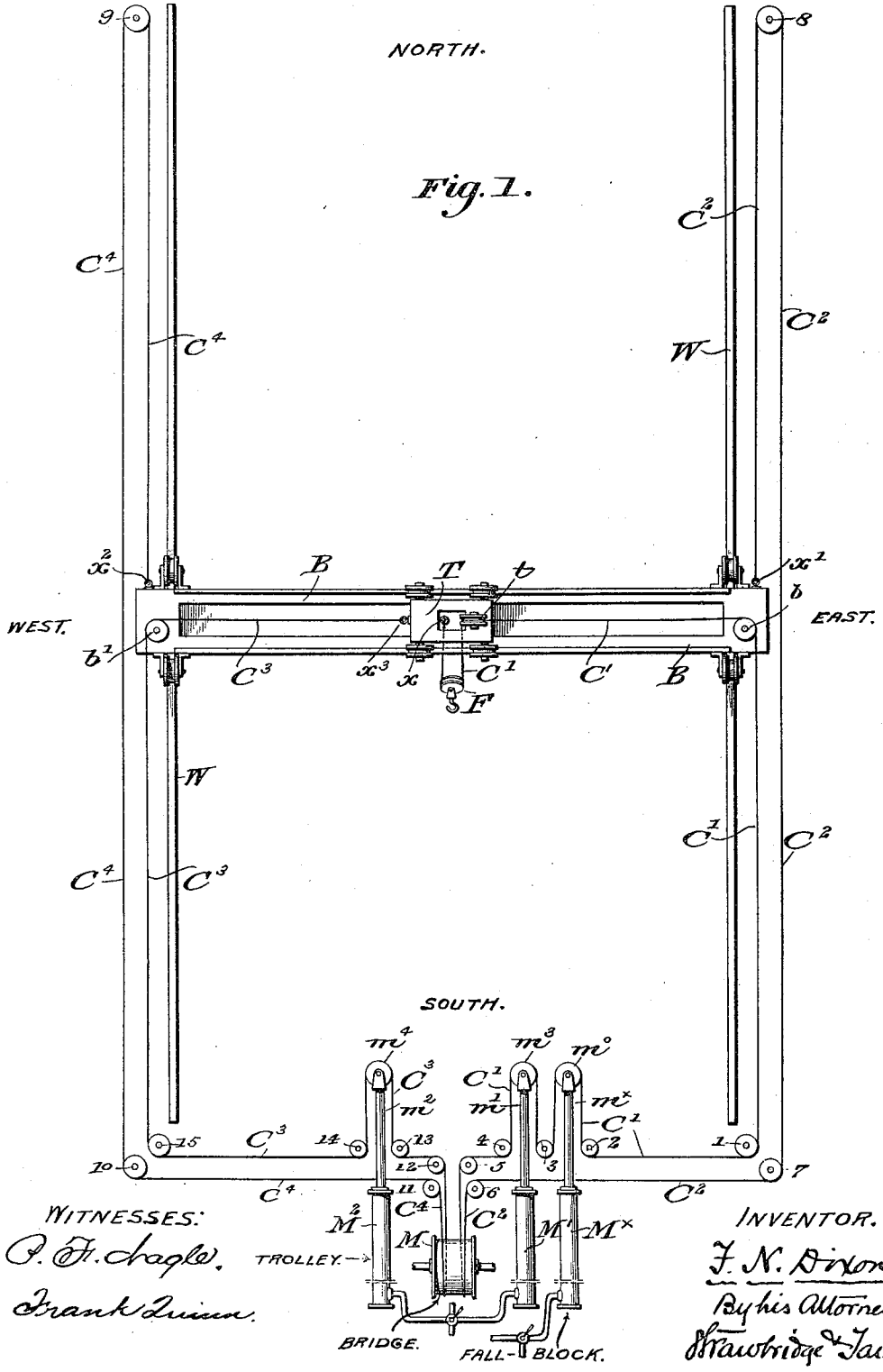
(No Model.) 8 Sheets—Sheet 1.

F. N. DIXON.

TRAVELING CRANE.

No. 451,269. Patented Apr. 28, 1891.

Fig. 1.



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(No Model.) 8 Sheets—Sheet 2.

F. N. DIXON.

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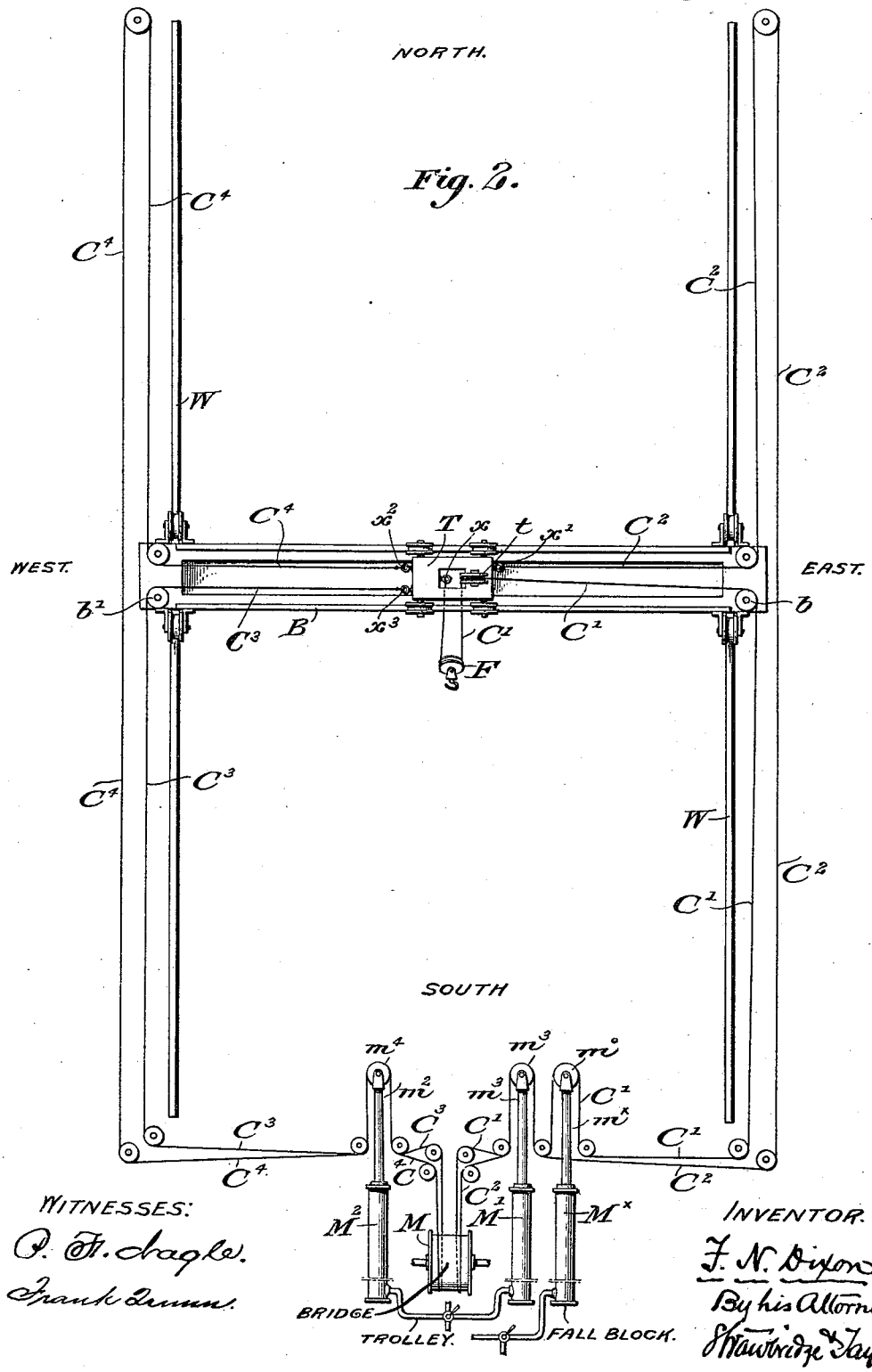

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F. N. DIXON.

TRAVELING CRANE.

