No. 661,045. Patented Nov. 6, 1900.

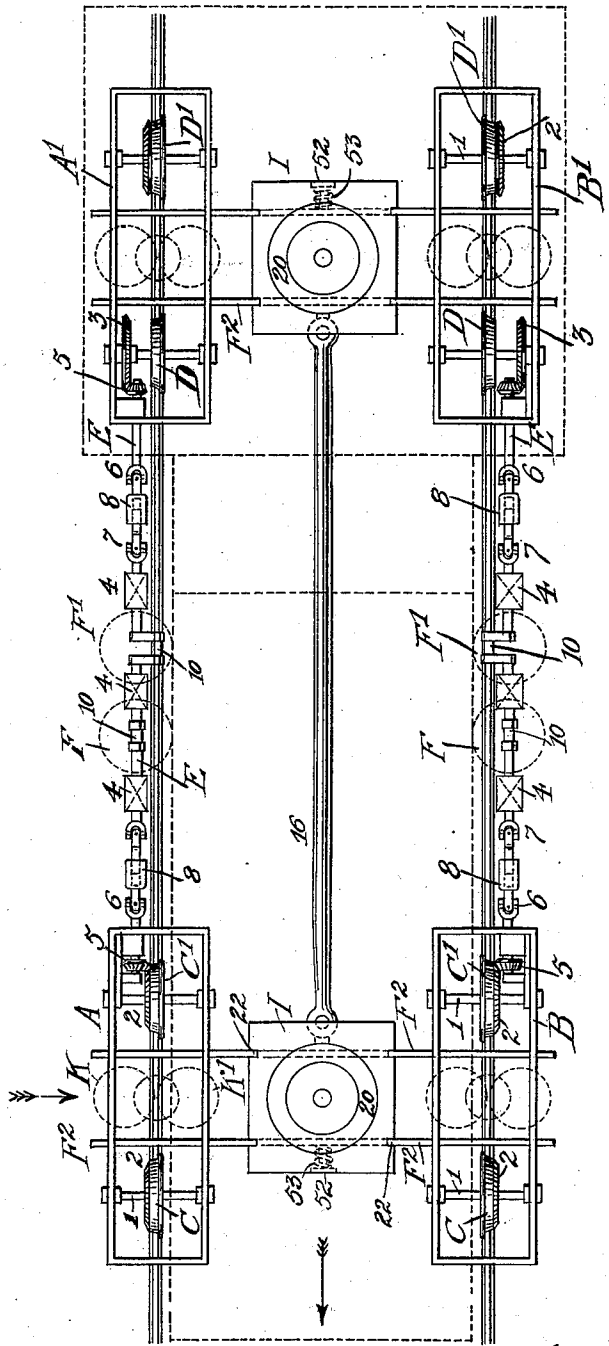
G. S. FOUTS.

MOUNTAIN LOCOMOTIVE.

(Application filed Nov. 15, 1899.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 1.



