April 6, 1943. J. W. DEIST 2,315,942

LUFFING CRANE

Filed Sept. 29, 1942 5 Sheets-Sheet 1

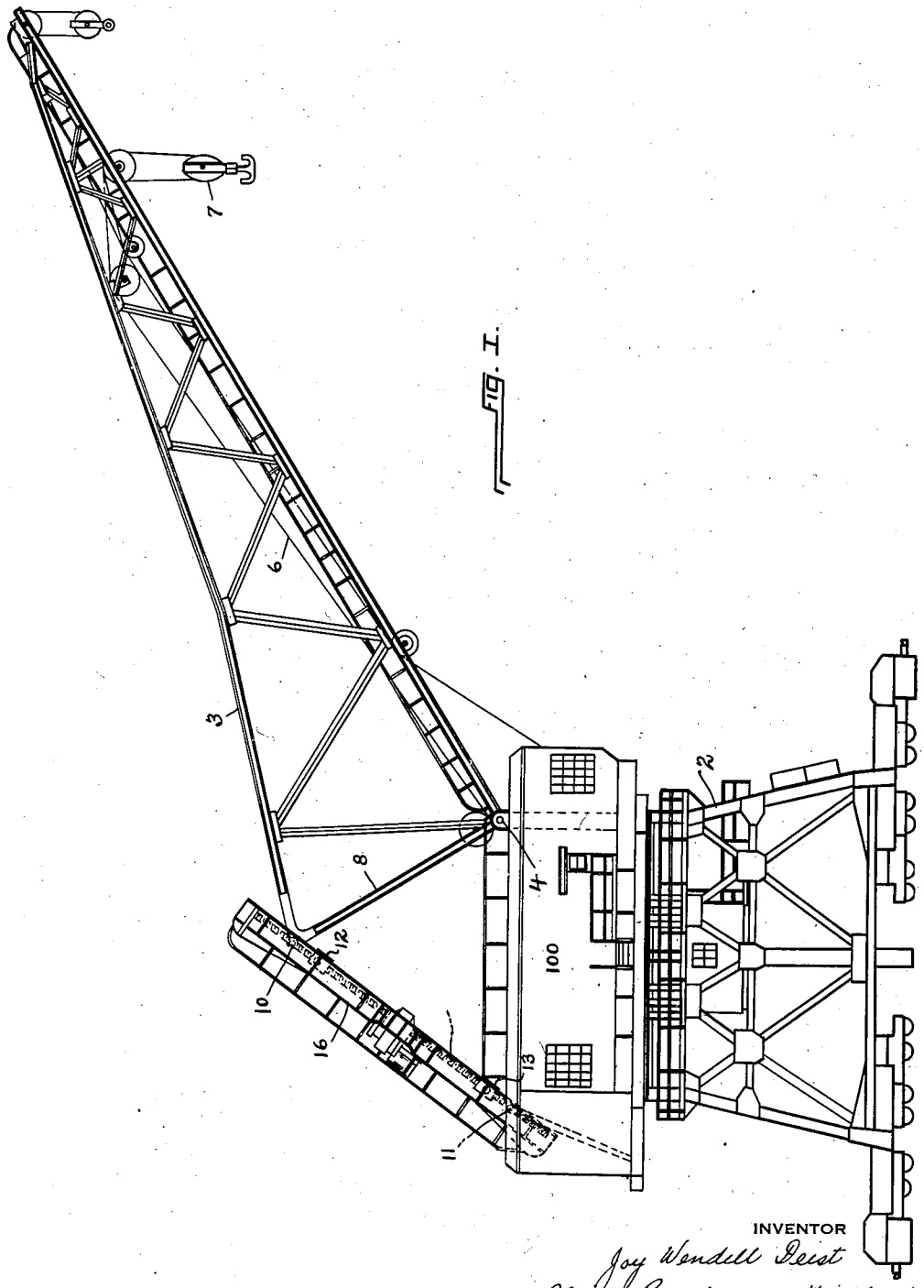


Fig. 1.

