No. 646,067. Patented Mar. 27, 1900.

J. E. COLAS.

APPARATUS FOR RECORDING FLEXURE OF RAILWAY RAILS, &c.

(Application filed Oct. 15, 1897.)

(No Model.) 3 Sheets—Sheet 1.

FIG1.

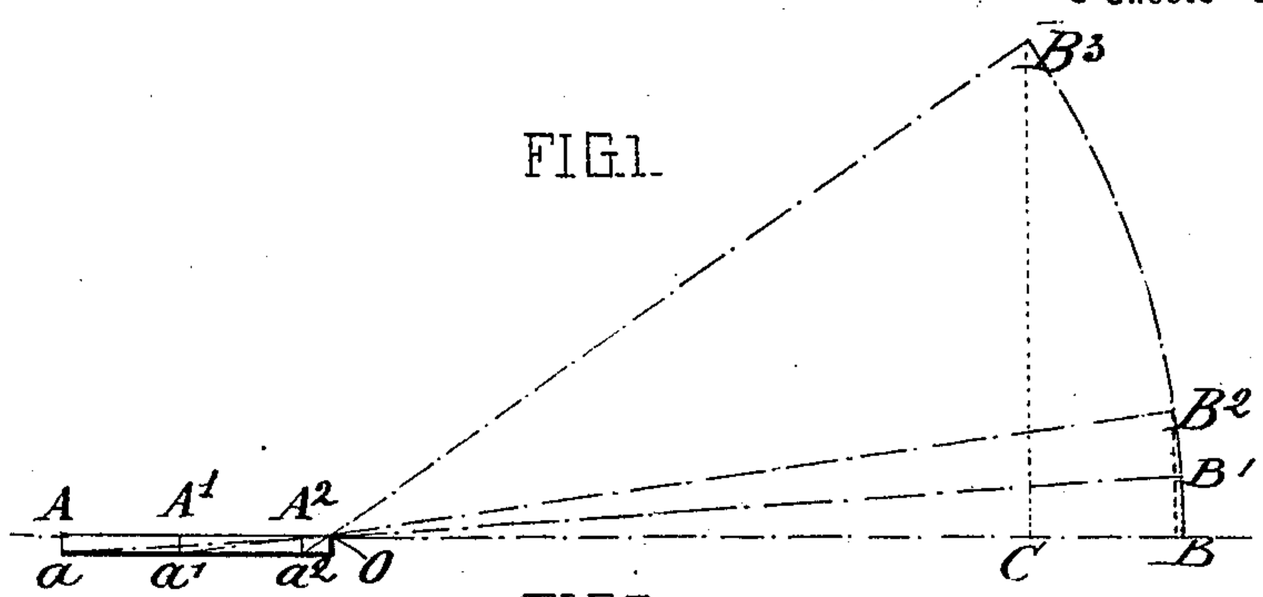


FIG2.

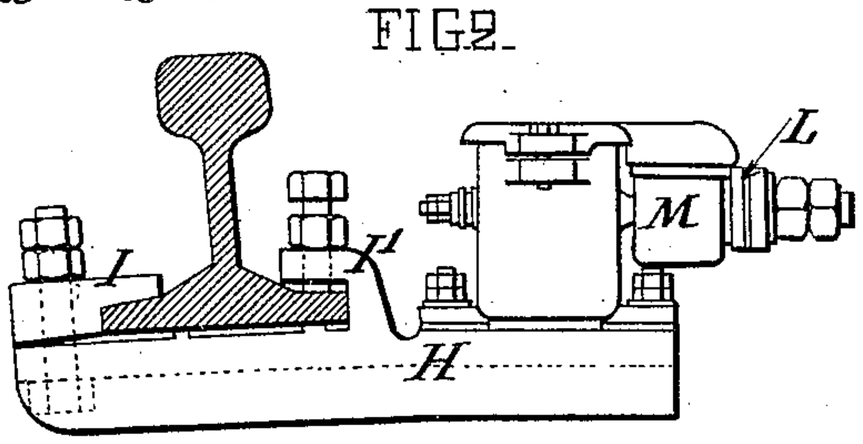


FIG3.

