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(54) **Telescopic fork**

(57) The fork includes a lower base (10) and a set of telescopically extendable mobile slides (20, 30), wherein each slide (20, 30) is slidable by means of a respective set of rollers (13, 14). The base (10) has a pair of parallel vertical flanges (11, 12) extending upwardly in respective vertical planes (P11, P12) from a base plate (16), the flanges holding a set of rollers (13) located transversely outside the flanges (11, 12) for supporting an intermediate slide (20) in sliding manner. This intermediate slide (20) has chain guiding grooves (26a, 26b) formed in transversely intermediate positions between the vertical planes (P11) and (P12) in which the flanges (11, 12) of the base (10) extend. A first optical device (F) is fixed to the base (10) in an intermediate position between the flanges (11) and (12); a second optical device (C) is fixed to a lower surface of the top slide (30). An opening (23) is formed in the intermediate slide (20), in such a way as to be aligned between the first (F) and second (C) optical devices in a working position of the fork.

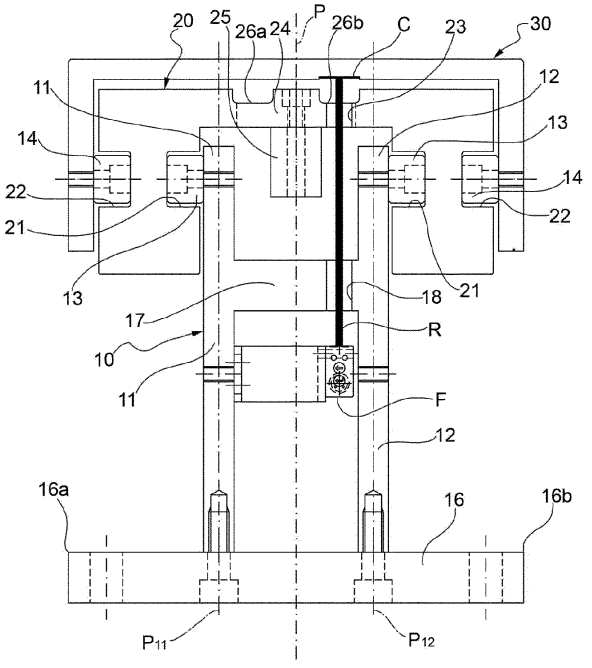

FIG.1

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Description

[0001] The present invention relates to a telescopic fork. Telescopic forks are used in the fields of automatic manipulation and industrial automation, and are widely applied, for example, in automated warehouses, typically in association with automated lift trucks for moving pallets.

[0002] As is known, a telescopic fork is composed of a fixed lower base and one or more overlapping extendable elements which move in a bilateral telescopic manner for the movement of loads. The number of mobile telescopic elements (two, three or four) is chosen to suit the desired overall length of travel and the size of the loads to be handled.

[0003] To assist the understanding of the prior art and its inherent problems, a known type of telescopic fork, shown in Figure 2 of the attached drawings, will be described initially. The fork includes a lower fixed base 10 having two vertical central flanges 11, 12 which carry a first set of rollers 13 with horizontal axes. The rollers 13 support, in a telescopically slidable manner, an intermediate slide or travelling element 20. By means of a second set of rollers 14, the intermediate slide supports, in a telescopically slidable manner, a top slide or travelling element 30 which can directly support the loads to be transferred when in use.

[0004] The ends of two chains 27 (only one of which is shown in Figure 2) are fixed to the flanges 11, 12 in laterally outer positions, these chains transferring to the top slide 30 the longitudinal sliding motion which is imparted to the intermediate slide 20 by a rack and pinion drive mechanism. This mechanism includes a rotating gear wheel (not shown) carried on the lower base 10 and a longitudinal rack 25 which runs centrally along the whole length of the bottom of the intermediate slide 20 between the flanges 11 and 12. The chains 27 are guided by parallel grooves 26a, 26b formed in the intermediate slide 20.

[0005] In order to control the position of the slides, many conventional forks are provided with control systems having mechanical or inductive end of stroke switches D mounted outside the body of the fork. This external location makes these end of stroke switches particularly vulnerable during the use of the fork, and increases the overall transverse horizontal dimension of the fork by about 5 to 10 cm.

