June 7, 1955 E. B. NICKLES 2,710,199

MOBILE, ARTICULATED CRANE SUPPORT

Original Filed Jan. 19, 1946 4 Sheets-Sheet 1

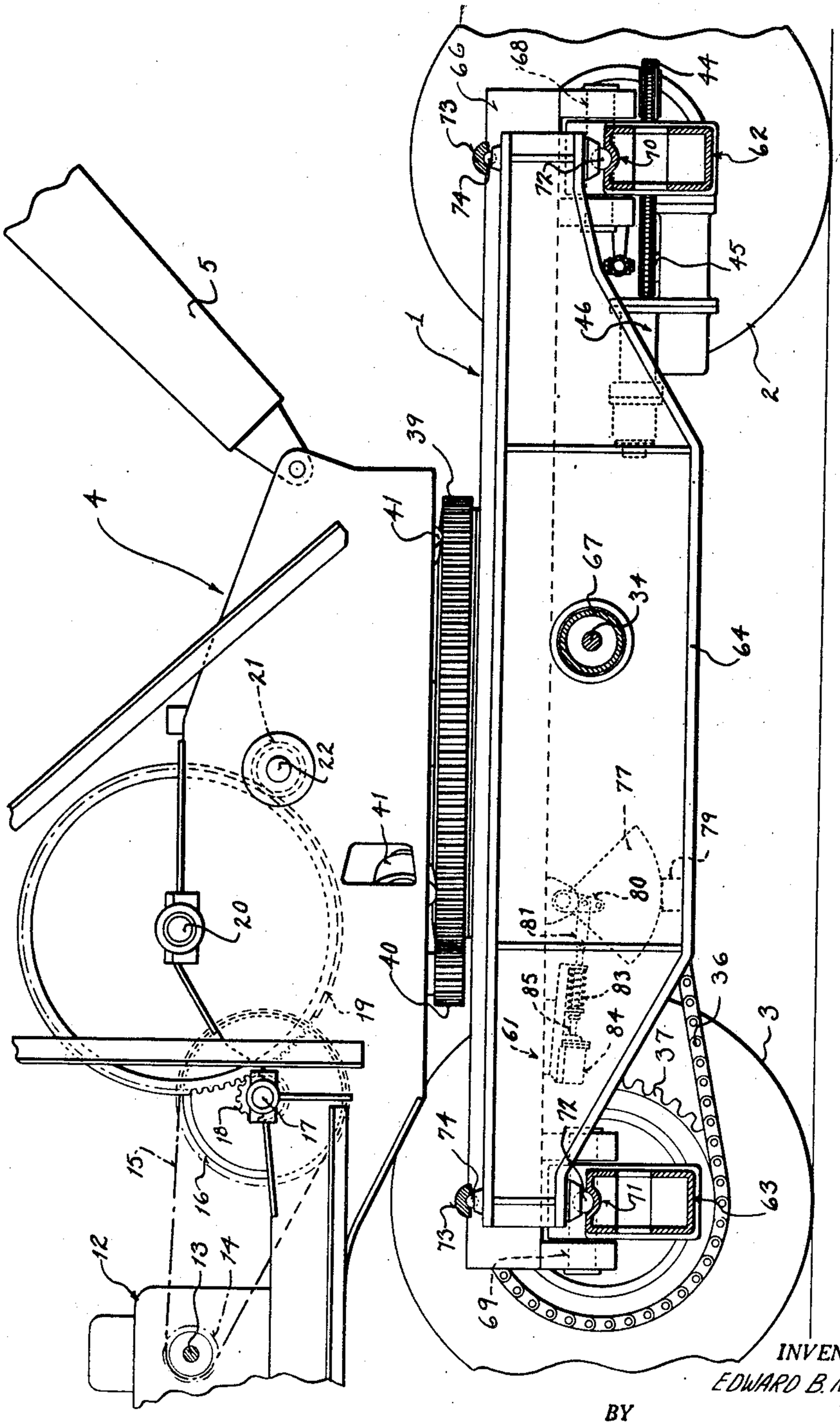

Fig. 1

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