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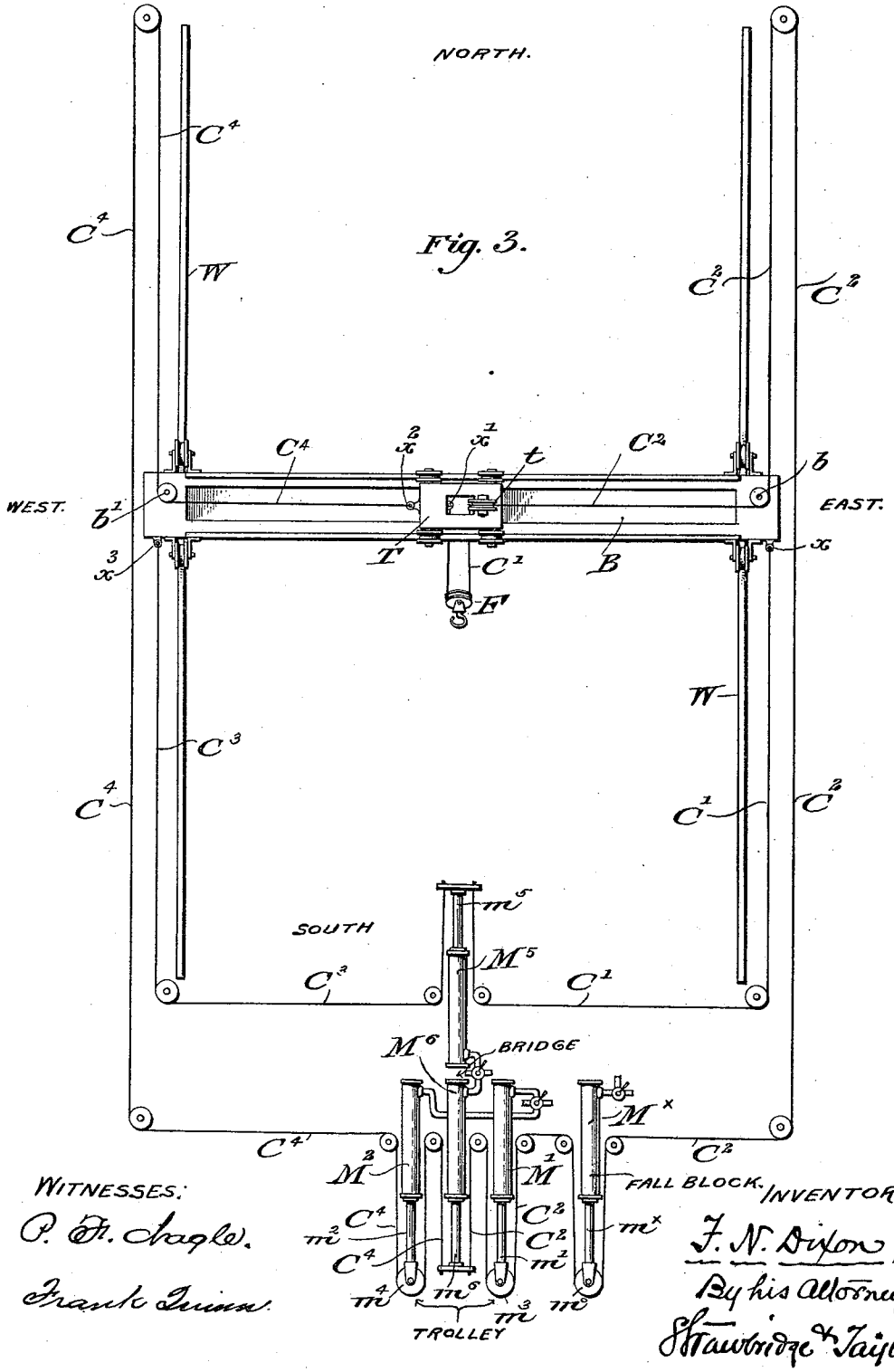

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TRAVELING CRANE.

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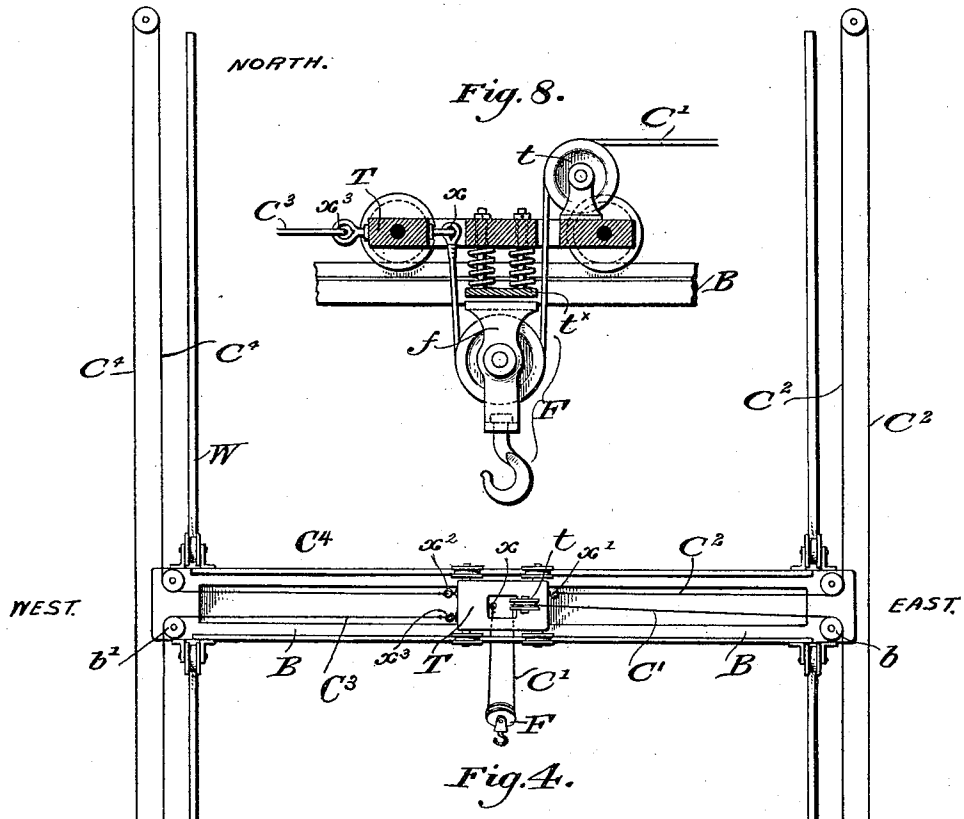

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(No Model.)

8 Sheets—Sheet 5.

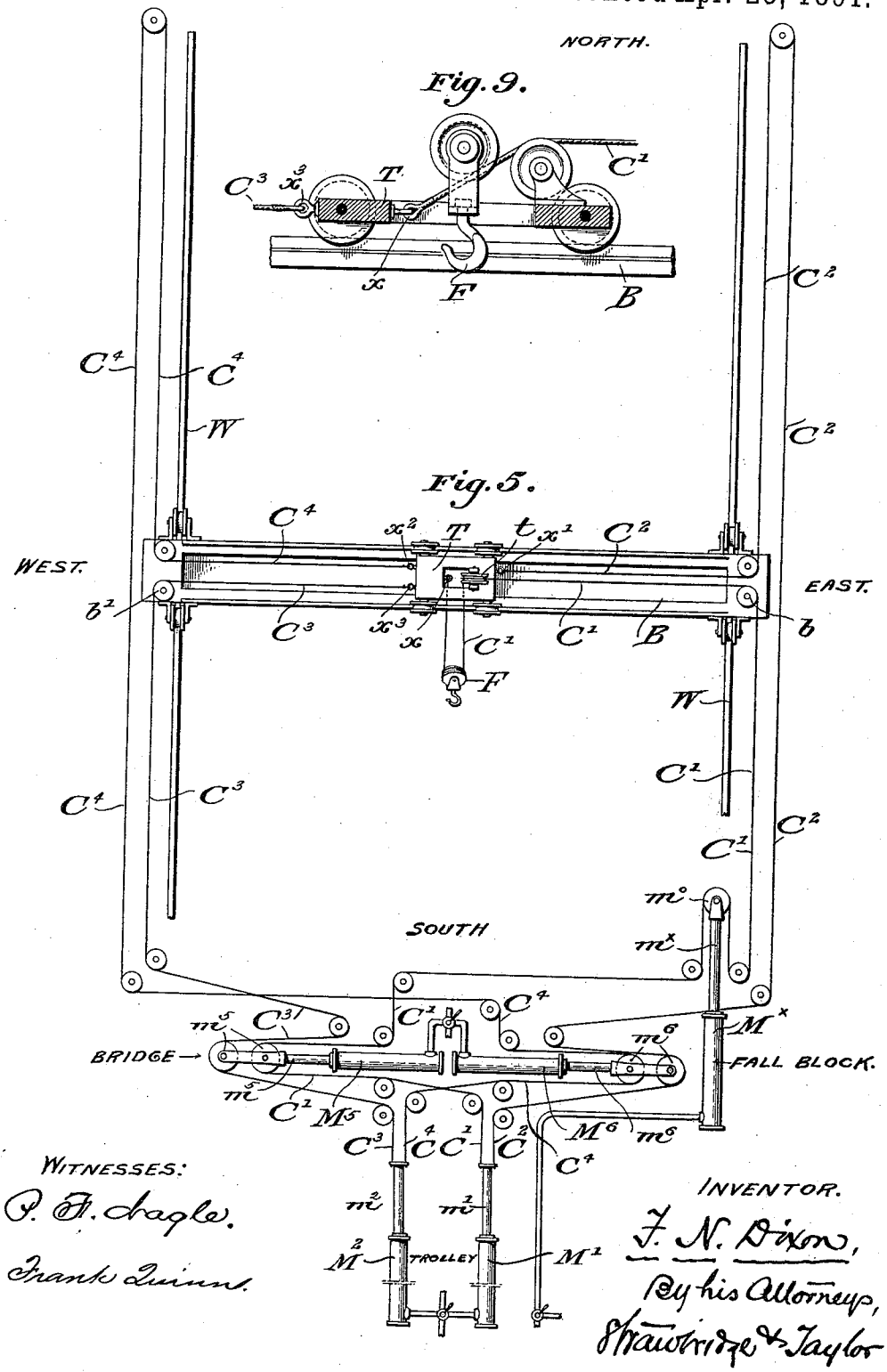
F. N. DIXON.

