(No Model.)

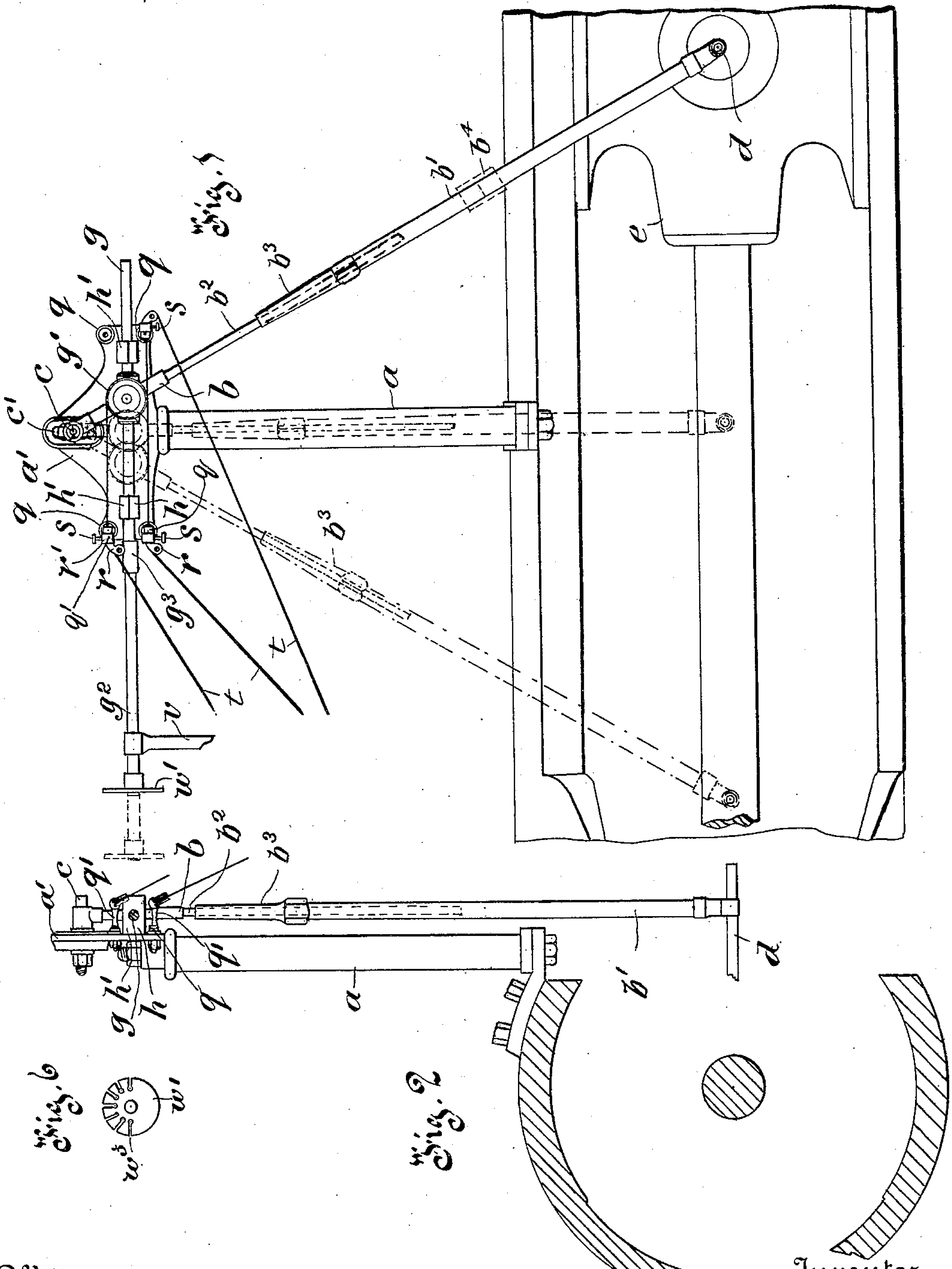
3 Sheets—Sheet 1.