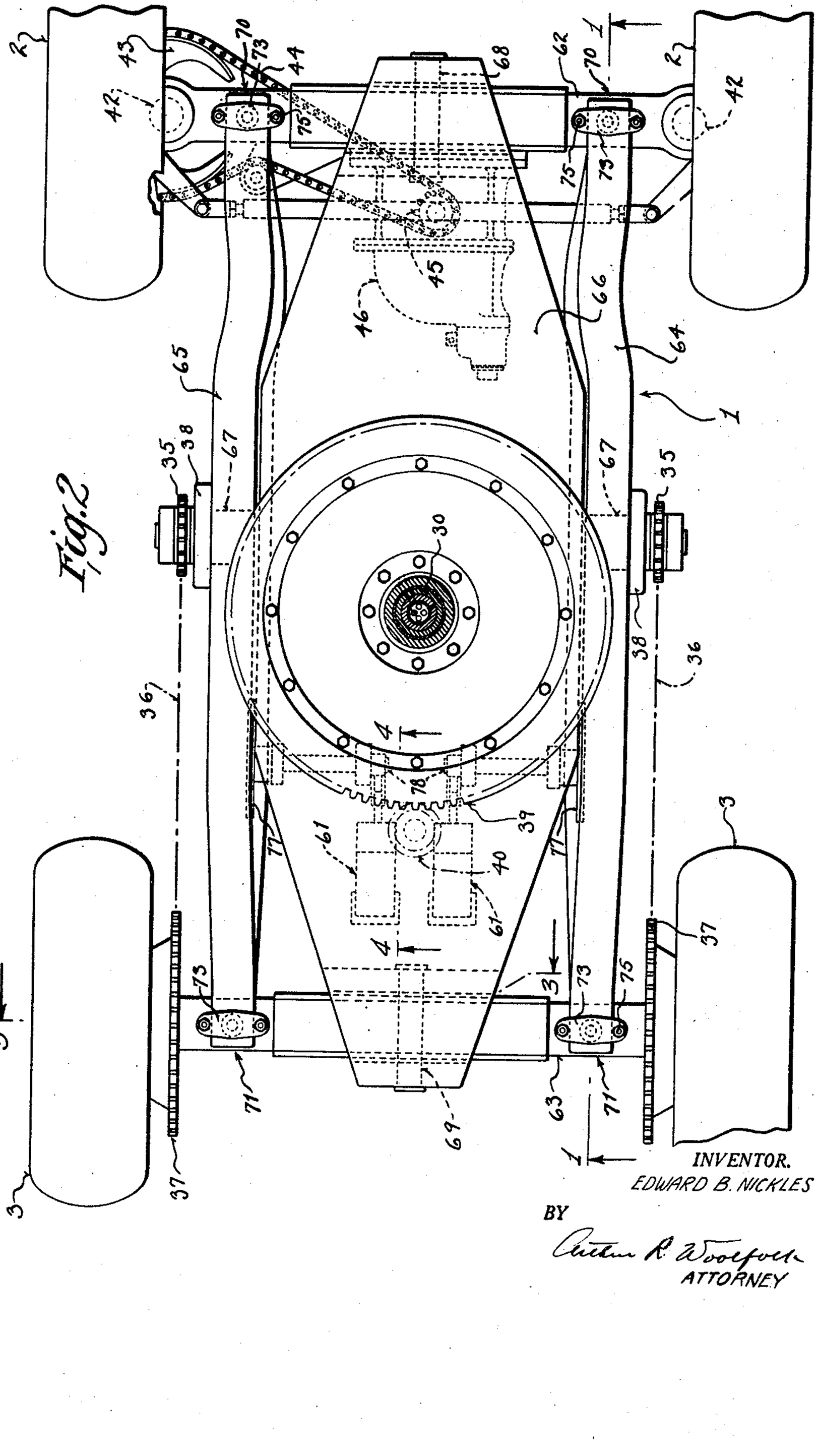
Original Filed Jan. 19, 1946 4 Sheets-Sheet 2



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MOBILE, ARTICULATED CRANE SUPPORT

