

No. 640,051.

Patented Dec. 26, 1899.

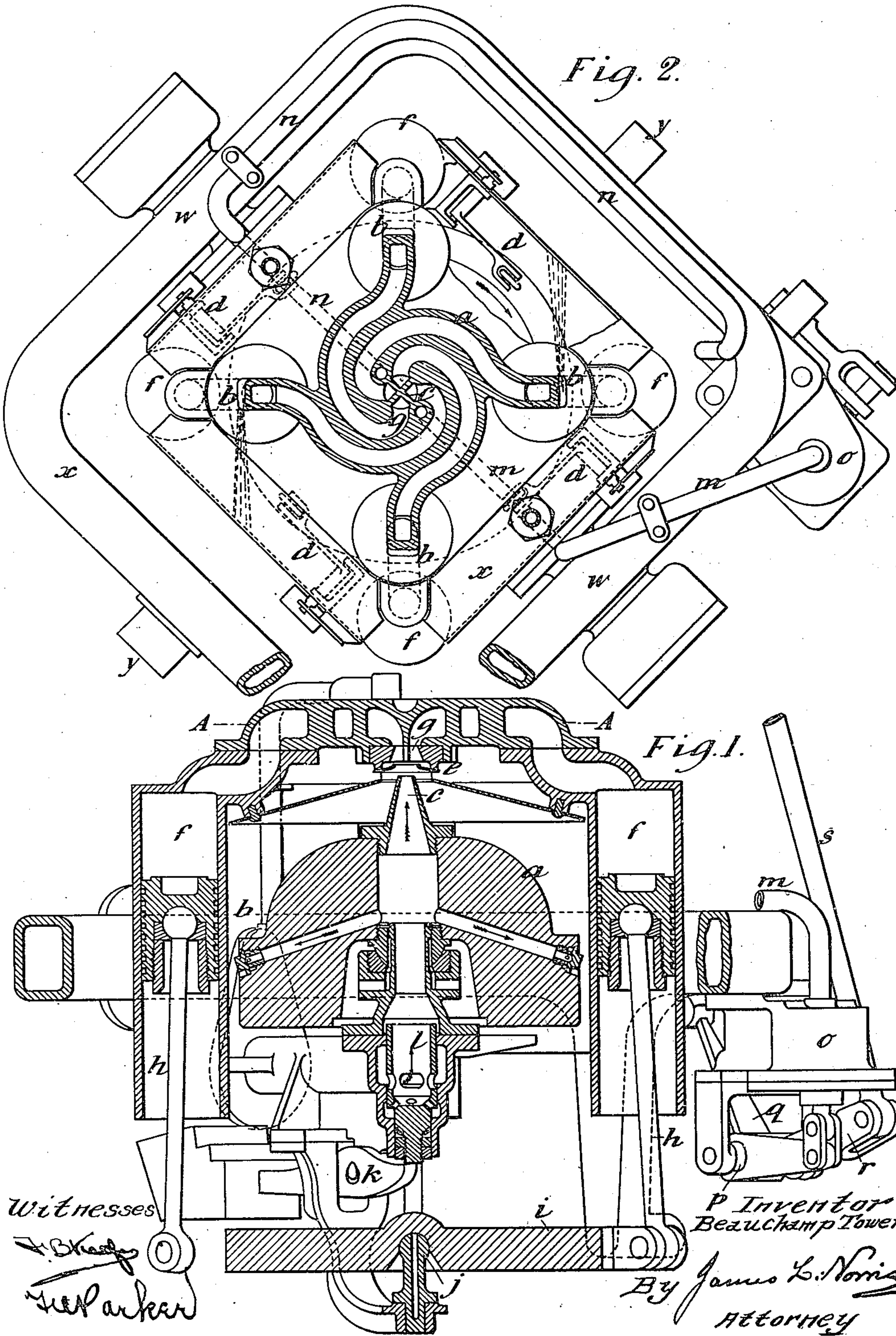
B. TOWER.

APPARATUS FOR STEADYING GUNS ON SHIPBOARD.

(Application filed June 26, 1899.)

4 Sheets—Sheet 1.

(No Model.)



