

electrical action in a galvanic battery, was not in accordance with the experiments of Mr. Cross, and he thought some misapprehension must exist on the point.

The paper also led to the consideration of the change which was induced in cast iron, by continued immersion in various fluids. This had been frequently discussed at the Institution, and it would be desirable if Mr. Adie would continue his experiments, with a view to elucidating that question, as the conversion of cast-iron into carburet of iron, or graphite, appeared, under certain circumstances, to be so rapid, as to have rendered necessary the substitution of other and more expensive metals. In breweries, for instance, the change had been produced so very speedily, wherever the acid wash came into contact with metal, that copper gratings had been of necessity substituted for cast iron.

Sir JOHN RENNIE, *President*, stated, that the earliest example in his recollection of the change produced by sea water in cast iron, was in some iron guns which were fished up in 1822 off Holyhead. They were supposed to have belonged to a pirate vessel which was destroyed there about 100 years previously. When found they were quite soft, but after exposure to the air for a time, they became so hard, that they were used to fire salutes, when George the IVth passed through Holyhead, on his way to Dublin, and it was remarked that the report from them was louder than from any other iron guns of a similar size.*

No. 703. Remarks on the utility and defects of the Moveable Jib Crane, according to the construction now generally used in Glasgow, with proposed Improvements to obviate its Defects. By William Gale, Glasgow.

The author's attention having been recently drawn to an examination of the causes of numerous accidents (many of them attended with fatal consequences) during the erection of some of the public buildings in Glasgow and the neighbourhood, he found that one of the most fruitful sources of these accidents was the defective construction and injudicious use of the moveable jib crane.

This crane, it may be remarked, has nearly superseded all others used by builders in Glasgow, and is at present employed at most of the public buildings in course of erection. It has, however, under-

* There is a curious case mentioned in Dr. Macculloch's *Western Islands*, of guns fished up during the reign of George I., from the wreck of the "Florida," belonging to the Spanish Armada, which was lost off the coast of Mull.

gone material alterations since its introduction by Francis Watt upon Mr. Stevenson's works, during the erection of the Bell Rock Lighthouse; but while undergoing these modifications and changes to suit convenience, the principle of construction has undergone a change, which has increased the strains to a very considerable extent.

As originally constructed, the post or upright was from 20 feet to 30 feet long, the jib being of about the same length; the upright was supported by gye-ropes or chains, similar to the mode usually adopted in quarries; but at present the post is reduced to 15 feet in height, and the jib is extended to 50 feet in length, whilst the inconvenience or rather impracticability of getting the gyes fastened in many cases, such as in erecting street buildings or quay walls, where there is a great traffic, led to the substitution of the two arms and the framing (Plates 22 and 23); and in order to prevent it upsetting, the framing is loaded with stones, or other heavy materials, or when placed on the upper stories or roof of a building, which is frequently done, the framing is lashed down with chains to some fixed points beneath.

It will at once appear evident, that this alteration in the construction, by shortening the post or upright, and lengthening the jib or derrick, must have increased the strain on the jib chain to an enormous extent, and in many instances the accidents occurred from the snapping of the chain.

No one who has seen this crane in operation can call in question its great utility to the builder, on account of the expedition and ease with which heavy blocks can be bedded over a considerable extent of front, without moving the position of the crane after it has been once fixed down; but the point to be objected to, is the great amount of strain thrown on the jib chain, even with moderate weights attached, when the jib is worked at a great inclination from the perpendicular, and when it is considered that a weight of 4 tons or 5 tons is frequently suspended from it, it is certain that if builders were only made sensible of the risk, they would be more scrupulous in hazarding the lives of those under their charge, and fewer accidents would be heard of.

From what has been stated it will be obvious, that the total strain thrown on the jib chain depends upon various causes. 1st, The length of the jib. 2nd, The height of the post. 3rd, The inclination of the jib. 4th, The weight attached. 5th, The proportion of weight due for the jib itself, with its mountings and chains; and 6th, The friction.