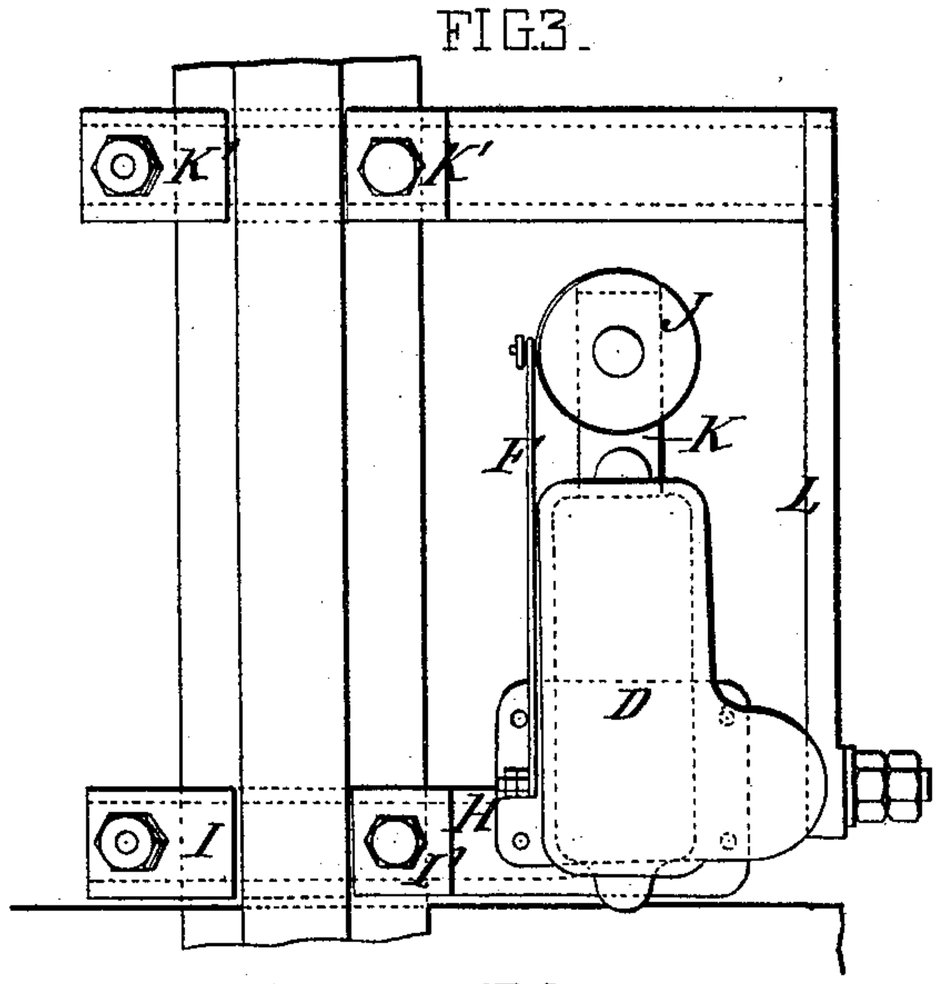
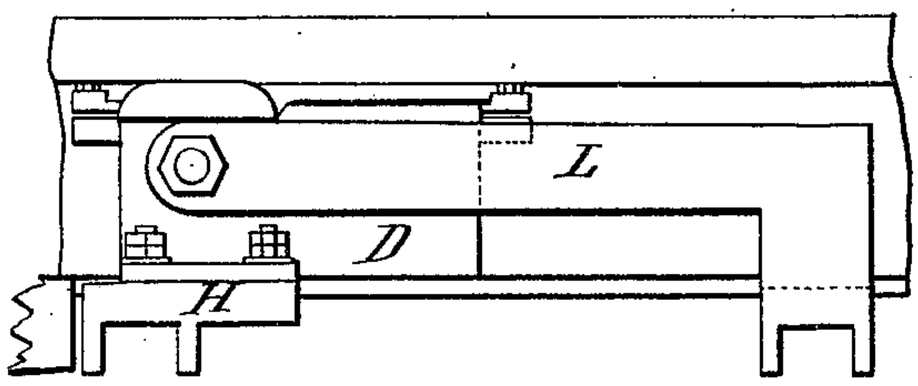


FIG4.



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(No Model.) 3 Sheets—Sheet 2.

FIG.5.

