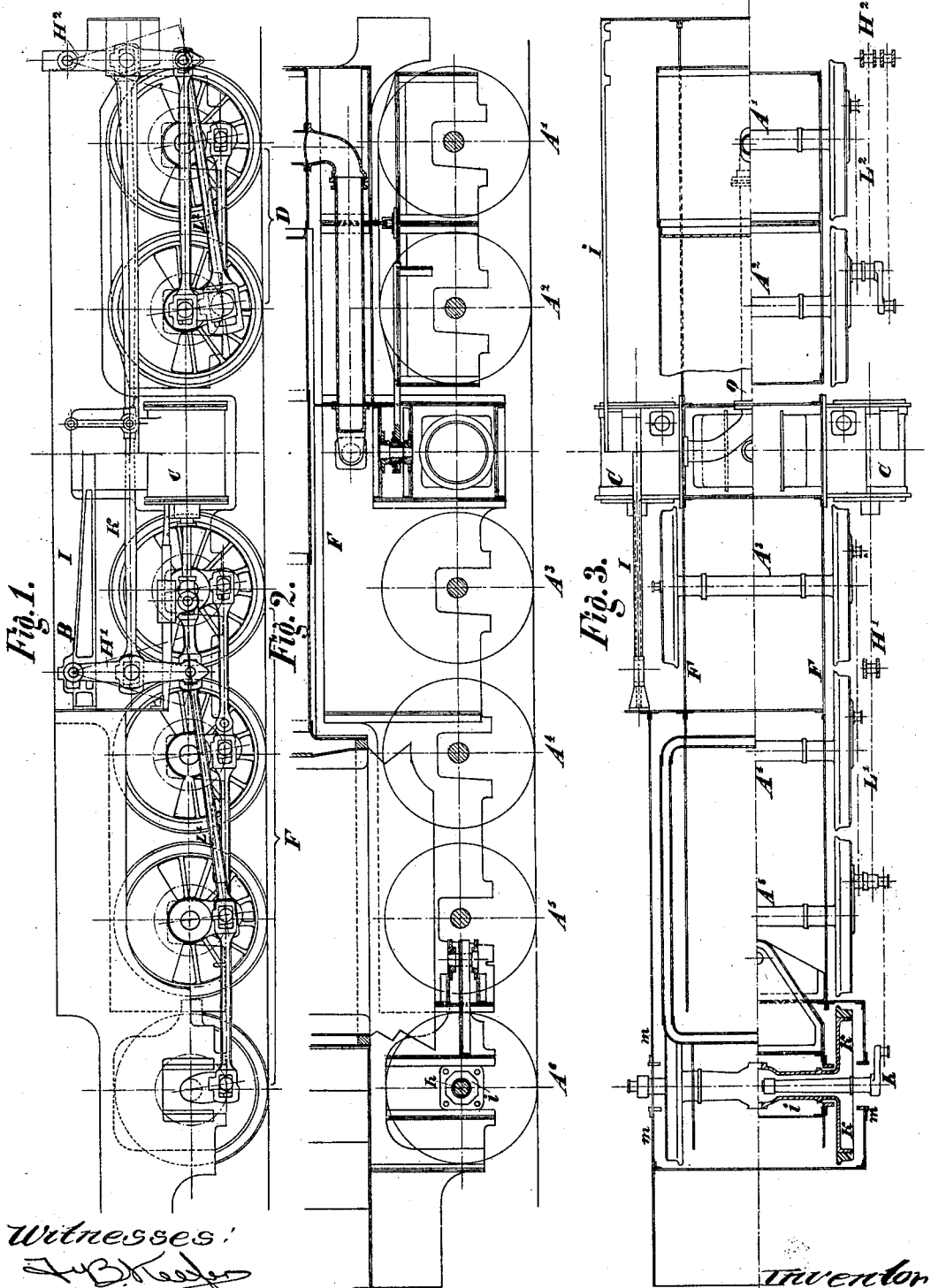
No. 699,517. Patented May 6, 1902.

C. HAGANS.

LOCOMOTIVE WITH DRIVEN BOGIE.

(Application filed Sept. 26, 1900.)

(No Model.) 4 Sheets—Sheet 1.



Witnesses:
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J. G. Meyers Jr.

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Fig. 5.

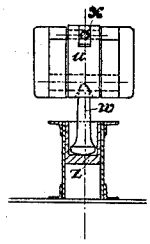

Fig. 4.