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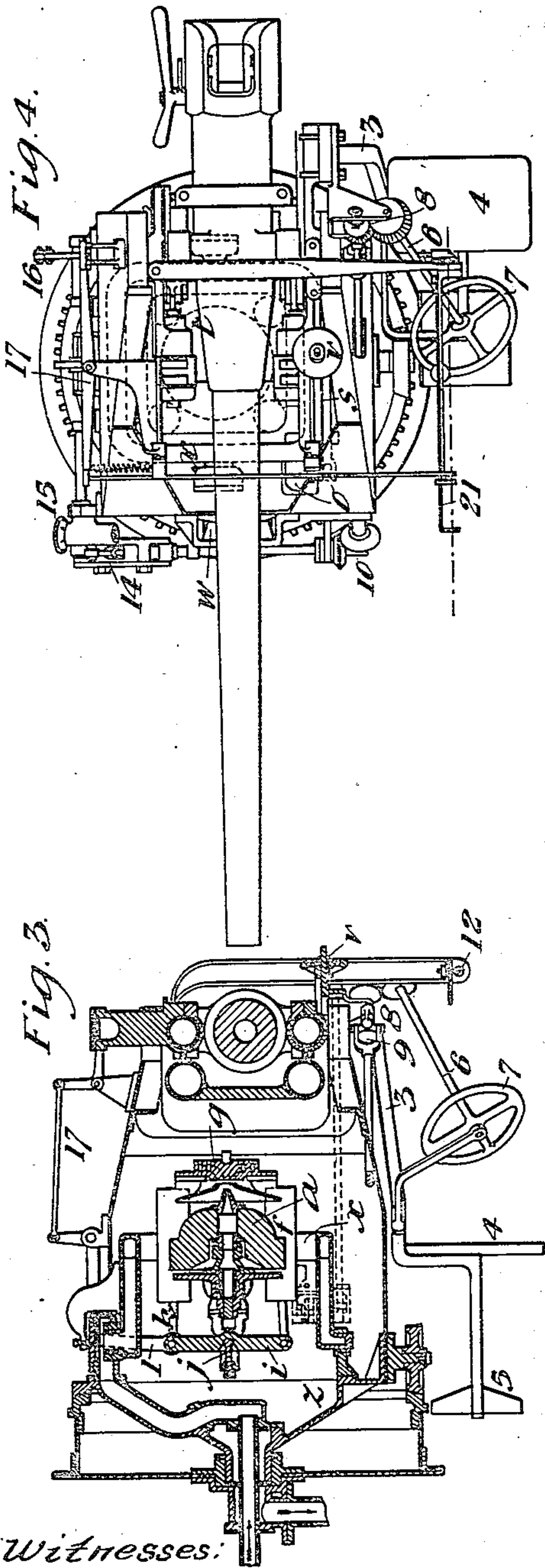
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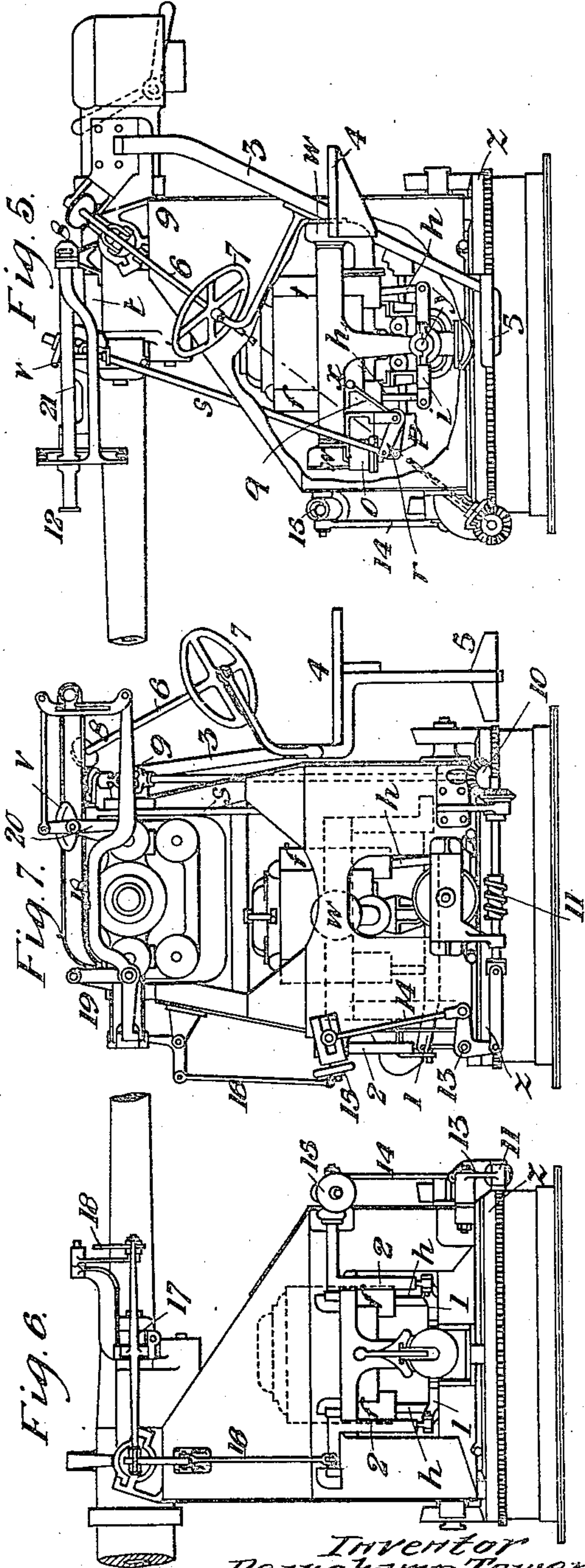
(Application filed June 26, 1899.)

(No Model.)