Original Filed Jan. 19, 1946 4 Sheets-Sheet 3

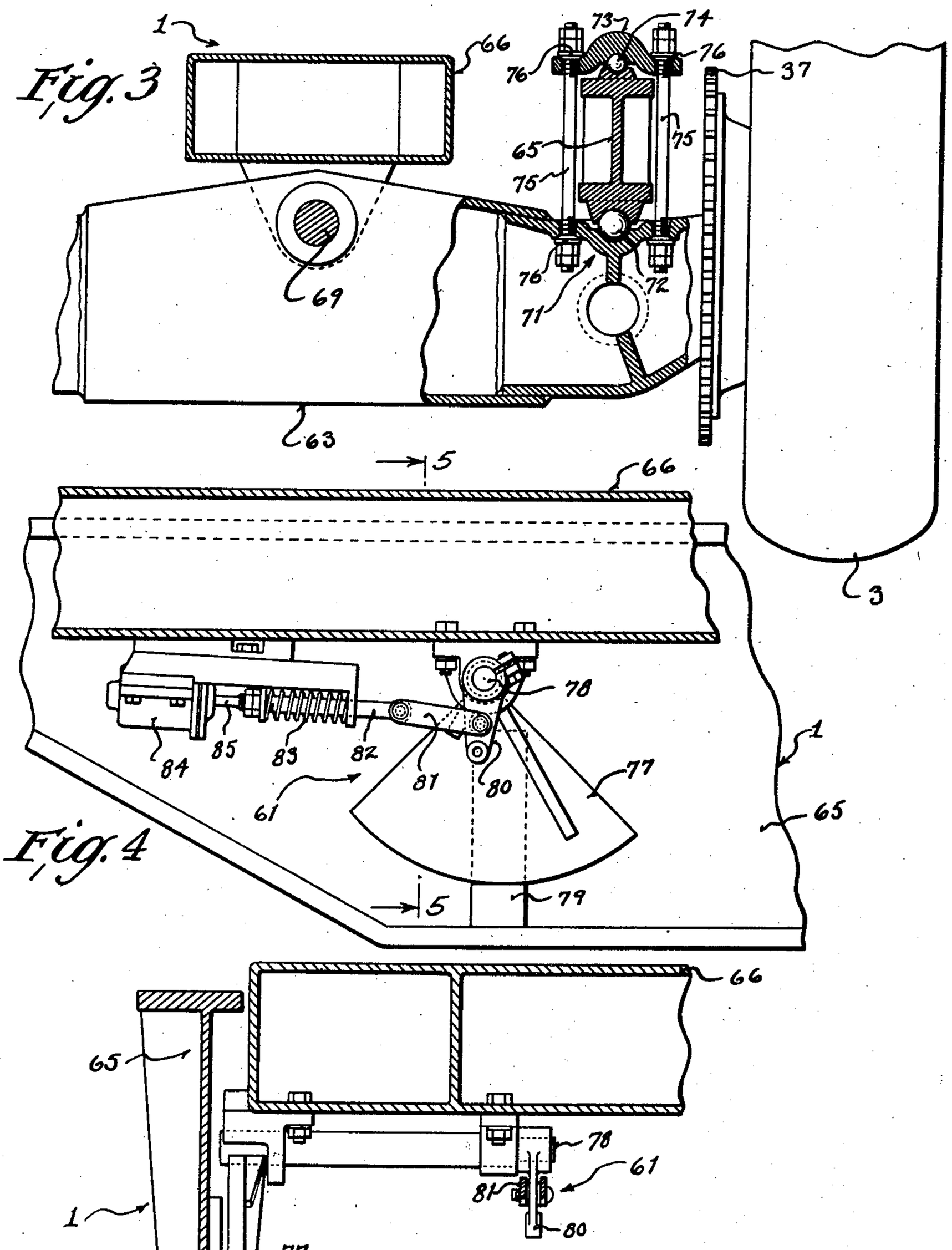

Fig. 3

Fig. 4

Fig. 5

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June 7, 1955 E. B. NICKLES 2,710,199