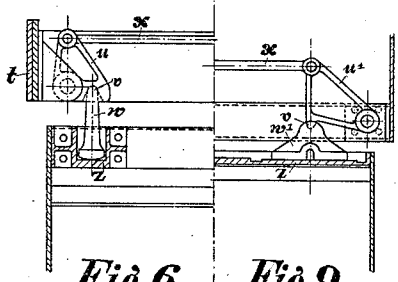

Fig. 7.

Fig. 8.

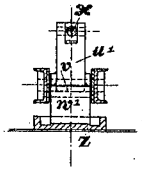

Fig. 6.

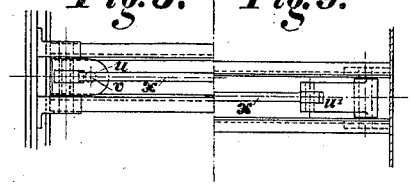

Fig. 9.

Fig. 10.

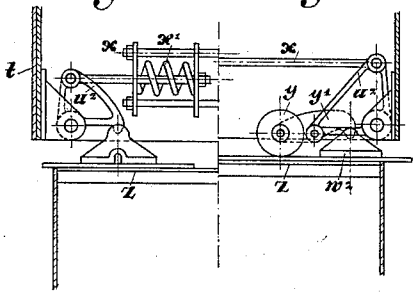

Fig. 11.

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Fig. 12.

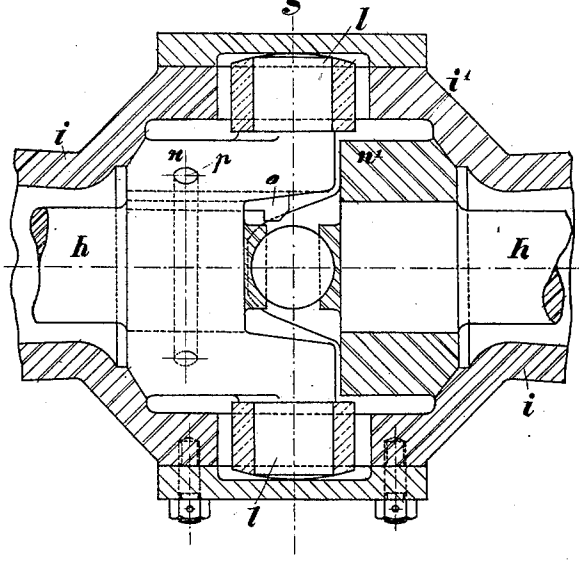

Fig. 13.

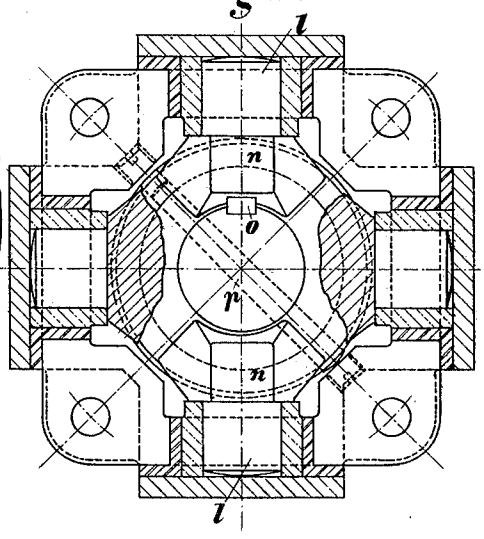

Fig. 14.

