Oct. 25, 1949. L. BIENFAIT 2,485,810

APPARATUS FOR DETERMINING THE CORRECT TRACING OF RAILWAY TRACKS

Filed Oct. 21, 1946 2 Sheets-Sheet 1

Fig.1

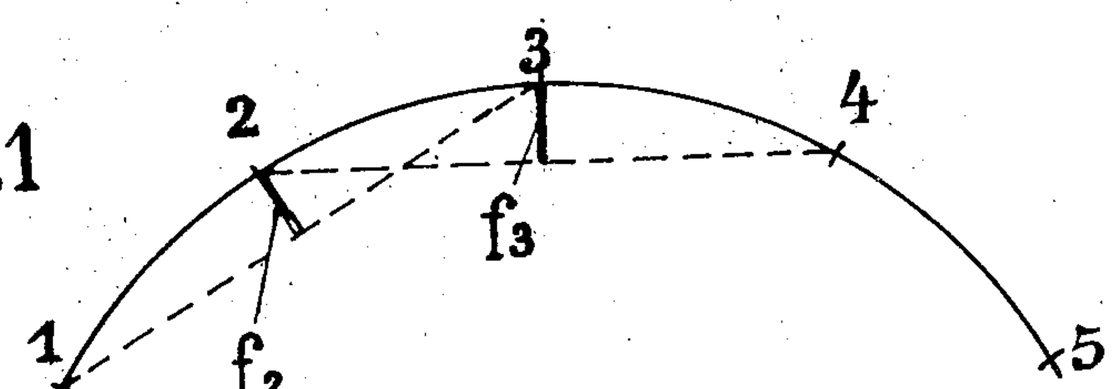

Fig.2

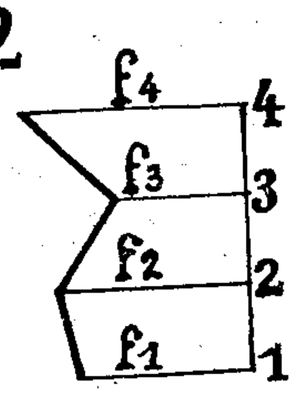

Fig.3

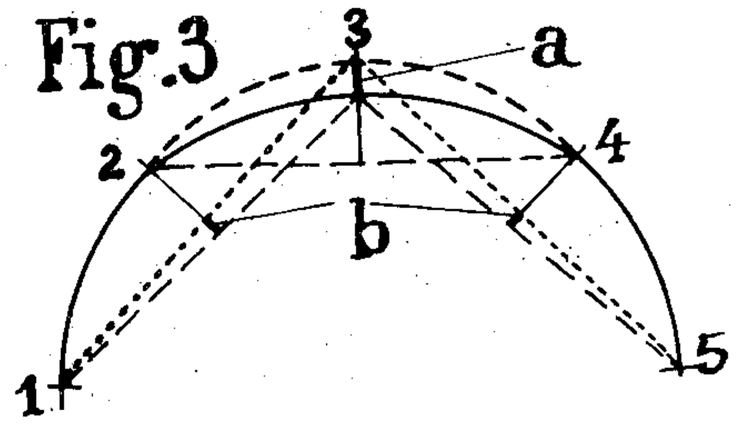

Fig.4

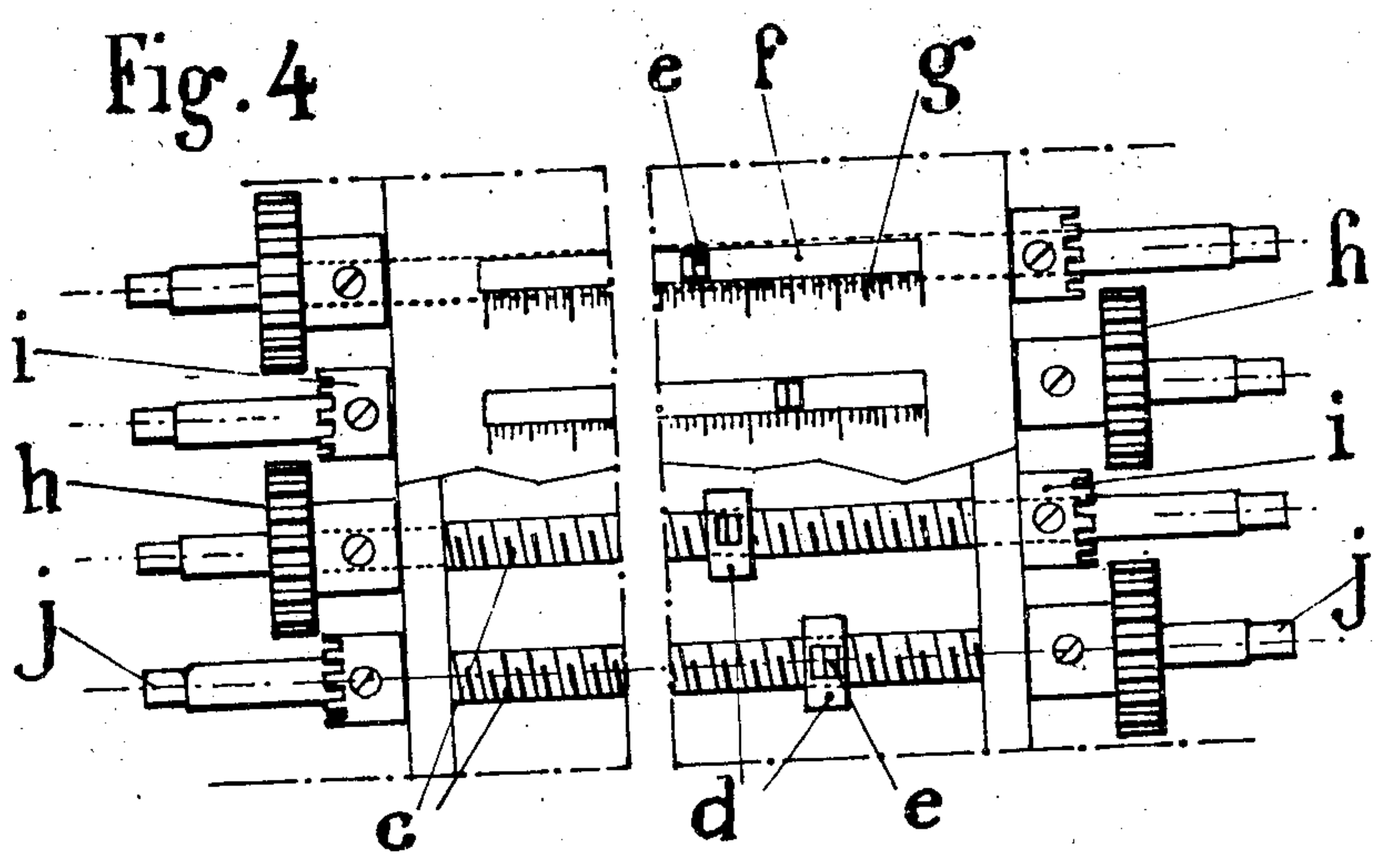