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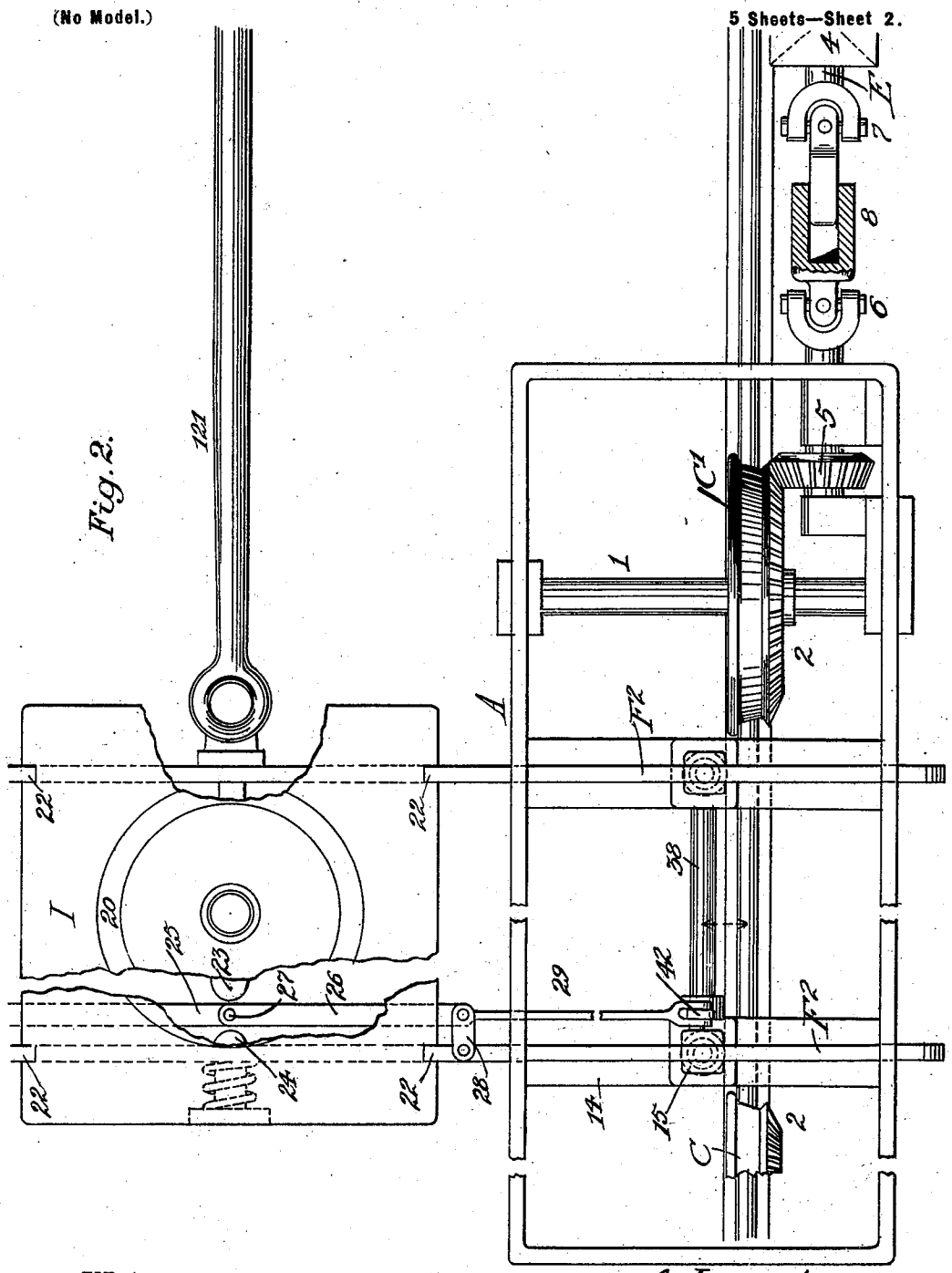
(No Model.) 5 Sheets—Sheet 2.

Fig. 2.



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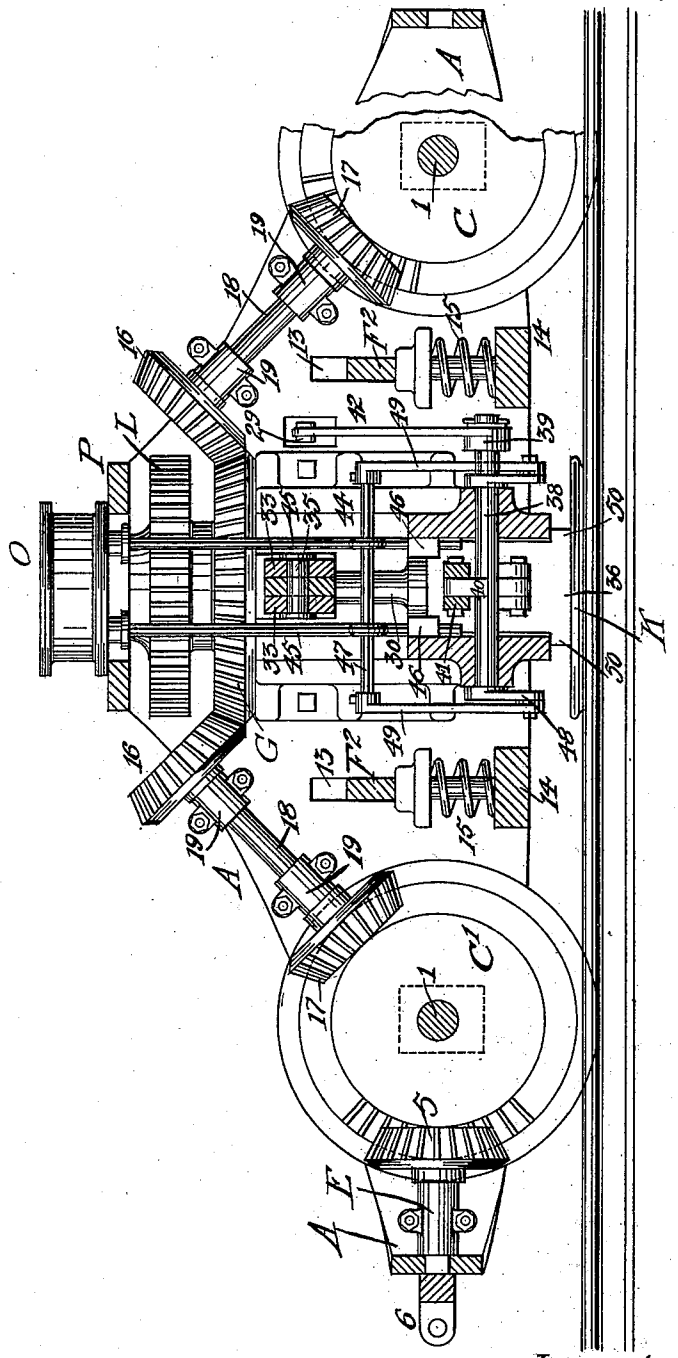
(No Model.) 5 Sheets—Sheet 3.