J. WRIGHT.

STEAM ENGINE INDICATOR REDUCING GEAR.

No. 545,184.

Patented Aug. 27, 1895.



Witnesses

Inventor

James Wright

By his Attorney

(No Model.) 3 Sheets—Sheet 2.

J. WRIGHT.

STEAM ENGINE INDICATOR REDUCING GEAR.

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Fig. 3

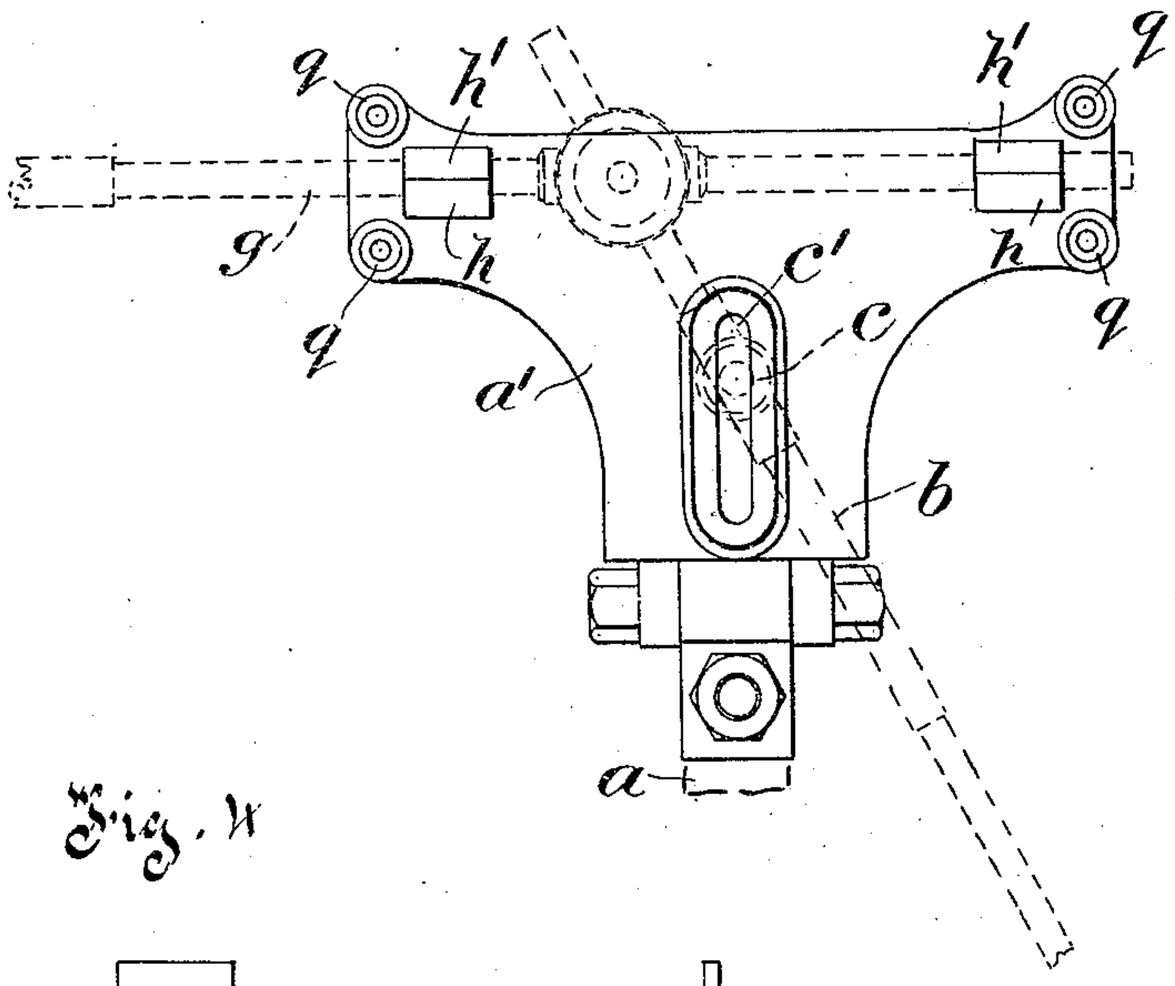
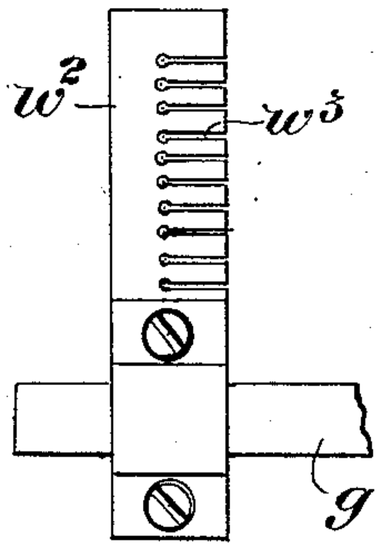