MOBILE, ARTICULATED CRANE SUPPORT

Original Filed Jan. 19, 1946 4 Sheets-Sheet 4

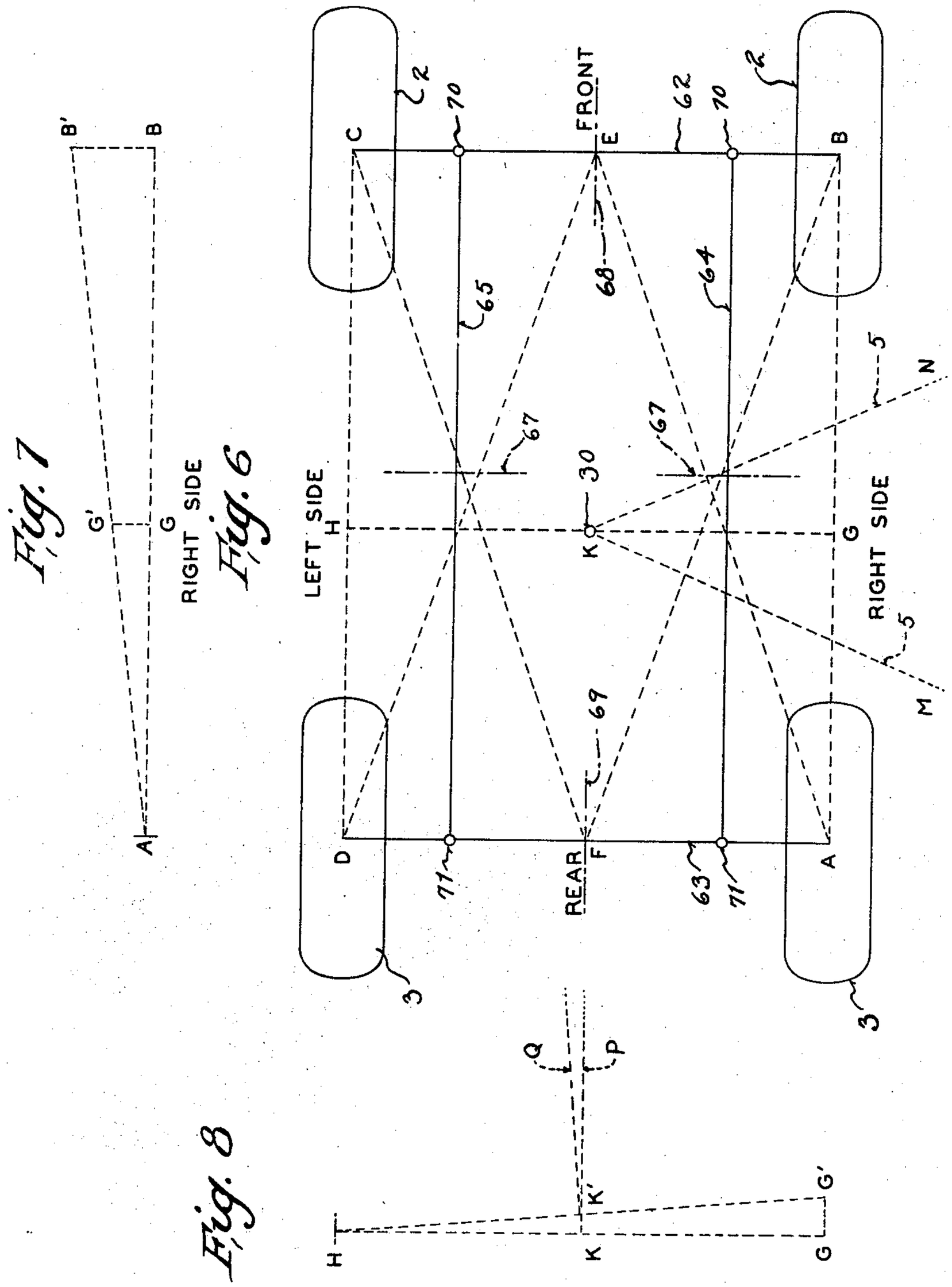

Fig. 7

Fig. 6

Fig. 8

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2,710,199

Patented June 7, 1955

2,710,199

MOBILE ARTICULATED CRANE SUPPORT

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Original application January 19, 1946, Serial No. 642,167, now Patent No. 2,590,787, dated March 25, 1952. Divided and this application June 17, 1947, Serial No. 755,043

2 Claims. (Cl. 280—104)

This invention relates to a mobile crane support and is particularly directed to an articulated mobile crane support of the truck type.

This application is a division of my prior application, Serial No. 642,167 filed January 19, 1946, for Truck Type Articulated Crane, now Patent No. 2,590,787, of March 25, 1952.

