

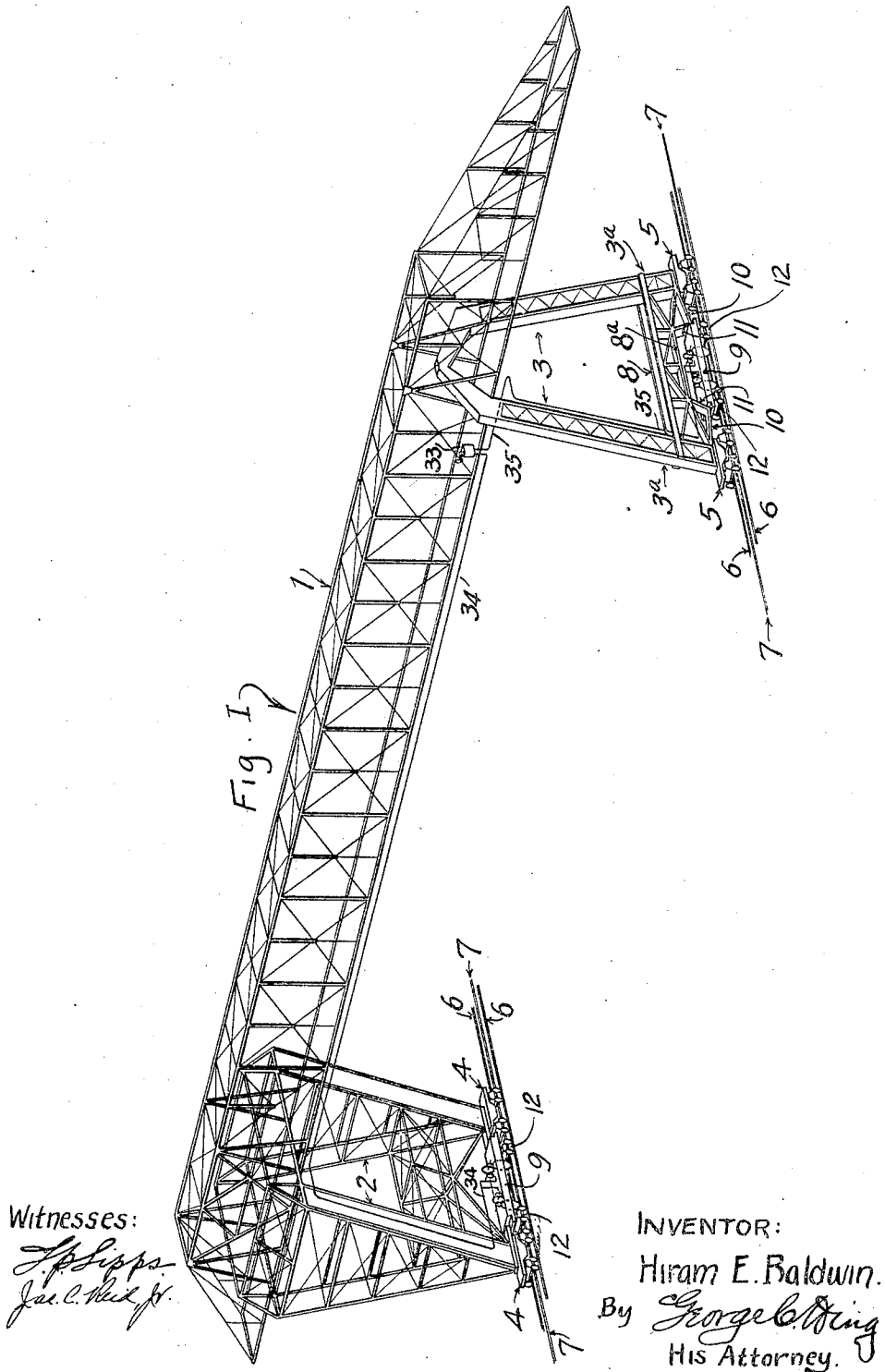
April 21, 1925.