Fig.5

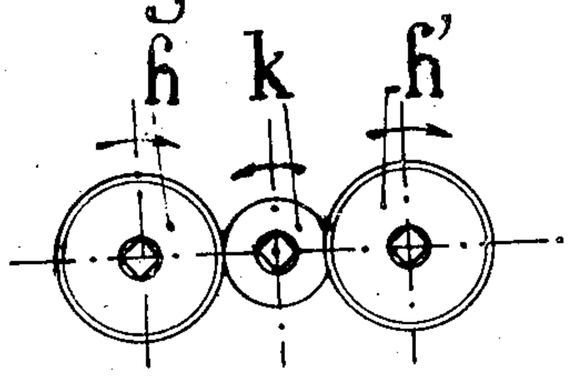

Fig.6

Fig.7

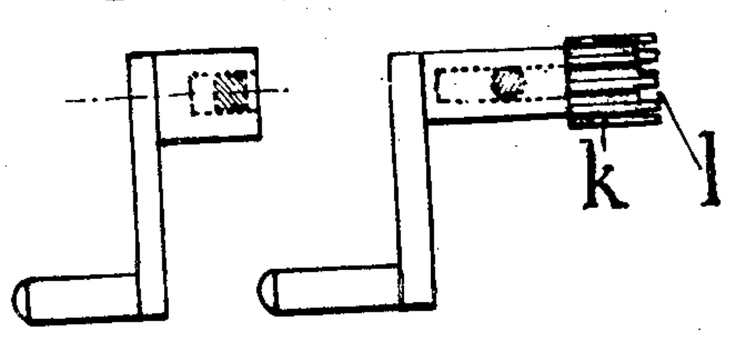

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Fig. 