April 2, 1957 E. A. CAMPBELL 2,787,385

MAST ERECTION

Filed July 8, 1954 3 Sheets-Sheet 1

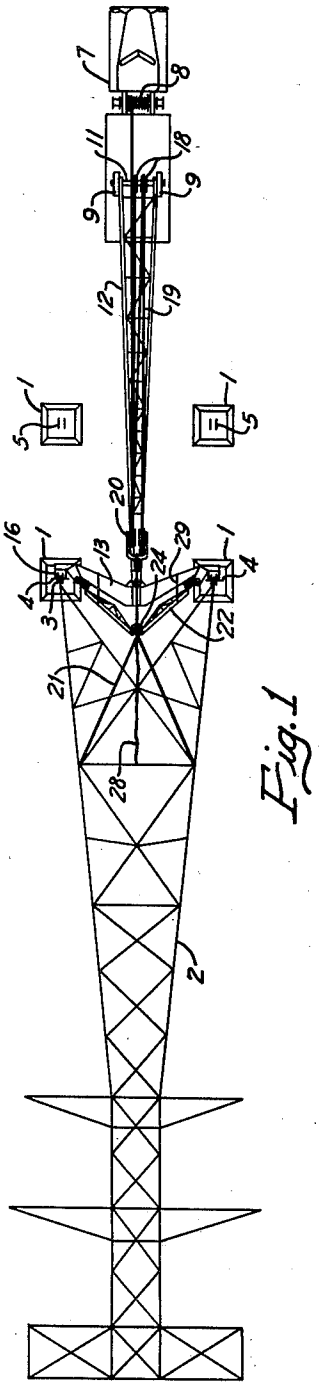


Fig. 1

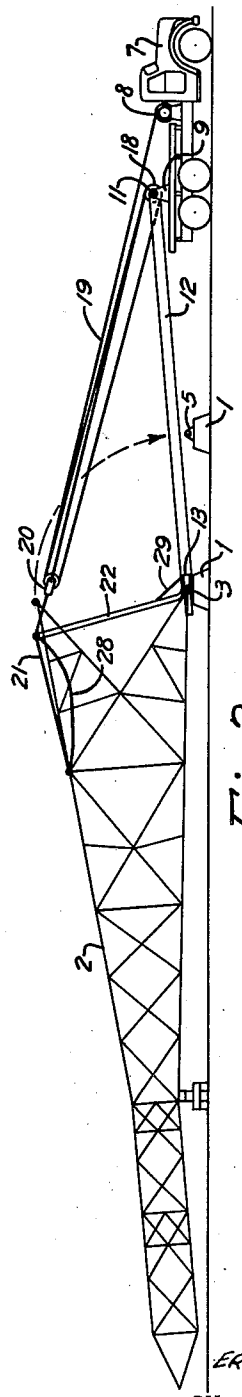


Fig. 2

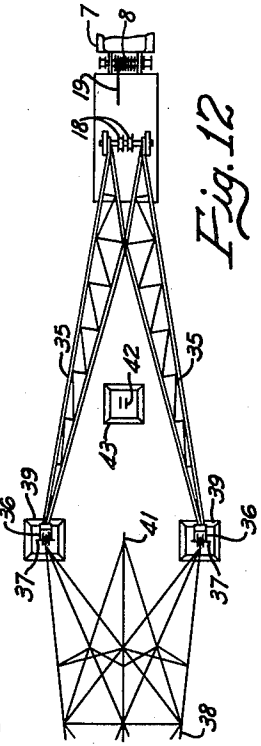


Fig. 12

INVENTOR.
ERWIN A. CAMPBELL

BY
Brown, Critchlow, Flicker & Peckham
HIS ATTORNEYS

April 2, 1957 E. A. CAMPBELL 2,787,385

MAST ERECTION

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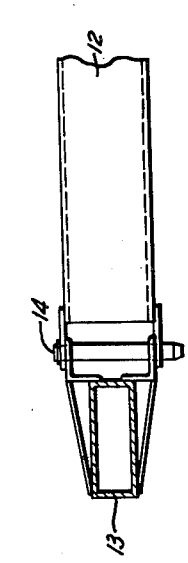