[0006] The object of the invention is to optimize the available space in a telescopic fork, and, in particular, to place an optical control unit in a protected position for the purpose of controlling the position of the top slide.

[0007] These and other objects and advantages, which are made clearer below, are achieved according to the present invention by a telescopic fork having the characteristics defined in the attached claims.

[0008] A preferred, but non-limiting, embodiment of the telescopic fork according to the invention will now be described; reference will be made to the attached drawings, in which:

Figure 1 is a cross-sectional view of a telescopic fork according to one embodiment of the invention; and
Figure 2 is a cross-sectional view of a conventional telescopic fork.

[0009] With reference to Figure 1, a preferred embodiment of a telescopic fork according to the invention includes a lower base 10, an intermediate slide 20 which is telescopically mobile with respect to the base 10, and a top platform or slide 30, which in turn is telescopically mobile with respect to the intermediate slide 20.

[0010] The lower base 10 has a lower horizontal plate 16 from which a pair of vertical lateral flanges 11, 12 extend, the flanges being transversely equidistant from a vertical central or mid-plane P. Viewed in cross section, the base 10 is approximately in the form of an inverted π symbol. The overall structure of the fork is symmetrical with respect to the vertical mid-plane P. Throughout the following description and claims, terms and expressions indicating relative orientations and positions such as "longitudinal", "transverse", "outer", and "inner" are to be interpreted relatively to the central vertical plane P and to the "longitudinal" direction of the telescopic motion of the fork, which is perpendicular to the plane of the drawing in Figure 1.

[0011] The flanges 11, 12 extend from the base plate 16 symmetrically with respect to the mid-plane P, in intermediate positions between the plane P and the respective opposite longitudinal sides or longitudinal edges 16a, 16b of the plate 16. More specifically, the flanges 11 and 12 are located approximately 1/3 and 2/3 of the way along the distance between the edges 16a, 16b. In the example shown in Figure 1, the flanges 11 and 12 are connected rigidly to one another by a horizontal plate 17, preferably formed by a horizontal plate portion which is made in one piece with the flanges 11 and 12 and which forms, together with the flanges, a single shaped member which is H-shaped when viewed in cross section.

[0012] A first set of rollers 13 with horizontal axes is mounted in positions transversely outside the flanges 11, 12, in order to support the intermediate slide 20 in a telescopically slidable way on the base 10. The rollers 13 engage in a rolling manner in two guides in the form of lateral longitudinal cavities 21 in the intermediate slide 20. The cavities 21 face the mid-plane P. The intermediate slide has a second pair of lateral longitudinal cavities 22, facing in opposite, transversely outer, directions. The rollers of a second set of rollers 14, projecting from respective vertical transversely outer flanges 36, 37 of the top slide 30, engage in a rolling manner in the cavities 22, in a general configuration of a known type.

[0013] The intermediate slide 20 includes a flattened central portion 24 in the form of a horizontal plate which extends in a bridge-like manner above the flanges 11, 12. A vertical through opening 23, in the form of a longi-

tudinally elongate slot, is formed in the proximity of one of the longitudinal ends of the intermediate slide 20, in the central area. A longitudinal rack 25 runs centrally along the whole length of the bottom of the intermediate slide 20, projecting from the lower face of the central portion 24 of the slide 20.

[0014] Parallel longitudinal grooves 26a, 26b are formed in the intermediate slide 20, and act as guides for respective chains (not shown) forming part of a transmission mechanism which transfers to the top slide 30 the sliding motion imparted to the intermediate slide 20 by the rack mechanism. Each of these chains has one end fixed to the lower base 10 and a second end fixed to the top slide 30.

[0015] The chain transmission mechanism in the fork according to the present invention is located nearer the mid-plane P than it is in the known fork shown in Figure 2. The vertical flanges 11, 12 are placed farther apart from one another transversely in order not to interfere with the transmission chains (not shown). As shown in Figure 1, the chain guiding grooves 26a, 26b are formed in a position nearer the mid-plane P of the fork, in transversely intermediate positions between the vertical planes P11 and P12 in which the flanges 11 and 12 extend from the base 10.