Fig. 4



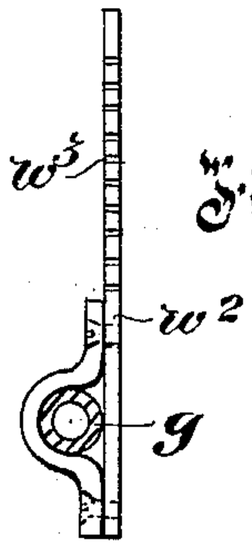
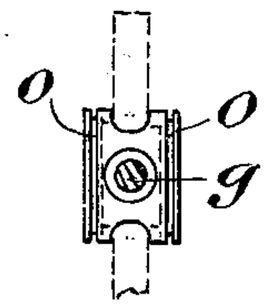


Fig. 5

Fig. 7



Witnesses

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By his Attorney

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(No Model.)

3 Sheets—Sheet 3.

J. WRIGHT.

STEAM ENGINE INDICATOR REDUCING GEAR.

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Fig. 8

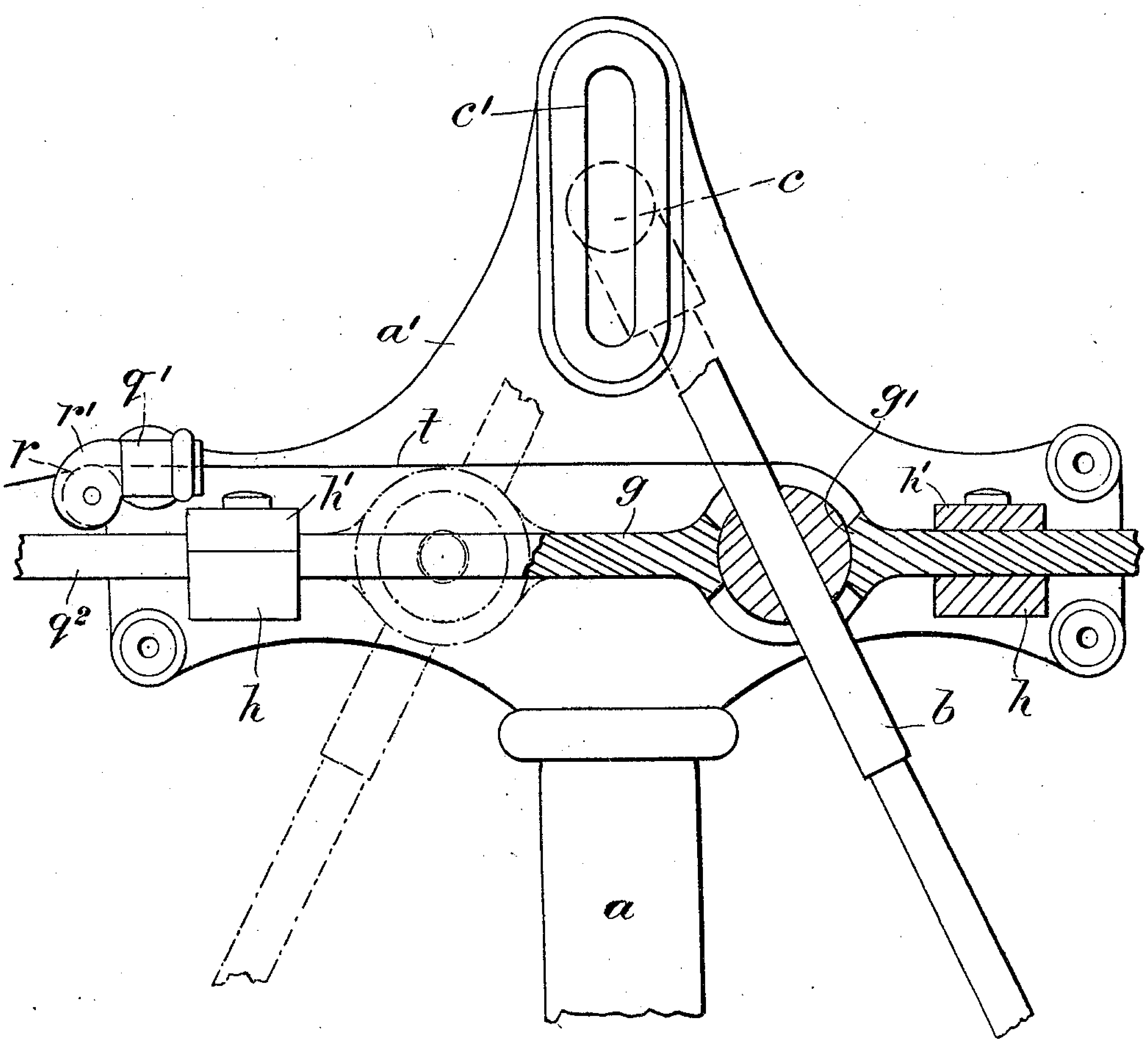

Fig. 9

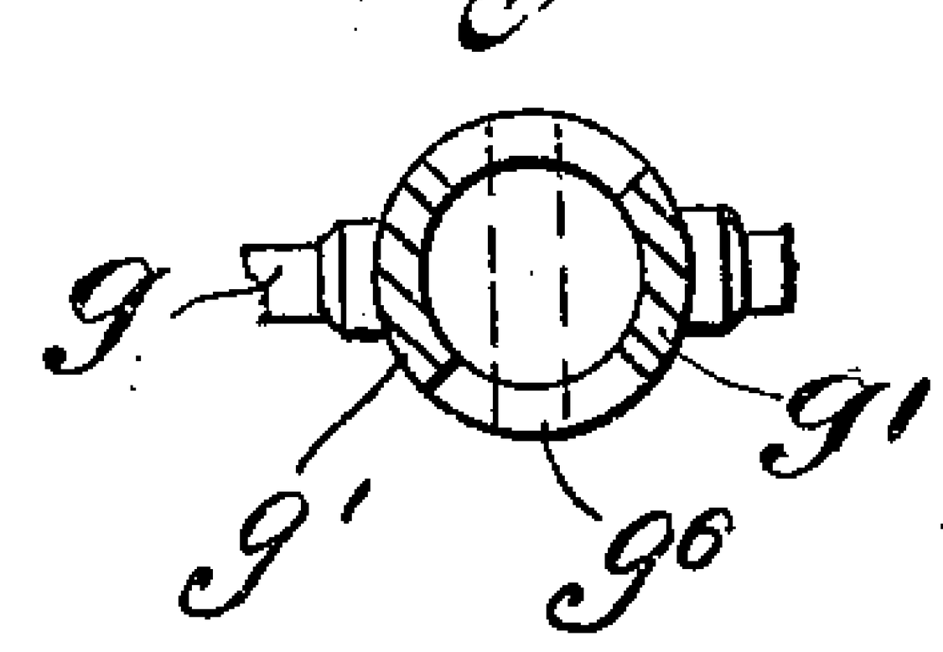

Fig. 10

Fig. 11

Witnesses

Inventor

By his Attorney

UNITED STATES PATENT OFFICE.

