

**Description:****Excess speed detector with multiple light barrier**

The invention concerns an excess speed detector with multiple light barrier and a flag track for the production of a shaft information for a lift plant.

In lift plants, buffers are installed in the shaft pit as safety equipments. In case of faulty functions of the drive, the cage on travelling past the lowermost stop or the counterweight or travelling past the uppermost stop is braked in defined manner. In the case of lifts with high nominal speeds, very large buffers are needed for this, which makes a deep shaft pit necessary and is correspondingly expensive to build. The lift regulations permit only shortened buffers insofar as the retardation of the lift cage is monitored by an independent safety equipment. This retardation check must in the case of a fault make certain that the maximum permissible buffer impact speed, which in the case of shortened buffers is smaller than the nominal speed, is not exceeded.

Such an equipment for the speed monitoring and stop initiation, in particular for lift cages, has become known by the US-PS 4 499 974. In this equipment, a flag track is mounted at one side of the lift shaft. A detector, for example in the form of a forked light barrier, is fastened at the cage. When the cage travels through the shaft and the light beams of the light barrier are interrupted, the time of the interruption is measured. When the time of the interruption is smaller than a preset value, this is then a measure for excess speed. The individual flags of the flag track are each so dimensioned that the preset passage times are fallen below and the safety switching elements are triggered when they are passed at more than the maximum permissible speed.

In the case of the aforescribed equipment, the speed of the cage is ascertained with the aid of a single measuring or checking equipment. It can not be recognised whether the light barrier engages sufficiently deeply into the flags in order to assure an interruption of the light beams. The absence of the flag track or even only individual flags can likewise not be ascertained

immediately thereby. Moreover, it can not be recognised with this equipment without interrupting the current circuit whether the working contacts of the safety switching elements function in order to make certain that they can actually be opened in the case of a fault.

The invention is based on the object of proposing an equipment for the ascertaining of excess speed of the initially named kind, which does not display its disadvantages and assures a high safety.

This problem is solved by the invention characterised in the patent claim 1.

The advantages achieved by the invention are to be seen substantially in that all the aforementioned fault functions can be recognised and the safety switching elements can be triggered by reason of an additional check track mounted at the flag track and a redundant forked light barrier.

Advantageous developments and improvements of the excess speed detector indicated in claim 1 are possible through the measures recited in the subclaims. Due to redundancy of the safety switching elements and a check circuit, faults of the relays can be recognised without interruption of the working current circuit.

Three examples of embodiment of the invention are illustrated in the drawing and explained more closely in the following. There show:

- Fig. 1 a schematic illustration of a lift plant with a first example of embodiment of the measuring strip according to the equipment according to the invention,
- Fig. 2 a forked light barrier according to the equipment according to the invention,
- Fig. 3 a functional block diagram according to the equipment according to the invention,
- Fig. 4 a signal course diagram of the forked light barrier in the fault-free operational state without excess speed,
- Fig. 5 a signal course diagram of the forked light barrier in a faulty operational state,
- Fig. 6 a second example of embodiment of the measuring strip according to the equipment according to the invention,

Fig. 7 a third example of embodiment of the measuring strip with a longitudinal section through the forked light barrier according to the equipment according to the invention and

Fig. 8 a signal course diagram of the forked light barrier according to the third example of embodiment.

Fig. 1 shows a schematic illustration of a lift plant with an equipment according to the invention for the detection of excess speed. A cage 2, which is guided in a lift shaft 1, is driven by way of cables 5 from a drive motor 3 with a drive pulley 4. The measuring strip 6 is mounted on one side of the lift shaft 1. A forked light barrier 7 is arranged at the cage 2, preferably on the cage roof. The measuring strip 6 consists of a markings track in the shape of a flag track 8 and a check track 9 and is made of a highly resistant material, preferably of steel sheet. The forked light barrier 7 is so arranged on the cage roof that it engages into the flag track 8 and into the check track 9. The measuring strip 6 is mounted over the entire shaft length. Markings in the form of flags 10 and windows 13 are arranged at the measuring strip 6 for scanning by the forked light barrier 7. A window 13 is arranged in the check track 9 at those places, where a flag 10 stands in the flag track 8. At this place, the light beam of the forked light barrier 7 is free each time at the control track 9 and can be tested. By reason of this arrangement, it is made certain that at least one light barrier is always interrupted. The length of the flags 10 is matched each time to the maximum speed of the cage 2, i.e. the flag segments 10 become ever shorter towards the upper and lower shaft end. When the depth of engagement of the forked light barrier 7 into the flag track 9 is now not correct or a flag 10 is absent, all light barriers become free.

By reason of this state, the faults are recognised and the safety switching elements are opened by the control.