Cranes have heretofore been mounted on truck frames but they have certain defects. For example, the truck frames are usually relatively narrow and long which limits their maneuverability and also limits the lifting capacity of the crane without employing blocked outriggers. It has been found that even where blocked outriggers are employed to increase the stability and consequently the lifting capacity of the crane, that the lifting capacity was necessarily limited by the strength that could be built into the narrow truck frame.

This invention is designed to overcome the above noted defects and objects of this invention are to provide a mobile crane support with a crane mounted thereon to lift larger loads without tipping and which has increased stability without the use of outriggers of any type, which has a relatively short wheel base and consequently has great maneuverability and which is so constructed that it is arranged to be operated by one man and does not have an independent truck cab, but in which the driving as well as the operation of the crane is under the control of a single operator located in the crane cab.

Further objects are to provide a mobile, articulated crane support of the truck type which utilizes pneumatic tires as distinguished from crawlers, which has approximately the same lifting capacity throughout the entire 360° swing, which is as convenient to operate in any position as it is when lifting over the rear end, and which has a substantially even distribution of weight on all four wheels regardless of the unevenness of the ground.

Further objects are to provide a mobile, articulated crane support which is so made that it is steady while traveling and which has the minimum whipping of the boom although the crane may be traveling over very uneven ground.

Further objects are to provide a mobile, articulated crane support in which, while it is traveling, provision is made for the independent adjustment of the wheels and side frame bars and front and rear axles to the uneven portions of the ground, and which when it is not traveling is so constructed that the effective base area can be instantly extended so that the base area which is effective against tipping can be greatly increased without the use of outriggers and by a simple locking mechanism which locks related portions of the truck structure against relative motion and which is controlled from the crane cab so that when the crane stops traveling and starts working at one fixed point, the base area effective against tipping can be extended to a greater degree without the use of outriggers or any auxiliary apparatus whatsoever.

An embodiment of the invention is shown in the accompanying drawings, in which:

Figure 1 is a sectional view approximately on the line **1—1** of Figure 2 with parts broken away.

Figure 2 is a plan view with the upper structure of the crane sectioned off and with parts broken away.

Figure 3 is an enlarged, sectional view on the line **3—3** of Figure 2.

Figure 4 is an enlarged, sectional view on the line **4—4** of Figure 2.

Figure 5 is a sectional view on the line **5—5** of Figure 4.

Figure 6 is a diagrammatic plan view of the crane illustrating the base area effective against tipping.

Figure 7 is a diagrammatic view from the right-hand side when the right-hand forward wheel encounters an elevated portion in the roadway.

Figure 8 is a diagrammatic view showing the relative shifting of the boom under the conditions illustrated in Figure 7.

Referring to the drawings, it will be seen that the crane support comprises a truck frame indicated generally by the reference character **1** provided with front and rear wheels **2** and **3**, respectively. These wheels are provided with pneumatic tires as indicated. A main crane body or rotating body **4** is pivotally mounted on the truck frame **1** and is adapted to rotate about a vertical axis. The crane body indicated generally at **4** has a boom **5** pivoted thereto. Any suitable type of hoisting arrangement may be provided for hoisting the load, and any desired type of load handling means can be employed. A boom hoist drum is also provided and is adapted to wind up or let out the boom hoist cable to elevate or lower the boom in accordance with the usual practice. All of the controls as well as the engine or motor **12**, see Figure 1, are mounted within the main cab of the crane body **4** and are under the control of a single operator. The operator controls the hoisting and lowering of the load and the raising and swinging of the boom and the forward or rearward traveling of the crane and the locking means hereinafter described from the interior of the cab.