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TRACTOR BRIDGE CRANE

Filed Nov. 8, 1924

2 Sheets-Sheet 1



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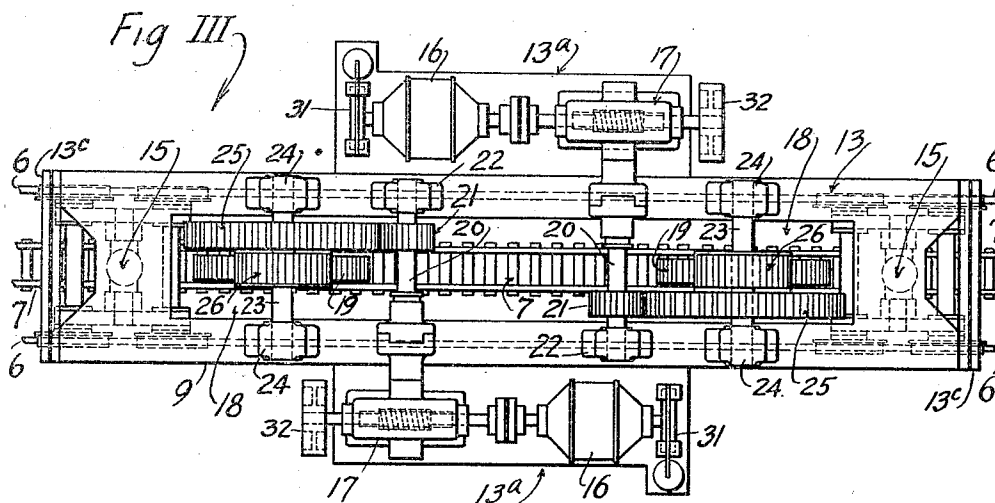
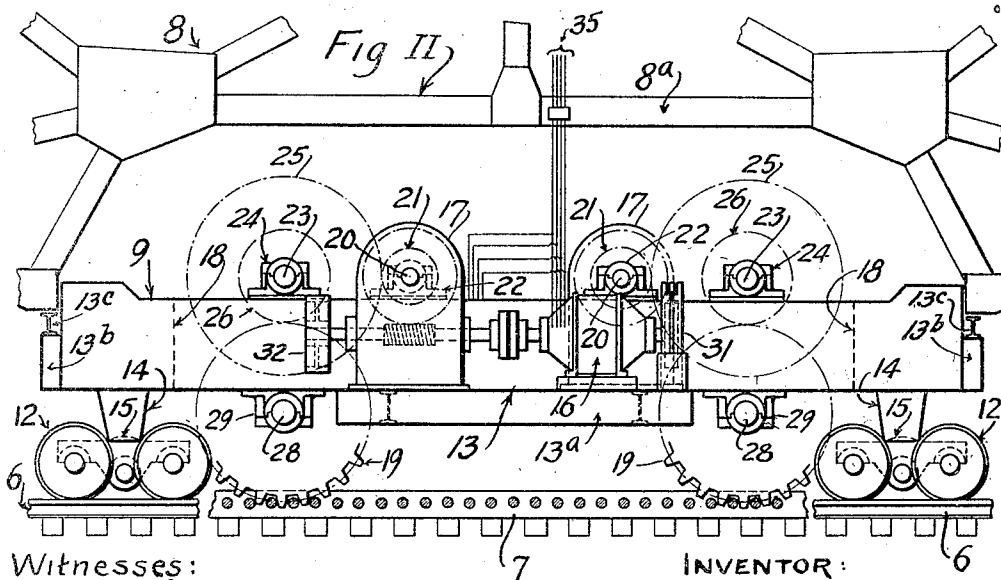
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TRACTOR BRIDGE CRANE

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2 Sheets-Sheet 2



Witnesses:

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## UNITED STATES PATENT OFFICE.

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## TRACTOR BRIDGE CRANE.

Application filed November 8, 1924. Serial No. 748,664.

*To all whom it may concern:*

Be it known that I, HIRAM E. BALDWIN, a citizen of the United States, residing in the city of Cleveland, county of Cuyahoga, and State of Ohio, have invented a new and useful Improvement in Tractor Bridge Cranes, of which the following is a clear and exact description, reference being made to the accompanying drawings, which form part of this specification, and wherein the same parts are designated by the same characters in each case.

My invention relates to traveling bridge-cranes, such as are used in the ore and coal handling trades to store material when unloaded from boats, and, to reclaim it and load it into cars for reshipment. It particularly relates to means for propelling bridge-cranes along their supporting track-rails.

On account of the large storage areas which cranes of this type are required to serve, and, of the quantity of material to be stored, (ore is sometimes piled seventy feet high) bridge-cranes are of great length and their supports, known as pier and shear legs, tower to a great height—as much as ninety feet in some instances. The span of these cranes sometimes exceeds a distance of four-hundred feet, which, together with long cantilever projections of upwards of two hundred feet, a trolley travel of nearly one thousand feet can be had. It will be quite evident that these modern Bridge-cranes are of enormous size and tremendous weight. These colossal structures weigh as much as twelve hundred tons and sustain and carry moving loads of one-hundred and eighty thousand pounds, comprising a man-trolley (so-called), a grab bucket and the load of material to be carried. Huge multi-wheeled trucks two under each supporting leg are required for the type of bridge shown in the drawings, to support the bridge-crane and to move it along its track-ways.