JAMES WRIGHT, OF MONTREAL, CANADA, ASSIGNOR OF ONE-HALF TO FRANK WRIGHT, OF SAME PLACE.

STEAM-ENGINE-INDICATOR REDUCING-GEAR.

SPECIFICATION forming part of Letters Patent No. 545,184, dated August 27, 1895.

Application filed June 26, 1894. Serial No. 615,784. (No model.)

To all whom it may concern:

Be it known that I, JAMES WRIGHT, of the city of Montreal, in the district of Montreal and Province of Quebec, Canada, have invented certain new and useful Improvements in Indicator Reducing-Gears; and I do hereby declare that the following is a full, clear, and exact description of the same.

This invention relates to devices used more particularly as an intermediary between a reciprocating part of an engine, generally the cross-head, and the customary indicator for recording the behavior of the prime mover—such as steam, water, gas, &c.—or of compressed air, or air being compressed, upon a piston or other reciprocating part, the object being to secure a reciprocating motion of a secondary part which shall be true with that of the initial reciprocating part and of any desired length or distance relatively thereto, while the velocity-ratio of the motion on both lines is constant and invariable throughout all variations in the relative positions of the parts and can be changed as desired, a further object being to produce a device which shall contain within itself all the several parts necessary to the proper reduction of the motion of the reciprocating part and for properly guiding the transmitting-cords without any necessity for disconnected intermediate guiding-sheaves. At the same time, when adjusted to suit the circumstances, the amount of the reduced motion shall be uniform at all speeds of rotation of the engine, with the ability of working with the engine for any time desired or necessary, and any desired number of indicators can be operated at the same time, making long or short diagrams, as preferred.

The invention consists of the several arrangements, devices, and combinations of parts hereinafter particularly described, and pointed out in the claims.

For full comprehension, however, of the invention, reference must be had to the annexed drawings, forming a part of this specification, in which the same symbols indicate the same or corresponding parts, and wherein—

Figure 1 is a front elevation of the device and showing a portion of the cross-head and guides of an engine; Fig. 2, an end or side elevation of same, showing the engine-frame in section; Fig. 3, a front elevation of a modified form of the device, the top portion only being shown. Figs. 4 and 5 are respectively front and end elevations of a modified form of guides for the transmitting cords or strings; Fig. 6, a detail front elevation of the form of guide shown in Fig. 1; Fig. 7, a detail view of casing; Fig. 8, an enlarged front elevation of the upper portion of the reducing-gear, and Figs. 9, 10, and 11 detail sectional views of portions of the slide-rod and lever connections.

My invention can of course be applied in the testing of all kinds of engines, whether driven by gas, steam, or air, as well as air-compressors, pumps and the like.

I will now describe the device with reference to Figs. 1, 2, 6, 9, 10, and 11.

a is a supporting pedestal or column of any desired construction secured at its lower end to the framing or any other suitable part of the engine or flooring of the room, and *a'* is a supporting frame-plate, preferably of the form shown, and either secured rigidly to the upper end of the pedestal or having a pivotal or hinged connection with the upper end of the pedestal, as shown in Fig. 3 at a^2, so that in the event of the working parts, when erected, not being in correct position relative to the piston rod or other mover, accurate adjustment can readily be attained and the parts secured in that position.