Fig. 5

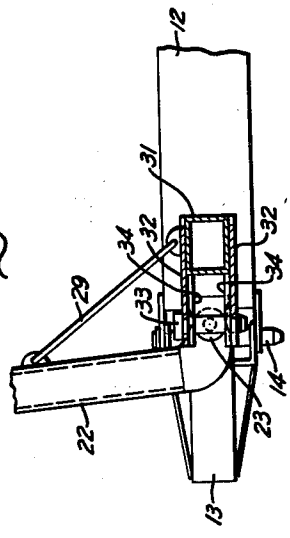


Fig. 6

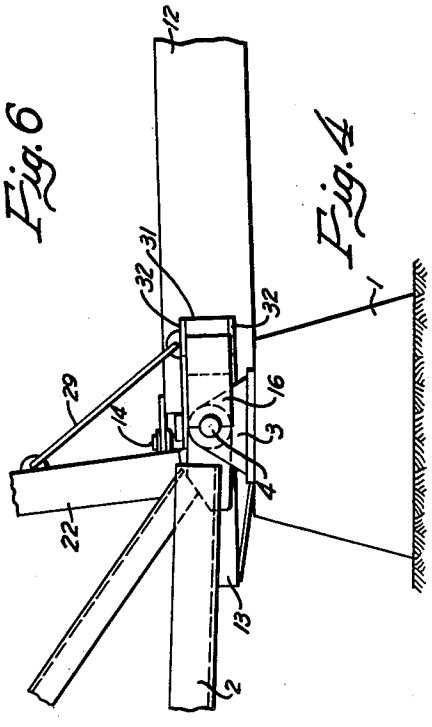


Fig. 4

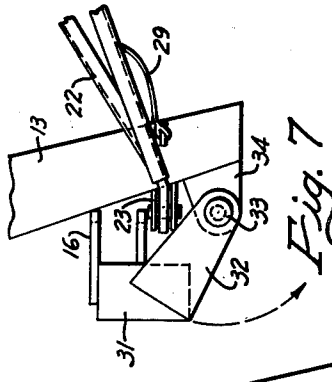


Fig. 7

Fig. 3

INVENTOR.
ERWIN A. CAMPBELL
BY
Brown, Critchlow, Flick & Peckham
HIS ATTORNEYS

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MAST ERECTION

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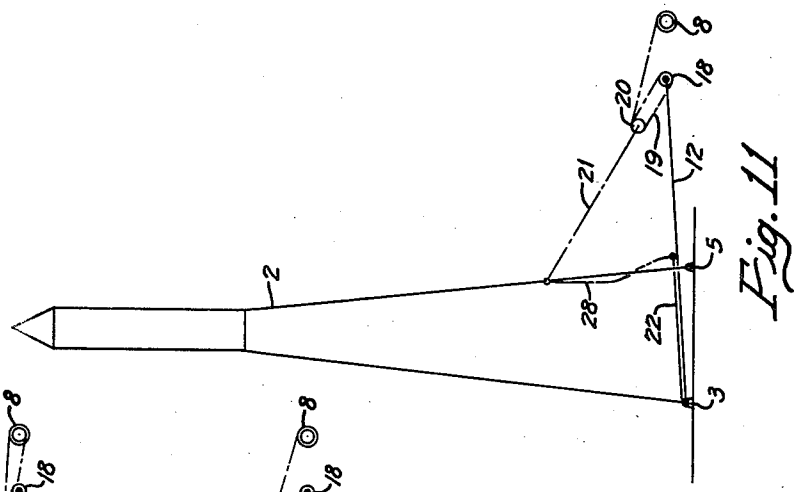