TRAVELING CRANE.

No. 451,269. Patented Apr. 28, 1891.

Fig. 9.

Fig. 5.



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TRAVELING CRANE.

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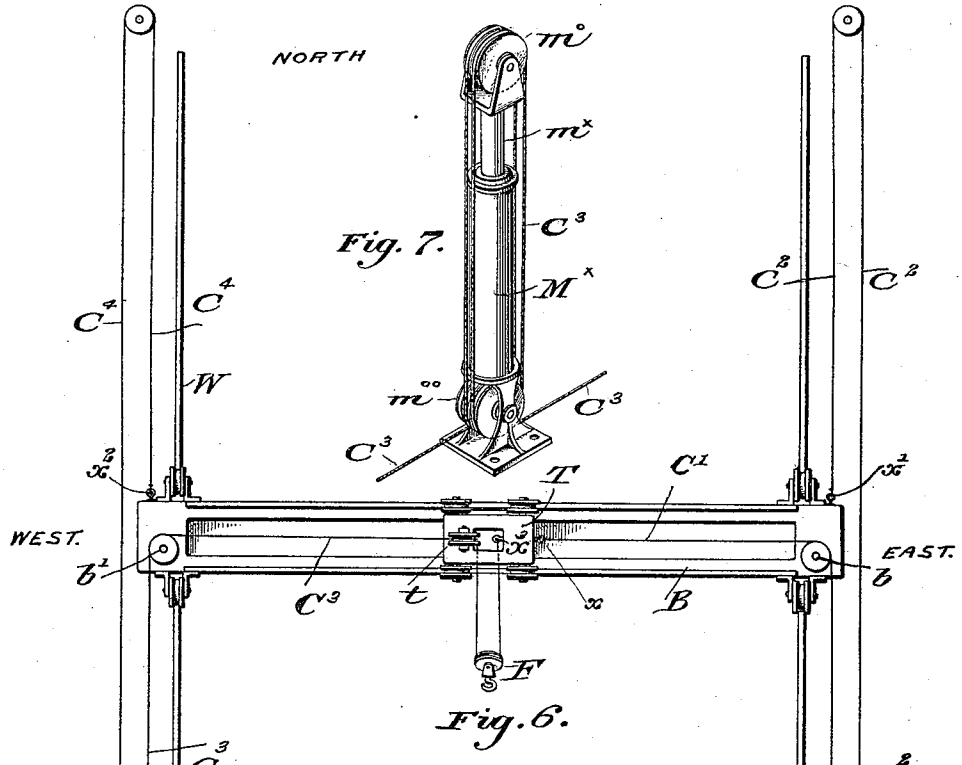
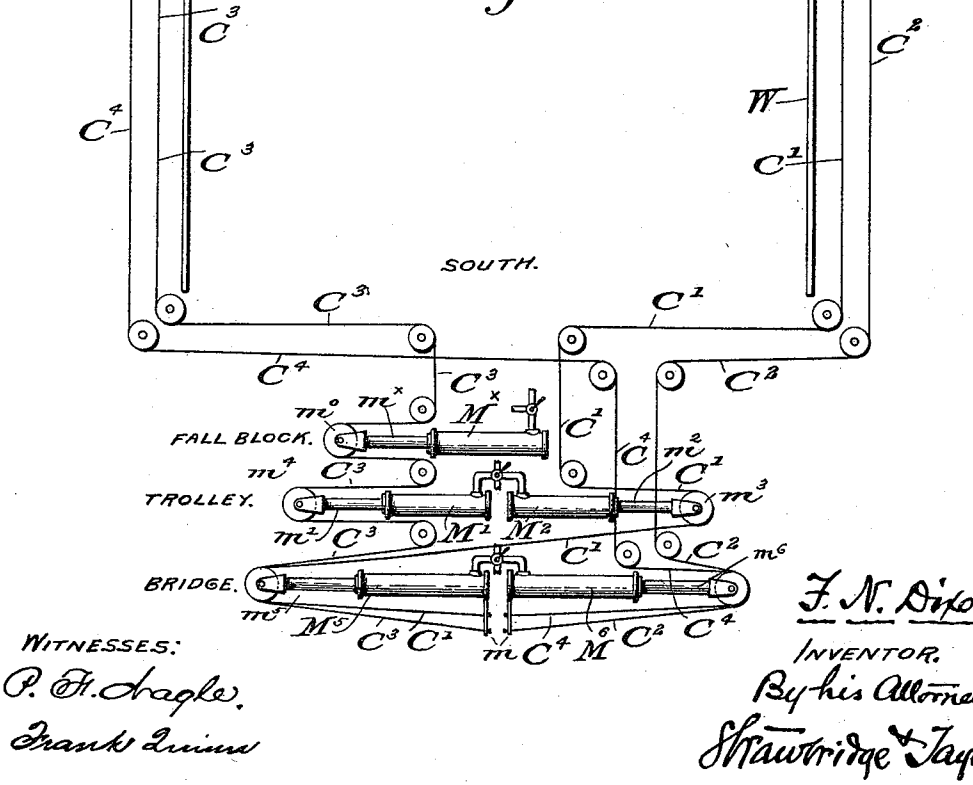


Fig. 7.

Fig. 6.



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F. N. DIXON.

TRAVELING CRANE.

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Fig. 10.

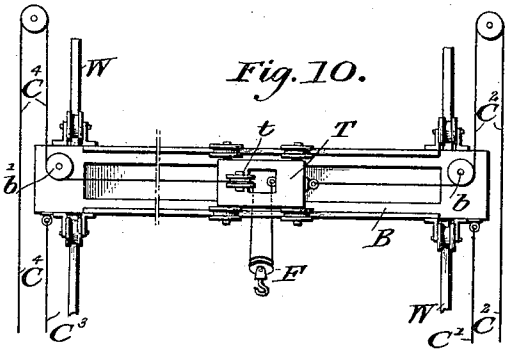


Fig. 11.

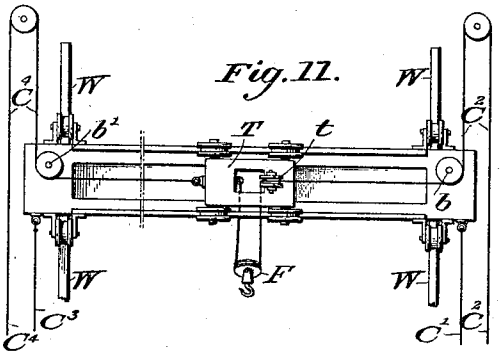


Fig. 12.

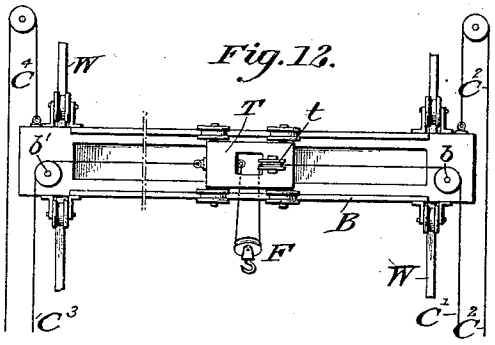


Fig. 13.

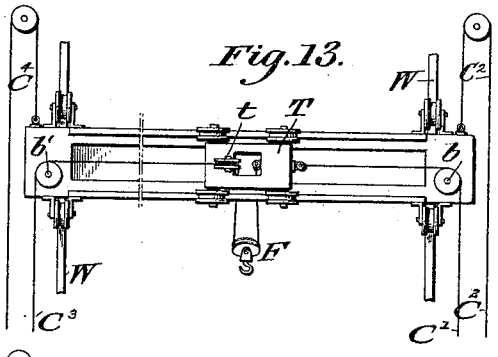


Fig. 14.

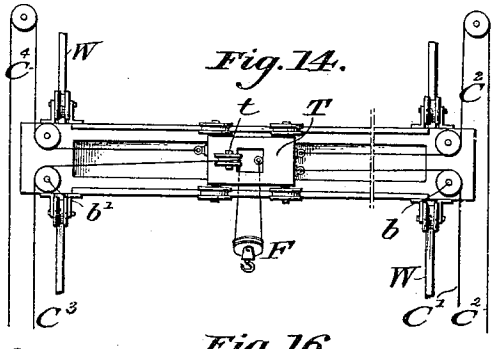


Fig. 15.

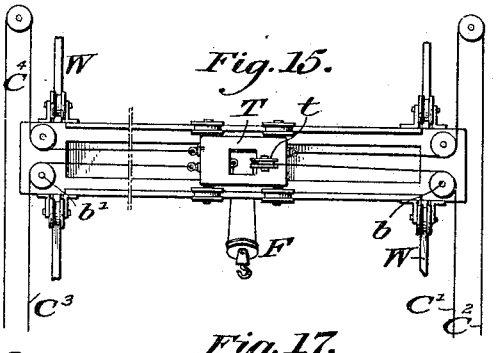


Fig. 16.

