United States Patent

Vasiliev et al.

[15] **3,638,375**

[45] **Feb. 1, 1972**

[54] HOISTING EQUIPMENT AND METHOD OF USE

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[22] Filed: **Aug. 4, 1970**

[21] Appl. No.: **60,904**

[52] **U.S. Cl.** .....**52/116**, 52/745, 214/1 Q

[51] **Int. Cl.** **B66f 11/02**, E04h 12/34

[58] **Field of Search**.....52/122, 126, 119, 120, 117, 52/745; 182/68, 69; 254/49, 50, 86 R, 10 C; 214/1 Q, 3

[56] **References Cited**

UNITED STATES PATENTS

573,719	12/1896	Strong	254/49
3,292,320	12/1966	Laharty	52/119
3,300,062	1/1967	Myer	52/745

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Attorney—Holman & Stern

[57] **ABSTRACT**

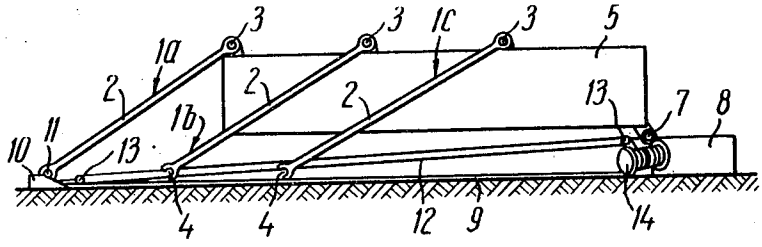
The present invention relates to hoisting equipment, and more specifically to a method of mounting a long-size heavy object into vertical or close to vertical, position by turning this object about a fixed axle, and to a device for realizing this method.

The invention can most successfully be used for mounting into vertical position, or close to it, column- and tower-type apparatuses, transmission line and cableway supports, metal smoke and air chimneys, masts of communication means, pile drivers, and other vertical-type constructions with a weight of 1,000–1,500 tons and more, with lateral dimensions of up to 10 m. and more, and a length of up to 150–200 m. and more.

The method according to the invention provides for moving the bottom ends of frame supports in a definite succession towards the supposed axis of turn of the object to be erected, whereto the frame supports are attached by their span pieces.

The method cuts the time of erection, and permits using winches of relatively small load capacity.