In some instances these bulky and unwieldy cranes are propelled along their track-ways by driving the supporting truck-wheels through trains of gears from the source of power on the structure. In other instances they are propelled by means of bull-pinions which are driven by the source of power through trains of gears and which engage racks that are located on the foundation adjacent to and parallel with the track-rails.

In the former mentioned case the source of power, usually an electric motor, sometimes is located on the bridge proper with the requisite shafting, equipped with the proper gears, leading therefrom to the gears on the driving-wheel axles; the source of power sometimes is located on the pier and shear truck-sills, in which case there are two propelling units—one on each sill—coupled up by the proper wiring to propel the pier and shear truck-wheels simultaneously and at the same rate. In a rack and bull-pinion arrangement the propelling units are generally likewise located on the pier and shear sills and act to drive the bull-pinions directly and thereby propel the bridge forwardly and backwardly upon its truck wheels.

Bridge-cranes when propelled through the medium of their supporting truck-wheels are usually equiped with railclamps (either automatic or hand-operated) to help the primary braking mechanism to hold them against skidding movement along their tracks during wind storms. When rack and bull-pinion units are employed as the propelling means, no ancillary holding devices are required to prevent any skidding movement of the bridge-cranes, as the bull-pinions when sufficiently locked against rotation will prevent any such movement.

My invention has to do with the so-called "rack-drive bridge-cranes." It was evolved to meet important and imperative trade demands and conditions, which require that bridge-cranes of the kind in question be fabricated and erected in a comparatively short time, as for instance, in the case of a crane suddenly demolished by a wind storm, a new crane must be fabricated and installed in great haste.

The principal advantages that my invention affords over the present time of "rack-drive" units are recited and described hereinafter.

It is practically impossible to standardize the massive structures under consideration because of the different problems and conditions presented by each customer. Every crane becomes "special" and considerable time is consumed in the engineering department to produce the drawings for special parts like the propelling units. The making of the patterns, producing and delivering the steel-castings from such patterns, as

well as machining the castings and fitting them to the structural parts consumes months of additional time. The structural parts are readily fabricated but they cannot  
 5 be assembled or erected until the moving gear mechanisms have been duly prepared and fitted to their places, and, as much time is consumed in such preparation, as just pointed out, the finished structural parts  
 10 must necessarily be stored until the mechanisms are ready.

The customary procedure in erecting bridge-cranes is: first, to build the pier, then  
 15 build the false-work that is to support the bridge-proper during erection, then to assemble the bridge span. After the bridge parts have been duly riveted and bolted the shear is erected and joined to the bridge, the cantilevers are then built outwardly from  
 20 the pier and shear supports.

It will be evident that when the propelling units are built in or upon the pier-leg and shear-leg sills, erection of the bridge-crane will be materially delayed and cannot  
 25 proceed expeditiously until all the mechanical parts have been finished and fitted to their respective places on the structural work.

A principal purpose of my invention therefore, is to facilitate and expedite the  
 30 erection of bridge-cranes, and I attain this object by my improved and simplified method of procedure, which consists in providing independent propelling units or tractors  
 35 for moving said bridge-cranes and arranging the supports of said cranes so that said tractors may at once be placed into position after the erection of said cranes.

Aside from the fact that erection may be  
 40 commenced as soon as the structural parts are ready, an important advantage gained by my improved method of erection is, that the propelling gear can be fabricated and assembled in the shop where facilities and  
 45 experience are available to insure a perfect mechanical job, and the tractors can be inserted in their designed places any time after the erection of the pier and shear legs without further finish or fitting in the field.

As will be manifest from subsequent descriptions herein, among the additional advantages of my novel correlation of bridge  
 50 and tractor as separate units, is the assurance of thereby obtaining a better and more constant pitch line engagement between the teeth of the rack and the bull-pinion, also, by reason of the fact that, different from the tractor feature of other types of crane, the tractor in my invention is supported and  
 55 moves upon the tracks rails of the crane instead of being carried by the leg-members, the weight of material and consequent structural strains of the main apparatus, are thereby correspondingly reduced.