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LUFFING CRANE

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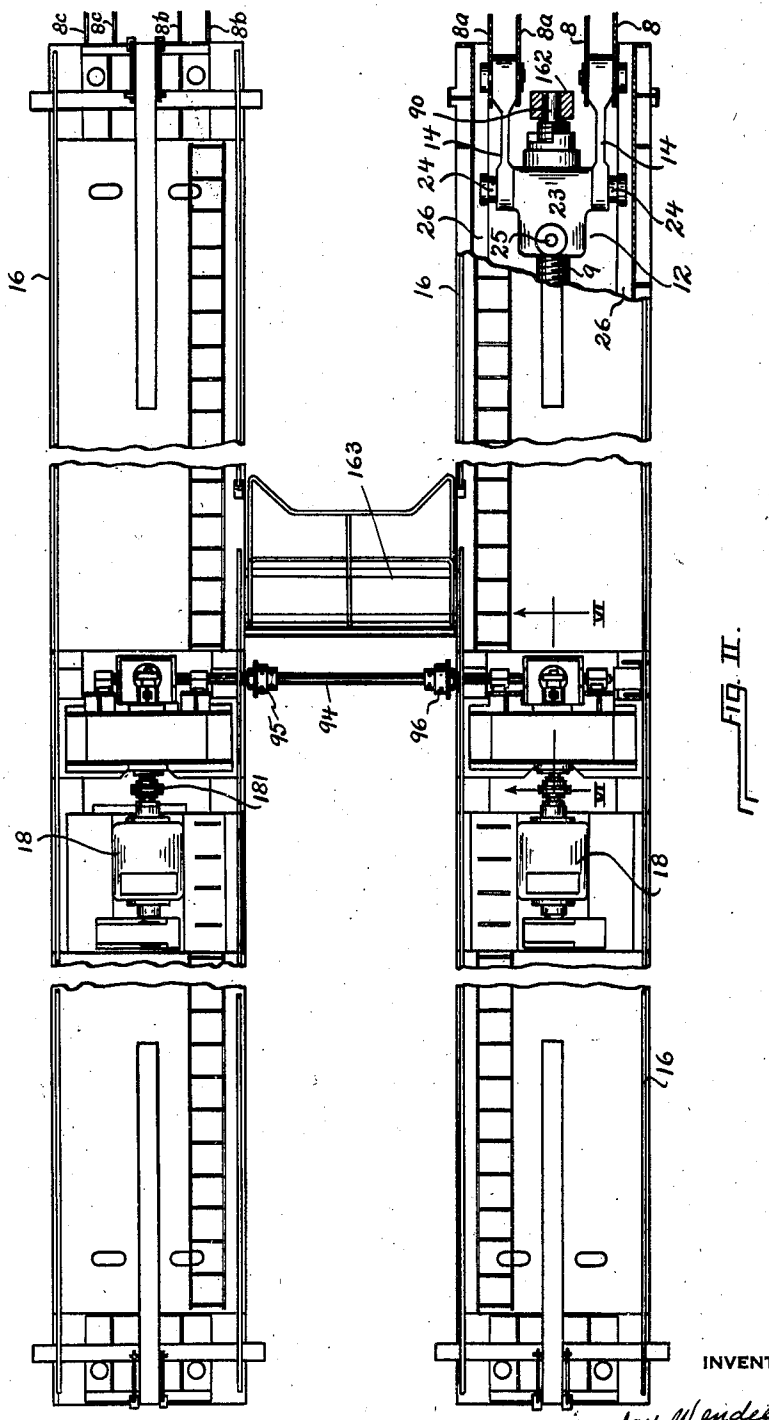


FIG. II.