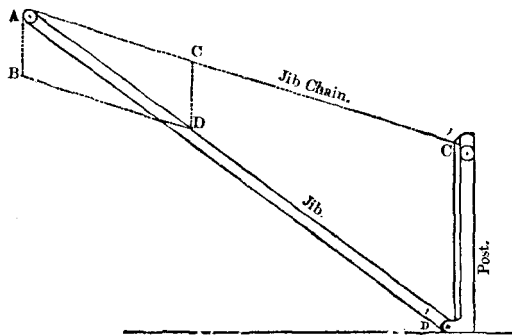
Aware of the danger of trusting to theory alone, in making an accurate investigation into these separate sources of strain, the author

had recourse to a variety of experiments, by model, being at the same time sensible of the fallacious nature of the results deduced therefrom, unless increased size and weight, and consequently increased leverage and friction, were all accurately calculated and allowed for. After numerous experiments, however, it was found, that a near approximate agreement took place betwixt the results brought out by the model and those deduced from theoretical investigation for the full-sized machine.

These results are introduced in a tabulated form in the Appendix, (page 337).

In the theoretical investigation of the question, the weight to be raised being known, (which must include the proportion of weight due for the jib, &c., along with that due for friction,) it is only necessary to apply the parallelogram of forces in the usual way, in order to obtain data whereby to ascertain the strains; thus (Fig. 1.) if $A B$ represent the total weight, $B D = A C$ gives the strain on the jib chain, while $A D$ represents the strain on the jib.

Fig. 1.



Or if $C'D'$ represent the total weight, AC' and AD' respectively represent the strain on the jib chain, and the jib or derrick.

Keeping in view, that the great utility of this crane, for street erections, consists in its having a long jib and short post, it became an object to improve the acknowledged defective part of the machine, the jib chain, not by adding strength to the chain itself, which had already been done by builders, until it was rendered quite inapplicable for winding round a barrel of 8 inches or 9 inches in diameter, but simply by introducing a pulley between two rods of iron, bolted to the point of the jib, as shown in Plate 22, and having the end of the chain attached to the top of the post or upright, instead of attaching it to the point of the jib. A mechanical advantage was thus gained, and a much lighter

chain than had hitherto been used, could with safety be adopted. The loss of speed was more than compensated by the increased ease with which the jib could be worked ; but speed in this part of the crane was of little importance, as the jib was generally placed at the required angle, or nearly so, before commencing to raise the block.

This is the chief improvement which it is intended to suggest where this description of crane may be found suitable.

It is preferable also to increase the diameter of the pulleys from 10 inches or 11 inches to 18 inches or 20 inches.

The importance of using large pulleys does not, however, seem to be sufficiently appreciated by the builders, otherwise they would not allow their machines to be fitted up with small ones.

Lastly, the friction caused by the angle of the jib chain, after passing the pulley in the post to either side of the barrel of the wheel and axle, may be obviated to a considerable extent, by confining the chain to a barrel of from 20 inches to 24 inches in length, as seen on the back view, Plate 22*.