60 Further, by disassociating the bull-pinion

tractor as an integral and fixed part of the crane, and giving it an entirely separate, though coactive unitary character. I accomplish that, like tires on wheels of the automobile, for instance, the tractors may  
 70 be carried as spare parts, so that in the event of an accidental disablement of the bull-pinion tractor in use, the crane itself will not be put out of commission for any  
 75 extended time while the broken tractor is being removed and a new one is accurately fitted and fixedly attached in its place.

In view of the considerable capital that is always directly or indirectly held idle by unanticipated interruptions in the work-  
 80 ing of plants of the kind in question, this removable and readily replaceable quality of my improvement, should prove of great value as compared with the type of bridge cranes wherein the tractor is integrally fixed  
 85 in its operative position.

The character of the invention, upon reference to the drawings and, when considered in conjunction with the specifications, will be  
 90 readily understood.

In the said drawings Figure I is an isometric view of a bridge-crane and propelling tractors, the said crane having its supporting legs adapted to receive the said  
 95 tractors between their pairs of trucks; Figure II, is an enlarged side view of one of the tractors showing its relation to a leg-sill, of which only a part is shown, and Figure III is a plan view of the tractor shown in Figure II.

Referring to the drawings 1 is a bridge-crane which is supported by pier-legs 2 and shear-legs 3. The said legs are mounted, respectively, on wheeled-trucks 4, 4 and 5, 5  
 105 and are adapted to travel on the track rails 6, 6, 6, 6.

Between and midway of the pairs of rails 6, 6 and 6, 6 and parallel therewith are racks 7, 7 which are secured to the track foundation (not shown).

Because of the difference in the contours and constructions of the pier-legs and shear-legs, the sills connecting the leg members must vary, to meet different conditions. However, the sills have a close similarity,  
 115 and in order to avoid seeming duplication, I accordingly have chosen to describe only the details of the shear-leg sill and the relation of the tractor to that sill and the shear rack and track.

A truss-sill 8 connects the lower ends of the shear-leg members 3<sup>a</sup>, 3<sup>a</sup>; it is located above the track rails at a height to provide enough space for a propelling unit or tractor 9 to be inserted between its lowest horizontal member 8<sup>a</sup> and the truck-rails 6, 6. Struts 10, 10, that extend inwardly a short distance from the bottom of the shear-leg members 3<sup>a</sup>, 3<sup>a</sup>, are supported from the sill 8 at their inner ends by the hangers 11, 11,  
 120 125 130

together serve to stop or limit any movement of the intervening bull-pinion tractors as hereinafter will appear.

The bull-pinion tractor 9 is made up of two pairs of trucks 12, 12 and a body or rectangular connecting frame 13. The trucks 12, 12 are of the same track-gage as the bridge-crane trucks and travel on the same tracks. The length of the frame 13 is slightly less than the distance between the inner ends of the struts 10, 10 and the latter distance will of course be such as to freely admit between the ends a tractor for the bull-pinions of suitable dimensions for all the purposes designed. The frame 13 is provided near its ends with depending members 14, 14 which are located centrally thereof on the median line, in plan, and which are provided with sockets to engage ball-like protuberances 15, 15 on the upper sides of the frames of the trucks 12, 12. The purpose of the ball and socket connections is to provide universal joints so that the trucks 12, 12 can adjust themselves to track irregularities without materially disturbing the balance or equilibrium of the tractor-frame. Extending laterally from the sides of the frame 13 and at the central portion thereof are sub-frames 13<sup>a</sup>, 13<sup>a</sup>. These sub-frames carry the gear driving motors 16, 16 and the worm-and-gear housings 17, 17. The frame 13 has a rectangular opening 18 which extends through its entire depth to admit bull-pinions 19, 19 and the gearing by which the bull-pinions are actuated. Primary counter-shafts 20, 20, carrying pinions 21, 21, extend from the worm-and-gear housings across the top of the frame 13 and are supported at their outer ends by bearings 22, 22, that are provided on the frame for the purpose. Secondary counter-shafts 23, 23, are located between the shafts 20, 20 and the ends of the frame 13; they extend across the top of the tractor-frame and are supported at their ends by bearings 24, 24 and 24, 24. Mounted on the shafts 23, 23 and in alignment with the pinions 21, 21 are spur-gears 25, 25. The shafts 23, 23 are further provided at their centers with spur-pinions 26, 26, which are also located on the median line of the frame. Directly below the shafts 23, 23 and extending across the bottom of the frame 13 are tertiary counter-shafts 28, 28, which are supported by depending bearings 29, 29. The bull-pinions 19, 19 are located in tandem on the shafts 28, 28 midway of the frame 13; they are of suitable size to extend to and mesh with the spur pinions 26, 26 and the rack 7 on the foundation. The frame 13 is further provided at its ends with shelf-like projections 13<sup>b</sup>, 13<sup>b</sup>, that extend from points on the frame that are below the struts, 10, 10, to a short distance beyond the ends of said struts. It will be observed, upon reference to Figure II in the drawings, that the