4 Sheets—Sheet 2.



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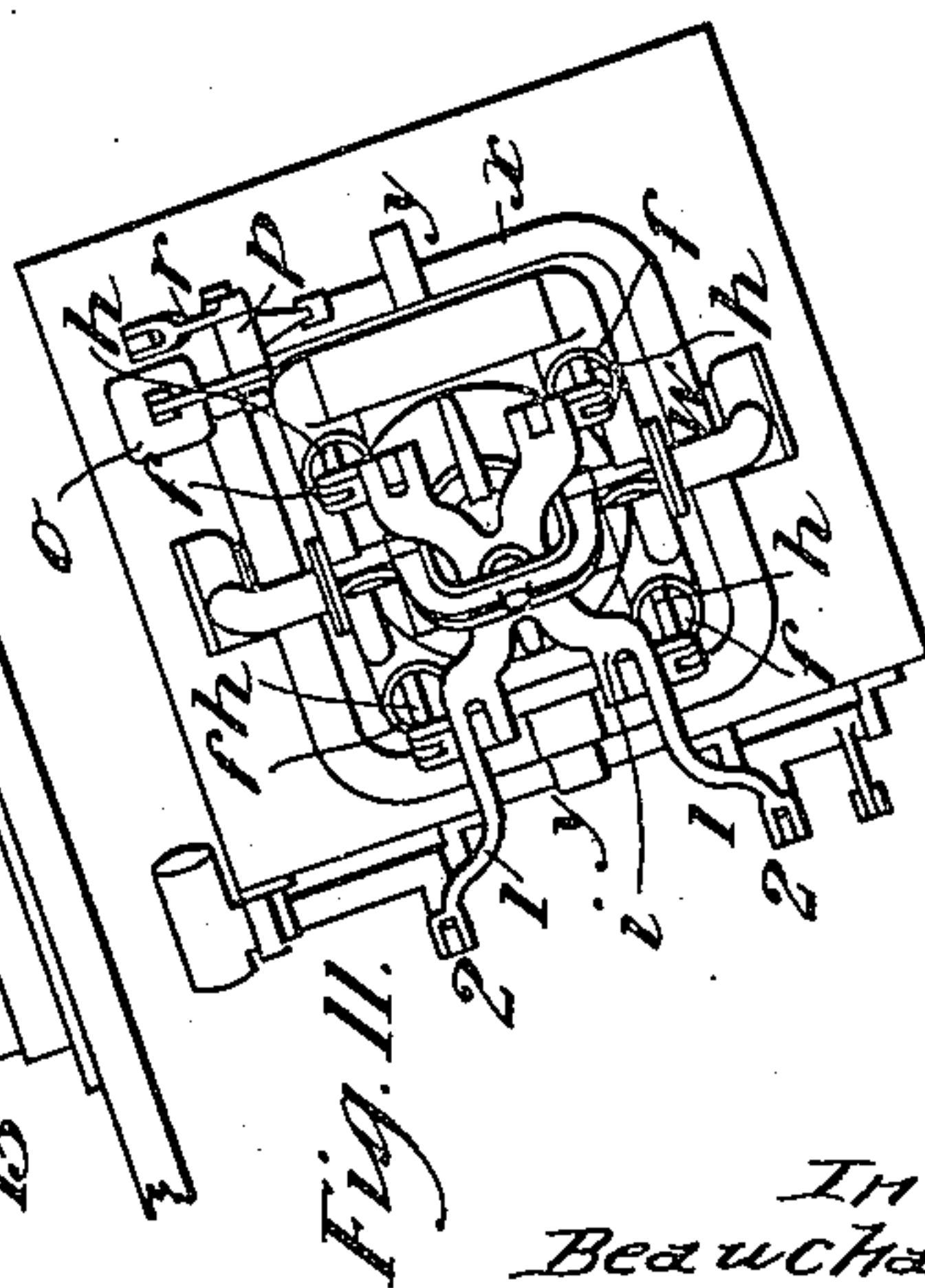