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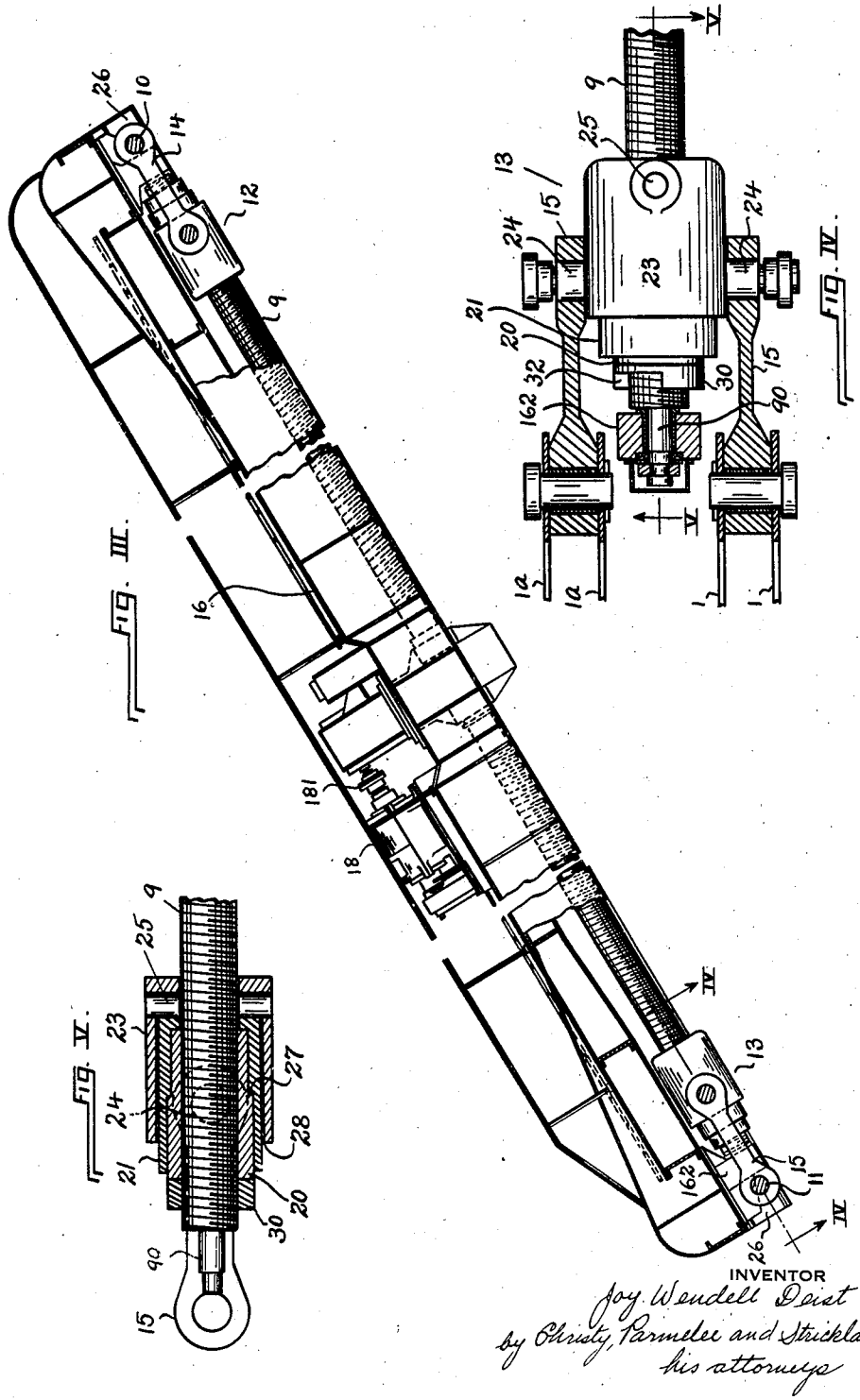
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LUFFING CRANE

