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(54) **MAST SYSTEM FOR CONSTRUCTING A MAST**

(57) The present invention relates to a mast system (1) for constructing a mast with a number of stackable mast parts (2). A lifting device is arranged on a frame (6) which is mountable round the mast. The frame is displaceable in longitudinal direction of the mast and lockable to the upper mast part. The lifting device comprises two arms (8) with winches (10) for lifting a mast part for stacking to a lifting position located above the highest point of the mast. The arms are mounted pivotally (S) on either side of the frame, each arm is provided with an individual drive (9) and the lifting device is configured to move the mast part for stacking from the lifting position to an aligned position by pivoting the arms.

The invention further relates to an attraction for amusement rides comprising the mast system and a method for constructing a mast using the mast system.

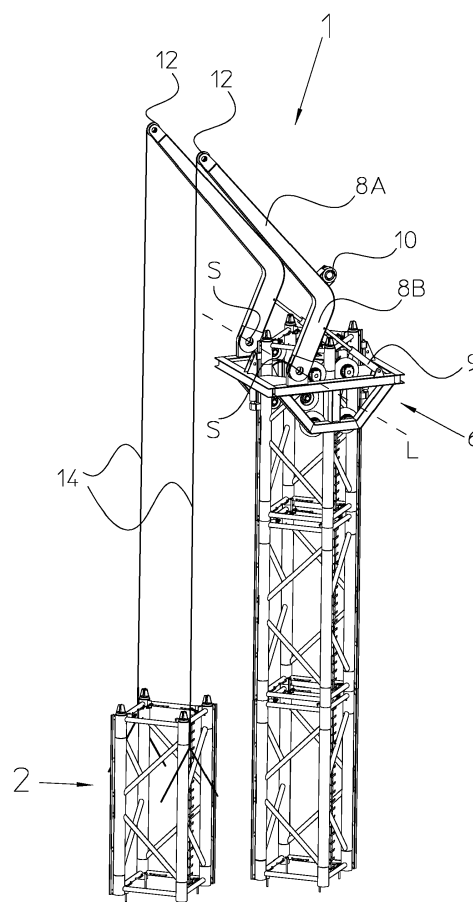


Fig.2

Description

[0001] The present invention relates to a mast system for constructing a mast, comprising:

- a) a number of stackable mast parts which are releasably connectable to each other in order to form the mast;
- b) a lifting device arranged on a frame which is mountable round the mast, which lifting device comprises a first arm provided with a first winch;
- c) means for displacing the frame in longitudinal direction of the mast to the upper mast part; and
- d) means for locking the frame to the upper mast part;

wherein the lifting device is configured to lift a mast part for stacking to a lifting position located above the highest point of the mast and to move the mast part for stacking to an aligned position lying in line with the mast.

[0002] Such a mast system is known from the Chinese utility model CN 202670977 U. The known mast system is part of a lift which is self-erecting and intended for use on a building site. This lift can be erected to a great height and serves to replace a tower crane for lifting light materials for finishing buildings. The deployment of a tower crane in the finishing of buildings can be avoided through use of this lift with the known mast system and the associated costs can be saved.

[0003] The known mast system has a number of drawbacks. The most significant drawback is that moving of the mast part for stacking to an aligned position lying in line with the mast has to be performed by manual rotation of the arm about the longitudinal axis thereof. The raised mast part moreover has to be aligned manually from the lifting position relative to the mast. Locking and unlocking of the frame has to take place using an operating handle. The winch is likewise manually operated.

[0004] The present invention has for its object to improve and make the known mast system suitable for other applications, for instance the construction of a mast for an amusement attraction.

[0005] The mast system according to the present invention has for this purpose the feature that the lifting device comprises a second arm provided with a second winch for lifting together with the first winch the mast part for stacking to the lifting position, that the arms are mounted pivotally on the frame and that each arm is provided with an individual drive, and that the lifting device is configured to move the mast part for stacking from the lifting position to the aligned position by pivoting the arms.

[0006] The pivotable lifting device enables a rapid positioning of the mast part for stacking on the mast. From the aligned position the stacking can be completed by paying out the winches. The separate operation of the drives of the arms makes it possible to carry the mast part for stacking into an optimally aligned position in line with the mast. Operation takes place by means of a controllable drive of the lifting device, which further increases

speed and accuracy. The dual embodiment of the arms moreover provides a strong construction with optimal safety. The mast system according to the invention is very compact, this being a particularly great advantage in the construction of a mast for mobile applications such as a fairground attraction. There is little space on a fairground so that a high-capacity lifting crane which can displace the mast parts to great height over a great distance must be utilized for the purpose of constructing high masts. Such cranes are expensive and must be reserved in good time by fairground operators. The mast system according to the invention therefore saves costs and increases flexibility.

[0007] In a first preferred embodiment the drive of each arm comprises a hydraulic cylinder which is connected to the frame and configured to move the arm. The choice of hydraulic cylinders contributes toward making accurate and reliable corrections to the aligned position.