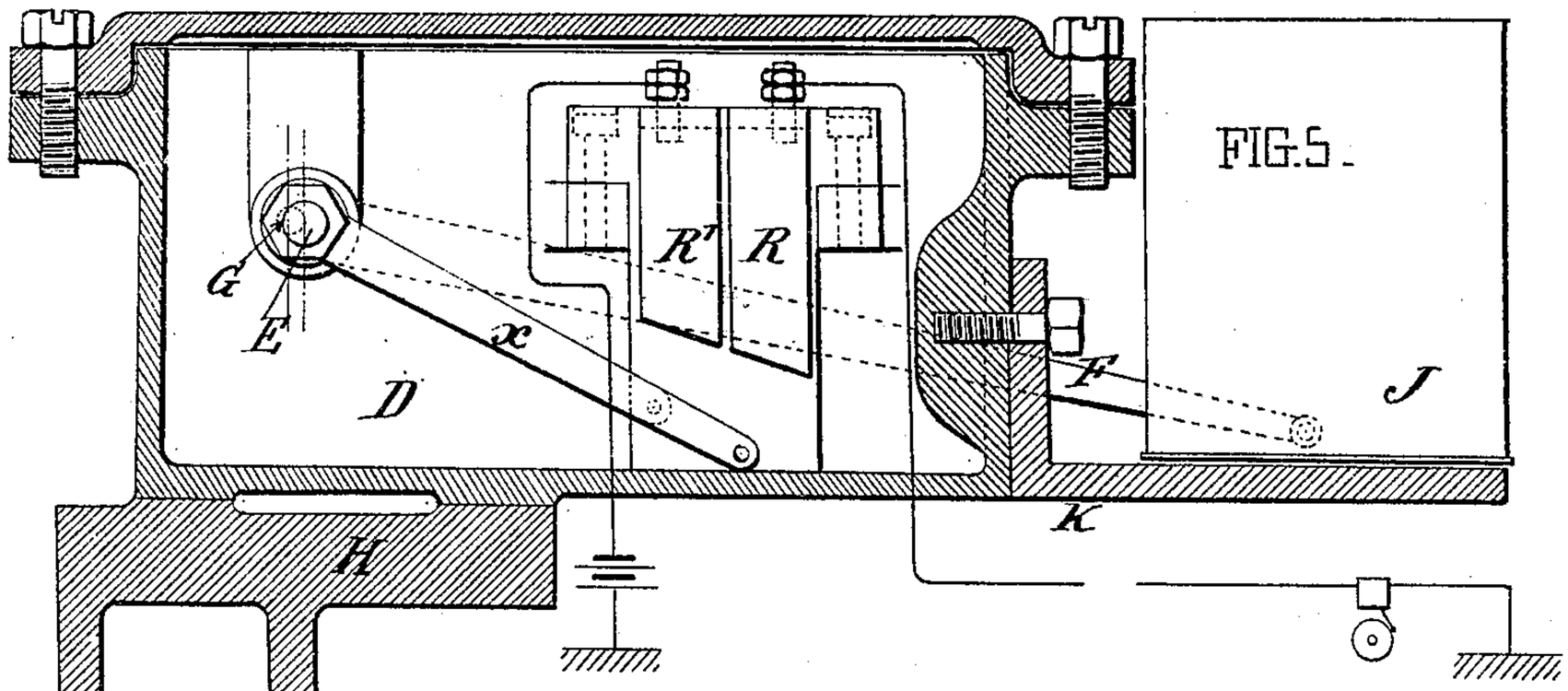
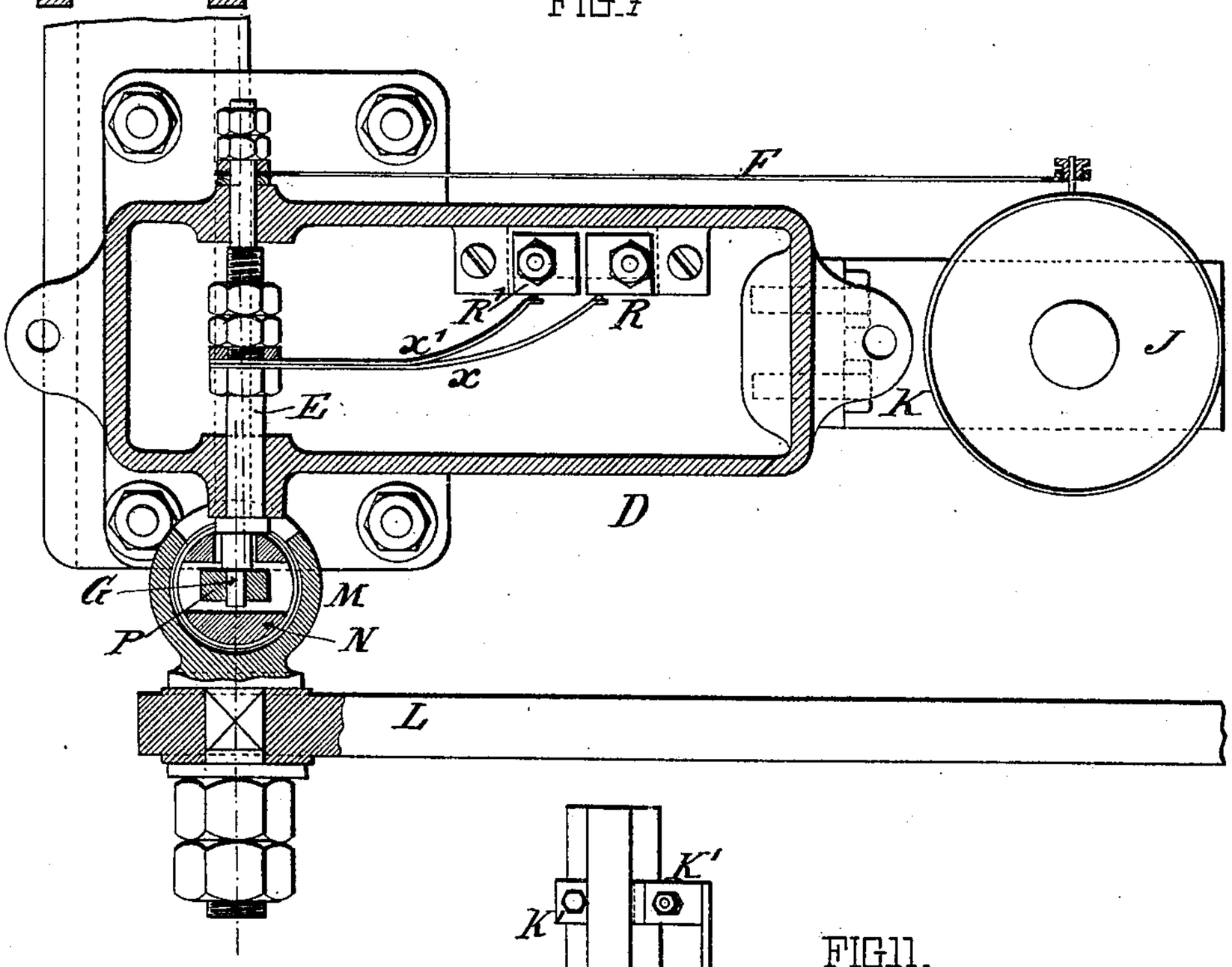