8

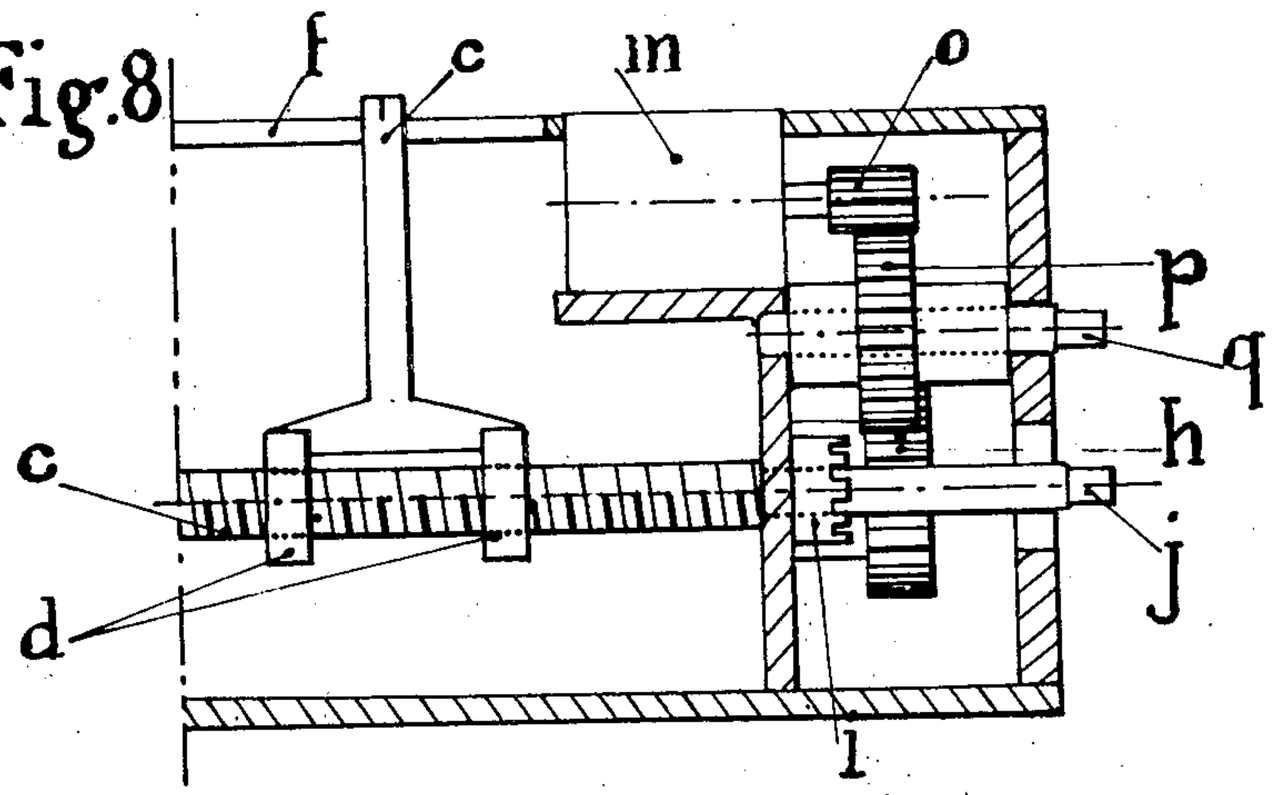


Fig. 9

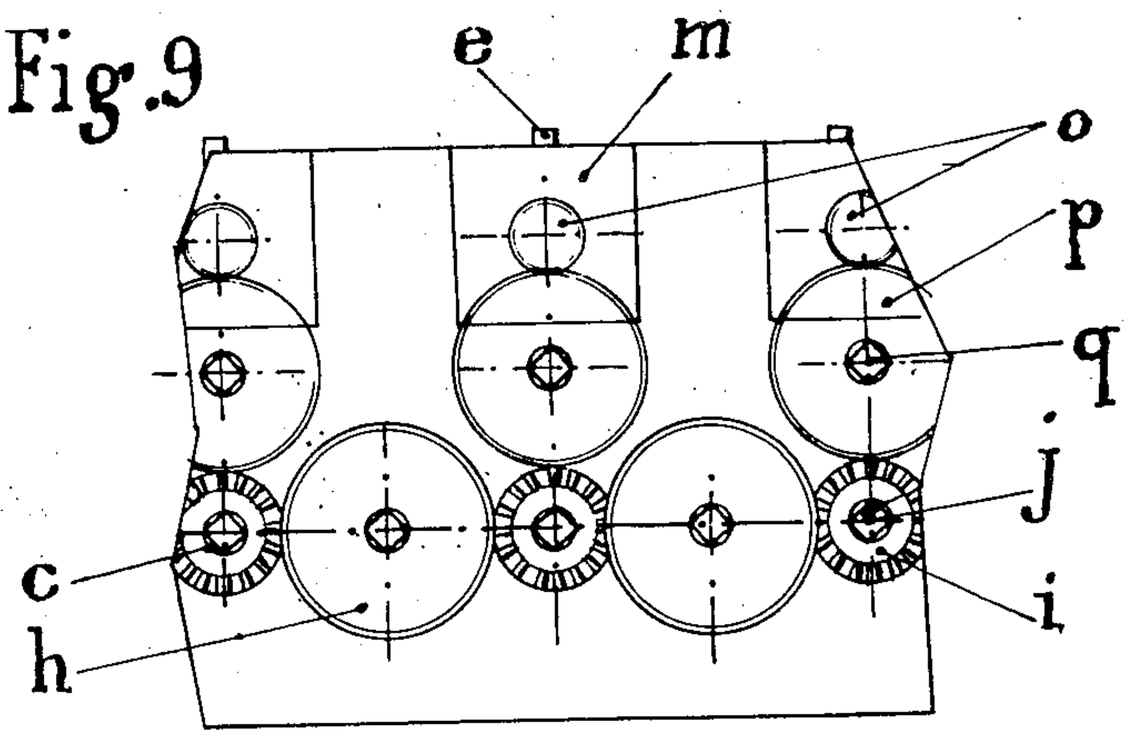
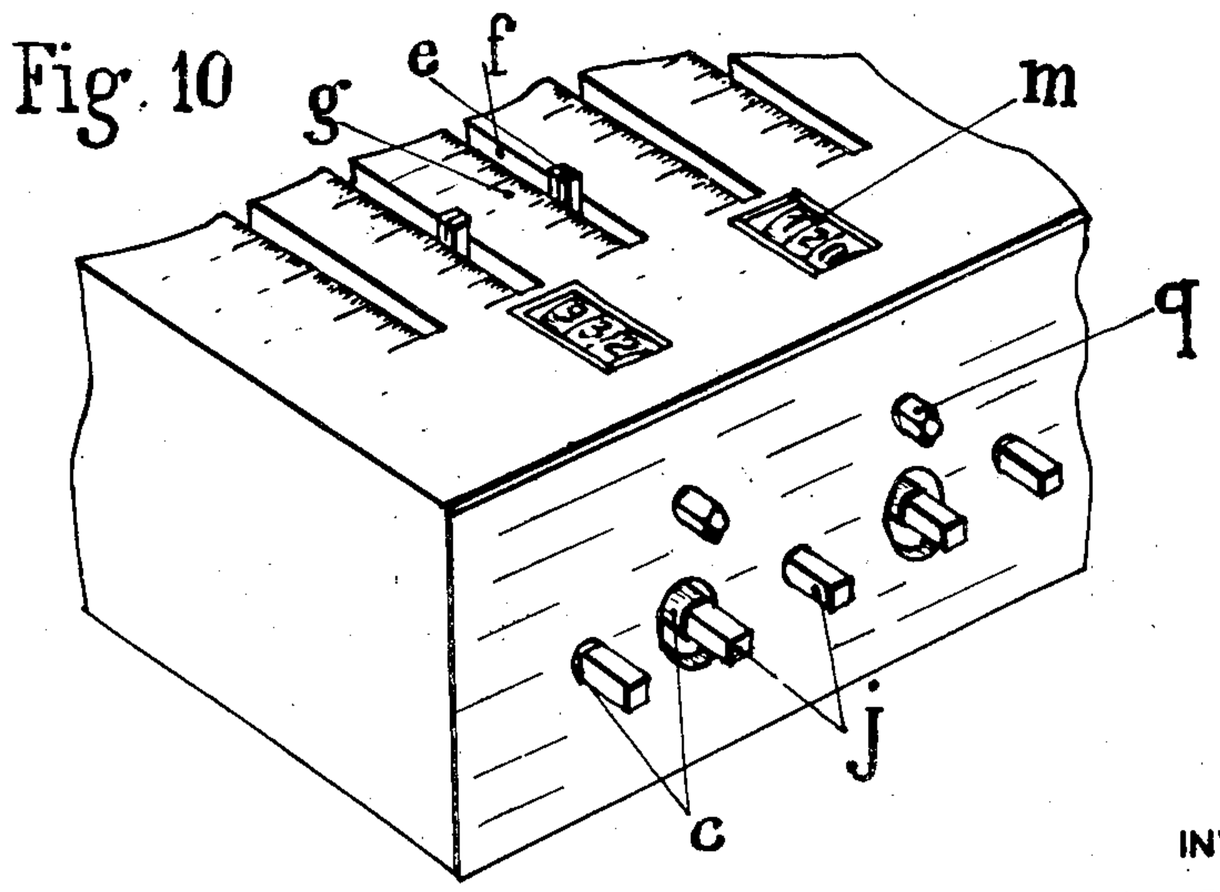