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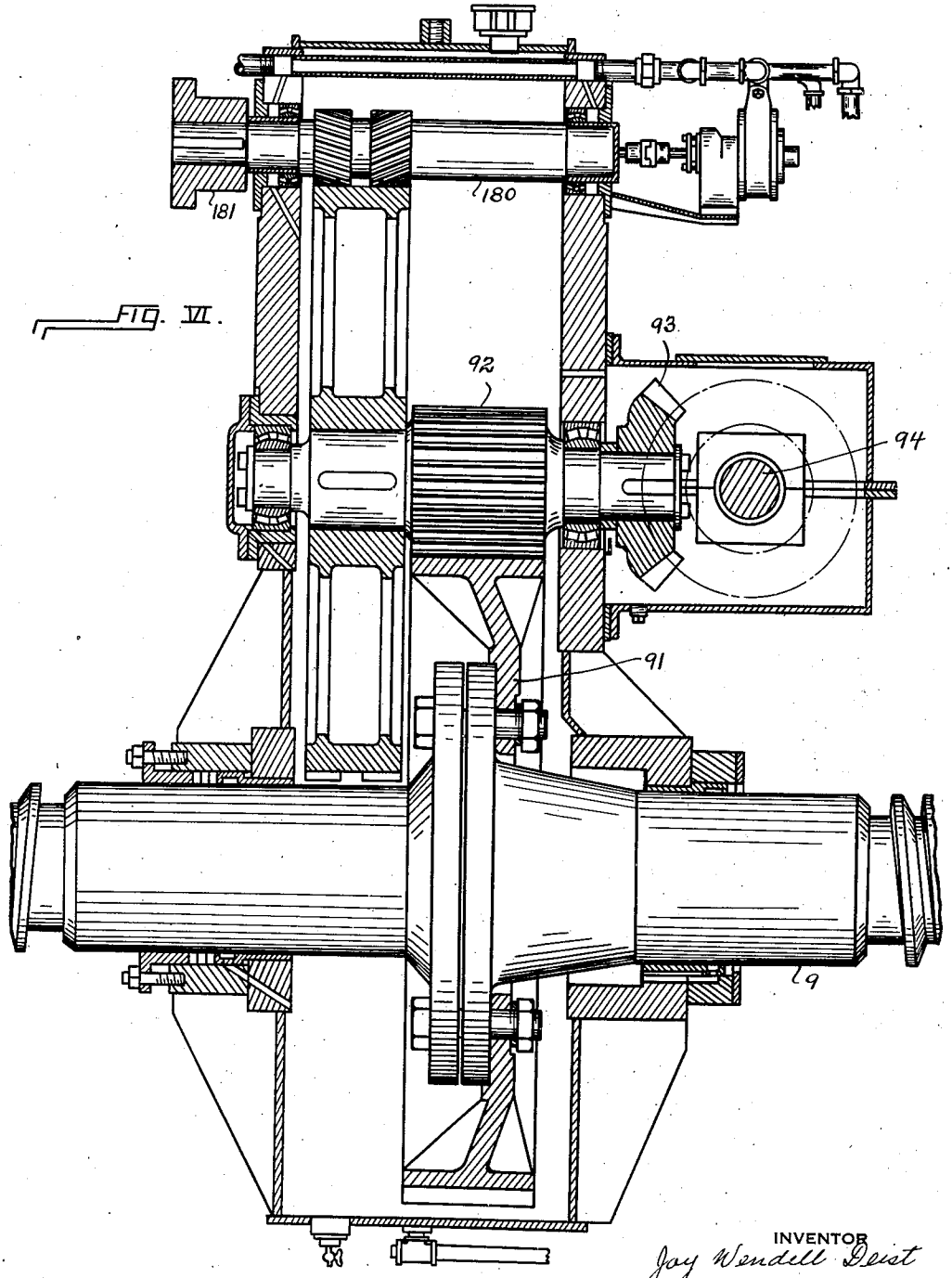
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LUFFING CRANE

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FIG. VI.