[0008] An imaginary line through pivot points of the arms preferably lies out of the centre of the frame so that space is available on the frame for the hydraulic cylinders.

[0009] According to a further preferred embodiment of the mast system according to the invention, each arm comprises two arm parts of differing length which make an angle with each other, wherein the shorter arm part is provided at an outer end with a pivot point for mounting on the frame. The bent arms guarantee an unimpeded movement of the cable along the cable pulley of the winch in all positions of the arms.

[0010] According to a practical preferred embodiment, the means for displacing and/or locking the frame are configured for co-action with uprights of the mast parts.

[0011] According to a further development of this practical preferred embodiment, the mast parts and the frame have a substantially square cross-section and the plane of the frame is rotated through an angle of substantially 45 degrees relative to the plane of the mast. The displacing means and/or locking means can now be mounted halfway along the sides of the square frame for co-action with the uprights in order to thus form a stable construction.

[0012] According to another preferred embodiment, the frame is provided with a work platform for personnel. It is usual in the field for adjacent mast parts to be stacked and locked by personnel who climb up the mast. In the mast system according to the invention personnel can make use of the work platform so as to thus further increase the speed of construction of the mast.

[0013] The present invention also relates to an attraction for amusement rides, such as a fairground attraction, comprising a mast system according to the invention.

[0014] The invention also relates to a method for constructing a mast, for instance a mast for an amusement attraction, using a mast system according to the invention, comprising the following steps of:

- a) positioning a first mast part on a ground surface;
- b) mounting the frame on the first mast part;

- c) displacing the frame in longitudinal direction of the mast to the upper mast part;
- d) locking the frame to the upper mast part;
- e) pivoting the arms to the starting position;
- f) coupling a subsequent mast part to the winches;
- g) lifting the subsequent mast part to the lifting position using the winches;
- h) positioning the subsequent mast part in line with the mast by pivoting the arms to the end position;
- i) paying out the subsequent mast part with the winches;
- j) uncoupling the subsequent mast part from the winches;
- k) locking the subsequent mast part to the adjacent mast part; and
- l) repeating steps c) to k) until the mast has reached a predetermined height.

[0015] The invention will now be described in more detail with reference to the figures.

Figure 1 is a schematic view of a preferred embodiment of the mast system according to the invention in a first position;

Figure 2 is a schematic view of a preferred embodiment of the mast system according to the invention in a second position;

Figure 3 is a schematic view of a preferred embodiment of the mast system according to the invention in a third position;

Figure 4 is a schematic view of a preferred embodiment of the mast system according to the invention in a fourth position;

Figure 5 is a schematic view of a preferred embodiment of the mast system according to the invention in a fifth position; and

Figure 6 is a schematic view of a preferred embodiment of the mast system according to the invention in a sixth position.

[0016] The same components are designated in all the figures with the same reference numerals.

[0017] Figures 1 to 6 illustrate a mast constructed by means of the mast system according to the present invention at different stages.

[0018] Mast system 1 according to the invention is illustrated in a preferred embodiment in which the mast is part of an attraction for amusement rides, in this case a fairground attraction. The mast is constructed from mast parts 2 with a lattice frame provided with four substantially parallel uprights 22. In the shown preferred embodiment the mast has a generally square cross-section. This form can of course also be different, for instance round or rectangular. Mast parts 2 are stackable and are provided for this purpose with coupling means 26. These coupling means are located at an outer end of uprights 22 of each mast part 2. Located at the other outer end of uprights 22 are co-acting coupling means (not shown) for receiving the protruding coupling means 26. The coupling means provide for a releasable coupling. Stacked mast parts 2 will be referred to in this text as "mast". This mast has a variable height. Stacked mast parts 2 can be locked to each other. Such masts are known in the relevant field, as are suitable locking means therefor.

[0019] Mast system 1 comprises a frame 6 which is mountable round mast parts 2. Frame 6 is provided with a lifting device for lifting mast parts 2. Frame 6 is displaceable in longitudinal direction of mast parts 2. Frame 6 is lockable at a desired height to each mast part 2. This locking preferably takes place on the upper side of the uppermost mast part of the mast.

[0020] The lifting device according to the invention comprises two arms 8. Each arm 8 is provided with a winch 10 with a cable 14 which is trained along an outer end of each arm 8, for instance by means of a cable pulley 12. Located at the other outer end of each arm is a pivot point S for mounting of the arm on frame 6. The lifting device according to the invention is configured to pivot a raised mast part 2 from a lifting position to an aligned position from which it can be stacked on the mast.

[0021] Operation of the lifting device takes place by means of a manually controllable drive. In the shown preferred embodiment each arm 8 is individually drivable. Each arm 8 is connected for this purpose to a hydraulic cylinder 9. The hydraulic cylinders are also mounted on frame 6.