[0016] The aforesaid configuration enables an optical control unit to be placed in a protected position near the centre of the fork, for directly controlling the position of the top slide. The greater transverse distance between the flanges 11 and 12 increases the lateral space between the rack and at least one of the lateral flanges 11, 12. Between the flanges 11 and 12 there is sufficient space in the transverse direction to accommodate a first optical device F, such as a photocell, mounted at one of the longitudinal ends of the lower base 10 in a laterally protected position between the flanges 11 and 12. Because of the free space created between the rack 25 and the flanges 11, 12, a second optical device C, for example a reflective element such as a reflector, affixed to the lower face at one of the longitudinal ends of the top slide 30, can be read directly by the photocell F when the opening 23 is aligned between the reflector C and the photocell F. The photocell F, the opening 23 and the reflector C are located in the same plane, preferably a vertical plane. In the illustrated embodiment, the two optical devices F, C and the opening 23 are aligned along the same ideal straight line when the fork reaches a specified working position, for example the fully retracted end of stroke position.

[0017] It will be evident that the optical system is protected from impact and does not increase the overall dimensions. Although the rack 25 extends along the whole length of the intermediate slide, it does not impede the passage of the light rays R emitted by the photocell F and reflected by the reflector C. It should be noted that the plate 17 is optional, and that, if present, it is fixed to the photocell F and must have a through hole 18 or other opening such that the rays R are not blocked. In the illustrated embodiment, the hole 18 is vertically aligned with the photocell F. It will be understood that the vertical direction of the rays R is not essential. The invention can be applied equally satisfactorily by directing the rays R in an inclined manner with respect to the vertical, and by inclining the reflector C in a corresponding manner if necessary. A relative advantage of the use of a reflector is that it diffuses the reflection towards the receiver in an effective manner without requiring a condition of absolute verticality. If the rays R are inclined with respect to the mid-plane P, the opening 23 in the intermediate slide will be designed or placed in a position such that the passage of the emitted ray and the reflected ray is permitted in a specified position of the fork, typically in the end of stroke position in which the fork is fully retracted.

[0018] The invention is not necessarily limited to an optical device F comprising a single photocell acting as transmitter and receiver. In other embodiments of the invention, which are not illustrated and which are less preferred, the incident ray and the reflected ray can form an acute angle between them in a plane confined laterally between one of the vertical planes (P11 or P12) in which one of the flanges 11 (or 12) lies and the side of the rack facing the flange in question. In this variant, a transmitting optical device and a separate receiving optical device are provided; the opening 23 is in all cases designed so as to permit the passage of both the incident ray and the reflected ray in the end of stroke position. Alternatively, there can be two openings in the intermediate slide, one for the incident ray and one for the reflected ray. Additionally, in the embodiment shown in Figure 1, which has a single transmitting and receiving optical device F, it is preferable for the opening 23 to be in the form of a slot, in other words slightly elongate in the longitudinal direction, in order to allow for the mechanical play between the slides in the longitudinal direction.

[0019] It is to be understood that the invention is not limited to the embodiment described and illustrated herein, which is to be considered as an example; in fact, the invention can be modified in respect of shape, dimensions, arrangements of parts, details of construction, and operation. For example, the option of providing a fork with only two mobile slides may be preferred in certain conditions of use, but it is not in any way essential for the purposes of the application of the invention. In particular, the invention can be applied in the form of a fork including three or more mobile slides. In these variants, the intermediate slides between the top slide and the base must have openings such that the passage of the emitted ray and of the reflected ray is permitted in a specified position of the fork, typically in the end of stroke position when the fork is fully retracted.

Claims

1. Telescopic fork including a lower base (10) and a plurality of mobile slides or telescopically extendable

elements (20, 30), wherein each slide (20, 30) is slidable by means of a respective set of rollers (13, 14) arranged symmetrically with respect to a vertical plane of symmetry (P), and wherein
the base (10) has a pair of parallel vertical flanges (11, 12) extending upwardly in respective vertical planes (P11, P12) from a base plate (16), the flanges holding a set of rollers (13) located transversely outside the flanges (11, 12) for supporting an intermediate slide (20) in sliding manner with respect to the base (10), and wherein
the intermediate slide (20) has longitudinal grooves (26a, 26b) which serve as guides for chains for transmitting a longitudinal sliding motion to a top slide (30); **characterized in that**

- the chain guiding grooves (26a, 26b) are formed in transversely intermediate positions between the vertical planes (P11) and (P12) in which the flanges (11, 12) of the base (10) extend, and **in that**
- at least a first optical device (F) is fixed to the lower base (10) in a transversely intermediate position between the flanges (11) and (12);
- a second optical device (C) is fixed to a lower surface of the top slide (30);
- at least one opening (23) is formed in the intermediate slide or slides (20) between the top slide (30) and the lower base (10), whereby the opening (23) is aligned between the first (F) and second (C) optical devices in at least one working position of the fork.