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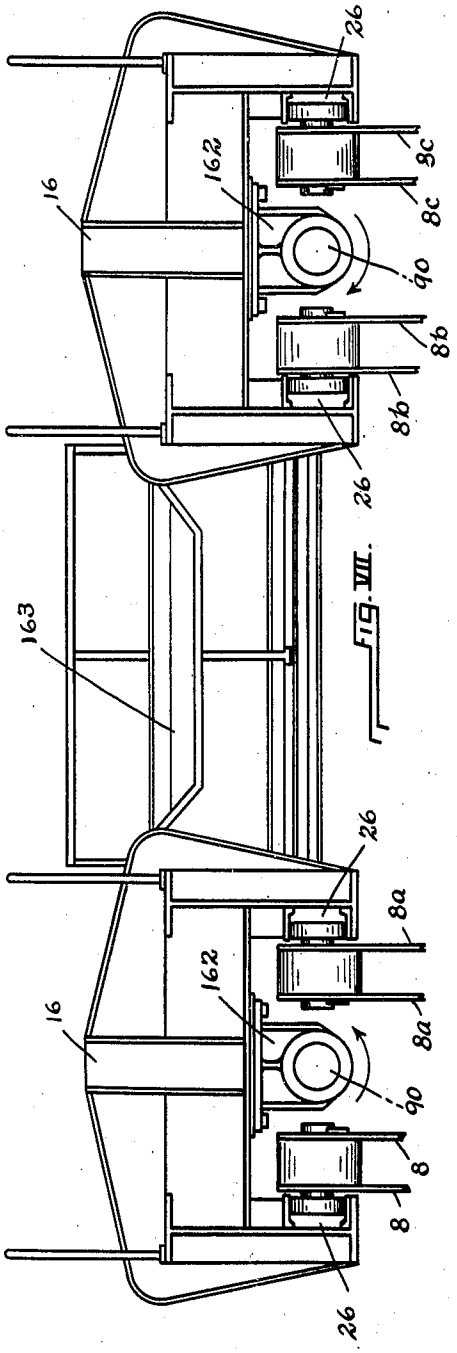


FIG. VII.

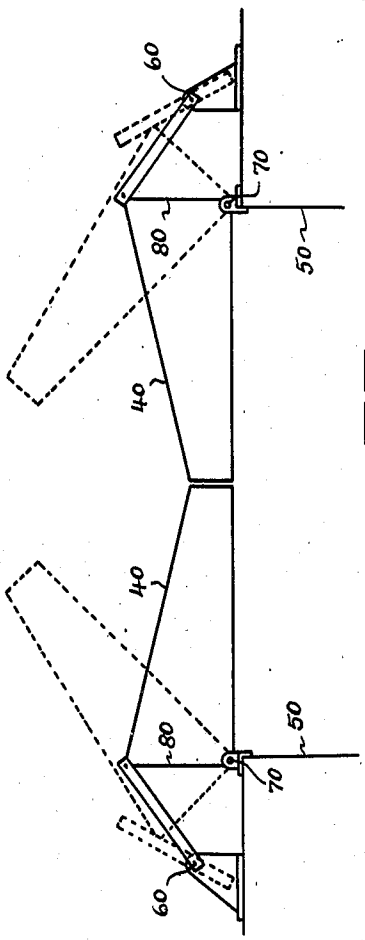


FIG. VIII.

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2,315,942

UNITED STATES PATENT OFFICE

2,315,942

LUFFING CRANE

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Application September 29, 1942, Serial No. 460,051

1 Claim. (Cl. 212—8)

This invention relates to luffing cranes and, generally, to structures that include pivotally mounted parts that require to be swung powerfully. Such structures may, for example, be draw-bridges or the gates of locks. The invention, however, has been developed in the building of luffing cranes, and in such specific association it will here be shown and described. The objects in view are speed and accuracy in operation and durability.

In Letters Patent of the United States, No. 2,188,686, granted January 30, 1940, on the application of Bernard H. Kersting and Hans Enard, means are described in association with a luffing crane for effecting the luffing movement. The present invention consists in improvement on the luffing means of the said patent.