Referring to Figure 1, the engine **12** is provided with an engine shaft **13** which has a sprocket wheel **14** connected by means of a chain **15** with a sprocket wheel **16** on a drive shaft **17**. The drive shaft **17** is provided with a pinion **18** which meshes with a large gear **19**. The large gear continuously drives the shaft **20** and also continuously drives the small pinion **21**. The shaft **20** is adapted to be operatively coupled to the hoist drum and the boom hoist drum in any suitable manner as, for example, that disclosed in the patent to Nickles et al., No. 2,254,083 of August 26, 1941, for Remotely Controlled Crane or the like. The gear **21** is mounted on the shaft **22** and continuously drives such shaft. The shaft **22**, indicated in Figure 1, loosely carries a pair of bevel gears, either one of which is adapted to be connected operatively to the shaft **22** or to be held against motion by clutch and brake means respectively as shown in the above noted patent, No. 2,590,787. Drive means are provided from the engine through a differential gear to the shafts **34**. This construction is illustrated in the above noted Patent No. 2,590,787. The shafts **34** are provided with sprocket wheels **35** at their outer ends. The sprocket wheels **35** are connected by means of chains **36** with sprocket wheels **37** rigid with the rear wheels **3**. The rear wheels **3** are independently revolubly mounted. Either the sprocket wheel drive shafts **34** or the rear wheels **3** may be provided with brake means. For instance, brake means has been indicated generally by the reference character **38** in Figure 2 for the sprocket drive shafts **34**. The brake means is controlled from within the cab or rotatable body **4** in any suitable manner not shown.

It is to be understood that suitable clutches and brake means or locking means are provided for the main hoist drum and for the boom hoist drum in accordance with

the usual practice, for example, as shown in the above noted Patent 2,254,083. These clutches and brake means are controlled from within the cab of the rotating crane body 4. A main ring gear 39, see Figure 1, is rigidly carried by the truck frame indicated generally at 1 and is engaged by means of a pinion 40 driven from the engine 12 in any suitable manner, and provided with clutch and lock means in accordance with the usual practice. Suitable supporting rollers 41 are provided which travel on a roller path carried by the truck frame 1.

Steering is accomplished through the front wheels 2 which are independently pivotally mounted on the pivot pins or knuckle pins 42, see Figure 2, suitable linkage mechanism connecting the wheels in the usual manner. One of the front wheel assemblies carries a segmental sprocket wheel 43 which is connected by means of a chain 44 with a small sprocket wheel 45 driven by means of a suitable motor and reduction gear assembly, such for example, as a combined air motor and reduction gear assembly indicated generally by the reference character 46 in Figure 2. This motor may be, as stated, of any suitable type but is preferably an air motor which is adapted to run in opposite directions depending on the direction of compressed air flow therethrough.

Pneumatic or hydraulic locking means indicated generally by the reference character 61 are provided, and will be described in greater detail hereinafter.

Attention is now directed to the articulated truck body indicated generally by the reference character 1. This truck body is composed of a front axle 62, a rear axle 63, a right side frame bar 64, a left side frame bar 65, and a floating, main central body or base 66, see Figure 2. The base or main central body 66 is provided with a pair of outer bearing members 67 on which the right and left side bars 64 and 65, respectively, are pivotally mounted so that they may pivot about the transverse horizontal axis of the sprocket wheel shafts 34. The front and rear axles are pivotally joined by means of pivot pins 68 and 69 respectively, with the front and rear ends of the central floating body or base 66, see Figures 1 and 2. As may be seen from Figure 1, the transverse axis about which the side bars 64 and 65 pivot and the longitudinal axis about which the front and rear axles pivot all lie in the same horizontal plane when the wheels rest on a horizontal surface.

The front and rear axles are joined to the front and rear ends of the right and left side bars by means of ball joint assemblies indicated generally by the reference characters 70 for the front axle and 71 for the rear axle. For example, as these ball joints are alike, a description of one of the ball joints for the rear axle will suffice. This is shown in detail in Figure 3. It will be seen that the rear end of the side frame bar 65 has a spherically recessed portion opposite a spherically recessed portion in the rear axle 63 which receives a hardened, steel ball 72. The side frame bar is held down by a saddle-like member 73 which has a spherically recessed portion opposite a similar spherically recessed portion on the upper side of the side frame bar 65 which receive a hardened steel ball 74. The ball 74 may be of smaller size than the ball 72 as it does not carry any weight and as it merely serves to hold the side frame bar from disengagement with the ball 72. The saddle-like member 73 is tied to the rear axle 63 by means of tie rods or bolts 75. These bolts are provided with washers 76 at their upper and lower ends which have spherical surfaces contacting adjacent spherically recessed portions of the saddle-like member 73 and the rear axle 63. All of the ball joints between the side frame bars and the front and rear axles are formed in exactly the same manner.

