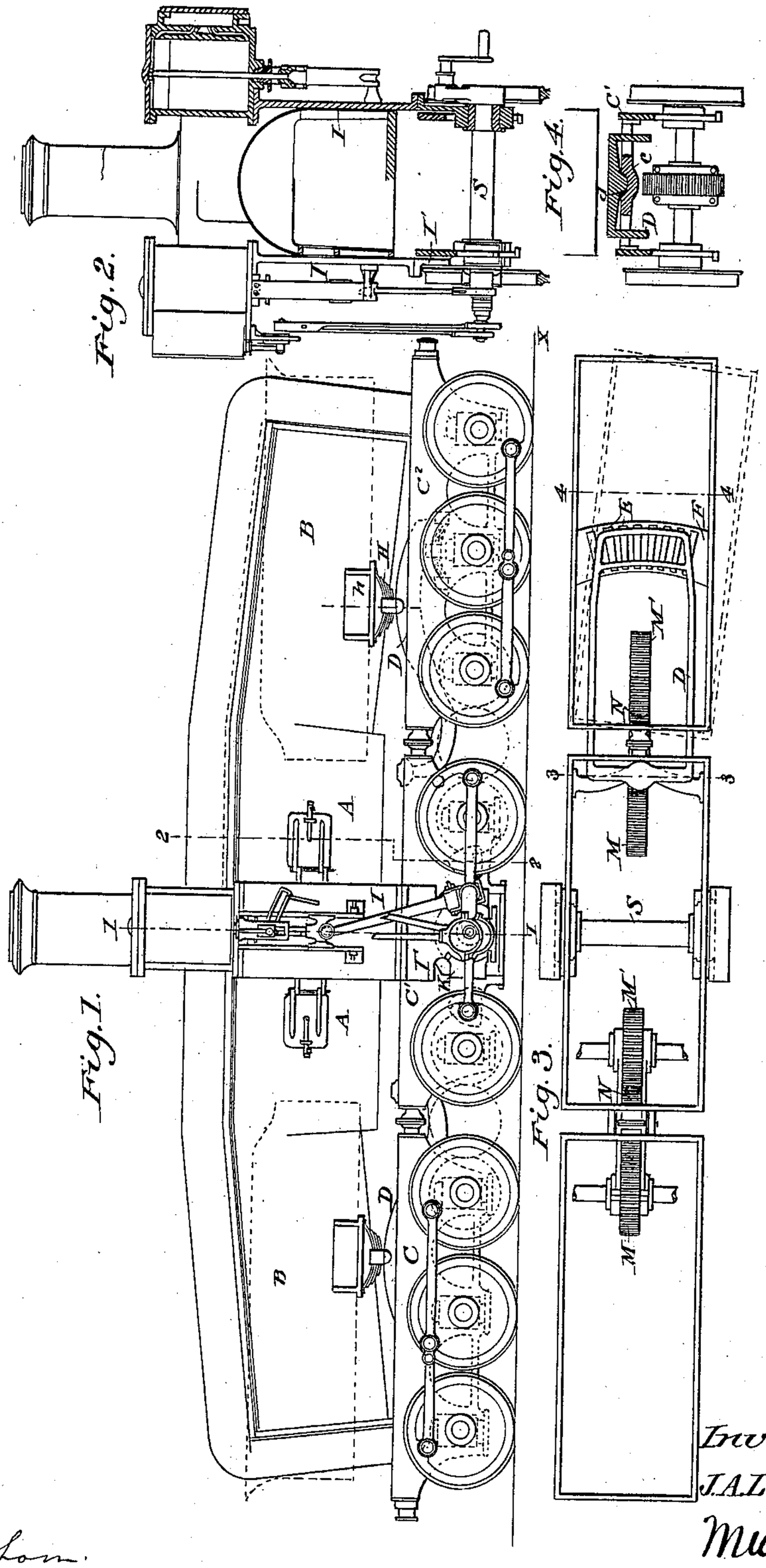
(No Model.)

2 Sheets—Sheet 1.

J. A. LONGRIDGE.

LOCOMOTIVE ENGINE.

No. 323,045. Patented July 28, 1885.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 5.