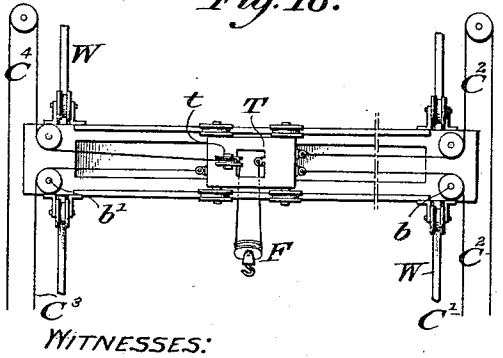
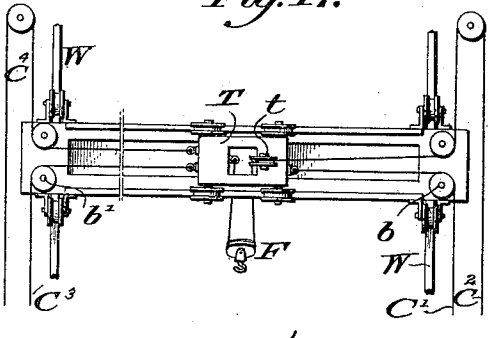


Fig. 17.



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F. N. DIXON.

TRAVELING CRANE.

No. 451,269. Patented Apr. 28, 1891.

Fig. 18.

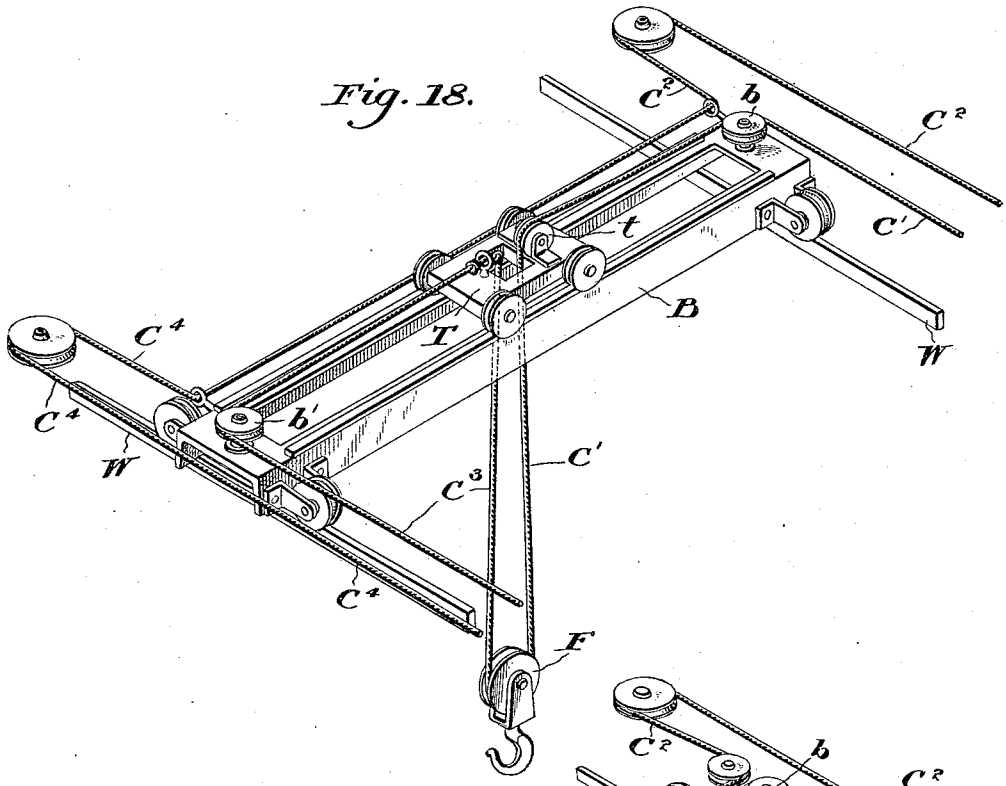
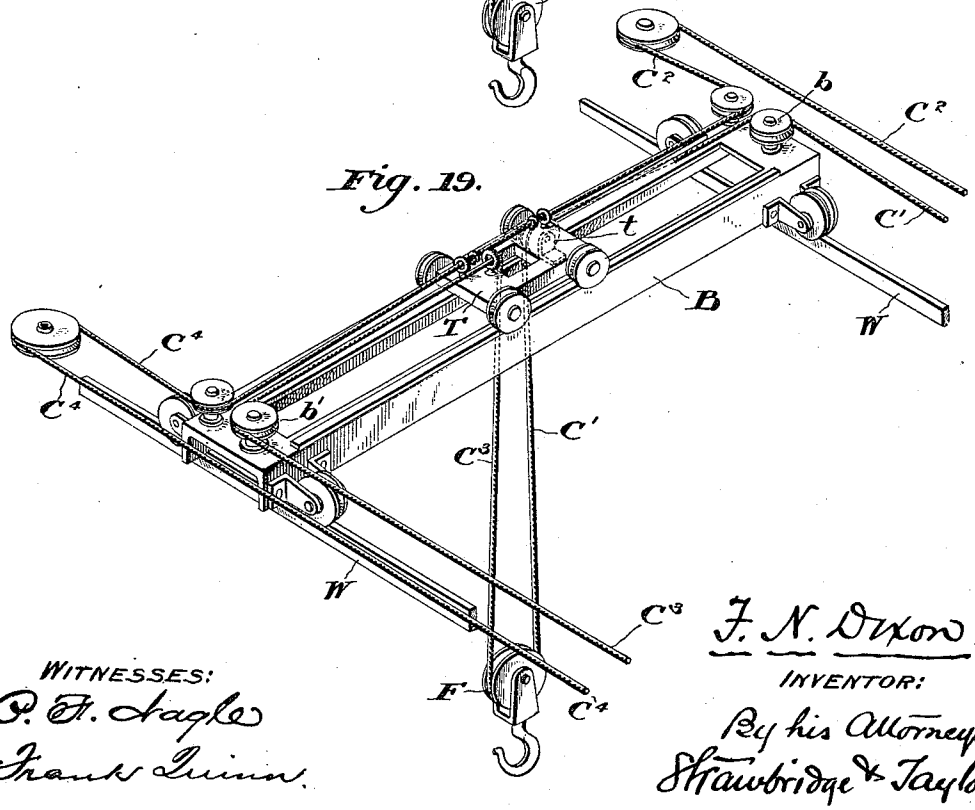


Fig. 19.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

FREDERIC NORMAN DIXON, OF PHILADELPHIA, PENNSYLVANIA.

TRAVELING CRANE.

SPECIFICATION forming part of Letters Patent No. 451,269, dated April 28, 1891.

Application filed January 7, 1891. Serial No. 377,010. (No model.)

To all whom it may concern:

Be it known that I, FREDERIC NORMAN DIXON, a citizen of the United States, residing in the city and county of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Traveling Cranes, of which the following is a specification.

My improvements relate to what are technically known as double-track traveling cranes, in which a transversely-extending bridge is adapted to be moved in either direction with respect to and longitudinally of parallel bridge-ways, in which a carriage or trolley is adapted to be moved in either direction with respect to and longitudinally of said bridge, and in which a hoisting-tackle, sheave-provided fall-block, or hook, depending from the trolley is adapted to have vertical movement with respect thereto.

In cranes of the foregoing character the bridge-ways, bridge, trolley, and fall-block, have been variously constructed and arranged, and the movement of the bridge with respect to its ways, of the trolley with respect to the bridge, and of the fall-block with respect to the trolley, have been accomplished by various means.

In traveling cranes of what are known as the "movable-cable" type, hereinafter referred to, as heretofore constructed, the bridge, the trolley, and the fall-block, are three elements the various movements of which are derived from a fourth element, namely, a motor or actuating device, operative upon a fifth element, namely, a rope or cable device, being a connective medium between the motor and the bridge, or the motor and the trolley, or the motor and the fall-block,—or, in connection with brakes, between the motor and the bridge and the trolley, or the motor and the bridge and fall-block, or the motor and the trolley and fall-block,—or, likewise in connection with brakes, between the motor and the bridge trolley and fall-block. While the history of the art shows merely mechanical variations in the construction and relative arrangement of the bridge, trolley, fall-block, and motor, it shows radical variations in the connective medium, being the rope or cable-connection operative between the motors or actuating devices, and the bridge trolley and fall block or actuated or movable devices.

In order that my improvements may be understood, it is proper to briefly describe the several important improvements in double-track traveling cranes heretofore known to the art. It being premised that a double-track traveling crane *per se* ante-dated them all, one of these improvements comprehended a double-track traveling crane in which fixed cables extending longitudinally of the bridge-ways were employed in connection with mechanism carried by the trolley upon the bridge and adapted to be engaged with said fixed cables in such manner that when operated, it, by virtue of such engagement, occasioned the desired movements of both the bridge and trolley or either of them. Certain improvements upon the foregoing fixed-cable type of crane, comprehended special mechanism located either on the trolley or the bridge, for securing the propulsion of the bridge and trolley by the aid of the fixed cables. Other inventions comprehended certain improvements in double-track traveling cranes, known as "movable-cable" cranes, in which the bridge was pulled along by moving cables (alone or in connection with a fixed cable,) as distinguished from the fixed cables of the earlier devices upon which the bridge was pulled along—the said movable cables having been suitably connected with the bridge and operated from a motor either independent of the crane structure or carried by the bridge. Another improvement comprehended a traveling-crane of the movable-cable type, in which a single movable cable engaged with the bridge and actuated by a motor independent of the bridge was employed to occasion the travel of the bridge; in which, also, a second single movable cable engaged with both the trolley and the fall-block and also actuated by a motor independent of the bridge was, by the aid of brakes applied in connection with the trolley, adapted to occasion the movements of both the trolley and fall-block and of either of them. Another improvement comprehended a traveling crane of the movable-cable type, in which a single movable cable actuated by a motor independent of

the bridge was engaged not only with the bridge and trolley but also with the fall-block, and, by the aid of brakes applied in connection with both the bridge and the trolley, was operative upon any one of said three elements. Another improvement comprehended a traveling crane of the movable-cable type, in which a movable-cable-connection, actuated by motors independent of the bridge, was engaged with both the bridge and the trolley, and, by the aid of brakes applied in connection with the bridge, was operative upon either the bridge or the trolley. Another improvement comprehended a traveling crane of the movable-cable type, in which a single movable cable engaged with the bridge trolley and fall-block was, by the aid of brakes applied in connection with the bridge, operative upon either the bridge or the fall-block. Another improvement comprehended a traveling crane, in which a single movement cable engaged with the bridge trolley and fall-block was, without the aid of brakes, operative upon the fall-block.