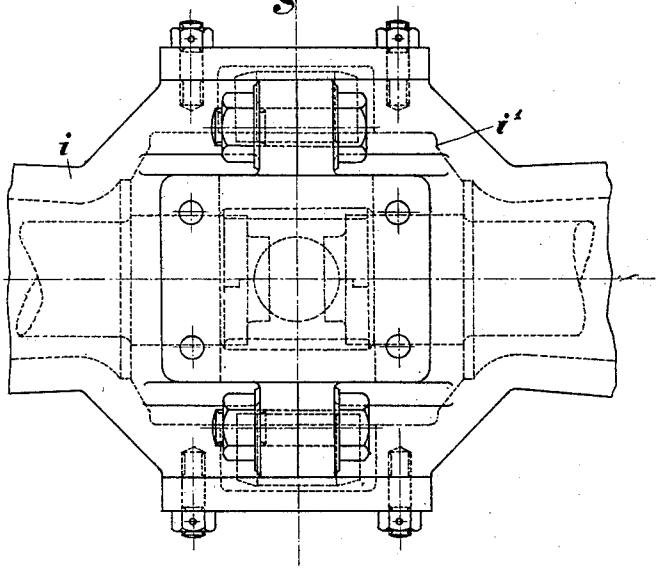

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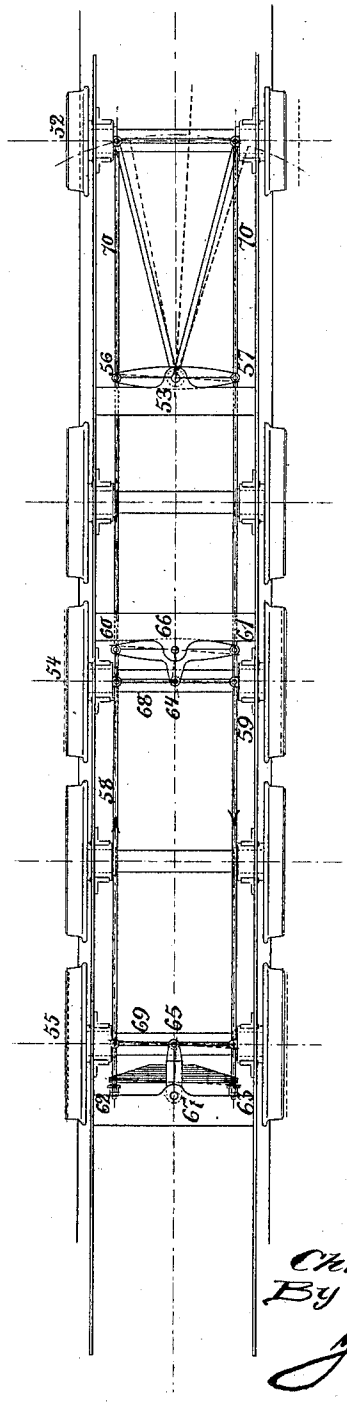
Fig 15.



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UNITED STATES PATENT OFFICE.

CHRISTIAN HAGANS, OF ERFURT, GERMANY.

LOCOMOTIVE WITH DRIVEN BOGIE.

SPECIFICATION forming part of Letters Patent No. 699,517, dated May 6, 1902.

Application filed September 26, 1900. Serial No. 31,204. (No model.)

To all whom it may concern:

Be it known that I, CHRISTIAN HAGANS, manufacturer, a subject of the King of Prussia, Emperor of Germany, residing at Erfurt, in the Kingdom of Prussia and German Empire, have invented certain new and useful Improvements in Locomotives with Driven Bogies, of which the following is a specification.

My invention relates to improvements in locomotive-engines with driven bogie-trucks; and their object is to impart to those engines the highest possible speed, and to this end to reduce the pitching and rolling motion of the engines as far as possible by the special mode of propulsion, and in this arrangement to couple as many axles as possible with each other, so as to utilize them as driving-axles, and notwithstanding the considerable length of the locomotive to give the boiler mobility in a suitable manner, and, further, where the engine is required to develop exceptionally high power. Moreover, special value is attached to giving the axles sufficient mobility to enable the engine to travel over sharp curves and arrange this adaptability or "lateral motion" so that the movement is a positive or compulsory one. Further, provision has been made to arrange the engine, in the case of compound engines, so that both the high and low pressure cylinders can work at high pressure and that there is as little crosshead friction as possible on either side of the engine.

My invention is illustrated in the annexed drawings, wherein—

Figure 1 shows one mode of driving a locomotive provided with driven front bogie. Fig. 2 shows a longitudinal section of the engine. Fig. 3 shows a plan of the underframe of the engine, which has five coupled axles and one sliding axle. Fig. 4 is a sectional elevation of the means employed as an adjustable resistance for the displacement of the bogie. Fig. 5 is a lateral elevation of Fig. 4. Fig. 6 is a plan of Fig. 4. Fig. 7 is a view, similar to Fig. 4, of a modified form. Figs. 8 and 9 are views of Fig. 7 similar to Figs. 5 and 6. Figs. 10 and 11 are views, similar to Fig. 4, of modified forms. Fig. 12 is a sectional elevation of the hollow axle broken away at each end. Fig. 13 is a sectional plan of the hollow axle. Fig. 14 is a top plan of the hollow axle. Fig. 15 shows an arrangement for positively-controlled motion of movable driving-axles on curves and on straight lines.