Fig. 10



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Patented Oct. 25, 1949 2,485,810

UNITED STATES PATENT OFFICE

2,485,810

APPARATUS FOR DETERMINING THE CORRECT TRACING OF RAILWAY TRACKS

Louis Bienfait, Chambly, France

Application October 21, 1946, Serial No. 704,649
In France May 12, 1942

Section 1, Public Law 690, August 8, 1946
Patent expires May 12, 1962

4 Claims. (Cl. 33—1)

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Railway tracks include straights and curves.

A curve is, theoretically, constituted by a circular portion, characterized by its radius R, connected to the adjacent straight lines through two parabolic or gradual transition lines along which the radius decreases from an infinite value in the straight line to radius R in the circular portion.

For safety and comfort of the passengers, for a good maintenance of the rolling stock and of the permanent way, the determination in plan view of railway tracks must be suitably performed, checked up and rectified. In straight lines, the eye of an expert is sufficient for ensuring by slipping of the track the necessary improvements. This is not true in curves where the best trained eye is unable to detect or to correct defects in curvature which may have a detrimental effect on the good working of the rolling stock and railway track.

Therefore, in order to check up and correct the tracing of railway tracks in curves, the following elementary theorem of geometry is applied: in a circumferential arc, equal heights corespond to equal chords (the word "height" being used in this case to designate the maximum distance between the curve and its chord).

The conventional method consists in measuring equidistant points along one of the rails of the track and measuring at every point the height corresponding to a chord constituted by a steel wire stretched between two lateral points.

Fig. 1 diagrammatically illustrates this principle: at the equidistant points 1, 2, 3, 4, 5, the corresponding heights f_2, f_3 etc. are measured.

The heights that are thus measured are plotted as equal intervals. The diagram thus obtained is a true image of the curve and indicates any defects thereof.

Fig. 2 shows this diagram (heights f_1, f_2, f_3, f_4 measured at points 1, 2, 3, 4).

If the curve is perfect, the heights, which are zero along the straights, increase in a regular way along the transition portions and are constant along the circular portion.

As a consequence, in particular, of the weight and speed of trains, the track is not quite fixed on the ground. It deforms, the curves lose their regularity and it is necessary periodically to check them up and to correct their defects.

For a long time, railway engineers have been devising methods for deducing from the heights that are measured the new heights to obtain and the corresponding displacements to be imparted to the track for giving the curves the correct shape.

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These methods do not differ very much from one another. They give good results but are rather complicated, necessitate relatively long calculations, without excluding fumbling, and require a good deal of experience for being correctly applied.