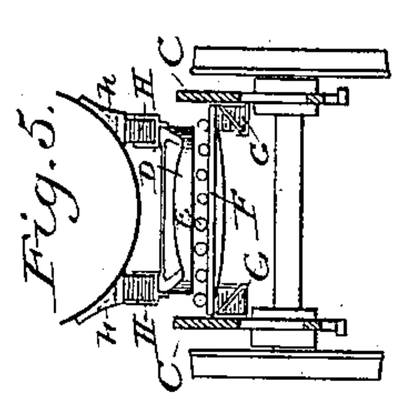


Fig. 12.

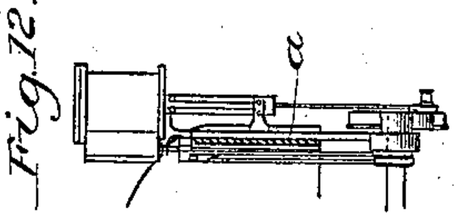


Fig. 8.

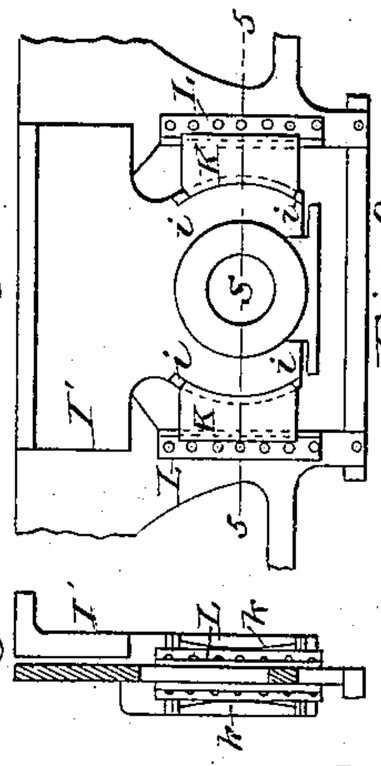


Fig. 9.

Fig. 11.

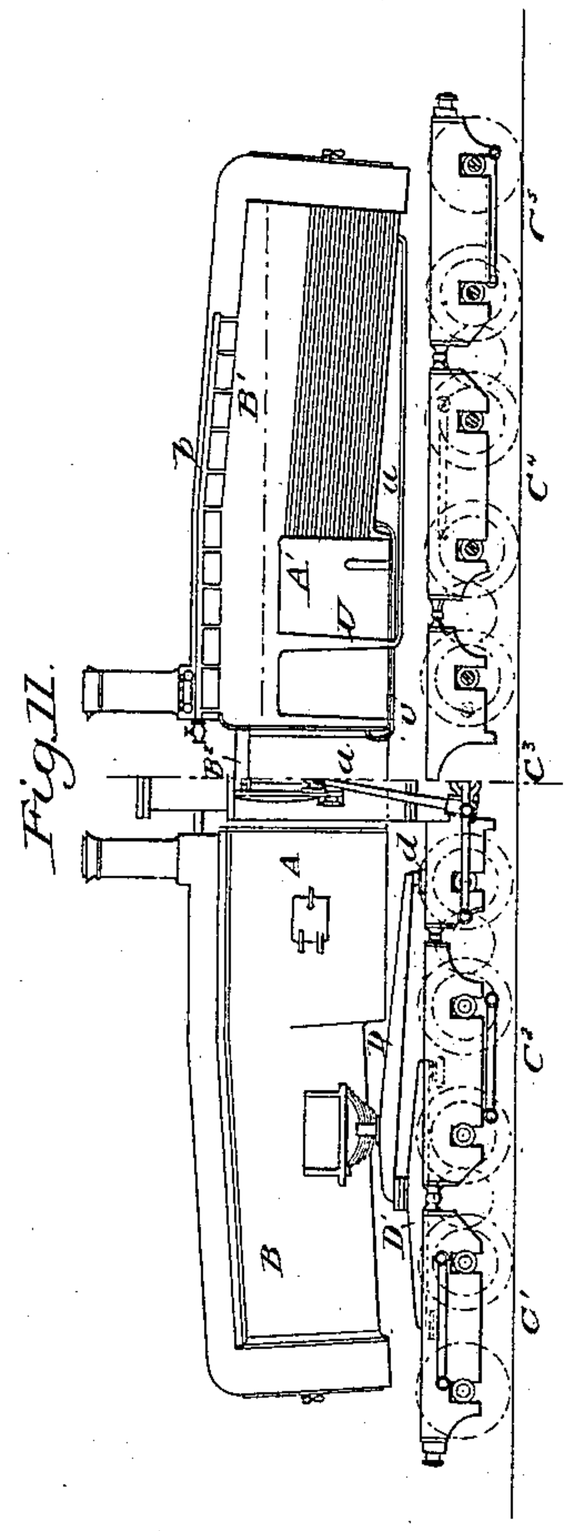


Fig. 13.