A swinging lever *b* is carried at one end by a fulcrum-pin *c*, which to vary the length of diagram may be set in any desired position in the slot *c'* (or in one of a series of holes) formed in the frame-plate, in order to allow variations in distance between the fulcrum and the end of the lever, whereby variations in the length of diagram can be secured, and when the pin is so set it constitutes a fixed point in the frame, the lever being carried at the other end by a pin such as *d* in the cross-head *e*, or other suitable reciprocating part of the engine. At both points *c* and *d* the lever *b* is free to rock on the pins, and the varying distance during a stroke between these pins is permitted by making it of a telescopic

character by the well-known device of a tubular part b' sliding on a rod b^2, the part b' being connected to the cross-head.

In order to insure accurate fitting between the parts b' b^2, a short length b^3 of brass, steel, or copper tubing about six or seven inches long is carried by the end of the tubular part b', and this short length only is made to fit snugly the rod portion b^2, the main tubular length being of a greater internal diameter. If desired the tubular part b' can be constructed in short pieces coupled together as indicated at b^4, Fig. 1, to facilitate applying the gear to different sizes of engines.

For many reasons it has been found preferable to place the frame so that the lever, in following the cross-head the full length of the stroke, shall swing approximately at an angle of thirty degrees each side of mid-stroke. Then the length of the lever at the end of the stroke is equal to the stroke of the engine; but this can be widely departed from if desired, and within the limits of the instrument. Under the above conditions, and with a thirty-six inch stroke of engine, the length of lever between the pins when it is perpendicular to the axis of the piston-rod is 31.176 inches, the tube b' having slid on the rod 4.824 inches since the commencement of the stroke.

g is the slide-rod. It is held in position on the frame a by two stationary guides h h, preferably made with removable covers h' h', to allow of the refitting of the bearings, when desired, and is free to slide to the extent required.

An open cylindrical case g' or boss is formed on the rod between the guides and internally carries a piece called the "rocking slide" g^5, which is a plain short cylinder. A true diametrical hole g^7 is drilled through the casing and rocking slide, and the holes in the casing are prolonged each way, forming slots g^6 g^6. The lever passes through these holes, the slots in the case permitting the lever to vibrate as required during a stroke. At the same time the lever turns the rocking slide in the case and the lever slides in the diametrical hole through it in conformity with the varying distance during a stroke between the fulcrum and the axis of the rocking slide. The sliding motion of the swinging lever through the rocking slide relative to the sliding motion of the rod in the tube is in the same ratio that the lever is divided by the axis of the rocking slide. Under ordinary circumstances the motion for the indicator is taken from the case on the slide-rod. The case is made wider than, and may project one-fourth inch or more beyond the ends of, the rocking slide. On this projecting part a peripheral groove is made on each end of the case, as shown at O in Fig. 7, and any required number of holes may be drilled from the groove to the interior of the case, constituting a means of attaching cords t to operate the indicators, and which at work must leave the case in a line parallel to the axis of the slide-rod.

As represented in Fig. 1, the cord leaves the groove on the casing at a tangent to a diameter of the case, which is at a right angle to the axis of the slide-rod. A cord from a hole which cannot fulfill this condition is led in the groove to this point of departure. To obviate the annoyance or detention caused by breaking a cord while testing engines, which should not be stopped or slowed, reserve cords may be put in these holes and used, if required.

I call the pin c in the frame on which the lever vibrates the "fulcrum," the end of the lever that is connected with the cross-head the "driven point," and the point of connection of the lever with the slide-rod the "actuating-point."

With all parts in proper position—viz., the frame carrying the slide-rod and rocking slide, the upper end of the lever hung on the fulcrum and connected in the proper manner with the rocking slide, the other end of the rod portion of the lever inserted into the tubular portion thereof a sufficient distance to secure correct action in all positions, and the other end of the tube connected in the proper manner with the cross-head of the engine—the action which takes place during a stroke is such that in all positions of the lever the ratio of the length between the fulcrum and driven point and between the fulcrum and the actuating-point is constant and cannot change, and such being the case the ratio of travel between the cross-head and slide-rod is also constant and cannot vary.