These methods of calculation are all based on the same elementary principle, to wit: when, in a curve, the value of the height of a chord is modified, the two adjoining chord heights are correspondingly modified in the opposite direction and by about one half of the modification of the first mentioned height (this rule is not perfectly accurate but due to the relatively important value of the radii in railway tracks, its approximation is quite sufficient for practical purposes).

Fig. 3 illustrates this rule. If the chord height at point 3 is given an increase equal to a, the chord heights at adjacent points 2 and 4 undergo a decrease b equal to

$$\frac{a}{2}$$

The chief object of my invention is to provide a mechanical device for materializing the diagram of a curve and for making it possible to obtain quickly, without calculation, from the chord heights that are measured, the new chord heights to use and the corresponding displacements.

A preferred embodiment of my invention will be hereinafter described with reference to the accompanying drawings, given merely by way of example, and in which:

Figs. 1 to 3 are explanatory diagrams already referred to;

Fig. 4 is a diagrammatic plan view illustrating the principle of the machine according to my invention;

Fig. 5 is an end view corresponding to a portion of Fig. 4;

Figs. 6 and 7 are diagrammatic detail views;

Fig. 8 is a vertical sectional view of a portion of Fig. 4;

Fig. 9 is an end view of Fig. 8 with the side wall of the casing removed;

Fig. 10 is a perspective view of the apparatus.

The principle of my apparatus is as follows (see in particular Fig. 4):

Every chord height is materialized by a threaded rod c adapted, when rotated about its axis, to impart a longitudinal sliding movement to a nut d provided with a pointer e slidable in a slot f along a graduated scale g.

Every threaded rod c is provided at one end

thereof with a spur gear *h* having *n* teeth and at the other end with a crown wheel *i*.

Spur gears *h* and crown wheels *i* are disposed alternately one on the right and the other on the left from one rod *c* to the next one. The ends of these rods are of square section at *j* so as to permit of rotating them separately by means of a crank as shown by Fig. 6.

Another crank, shown by Fig. 7, provided at the end thereof with teeth *l* adapted to mesh with the teeth of the crown wheel *i* of a rod on which said crank has been engaged, includes, integral therewith, a pinion *k* having teeth adapted to mesh with those of gears *h* but the number of which is one half of that of said gears *h*. When this crank is fitted on the end *j* of a rod *c* that carries a crown wheel *i*, it meshes simultaneously with this crown wheel and with the two gears *h* located on either side thereof, that is to say belonging to the two adjacent rods *c*.

When the crank thus engaged on a rod *c* is rotated, it causes the pointer of said rod *c* to move a certain distance in one direction and the pointers of the adjacent rods *c* to move one half of this distance in the opposite direction (see Fig. 5).

By adjustment through cranks of the kind shown by Fig. 6, this mechanical device permits of materializing a diagram such as that of Fig. 2, pointers *e* giving the different points of this diagram, i. e., the chord heights at successive points of the curve.

By means of the cranks shown by Fig. 7 it is then possible to ascertain the consequences of modifications of the respective chord heights (every modification of a chord height influencing the values of the two adjacent chord heights, as above explained).

It is thus possible, by successive improvements, empirically to determine the new chord heights corresponding to an acceptable curve.

My apparatus permits of obtaining without calculation the displacements corresponding to the respective points of the curve that are considered, that is to say the distances the points in question of the track are to be moved to obtain the new chord heights.

This particularly important result is obtained in the following manner:

The pointer indicating each chord height undergoes, in the course of the rectifications taking place when the rods are displaced three by three, two kinds of displacement, to wit:

(*a*) Direct displacements D equal to the variations of chord height imparted to each rod by the rotation of the crank (as shown by Fig. 7) engaged on the end thereof; and

(*b*) Indirect displacements

$$\frac{D}{2}$$

due to the direct actuation of the adjacent rods.

The final displacement to be imparted to each point that is considered is the algebraic sum of the direct displacements of the pointer *e* corresponding to this point.

The apparatus indicates this algebraic sum in the following manner:

In line with each slot *f* and above the end of the corresponding rod *c* that carries a crown wheel *i*, there is provided a revolution counter *m* including a pinion *o* in mesh with an intermediate pinion *p* adapted to cooperate with the toothed wheel *k* of a crank of the kind illustrated by Fig. 7 engaged on the end of said rod *c*.

The ratio of the numbers of teeth of these pinions and wheels is such that counter *m* marks one unit every time pointer *e* moves one millimeter.