Fig. 3.



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(No Model.) 5 Sheets—Sheet 4.

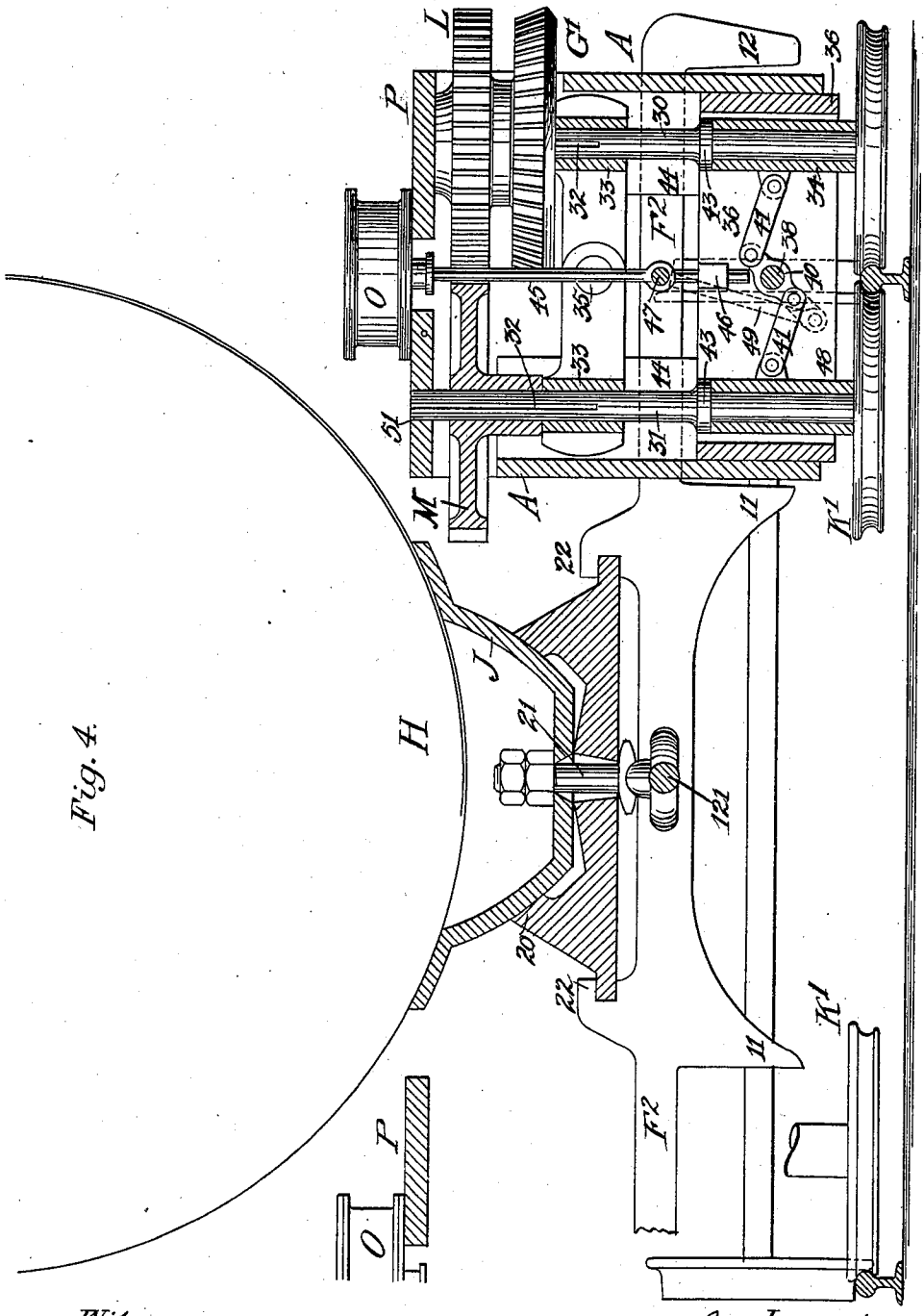

Fig. 4.

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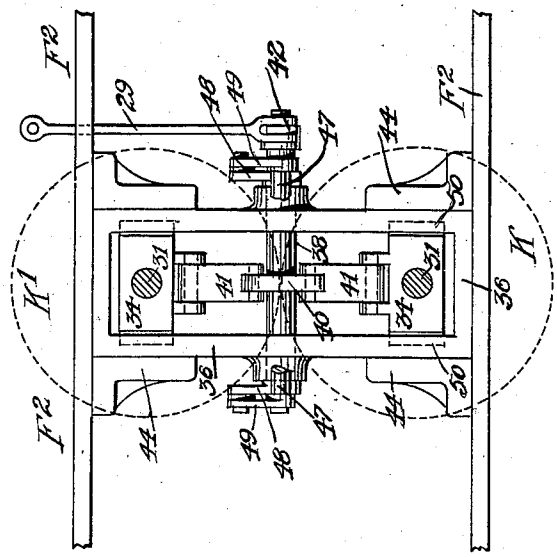
(No Model.) 5 Sheets—Sheet 5.

Fig. 5.



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UNITED STATES PATENT OFFICE.

GEORGE S. FOUTS, OF SAN FRANCISCO, CALIFORNIA.

MOUNTAIN-LOCOMOTIVE.

SPECIFICATION forming part of Letters Patent No. 661,045, dated November 6, 1900.

Application filed November 15, 1899. Serial No. 737,121. (No model.)

To all whom it may concern:

Be it known that I, GEORGE S. FOUTS, a citizen of the United States, residing at San Francisco, in the county of San Francisco and State of California, have invented certain new and useful Improvements in Mountain-Locomotives, of which the following is a specification.

My invention relates to railway traction, and more particularly to traction on mountain-roads and heavy grades of the character that only cable traction has heretofore been capable of surmounting.

One object of my invention is to do away with traction-cables, which are originally costly, have a comparatively short life, require renewal when worn out, and must be driven by expensive power-stations. Hence they are not adapted for very long roads nor for such cheaply-constructed roads as, for instance, logging-railways.

A further object is to reduce the cost of railway construction on roads of this general character, for it is evident that with a locomotive which can haul or push a load up grades of thirty per cent. or more and safely descend the same railway surveyors will be enabled to materially shorten their lines. Accordingly another object of my invention is to construct such a locomotive.

A further object is to make the locomotive practically operative on the sharpest of curves, whether on the level or on heavy grades, and this is a further indication of the effect of my invention in reducing the cost of railway construction, since it is evident that on account of the disregard of grades and the ability to use very sharp curves the railway surveyor can follow more direct lines and do without many cuttings and embankments which in a hilly country are now required in making practicable grades.