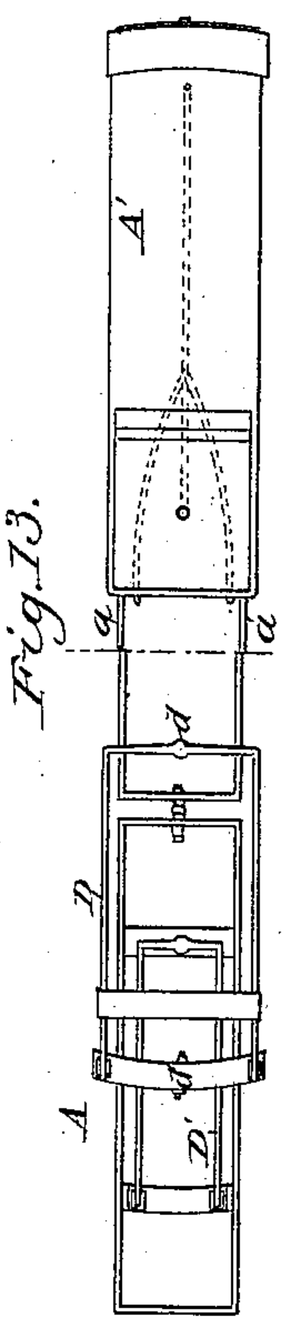
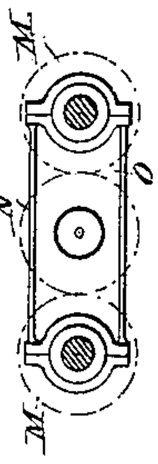


Fig. 7.

Fig. 10.

Fig. 6.



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UNITED STATES PATENT OFFICE.

JAMES ATKINSON LONGRIDGE, OF WESTMINSTER, ENGLAND.

LOCOMOTIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 323,045, dated July 28, 1885.

Application filed February 28, 1885. (No model.) Patented in England November 19, 1884, No. 15,773.

To all whom it may concern:

Be it known that I, JAMES ATKINSON LONGRIDGE, a subject of the Queen of Great Britain, residing at 15 Great George street, in the city of Westminster, England, civil engineer, have invented certain new and useful Improvements in locomotive-engines, of which the following is a specification.

My invention relates to improvements in locomotive-engines of the kind illustrated in Figure 2 of the specification of an English patent granted to me, dated November 2, 1872, No. 3,259, in which the boiler is supported on three swiveling or bogie frames, the adjacent axles of the adjoining frames being geared together by spur-gearing, and the frames themselves being connected by ball-and-socket couplings.

My present improvements have for their object to facilitate the passage of the engine round sharp curves, and to avoid undue strains upon the gearing or couplings which would be caused by a change of gradient, as well as those which would be caused by inequalities in the level of the rails.

My invention consists in the construction and arrangement of parts, as will be hereinafter described and claimed.

Reference is to be had to the accompanying drawings, forming part of this specification, and to the letters and figures marked thereon.

Fig. 1 illustrates a side elevation of a locomotive provided with the improvements of my present invention. Fig. 2 is a cross-section, one-half on the center line 1 1, and the other half on the line 2 2, Fig. 1. Fig. 3 is a plan of the bogie-frames only, the boiler being removed. Fig. 4 is a cross-section on the line 3 3, Fig. 3. Fig. 5 is a cross-section on line 4 4, Fig. 3. Fig. 6 is a side view of one set of spur-wheels by which the adjacent axles of two bogie-frames are geared together, according to another English patent, hereinafter referred to. Fig. 7 is an end, and Fig. 8 a side, elevation, and Fig. 9 a cross-section on line 5 5, Fig. 8, of the main bearing for the driving crank-shaft, showing the slide-blocks by which the center bogie-frame is enabled to oscillate either in a fore and aft or in a lateral direction or to slide vertically independently of the engine-frame. Fig. 10 is a longitudinal section of the improved ball-and-socket coupling by which the bogie-frames are connected. Figs. 11 to 13 illustrate another improvement relating to the construction of the boiler and to the mode of supporting the same upon five bogie-frames.

