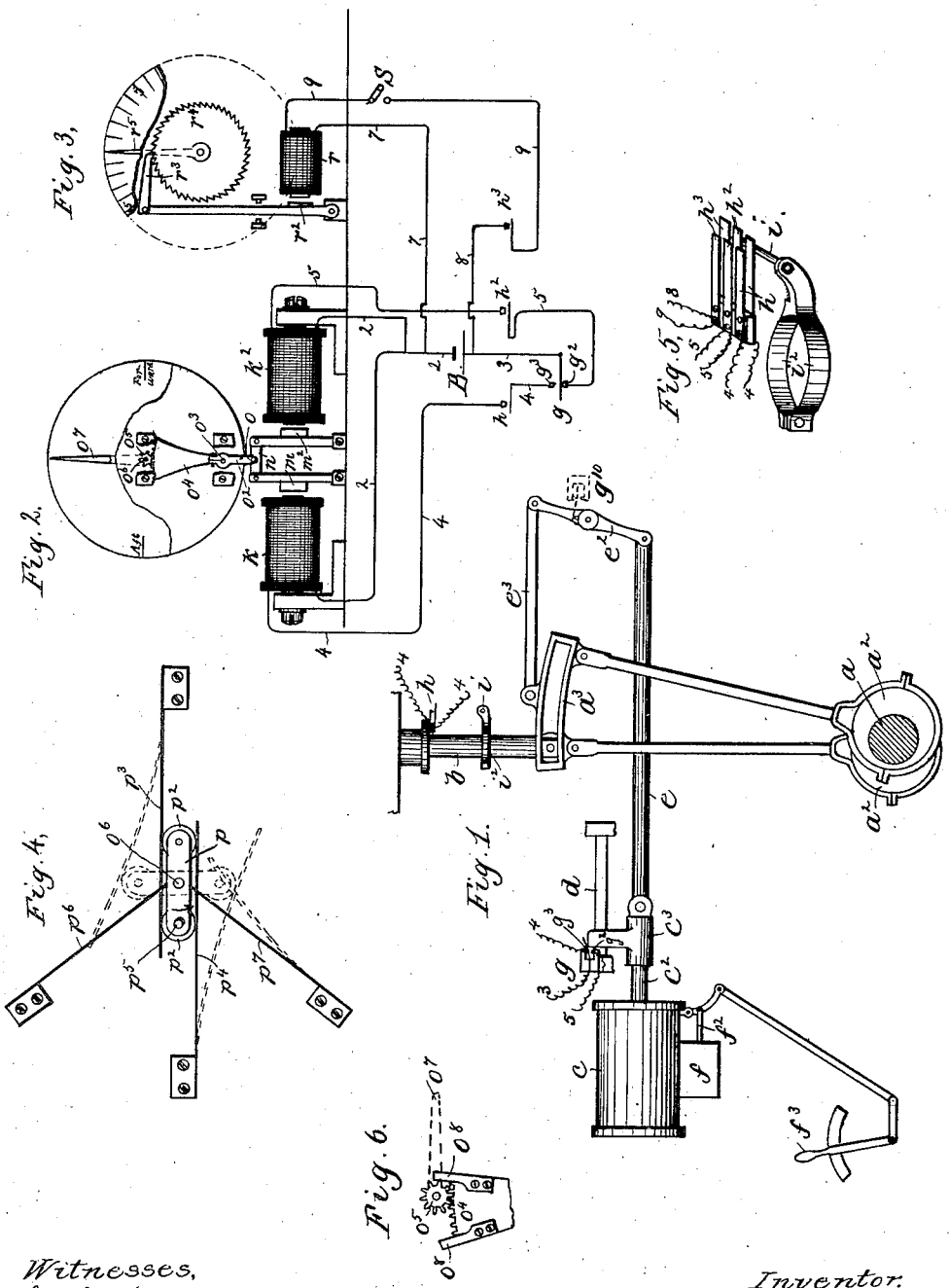
(No Model.)

W. E. HADLOCK.

ENGINE INDICATOR FOR STEAM VESSELS.

No. 453,696. Patented June 9, 1891.



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ENGINE-INDICATOR FOR STEAM-VESSELS.

SPECIFICATION forming part of Letters Patent No. 453,696, dated June 9, 1891.

Application filed November 14, 1889. Serial No. 330,294. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM E. HADLOCK, of Wenham, county of Essex, and State of Massachusetts, have invented an Improvement in Engine-Indicators for Steam-Vessels, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention relates to an indicator for steam-vessels by which the movement of the engine and direction of the movement may be indicated at a distant point—as, for example, in the pilot-house of the vessel—so that the pilot may know positively whether or not the signals to the engineer have been properly understood and responded to.