The general arrangement of the engine is as follows:

Hitherto the only method known of constructing locomotives, more especially the so-called "Hagans" locomotives, according to the French patent of Christian Hagans, No. 210,814, with coupled bogie-truck, was to arrange the pivoted truck ("pony" or bogie truck) behind the principal fixed truck, so that the latter runs in front of the bogie. Now for reasons connected with the safe running of the engine the wheel-base of the fixed truck cannot be reduced below a stated measure, and consequently the angle at which the tires of the front wheel bear against the rails in rounding curves will remain a comparatively large one, so that even apart from the heavy wear of tires and rails on account of the friction the risk of derailment renders any great speed of traveling of such locomotives inadmissible and impracticable.

The purpose of the engine shown in Figs. 1 to 15 is to increase to a material extent the admissible speed of traveling without endangering the safety of the train and without any risk as regards the safe guidance and running of the entire locomotive wheel-base. This is attained in the present invention by placing the driven bogie-truck in front of the cylinders and coupling it with the fixed wheel-frame placed behind the cylinders. As in such an arrangement the grate is placed above the fixed wheel-frame, the extent of the displacement both ways undergone by the bogie-frame according to Hagans' patent (French Patent 201,084) in rounding a curve will not be lost for the available width of the grate, but can be fully utilized, whereby the efficiency of the boiler is considerably increased, which is a paramount consideration in heavy engines.

D is the bogie, placed in front of the cylinders, with the axles A′ and A^2.

F is the fixed wheel-frame, situated behind the cylinders C, with the axles A^3 A^4 A^5. The lever of the second order H′, driven by the piston-rod C′ and suspended on the pin B, drives, by means of the connecting-rod L′, the

driving-axle A^5 of the fixed wheel-frame and transmits its motion by means of the coupling-rod K to the lever H^2, which in the manner now customary in the case of bogies with lever driving arrangement drives the driving-axle A^2 of the bogie B by means of the connecting-rod L^2. In this arrangement the position of the lever H^2 for driving the bogie D is optional. It is necessary, however, that the connecting-rods L' and L^2 should be placed in the same direction.

In order to obtain flexibility of the coupled axle A^6, so as to enable it to adapt itself to a curve, it is made in the form of a hollow axle and fitted to a pivoted or so-called "pony" truck, Figs. 2, 3, 12, 13, and 14. A hollow axle *i* is arranged around the driving-axle *h*. The hollow axle *i* is borne close to the wheels *k*. It is set in motion by the stud *l* of the driving-axle *h*, which is borne in the main frame *m*, but without being made to bear its load. This hollow axle *i* is driven by two half crank-axles *a*, which are borne with their outer journals in the main frame *m* and with their other ends catch into the clutches of a universal coupling, the studs *l* of which lodge in the hollow axle, which at the same time forms the coupling-ring.

The two axles can be displaced with regard to each other in an approximately horizontal direction only, as required by the various positions of hollow axle and driving-axle in rounding curves. In doing so both axles retain their ordinary speed of revolution.

The coupled axle a^6 consists of the hollow axle *i*, in which are mounted the two half driving-axles *h*, which are borne in a known manner in lateral displaceable outside bearings, Figs. 2 and 3, and the crank-pins of which are worked by the coupling-rods with the aid of suitable bearings. The hollow axle forms the catch or coupling ring of a cross-articulation, the pins *l l* of which are situated in one vertical plane and the forks of which are fixed on the two halves of the driving-axle. The forks have at their outer edges working faces 1, which are turned in the form of spherical surfaces and bear with these surfaces against the surfaces 2 of the hollow axle *i*. The two halves *h h* of the driving-axle are provided at their opposite ends with spherical bearing-bushings 3, in which the sphere 4 is cut. By means of the latter arrangement every lateral displacement which may be undergone by one of the halves of the driving-axle is transferred without any shock and without the interposition of springs upon the other half of the driving-axle. Furthermore, by means of the articulated connection one of the halves of the driving-axle just described and owing to their situation on the spherical surfaces of the hollow axle *i* the lateral displacement of the hollow axle is transmitted in the same manner to the solid axle. In order to obtain in such locomotives a flexibility of the wheel-base, with adjustable resistance to such displacement, utilizing for this purpose the resistance of both rotary and sliding friction, the supporting arrangements causing rotary friction are indirectly connected with the supporting arrangements causing sliding friction. This arrangement is illustrated in Figs. 4 to 11, both inclusive.