Referring to Figs. 1 to 10, the boiler is supported upon compensating or balance levers, and in general principle and arrangement resembles that described in my aforesaid English patent of 1872. The boiler is a double boiler, with two fire-boxes, A A, and two barrels, B B, each containing a set of tubes having a downward inclination toward the smoke-boxes at the ends of the engine, return-flues from the smoke-boxes running above the body of the boiler to one or more chimneys in the center. The boiler does not rest immediately on the bogie-frames, but upon two balance-beams, D D, which beams rest at one end on the middle truck or frame, C′, and at the other end upon the center of the leading and trailing frames C C^2, respectively, the points of support of the boiler on the balance-beams being so placed as to divide the total weight of the boiler, engines, and tanks between the several bogie-frames in the proportion of the number of wheels in each.

My first improvement has for its object to permit of the lateral oscillating motions of the bogie-frames independently of the balance-levers which rest upon them. For this purpose I make the bearing-surfaces of the ends of the balance-levers which rest on the middle frame or truck in the form of a ball and socket constituted by a hemispherical boss, *d*, Fig. 4, resting in a corresponding cup, *c*, formed on a stretcher between the side frames of the bogie-truck C′. This spherical bearing is situated in the center line of the truck C′, so that the latter can yield to any transverse inequality of the rails without causing any strain on the balance-lever. The ends of the balance-levers which rest on the other bogies are of considerable breadth, and each rests upon a set of rollers, E, Figs. 3 and 5, running on a roller-path, F, and radiating from the coupling between the bogie-frames. The roller-plate F is supported at its ends on springs G, of semi-elliptic or volute form, carried by the side frames of the bogie-trucks, whereby oscillating motion of the bogie-frame independently of the roller-path is permitted. Further,

to prevent any strains upon the boiler consequent upon unequal oscillations of the two end trucks, springs H, Figs. 1 and 5, are interposed between the two balance-levers and the points of support of the boiler. These springs H are fixed in pairs, one at either side of each balance-lever, and take under brackets *h*, fixed to the shell of the boiler, and form the four points of support upon which the entire upper portion of the engine is carried. All lateral oscillations of the bogie-frames are thus taken up by the two sets of springs G H.

The second improvement relates to the connection of the engine-framing with the framing of the middle bogie in order to permit of the fore-and-aft and lateral oscillations and the rising and falling motions of the latter independently of the engine frame. The cylinders, which are placed vertically at the middle of the engine, one at either side, are attached, together with their cross-head guides each to a vertical plate, I, Fig. 1, fixed to the side of the boiler. This plate I is in two parts, I I′, bolted together. The parts I′, Figs. 7 and 8, carry the bearings in which the main driving-shaft S is mounted. Each bearing is formed of the usual brasses, fitted in a boss formed in the part I′. This boss has two circular segments, *i*, concentric with the main or driving crank-shaft, and between these segments and the horn-plates of the bogie-frame are fitted slide-blocks K. These blocks are curved concentrically with and embrace the segments *i*, the segments and blocks being rabbeted together, so that the blocks can slide around the axis of the main bearing. The outer edges of the slide-blocks are grooved and rectilinear, to slide upon straight vertical guides L, carried by the horn-plates, the flanges *k* of the slide blocks being convexly curved on their inner surfaces, as shown in Fig. 7. By this means the boiler is held in proper position upon the three bogie-frames, while the middle bogie-frame is free to oscillate in a fore-and-aft direction about the shaft S as a center, or in the lateral direction, or to rise and fall, without putting any strain on the engine-framing.