Such being a summary of the prior art, it should be further explained that my improvements relate to traveling cranes of the movable-cable type, in which the actuating mechanism is independent of the bridge and consequently of the crane structure, and preferably grouped or concentrated in the region of what is termed the "initial" as opposed to the "distant" or "terminal" end of the bridge-ways or "line."

The object of my improvements is the construction of a double-track traveling-crane of the movable-cable type, in which the connective medium is common to and operative upon any two or all three, that is to say upon a plurality, of the movable devices, namely, the bridge the trolley and the fall-block, and adapted solely through the instrumentality of suitable motive or actuating mechanism located at a point independent of the crane structure, and wholly without the aid of brakes or kindred contrivances, to operate, as the case may be, any one any two or all three of said movable elements, and in which every desired or possible movement of said devices or elements, or of any one, any two, or all three of them, can be induced through said common cable-connection as operated from a point independent of the crane structure solely by said suitable motive mechanism operative parts of which are in operative engagement with said cable-connection. The brakes heretofore employed,—and which, as stated, I dispense with,—have been connected with or carried by either the bridge or the trolley, and have been directly operative upon the cable-connection to, at will when operated, temporarily but positively attach said connection to either one or to both of said elements. My improvements, in this omission of brakes or their equivalent, comprehend a radical departure from prior constructions of double-track movable-cable traveling cranes, and careful contradistinction must, therefore, be drawn between that which is of the essence of the invention and that which is merely formal and mechanical. As a prefatory explanation it may, accordingly, be said that my invention comprehends the combination with any two or with all three, that is to say with a plurality, of the movable elements of a double-track traveling-crane, of a movable-cable-connection common to and operative upon any two or all three of said movable elements and with respect to them operatively connected with suitable actuating mechanism which comprises operative parts respectively adapted through said cable-connection to control the respective movable devices, in such manner that said cable-connection may, at will, by the action of the appropriate operative part or parts of the actuating mechanism, be controlled to occasion any desired separate successive or simultaneous movement of said movable devices,—the operative part or parts of said mechanism which are for the time being out of action simply maintaining the movable device or devices which it or they control, at rest and unaffected by the traction upon the common cable-connection occasioned by the action of the operative part or parts in motion,—and all wholly without resort to brakes or their equivalents.

The practical or mechanical or workshop embodiment of my improvements, that is to say, the application and arrangement of the cable-connection with respect to the movable devices, and the organization application and arrangement of the actuating mechanism *per se* and with respect to the cable-connection, may be almost indefinitely varied.

Several of the many possible and practical types of modification or variation in the constructions and arrangements of the elements which in their organization and relative application or arrangement equally and alike embody my improvements, are represented in the accompanying drawings, and hereinafter described.

All of the figures of the accompanying drawings, except Figures 7, 8, 9, 18 and 19, are diagrammatic views illustrating in outline or "dummy" plan, and without regard to mechanical details which appertain solely to the workshop and are within the province of any constructor, the general construction and special applications and relative arrangements of the various elements in the combined assemblage of which my improvements are embodied.

In all of the figures similar letters of reference indicate corresponding parts, and in all of them the parallel bridge ways are designated by the letter W, the bridge by the letter B, the trolley by the letter T, the fall-block by the letter F, the cable-connection by powers of the letter C, the actuating or motor mechanism by the letter M and by powers

thereof both in upper and lower case, and the directing sheaves, wherever designated, by numerals.

I have also, to facilitate description, applied to each sheet assumed cardinal points of the compass.

In the drawings I have also represented actuating mechanism in the form only of hydraulic rams or of drums assumed to be operated either by rams or otherwise, as desired. It is, however, to be understood that in depicting only such devices, I do not intend to limit myself to them alone as motors, but simply to indicate them as convenient and useful types of motors, for which, however, may be substituted other known motors actuated by steam, pneumatic or hydraulic pressure, or electricity. Whenever, moreover, I represent as an operative part of the actuating mechanism, a double ram embodying a pair of cable-sheave-provided plungers, the movement of these plungers is to be understood as in uniformly equal opposite correspondence.

Referring now to Fig. 1, in which is represented a very simple embodiment or type of my invention, in which the bridge trolley and fall-block are each and all adapted to be operated by a common rope or cable-connection actuated by a motive instrumentality independent of the bridge and preferably located and concentrated at the initial end of the bridge-ways or "line",—the bridge ways W, bridge B, trolley T, and fall-block F, are all of any usual or preferred construction. Of these devices the bridge trolley and fall-block may be designated as the "movable" or actuated devices. The motive instrumentality or actuating mechanism represented in this embodiment is composed of certain operative parts or members, namely:—a motor drum M, adapted in any preferred manner to be rotated in either direction upon its axis,—a double ram, composed of a pair of cylinders M' M^2, the plungers m' m^2 of which are at their outer extremities equipped with plunger or cable sheaves m^3 m^4,—and a single hydraulic ram $M^\times$, the plunger $m^\times$ of which is similarly equipped with a plunger or cable sheave m^0. This motive mechanism considered as an entirety is operative upon the cable-connection to occasion in it, or in selected portions or divisions of it, various movements; and of its operative parts or members the drum may, for the sake of explanation, be said to be the actuating device of the bridge or the bridge-moving part or member,—the double ram the actuating device of the trolley or the trolley-moving part or member,—and the single ram the actuating device of the fall-block or the fall-block-moving part or member.

The cable-connection, although herein for explanation described as composed of portions or divisions, is, in fact, a unit intermediary of the actuating and actuated devices. Tracing the course of the cable-connection, the better to describe it, as shown in the construction of said Fig. 1, it may, for purposes of explanation only, be considered as commencing at and securely connected with the trolley at x, and, under the designation of the division C', as passing thence down and around the usual sheave of an ordinary fall-block F, thence up and around a trolley-sheave t, thence east along the bridge to a bridge sheave b at the eastern end of the bridge, thence south along the eastern bridge-way to the initial end of the "line," thence around one or more directing sheaves 1 and 2, thence around the plunger or cable-sheave m^0 of the (fall-block) ram $M^\times$, thence around a directing sheave 3, thence around the plunger or cable sheave m^3 of the cylinder M' of the double (trolley) ram, thence around directing sheaves 4 and 5, and thence to and once or oftener around the motor (bridge) drum M;—and, under the designation of the division C^2, as passing from said drum around one or more directing sheaves 6 and 7, thence north along the eastern bridge-way to and around a directing sheave 8 at the terminal end of the "line," thence south to the bridge, to which, in the arrangement shown, it is securely fixed at x', although for the purpose of illustrating its practical continuity it may, as shown in Fig. 18, be considered as continuing west along the bridge to its point of connection x^2 at the western end of the bridge;—and, under the designation of the division C^4, as passing thence north from the point of connection x^2 to a directing sheave 9 at the terminal end of the "line", thence south along the western bridge-way to a directing sheave 10 at the initial end of the "line," thence east to a directing sheave 11, thence to and once or oftener around the motor (bridge) drum M;—and, under the designation of the division C^3, as passing from said drum around one or more directing sheaves 12 and 13, thence around the plunger-sheave m^4 of the cylinder M^2 of the double (trolley) ram, thence around one or more directing sheaves 14 and 15, thence north in the direction of the western bridge-way to a bridge-sheave b' at the western end of the bridge, thence east along the bridge to a point of fixed attachment x^3 with the trolley, at which point said cable-connection may, for the purposes of this explanation only, be considered as terminating, although, for the purpose of illustrating its physical continuity, it may, as shown in Fig. 18, be considered as united with the division C'. Consideration of this cable-connection will render it apparent that, while for descriptive purposes it has been treated as composed of divisions C', C^2, C^3, and C^4, and while it may be properly considered as so composed, it yet in fact and effect and with equal propriety of consideration is, as shown in Fig. 18, a practically single rope or cable, which may as well be considered as starting from a part of the actuating motor or from the bridge or fall-block as from the trolley, and which runs a practically endless although divisional course in common operative connection with all of the members (drum,