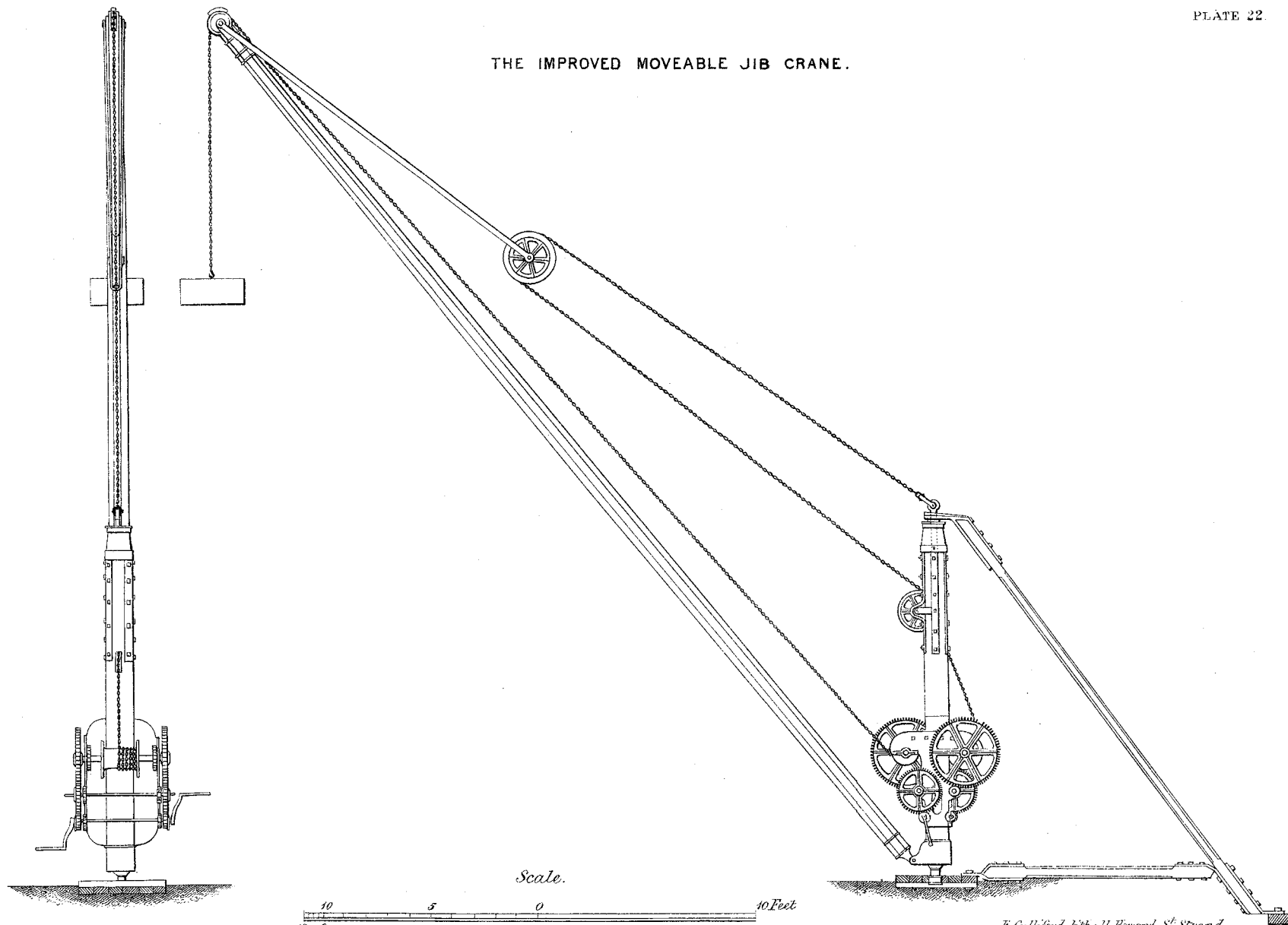
The strength of chain necessary for working the jib of this crane will depend on the nature of the work, but for general purposes a chain made of the best iron, $\frac{3}{8}$ ths inch or $\frac{1}{2}$ ths inch diameter, will be found amply sufficient.

As some builders might prefer using a rope instead of a chain for working the jib, the crane shown in Plate 23 is given. It will be observed that two pulleys are introduced at the end of the iron rods, the other end being bolted to the end of the jib, as in Plate 22, and a third pulley is fixed to the top of the post. The rope is fastened to the barrel of the wheel and axle, thence it passes over a pulley fixed to the one side of the post, and then over one of the pulleys at the end of the iron rods ; it then returns to the pulley at the top of the post, and passing over the other pulley at the rods, returns to that fixed on the other side of the post, and is fastened to the barrel of the wheel and axle. Thus there is one continuous rope, equally strained by means of the pulley at the top of the post. By having also the barrel of the wheel and axle divided into two compartments, as shown in Plates 22* and 23 (back view), the one compartment being about 2 inches larger in diameter than the other, the whole of the pulleys will be set in motion when the jib is working.

The rope necessary to work this crane may vary from $1\frac{1}{2}$ inch to $1\frac{3}{4}$ inch in diameter, according to the weight of the materials used, and it would be preferable to a chain, where this construction is adopted.