space between the tops of the extensions 13<sup>b</sup>, 13<sup>b</sup>, and the struts 10, 10, is sufficient to admit and afford seats on the projections for I-beams 13<sup>c</sup>, 13<sup>c</sup>, with enough clearance above such members to take care of track variations when the bridge-crane is propelled by the tractor. It will be evident that when the I-beam members 13<sup>c</sup>, 13<sup>c</sup>, are removed from the tractor the latter can be skidded sideways into position between the struts 10, 10, then lowered onto the track-rails, or, by raising the tractor until its track-wheel flanges clear the rails, it can be removed sideways from its position between the leg-members. The worm-and-motor shafts 30, 30, are provided with solenoid-brakes 31, 31 and fly-wheels 32, 32.

While I have chosen to show and describe a tractor with two separate driving units such as motors, I do not intend to limit my claims to a device when so equipped. One driving unit per tractor will be sufficient to hold or drive a bridge-crane. A second driving unit is installed as a precautionary measure only, to provide against a possible failure of the mechanism and bull-pinion teeth for a given unit.

A controller 33 for regulating the flow of electric current to the several motors through the cables 34 and 35 for a simultaneous operation of the tractors is indicated on the bridge span within easy access of the operator on the man-trolley (not shown).

After a perusal of the foregoing the operation and the propelling and holding functions of the tractors will be quite apparent and it will further be apparent that the tractor cannot be dislodged from its position within the sill.

Because of the large capacity grab-buckets carried by the man-trolleys employed on these gigantic bridge-structures, which have a great spread and are carried through the pier and shear supports, and, because of the height of the span, the pier-leg and shear-leg members must necessarily be built far enough apart to accommodate those conditions; consequently the center to center distance of the supporting trucks is as much as sixty feet, which is substantially the length of the sills. It will be evident when the propelling mechanism is of the rack and pinion type and is built upon or into the sill structure as in prevailing types, that because of the unevenness and irregularities in the foundations, track-ways and racks the rack and bull-pinion cannot at all times be in perfect mesh. To illustrate: When the sills span depressions in the rack and track-ways, as for example like the chord of an arc, they will be farther away from the tracks and racks at their center portions, where the bull-pinions are mounted, than at their ends which are near the trucks, consequently, the bull-pinions will be lifted out

of an arcuate mesh with the rack, and, conversely, when there is a hump in the rack and track-ways between the trucks, the bull-pinions will project farther into the rack  
 5 out of a true mesh, and, to an extent that will jam together the teeth of the rack and bull-pinion with the force exerted at that point by the weight of the bridge-structure above. By utilizing tractor units, as herein  
 10 described and claimed, as the means for propelling bridge cranes the conditions, just above recited, will have no appreciable effect on the mesh of the bull-pinion with the rack, because the center to center distance of  
 15 the tractor-trucks is less than half the distance between the main or bridge-trucks.

Most bridge-cranes are adapted to skew, because the propelling elements do not drive the pier and shear truck at a uniform speed.  
 20 When either end of the bridge is advanced over the other the bridge span has a skewed relation with its pier and shear supports which results in the shear legs tilting inwardly at the top, toward the pier. Now,  
 25 since the sill is a component and integral member of the shear support, it will likewise be out of plumb, as will also any mechanisms that are attached to it. My method of driving, however, will not be affected by  
 30 this condition inasmuch as the propelling tractor is a separate and independent unit.

It will thus be seen that with my construction, propelling units are provided which can be easily positioned between the shear  
 35 leg-members and also between the pier leg-members of a bridge-crane and which can be easily removed therefrom when occasion requires. The fabrication of the crane proper and of the propelling units can proceed separately and independently and the  
 40 completed tractor units, which require more time to produce, can be installed after the bridge-crane has been completely erected.