double ram, and single ram) of the selected type of motive or actuating mechanism of the crane, and also in common operative connection with the other or "moving" members of the crane as an entirety, namely, the bridge the trolley and the fall-block. From a contemplation of the course and application of the so-called division C′ of the cable-connection, it will moreover be readily apparent that if traction be exerted upon said division C′, the result, if the fall-block be down, will simply be to raise it to the limit of its upward movement; and be equally apparent that the expulsion of the plunger $m^{\times}$ of the single ram $M^{\times}$ acting upon said branch C′ will serve to effect this result, from which it follows of course, that if the plunger be retracted, the fall-block will descend. From a contemplation of the courses and connection of all of the so-called divisions of said cable-connection, it will be further apparent,—assuming the fall-block either elevated taut as shown in Fig. 9, or into contact with the trolley, as shown in Fig. 8, or else held down by a load sufficient to maintain the division C′ taut against traction,—that if traction to the southward be exerted equally and simultaneously upon the divisions C′ and C^3, and release be simultaneously equally and correspondently made upon the divisions C^2 and C^4, the bridge will be drawn to the south, the trolley simply acting as a continuation of the bight formed by the running in along the bridge and practical merger in it of the divisions C′ and C^3, and not itself moving. It will be further apparent that if, upon the other hand, similar traction be similarly exerted upon the divisions C^2 and C^4, and similar simultaneous release be similarly made upon the divisions C′ and C^3, the bridge will be caused to move to the north, the trolley again not moving but being maintained in equilibrium by the divisions C′ and C^3. Now the above described traction upon a given pair of the divisions of the cable-connection, and the above-described proportional release upon the correspondingly-opposite (antipodal) pair of divisions, is easily and accurately effected by the rotation in one or the other direction of the motor drum M with which all of the so-called divisions of the cable-connection are, by being wrapped around it, operatively engaged,—the said rotation operating to pull in and to correspondingly pay out the opposing pairs of divisions. The motor drum, therefore, according to the direction of its rotation, occasions, in the typical organization under discussion, the travel of the bridge either north or south, without in any wise affecting either the trolley or the fall-block. From a still further consideration of the so-called divisions and points of application of the cable-connection, it will be further apparent that if, while the divisions C^2 and C^4 are held or maintained so as to be temporarily inactive or static, the division C′ be pulled to the south and the division C^3 correspondently and simultaneously released so that it may move to the north, the trolley will be drawn to the east; whereas if, during the similar inaction or repose of the divisions C^2 and C^4, the division C^3 be pulled to the south and the division C′ correspondently and simultaneously released so that it may move to the north, the trolley will be drawn to the west,—the bridge in either case remaining in a state of equilibrium or rest. This corresponding opposite manipulation of divisions which in the typical organization under discussion directly act upon the trolley or the trolley and fall-block, as C′ and C^3, while other divisions, as C^2 and C^4, are permitted to be inactive and maintained at rest, is, in said typical organization, conveniently accomplished by the correspondingly opposite movement of the cable-sheave-provided plungers of the double ram $M'\ M^2$,—traction upon the division C′ being occasioned by the expulsion of the plunger m' of the cylinder M′, while equal release upon the division C^3 is simultaneously and correspondently made by the retraction of the plunger m^2 of the cylinder M^2, which retraction, as explained, is necessarily correspondently opposite to the movement of expulsion of the plunger m'. Obviously, the reverse movement of the said plungers m' and m^2 will occasion through the expulsion of the plunger m^2 and the retraction of the plunger m', traction upon the division C^3 and correspondent release upon the division C′, with the result that the trolley will under such action be moved to the west instead of to the east as in the movement of the associated rams first described.

Having now explained in what manner the actuating mechanism is operative, in the construction represented in Fig. 1 under discussion, to occasion the separate operation of the fall-block, or of the trolley, or of the bridge, it will be manifest that any one of these so-called "movable" elements (bridge, trolley, or fall-block) may be separately first moved and the other two be in either sequence subsequently moved, or that any two or all three may be simultaneously moved,—and this by reason of the fact that the rope division C′ will always run idly although in operative connection or engagement with respect to the cable-sheave m^0 of the single (fall-block) ram $M^{\times}$; and that, similarly, the rope divisions C′ C^3 will always run idly although in operative connection with respect to the cable-sheaves of the double (trolley) ram $M'\ M^2$,—and this notwithstanding what for the time being may be the extent or direction of the movement of the cable-connection considered as an entirety under the movements imparted to it by the rotation of the motor drum M. It is equally apparent that any predetermined movement of either the double ram $M'\ M^2$ or of the single ram $M^{\times}$ or of both, may be made simultaneously and without any possible interference with any predetermined movement of the motor drum M. So far, however, as the double

ram M′ M² (or, in fact, any of the associated rams represented or herein described), are concerned, the portions of the divisions upon which they act may, for the purposes of explanation, be, in the typical embodiments represented in the drawings, considered simply as so many added lengths or loops of the cable-connection *per se*, the corresponding opposite manipulation (shortening and lengthening) of the two halves, so to speak, of which particular lengths or loops to occasion the movement of one movable device, is wholly without effect upon all remaining added lengths or loops of said cable-connection by the lengthening or shortening of which other movable devices are moved.

In the foregoing embodiment of my invention, which is not, however, individualized and first described because the preferred embodiment, it is obvious that the several movements, separate successive or simultaneous, of the bridge trolley and fall-block are occasioned through manipulations of the so-called divisions of the cable-connection; and, by a parity of reasoning, said cable-connection being a unit, by the manipulation of said connection itself; and obvious that this manipulation is occasioned by the operation of the actuating mechanism or of the operative parts thereof. It is further apparent that the so-called manipulation of the cable-connection to occasion bridge or trolley movements, is synonymous with the exertion of traction or force to take-up or pull in a given division or given divisions or portions of said connection, when simultaneously accompanied by the corresponding release or paying out of another or of other given divisions or portions, which in the selected movements are correspondingly opposite (antipodal) divisions or portions of the said cable-connection,—and this wholly without regard to whether other given divisions or portions of said cable-connection are maintained by the actuating mechanism in a condition of temporary rest or inaction. Thus the travel of the bridge in either direction is occasioned by traction upon divisions or portions of the cable-connection in relatively fixed or operative engagement with the bridge and leading from said bridge in the direction of its desired movement, when such traction is simultaneously accompanied by the correspondent release of maintenance balance equilibrium or retention, of other divisions or portions of said cable-connection likewise in relatively fixed or operative engagement with said bridge and leading therefrom in a direction opposite to that of its desired movement, without regard to whether said divisions considered with respect to their relation with the trolley or fall-block are active or inactive. Thus, again, the travel of the trolley in either direction is occasioned by traction exerted upon portions or divisions of the cable-connection in relatively fixed or operative engagement with it and leading from said trolley in the direction of its desired movement, when such traction is simultaneously accompanied by the correspondent release of maintenance balance equilibrium or retention of other portions or divisions of said cable-connection likewise in relatively fixed or operative engagement with said trolley and leading therefrom in a direction opposite to that of its desired movement,— without regard to whether other divisions or portions are maintained in a condition of temporary rest or inaction. It is still further apparent that the so-called manipulation of the cable-connection to occasion the movement of the fall-block toward or from the trolley, is synonymous either with the exertion of traction to take up or of release to pay out a selected portion or division of said connection,— and this also wholly without regard to whether other portions or divisions of said cable-connection are in motion under the action of the actuating mechanism or are by it maintained in a condition of temporary rest or inaction. Thus the movement of the fall-block toward or from the trolley is occasioned either by the traction or by the release of a portion of the cable-connection which is selected to be placed in operative engagement with said fall-block, and without regard to whether other divisions or portions of said cable-connection happen to be in a condition of action or of inaction or temporary maintenance in their then position.

In any one of the possible movements of the bridge trolley or fall-block, which, as stated, may be made either separately, or successively in any preferred sequence, or simultaneously, the operating power applied to the cable-connection, that is to say to a selected division or selected divisions thereof, is preferably applied to said connection at a point of actuation independent of the crane structure and bridge, and preferably in the region of the initial end of the line, and applied by a motive or actuating instrumentality of any preferred character located at said point, as to its components or several operative members preferably concentrated, and by virtue of its organization susceptible of the separate or, in any preferred sequence, of the successive, or of the simultaneous, movement of its operative members,—be they drums or rams or other preferred mechanical contrivances under the volitional control of an operator,—upon the common cable-connection. Such being the case, it is apparent that variations in the structure of the motor and in the arrangement and application of the common cable-connection may be almost indefinitely embodied and applied. Thus, for instance, assuming the cable-connection to lead in the form of double and oppositely corresponding divisions or pairs, as for instance, C′ C² and C³ C⁴ away from the actuating mechanism, these divisions or pairs may be connected with the bridge and trolley, or with the bridge trolley and fall-block, in an almost indefinite variety of ways, and, for in-

stance, in any one of the several typical arrangements selected at random and depicted in the drawings. Thus in Figs. 2, 4, 5, 14, 15, 16, 17, and 19, the divisions C′ and C³ are both directly led to the bridge and then both in to engagement with the trolley, while the divisions C² and C⁴ are both led first to the distant end of the line, then back to the bridge, and then both in to engagement with the trolley. Thus, again, in Figs. 1, 6, 12, 13 and 18, the divisions C′ and C³ are both directly led to the bridge and then both in to engagement with the trolley, while the divisions C² and C⁴ are both first led to the distant end of the line, and then both back to the bridge and respectively engaged therewith. Thus, again, in Figs. 3, 10, 11, the divisions C′ and C³ are both directly led to the bridge, and respectively engaged therewith, while the divisions C² and C⁴ are both first led to the distant end of the line, then both back to the bridge, and then both in to engagement with the trolley.