In another application, Serial No. 292,597, filed by me December 4, 1888, I have shown and described an indicator for the same purpose as that forming the subject of this invention, in which an electrically-operated indicating-instrument in the pilot-house is connected by an electric circuit with the engine and controlled by circuit-closers operated by a cam or projection carried by the engine-shaft. It is in some cases desirable to operate the circuit-closers by some other part of the engine than the shaft, as the latter moves at great speed and consequently subjects the circuit-closers or part that is employed to act directly upon them to severe shocks, necessitating great care in construction to afford durability. In the present invention the circuit-closers by which the indicating-instrument is controlled are operated by some reciprocating part of the engine, preferably the valve-rod, which has a comparatively slow movement which is very slow near the end of its stroke, so that if the circuit-closers be engaged and operated by the valve-rod or a suitable arm or projection connected therewith they will have a comparatively easy and slow movement, and may thus be of comparatively delicate construction without impairing their durability. As the movement of the valve-rod is the same substantially whether the engine is running forward or backward, there is in accordance with this invention a second circuit-controller provided, which is operated by some part of the reversing-gear, and thus directs the current properly to the indicating-instrument to cause the latter to give different indications when the engine is moving forward from those which are given when it is moving backward. A revolution-counter is also provided which may be thrown into operation at any time and at the end of a given period of time will indicate the number of revolutions of the engine-shaft that have taken place in the period of time that has elapsed since the counter was thrown into operation.

Figure 1 represents in diagram a sufficient portion of the valve-gear of the engine to illustrate this invention. Fig. 2 is a front elevation of the engine-indicator; Fig. 3, a front elevation of the revolution-counter, Figs. 2 and 3, having portions of the dial or front plate removed to show the working parts, and also having the circuits and their controlling devices shown in diagram; Fig. 4, a detail to be referred to, showing a portion of the indicating-instrument; Fig. 5, a detail of the circuit-closers, and Fig. 6 a detail of the indicating-instrument to be referred to.

The invention is shown as applied in connection with an engine of usual construction, the main shaft a of which is provided with eccentrics a^2, operating the usual link a^3, which in turn operates the valve-rod b, and is shifted or reversed by an auxiliary engine comprising a cylinder c, in which is operated a piston-rod c^2, which is connected with a cross-head c^3, working on a guide d, and being connected by a pitman e with one arm of a lever e^2, the other arm of which is connected by a connecting-rod e^3 with the valve-gear link a^3, so that the traverse of the piston in the cylinder c reverses the position of the link a^3 with relation to the valve-stem, and thus reverses the line of movement of the engine in the well-known manner.

Admission of steam to one or the other end of the cylinder c is controlled by a valve in the steam-chest f, said valve having a rod f^2, connected by suitable mechanism with a hand-lever f^3, so that movement of said hand-lever in one or the other direction causes the link of the valve-gear to be reversed. Thus the link a^3 and the entire train of mechanism that has just been described as controlling its movements terminating with the hand-lever f^3 has its position reversed, according as the

engine is running in one or the other direction, and any of said parts may be employed to control a circuit-closer, which may thus have one position when the engine is running forward and another position when the engine is running backward. The said entire train or reversing-gearing will be referred to as the "reversing valve-gear," and it is obvious that any part may be used to control the circuit-changer referred to, the choice depending largely on convenience of applying the circuit-changer in any particular case. Such circuit-changer is shown is full lines, Fig. 1, at g, as applied to one of the supports of the cross-head guide d, in position to be operated by the cross-head c^3, and is shown in dotted lines at g^{10} in position to be operated by the rock-shaft or hub portion of the lever e^2. The relation of the said circuit-changer to the indicating-instrument controlled by it will be described later on in connection with the description of said instrument.