[0022] In the shown preferred embodiment each arm 8 takes a bent form. Each arm 8 comprises two arm parts 8A, 8B which make an angle with each other. The shorter arm part 8B is provided with the pivot point S and is connected to hydraulic cylinder 9. In the shown preferred embodiment arms 8 are mounted on either side of frame 6. An imaginary line L through the pivot points S lies out of the centre of frame 6. In the shown preferred embodiment frame 6 likewise has a generally square cross-section and is constructed from four beams 7. The pivot points S of each arm 8 are mounted out of the centre of two of the beams 7.

[0023] The arms can alternatively take a straight form. Arms 8 preferably take an identical form.

[0024] Arms 8 are pivotable between a lifting position, in which arms 8 incline forward toward the mast part 2 for lifting. This lifting position is illustrated in figure 2. Arms 8 are also pivotable to a rest position in which both arms 8 extend substantially in longitudinal direction of the mast. This rest position is illustrated in figure 1 as starting position and in figure 6 as end position. The lifting device can also take up diverse aligning positions. Using the individual drives 9 both arms 8 can take up different positions for the purpose of aligning the mast part 2 for stacking on the mast. A possible aligning position is illustrated in figure 4.

[0025] Frame 6 is arranged round mast 2 such that the plane of frame 6 is rotated through an angle A about the longitudinal axis of the mast relative to the plane of the mast. Angle A is substantially 45 degrees. Frame 6 has

to have a cross-section shaped in accordance with the cross-section of the mast parts. In this preferred embodiment this is a generally square cross-section. The cross-section of the frame can however also take other forms, for instance round.

[0026] Frame 6 is provided with rolling elements, in this example wheels 16, which are arranged on beams 7 and/or on sub-beams 17. Wheels 16 roll along uprights 22 of mast parts 2. Frame 6 is further provided with a suitable drive for displacement along the mast in longitudinal direction of the mast.

[0027] The other two uprights 22 which do not guide wheels 16 of frame 6 are configured for co-action with locking means. In the preferred embodiment these locking means comprise claw brakes 18. Uprights 22 are provided with profiles 24, for instance T-profiles, co-acting with claw brakes 18. Known in related fields are other suitable locking means, for instance pin-hole connections of jack-up systems.

[0028] The drive for frame 6 preferably takes a hydraulic form, for instance with hydraulic cylinders 15. The means for displacing the frame and the means for locking the frame are preferably integrated. Hydraulic cylinders 15 can be provided for this purpose with the claw brakes 18, whereby frame 6 can also ascend and descend along the mast.

[0029] In the shown preferred embodiment frame 6 is further provided with a work platform 19 which is accessible by personnel. A control for operating the diverse (hydraulic) drives is preferably arranged on work platform 19. Frame 6 with work platform 19 will of course be embodied completely in accordance with current safety standards. Work platform 19 will be provided with a rail (not shown) and personnel have to be secured when working on the work platform. The presence of personnel is necessary for the purpose of locking the stacked mast parts 2 to each other and for coupling and uncoupling the cables 14 to and from each mast part 2.

[0030] The steps of the method for constructing a mast using a mast system according to the invention will be further elucidated below.

[0031] Figure 1 illustrates positioning of a mast part 2 for stacking adjacently of a partially erected mast. Displacement of the frame in longitudinal direction of the mast to the uppermost mast part and locking of frame 6 to the uppermost mast part have taken place and arms 8 are in the rest position.

[0032] In subsequent steps the arms are pivoted to the starting position or lifting position and the mast part 2 for stacking is coupled by operating personnel present to cables 14 of winches 10. The result is illustrated in figure 2.

[0033] Lifting of the mast part for stacking then takes place to the lifting position shown in figure 3. The motorized winches 10 are controlled manually.

[0034] Figure 4 illustrates positioning of the mast part 2 for stacking in line with the mast by pivoting the arms to the end position or rest position. If necessary, the po-

sition of the mast part can be corrected visually by hand by individual operation of drives 9 of arms 8.

[0035] The actual stacking subsequently takes place by lowering mast part 2 by paying out winches 10. The resulting higher mast is illustrated in figure 5.

[0036] After uncoupling of the stacked mast part from winches 10 the stacked mast part is locked to the adjacent mast part. Frame 6 is displaced in longitudinal direction of the mast to the stacked mast part and locked thereto. This is illustrated in figure 6.

[0037] The above steps are repeated for each mast part until the mast has reached the desired height, always beginning from the situation shown in figure 1 and ending at the situation shown in figure 6.

[0038] Once the mast has been completed, the frame can remain in place at the top of the mast and the attraction can be constructed on the mast.

[0039] The mast system according to the invention is also suitable for dismantling of the mast. During assembly the arms pivot backwards and during disassembly the arms pivot forward. The above described steps have to be performed in reverse sequence during disassembly. The mast parts are then removed one by one, starting from the situation shown in figure 6 and ending at the situation shown in figure 1.

[0040] The invention is of course not limited to the described and shown preferred embodiment but extends to any embodiment falling within the scope of protection as defined in the claims and as seen in the light of the foregoing description and accompanying drawings.