The arrangement according to Figs. 4 to 11 serves the purpose of permitting the bogie arranged under the main underframe of the engine to shift laterally in a horizontal plane and to swivel without putting an unequal load on the axle of the bogie and without raising the main underframe. This is attained in Fig. 7 on the right, as follows: On the main underframe of the engine an angle-lever or bell-crank lever *u'* is borne with liberty to revolve, which lever presses at *v* upon the slide-block *w'*. The slipper *w'* slides on the slide *z* of the bogie. This arrangement of the angle-lever is provided on both sides of the main underframe of the engine. The upper arms of these two angle-levers *u'* are connected with each other by a common bar *x*. If the bogie shifts under the main underframe of the engine, the slippers *w'* slide on the surface *z* and the angle-levers do not swivel—that is to say, they remain in the same position. If, on the other hand, the bogie is swiveling toward the main frame of the locomotive, as will happen, for instance, when the engine enters a superelevated curve, the angle-lever *u'* on the raised side will rise, the angle-lever *u'* will depress the other angle-lever by means of the bar *x*. However much the angle-lever *u'* may be raised at one side the other angle-lever *u'* on the other side will be lowered to the same extent and with it, accordingly, its slipper underneath. Hence a sliding connection is produced between the bogie and the engine-frame, and the latter is always maintained level, even when the bogie assumes a slanting position when passing over superelevated curves. In Fig. 4 the slipper *w'*, Fig. 7, is replaced by a pin *w*, which rests above in a recess *v* of the angle-lever and below in a step *z*. This pin will oscillate in the case of lateral displacement or swiveling of the bogie-frame. The arrangement of Fig. 11 differs from that in Fig. 7 by the circumstance that not only sliding friction is created by the slipper *w'*, Fig. 7, but sliding friction by means of the slipper w^2 and rotary friction by means of the roller *y*. The beam *y'* bears with one end upon the roller *y* and with the other end upon the slipper w^2. This beam *y'* is subjected to the pressure of the angle-lever u^2, the lower arm of which pivots on the beam. The bar *x* lies transversely to the main underframe and is provided at its other end with an identical arrangement. In the arrangement Fig. 10 a spring *x'* is interposed on the bar *x*, so that the motion of the angle-lever u^2 is an elastic one, and, therefore, also the pressure exerted by the angle-levers on the slipper w^2 is an elastic presure. Hence in the arrangement Figs. 4, 7, and 10 sliding friction is utilized,

while in the arrangement Fig. 11 sliding and rolling friction is utilized in order to always bear the main underframe well on the bogie-frame.

In such locomotives built on Hagans' system with driving-levers and in which the steam-cylinders are fixed to the frame during the actions of the pistons on the driving-levers external forces will manifest themselves both in these and in the cylinders, which will act as strains of torsion in the driving-levers and cylinders and as shearing strains tending to wrest the cylinders from the frames. Thereby the frame structure is strained and the arrangement of the fastening of the cylinders to the frame is rendered exceedingly difficult and scarcely practical. Besides, these external strains not being taken up will produce oscillations and will therefore have an injurious effect on the action of the engine. In order to avoid these external strains, the forces tending to produce the strain are so taken up at the moment of their development as to convert them into strains acting inside instead of externally, and thereby preventing them from exerting their injurious effect by causing these forces to mutually compensate each other. For this purpose compensating bars I, Figs. 1 and 3, are arranged, which are connected with the cylinders C and the lever-bearings B and which compensate to these forces at the moment of their development or take them up and neutralize their influence toward producing oscillations. In this arrangement such compensating bars I may at the same time be utilized as fulcra or pivots for reversing brake and other levers.