The communication is illustrated by two drawings, Nos. 3665 and 3666.

THE IMPROVED MOVEABLE JIB CRANE.

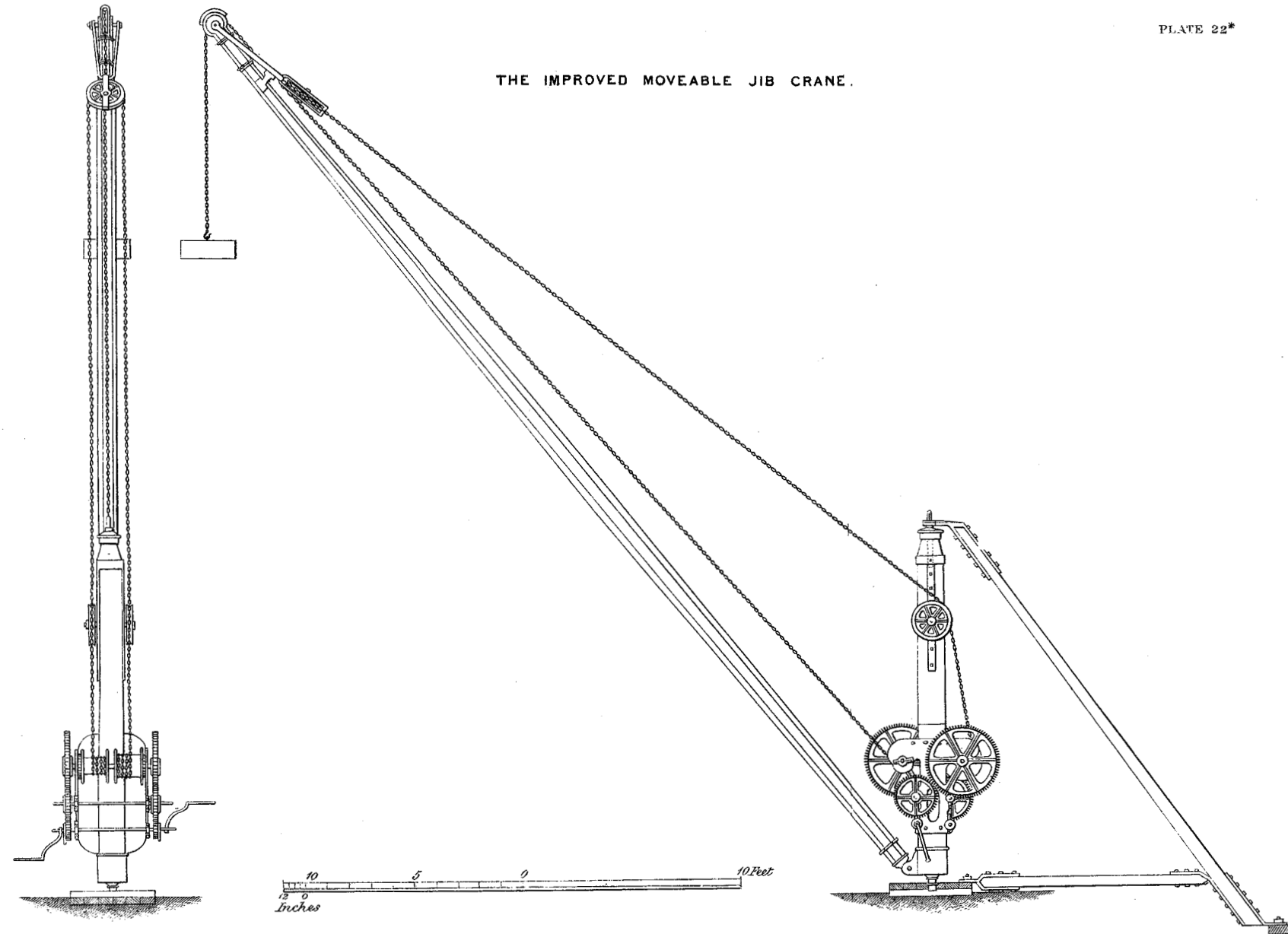


Scale.