Claims

1. Mast system for constructing a mast, comprising:

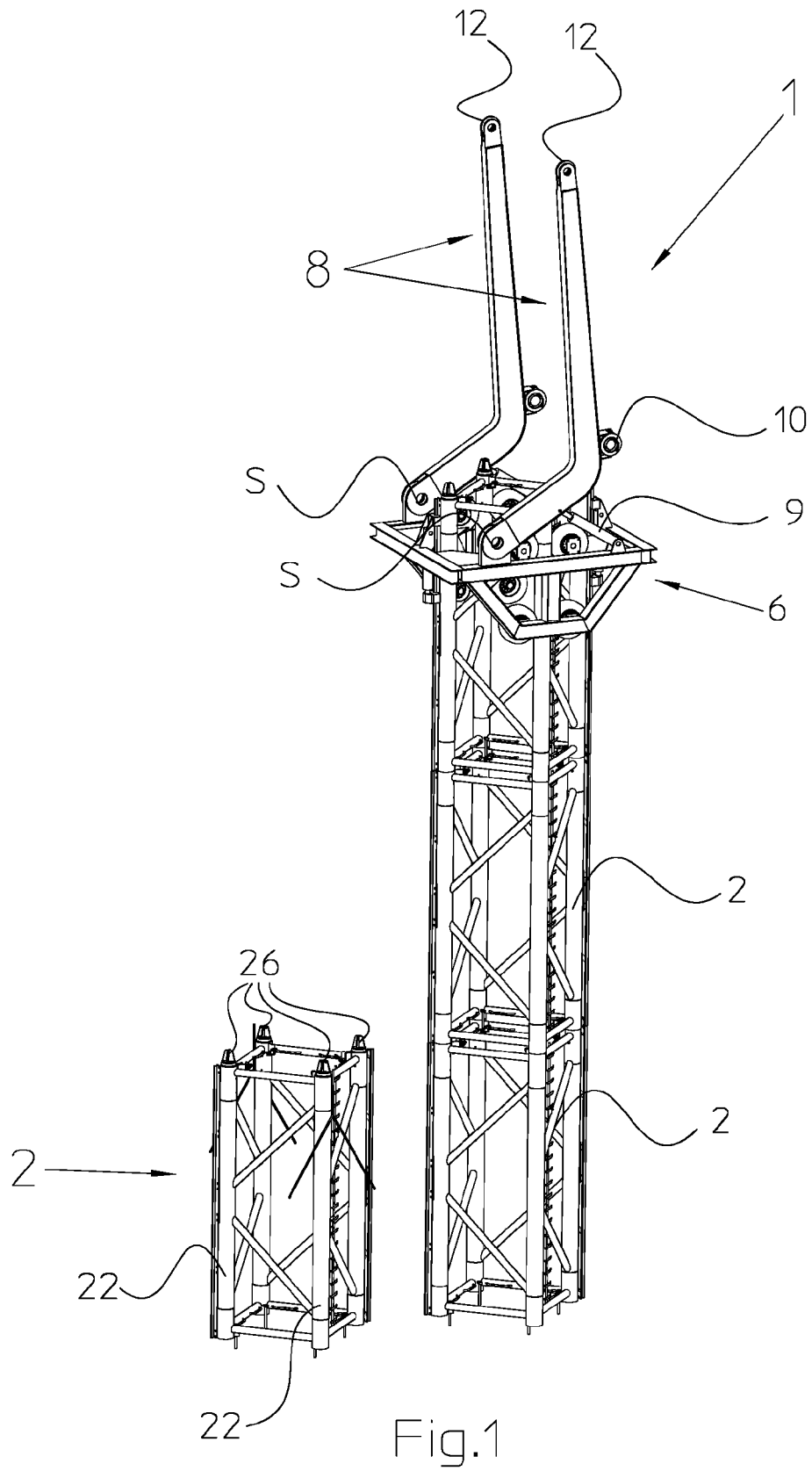
- a) a number of stackable mast parts which are releasably connectable to each other in order to form the mast;
- b) a lifting device arranged on a frame which is mountable round the mast, which lifting device comprises a first arm provided with a first winch;
- c) means for displacing the frame in longitudinal direction of the mast to the upper mast part; and
- d) means for locking the frame to the upper mast part;

wherein the lifting device is configured to lift a mast part for stacking to a lifting position located above the highest point of the mast and to move the mast part for stacking to an aligned position lying in line with the mast, **characterized in that** the lifting device comprises a second arm provided with a second winch for lifting together with the first winch the mast part for stacking to the lifting position, that the arms are mounted pivotally on the frame and that each arm is provided with an individual drive, and that the lifting device is configured to move the mast part for

stacking from the lifting position to the aligned position by pivoting the arms.