My invention is in part a development of the old idea of an extra rail gripped by horizontal friction-rollers, such as was used years ago on the Mont Cenis railway and which was patented in England and the United States as early as 1835. In these constructions a third or center rail was used in connection with two horizontal friction-wheels, one of which was geared to the power, while the other was movable, so as to be thrown by a lever against the rail or removed from it at will. It is now understood that on the railway referred to this construction was effective upon grades of about eight per cent., which was sufficient, and, further, that in that case the expense of the third rail was not an important consideration. Upon such lines, however, as logging-railways and those extending to mountain-mines it would be impracticable to use the third rail, partly on account of the expense, partly because of the heavy loads hauled, for which such a center-rail grip would not be sufficient, and, further, because mountain-locomotives are now constructed with geared carrying-wheels which can safely ascend and descend grades as steep as those referred to on ordinary tracks. A further objection to the third rail is that it is difficult, if not impossible, to operate switches, and in roads of the character I have described switching operations are important features. Therefore it may be said that grades which cannot be surmounted by the geared locomotives now in use can only be operated upon by cable traction, the objections to which have been pointed out. I have designed a construction of locomotive by which I acquire traction enough for grades of thirty per cent. at a conservative estimate, and it is well understood that if on such a grade there is a sufficient traction there is no difficulty about securing sufficient power to use it. In operating my locomotive I make no change whatever in the road-bed, rails, ties, switches, or in any feature of railway construction; but my improved locomotive can be used upon any track laid in the usual way where the grades are of such steepness as to warrant its employment.