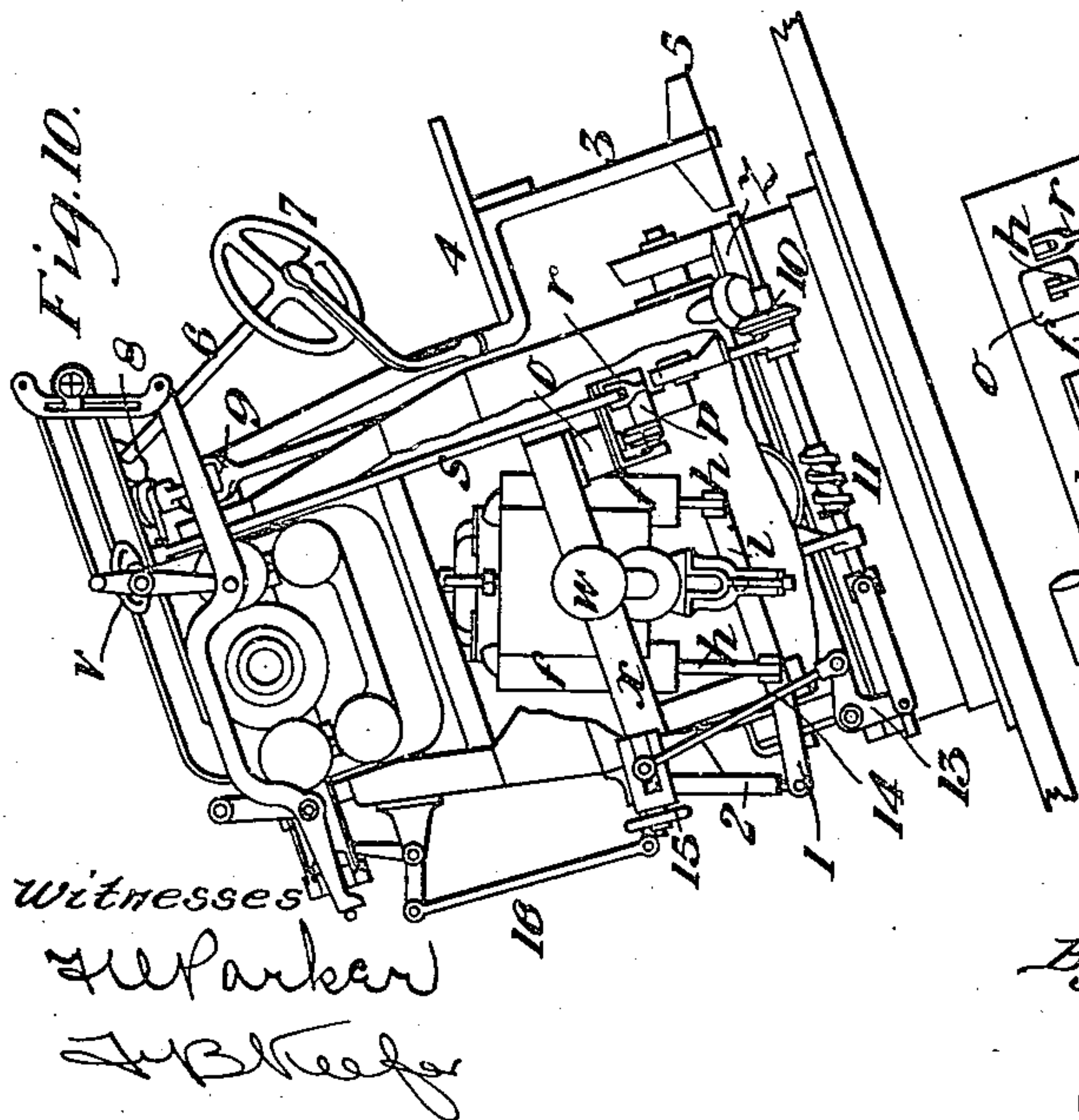
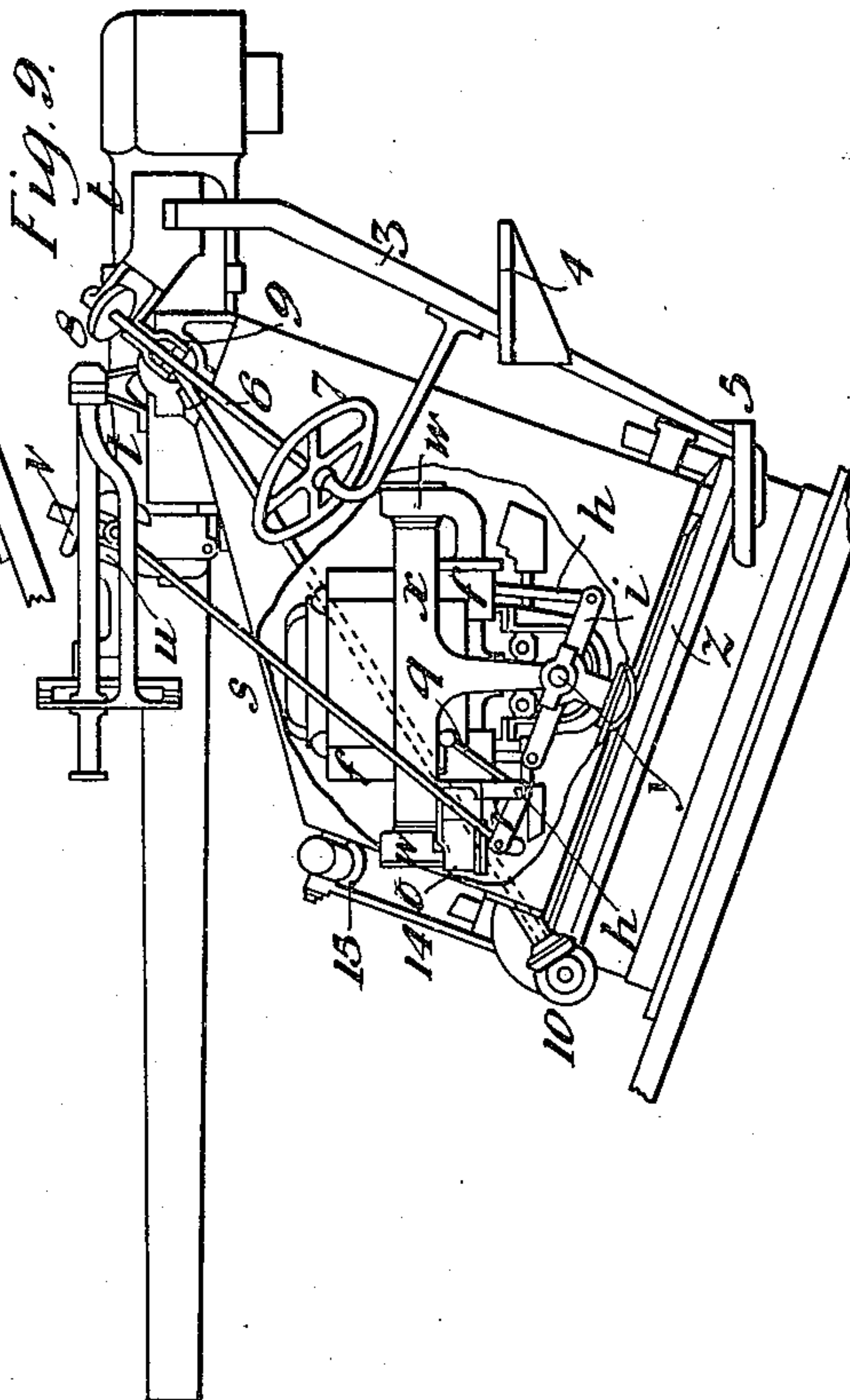
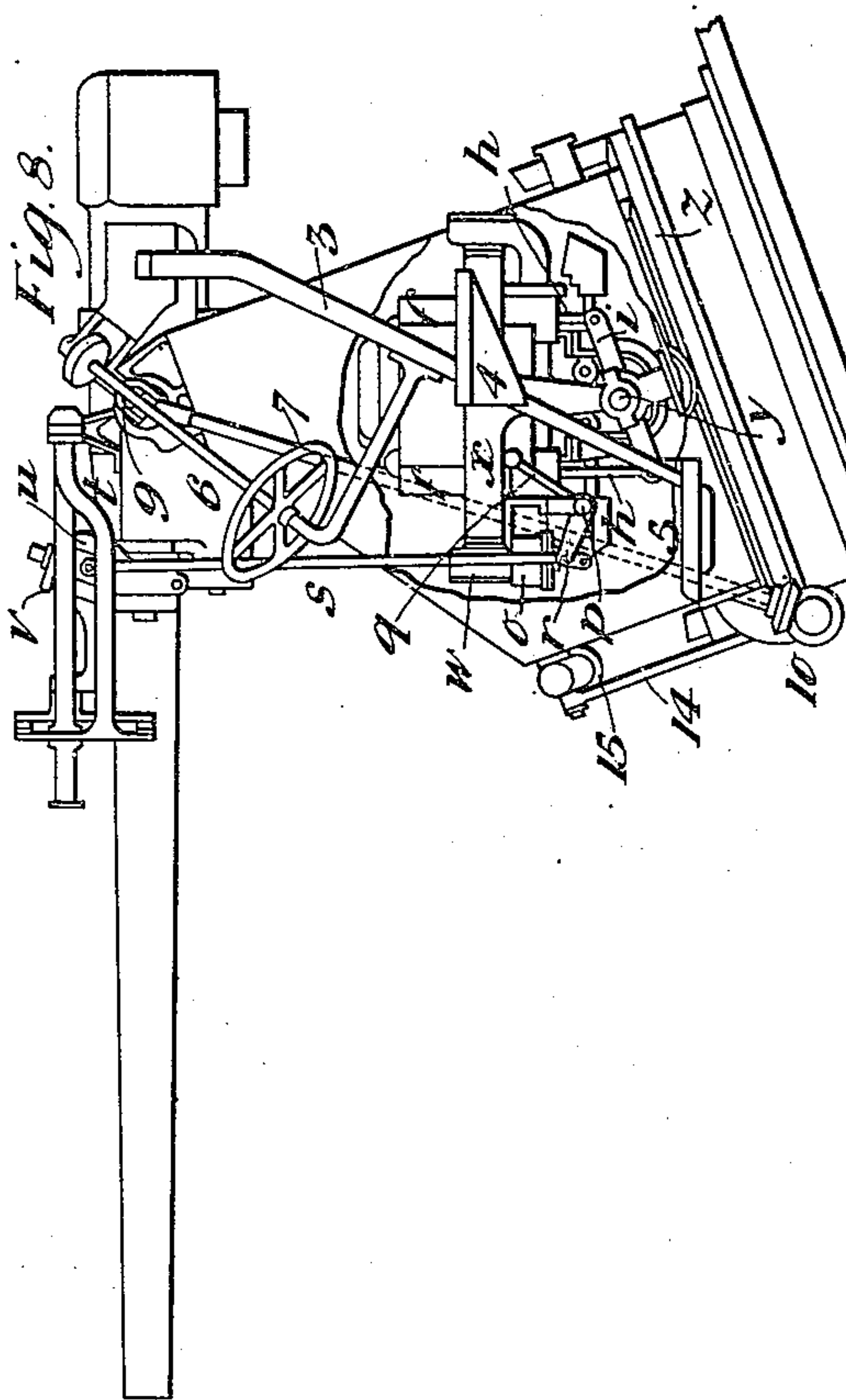
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(Application filed June 26, 1898.)