10 Feet

E. Gulliford, lith. H. Howard St. Strand.

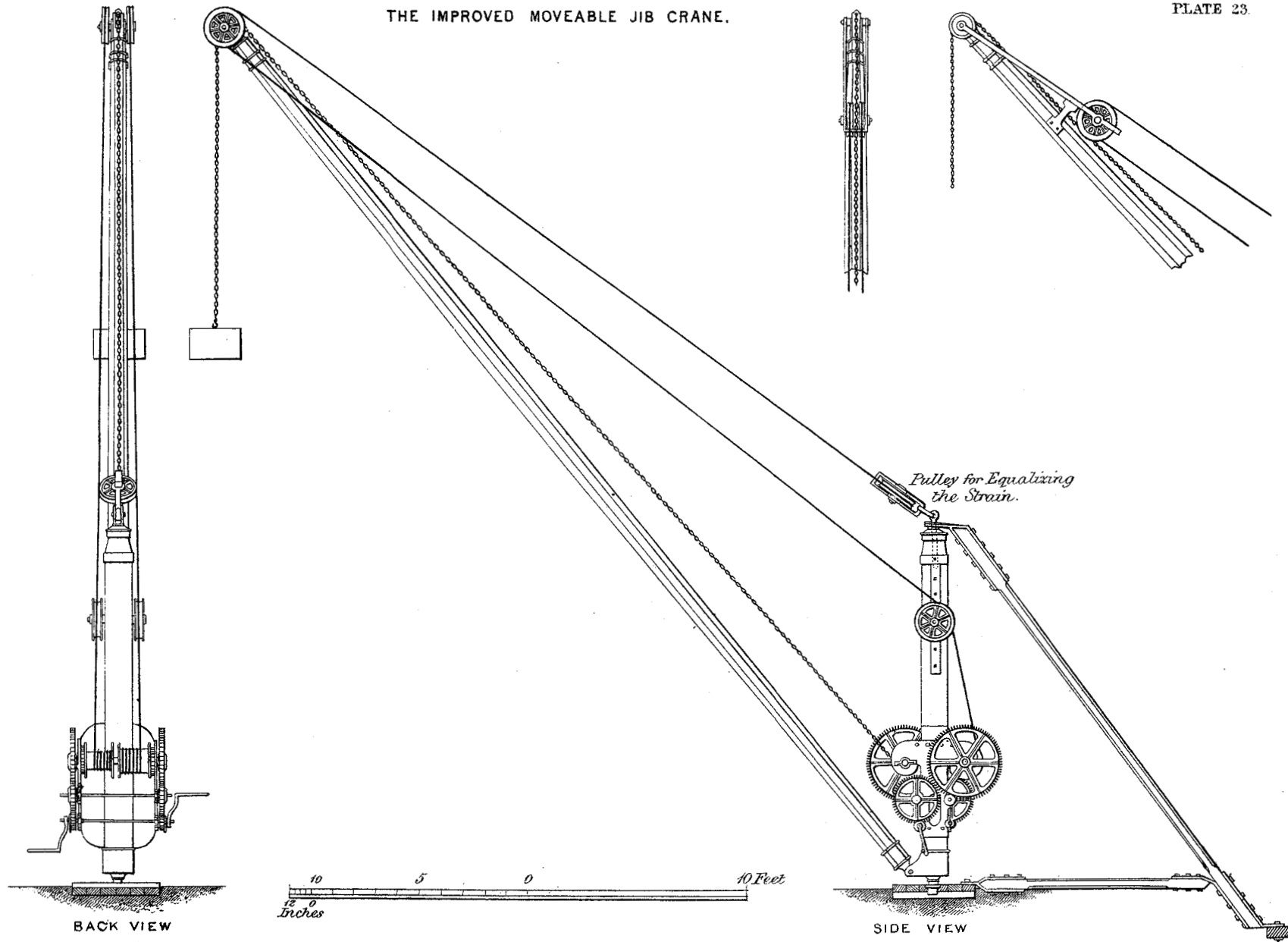
THE IMPROVED MOVEABLE JIB CRANE.