Fig. 11

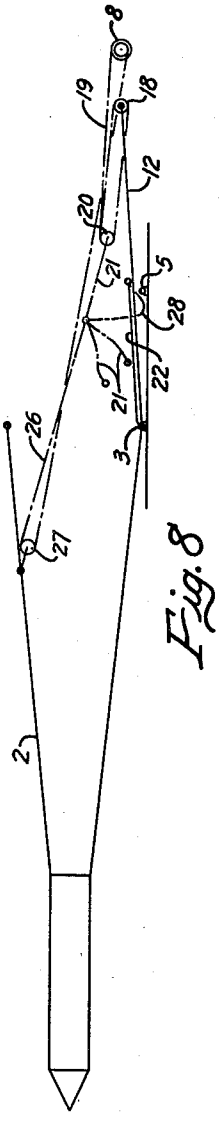


Fig. 8

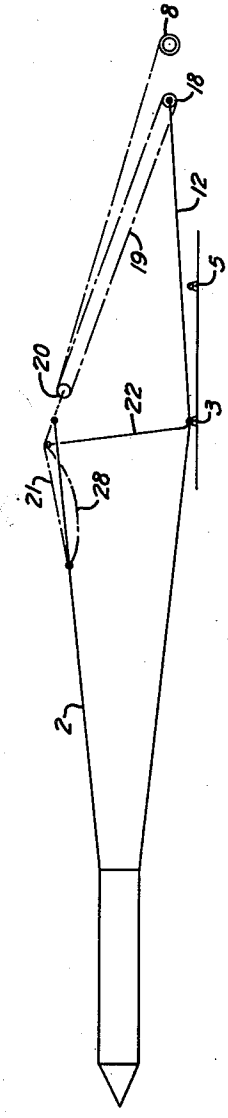


Fig. 9

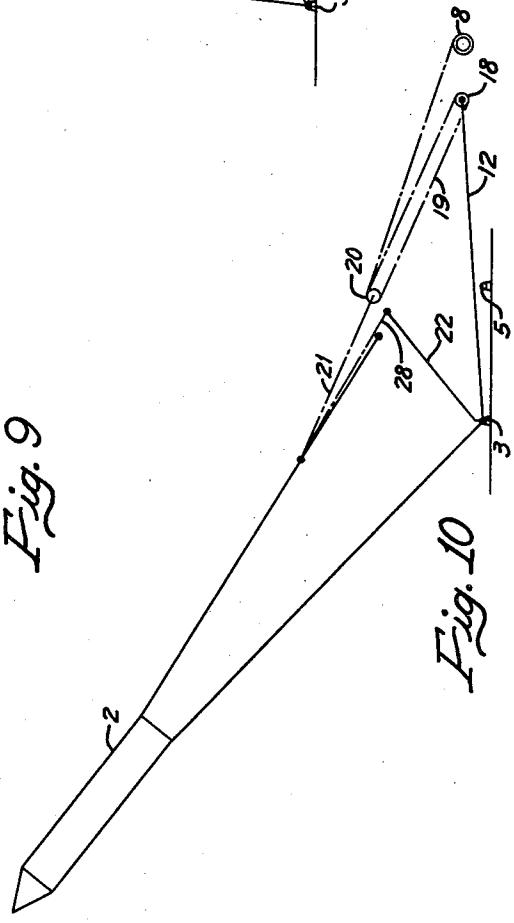


Fig. 10

INVENTOR.
ERWIN A. CAMPBELL
BY
Brown, Critchlow, Flick & Peckham
HIS ATTORNEYS

United States Patent Office

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MAST ERECTION

Erwin A. Campbell, Wexford, Pa., assignor to Lee C. Moore Corporation, Pittsburgh, Pa., a corporation of Pennsylvania

Application July 8, 1954, Serial No. 442,031

9 Claims. (Cl. 214—1)

This invention relates to the erection of towers or masts, and more particularly to aparatus for swinging them up from a reclining position along the ground.