The valve-rod b has a reciprocating movement, making a complete to-and-fro movement at each complete revolution of the engine, and in engines of the kind to which this apparatus will be commonly applied the main valve-rod has a uniform stroke, as the reversing-gear before referred to is always thrown from one to the other extreme position, the cut-off of steam being controlled by another valve instead of by the main slide-valve operated by the link-motion which directs the stem to one or the other end of the cylinder. The length of stroke of the valve and the valve-rod b with relation to the other movements of the engine is comparatively short, and owing to its actuation from an eccentric on the main shaft its movement is most rapid at the middle of its stroke and becomes very slow near the end of its stroke, and for these reasons its movement may be very advantageously availed of to operate the circuit-closers by which the indicating-instruments are directly controlled, said circuit-closers being represented at h in position to be operated by a pin i, carried by a collar i^2, that may be fastened upon the valve-rod b in the proper position to cause the said pin i (see Fig. 5) to actuate the circuit-closers at the end of the stroke of the valve. The collar i^2 may be made in two parts, or as a flexible strap, so that it can be securely clamped upon the valve-rod without marring or requiring any machine-work upon the latter. The said pin i may simultaneously operate several circuit-closers placed in a gang or row, one only of which is shown at h, Fig. 1; but there being in fact three, as shown in Fig. 5, and at h h^2 h^3 in the diagram in connection with Figs. 3 and 4.

The indicator for showing backward or forward motion of the engine is represented in Fig. 2 and comprises two electro-magnets k k^2, placed opposite one another, the armatures m m^2 of which are connected by a link n, which has a notch that engages a pin o, projecting from an arm o^2, fixed upon the arbor o^3 of a segmental gear o^4, that meshes with a pinion o^5 on a shaft o^6, connected with a pointer o^7. Thus when one of the magnets k or k^2 is energized the pointer o^7 is turned in one direction, and when the other magnet is energized it is turned in the opposite direction from the position shown in Fig. 2, and the gearing is preferably so proportioned that the attractive movement of the armature will produce about a quarter-turn of the pointer from its normal or vertical position.

The segment o^4 is provided with ears or projections o^8, that come against the side of the pinion o^5, and thus limit the movement of the segment, pinion, and pointer to the desired amount. (See Fig. 6.)

The shaft o^6 of the pointer is provided with a centering or restoring device, (shown in Fig. 4,) which tends to return the pointer to its normal or upright position whenever the attraction of the magnet by which the pointer was moved away from said position is removed, said centering device thus constituting the retractor for the armatures m m^2 of the magnets k k^2. The said device consists, essentially, of a cross-bar p, fixed upon the arbor o^6, and provided at its ends with anti-friction rolls p^2, which are acted upon by long flexible springs p^3 p^4, which by their pressure on said rolls tend to keep the cross-bar p substantially in line with said springs, or in the position shown in full lines, Fig. 4, in which position the pointer o^7 will be in normal or vertical position, as shown in Fig. 2. The rotation of the arbor o^6 turns the cross-bar p in one or the other direction and its movement in either direction strains the springs p^3 p^4, as shown in dotted lines, Fig. 4, so that said springs tend to turn the cross-bar to its full-line position as soon as the force by which it is turned from said position is withdrawn. It will be understood, however, that if the movement of the cross-bar p were sufficient to bring the line of pressure of the springs directly in line with the arbor o^6 the cross-bar p would be in a dead-center position with relation to said springs, so that they would not return it to its original position; and, furthermore, it is obvious that the power of the springs to return the pointer tends to diminish as they approach said dead-center position, although the force of the springs becomes greater as they are strained more and more in approaching said position.

In order to prevent the cross-bar from remaining in dead-center position with relation to the springs and to assist said springs as they begin the return movement of the pointer, one end of the cross-bar is provided with a laterally-projecting pin p^5, and springs p^6 p^7 are set to engage the said pin before the cross-bar arrives at dead-center position with relation to the springs q^3 p^4, the pressure of the said springs p^6 p^7 being then at about right angles to the line of pressure of the springs p^3 p^4.

In Fig. 4 the parts are represented in their

normal position in full lines and in dotted lines in the position assumed at the end of the movement of the cross-bar in the direction of the arrow thereon, and it will be seen that the cross-bar has slightly passed the dead-center position with relation to the springs p^3 p^4, so that they would tend, if anything, to turn the cross-bar still farther in the direction of the arrow, instead of turning it back to the full-line position in the direction opposite the arrow. They act, however, nearly in line with the pivot and with but comparatively small leverage to turn the cross-bar. In coming to the dotted-line position, however, the pin p^5 has engaged the spring p^7 and strained the same, so that it exerts a force with nearly maximum leverage, tending to turn the cross-bar from the dotted to the full line position in the direction opposite to the arrow, and it will carry the said cross-bar in that direction far enough to bring it in the position in which the spring p^3 p^4 will have a strong tendency to continue the movement in the direction opposite the arrow. If the cross-bar had been turned originally in the other direction, the spring p^6 would have engaged the pin p^5 and would act with a tendency to return the cross-bar to the position from which it was moved. By this arrangement the pointer is promptly returned to normal position when the attraction of the magnet by which it was moved from the normal position is withdrawn and is stopped in the normal position without vibrating across said position.