2. Mast system as claimed in claim 1, wherein the drive of each arm comprises a hydraulic cylinder which is connected to the frame and configured to move the arm. 5
3. Mast system as claimed in claim 2, wherein an imaginary line through pivot points of the arms lies out of the centre of the frame. 10
4. Mast system as claimed in claim 1, 2 or 3, wherein each arm comprises two arm parts of differing length which make an angle with each other, wherein the shorter arm part is provided at an outer end with a pivot point for mounting on the frame. 15
5. Mast system as claimed in any of the foregoing claims, wherein the means for displacing the frame are configured for co-action with uprights of the mast parts. 20
6. Mast system as claimed in any of the foregoing claims, wherein the means for locking the frame are configured for co-action with uprights of the mast parts. 25
7. Mast system as claimed in any of the foregoing claims, wherein the mast parts and the frame have a substantially square cross-section. 30
8. Mast system as claimed in claim 7, wherein the plane of the frame is rotated through an angle of substantially 45 degrees relative to the plane of the mast. 35
9. Mast system as claimed in any of the foregoing claims, wherein the frame is provided with a work platform for personnel. 40
10. Attraction for amusement rides, such as a fairground attraction, comprising a mast system as claimed in any of the foregoing claims.
11. Method for constructing a mast, for instance a mast for an amusement attraction, using a mast system as claimed in any of the foregoing claims 1-9, comprising the following steps of: 45
 - a) positioning a first mast part for the purpose of forming a mast on a ground surface; 50
 - b) mounting the frame on the first mast part;
 - c) displacing the frame in longitudinal direction of the mast to the upper mast part;
 - d) locking the frame to the upper mast part; 55
 - e) pivoting the arms to the starting position;
 - f) coupling a subsequent mast part to the winches;

- g) lifting the subsequent mast part to the lifting position using the winches;
- h) positioning the subsequent mast part in line with the mast by pivoting the arms to the end position;
- i) paying out the subsequent mast part with the winches;
- j) uncoupling the subsequent mast part from the winches;
- k) locking the subsequent mast part to the adjacent mast part; and
- l) repeating steps c) to k) until the mast has reached a predetermined height.