In the first of the foregoing arrangements in which all four of the divisions are led in to the trolley, it is apparent, as indicated in Figs. 2, 4, 5, and 14 to 17 inclusive, that any one of them may be selected to pass over a trolley sheave, thence down and around a sheave of the fall-block, and thence up to a point of engagement with the trolley, or, as hereinafter more particularly explained, and as, for instance, shown in Figs. 18 and 19, of endless connection with another division, so as to form a bight, simple or multiplied, with respect to which the fall-block is suspended.

In the last two of the foregoing arrangements in which either the divisions C′ and C³ or else the divisions C² and C⁴ are respectively led in to the trolley, it is apparent that either of the said divisions so led in may be passed over a trolley sheave, thence down and around a sheave of the fall-block, and thence up to a point of fixed attachment with the trolley, or, as shown in Figs. 18 and 19, of endless connection with its opposite or balancing division. These various arrangements, which are purely mechanical, are respectively represented in Figs. 1, 6, 12, and 13, and in Figs. 3, 10, and 11, of the drawings. It is proper in this connection to reiterate that the fall-block may be constituted by a simple hook at the end of a division of the cable-connection, adapted to carry the load and to be at will raised to the trolley so as to "chock" against it to render the said division taut for traction. Thus, upon the other hand, considering the actuating mechanism, it is apparent that the motor drum M, represented in Fig. 1, and hereinbefore described, as that member of the actuating mechanism by the rotation of which in either direction the bridge movement is, in the organization depicted, occasioned, may be replaced, as shown in Figs. 3, 4, 5, and 6, by a double ram M⁵ M⁶, the plungers m^5 m^6 of which are connected respectively with or otherwise respectively operative upon the divisions C′ C³ and C² C⁴ of the cable-connection in such manner that by the corresponding opposite movement of said plungers traction is exerted upon the divisions C′ and C³ and simultaneous release made of the divisions C² and C⁴, or traction exerted upon the divisions C² and C⁴ and simultaneous release made of the divisions C′ and C³, to the end of occasioning the desired movement of the bridge.

In the construction represented in Fig. 3 the ram M′ M² which occasions the trolley movement is shown as operative upon the divisions C² and C⁴, while in Fig. 6 the said ram M′ M², which in said construction similarly occasions the trolley movement, is shown as operative upon the divisions C′ and C³. In either of these constructions it is obvious that when the ram M⁵ M⁶ which occasions the bridge movement is in action and the ram M′ M² inactive, the cable-connection, whether it be the divisions C² and C⁴ or the divisions C′ and C³, operative in connection with said ram M′ M², runs idly with respect to the cable sheaves of its plungers during the period of the action of the said ram M⁵ M⁶.

In the construction shown in Fig. 6 the ram M⁵ M⁶ which is operative to occasion the movement of the bridge, is organized with double sheaves upon its plungers, and the divisions C′ C³ and C² C⁴ are shown as anchored at *m*, in lieu of the fixed attachment or anchoring of the said divisions C′ C³ and C² C⁴ respectively to the plungers m^5 m^6 as is illustrated in the construction of Fig. 3.

In Fig. 2 in which the actuating mechanism is of the organization shown in Fig. 1, both divisions C′ C² are led over double plunger sheaves m^3, and both divisions C³ and C⁴ led over double plunger sheaves m^4,—the only distinction being that in the construction of Fig. 1 only the divisions C′ and C³ are led over plunger sheaves happening to be single sheaves, while the divisions C² and C⁴ are led directly to the motor drum M.

In Fig. 5 the double ram M⁵ M⁶ is shown as operative upon the divisions C′ C³ and C² C⁴ to occasion the bridge movement, the plungers m^5 m^6 being provided with double sheaves for engagement with said divisions, while the double ram M′ M² is shown as fixedly connected through its plungers respectively with the divisions C′ C² and C³ C⁴, to occasion the trolley movement.

In the construction represented in Fig. 4 the double ram M⁵ M⁶ is operative through its plungers, which are equipped with double sheaves, respectively upon the divisions C′ C³ and C² C⁴ to occasion the bridge movement, while the trolley movement is occasioned by the operation of a drum M⁷ around which are led all of the divisions, C′ and C³ being respectively, so to speak, continuations of each other or endless, and C² and C⁴ similarly respectively continuations of each other or endless.

It is obvious that according to the direction of the rotation of the drum M⁷, simultane-

ous traction will, in this construction, either be exerted upon the divisions C′ and C^2, accompanied by the correspondent simultaneous release of the divisions C^3 and C^4, with the result that the trolley is moved to the east,—or else that simultaneous traction will be exerted upon the divisions C^3 and C^4, accompanied by the correspondent simultaneous release of the divisions C′ and C^2, with the result that the trolley will be moved to the west. Obviously, the trolley movement may take place either simultaneously with or before or after the bridge movement.

Whatever be the preferred arrangement of the actuating mechanism and cable-connection to occasion the operation of the bridge and trolley, the operation of the fall-block is preferably occasioned by the application of a ram, being an operative part or member of the actuating mechanism proper under the control of an operator, and operative upon whatever portion or division of the cable-connection happens to be selected as that division or portion which is extended into a loop or bight below the trolley and provided with a fall-block, or which, as explained, is directly connected with the load-engaging device. This division or portion, as the various arrangements of the cable-connection depicted in Figs. 10 to 17 inclusive of the drawings illustrate, may be any one of the divisions C′ C^2 C^3 C^4, or it may in fact be a combined division, so to speak, as in the case of the endless continuation into each other, so to speak, longitudinally across the trolley of the divisions C′ and C^3, as shown in Figs. 18 and 19, or of the divisions C^2 and C^4, or transversely across the trolley of the divisions C′ and C^2 or the divisions C^3 and C^4. I have not deemed it necessary to illustrate every one of these last above named obvious special arrangements, it being, as explained, inconsequential whether the so-called divisions of the cable-connection are in selected pairs united with or merged into each other at the trolley (or the bridge), or whether they are at the trolley (or the bridge) divided and each directly connected to it, one preferably through the intervention of the fall-block or load-grapple.

It is proper to again state, that the fact that a particular division or portion of the cable-connection is operative upon or in connection with the fall-block, in no wise affects the capacity of said division for operation upon the trolley and the bridge, because, if the fall-block be not loaded with a load the power required to raise which is greater than that required to move either the bridge or the trolley (in which event the division carrying the fall-block is operatively taut throughout its course), it is only necessary to first actuate the motor to raise the fall-block or its housing preferably into contact with the trolley, to render the branch which carries said fall-block operatively taut throughout its course, and consequently operative for occasioning the movement of either the bridge or the trolley.

To facilitate the last named operation I find it convenient to provide the fall-block with a housing *f*, such, for instance, as shown in Fig. 8, adapted to make contact with a spring buffer $t^{\times}$ upon the trolley. This, however, is simply a device of convenience for which there are obvious substitutes, such, for instance, as an arrangement in which the division is simply pulled out taut with the fall-block or grapple "dangling" on it, as shown in Fig. 9.

In speaking of the divisions of the cable-connection as being taut throughout their course, I do not mean to be understood that in practice there is no slack in them, but simply that they are with respect to bridge trolley and fall-block, the various operative parts or members of the motor, and the various directing sheaves over which they pass, under sufficient tension to, without lost motion, occasion, under the impulse of the motor, any desired movement of the bridge, trolley, or fall-block.

Having now described several constructions alike embodying my invention in each of which a common cable-connection is by the aid of the operative parts of the actuating mechanism, potent to, without the aid of brakes or kindred contrivances, occasion the separate, in any sequence successive, or simultaneous, movements of any one any two or all three of the three moving elements (bridge trolley and fall-block) of the crane,—it is proper to explain that my invention comprehends constructions in which a common cable-connection in operative engagement with given operative parts of the actuating mechanism is employed to occasion only the separate or simultaneous movement of any two and not of the third of the said three moving elements, for instance, of the bridge and trolley, but not of the fall-block,—or of the bridge and fall-block, but not of the trolley,—or of the trolley and fall-block, but not of the bridge,—and in which other means than the common cable-connection of the other two elements is employed to occasion the movement of the fall-block, of the trolley, or of the bridge, as the case may be. I make this explanation not because it is, in my judgment, of advantage to resort to any one of these plans, but to emphasize the fact that it is competent for me to do so without departure from my invention.

As already explained, in order to simplify the illustration, the actuating mechanism is represented in "dummy" plan, but it is to be understood that in the practical employment of my invention the motor drums when employed are of the usual construction of cable-propelling drums and are operated by any power adapted to rotate them in either direction; and also to be understood that the cylinders of the hydraulic rams are suitably and preferably vertically disposed, and provided

with suitable pipe connections from a source of hydraulic pressure and with the usual valves for controlling the movement of their plungers. All such details, however, being within the province of the constructor, are, for simplicity, omitted from the drawings.