The customary way of erecting skeleton towers or masts, such as structural steel electric transmission towers is to prepare foundation supports for the feet of the tower and then construct the tower piece by piece on the supports. This requires men to work at great heights, with the accompanying hazards and expense. Of course, in the case of transmission towers, the electric lines cannot be attached until the towers have been completely erected. Oil well masts have been erected by swinging them up from reclining positions, but transmission towers which are erected in permanent locations do not lend themselves to the methods used in raising oil well masts. Furthermore, oil well derricks include drawworks which can be used in erecting the masts. No such hoisting equipment is used with electric transmission towers.

It is among the objects of this invention to provide apparatus for erecting electric transmission towers and the like which is independent of the towers, which is carried by a vehicle from one tower to another, which is not removed from the vehicle during use, and which is relatively simple in construction and operation.

In accordance with this invention, a tower or mast is assembled in reclining position along the ground and has at least two feet. These feet are hinged to supports anchored in the ground, and the reclining mast extends forward away from them. A vehicle, such as a truck or tractor, is drawn up behind the supports and carries a reclining boom which extends toward the mast. The inner end of the boom is secured to the vehicle, preferably pivotally on a horizontal axis. A pulley block above the feet is connected with the reclining mast, while sheaves are mounted on the vehicle. Reeved around the sheaves and pulley block is a line, one end of which is attached to a winch on the vehicle. The line is reeled in by the winch, which swings the mast upward and backward to erect position. On the outer end of the boom there are means bearing against the back of the mast hinging means to keep the vehicle a predetermined distance from them while the mast is being raised. Preferably, a gin pole extends upward from the bearing means and supports a line that connects the pulley block to the mast. This gin pole holds the pulley block at the desired elevation and also keeps the line that fastens the block to the mast from bending any of the cross members of the mast.

The invention is illustrated in the accompanying drawings, in which

Fig. 1 is a plan view of an electric transmission tower about to be raised by my erecting apparatus;

Fig. 2 is a side view;

Fig. 3 is an enlarged fragmentary plan view of the mast supports;

Fig. 4 is a side view of the same support;

Figs. 5 and 6 are vertical sections taken on the lines V—V and VI—VI, respectively, of Fig. 3;

Fig. 7 is a fragmentary plan view of one end of the yoke in retracting position;

Figs. 8 to 11 are schematic views showing the tower in four different stages of erection; and

Fig. 12 is a fragmentary plan view of a modified embodiment of the invention.

Referring to Figs. 1 and 2 of the drawings, four concrete foundation pillars **1** project above the ground in positions to support the four feet of a four-legged mast, such as an electric transmission tower **2**. Secured to a pair of the concrete pillars, called the front pair for convenience, are shoes **3** in which the front pair of feet of the tower are pivotally mounted on hinge pins **4**. When the tower is reclining, it extends forward along the ground away from the shoes. The rear pair of shoes **5** are formed for receiving the other pair of feet of the tower after it has been erected.

Some distance behind the rear foundation blocks is a suitable vehicle **7**, a truck being shown for the purpose of illustration. This truck is headed away from the tower, but is in line with its center. The truck carries the usual truck winch **8** behind the cab. Mounted on the bed of the truck above its rear wheels is a pair of bearing pedestals **9**, in which a cross shaft **11** is mounted. Pivotally mounted on this shaft is the inner end of a boom **12** that extends along the ground toward the tower. The boom may be constructed from structural steel elements and it tapers from a wide inner end above the truck to a narrow outer end at the tower. The outer end of the boom supports a cross beam or yoke **13** by means of a vertical pivot pin **14** between them. The front of the opposite ends of the yoke are formed to bear against the back of the hinge connections between the mast and foundation pillars. Preferably, a fork **16** (Fig. 3) projects forward from the front of each end of the yoke astraddle of the shoe **3** in front of it, and the front ends of the forks are provided with recesses that fit around the backs of hinge pins **4**. By bowing the yoke forward so that pivot pin **14** is slightly ahead of the backsides of the hinge pins, there will be no tendency for the yoke to turn over when pressure is applied to the back of it by the boom.