E. Culliford, 11th Howard St. Strand.

THE IMPROVED MOVEABLE JIB CRANE.

PLATE 23.



E. Gullford, 12th. St. Howard St. Strand.

TABLE contrasting the AMOUNT OF STRAIN on the JIB CHAIN according to the Present and Proposed Modes of Construction of the Moveable Jib Crane, having Weights attached of from One to Five Tons; the height of the Pulley in the Post being 12 feet.

Length of Jib.	Inclination of Jib.	Weight attached—1 Ton.		Weight attached—2 Tons.		Weight attached—3 Tons.		Weight attached—4 Tons.		Weight attached—5 Tons.	
		Present.	Proposed.	Present.	Proposed.	Present.	Proposed.	Present.	Proposed.	Present.	Proposed.
Feet.	Hor.	Tons. cwt. qrs. lbs.	Tons. cwt. qrs. lbs.	Tons. cwt. qrs. lbs.	Tons. cwt. qrs. lbs.	Tons. cwt. qrs. lbs.	Tons. cwt. qrs. lbs.	Tons. cwt. qrs. lbs.	Tons. cwt. qrs. lbs.	Tons. cwt. qrs. lbs.	Tons. cwt. qrs. lbs.
25	45°	3 6 2 7	1 12 0 27	5 18 2 10	2 16 1 11	8 10 2 13	4 0 1 23	11 2 2 16	5 4 2 7	13 14 2 19	6 8 2 19
		1 18 3 8	0 18 0 18	3 10 1 0	1 12 2 1	5 1 2 20	2 6 3 12	6 13 0 12	3 1 0 23	8 4 2 4	3 15 2 6
30	Hor.	3 19 1 26	1 18 1 24	6 19 2 22	3 6 1 3	9 19 3 18	4 14 0 10	13 0 0 14	6 1 3 17	0 1 10	7 9 2 24
		2 9 0 8	1 2 3 20	4 7 2 13	2 0 2 0	6 6 0 18	2 18 0 8	8 4 2 23	3 15 2 16	10 3 1 0	4 13 0 24
35	Hor.	4 13 3 21	2 5 0 16	8 2 3 0	3 16 2 16	11 11 2 7	5 8 0 16	15 0 1 14	6 19 2 16	18 9 0 21	8 11 0 16
		3 0 0 25	1 7 3 27	5 6 0 6	2 8 3 3	7 11 3 15	3 9 2 7	9 17 2 24	4 10 1 11	12 3 2 5	5 11 0 15
40	45°	9 5 2 7	2 12 1 10	9 6 3 23	4 7 2 3	13 4 1 11	6 2 2 24	17 1 2 27	7 17 3 17	20 19 0 15	9 13 0 10
		3 12 0 20	1 13 1 17	6 5 1 5	2 17 1 19	8 18 1 18	4 1 1 21	11 11 2 3	5 5 1 23	14 4 2 16	6 9 1 25
45	Hor.	6 6 3 7	3 0 1 26	10 12 3 27	4 19 2 8	14 19 0 19	6 18 2 18	19 5 1 11	8 17 3 0	23 11 2 3	10 16 3 10
		4 5 1 1	1 19 2 1	7 5 3 11	3 6 3 24	10 6 1 21	4 14 1 19	13 7 0 3	6 1 3 14	16 7 2 13	7 9 1 9
50	45°	7 5 2 2	3 9 1 15	12 0 1 24	5 12 1 17	16 15 1 18	7 15 1 19	21 10 1 12	9 18 1 21	26 5 1 6	12 1 1 83
		4 19 1 4	2 6 1 15	8 7 1 8	3 17 1 26	11 15 1 12	5 8 2 9	15 3 1 16	6 19 2 20	18 11 1 20	8 10 3 3
55	Hor.	8 5 3 19	3 19 0 0	13 9 2 13	6 5 3 18	18 13 1 7	8 12 3 8	23 17 0 1	10 19 2 26	29 0 2 23	13 6 2 16
		5 14 1 12	2 13 3 4	9 9 2 15	4 8 2 2	13 4 3 18	6 3 1 0	17 0 0 21	7 17 3 26	20 15 1 24	9 12 2 24
60	Hor.	9 8 1 9	4 9 3 3	15 0 3 1	7 0 2 12	20 13 0 21	9 11 1 21	26 5 2 13	12 2 1 2	31 18 0 5	14 13 0 11
		6 10 2 23	3 1 3 9	10 13 2 13	5 0 0 26	14 16 2 3	6 18 2 15	18 19 1 21	8 17 0 4	23 2 1 11	10 15 1 21