Counters *m* work both ways, i. e. mark increasing numbers when pinion *o* is being rotated in one direction and decreasing numbers when said pinion is rotating in the opposite direction.

Each counter may be separately operated for its resetting without corresponding displacement of the corresponding pointer *e* by making use of the crank of Fig. 6 engaged on the square end *q* of the intermediate pinion *p*.

My apparatus may include any number of rods *c* of suitable length.

For practical purposes, an apparatus including thirty rods for the indicating of chord heights of 20 cms. gives very interesting results.

If, exceptionally, the diagram of the curve includes chord heights of greater value, heights marked on the apparatus will be chosen equal to one half of the actual values of said heights and the counters will indicate values equal to one half of the values to be obtained.

The apparatus according to my invention has many advantages among which I may particularly cite the following ones:

Calculation is wholly eliminated.

The new chord heights are not to be calculated; they are indicated directly by the pointers.

No calculation of moments is necessary, nor are these moments to be balanced. Balancing is automatically ensured.

The displacements need not be calculated. They are directly indicated by the counters.

The work to be performed is considerably shorter.

Whereas calculation methods give their results at the end of a series of operations, my apparatus indicates results at any time during these operations.

The displacements to be made in accordance with the indications given by my apparatus are reduced to a minimum, and considerably smaller than those obtained when calculation methods are applied.

Furthermore my apparatus permits of easily obtaining the solutions of special problems, for instance causing the track to pass through a given point, or giving it a predetermined radius at a certain point, etc.

It can be applied not only to the rectification of railway tracks, but to the tracing of new tracks, of roads, channels, electric lines, etc.

In a general manner, while I have, in the above description, disclosed what I deem to be practical and efficient embodiments of my invention, it should be well understood that I do not wish to be limited thereto as there might be changes made in the arrangement, disposition and form of the parts without departing from the principle of the present invention as comprehended within the scope of the accompanying claims.

What I claim is:

1. An apparatus of the type described which comprises, in combination, a plurality of mechanical means for indicating chord heights, said mechanical means being disposed adjacent one another, means for independently setting said indicating means to given values, means for adjusting said mechanical indicating means adapted to impart a direct displacement to one of said indicating means, and said adjusting means including means to impart indirect displacements

of an amplitude equal to one half of this direct displacement, and in a direction opposed thereto, to the two indicating means disposed on either side of said first mentioned indicating means, and counting means for indicating the algebraic sum of the direct displacements imparted to each of said indicating means.

2. An apparatus of the type described which comprises, in combination, a frame, a plurality of parallel threaded rods journalled in said frame, a plurality of nuts engaged on said rods respectively and guided to be movable only with a translatory motion parallel to said rods, a pointer carried by each of said nuts, a graduated scale along the path of each pointer, setting means adapted to cooperate with each of said rods for independently rotating it in said frame, adjusting means adapted to cooperate with each group of three consecutive rods for rotating the middle one of the three in one direction and the two others in the opposite direction and through an angle equal to one half of the angle of rotation of said middle one, and counting means associated with each of said rods for indicating the algebraic sum of the rotations imparted thereto when it constitutes the middle element of a group of three consecutive rods.

3. An apparatus of the type described which comprises, in combination, a frame, a plurality of parallel threaded rods journalled in said frame, a plurality of nuts engaged on said rods respectively and guided to be movable only with a translatory motion parallel to said rods, a pointer

carried by each of said nuts, a graduated scale along the path of each pointer, setting means adapted to cooperate with each of said rods for independently rotating it in said frame, a toothed wheel fixed to each of said rods, all of these wheels having the same number of teeth, a cranked operating member adapted to be engaged on any of said rods for rotating it, a pinion carried by said cranked member adapted to mesh with the toothed wheels carried by the next rods located on either side of that on which said member is engaged, the number of teeth of said pinion being one half of that of said wheels, a revolution counter carried by said frame at the end of each of said scales, and gear means for connecting each of said counters with the pinion of the cranked operating member engaged on the corresponding rod.

4. An apparatus according to claim 3 in which said rods extend on either side of said frame and the toothed wheels they carry are mounted alternately on one side and the other thereof.

LOUIS BIENFAIT.

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The following references are of record in the file of this patent:

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