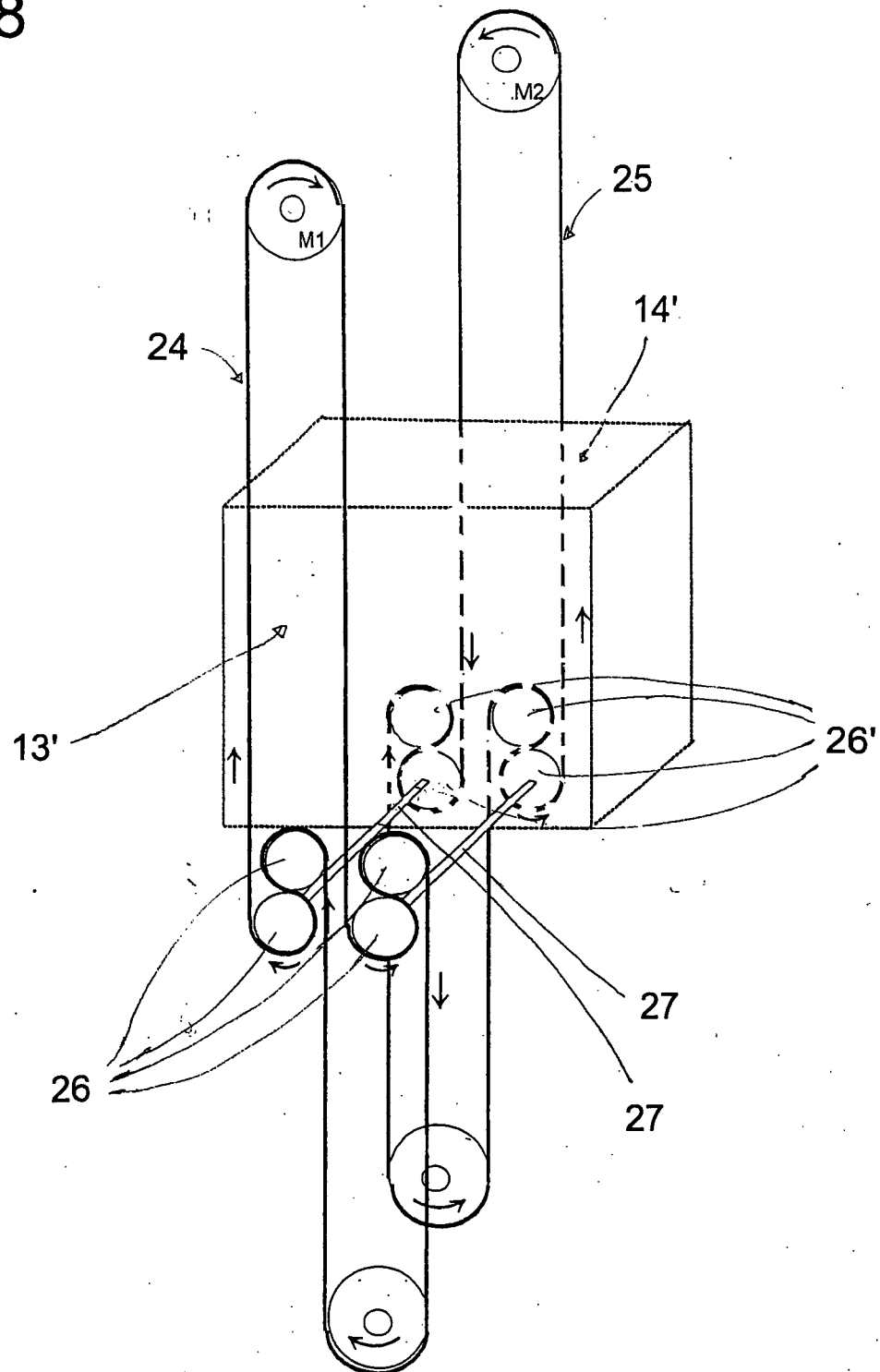


Fig. 9

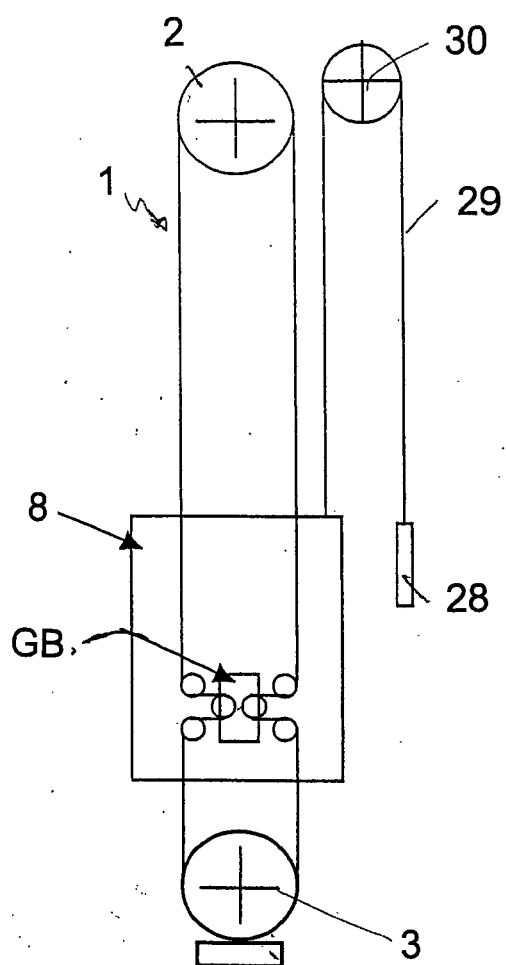


Fig. 10

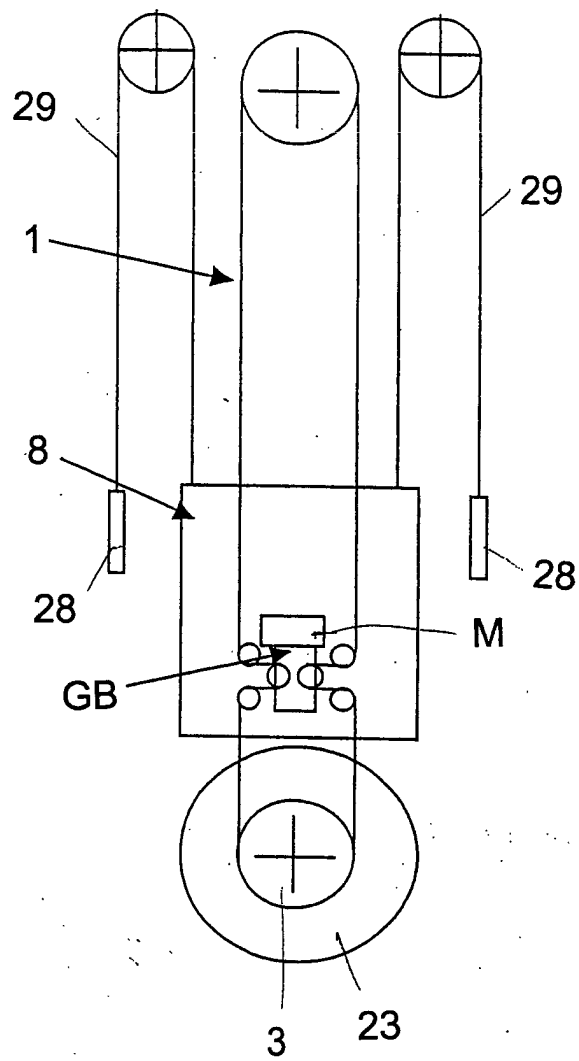


Fig. 11