In the accompanying drawings Fig. I is a view in side elevation of a gantry crane of turret type, mounted to travel upon rails, in which the luffing means of this invention are employed; Fig. II is a fragmentary view to larger scale, showing in plan the luffing mechanism; Fig. III is a fragmentary view in side elevation of the luffing mechanism, the wall of the mechanism being broken away in part, and the structure beyond the wall shown in vertical section in the plane of the axis of one of the screws; Fig. IV is a fragmentary and sectional view to yet larger scale, on the plane IV—IV, Fig. III; Fig. V is a view in section, on the plane indicated at V—V, Fig. IV (from the showing of Fig. V, however, certain details of structure are lacking); Fig. VI is a sectional view to yet larger scale, on the plane indicated at VI—VI, Fig. II; Fig. VII is a view to yet larger scale, presenting in end elevation the luffing mechanism that in Fig. II is shown in plan; Fig. VIII is a diagrammatic view in side elevation of a draw-bridge which includes a pivotally mounted element, and to which application is made of the swinging means of the invention.

Referring, first, to Fig. I, the crane is mounted upon a base, in this instance a platform 100 mounted to rotate turret-like upon a derrick 2. The crane includes a jib 3 pivoted upon a horizontal axis to the base at 4 and adapted to swing vertically upon such pivotal mounting. Such vertical swinging is termed luffing. From a drum (not shown, but rotatably mounted on platform 100, as is usual) a hoist line 6 extends throughout the length of the jib and supports, in a suitably formed bight, a block 7. Upon this block the load is hung.

The jib 3 of the crane is, as in Fig. I it is shown to be, a truss structure, of general triangular outline, pivoted at one corner of the triangle at 4 upon the base 100. This triangular truss structure includes the basal chord member 8. A third member (in this case and for the purposes of invention a multiple member, consisting of duplicate screws 9, 9) is, through intermediate parts, pivoted at one end (on a horizontal axis of pivoting) to the otherwise free end of member 8 of the truss-formed jib (at 10), and is, through intermediate parts, pivoted at the opposite end (and on a horizontal axis of pivoting) to the base 100 at the point 11, remote from the pivot point 4. The base 100, the chord member 8, and the duplicate screws 9 thus form a triangle (called in the industry an A frame). Of this triangle of members, the effective length of one side (formed by the duplicate screws 9) is variable; and, by variation of the effective length of this member, the jib is swung and luffing is effected.

In the Kersting and Enard patent alluded to the screw 9 is a single tension member and the stresses of service are centered in the axis of the screw. The trussed jib 3 is a three-dimensional structure, of substantial extent in the direction perpendicular to the plane of the side elevation, Fig. I. Referring to Fig. II, the truss of the jib 3 will be seen to include, not the member 8 only, nor even the pair of members 8, 8, but a second pair 8^a, 8^a, and a duplicate and more widely distant set of members 8^b, 8^b and 8^c, 8^c. The invention consists in an elaboration of the luffing means of the Kersting and Enard patent and an organization of the elaborated parts, by which the three-dimensional jib may be more effectively luffed.

I have prepared duplicate screws 9, one for each of the two sets of truss members 8, 8 8^a, 8^a and 8^b, 8^b, 8^c, 8^c, and have centered the screws, one in each of the two groups, as sufficiently illustrated in Fig. II. The two screws, so severally centered, are geared to an interconnecting cross-shaft, whereby simultaneity in rotation and at equal speed is insured. And by such means the assembled structure is re-enforced, to resist racking strains, and security, accuracy of operation, and durability are enhanced. I have used the term duplicate screws 9, and the word duplicate will not be misunderstood. With such interconnection as that shown in Fig. II, the two screws, to be effective in the manner described (cf. Fig. VII), will be oppositely threaded. Subject to this detail of

oppositely directed threads, the screws are duplicates.