6 Claims, 10 Drawing Figures



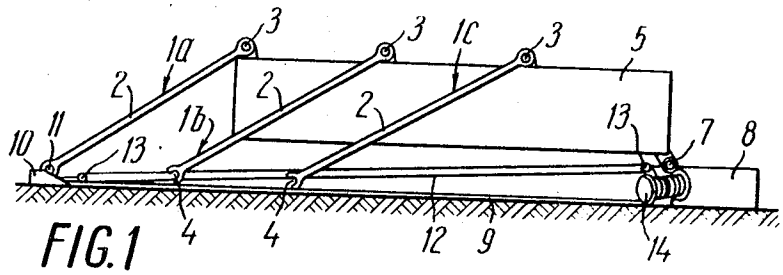


FIG. 1

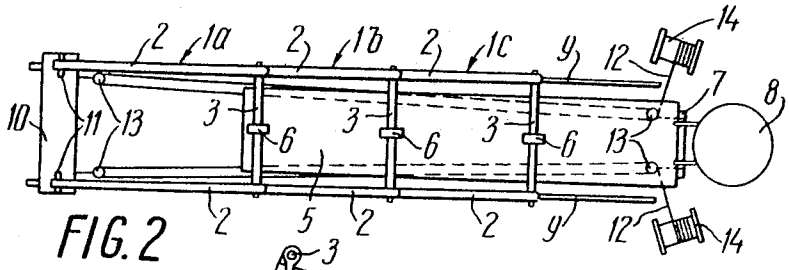


FIG. 2

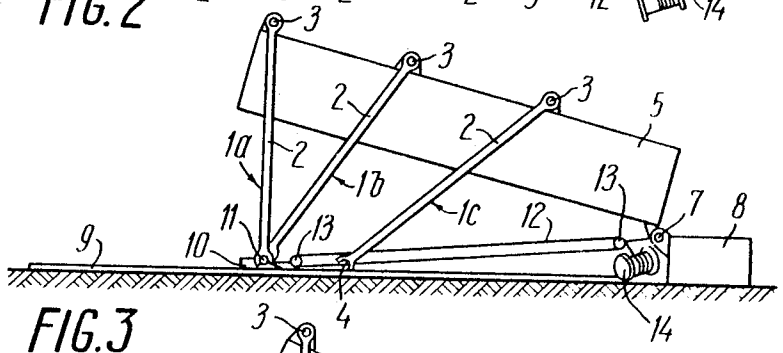


FIG. 3

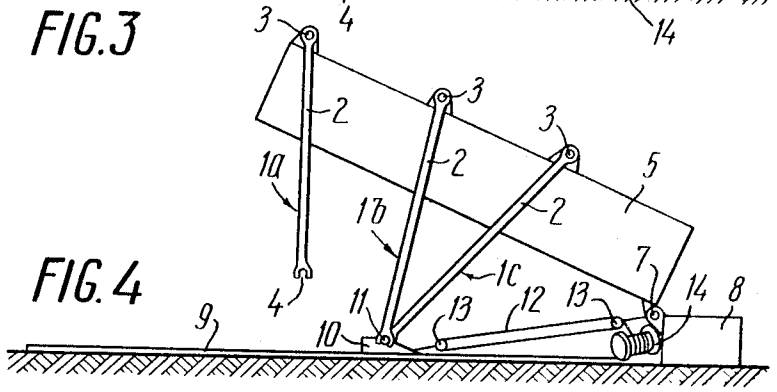


FIG. 4

FIG. 5

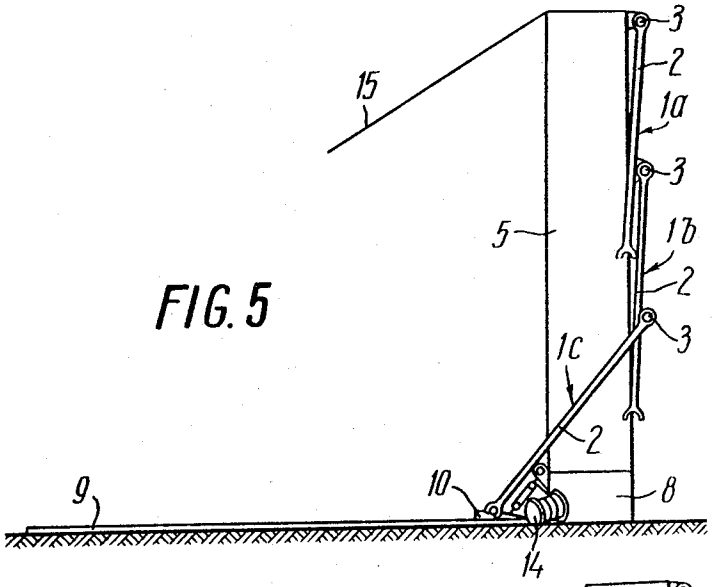
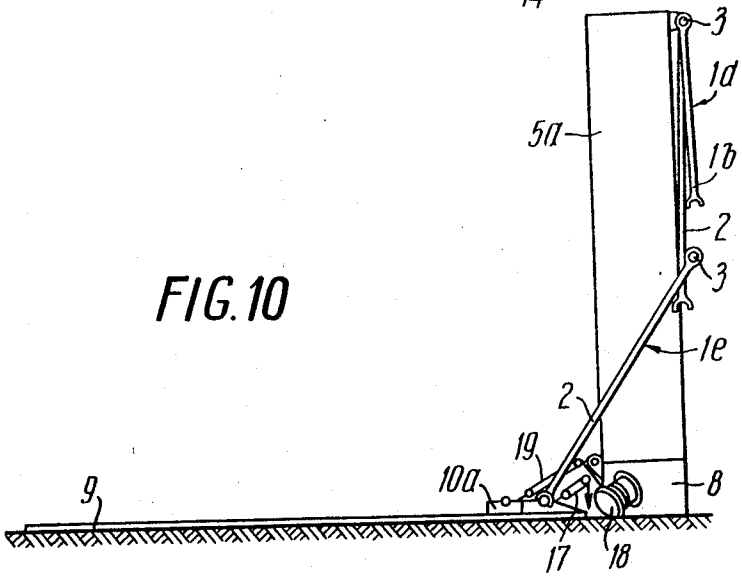