2. Telescopic fork according to Claim 1, **characterized in that** it further comprises a rack (25) which extends substantially over the entire length of the intermediate slide (20), and **in that** the optical devices (F, C) and the opening (23) are transversely or laterally confined between an ideal vertical plane (P12) in which one (12) of the flanges extends (11, 12) and another ideal vertical plane in which the side of the rack (25) facing and closest to this flange (12) extends.

3. Telescopic fork according to Claim 1 or 2, **characterized in that** the opening (23) is longitudinally elongate.

4. Telescopic fork according to Claim 1 or 2 or 3, **characterized in that** the opening (23) is formed in a central portion (24) extending in bridge-like manner above the flanges (11, 12).

5. Telescopic fork according to any one of the preceding claims, **characterized in that** in the working position of the fork the opening (23), the first (F) and the second (C) optical devices are aligned in a vertical plane.

6. Telescopic fork according to Claim 5, **characterized in that** in the working position of the fork the opening (23), the first (F) and the second (C) optical devices are aligned along a vertical straight line.

7. Telescopic fork according to any one of the preceding claims, **characterized in that** the flanges (11, 12) are arranged symmetrically with respect to the plane (P) at transversely intermediate positions between the mid-plane (P) and the opposite longitudinal edges (16a, 16b) of the base plate (16).

8. Telescopic fork according to any one of the preceding claims, **characterized in that** the flanges (11, 12) are rigidly connected to one another by a horizontal plate portion (17) which is located above the first optical device (F) and has a through opening or hole (18) substantially aligned vertically above the optical device (F).

9. Telescopic fork according to any one of the preceding claims, **characterized in that** the first optical device (F) is an optical transmitter/receiver, such as a photocell.

10. Telescopic fork according to any one of the preceding claims, **characterized in that** the first optical device (F) is mounted at one of the longitudinal ends of the lower base (10).

11. Telescopic fork according to any one of the preceding claims, **characterized in that** the second optical device (C) comprises a reflective element such as a reflector.

12. Telescopic fork according to any one of the preceding claims, **characterized in that** the second optical device (C) is located at one of the longitudinal ends of the top slide (30).

13. Telescopic fork according to any one of the preceding claims, **characterized in that** the working position of the fork is an end of stroke position when the fork is telescopically retracted.