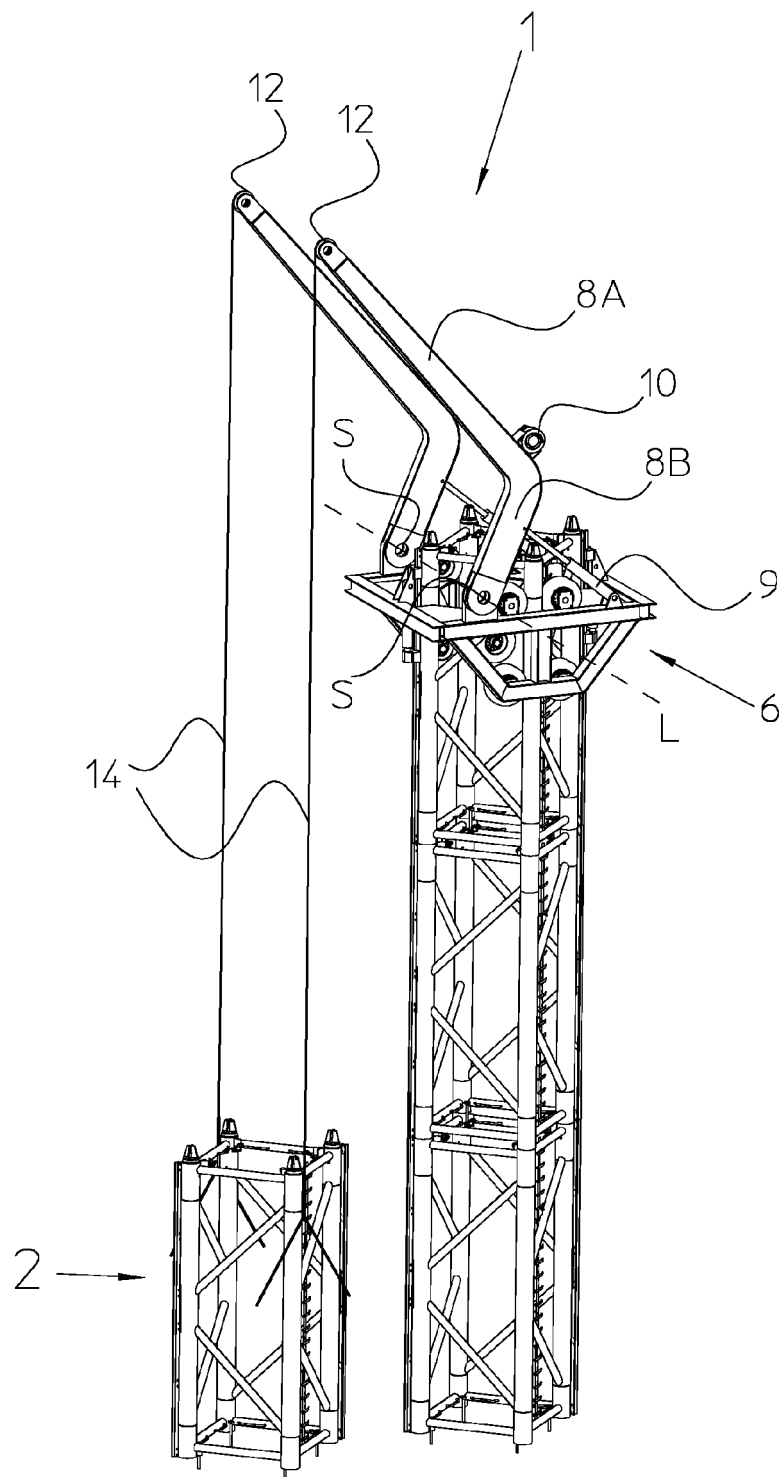


Fig.2

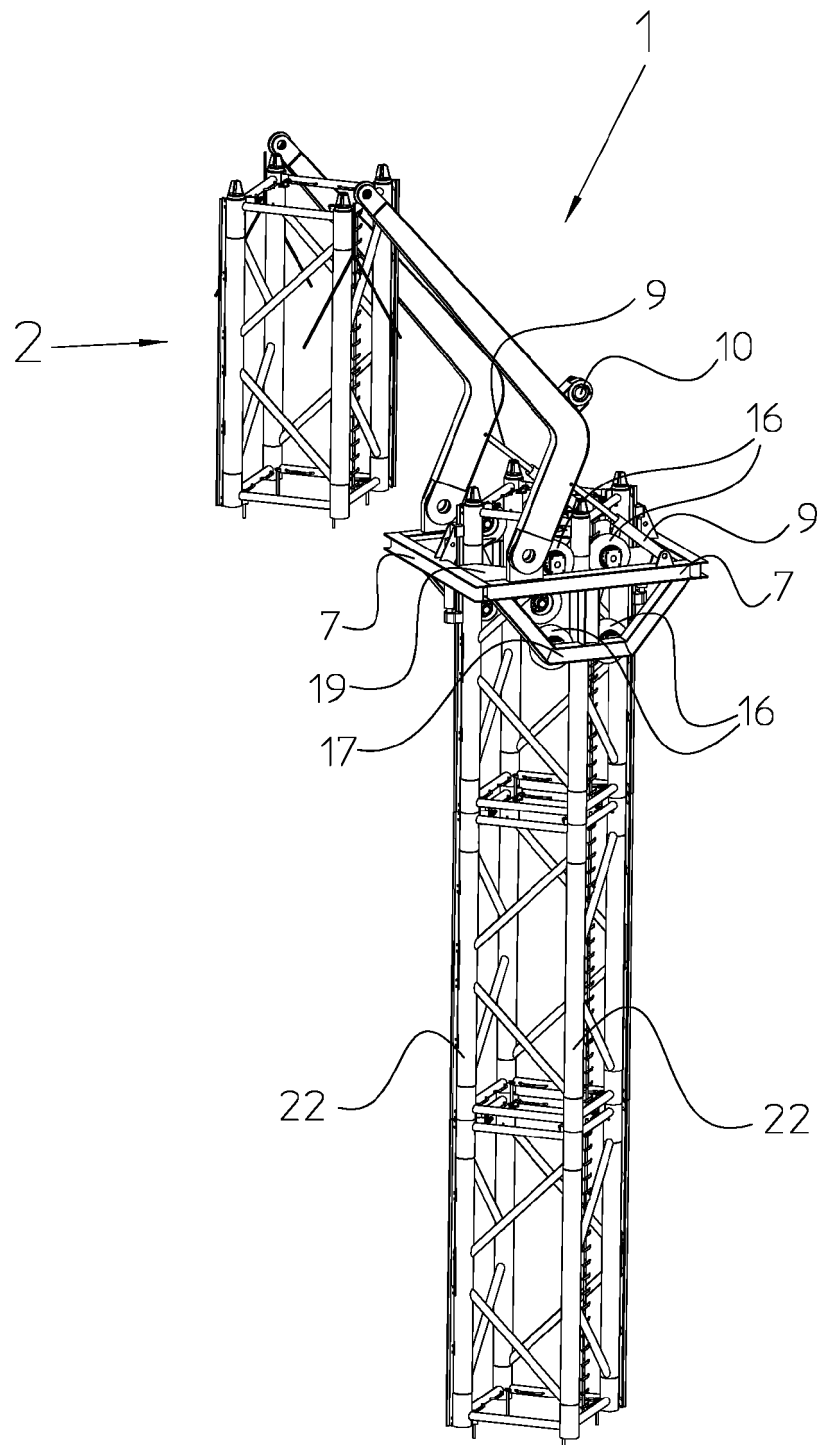


Fig.3

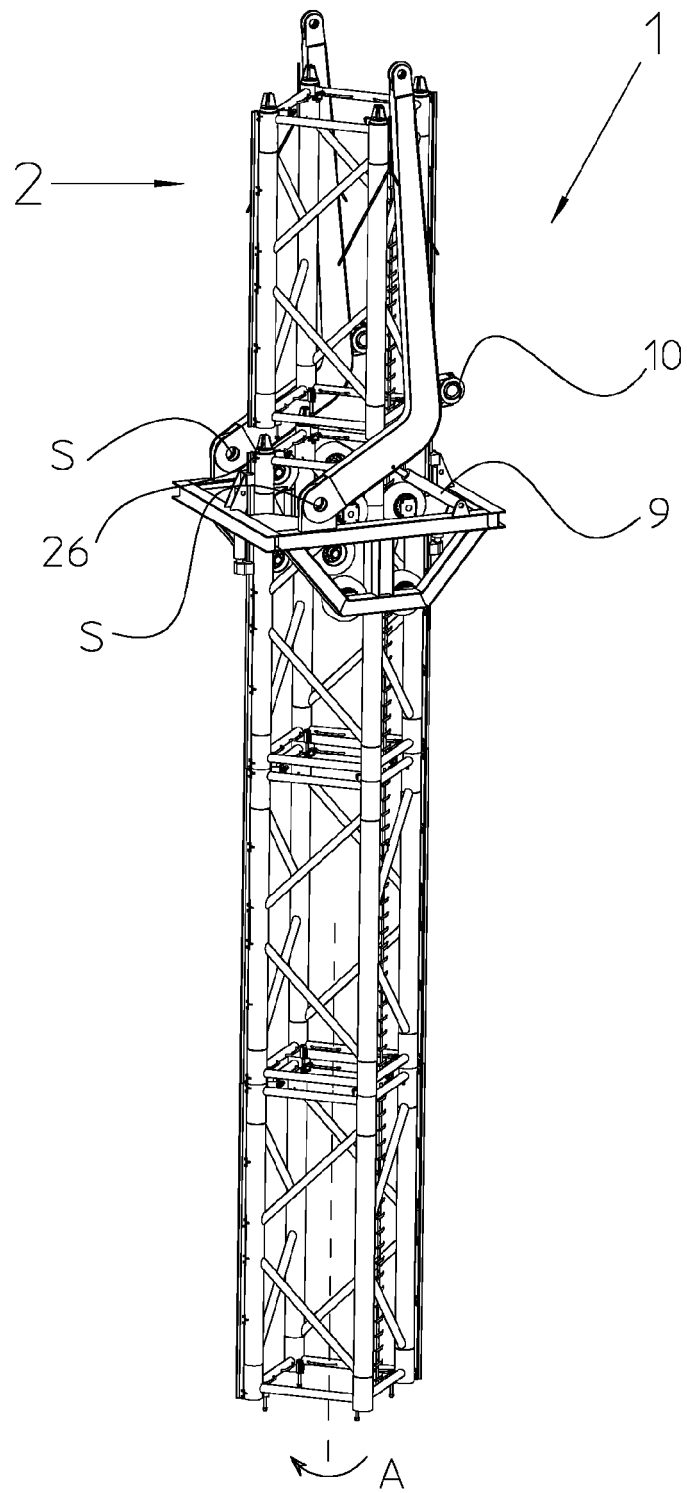


Fig.4

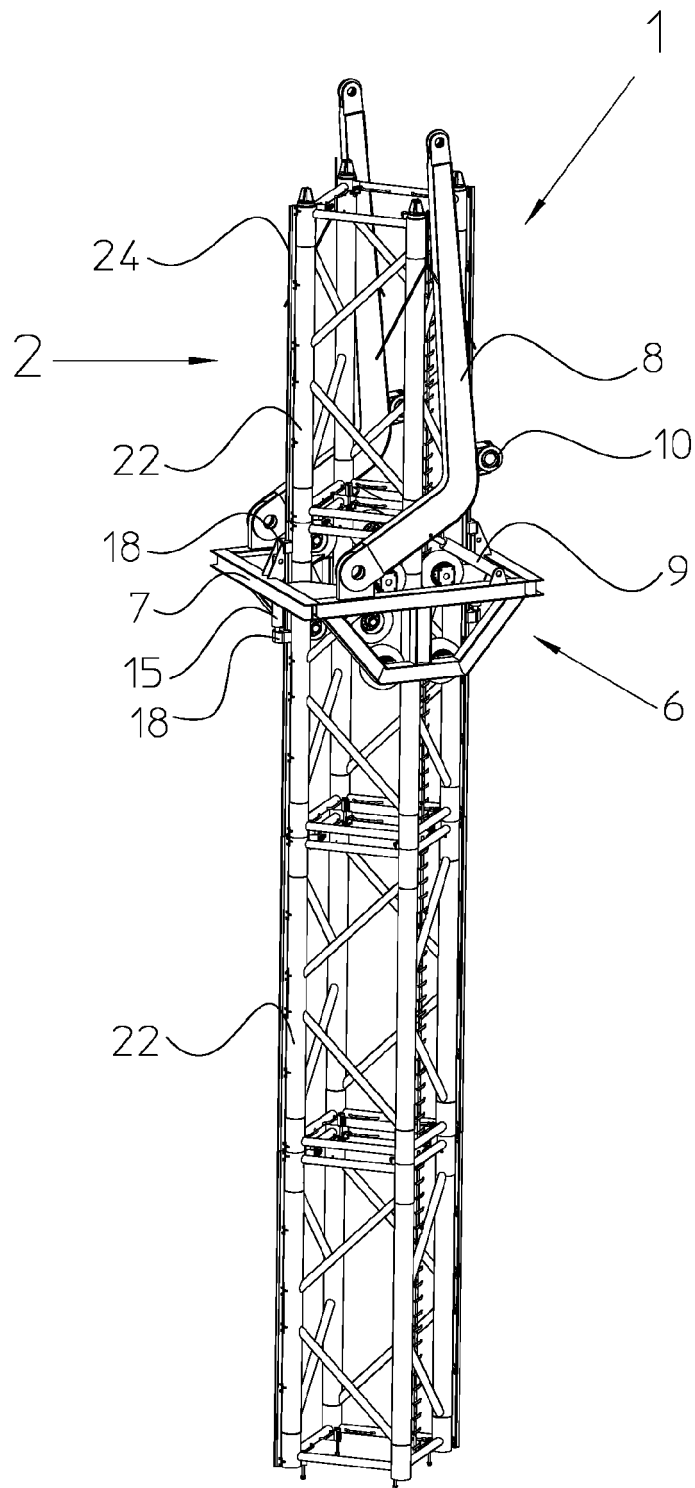


Fig.5

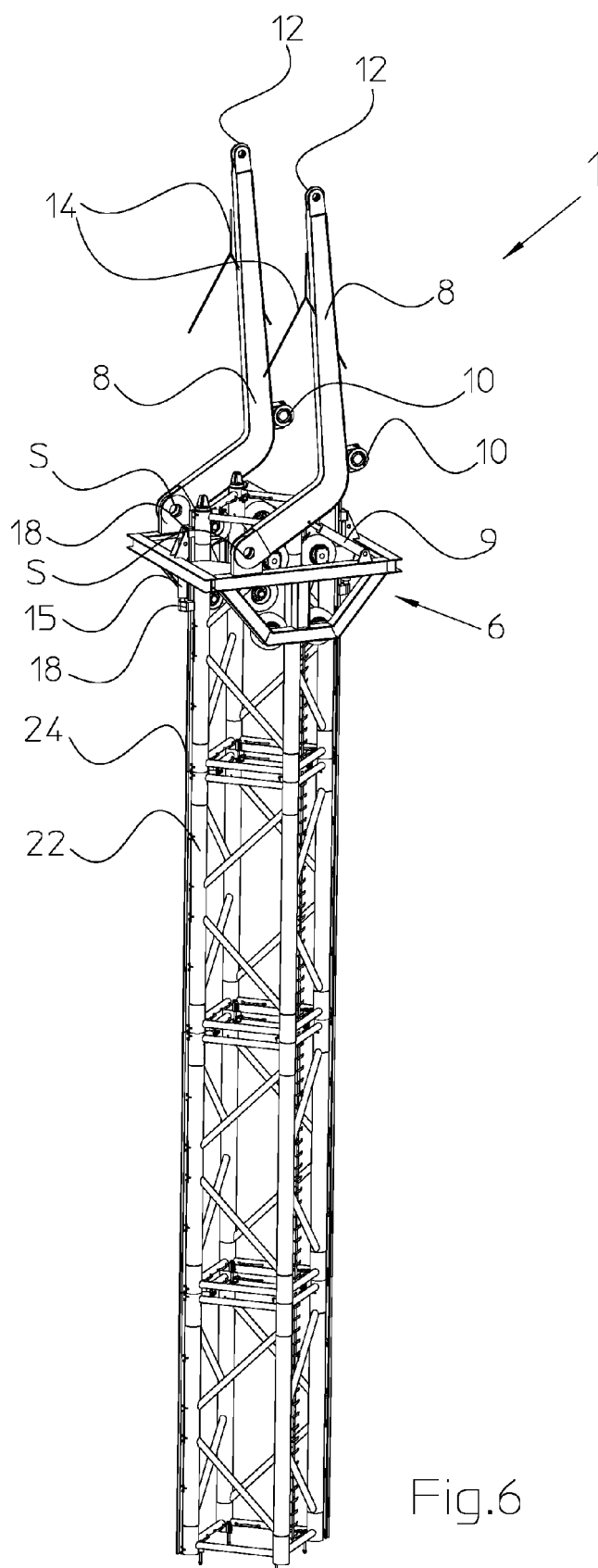


Fig.6



EUROPEAN SEARCH REPORT

Application Number
EP 15 16 3496

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			E04H A63G B66C
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 21 August 2015	Examiner Stefanescu, Radu
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 15 16 3496

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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21-08-2015

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REFERENCES CITED IN THE DESCRIPTION

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