Also journaled on shaft **11** on the truck is a group of sheaves **18**, which are connected by a line **19** to a pulley block **20** above the lower feet of the reclining tower. The pulley block is attached to and supported by a bridle cable **21** that extends up over the tower and is connected to its upper legs several feet from its upper feet. To hold the pulley block at a higher level than otherwise would be the case, and also to prevent the bridle cable from pulling down across the diagonal braces of the tower and possibly bending them, the cable is supported near the block by the top of a gin pole. The gin pole is formed from a pair of upwardly converging legs **22**, the lower ends of which are pivotally connected to brackets **23** on the front of the yoke near its end portions. The upper ends of the legs are connected by a saddle member **24**, on which the bridle cable rests.

When a tower is ready to be raised, the truck is backed up into the position shown in Fig. 1, with the opposite ends of yoke **13** behind front shoes **3** and with forks **16** engaging hinge pins **4**. At this time the gin pole is in a reclining position over the yoke and boom, as indicated in Figs. 7 and 8. To raise the gin pole, a hand line **26** is attached to the central part of bridle cable **21** temporarily and threaded through a snatch block **27** hanging from the upper side of the reclining tower. The line then extends back to the capstan on the truck winch so that the pulley block can be pulled forward. At the same time, a tag line **28** between the bridle cable and top of the gin pole is pulled toward the snatch block, thereby swinging the gin pole upward and forward until

it passes over center. The pole then starts to fall forward by gravity, but it is soon arrested by any suitable means, such as flexible tension members 29 connecting its legs with the yoke. As the gin pole rises, its saddle 24 engages and lifts the portion of the bridle cable between the hand line and pulley block. The hand line is reeled in by the winch until the front ends of the bridle cable can be fastened to the upper legs of the reclining tower. At about the same time the slack tag line 28 also is attached to the mast. The hand line and snatch block then are removed, and the structure appears as shown in Figs. 2 and 9.

The winch then can be operated to reel in line 19 to pull the pulley block toward the truck. This will cause the bridle cable to pull against the tower and swing it upward and backward. At the beginning of this operation the cable will be supported by the gin pole, which will be swung backward with it until the cable lifts free of the pole. The tag line will prevent the gin pole from falling down onto the boom at that time, but will lower it slowly with the descending upper feet of the tower, as shown in Fig. 10. When the center of gravity of the tower starts to pass over shoes 3, a suitable snubbing line (not shown) is used to control the movement of the tower the rest of the way to final erect position, in which the rear shoes 5 receive the corresponding feet of the tower. The bridle cable and tag line then are disconnected from the tower and the truck can be driven away with the boom carrying the yoke behind it.

While the tower is being raised, the boom not only prevents the truck from being pulled back toward the mast, but it also prevents the rearward pressure of the tower against front shoes 3 from possibly dislodging them from the foundation blocks. That is, while the tower is pushing backward on the shoes, the yoke is pushing forward against them with the same force, whereby the opposed forces are balanced.

Provision is made for permitting the yoke to pass between the rear legs of the tower when the truck starts away from the tower. This is done by forming the ends of the yoke in such a way that it can be shortened. This can be accomplished by making the end portions 31 of the yoke separate from its body and attaching them to forwardly extending arms 32 mounted on vertical pivot pins 33 in brackets 34 projecting from the front of the yoke. While forks 16 are pressed against hinge pins 4, the end portions of the yoke are pressed against its body, but when the yoke is pulled away from the pins the end portions will strike rear shoes 5 and be swung around to the positions shown in Fig. 7. This reduces the length of the yoke sufficiently to permit it to pass between the back shoes.