When such locomotives are passing from straight sections into curves, it is desirable that certain axles should be capable of lateral displacement, so that they may adjust themselves to suit the curves, while, on the other hand, it is desirable that such axles arranged for lateral displacement may be dependent from or controlled by each other, so as to be incapable of displacement as regards their position toward each other while running on a straight line. This is illustrated in Fig. 15. The axle 52 is here assumed to be a "Bissell" axle pivoted at point 53. This serves for the horizontal adjustment of the axles 54 and 55. To the radius-bar 56 57, fixed on the pivot 53 of the Bissell (pony) truck, bars 58 59 are attached, which on their part are joined to the ends of the equalizing-arms 60 61 62 63, respectively. These beams are pivoted on pins 66 and 67, fixed on the engine-frame, and with their pins 64 and 65 are attached to short bars 68 and 69, carried to the axle-bearings. According to the position of the point of attack (64 or, respectively, 65) of the equalizing-beams on the bars 68 or 69 with reference to the pivoting-point 66 or 67 of these beams in front of or behind the axle 54 or 55, which is to be adjusted, displacement toward one or the other side will take place. This arrangement is suitable for two-thirds, three-fourths, and four-fifths coupled locomotives, and the arrangement may also be applied to such locomotives as have for their front truck a two-axled bogie or a single axle, whether coupled or not, in which latter event instead of a double radius-bar 56 57 an equalizing-beam after the style of 60 61 is adopted. If the construction be sufficiently substantial, the bars 70, which transmit the displacement of the pivoting truck to the radius-bar 56 57, may be dispensed with. Similarly the bars 68 and 69 may be dispensed with and other suitable means employed to form the points of attack for the gudgeons 64 65 of the equalizing-beam. As on the engine entering or leaving a curve the flexible trailing axles are held fast in position, while the leading axle tends to adjust itself, as the case may be, to the curve or to the straight line, a strain will necessarily be thrown on the system of rods and bars. In order to render this strain innocuous, one or the other equalizing-beam may be arranged in the form of a spring, as shown in Fig. 15, with regard to beam 62 63. Such a spring-beam spring arrangement of the system of bars and rods will not only render any play in this system harmless, but it will at the same time serve to maintain this system in a certain state of tension while running on a straight line, so that the entire wheel-base acts as a fixed wheel-base, this minimizing the rolling motion. In place of spring-beams some sort of spring arrngement may be inserted at suitable points in the system.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In a locomotive, a bogie at the front of the cylinders thereof, a fixed truck provided with coupled axles at the rear of the cylinders, a connecting-rod for operating said coupled axles, a lever connected to said rod for operating the same, a lever connected with said bogie, and means connecting said levers together for operating said bogie.

2. In a locomotive of the character described, a pivoted frame or truck, a coupled axle supported thereby and consisting of a hollow axle forming a coupling-ring, a pair of half crank-axles mounted in said hollow axle and journaled in the main frame of the locomotive, and a universal coupling seated in said hollow axle and engaging the inner end of said half crank-axles.

3. In a locomotive of the character described, a pivoted frame or truck, a coupled axle supported thereby and consisting of a hollow axle having its inner face formed with bearing-surfaces and forming a coupling-ring, a pair of half crank-axles mounted in said hollow axle, journaled in the main frame of the locomotive and provided with working faces engaging the bearing-surfaces of the

hollow axle, bearing-bushings provided on the inner end of said half crank-axles, and a sphere mounted between the said bushings.

4. In a locomotive of the character described, a pivoted frame or truck, a coupled axle supported thereby and consisting of a hollow axle provided with bearing-surfaces and forming a coupling-ring, a pair of half crank-axles mounted in said hollow axles and journaled in the main frame of the locomotive, an articulated connection between the said half crank-axles and provided with working faces engaging the bearing-surfaces of the said hollow axle, bearing-bushings on the inner end of said half crank-axles, and a sphere mounted between the said bearing-bushings.

5. In a locomotive-engine, an adjustable resistance for the displacement of the bogie consisting of means interposed between the main frame of the engine and the bogie for causing friction, pivoted levers engaging with the said means and operated by the movement of the frame for operating the said means, and means attached to the levers for connecting them together.

6. In a locomotive of the character described, an adjustable resistance for the displacement of the bogie, comprising slide-blocks, rollers connected thereto, and beams for connecting the rollers to the slide-blocks.

7. In a locomotive of the character described, an adjustable resistance for the displacement of the bogie, comprising slide-blocks, rollers connected thereto, beams for connecting the rollers to the blocks, and levers for operating the blocks upon the movement of the bogie.

8. In a locomotive of the character described, a bogie provided with pivoted axles, a truck provided with adjustable axles, bars for connecting the pivoted to the adjustable axles, beams oscillating on fixed pivots suitably connected to said bars, pins attached to said beams, and bars attached to the axle-bearings and to said pins.

9. In a locomotive of the character described, a bogie provided with pivoted axles, a truck provided with adjustable axles, bars for connecting the pivoted to the adjustable axles, beams oscillating on fixed pivots suitably connected to said bars, pins attached to said beams, bars attached to the axle-bearings and to said pins, and spring-arms suitably arranged in relation to the said equalizing-beams for the purpose of giving a certain initial tension and facilitating an adjustment of one axle to the curve, while the other axle is still located on the straight part of the line.

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

CHRISTIAN HAGANS.

Witnesses:
MAX MEYERS,
WILHELM BINDEWALD.