FIG.7



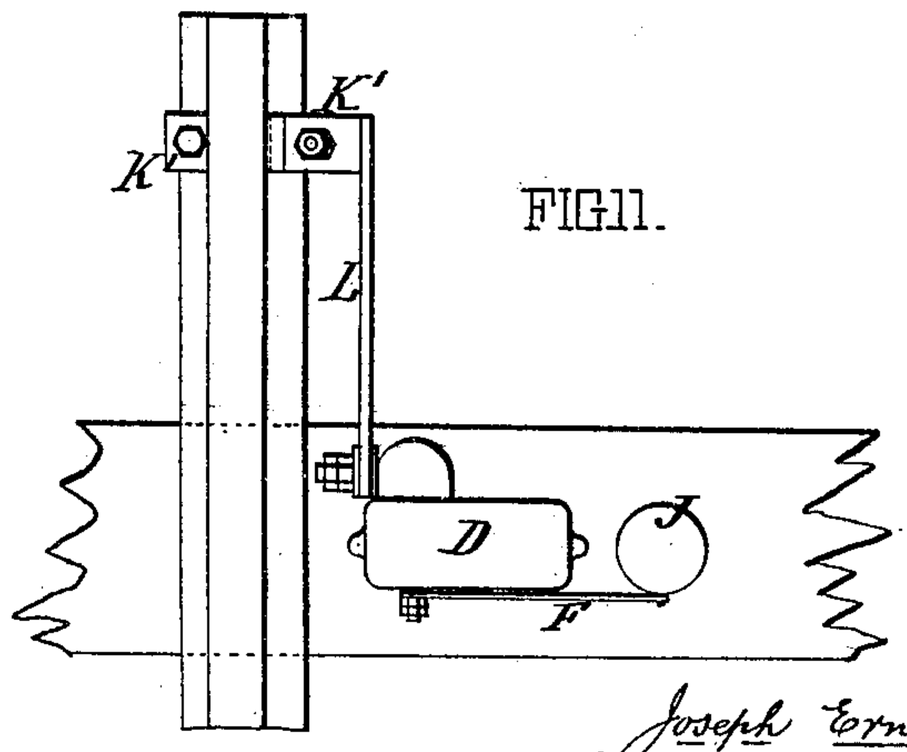


FIG11.

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APPARATUS FOR RECORDING FLEXURE OF RAILWAY RAILS, &c.