(No Model.)

4 Sheets—Sheet 3.



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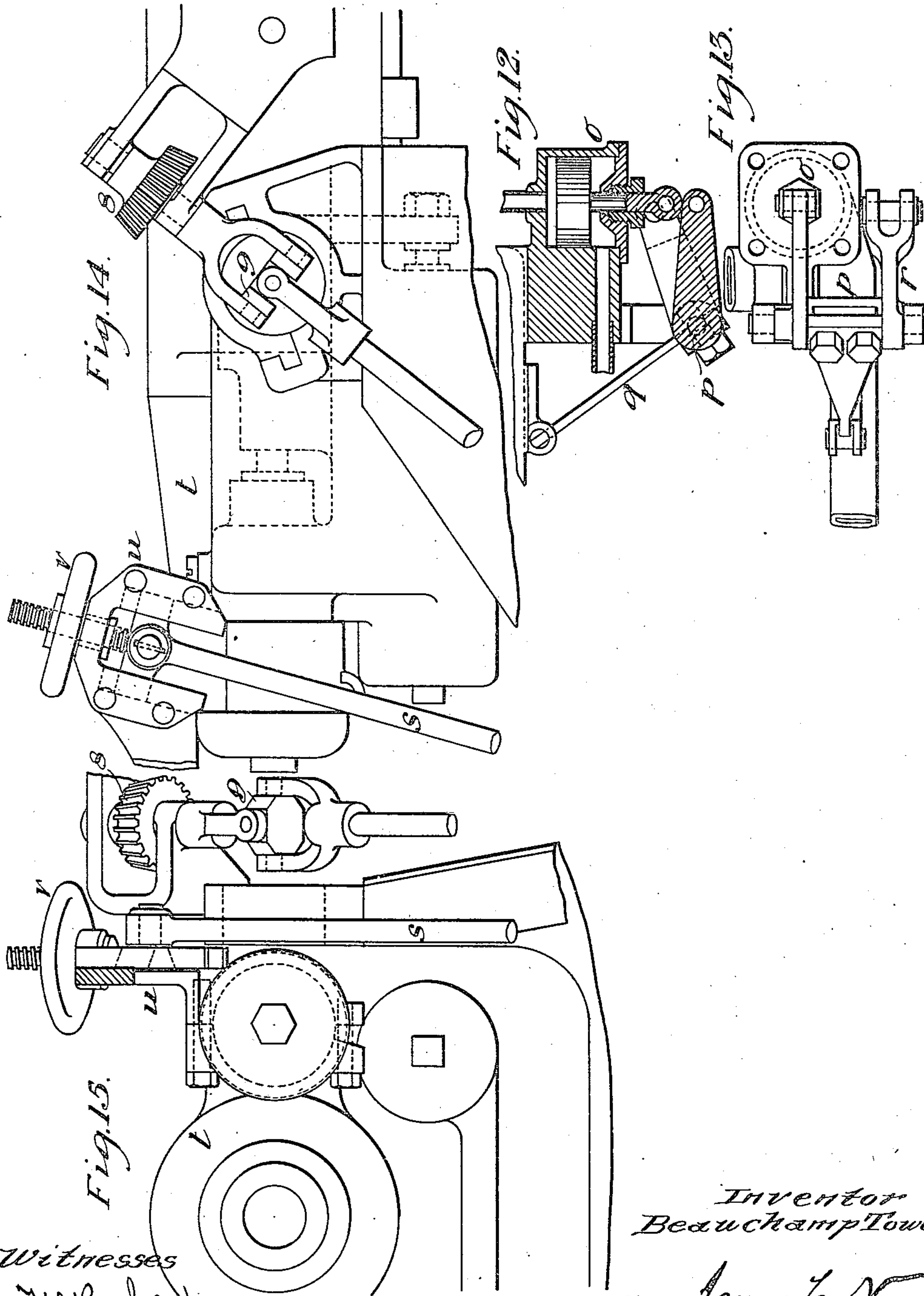
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(Application filed June 26, 1899.)

(No Model.)

4 Sheets—Sheet 4.



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UNITED STATES PATENT OFFICE.

BEAUCHAMP TOWER, OF LONDON, ENGLAND.

APPARATUS FOR STEADYING GUNS ON SHIPBOARD.

SPECIFICATION forming part of Letters Patent No. 640,051, dated December 26, 1899.

Application filed June 26, 1899. Serial No. 721,977. (No model.)

To all whom it may concern:

Be it known that I, BEAUCHAMP TOWER, engineer, a citizen of England, residing at No. 5 Queen Anne's Gate, Westminster, London, England, have invented certain new and useful Improvements in Apparatus for Steadying Guns on Shipboard, (for which I have applied for a patent in Great Britain, dated December 6, 1898, No. 25,737,) of which the following is a specification.

In my Patents Nos. 366,438 and 464,806 I have described means of maintaining a constant plane in a floating vessel, and in the later patent, No. 464,806, I have described the mounting of a gun on the plane so maintained constant.

According to my present invention instead of placing the gun on the steadying apparatus I fit it in a recoil-cradle trunnioned in a suitable gun-mount, and within the mount I arrange steadying apparatus of the kind described in my former patents. I connect the gun-cradle to a suitable part of the steadying apparatus, so that the gun is held steady, while nevertheless it can recoil in the cradle without throwing disturbing force on the steadying apparatus.