It will be observed that the reciprocating motion of the sliding rod is similar and synchronous with the visible motion of the piston-rod, and it follows that the effects due to the angularity of the connecting-rod or defects in the valve-gear and steamways, the when and where they occur, are truly recorded on the diagram.

The frame-plate a' carries four standards q, as shown in Figs. 1, 2, 3, and 8, each of which has a lateral arm-projection q' and is porforated horizontally in line with the center of such arm, the perforation extending through both standard and arm, and on each of the latter is set small sheaves r, located in carriers r', having socketed ends to fit such arms. These standards and sheaves are placed in such a manner that the cords from the casing g' to the sheaves will be in line with or parallel to the axis of the slide-rod and from the sheaves can be led direct to the indicator at any angle by rotating the carriers r' upon the arms q' until the desired angle is reached, after which they are secured in place by set-screws s, the carriers being perforated in line with the perforations in the standards to allow the passage through it of the cords leading to the indicators, which latter are not shown. If desired, the slide-

rod can be extended, as shown in Fig. 1, by means of an additional length of rod or tubing q^2, coupled at g^3 to the end of the slide-rod and supported, as required, by an arm or standard v from any convenient part of the engine-frame or the flooring. (Not shown.) On this extension are placed one or more movable and adjustable clamp disks or arms—such as w', Figs. 1 and 6, or w^2, Fig. 4—having a series of holes or holes with slits—such as w^3—so that the cord t for operating the indicator be placed in the holes in said disk or arm and extend between the indicator and the disk or lever on a line parallel to the axis of the slide-rod or its extension. In the majority of cases the cord of the paper barrel is sufficient.

This reducing-gear can be erected in any position that convenience or taste may require, either perpendicular or horizontal or at any angle. This extending of the slide-rod will be found particularly useful in connection with forms of pumping-engines where the motion of the piston can only be obtained at the pump end of the engine as the extension of the slide-rod may go the whole length of the engine and simultaneous diagrams be taken from both ends of the steam-cylinders and the pump by means of adjustable disks or clamped levers, as shown at w' w^2 in Figs. 4 and 6. If four or six indicators are in use at the same time, it is advisable to set the clamp-levers and indicators in such a manner that the springs of the paper barrels practically neutralize each other in their pull on the rod.

By the reduction-gear described the behavior of the steam during a stroke and the irregularities in action due to the influence of the connecting-rod, or defects in the valve-gear, are faithfully recorded on the diagram.

What I claim is as follows:

1. As an indicator reducing gear, an intermediary between the moving part of the engine and the connections leading to the indicator, in the form of a slide rod and lever for transmitting to such slide rod the motion of said moving part of the engine, the lever having one end connected directly to said moving part of the engine.

2. In an indicator reducing gear, the combination with a suitable frame or standard, of a slide rod, connections leading from it to the indicator, and a lever pivoted to said frame or standard and having a sliding and rocking connection with the slide rod, the lever being connected directly with the moving part of the engine and variable in length to allow of its oscillation at different angles to the lines of motion of the moving part and slide rod and the slide rod being arranged in such position relatively to the line of reciprocation of the moving part of the engine that the velocity ratio of motion of the acting points are constant and invariable.

3. In an indicator reducing gear, the combination with a suitable frame or standard,—of a slide rod; connections leading from it to the indicator, and a lever pivoted to said frame or standard and having a rocking sliding connection with the slide rod, the lever being connected directly with the moving part of the engine and variable in length to allow of its oscillation at different angles to the lines of motion of the moving part and slide rod and the slide rod being arranged in such position relatively to the line of reciprocation of the moving part of the engine that the velocity ratio of motion of the acting points are constant and invariable.