From the description thus far given it is apparent that when the crane travels over uneven ground that the wheels will be raised and lowered in conformity with the contour of the uneven ground and that the articulated chassis frame and central main floating body or support

will adjust themselves to these motions of the wheels, there being sufficient play in the pivots for the floating central body or support. The chassis frame is composed of the front and rear axles 62 and 63 and the right and left side bars 64 and 65.

It is desirable when the crane is not traveling but is working at a fixed position, to rigidly lock the several parts constituting the chassis and main central floating body or support in such a manner that they cannot have relative motion with respect to each other but, instead, become in effect a rigid unitary structure. This is readily accomplished by the automatic locking means indicated generally at 61. From Figure 2 it will be apparent that this means consists of two separate elements which are arranged to simultaneously operate as will be described hereinafter. Each of the elements consists of a sector-shaped cam member 77 rigidly carried by a rock shaft 78 and arranged to coact with a pressure block 79. Two pressure blocks 79 are provided, one for each of the side frame bars 64 and 65. These pressure blocks are rigidly mounted on the side frame bars and coact with the corresponding sector-shaped member 77 to lock the central main floating frame 66 rigidly to the side frame bars and prevent relative motion between these members. This, in turn, prevents relative motion between the front and rear axles 62 and 63 and the right and left side frame bars 64 and 65. The purpose of this will appear as the description proceeds.

Each of the rock shafts 78 is provided with a crank arm 80 rigid with such shaft and connected at a selected point by means of a link 81 with the rod 82. The rod 82 is spring pressed rearwardly by means of the spring 83 so as to tend to pull the cam members 77 into binding engagement with the pressure blocks 79. This locking or coaction is prevented whenever air or other fluid under pressure is admitted to the motor cylinder 84 which is arranged to force the piston rod 85 forwardly against the action of the spring 83 and thus force the rod 82, which forms a continuation of the piston rod, forwardly and rock the segmental cam members 77 in a counter-clockwise direction out of engagement with the pressure blocks 79 and thus allow free articulation or relative motion between the front and rear axles, the side frame bars and the central floating member.

All of the controls for governing the several parts of the crane and for governing the action of the locking sector-shaped members 77, as well as for governing the steering of the crane when it is traveling, are mounted within the cab of the crane body portion 4, as illustrated and described in the above noted Patent No. 2,590,787. They may be of any suitable type well known in the art and they may control either air, or oil, or other fluid under pressure for operating the steering and the locking members, or may through mechanical means control the several parts of the crane in accordance with the well known practice.

Attention is now directed to Figures 6, 7 and 8 which are diagrammatic views of parts of the crane. If it is assumed that the boom is in the position shown by the line MK and the crane is lifting a load and the locking members are not in locking position, it will be apparent that the crane will tend to tip about the line FB. On the other hand, if the boom was in a similar position on the left-hand side, the crane would tend to tip about the line FC. Obviously if the boom was pointed directly forwardly, the crane would tend to tip about the line BC. Thus the triangle BFC determines the base area or area effective against tipping when the boom is in the positions hereinabove described. If on the other hand, the boom was in the position NK it is clear that the crane would tend to tip about the line AE. If the boom was in a similar position on the left-hand side, the crane would tend to tip about the line DE. Obviously, if the boom pointed directly rearwardly, the crane would tend to tip about the line AD. Thus the triangle ADE determines

the base area effective against tipping when the boom is in the positions hereinabove described. Thus the two overlapping triangles FCB and ADE define the base area effective against tipping when the crane is in its unlocked or freely articulated condition. On the other hand, if the crane is in its locked or rigid condition it is obvious that if the boom projected to the right side that the tipping line would be the line AB. Similarly if the boom projected to the left side, the tipping line would be the line DC. Similarly, if the boom were to the front or rear of the crane body the tipping lines would be the lines BC and AD, respectively. Thus the rectangle ABCD determines the base area or area effective against tipping when the crane is in its locked condition. This rectangle, it will be noted, encloses the two overlapping triangles.

It is clear, therefore, that this invention provides an articulated, mobile crane support which, when in its unlocked position, may freely travel over uneven ground and will adjust itself to the unevenness of the ground and still distribute its weight on all of the wheels.