FIG.1

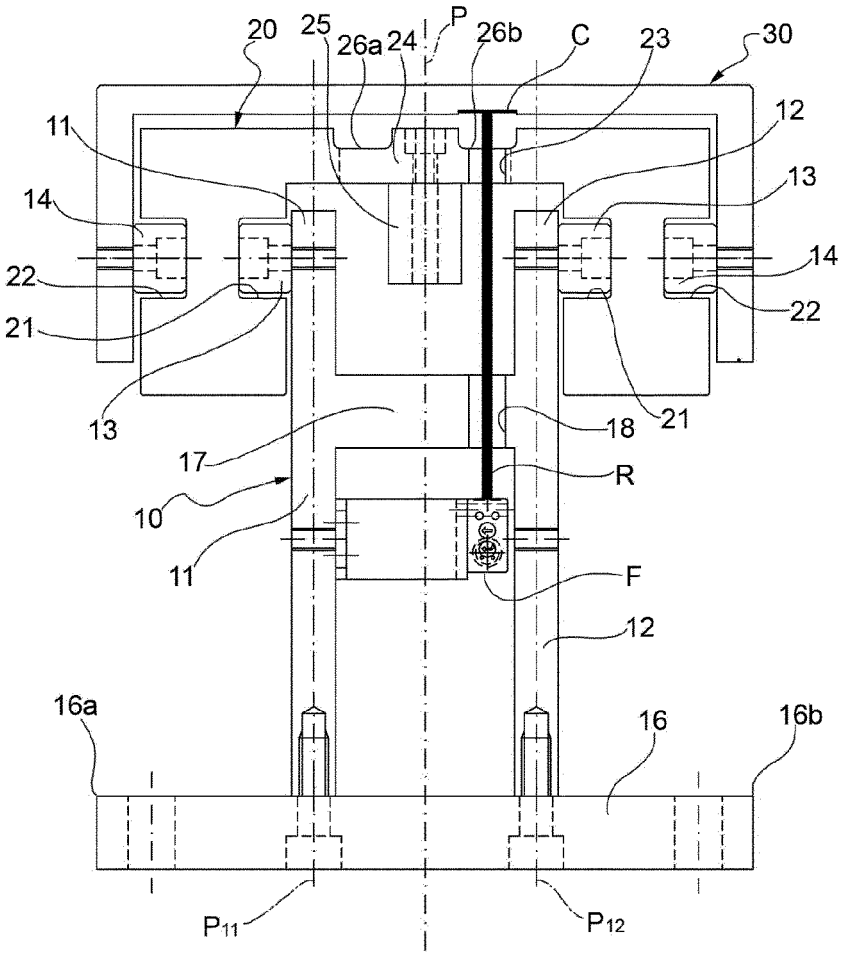
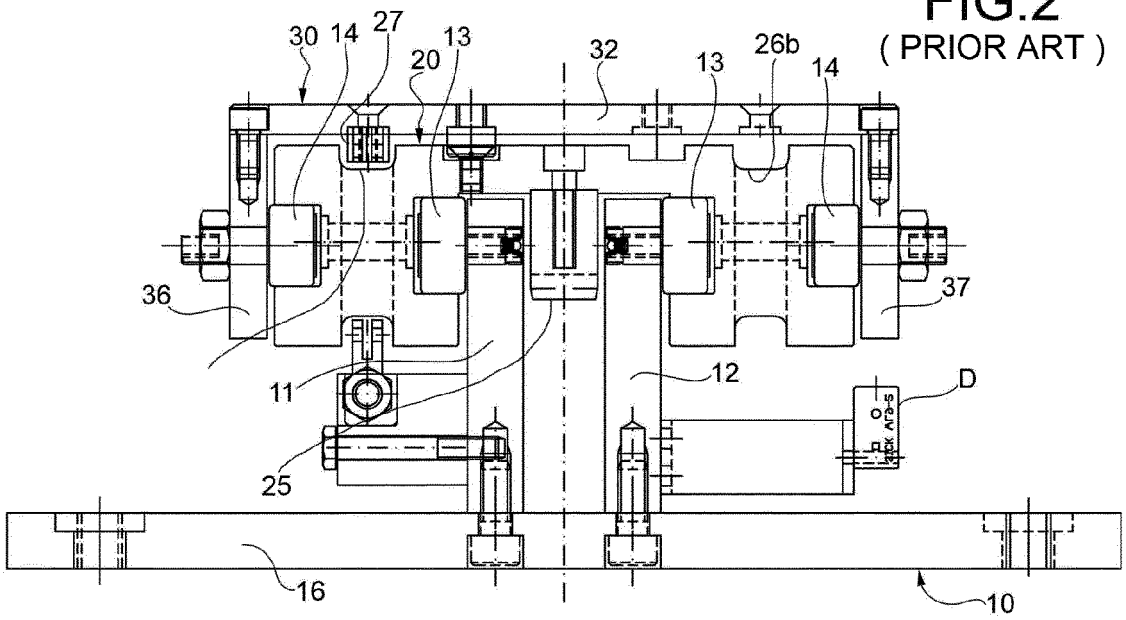


FIG.2
(PRIOR ART)



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EUROPEAN SEARCH REPORT

Application Number
EP 11 19 2272

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	GB 1 383 185 A (BYGG OCH TRANSPORTEKONOMIE AB) 5 February 1975 (1975-02-05) * the whole document * -----	1	INV. B66F9/14
A	FR 1 527 570 A (DEMAG ZUG GMBH) 31 May 1968 (1968-05-31) * figure 3 * -----	1	

TECHNICAL FIELDS SEARCHED (IPC)

B66F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	1 March 2012	Sheppard, Bruce

CATEGORY OF CITED DOCUMENTS

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01-03-2012

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