Each of the two screws 9 is oppositely threaded at its two ends, and each carries upon its oppositely threaded ends two oppositely threaded nuts, 12 and 13. The nuts are pivotally mounted in pairs of links, 14, 14 and 15, 15, that move in runways 26 in two duplicate frames 16, 16, and in their mountings are secured against rotation. The links are pivoted—the links 14 at one end of the screws 9 to the paired truss members 8, 8, 8^a, 8^a etc., and the links 15 are pivoted to a correspondingly elaborated anchorage in base 100 (note in Fig. IV the elaboration 1, 1 1^a, 1^a). It is manifest, then, that, as the screws 9, 9 are rotated in one direction or the other and the pairs of links drawn together or spread apart, the effective length of the paired screws as a member of the A frame is diminished or increased, and the jib 3 is swung upward or downward.

As appears in Fig. VI, each of the screws 9 may conveniently be formed of two severally formed and essentially duplicate halves placed end to end and bolted together and carrying bolted to them a gear wheel 91. Upon each frame 16 a motor 18 is mounted, and from the driven shaft 180 of the motor, through the gearing illustrated in Fig. VI, the shaft 9 is driven. The gearing includes a pinion 92, whose shaft carries a bevel gear 93; and the duplicate bevel gears so associated, one with each of the driving apparatus of the two shafts 9, are in mesh with duplicate complementary bevel gears, both borne by a single, transversely extending shaft 94. For purposes of assembly and adjustment, separable couplings 181, 95 and 96 are conveniently provided. By such provision the two motors 18 cooperate in rotating the two screws 9, 9 in simultaneity.

It will be understood that, even though the direct loads on the duplicate screws 9, 9 are substantially equal, the power required to drive one of the screws may be different from the power required to drive the other. This is due to inequalities in the frictional resistance between the relatively moving parts of the two screw assemblies, caused particularly by unavoidable variations in the lubrication of the parts, and by minute variations in the contours of the threads of the screws. The cross-shaft 94 operates, manifestly, to equalize the work imposed upon the two motors, and thus it is possible to construct the shafts and the gears of the duplicate luffing mechanisms much lighter and at less cost than otherwise.

The duplicate frames 16, so assembled with links 14, 14, 15, 15 afford a floating runway and a tension-resisting member for the links and support for the motors 18. The frames are formed of steel plate and are of the general trough-shape shown. The two frames are interconnected by a walkway 163. In the ensuing claim the term frame will be employed to include such a multiple part. Screws 9 are prolonged in shaft-like extensions 90 of reduced diameter that turn in frame-borne bearing-blocks 162. And upon these blocks the bodies of the screws make endwise abutment. Manifestly, it is only the reaches of screws 9 between the nuts 12 and 13 that are subject to the tension stresses of the loaded crane; and, of course, if the screws break, they will break somewhere in the interval between the nuts. In the event of such screw failure, the ends of the broken screw become compression members and transfer through the blocks 162 to the body of the frame 16 the load-sustaining tension. Thus the frames 16, normally serving as runways and motor supports, are adapted in emergency to become effective load-sustaining members, preventing undue harm to the apparatus and guarding workmen from serious danger.

Provision is made for the distribution of stress between nut and screw. The practical limitations upon the degree of perfection attainable in the preparation of material and the fabrication of parts give value to this provision. The nut has gimbal mounting in the pairs of links; and, accordingly, under the stress transmitted between screw and link, the nut adjusts itself upon the screw, and stress that otherwise might be concentrated at one point is distributed around the circumference of the interengaged threads. The gimbal mounting is found in a cylindrical cup 23 with a bottom orifice through which, in the assembly, the screw 9 extends, and within which the nut is arranged. Externally, the cup is provided with trunnions 24, by which it is pivotally mounted in the associated pair of links (14, 14 or 15, 15). Internally, the cup is provided with transversely extending cylindrical bosses, conveniently formed as pins 25, welded in orifices in the cup walls. The axes of trunnions 24 and of pins 25 are angularly displaced at a 90° angle, with respect to the axis of the cup (and of shaft 9) as a centre. Upon the bosses 25 the nut makes thrust bearing, the bearing surface of the nut being, correspondingly cylindrical in shape. Elsewhere than over the thrust surfaces specified, the nut has clearance, indicated at 28, from the surfaces of the cup.