The structuring of the markings at the measuring strip 6 can also take place in different other ways, such as for example as slots, holes or in the shape of a strip with reflecting and non-reflecting portions.

Fig. 2 shows a forked light barrier 7. This forked light

barrier 7 is built up in two channels each with three, preferably infrared light barriers 14 for each channel and with a monitoring circuit which compares the state and the measurement results of both the channels. A first light barrier 15 and 16 is used for each channel in order to measure the passage time of the flag 10. The second light barrier 17 and 18 is displaced vertically in order that it can be ascertained whether the flag was passed or only touched. The third light barrier 19 and 20 is disposed in the check track 9 and serves for ascertaining whether all flag segments 10 are present and the forked light barrier 7 is mounted correctly. Both channels of the forked light barrier 7 take over the same functions. In order to exclude a mutual influencing of the altogether six light barriers 14, only one transmitter is switched in each time. The co-ordination between the light barriers 14 is taken over by a switching-over of the channels. Should a fault arise in the channel switching, the safety switching elements are opened. It is recognised as a faulty function when both the channels transmit at the same time or when the time requirement for the operation of a light barrier 14 deviates from the normal value. Both the channels measure the flag passage time each independently of the other.

Fig. 3 shows a functional block schematic diagram according to the equipment according to the invention. The channel A and the channel B are constructed identically. Only the channel A is described in the following. A channel switching 24 takes over the co-ordination of the light barriers 14, i.e. the switching-over from one light barrier 14 to the next one of both the channels A and B. Equally, the optical parts 25, 26 and 27 are built up identically. They consist substantially of transmitter and receiver units as well as a sequence control and transmitter and receiver test units. The build-up of such a light barrier is described in the EP 483 560. The first two optical parts 25 and 26 scan the flag track 8. The flank recognition 28 starts a counter 29 on a flag 10 being entered. On coming out of the flag 10, the counter 29 is stopped, the counter state is passed over to an intermediate storage device 30 and the counter 29 is again reset. Thereby, the counter 29 is again ready for the next time measurement. It can happen that the counter 29 is

started at a flag edge due to toggling, i.e. oscillating upward and downward movements. In this case, the counter 29 is reset by a toggle recognition 31 and the passage is recognised as incorrect. When a correct flag passage has thereagainst taken place, the evaluation of the counterstate is caused by the toggle recognition 31 to take over and check the count value. When the count value lies below a defined limit value, then the flag 10 was travelled through too fast, which is equivalent to excess speed. In the case of excess speed, the safety relays 34 and 35 are opened and the lift thus stopped. After a valid flag passage, the counter states (the measurement values) are present at both channels A and B. Differences between both the counter states are recognised by the counter comparison with count tolerance consideration 36 and lead to the opening of the safety relays 34 and 35.

The counter 29 counts a constant counting rate 37. The monitoring of the time base 38 checks the counting rate 37. An incorrect check track signal 39 is detected by the monitoring of the check track 40. A relay watchdog 41 checks the reset pulses. Optical error signals 42 can be detected by the receiver and transmitter test units of the optical pulse 25, 26 and 27. Should one of the aforementioned faults arise, the safety relays 34 and 35 are opened.

The relays 34 and 35 comprise two switching contacts 45 and 46, which are constrainedly moved one to the other and of which each switch contact is in one working current circuit 47. The second relay contact serves for the monitoring of the relay states 48. Faulty relay states lead to a relay switching-off command. In the normal lift operation, no excess speed arises. This has the consequence that the relays 34 and 35 need never be switched off and their function can thus not be checked. In order to check the function of the relay safety contacts, these must be opened without interrupting the working current circuit. For that reason, two safety relays (34, 35), the switching contacts (45, 46) of which are connected in parallel, are installed for each channel (A, B). The function of the working contacts can be checked by way of the contacts constrainedly led to working contacts when the relay (34,

35) is switched. With the aid of the bridging-over of the working current circuit 49, this test becomes possible without opening the working current circuit 47.

Fig. 4 shows a signal course diagram of the forked light barrier in the fault-free operational state without excess speed. The upper course represents the flag track signal 51 and the lower course represents the check track signal 52. During the movement of the flags 10 through the light barrier 15, the passage time 53 is measured and a possible excess speed detected. Since one flag 10 and one window 13 always stand one opposite the other at the measuring strip 6, the absence of flag segments 10 or a faulty positioning of the forked light barrier 7 can be recognised at once, since a check window recognition 54 always takes place within the passage time 53 of the flags 10.