(No Model.) (Application filed Oct. 15, 1897.) 3 Sheets—Sheet 3.

FIG.6

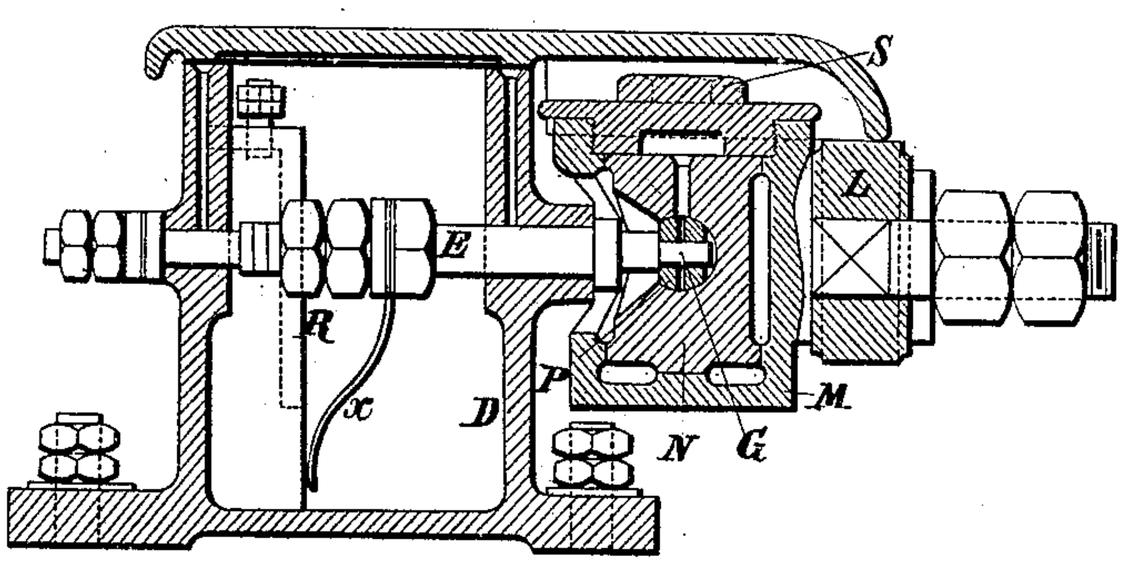


FIG.8.

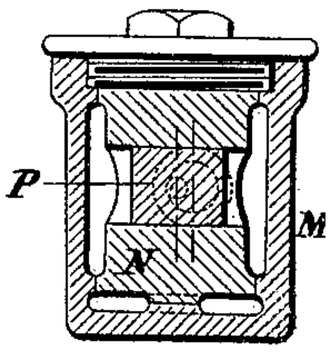


FIG.9.