The nut is compound, and consists of the concentrically arranged parts 20 and 21. It is the outer of these two parts that engages the cup 23 over the cylindrical-bearing surfaces specified; it is the inner part 20 that is the threaded part and that immediately engages the threaded stem 9. The inner part makes stress-transmitting engagement with the outer over the shoulder 27.

Upon the part 20 a supplementary nut 30 is mounted. The supplementary nut is cut away in part, as indicated at 32 (Fig. IV), exposing the assembled threads of nut and screw. The threads within the part 20 are so proportioned as to fill the complementary threads of the screw; the threads in the supplementary nut 30 are so proportioned as normally to leave a small space between the opposed surfaces of nut and screw. When the parts are initially assembled, the faces of the threads of the supplementary nut stand away from the faces of the threads of the screw. In consequence, it is the nut part 20 through which alone the stresses of service are normally transmitted. As in continued use the interengaged surfaces wear away, the spaces at which the surfaces of the supplementary nut 30 stand away narrow. This narrowing of space is visible through the cut-away space 32. Thus a tell-tale is provided, by which determination may be made, when the nut part 20 is so far worn as to require replacement.

The nut part 20 will ordinarily be formed of bronze; but the supplementary nut 30, serving the described purpose, not of tell-tale merely, but (if, for any reason, the threads in the bronze nut part 20 fail) of compression member also, will advantageously be formed of steel of high shear strength.

When the parts are assembled, the appropriate couplings 81, 95, and 96 may be opened and the screws 9, 9 individually rotated until brought by the spread of the nuts to equal effective length. The couplings may then be closed and the apparatus then is ready for service.

The operation of luffing is effected by rotation of the screws 9, 9, with the effect that the pairs of links 14 and 15 are drawn together and spread apart; the effective length of one arm of the A frame is diminished or increased; and arm 3 is raised or lowered. The provision of duplicate screws 9, arranged in parallelism and spaced apart in the direction of the breadth of the truss that constitutes the jib 3, adjustable to equality in effective length, and, when adjusted, adapted to be rotated in simultaneity and at equal speed, affords an assembly that is rugged, braced against racking stress, and of notable rigidity and durability.

In Fig. VIII a draw-bridge is diagrammatically shown, consisting of two halves 40 severally mounted pivotally upon opposed bridge-heads 50, and adapted to be swung vertically between full-line and dotted-line positions. In this case, also, each bridge half is in structure a truss that includes a chord member 80, and the truss has breadth: it extends in a third dimension, perpendicular to the plane of view of Fig. VIII. Between the distal end of chord 80 (the end remote from the point of pivoting) and a pivot 60 mounted on the bridge-head 50 at an interval from the pivot 70 of the chord member 80, such a structure as that already described may be introduced. By means of such a structure the draw-bridge halves may be raised and lowered. By virtue of the duplication of the screws 9 of the structure, connected to the relatively movable parts and spaced from one another across the breadth of the structure, the ends already named of rigidity and durability are gained.

The invention in like manner is applicable to the swinging of single-span draw-bridges. It is manifestly applicable to the swinging of the gates of canal locks; and generally to the swinging of pivotally mounted structures that require to be powerfully swung.

I claim as my invention:

Means for swinging a structure pivotally mounted upon a support and having extension in the direction of the axis of pivoting, such means including a frame, two pairs of carriages mounted in the frame, the carriages of each pair in alignment, and the two pairs arranged in succession in the direction of the said axis of pivoting, the carriages mounted for longitudinal movement in the frame, one carriage of each pair being pivoted to the swinging structure and the other carriage of each pair being pivoted to the support at points remote from the said axis of pivoting, two pairs of nuts mounted one pair in each of said carriages, two screws simultaneously engaging severally the two nuts of the two pairs and adapted on rotation to effect the drawing together and the separation of the so-engaged carriages, two motors, driving connections from the motors severally to the two screws, and a cross-shaft interconnecting the two screws, whereby the two motors co-operate in rotating the two screws and the load imposed upon the motors is equalized between them.

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