My third improvement relates to the couplings of the bogie-frames. The transmission of the power from the main crank-shaft to the wheels of the middle bogie, C′, is effected by coupling-rods, and from the axles of this bogie to the adjacent axles of the bogies C C^2 by sets of cog-wheels M N M′, of which M M′ are mounted on the respective axles, to be coupled by universal joints, as described in an English patent granted to me, dated November 22, 1877, No. 4,389, and the middle wheel, N, is mounted on a short axle, turning in bearings in side frames, O, as in my said English patent. By this arrangement it is evident that the distance apart of the axles so geared together is rigidly fixed. Consequently, at a change of gradient the distance of the ends of the bogie-frames from each other must vary; and the present improvement has for its object to enable this variation to take place without throwing undue strains either on the couplings of the bogie-frames or on the wheel-axles, and also to cause the tractive force to be borne chiefly by the couplings.

The improvement consists in providing ball-and-socket couplings, such as described in my English patent of 1872, with springs, which permit either of elongation or of compression of the coupling, as the case may be.

The improved coupling is illustrated in Fig. 10, P being the ball and Q the socket, respectively attached to stems *p q* passing through the ends of the bogies and secured by nuts. The nuts and the shoulders of the stems slide in casings R, sets of india-rubber or volute springs T being inserted at either side of the end plate of the bogie-frame and between it and the nut and shoulder on the stem. Instead of applying these springs to the stems of both parts of the coupling, one stem may be rigidly fixed to its frame, the other one only being provided with springs. In either case when the bogie-frames are coupled together the springs are compressed by tightening the nut until the compression upon them is approximately equal to the tractile force which will usually be exerted upon that coupling.

Figs. 11 to 13 illustrate another improvement, relating to the construction of the boiler and the mode of supporting the engine on five bogie-frames.

I make the boiler in two distinct portions, A B A′ B′, each of which is a duplicate of the other, but is complete in itself, inasmuch as it has its own fire-box, fire-grate, tubes, flues, and chimney. These two parts are, however, rigidly connected together by a strong framing or plate-bracing, *a a*, to which they are bolted or riveted, leaving a vacant space of two or three feet or more between the two fire-box ends. In this space are placed the cylinders and gearing of the engine, and the cylinders work vertically above the main driving-shaft. The cylinders may be placed either inside the framing *a a*, which connects the boilers, or outside, and the motion is transmitted to the wheels as described in my English patent of 1872. The steam-pipes *b*, leading to the cylinders, are placed outside the boiler in the return-flue, and are connected at intervals by smaller vertical pipes with the top of the boiler-shell, as shown in the drawings. By this arrangement the steam is superheated, and priming is avoided either on a level or on steep inclines. The two sections of the boiler are united at or near the top of the fire-box end by one or more steam-pipes, B^2, which traverse the intermediate space between the sections. There is thus a free steam-connection between the two sections, but no water-connection, in cases where this is desirable.

A further improvement consists in the introduction of circulating pipes and tubes, whereby the free and rapid circulation of the water throughout the boiler is obtained. This

is attained first by the introduction of one or more conical tubes, U, in the fire-boxes, which are open at top to the water in the boiler and at the lower end pass through the fire-grate and are connected with one or more tubes or pipes, *u*, leading to the bottom of the boiler at the smoke-box end. Besides this, other pipes or tubes, *v*, are carried from the back or outside of the fire-box down and through under the fire-grate to the body of the boiler, to which they are attached at any point that may be desirable.

In compound engines the high-pressure cylinders may be placed outside and one large low-pressure cylinder inside the framing which connects the fire-box ends.

When very powerful engines are required, or engines to work on light rails and with heavy gradients and severe curves, I place the boilers and cylinders as above described on five trucks or bogies, C′ C^2 C^3 C^4 C^5, coupled as described in my English patent and in a previous part of this specification. The center bogie, which carries the main or driving shaft, has only four wheels; the other bogies may have four or six wheels, as may be required. By this means the adhesion may be utilized of twenty or twenty-eight wheels, all working as driving-wheels.