It will also be seen that the propelling  
 45 units are not rigidly secured to the bridge-crane. One end or the other of each tractor unit merely contacts with the adjacent leg-member to propel or hold the crane, and sufficient clearance is provided between each unit  
 50 and the sections of the leg-members with which it may contact so that relative movement of the propelling unit and crane legs may take place to compensate for variations in track and rack levels, while maintaining  
 55 a suitable propelling or holding relation with the legs.

Having thus described my said invention as represented in a concrete form or embodiment, what I claim and wish to secure by  
 60 Letters Patent, is:—

1. In combination, a bridge-crane having supporting legs mounted on wheeled trucks; parallel track rails forming runways for  
 65 said trucks; racks along said runways be-

ably mounted on said rails centrally of the leg-members, in operative relation to said racks; sills, connecting said leg members above the tractors, and stop-members severally extending from the sills to the front  
 70 and rear of said tractors when in their stated positions on the rails.

2. In combination, a bridge-crane having supporting legs mounted on wheeled trucks; parallel track rails forming runways for  
 75 said trucks; racks alongside said runways; bull-pinion tractors, having flanged truck wheels mounted on said track rails centrally of the leg-members and in mesh with said racks; truss-sills, connecting the leg-mem-  
 80 bers at suitable height above the tractors to leave a clearance between the lowest horizontal member of the sill and said tractors of not less than the distance the tractors extend below their supporting rails when in  
 85 normal place thereon, and stop-like members, supported by the sills, at the front and rear of the tractors when in their said normal places.

3. In combination, a bridge-crane having  
 90 supporting legs mounted on wheeled trucks; parallel track rails forming runways for said trucks; racks along said runways between said rails; bull-pinion tractors, having flanged truck wheels mounted on said track  
 95 rails between the leg-members and in operative engagement with said racks; truss-sills, connecting the leg-members at suitable height above the tractors to permit the tractors to be raised clear of their rails and rack  
 100 engagement when said tractors are to be removed from or placed in their normal positions between said leg-members, and stop-like members supported by said sills at the front and rear of said normal positions, substantially as shown and described.  
 105

4. A crane comprising an overhead bridge; supporting legs therefor mounted on wheeled trucks; parallel track rails forming runways for said trucks; racks along said runways  
 110 between said rails; bull-pinion tractors movably mounted on said runways in operative engagement with said racks; truss-sills extending between the leg-members at a suitable height above the bull-pinion tractors  
 115 to leave sufficient clearance to permit said tractors to be raised free of their rails and rack engagement, together with stop-like parts depending from said sills at the front and rear of the spaces occupied by said tractors when in their normal positions on the runways, substantially as shown and described.  
 120

5. A crane comprising an overhead bridge; supporting legs therefor mounted on wheeled  
 125 trucks; parallel track rails forming runways for said trucks; racks along said runways between said rails; bull-pinion tractors movably mounted on said runways in operative engagement with said racks, and a frame-  
 130

work affixed to said leg-members extending above and at the front and rear of the space normally occupied by said tractors when in their normal positions on said rails.

5 6. A crane comprising an overhead bridge, supporting legs therefor mounted on wheeled trucks; parallel track rails forming runways for said trucks; racks along said runways between said rails; bull-pinion tractors 10 movably mounted on the runways centrally of the leg-members and in operative engagement with said racks; a framework affixed to said leg-members extending to the front and rear of the space occupied by said tractors 15 when in their normal places on the runways with its lowest horizontal member above the tractors when in such position, at a suitable height to permit the tractors to be raised clear of their rails and racks when 20 they are to be removed from, or placed in, said positions, and, removable means for locking the tractors in their said positions on said runways, substantially as shown and described.

25 7. A tractor bridge-crane comprising an overhead bridge with supporting legs; track rails upon which the legs are movably mounted; racks alongside the rails; bull-pinion tractors movably mounted on said

rails intermediate of the lower ends of said 30 leg-members in operative relation to said racks; a truss-sill connecting the leg-members and extending downwardly at the front and rear of the spaces occupied by said tractors 35 when in their said positions on said rails with their lower-horizontal member of said sill at a sufficient height above said space to permit the tractors to be raised from said positions until clear of their rails.

8. In combination, a bridge-crane having 40 supporting legs for its overhead bridge mounted on wheeled trucks; parallel track rails forming runways for said trucks; racks along said runways between the rails; bull-pinion tractors, having wheeled trucks to 45 which they are jointedly connected, mounted on said rails between said leg-members with their bull-pinion members in operative relation to said racks; truss-sills, connecting 50 said legs above said tractors and extending downwardly at the front and rear ends of said tractors when in their stated position on said rails.

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Witnesses:

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