FIG. 10



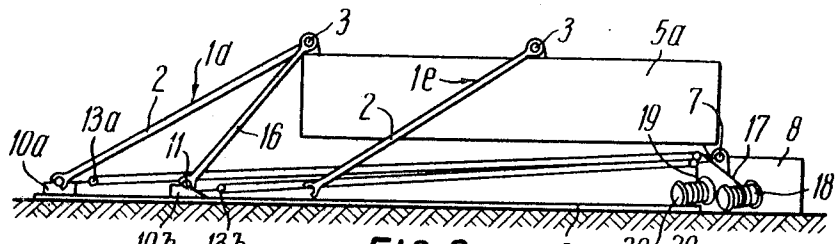


FIG. 6

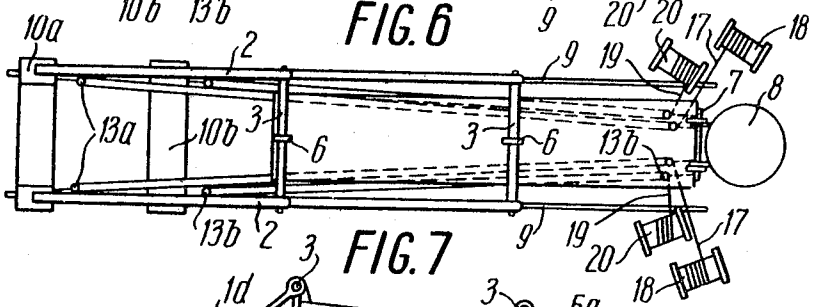


FIG. 7

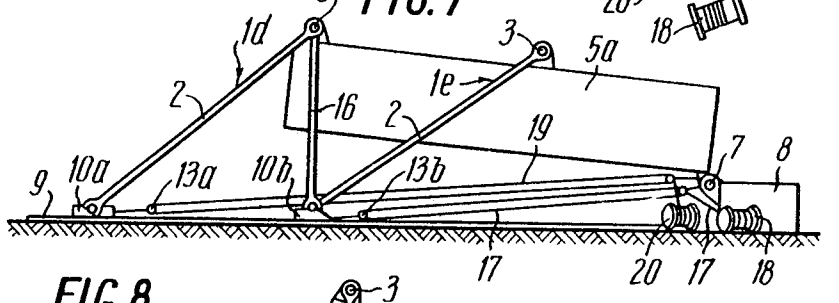


FIG. 8

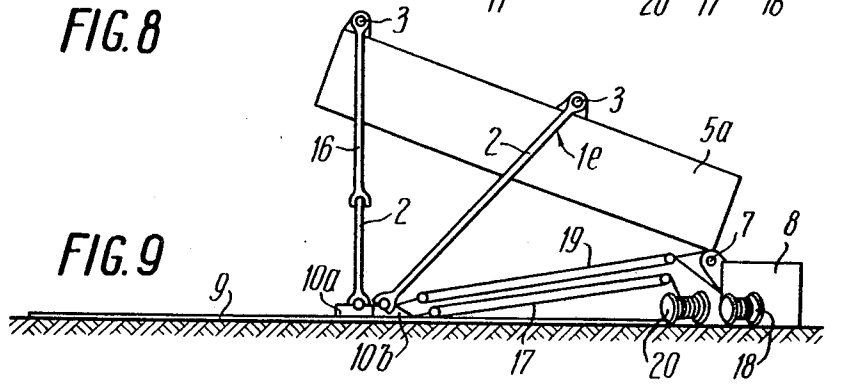


FIG. 9

HOISTING EQUIPMENT AND METHOD OF USE

The present invention relates to hoisting equipment, and more specifically to a method of mounting a long-size heavy object into vertical or close to vertical position by turning this object about a fixed axle, and to a device for realizing this method.

The invention can be most successfully used for mounting into vertical position, or close to it, column- and tower-type apparatuses, transmission line and cableway supports, smoke and air metal chimneys, masts of communication means, piledrivers, and other vertical constructions with a weight of 1,000–1,500 tons and more, with lateral dimensions of up to 10 m. and more, and a length of up to 150–200 m. and more.