4. In an indicator reducing gear, the combination with a suitable frame or standard as a, having guides h h slide rod g, carried and movable in said guides and having an open cylindrical case or boss g', connections leading from such slide to the indicator, the rocking slide g^5 having perforations g^7 and fitting the open cylindrical case or boss g' of the slide rod, lever b fulcrumed upon said frame a at c, and having one of its ends working in the perforation g^7 of the rocking slide g^5 while the opposite end is made variable in length by means of telescoping parts b' b^2 and a pivotal connection of the part b' with the moving part of the engine as shown and for the purpose set forth.

5. In an indicator reducing gear, the combination with frame a and the parts for operating the cord or cords t leading to the indicator, of the standard q, one or more guide sheaves r and carriers adjustably mounted in such standard with means for holding the standard in place.

6. In an indicator reducing gear, the combination with a supporting frame, of a telescopic or sliding lever having one end connected directly with the moving part of the engine, slide rod and rocking slide, with which latter said lever has a sliding connection, in conjunction with one or more leading and adjustable pulleys for the transmitting cords or wires extending to the indicator or indicators.

7. In an indicator reducing gear, the combination with the supporting frame plate having a slot therein of a telescopic or sliding lever fulcrumed to same, a slide rod, and rocking slide with which latter said lever has a sliding connection, said slot allowing of varying the distance between the slide rod and the pin or fulcrum on which the lever swings for the purpose set forth.

8. In an indicator reducing gear, the combination of the slide rod with the case or boss carrying the rocking slide, the lever passing diametrically through such boss and rocking slide, the case being slotted to permit the required amount of vibration of the lever, having its outer periphery grooved and holes passing through the rim thereof in the manner and for the purpose described.

9. In an indicator reducing gear, the combination with a supporting frame, of a slide rod carried thereby, extensions from such

slide rod, means for actuating the latter, and adjustable string or cord-guiding disks or levers carried by the extensions presenting along their edges a series of points of attachment for the cord or cords.

10. In an indicator reducing gear, the combination with perforated standards carried by the supporting frame of adjustable pulleys provided with socketed casings pivotally connected with said standards and the casings being perforated in line with the perforation in the standard for the purpose set forth.

11. In an indicator reducing gear, the circular case in the slide rod, with the slots allowing free vibration of the lever, with the projections of the case beyond the rocking slide with the circumferential groove, and string holes passing to the interior, in the manner and for the purpose set forth.

12. In an indicator reducing gear, the combination with a slide rod and operating lever, of a rocking slide, of plain cylindrical form and the slide rod formed to receive it for the purpose set forth.

13. In an indicator reducing gear, the extension from the end of the slide rod, and movable and adjustable levers or disks clamped in proper position on the extension presenting along their edges a series of points of attachment for the cord or cords, and also increase the number of indicators which can be used at the same time.

14. In an indicator reducing gear, the combination on a frame plate, of a telescopic lever, a slide rod, and extension of the same the said lever being fulcrumed to the frame plate, having one end connected to the moving part of the engine and having a sliding connection with said slide rod, and tangent or leading sheaves in the manner and for the purpose set forth.

15. In an indicator reducing gear, the combination with frame plate having a slot and the telescopic lever adjustably fulcrumed therein for the purpose of varying the length of diagram if desired, and also extending the action of the device to greater variations in the length of stroke.

16. In an indicator reducing gear, a telescopic lever, the main tubular part of which is constructed of two or more lengths or pieces coupled together, by which the instrument can at once be changed from a short to a long stroke.

17. In an indicator reducing gear having a frame plate, slide rod, and operating lever, the combination with the lateral arms or standards on the frame plate of adjustable tangent pulleys with their carriers pivotally mounted in said standards, for the purpose set forth.

18. In an indicator reducing gear, having a frame plate, slide rod, and operating lever, the vertical pivotal connection between the frame plate and the standard or other means of securing it in place for the purpose set forth.

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Witnesses:
WILL. P. MCFEAT,
FRED. J. SEARS.