In the modification shown in Fig. 12, a yoke is not necessary because the boom is formed from two beams 35 that diverge toward their outer ends. The outer end of each beam is equipped with a form 36 that bears against the hinge pins 37 which fasten the front feet of the tower 38 to the front foundation blocks 39. This form of boom is especially suitable for a three-legged tower, because the rear foot 41 can swing down between the two beams to shoe 42 on block 43.

With the apparatus disclosed herein, transmission towers and the like can be constructed along the ground and the electric transmission lines even can be fastened to the arms of a tower before it is raised. The tower then can be raised to erect position quickly and easily. There is no need to anchor the truck, because the boom will hold it away from the tower. After a tower has been erected, the erecting apparatus can be quickly driven to the next location and put in operating position.

According to the provisions of the patent statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. Portable erection apparatus for erecting a reclining mast having a pair of laterally spaced feet connected by hinging means to fixed supports, said apparatus comprising a vehicle, a reclining boom secured to the vehicle and extending rearwardly therefrom, a transverse yoke mounted on the outer end of the boom and extending laterally away from its opposite sides, the opposite ends of the yoke being formed to bear against the side of said hinging means opposite to the mast when the vehicle backs the yoke up against them, sheaves mounted on the vehicle, a pulley block behind the sheaves, a line reeved around the sheaves and pulley block, means secured to the pulley block for detachably connecting it to the reclining mast above its feet, and a winch on the vehicle for reeling in the line to swing the mast upward to erect position.

2. Portable erection apparatus as recited in claim 1, in which the boom is secured to the vehicle on a hozizontal axis.

3. Portable erection apparatus as recited in claim 1, in which said ends of the yoke are pivotally connected to the rest of the yoke on vertical axes to permit them to be swung away from the vehicle and inward toward each other after the yoke has been pulled away from said supports.

4. Portable erection apparatus as recited in claim 1, in which the central portion of the yoke is bowed away from the vehicle to locate its connection to the boom behind the ends of the yoke.

5. Portable erection apparatus as recited in claim 1, in which the boom is pivotally supported on the vehicle on a horizontal axis and is pivotally connected to the yoke on a vertical axis.

6. Portable erection apparatus for erecting a reclining mast having a pair of laterally spaced feet connected by hinging means to fixed supports, said apparatus comprising a vehicle, a reclining boom secured to the vehicle and extending rearwardly therefrom, a transverse yoke mounted on the outer end of the boom and extending laterally away from its opposite sides, the opposite ends of the yoke being formed to bear against the side of said hinging means opposite to the mast when the vehicle backs the yoke up against them, a gin pole extending upward from the yoke, sheaves mounted on the vehicle, a pulley block between the sheaves and gin pole, a line reeved around the sheaves and pulley block, a cable secured to the pulley block and extending backward over the top of the gin pole in engagement therewith, the rear end of the cable being adapted to be detachably connected to the reclining mast adjacent the top of the gin pole, and a winch on the vehicle for reeling in the line to swing the mast upward to erect position.

7. Portable erection apparatus as recited in claim 6, in which the bottom of the gin pole is pivotally connected with said yoke so that the top of the pole can move with said cable.

8. Portable erection apparatus as recited in claim 7, including flexible means secured to the pivoted gin pole and adapted to be detachably connected to the mast so that the pole will be lowered by the mast as the latter is raised.

9. Portable erection apparatus for erecting a reclining mast having a pair of laterally spaced feet mounted on aligned hinge pins on fixed supports, said apparatus comprising a vehicle, a reclining boom secured to the vehicle and extending rearwardly therefrom, a transverse yoke mounted on the outer end of the boom and extending laterally away from its opposite sides the opposite ends of the yoke being provided with recessed members for bearing against the side of said hinge pins opposite to the mast when the vehicle backs the yoke toward the pins, sheaves mounted on the vehicle, a pulley block be-

hind the sheaves, a line reeved around the sheaves and pulley block, means secured to the pulley block for detachably connecting it to the reclining mast above its feet, and a winch on the vehicle for reeling in the line to swing the mast upward to erect position.

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