Known in the art is a method to mount a long-size heavy object onto vertical position, or close to it, by turning the object about a fixed axle hinging it to a stationary basement, with the aid of two movable frame supports, which before the start of lifting are located at different distances from the axle of turn, and are inclined at different angles to the longitudinal axis of the object in the direction of its turn, their upper ends being hinged to the object.

During the lift the bottom ends of the frame supports, which rest on carriages, are moved on guides in the direction of the supposed axis of turn of the object by means of a cable passing around a pulley mounted near the object's axis of turn, and a winch (see, for example, a USSR magazine "Shakhtnoye stroitelstvo"/""/No. 8, 1966, p. 25).

When the object is mounted by this conventional method, moved first are the bottom ends of the frame support nearest to the supposed axis of turn of the object, until this support takes a vertical or close to vertical, position, whereupon moved in the same direction are the bottom ends of the frame support located further from the axis of turn, lifting being thus completed.

The conventional method permits mounting into vertical position objects weighing up to 100 t. with lateral dimensions of about 10 m. and a length of up to 25 m.

The arrangement to fix the cable to the movable supports, which weighs about 200 kg., has to be moved from one support to the other under the object, which is dangerous. Besides, the time required to displace said fixing arrangement is relatively long.

The present invention is aimed at obviating said difficulties.

The invention is specifically aimed at organizing such an order of moving the ends of the frame supports, that would make possible mounting a relatively long and large-weight object with relatively small forces required to turn this object into vertical position, or close to it.

According to the invention, this is achieved by that moved first are the bottom ends of a frame support most distant from the axis of turn, until this support takes vertical position or a position close to it, whereupon moved in the same direction are the bottom ends of the frame support located nearer to the axis of turn. This permits mounting relatively long objects with a relatively small force within comparatively short time.

The device intended to realize this method comprises, according to the invention, several frame supports, the number of which is determined by the length and weight of the object, their least number being two, and these supports being disposed along the object to be mounted, and also comprises a means to move the bottom ends of these supports.

Advantageously, said moving means should be connected to a carriage to be moved by this means along the object in the direction of the supposed axis of turn of the object, resting on which carriage in the beginning of the object erection are the bottom ends of the frame support most distant from the axis of turn of the object, each subsequent frame support starting to rest on the carriage through its bottom ends by the moment the previous frame support takes vertical position.

At the same time the cable fixing arrangement is connected only to the carriage, the bottom ends of the frame supports automatically interacting therewith in succession, starting from the frame support most distantly located from the axis of turn of the object.

The time of lifting the object is significantly reduced.

The need for the presence of working personnel under the object is also excluded.

When mounting quite heavy long-size objects into vertical or close to vertical, position, it is advisable that in this device the frame support most distant from the supposed axis of turn of the object should consist of a frame with jibs, which are shorter than the frame, and are hinged thereto on the side of said axis of turn, the carriage first taking up the bottom ends of the jibs.

Such design of the frame support enables turning the object in the initial moment with a relatively small force, due to the fact that the angle between the jibs and the horizontal is relatively large.

In the preferred embodiment of the device, according to the invention, it is expedient that the ends of the frame supports have heels, and the carriages have seats congruent with these heels.

Such design of the frame supports and the carriage ensures their reliable interaction during the carriage movement along the object.

For a significant reduction of forces to turn the object, the upper ends of the frame supports in the beginning of the object erection should advantageously be disposed over the object. In this case the angle between each frame support and the horizontal will be relatively large.

Rather important for reducing the force required to turn the object in the initial moment, is the disposition, with respect to the object, of the frame support most distant from the axis of turn of the object. This support is advisable to be connected to the end of the object. This extends the arm of the force applied.

A significant advantage of the present invention consists in that it ensures mounting into vertical or close to vertical, position an object with a weight of 1,500 t., length of 200 m., and lateral dimensions of up to 10 m. within 6 months, including the time of preparation works.