It is also clear that when the crane is at a fixed point where it will remain during the time it is doing its work, that the parts may be locked against relative motion and thus instead of being an articulated chassis and central, floating body structure, such elements now become a rigid substantially unitary assembly. In this way, the base area which is effective against tipping is extended and a marked increase in stability and a marked increase in the amount of load the crane can lift is obtained without the use of blocked outriggers or any other auxiliary part. This extension of the base area effective against tipping which is secured by changing from an articulated condition to a locked condition, is instantly secured by means of controls located in the cab of the crane body. Similarly, the change back to an articulated condition is also instantly secured by means of the controls within the cab of the crane body.

It is to be noted, that if the crane is resting on uneven ground when the locking occurs, that as the locking means are independent of each other though simultaneously operated, each will lock its associated parts in the particular position they occupy due to the unevenness of the ground.

It will be seen, therefore, that this invention provides a mobile, articulated crane support which will adjust itself to irregularities in the road when traveling and which also can be instantly changed from controls within the cab so as to greatly extend the effective base area whenever the crane is standing still without requiring the operator to leave the cab and without the use of blocked outriggers.

This invention also provides another highly advantageous feature, as it provides against excessive whipping of the boom when the crane is traveling and when in an articulated or unlocked condition. Though it is desirable to minimize whipping of the boom even when the boom is unloaded, it is particularly important to reduce whipping of the boom when the boom is loaded.

Assume now that one of the wheels, for instance the right front wheel, passes over an elevated portion of the road and rises from the point B to the point B', see Figure 7, Figure 7 being a side elevation of the line BA. The front right wheel thus rises a distance equal to the line BB'. The point G on the line BA rises a much lesser amount, namely, from the point G to the point G', see Figure 7. Now consider the line GH, see Figure 6 and Figure 8. Since the point G has risen to the position G', the line GH will move to the position G'H and consequently the point K, or center point about which the body of the crane rotates, will move to the point K' which is a much lesser distance than the distance between the points G and G'. Thus there is a marked reduction between the distance traveled upwardly by the right, front wheel and the distance through which the center point of rotation of the crane body travels. This consequently produces a very small motion or angular shifting of the boom and thus clearly reduces whipping of the boom. Lines have been drawn normal to the lines GH and G'H and are indicated by the reference characters P and Q, see Figure 8. The angle between the lines P and Q which corresponds to the angle through which the boom would move when the front, right wheel moves over uneven ground hereinbefore described is very small and it is, therefore, clear that whether the boom is loaded or unloaded a very small whipping action occurs and thus the stresses imposed on the crane due to irregularities in the roadway are markedly reduced.

It will be seen that a novel form of mobile, articulated crane support of the truck type has been provided by this invention which is so constructed that it clearly reduces whipping of the boom when the crane is in its unlocked or articulated condition even when the crane is traveling over uneven ground.

It will be seen further that a novel form of crane support has been provided which is so constructed that the base area effective against tipping can be instantly extended by locking the parts against relative motion as hereinbefore stated and without requiring the use of blocked outriggers or other similar elements.

Although this invention has been described in considerable detail, it is to be understood that such description is intended as illustrative rather than limiting, as the invention may be variously embodied and is to be interpreted as claimed.

I claim:

1. A mobile support comprising a floating central base, two side bars pivotally connected to said central base on a transverse axis, front and rear axles pivotally connected to said central base on a longitudinal axis, articulated tie means connecting opposite ends of said side bars to the front and rear axles, respectively, and independently automatically adjustable locking means for temporarily individually locking each side bar and central base against relative motion, said locking means each including an adjustable locking member to allow for varying positions of the corresponding side bar relative to the central base whereby said locking means are arranged to lock the side bars irrespective of their angular relation to said central base.

2. A mobile support comprising a floating central base, two side bars pivotally connected to said central base on a transverse axis, front and rear axles pivotally connected to said central base on a longitudinal axis, articulated tie means connecting opposite ends of said side bars to the front and rear axles, respectively, independently automatically adjustable locking means for temporarily individually locking each side bar and central base against relative motion, said locking means each including an adjustable locking member to allow for varying positions of the corresponding side bar relative to the central base whereby said locking means are arranged to lock the side bars irrespective of their angular relation to said central base, said locking means being biased towards locking position, and means for normally holding said locking means in an inoperative position.

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