Although the steadying apparatus is arranged to operate on the gyroscopic principle, as set forth in my former patents, I modify many of the details, as I shall describe, referring to the accompanying drawings.

Figure 1 is a vertical section of the steadying apparatus constructed according to my present invention. Fig. 2 is a plan of the same, partly sectional, on the line A A of Fig. 1. Fig. 3 is a vertical section on a smaller scale, and Fig. 4 is a plan, showing the gun-mountings and their accessories. Figs. 5 and 6 are views on opposite sides with parts broken away to show internal parts, and Fig. 7 is an end view. Figs. 8 and 9 are side views, and Fig. 10 is an end view, showing positions of gun and its mountings when the vessel pitches and rolls. Fig. 11 is a plan of the steadying apparatus, looking from below. Fig. 12 is a section, and Fig. 13 is a plan, of the correcting-cylinder. Fig. 14 is a side view, and Fig. 15 is an end view, of the upper parts of the training and elevating gear.

The gyroscope *a*, with its tangential jets *b* and its axial jets *c*, its four leveling-pendu-

lums *d* and its deflecting-cone *e*, revolves, as described in my former patents, in a cell of which the four cylinders *f* form the corners. The axial jets *c* impinge, as before, on the four open-mouthed ports *g*; but instead of each of those ports communicating, as before, with the cylinder *f* on the same side with it it is carried half around, so as to communicate with the cylinder *f* directly opposite to it, and the cylinders *f* instead of being, as formerly, open at the top and closed at the bottom are now closed at the top and open at the bottom, their pistons being connected by rods *h*, extending downward, to a swing-frame *i*, which is mounted on a spherical pivot *j*, carried on a U-shaped bracket projecting down from the gyroscope-cell. On this bracket are mounted a pair of levers *k*, one end of each of which is loaded, and the other end bears against the stem of an adjustable valve *l* in the passage by which the water enters for supply of the jets *b* and *c*. These loaded levers *k* and valve *l* operate as follows: The gyroscope revolving on its cup-and-ball bearing has the greater part of its weight carried by the upward pressure of the water passing through this bearing. As the vessel sinks downward on a wave the tendency to leave the gyroscope behind diminishes its downward pressure on the water, so that it might be lifted by the water from its bearing. This same tendency acting at the same time on the weights of the levers diminishes their upward pressure on the valve *l* and causes it to partly close and diminish the pressure of the water under the gyroscope in the same degree as the downward weight of the gyroscope is diminished.

As in the former patent, No. 464,806, there is besides the main ports *g* a narrow central passage leading by pipes *m* and *n* to the correcting-cylinder *o*, the piston of which is linked to an arm *p'* on a rocking shaft *p*, through a slot of which passes the end of a blade-spring *q*, tending to hold the piston of *o* central. On the rocking shaft *p* is fixed another arm *r*, which is connected by a rod *s* to the recoil-cradle *t* of the gun. As shown in Figs. 14 and 15, the connecting-pin of the upper end of the rod *s* is fitted to slide *u'* in a bracket *u*, fixed on the cradle *t*, and can be raised or lowered by turning a hand-wheel

nut *v*, so as to vary as desired the elevation of the gun.

The cell of which the cylinders *f* form the corners contains the gyroscope *a* and is that which remains steady with respect to two vertical planes at right angles to each other notwithstanding the pitching and rolling of the vessel. The cell is, as before, mounted in gimbals—that is to say, it is pivoted by two opposite trunnions *w* to a square ring *x*, having downwardly-projecting arms *x'*, Figs. 5 and 9, provided with trunnions *y*, pivoted in a bracket projecting upward from the turn-table *z*, whereby the ring *x* is pivotally mounted on said turn-table. The axis of the trunnions *y* *y* is at right angles to the axis of *ww*, but is at a lower level. The gimbal-ring *x* has the steadiness of the gyroscope-cell in the vertical plane in which the axis of the gun moves when it is elevated or depressed, and the steadiness in this plane is imparted to the gun-cradle by the rod *s*, which connects the cradle to the rocking-shaft of the correcting-cylinder *o*, which is attached to the gimbal-ring. As before, the trunnions and gimbal-ring are made hollow for passage of water to the jets of the gyroscope.

From one side of the swing-frame *i* project two arms 1 1, which are linked by rods 2 2 to the frame of the gun-mounting, the length of the links 2 2 being equal to the distance of the center of the spherical pivot *j* below the axis of the trunnions *ww*. Thus the swing-frame *i* is suspended by three hangers of equal length, so that however it swings it always remains parallel to the plane passing through the axes of the trunnions and the upper pivots of the rods 2. As the pistons of the four cylinders *f* are jointed to the swing-frame *i*, they cause the movement of the gyroscope-cell relatively to the swing-frame and the vessel, and thus as the motions of the pistons are determined by the directions of the axial jets *c* the gyroscope-cell is kept steady notwithstanding the movements of the vessel.