Following is a detailed description of the preferred embodiments of the device according to the invention, and of the methods of their operation, with references to the appended drawings, wherein:

FIG. 1 shows the initial position of the parts of the first version of the device before starting to lift a long-size object;

FIG. 2 same, top view;

FIG. 3 shows the object and the parts of the device in a position where the carriage together with the frame support most distant from the object's axis of turn, has been moved to the next frame support;

FIG. 4 shows the object and the parts of the device in a position where the carriage together with the second frame support has approached the last frame support;

FIG. 5 shows the object and the parts of the device in the position where turning of the object is finished;

FIG. 6 shows the initial position of the parts of the second version of the device before starting to lift a long-size large weight object;

FIG. 7 same, top view;

FIG. 8 shows the object and the parts of the second version of the device in a position where the second carriage together with the jibs of the first frame support has been moved to the second frame support;

FIG. 9 shows the object and the parts of the second version of the device in a position where the first carriage together with the first frame support has approached the second carriage, the jibs now hanging on the object;

FIG. 10 shows the object and the parts of the second version of the device in the position where turning of the object is finished.

The device comprises three frame supports 1*a*, 1*b* and 1*c* (FIGS. 1 and 2), each of which consists of a frame made of two struts 2 and a spanpiece 3.

The bottom ends of struts 2 have cylindrical heels 4.

The top ends of the frame supports are through spanpieces 3 hinged to the upper part of the horizontally disposed object

5. The joint of each spanpiece 3 with the object comprises yokes 6 welded to object 5.

Yokes 6 are equally spaced apart.

The long-size object 5 is by means of a cylindrical hinge 7 connected to a stationary basement 8.

Laid on the ground along the object are rails 9 serving as guides for carriage 10, provided on which are cylindrical seats 11 congruent with heels 4 of the frame supports 1*a*, 1*b*, and 1*c*.

Carriage 10 is by means of cables 12 passing through a system of pulleys 13, connected to winches 14. Cables 12, the system of pulleys 13, and winches 14 serve as a means to move carriage 10 along the object in the direction of hinge 7.

Before lifting is started, one end of the long-size object 5 rests on hinge 7, and the other end is laid on a temporary support (not shown in the drawing).

To explain the method of lifting, the frame supports 1*a*, 1*b*, 1*c* are further conventionally called first frame support 1*a*, second frame support 1*b*, and third frame support 1*c*, respectively.

The top ends of each frame support 1*a*, 1*b* and 1*c* are in the beginning of the object erection disposed over this object in order to increase the angle between this support and the horizontal.

This is done for the purpose of reducing the force required to turn the object.

The first frame support 1*a*, which is the farthest from the axis of turn of object 5, i.e., from the fulcrum of hinge 7, is connected to the end of object 5.

This is necessary in order to lengthen the arm of the force applied in the initial moment of the object erection, hence reducing the force required to move carriage 10 in the direction of hinge 7.

As carriage 10 is moved together with the bottom ends of the first frame support 1*a* in the direction of hinge 7, this support turns from the inclined position into a position close to vertical.

At the moment when this support 1*a* tends to take vertical position, carriage 10 (FIG. 3) approaches heels 4 of the second frame support 1*b*.

Since the distance between the heels of the second frame support 1*b* is less, than that between the heels of the first frame support 1*a*, the heels of support 1*b* start resting on the cylindrical seats 11 of carriage 10. In the following moment object 5 continues turning due to the movement of the second support 1*b* about its spanpiece in the course of further displacement of carriage 10 in the direction of hinge 7.

The first frame support 1*a* now suspends on object 5, and is lifted together with the end of the latter.

In further movement of carriage 10 in the direction of hinge 7 the third frame support 1*c* (FIG. 4) starts to interact with this carriage, and in the course of the continuing movement of the carriage this frame support turns the object into vertical position (FIG. 5).

To prevent the bottom end of object 5 from striking against the stationary basement 8, attached to the top end of this object before it takes vertical position is one end of cable 15, whose other end is fixed to an additional winch (the additional winch is not shown in the drawing).

As the object approaches vertical position, cable 15 gradually reels off the additional winch, tension though being maintained in this cable.

Employed instead of cable 15 and the additional winch may be a jack, one end of which rests on the stationary basement 8, or on the ground, and the other end abuts against the bottom end of the object to be mounted.

It stands to reason, that the heels of the frame supports may have a convex shape, while the seats on the carriage for these heels may be concave.

For mounting large-weight long-size objects 5*a* (FIGS. 6, 7) a second version of the device is provided.

In this embodiment there is available a frame support 1*d*, the farthest from hinge 7, which support consists of a frame comprising two struts 2 connected together by a spanpiece 3, with two jibs 16 that are shorter than struts 2.