Fig. 5 shows a signal course diagram of the forked light barrier in the case of an incorrect depth of engagement of the forked light barrier 7 or in the case of absent flag segments 10. In both cases, the light beams become free simultaneously at the flag track 10 and the check track 9. The check track monitoring 40 and the flank recognition 28 recognise the fault state 55 and cause an opening of the safety relays 34 and 35. As soon as a fault arises, the channel, which has first discovered it, releases its relays and gives the relay switching-off command to the other channel.

Fig. 6 shows a second example of embodiment of a measuring strip 65 according to the equipment according to the invention. This measuring strip 65, apart from a markings track in the shape of a flag track 66 and a check track 67, in addition still displays a safety track 68. This track serves for the additional checking in the upper and lower shaft end. For this purpose, the measuring strip 65 displays a free strip 69, which in the region of the upper and the lower shaft ends displays at least one respective marking in the form of a slot or a hole 70, between the flag track 66 and the check track 67. The forked light barrier belonging to this example of embodiment therefore comprises a further light barrier pair which can detect the end of the shaft with the aid of the slot or the hole 70. The arrangement of the flags 10 and windows 13 is identical with the

first example of embodiment. This construction enables an additionally high operational reliability against faulty triggering, such as for example in the case of possible contamination of the measuring strip 65, when the check windows 13 can no longer be recognised by the light barriers 19 and 20.

Fig. 7 shows a third example of embodiment of a measuring strip 75 with a longitudinal section through the forked light barrier 76 according to the equipment according to the invention. This measuring strip 75 consists of a markings track in the form of a window track 77 and a check track 78. The measuring strip 75 displays markings in alternation in the shape of windows 79 on the window track 77 and the check track 78. The windows 79 of both tracks have the same size and are each time arranged centrally between two windows 79 of the other track. By reason of this arrangement of the windows 79, the light barriers 80 of both the channels A and B are arranged symmetrically. The measurement value registration can take place through the freeing or through the interruption of the light beams of the light barrier in the track concerned. An advantage of this variant is that a contact safety device, which prevents a tearing-off of the measuring strip 75 in consequence of protruding parts, is formed by a web 81 in front of the window track 77.

Fig. 8 shows a signal course diagram of the light barriers 80 according to the third example of embodiment. This signal course diagram shows a fault-free operational state. The upper course represents the window track signal 82 and the lower course represents the check track signal 83. The detection of excess speed takes place in the same manner as for the first example of embodiment. It can be recognised as further faults when a pulse is absent or a channel has constant level 0 or constant level 1.



### Patent Claims

1. Excess speed detector with multiple light barrier, wherein the light barriers (14, 80), which are combined into a forked light barrier (7, 76) and arranged at a lift cage (2), read measurement values from a measuring strip (6, 65, 75) fastened at one side of the lift shaft (1) and in case of faulty operation stop the lift through the release of safety switching elements (34, 35), characterised thereby, that the measuring strip (6, 65, 75) is constructed with redundancy, consists of a markings track (8, 66, 76) and a check track (9, 67, 77) and displays markings (10, 13, 70, 81) for scanning.
2. Excess speed detector according to claim 1, characterised thereby, that a flag (10) and a window (13) each time lie one opposite the other at the measuring strip (6, 65).
3. Excess speed detector according to claim 1, characterised thereby, that windows (81) of the window track (77) and windows (81) of the check track (78) are arranged in alternation at the measuring strip (75).
4. Excess speed detector according to one of the claims 1 to 3, characterised thereby, that the forked light barrier (7, 76) displays two channels (A, B).
5. Excess speed detector according to one of the claims 1 to 4, characterised thereby, that the measuring strip additionally displays a safety track (68).
6. Excess speed detector according to one of the claims 1 to 5, characterised thereby, that the safety track (68) displays measuring points in the shape of slots or holes (70).



7. Excess speed detector according to one of the claims 1 to 6, characterised thereby, that the forked light barrier (7) displays a second light barrier (17, 18), which is vertically spaced from the first light barrier (15, 16), for each channel (A, B) for the scanning of the flag track (8, 66).

8. Excess speed detector according to one of the claims 1 to 6, characterised thereby, that the light barriers (80) of both the channels (A, B) of the forked light barrier (76) are arranged symmetrically for the scanning of the window track (77) and the check track (78).

9. Excess speed detector according to one of the claims 1 to 8, characterised thereby, that both the channels (A, B) perform speed measurements each independently of the other.

10. Excess speed detector according to one of the claims 1 to 9, characterised thereby, that a channel-switching device (24) undertakes the switching over from one light barrier (14, 30) to the respective next one.

11. Excess speed detector according to one of the claims 1 to 10, characterised thereby, that each channel (A, B) displays two safety switching elements (34, 35) with parallel switch contacts (45, 46).