The circuits of the magnets k k^2 are as follows: One terminal of each magnet is connected by wire 2 with one pole of the battery B, the other pole of which is connected by wire 3 with the movable member of the circuit-changer g, which is shown as a spring co-operating with two contacts g^2 g^3, and so constructed that the said movable member, which is shown as a spring, normally makes contact with one of said contact-pieces, as g^2, and is disconnected from the other g^3; but when engaged by the movable portion of the reversing valve-gear of the engine it is disconnected from the contact g^2 and pressed into electrical connection with the contact g^3. Thus when the reversing valve-gear of the engine is in one position—as, for example, for the engine to run forward—contact is made between the battery-wire 3 and the contact g^2; but when in the other position assumed when the engine is running backward the battery-wire is in connection with the contact g^3. The contact g^3 is connected by wire 4 with the other terminal of the magnet k than the one connected by wire 2 with the battery, and the contact g^2 is connected by wire 5 with the corresponding terminal of the magnet k^2, and the said wires 4 5 include circuit-closers h h^2, respectively, which are normally open, but are closed by the valve-stem or other reciprocating part of the engine at the end of its stroke. When the circuit-changer g is in normal position in contact with the piece g^2, closure of the circuit-closer h produces no effect on the magnet k, as the said circuit is open between g and g^3; but the closure of the circuit-closer h^2, which takes place at the same time, completes the circuit of the magnet k^2, which circuit is connected at g g^2, so that the magnet k^2 is energized and the pointer o^7 moved from its normal position to the side designated by the word "forward," or any other mark indicating forward movement of the engine, and such movement of the pointer takes place at each to-and-fro movement of the valve-stem b or other reciprocating part of the engine, thus showing the direction of the movement of the engine and also the frequency of rotation of the main shaft of the engine. If, however, the engine is reversed, the circuit-changer will be connected at g^3 and disconnected at g^2, and simultaneous closures of the circuit-closers h h^2 will produce no effect in the circuit of the magnet k^2, but will complete the circuit of the magnet k, thus producing corresponding movements of the pointer o^7 in the direction to indicate backward movement of the engine. The movement of the pointer o^7 thus indicates the direction of movement of the engine-shaft, and also the frequency or rapidity of its rotations; but in order to determine the rapidity of movement without actual watching the lapse of time and counting the number of movements of the pointer o^7 an additional revolution-counter is provided, as shown in Fig. 4, consisting of an electro-magnet r and armature r^2 therefor, the lever of which is provided with a pawl r^3, co-operating with a ratchet r^4 on a shaft provided with a pointer r^5, that moves over a suitably-graduated dial.

The circuit of the magnet r may include the battery B or any other suitable battery, being shown in this instance as having one terminal connected by wire 7 with one pole of the battery, the other pole of which is connected by wire 8 with one member of a circuit-closer h^3, the other member of which is connected by wire 9 with the other terminal of said magnet r. Thus each closure of the circuit-closer h^3, produced by the movement of the valve-stem or other reciprocating part of the engine, causes the magnet r to be energized and the pointer r^5 to be advanced one step. Thus the operator by closing the circuit of the magnet r by the switch S or other suitable device and observing the time of the first movement by a clock can at the end of any desired interval of time observe directly by means of the pointer r^5 and its dial the number of revolutions of the shaft that have taken place since the revolution-counter or number-indicator was thrown into operation.

I claim—

1. The combination, with a steam-engine, of an indicating-instrument comprising an electro-magnet, a circuit-closer in circuit with

said magnet, and a projection on the valve-stem of said engine for operating the circuit-closer, substantially as described.

2. The combination of an indicator dial and pointer with two electro-magnets and armatures therefor, a link connecting said armatures, and a segment engaged with said link and meshing with the pinion on the pointer-arbor, substantially as described.

3. The combination of an indicator dial and pointer with two electro-magnets and armatures therefor, a link connecting said armatures, and a segment engaged with said link and meshing with the pinion on the pointer-arbor, and stop projections on said segment for limiting the movement of said pointer, substantially as described.

4. The combination of an indicator dial and pointer with two electro-magnets and armatures therefor, a link connecting said armatures and segment engaged with said link and meshing with the pinion on the pointer-arbor, and a centering cross-bar on said pointer-arbor and springs co-operating therewith, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM E. HADLOCK.

Witnesses:
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