These jibs are hinged to spanpiece 3.

In the beginning of the lifting process struts 2 rest on an additional carriage 10*a*, jibs 16 rest on the main carriage 10*b*, and the frame support 1*e* located nearer to hinge 7 rests on rails 9 along which it slides until it contacts the main carriage 10*b*.

The additional carriage 10*a* is attached to a means for its movement towards hinge 7, which means comprises cables 17 passing through a system of pulleys 13*a*. One end of each of cables 17 is connected to this carriage, and the other end is attached to the drum of one of the pair of winches 18.

The main carriage 10*b* is connected to a means for its movement towards hinge 7, comprising cables 19 passing around a system of pulleys 13*b*. One end of each of cables 19 is attached to this carriage, and the other end is fixed to the drum of one of the pair of winches 20.

Winches 18 and 20 are mounted symmetrically about the longitudinal axis of object 5*a* to preclude distortion of carriage 10*b*. The moving means can alternatively work with one winch 18 or 20, but in this case one end of the cable must be affixed on a dead abutment (this embodiment of the device is not shown in the drawings).

In the initial moment of lifting object 5*a* the main carriage 10*b* is moved, resting on which are jibs 16. Since jibs 16 are relatively short, they are inclined to the horizontal at a relatively large angle.

This is why the force required to move carriage 10*b* is relatively small. As carriage 10*b* moves towards hinge 7, jibs 16 turn about the axis of spanpiece 3 tending to take vertical position. By the moment these jibs approach vertical position, the frame support 1*e* starts resting on carriage 10*b*, its heels being spaced nearer to each other, than the heels of jibs 16.

Thereupon movement of the additional carriage 10*a* (FIG. 8) is started, and struts 2 of the frame support 1*d* begin turning about the axis of spanpiece 3. Object 5*a* continues turning about hinge 7, and carriage 10*a* approaches carriage 10*b* which heretofore continued moving in the direction of hinge 7 together with the bottom end of the frame support 1*e*.

The moment carriage 10*a* (FIG. 9) moves up to carriage 10*b* struts 2 take vertical position. Thereafter only the main carriage 10*b* is moved, the frame support 1*e* acting on object 5*a* and mounting it into vertical position (FIG. 10).

It is understood, that the number of the frame supports is chosen according to the length of the object, and the forces required to erect this object.

To maintain permanent forces in the winches it is expedient, that the frame supports should have equal lengths, and should be equally spaced apart.

It is extremely important, that the center of gravity of the object should be always located between the heels of the frame support closest to the axis of turn of the object, and this axis.

What we claim is:

1. A method to mount a long-size heavy object into vertical or close to vertical, position by turning this object about a fixed axle with the aid of at least two movable frame supports, which before the start of lifting are located at different distances from the axis of turn, are inclined to the longitudinal axis of the object in the direction of its turn, and are by their top ends hinged to the object, consisting in moving towards said axis of turn of said object first the bottom ends of a frame support most distant from said axis of turn, until this support takes vertical position, or a position close to it, and then moving in the same direction the bottom ends of the frame support located nearer to said axis of turn.

2. A device to realize the method of mounting a long-size heavy object into vertical or close to vertical, position by turning this object about a fixed axle, comprising: at least two frame supports disposed along said object to be erected, the top ends of said supports being hinged to this object; a means to move the bottom ends of these supports; a carriage attached to said means to move it along said object in the direction of said supposed axis of turn of this object, resting on which carriage in the beginning of the erection of said object

are the bottom ends of the frame support most distant from said axis of turn of said object, each subsequent frame support starting to rest on said carriage through its bottom ends by the moment the previous frame support takes vertical position.

3. A device as claimed in claim 2, wherein said frame support most distant from said supposed axis of turn of said object to be erected, consists of a frame and jibs, which are shorter than the frame, and are hinged to this frame from the side of said axis of turn, said carriage first taking up the bottom ends of said jibs.

4. A device as claimed in claim 2, wherein said bottom ends of said frame supports have heels, and said carriage has seats congruent with these heels.

5. A device as claimed in claim 2, wherein the top ends of said frame supports in the beginning of erection of said object are located over this object.

6. A device as claimed in claim 2, wherein said frame support most distant from said supposed axis of turn of said object, is connected to the end of this object.

* * * * *