In order to distribute the weight equally over the wheels, I make use of a combination of balance-beams arranged as follows: The whole weight of the boilers, tanks, coal-bunkers, cylinders, &c., is borne at four points by two double balance-beams, D D. Each of these balance-beams rests on the end or near the end of the frame of the center bogie, C^3, on a pivot or hemispherical end, *d*, which rests on a cup immediately below the axis of the engine, as previously described. On this bogie there are therefore two points of support only. Each beam D is composed of a transverse member passing below the fire-box level and two side members passing alongside of the boiler to a point over the coupling between the two next bogies, C′ C^2 or C^4 C^5, as the case may be, where they are connected again by a transverse member forming a roller-plate, *d′*. On each of these side beams is a bearing for the boilers, &c., which rests on springs H and brackets *h*, as before. The position of these bearings is fixed by the number of wheels in the middle bogie as compared with the number in the other bogies. For instance, if the other bogies are six-wheeled bogies, there will be twenty-eight wheels in all; therefore, fourteen twenty-eighths of the whole weight will be borne by each main balance-beam. Of this, two-fourteenths will be borne by the middle bogie, and six-fourteenths by each of the adjacent bogies, or twelve-fourteenths by the other end of the balance-beam. The point of support will therefore be twelve-fourteenths from the pivot end and two-fourteenths from the roller-bearing end.

In order to distribute the twelve-fourteenths equally over the other bogies, a secondary balance-beam, D′, is employed for each pair of bogies C′ C^2 and C^4 C^5. This beam rests on a pivot or hemispherical ball end, which rests on a cup at the center of the bogie C^2 or C^4 next the middle bogie, and on a roller-bearing placed at the middle of the other bogie. In the middle of these secondary beams D′ there is a roller plate or bed on which the roller-plate *d′* at the short end of the main balance-beam D rests, a set of rollers being interposed, as in the former case, and thus the twelve-fourteenths of the weight is equally distributed over the twelve wheels of the two bogies at each end of the engine. These balance-beams and roller-plates are provided with springs, as already described in another part of this specification.

The water-tanks, foot-plates, and coal-bunkers are attached to the boiler, and not to the bogie-frames.

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

1. In a locomotive-engine in which the superincumbent weight of the boiler is distributed upon two adjacent bogie-frames by means of a balance-beam, the construction of the point of support of one end of the balance-beam in the form of a ball-and-socket or universal joint, substantially as and for the purpose herein described.

2. In a locomotive-engine in which the superincumbent weight of the boiler is distributed upon two or more adjacent bogie-frames by means of a balance-beam, supporting one end of the balance-beam on a ball-and-socket or universal joint, and the other end upon a rolling bearing carried upon springs, whereby the movements of the bogie-frames due to inequalities of the rails are in great part prevented from being transmitted to the balance-beam, and whereby the bogie-frames are enabled to adapt themselves to the curve of the line, substantially as shown and described.

3. The combination, with a balance-beam supported at one end on a ball-and-socket and at the other on a rolling bearing, of springs interposed between the balance-beam and the boiler to carry the latter, substantially as shown and described.

4. In a locomotive-engine in which power is transmitted to the driving-wheels of a bogie-frame through the medium of a crank-shaft hung in bearings on the engine-framing between the driving-wheels of the said bogie-frame, but independent of said frame, the combination, with the circular guides around said bearings and with the straight guides of the horn-plate, of sliding blocks adapted to slide around the axis of the crank-shaft, which permit of the fore and aft and lateral oscillations and the rising and falling motions of the bogie-frame independently of the crank-shaft bearings, substantially as shown and described.

5. In a locomotive-engine supported on two

or more bogie-frames, and in which the adjacent axles of adjoining frames are geared together by spur-gearing and the frames are connected by ball-and-socket couplings, as described, the combination, with the stems of the couplings, of springs whereby the coupling is enabled to yield to strains either of tension or compression in excess of the normal tractive strain on the coupling, substantially as described.

6. The combination, in a locomotive-engine, of two distinct boilers separated by an intermediate space but connected together rigidly with the steam-cylinders, and valve-gear arranged vertically between them, substantially as described and shown.

7. In a locomotive-engine in which the weight of the boiler is distributed over five adjacent bogie-frames, the combination and arrangement for that purpose of two sets of superposed balance-beams, substantially as above described.

8. In a locomotive-engine in which the weight of the boiler is distributed over five bogie-frames, the arrangement at each end of the engine of a set of superposed balance-beams, each resting on a pivot-bearing at one end and on a roller-bearing at the other, for the purpose of dividing the amount of lateral motion between them in traversing curves.

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