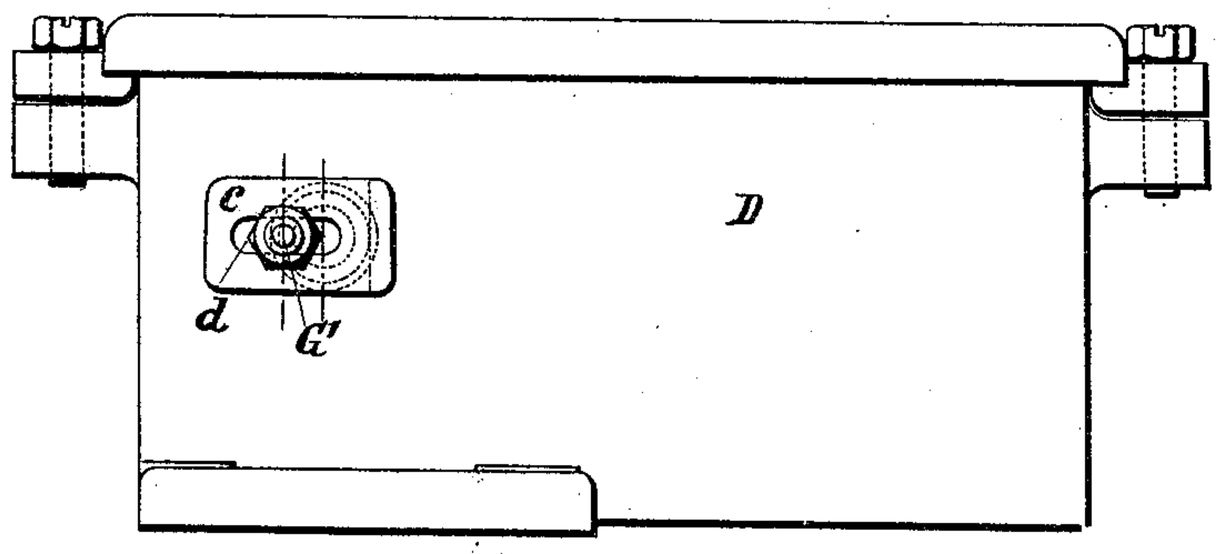
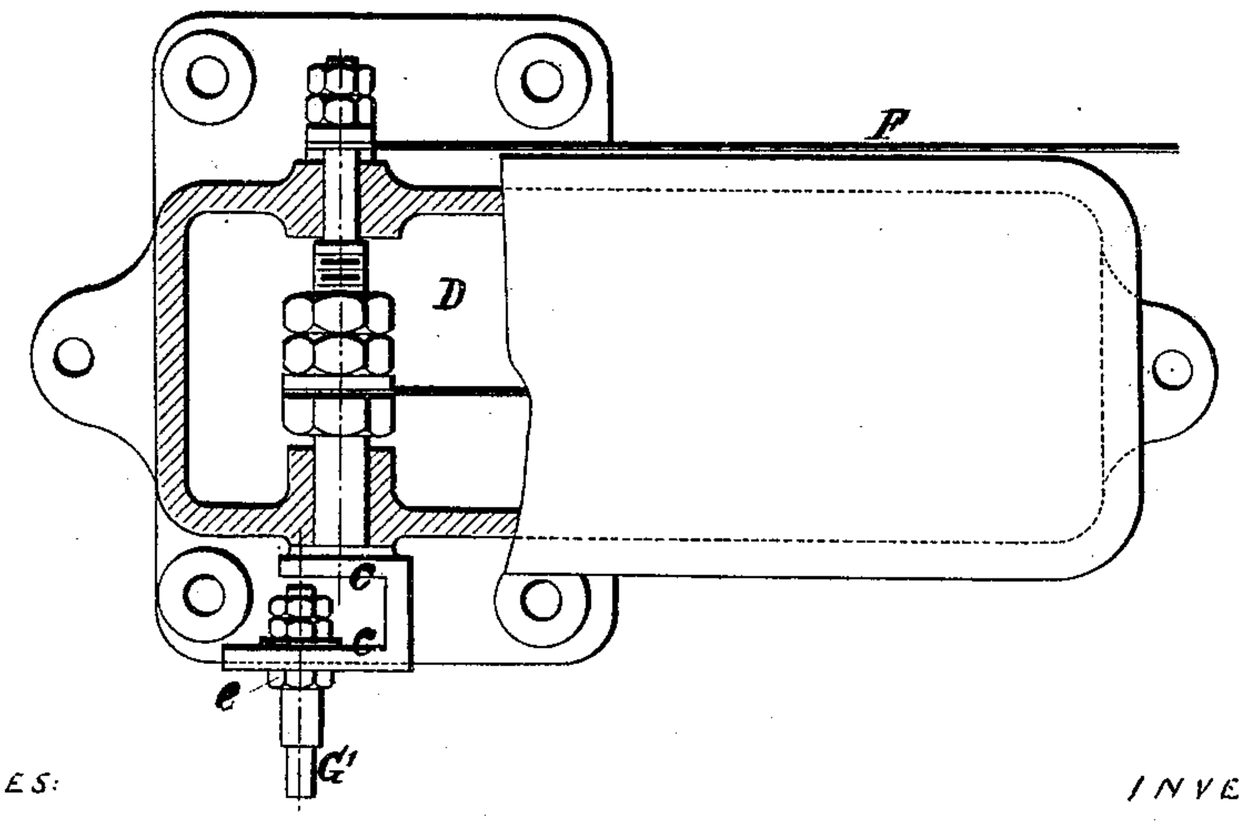


FIG.10.



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UNITED STATES PATENT OFFICE.

JOSEPH ERNEST COLAS, OF CREIL, FRANCE.

APPARATUS FOR RECORDING FLEXURE OF RAILWAY-RAILS, &c.

SPECIFICATION forming part of Letters Patent No. 646,067, dated March 27, 1900.

Application filed October 15, 1897. Serial No. 655,280. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH ERNEST COLAS, a citizen of the Republic of France, residing in Creil, Oise, France, have invented certain new and useful Improvements in Apparatus for Recording the Flexure of Railway-Rails and Signaling Passage of Trains, (the same being the subject-matter of Letters Patent in France No. 261,263, dated November 13, 1896,) of which the following is a specification.