A bar 3, carrying a seat 4 and a foot-rest 5, is attached to the gun-cradle *t* in a convenient position for the gunner, who when seated is kept steady with the cradle. He has within reach the hand-wheel *v*, by turning which, as already described, he can vary the elevation of the gun. He has also within reach a hand-wheel 7 on a spindle 6, which by gearing 8 works a spindle having a universal joint 9 and extending down to bevel-gear 10, connecting it to a worm 11, which engages teeth on the circular base of the turn-table. Thus the gunner by turning the wheel 7 can train the gun as desired. The gunner has also within reach suitable firing apparatus and can determine direction of the gun by means of sights 12. As the gun-cradle can rock to a certain extent in the vertical plane passing through the axes of its trunnions, this rocking movement affects to a certain extent the direction of the gun in respect of training. In order to correct this, I fit the training-

worm 11 in bearings in which it can slide lengthwise and I connect one end of the worm-spindle to one arm of a bell-crank 13, the other arm of which is connected adjustably by a link 14 to an arm on the rocking shaft from which one of the suspending-links 2 extends down to one of the arms 1 of the rocking frame *i*. As this rocking shaft is partly turned by the swing of the arm 2, the training-worm 11 is moved lengthwise, so turning the gun-mounting sufficiently to compensate for the virtual error in training due to the rocking of the trunnions. The length of arm to which the link 14 is jointed is adjusted by a hand-wheel 15 and screw to suit different elevations of the gun, the arm being elongated as the elevation is increased, so as to give the greater amount of correction required for the training. Another of the suspending-links 2 has an arm on the rocking shaft from which it hangs connected by a link 16 to one arm of a bell-crank 16^a, Fig. 7, the other arm of which is jointed to one arm of a lever 17. The other arm of this lever is jointed to one end of a rod 18, which is suspended by a pair of equal radial arms 19 and 20 and connected to a sight-carrier, which carries the sight-bar 21, this sight-carrier having an arm extending upward and linked to an equal arm projecting up from the arm 20. Thus as the sights are elevated or depressed their movement is in a vertical plane however the vessel may rock.

Having thus described the nature of this invention and the best means I know of carrying the same into practical effect, I claim—

1. The combination with a gun-mount, a gun, and a recoil-cradle trunnioned on the gun-mount and in which the gun can slide, of the gyroscope, the hydraulic gyroscope-cylinders governed by the gyroscope, a swing-frame suspended under the gyroscope and connected with the pistons of the said cylinders, the correcting-cylinder, a swinging arm connected with and controlled by the piston of the correcting-cylinder, and a rod connecting said swinging arm with said recoil-cradle, substantially as described.

2. The combination with a gun-mount, a gun, and a recoil-cradle trunnioned on the gun-mount, of the gyroscope having axial jets *c* and open-mouthed ports *g* in its top portion, the hydraulic gyroscope-cylinders having their lower ends open and their upper ends closed but communicating with said open-mouthed ports, the suspended swing-frame arranged below the gyroscope and connected with the lower ends of the piston-rods of said cylinders, a center pivot suspended from a part of the gyroscope and on which the swing-frame centrally bears, the correcting-cylinder governed by the gyroscope, a swinging arm connected with the piston of the correcting-cylinder, and a connection between said swinging arm and the recoil-cradle of the gun, substantially as described.

3. The combination with a gun-mount, a

gun and a recoil-cradle in which the gun can slide, of a circular base having teeth on its periphery, a worm engaging said teeth, a hand-wheel and gear carried by the gun-mount, and a universal-joint connection arranged in line with the cradle-trunnions and connecting said gear with said worm, substantially as described.

4. The combination with a gun-mount, a gun, and a recoil-cradle trunnioned on the gun-mount and in which the gun can slide, of a circular base having teeth on its periphery, a slidable and rotatable worm, the gyroscope, the hydraulic gyroscope-cylinders, the swing-frame arranged under the gyroscope and connected with the pistons of said cylinders, suspending-links for suspending the swing-frame from the gun-mount, a bell-crank connected with the worm-shaft, and a link adjustably connected with one of said suspending-links and with said bell-crank, for correcting the training of the gun when affected by the rocking of the recoil-cradle, substantially as described.

5. The combination with a gun-mount, a gun, and a recoil-cradle trunnioned in the gun-mount, of the gyroscope, the hydraulic gyroscope-cylinders governed by the gyroscope, a swing-frame arranged under the gyroscope, suspended from the gun-mount and

connected with the pistons of said cylinders, the correcting-cylinder, a swinging arm connected with and controlled by the piston of the correcting-cylinder, a hand-wheel, screw and slide carried by said recoil-cradle, and a rod connecting said swinging arm with said slide, substantially as described.

6. The combination with a gun-mount, a gun, a recoil-cradle trunnioned on the gun-mount, and a sight-carrier carrying a sight-bar, of the gyroscope, the hydraulic gyroscope-cylinders, the swing-frame, the suspending-links for suspending said swing-frame from the gun-mount, a suspended swinging rod connected with the sight-carrier, a bell-crank, a lever connecting one arm of the bell-crank with said swinging rod, and connections between the other arm of the bell-crank and one of the said swing-frame suspending-links, for maintaining the movement of the sight-bar in a vertical plane, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

BEAUCHAMP TOWER.

Witnesses:

GERALD L. SMITH,
C. S. HOPKINS.