It is further to be remarked that where rams occasion the movement of the bridge, devices for multiplying the thrust of their plungers are preferably applied, for the reason that, the bridge movement being of greater extent than the trolley movement and it not being desired to employ cylinders and plungers of great length, it is of advantage to arrange them with several sheaves not only upon the plungers but also upon the distant end of their cylinders, or other permanent body, in a manner well known and typically represented in Fig. 7, in order that by leading the divisions of the cable-connection operative in connection with given cylinders and plungers around their sheaves in the manner indicated, for instance, in the cylinder and plunger represented in said Fig. 7, the thrust of the plungers occasioning the cable movement will be multiplied by the number of turns which the cable-connection makes with reference to the sheaves of the said plungers and cylinders.

It is further to be understood that the throttle or valve levers or kindred devices which operate to control the desired movements of the operative parts of the motor, and which are indicated, but, for clearness, not lettered in the drawings, are preferably concentrated at a single point, so that a single operator can, without moving from his post, control every member of the motor and of every operative part thereof, and consequently occasion any desired movement of any "moving" member (bridge trolley or fall-block) of the crane.

Obviously, the association or correlation of the operative parts or members of the motor controlling the cable-connection with the bridge, is, from a mechanical stand-point, such as to occasion uniform traction or release upon correspondingly opposite divisions or portions of said cable-connection, to the end that in the movement of the bridge upon its ways the traction upon each of its ends may be equal, and the bridge in consequence be controlled against torsion.

In conclusion, it is manifest that whatever be the selected type of apparatus in which my invention be embodied, the mutual relationship of all of the instrumentalities which together constitute the apparatus as an entirety, is such that any desired movement of the bridge or the trolley or the fall-block may be performed without any interference with the simultaneous performance of any movement of which either or both of the other two members is capable; and that, in consequence, the bridge, for instance, may be moved to any extent in either direction without reference to the position upon it which the trolley for the time being occupies, and without reference, in fact, to whether the trolley be at rest or in motion; and that similarly the trolley may be moved in either direction upon the bridge without regard to the position which the latter occupies upon the ways, and without reference to whether it be at rest or in motion, and also without respect to the height which the fall-block, when loaded, occupies with reference to it, and without regard to the elevation or descent of said fall-block; and, in consequence, that the fall block may be lifted or dropped without regard to the action or temporary rest of the bridge or the trolley, or to the relative position of the bridge with respect to its ways or of the trolley with respect to the bridge.

In a word, any movement of the bridge or the trolley or the fall-block may be separately performed independently or in any predetermined sequence, or any movement of either two, or of all three, of said elements may be simultaneously performed, without mutual interference,—the apparatus in its entirety possessing the capacity for the simultaneous, the successive, or the separate, use of either the operative parts or members which together compose its actuating mechanism or of the moving parts or members which together compose its actuated mechanism.

The advantages appertaining to my invenvention are so obvious to those familiar with cranes of the movable-cable type as heretofore constructed, as not to require special mention.

Having thus described my invention, I claim and desire to secure by Letters Patent:—

1. In a traveling crane, in combination:— a movable bridge,—a movable trolley,—a movable fall-block,—a cable-connection common to and operatively engaged with a plurality of said movable devices,—and actuating mechanism independent of the crane structure, the operative parts of which are independently operative upon said common cable-connection,—substantially as and for the purposes set forth.

2. In a traveling crane, in combination:— a movable bridge,—a movable trolley,—a cable-connection common to and operatively engaged with both,—and actuating mechanism independent of the crane structure, and embodying bridge-moving parts and independent trolley-moving parts both of which are operative upon the common cable-connection, substantially as set forth.

3. In a traveling crane, in combination:— a bridge and a trolley,—a cable-connection common to both, connected with the trolley, and passing around bridge sheaves,—and actuating mechanism comprising independently operative trolley-moving parts and bridge-moving parts engaged upon common divisions of the cable-connection and which are adapted to simultaneously or separately

take up and pay out portions of said cable-connection,—substantially as and for the purposes set forth.

4. In a traveling crane, in combination:—a bridge and a trolley,—a cable-connection common to both, connected with the trolley, and passing around bridge sheaves,—and actuating mechanism comprising independently operative trolley-moving parts and bridge-moving parts engaged upon common divisions of the cable-connection, and one of which moving parts is equipped with cable sheaves which in its operation act to correspondently take up and pay out portions of said cable-connection,—substantially as set forth.

5. In a traveling crane, in combination:—a movable bridge,—a movable trolley,—a cable-connection leading in opposite directions from the bridge and in opposite directions from the trolley, the divisions which lead from the trolley passing around bridge sheaves near the extremities of the bridge and all the divisions extending along the bridge ways,—and actuating mechanism, an operative part of which is adapted to correspondently take up and pay out divisions of said cable-connection leading from opposite sides of one of said movable devices, and an operative part of which, comprising correspondently associated sheave-equipped members, is interposed between the operative part first mentioned and the movable devices, and is adapted to correspondently take up and pay out divisions of said cable-connection leading from opposite sides of the other of said movable devices,—substantially as set forth.

6. In a traveling crane, in combination:—a movable bridge and a movable trolley,—a cable-connection which is common to and operatively engaged with both,—and actuating mechanism comprising independently operative trolley-moving parts and bridge-moving parts engaged upon the common cable-connection, one of which moving parts embodies a pair of cable sheaves which operate in association and with reference to directing sheaves in such manner that one of the pair takes up while the other pays out a portion of the cable-connection, and the other of which moving parts, in order to shift or move the other movable device, moves or shifts said cable-connection through or with respect to said cable-sheaves,—substantially as set forth.

7. In a traveling crane, in combination:—a bridge,—a trolley,—a cable-connection in operative engagement with both said bridge and trolley,—and actuating mechanism independent of the crane structure, operative parts of which are in operative engagement with said cable-connection and through it adapted to occasion the movement of both said bridge and trolley or of either of them, and the action of the bridge-moving parts of which when accompanied by the inaction of the trolley-moving parts occasions the travel of the bridge and the rest of the trolley,—the action of the trolley-moving parts of which when accompanied by the inaction of the bridge-moving parts occasions the movement of the trolley and the rest of the bridge,—and the simultaneous action of both the bridge-moving and the trolley-moving parts of which occasions the independent but simultaneous movement of both bridge and trolley,—substantially as set forth.

8. In a traveling crane, in combination:—a movable bridge,—a movable trolley,—a movable fall-block,—a cable-connection common to and operatively engaged with said bridge and fall-block,—and actuating mechanism independent of the crane structure, and embodying independently operating bridge-moving parts and fall-block-moving parts, both of which are operative upon the common cable-connection,—substantially as set forth.

9. In a traveling crane, in combination:—a movable bridge,—a movable trolley,—a movable fall-block,—a cable-connection common to and operatively engaged with both said trolley and said fall-block,—and actuating mechanism independent of the crane structure, and embodying independently operating trolley-moving parts and fall-block-moving parts, both of which are operative upon the common cable-connection,—substantially as set forth.

10. In a traveling crane, in combination:—a movable bridge,—a movable trolley,—a movable fall-block,—a cable-connection common to and operatively engaged with said bridge trolley and fall-block,—and actuating mechanism independent of the crane structure, and embodying bridge-moving parts trolley-moving parts and fall-block-moving parts all of which are independently operative upon said common cable-connection,—substantially as set forth.

11. In a traveling crane, in combination:—a movable bridge,—a movable trolley,—a fall-block,—a cable-connection leading in opposite directions from the bridge and in opposite directions from the trolley, the divisions which lead from the trolley passing around bridge sheaves near the extremities of the bridge, all of the divisions extending along the bridge ways, and one division leading from the trolley being engaged with the fall-block,—and actuating mechanism, an operative part of which is adapted to correspondently take up and pay out divisions of said cable-connection leading from opposite sides of either of said movable devices (bridge or trolley),—an operative part of which, comprising correspondently associated sheave-equipped members, is interposed between the operative part first mentioned and the aforesaid movable devices, and is adapted to correspondently take up and pay out divisions of said cable-connection which lead from opposite sides of the other of said movable devices,—and an operative part of which, comprising a sheave-equipped member, is engaged with that cable division which is

engaged with the fall-block, substantially as set forth.

12. In a traveling crane, in combination:—a movable bridge,—a movable trolley,—a movable fall-block,—a cable-connection in operative engagement with said movable devices,—and actuating mechanism independent of the crane structure, the bridge operative, trolley-operative, and fall-block-operative parts of which are in operative engagement with said cable-connection and adapted through it either by action to occasion the movement or by inaction to secure the rest, of any or all of said movable devices,—the arrangement being such that a given operative part or given operative parts are active or inactive at will without reference to the action or inaction of other given operative parts or of another given operative part,—substantially as set forth.

13. In a traveling crane, in combination:—a bridge and a trolley,—a cable-connection common to both connected with the trolley and passing around bridge sheaves,—and actuating mechanism, comprising bridge-moving parts and trolley-moving parts, one of which moving parts consists of a drum, and the other of a pair of associated cable-sheave-provided plungers interposed between the first-named moving part and the bridge and trolley, and engaged upon the appropriate divisions of the cable-connection,—substantially as set forth.

In testimony that I claim the foregoing as my invention I have hereunto signed my name this 6th day of January, A. D. 1891.

FREDERIC NORMAN DIXON.

In presence of—

J. BONSALL TAYLOR,

WM. C. STRAWBRIDGE.