This application has for its object an apparatus by means of which the flexure of a railway-rail on passage of a train can be measured, so as to ascertain the working of the rail. Thus comparative diagrams can be drawn from which can be deduced consequences very important as regards the best section of rail to be adopted and the intervals between the sleepers to be determined, so as to present the best conditions for the structure of the permanent way. At the passage of each axle there is a movement of the tracer. By measuring the corresponding ordinate the amount of shock caused by the passage of this axle is measured. The weight carried by this axle being known, it can be seen if the measured ordinate corresponds to the effort produced. If the ordinate is greater, this indicates some defect in the wheel-tire.

This apparatus can also serve to measure the deflection of the rail on passage of a train.

The principle of the apparatus is based on the multiplication by leverage of the relative flexure between two given points of a rail under the weight of the engines and of the carriages. The free end of the long arm of the lever carries a tracer, the movements of which draw a diagram on a traveling sheet of paper, which may be on a rotating drum or on a moving table.

The accompanying drawings show embodiments of my invention.

Figure 1 is a diagram of the leverage. Figs. 2, 3, and 4 are respectively an end elevation, plan, and side elevation of one embodiment of my apparatus applied to measure the relative flexure of two points of a rail. Figs. 5, 6, and 7 are respectively a cross-section, longitudinal section, and horizontal section of the registering apparatus of Figs. 2, 3, and 4, on an enlarged scale. Fig. 8 is a transverse section of the axis of the registering apparatus. Figs. 9 and 10 are respectively a side elevation and partial horizontal section of a modification, and Fig. 11 shows the apparatus arranged to measure the flexure of the rail relatively to a sleeper.

The apparatus is constructed according to the following principles:

Let A O B, Fig. 1, be a lever moving in a vertical plane around the pivot O, the long arm O B having its length invariable, and let us assume that the length of the short arm be varied and the different points A A′ A^2 be considered. It will be seen that on lowering these points by a constant amount they will, describing small circular arcs, come to a straight line parallel to A O and reach, respectively, the points $a\ a'\ a^2$. The corresponding movements of B will be the circular arcs B B′ $B B^2$ $B B^3$. The maximum movement of B will be given by the point of the short arm situated at a distance from O equal to the constant amount by which the points A A′ A^2 are lowered and will be a quarter of the circumference of a circle whose radius is O B. The length of the half-chord B^3 C being known, the movement $A^2\ a^2$ is given by

$$x = \frac{O\ a^2}{O\ B} B^3\ C = \frac{r}{R} B^3\ C,$$

r being the length of the line O a^2 and R the length of O B. O A^2 and O B being known, B^3 C can be measured on the diagram traced by my apparatus, it being observed that for such slight deflections as occur in practice O a^2 and O A^2 are substantially equal. The probable error in measuring the line B^3 C being the same, whatever its length, the length of $A^2\ a^2$ will be more accurately determined, as the ratio $\frac{r}{R}$ is less.

In order to measure the flexure of a rail at a given point, the registering appliance is fixed, as shown in Figs. 2, 3, and 4, to the rail at a point as near as possible to the point of support of the rail—for instance, the sleeper.

The registering appliance (shown separately on an enlarged scale in Figs. 5, 6, and 7) consists of a box D crossed by an axis E, which at one end carries the tracer F and at the other a small eccentric-pin G. The box D is fixed to the rail by a support H, extend-

ing beneath the rail and held to it by a clamp in two parts I I'. A tracer F, responding to the deflections of the rail, moves in front of a drum J, uniformly rotating, the drum being carried by an arm K, fixed to the box D or cast on it. The tracer moving over the paper which covers the drum draws curves showing the successive flexures by means of the following arrangement: A bar L, having a right-angle bend, is fixed at the point where the flexure is to be measured by jaws K' K'. This bar is connected to the pin G by a universal joint. For this purpose the end of bar L has bolted to it a cylindrical box M, having its axis vertical. Inside this box is a cylinder N, which can turn with slight friction around the axis of M. Through N there is a horizontal cylindrical hole perpendicular to its axis and parallel to the plane of L. This hole receives a block P of the same form, which can turn around its axis. Another hole perpendicular to the axes of N and P receives the pin G of the axis E. (See Fig. 8.) Owing to this arrangement the position of the box D relatively to L does not require delicate adjustment, the block P, which engages the pin G, being capable of yielding in the two directions, vertical and horizontal, insuring the connection of the two parts of the apparatus, even if the axis of revolution of the bar L and the axis E differed in direction, clearance-spaces being provided in M and N to allow of the double movement. Moreover, owing to this arrangement the action of a wheel on the rail at the clamp K' is always transmitted normally to the pin G. The screw-cap S covers the box M, the upper part of which contains lubricant for the whole joint. This head is screwed down after the appliance is put in position.