[1845.]

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TABLE showing the different Calculations entered into in order to obtain the Amount of Strain on the Jib Chain, with Jibs of various lengths, according to the Present and Proposed Construction of the Moveable Jib Crane; the height of the Pulley in the Post being 12 feet, and the Weight attached being One Ton.

Common to both modes.				Present Construction with Single Jib Chain.						Proposed Construction with Double Jib Chain.					
Length of Jib.	Angle of Jib.	Amount of Weight of attached	Amount of Weight of actual Weight Raised.	Value of Multiple	Strain on Jib Chain, exclusive of Friction.	Value of Multiple for Friction.	Amount of Weight for Friction.	Total Amount of Strain on Jib Chain.	Amount of Weight of actual Weight Raised.	Value of Multiple	Strain on Jib Chain, exclusive of Friction.	Value of Multiple for Friction.	Amount of Weight for Friction.	Total Amount of Strain on Jib Chain.	Tons, cwt., qrs., lbs.
Feet.	Hor.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	Tons, cwt., qrs., lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	Tons, cwt., qrs., lbs.	
25	45°	2,240	6.6	2,866	6,878	.084	577	3 6 2 7	756	2,996	3,295	.096	316	1 12 0 27	
30	45°	2,240	527	2,767	4,095	.062	253	1 18 3 8	597	2,837	1,872	.087	162	0 18 0 18	
30	Hor.	2,240	717	2,957	8,220	.083	682	3 19 1 26	859	3,099	3,835	.095	373	1 18 1 24	
35	45°	2,240	612	2,852	5,100	.059	306	2 9 0 8	683	2,923	2,367	.085	201	1 2 3 20	
35	Hor.	2,240	818	3,058	9,724	.082	797	4 13 3 21	970	3,210	4,622	.094	434	2 5 0 16	
40	45°	2,240	704	2,944	6,388	.056	357	3 0 0 25	776	3,016	2,895	.083	240	1 17 3 27	
40	Hor.	2,240	931	3,171	11,352	.081	919	5 9 2	1,092	3,332	5,364	.093	498	2 12 1 10	
45	45°	2,240	804	3,044	7,670	.054	414	3 12 0 20	876	3,116	3,458	.082	283	1 13 1 17	
45	Hor.	2,240	1,056	3,296	13,151	.080	1,052	6 6 3 7	1,226	3,466	6,204	.092	570	3 0 1 26	
50	45°	2,240	912	3,152	9,077	.052	472	4 5 1 1	984	3,224	4,094	.081	331	1 19 2 1	
50	Hor.	2,240	1,193	3,433	15,105	.079	1,193	7 5 2 2	1,373	3,613	7,117	.092	654	3 9 1 15	
55	45°	2,240	1,029	3,269	10,591	.050	529	4 19 1 4	1,101	3,341	4,811	.080	384	2 6 1 15	
55	Hor.	2,240	1,344	3,584	17,239	.078	1,344	8 5 3 19	1,537	3,777	8,120	.091	728	3 19 0 0	
60	45°	2,240	1,155	3,395	12,222	.048	586	5 14 1 12	1,228	3,468	5,583	.079	441	2 13 3 4	
60	Hor.	2,240	1,512	3,752	19,585	.077	1,508	9 8 1 9	1,716	3,956	9,217	.091	888	4 9 3 3	
45°		2,240	1,291	3,531	13,982	.047	657	6 10 2 23	1,366	3,606	6,418	.078	507	3 1 3 9	