In order to utilize the apparatus for announcing the passage of a train, two light blades x x' are fixed on the axis E, and when this axis turns they rub along two metal plates R R', insulated from each other, putting them in electrical communication. The plates R R' are connected the one to the line and the other to earth and a battery, an electric bell being arranged in the circuit. (See Fig. 5.)

It is to be observed that the moving parts are extremely light, thus avoiding objectionable shocks and vibrations during the working, for the mass of these parts being very small, the *vis viva* produced at the moment of the flexure of the rail is very much reduced, and this allows the tracer and the rubbers to return to their position of rest as soon as the action of the wheel ceases.

If the apparatus is used solely for recording, the axis E, tracer F, and drum J alone are required. If, on the other hand, the apparatus is used to announce passage of trains, the axis E, rubbers x x', and plates R R' are employed and the other parts can be dismounted.

Under the weight of a locomotive or carriage the clamps K' K', and consequently the bar L, follow the motion of the rail. The box fixed at the other point also follows the movement. The different points of the rail where the clamps are fixed are unequally depressed, so that there is a relative difference of level produced in regard to the bar L and the recording appliance, and consequently the axis E is partly turned, moving the tracer and the rubbers. The tracer then draws on the paper on the drum a diagram representing the relative flexures multiplied due to the passage of the successive wheels. In dealing with rails of different section and weight these flexures are studied and there can be deduced the mode in which they respectively act under the pressure of a given train. During the flexure of the rail the rubbers x x' move over the contacts R R' and close the bell-circuit.

Figs. 9 and 10 show a modification of the arrangement of the axis E, by means of which the short arm of the lever on which the flexure of the rail acts can be varied. For this purpose the axis E has outside the box D a piece c c, provided with a mortise d, in which the pin e of the eccentric-pin G' can be moved to any position desired, according to the sensitiveness which the apparatus is to have. The pin G' is held in position by a nut and lock-nut.

When the flexure of the rail relatively to a sleeper is measured, a like apparatus is used; but the box D is fixed on the sleeper, as shown in plan in Fig. 11, the clamp I I' being then dispensed with.

This apparatus can also be used to measure the flexure of a fish-joint. For this purpose the bar L may be fixed to the fish-joint.

The operation is as follows: The bar L being rigidly attached to the rail receives at every point a vertical movement equal to that of the rail at K' K', transmitting the difference between the movements at the two points I and K' of the rail to the eccentric-pin, which is, in effect, a very short arm on the shaft, an arm whose length is less than the diameter of the shaft. Figs. 9 and 10 show more clearly that it is an arm. The movement of this short arm is multiplied by the long arm on the same shaft of which the pencil or tracer at the end, bearing against the cylinder, registers the movement. This cylinder is designed to carry a sheet of cross-ruled or other paper and be turned by any of the means usual in this type of machines. The ordinates of the curve traced on the paper will then indicate the deflection of the rail on an enlarged scale, the horizontal distances indicating the periods of time between deflections represented by different points of the curve, which periods of time will be proportional to the distances between the wheels of a train.

I claim as my invention—

1. An apparatus for measuring the flexure of railway-rails, comprising a lever having short and long arms, means for communicat-

ing the movement of flexure from the rail to the short arm, the long arm of the lever carrying a tracer, and mechanism for holding a record-sheet to receive the tracing therefrom.

2. The combination of a pivotal axis E having a long lever-arm F and a short arm, means for communicating the movements of the rail to said short arm, and an interposed universal joint.

3. The combination with axis E and eccentric-pin G constituting a short lever-arm, of an arm L for communicating motion thereto, and an interposed universal joint comprising a box M fixed to said arm, a cylinder N inclosed therein, a cylindrical plug P on an axis substantially perpendicular to said cylinder N, said plug having a hole perpendicular to its axis for receiving said pin G.

4. The combination with axis E, long lever-arm F and a short lever-arm, and means for varying the length of said short arm, consisting of an interposed frame *c* having a mortise *d*, and means for clamping the short arm in said mortise, whereby it may be adjusted longitudinally thereof.

5. The described circuit-closer comprising a box D, an axis E passing through said box, means for connecting said axis to the rail whereby deflections of the rail cause an oscillation of said axis, contact-pieces R R′ in said box, and contact-arms *x x′* fixed on said axis and movable thereby into or out of contact with said contact-pieces.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JOSEPH ERNEST COLAS.

Witnesses:

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EDWARD P. MACLEAN.