In my improved locomotive I can obtain and combine traction in three ways—first, by the weight of the locomotive upon the rails; secondly, by gearing all the carrying-wheels to shafts driven by the engine or engines; thirdly, and, most important, by horizontal wheels adapted to grip either or both track-rails. I can also provide means by which the pull or push of the load is exerted automatically to maintain the pressure of such wheels and to increase the pressure as the grade increases, whether in ascending or descending. A construction by which I obtain these re-

sults is illustrated in the accompanying drawings, in connection with which this specification should be read.

Figure 1 is a top plan of four connected locomotive-trucks which support the entire mechanism. Fig. 2 is an enlarged plan of two single trucks. Fig. 3 is a sectional elevation of one side of a truck looking from the side of the track toward one of the rails, as shown by an arrow in Fig. 1. Fig. 4 is a sectional elevation of the right-hand front truck of the locomotive. Fig. 5 is a plan view of the connections for operating and lifting the grip-wheels.

My locomotive is carried by single independent trucks, of which I prefer to use four, two on each side. The trucks A A′ on one side and B B′ on the other have boxes for the short axles 1 of the carrying-wheels C C′ D D′. Each carrying-wheel is provided with a bevel-gear, by which it is driven. The wheels in the trucks A and B and two of the wheels in the trucks A′ and B′ have the gears 2 bolted directly to them on the outside; but two of the wheels, as D, in the trucks A′ and B′ have the gears 3 secured to their respective axles on the outside in order that the engaging gears on the driving-shafts E revolve them in the proper direction. The driving-shafts E are journaled in the engine-frame in bearings 4 and also in the ends of the truck-frames, and their construction is the same on both sides. At the ends of the shaft are bevel-pinions 5, which engage, respectively, with bevel-wheels 2 and 3 of truck-wheels C and D. Each shaft is provided with knuckle-joints 6 7 to make it universally flexible, and near each end a slip-joint is provided, consisting of a sleeve 8, into which the shaft itself is either squared or sets with a feather and in which it is free to slide. This is to permit the shaft to elongate and shorten as the trucks swing on curves. By these provisions I am enabled to gear all my truck-wheels on each side from a single shaft and yet turn curves and change grades with perfect facility.

I prefer to drive each shaft from two engine-cylinders F F′ on each side, whose piston-rods are connected to cranks 10, set quartering on the shafts E, so as to avoid dead-centers; but I design to operate all the engines with a single throttle and one reversing-lever, so that all the cylinders receive steam alike, and although the steam-pressure is the same in all the engines the outside wheels on any curve will of course automatically run faster than the inside wheels, since the opposite wheels have separate axles and the radius of motion is longer.

The opposite trucks are loosely connected and held together by parallel bolsters F^2, which are suitably braced together to form rigid transverse framings. Each bolster is provided with downwardly-projecting arms 11 12, which bear inwardly and outwardly against the respective truck-frames, the bolsters passing through opposite slots 13 in such frames, as shown in Fig. 3. The side pieces of each truck are also rigidly connected by cross-beams 14, between which and the bolsters are interposed springs 15, Figs. 2 and 3. These bolsters support the boiler and engine-frame. It is evident that while the bolsters connect opposite trucks, so as practically to form one swing-truck, yet the connection is a loose one and permits the trucks to rock and roll freely without affecting the trucks, and, further, that since opposite wheels have individual axles such wheels are independent upon curves. The reason for making this loose bolster connection between independent wheels is that it is a feature of my construction that no wheel on either side is to be allowed to slip on a curve, as will be more fully hereinafter explained. The bolsters of front and rear trucks are connected by a longitudinal central reach 16, jointed, as shown, to each bolster in order to keep the truck from varying in the curves and also to secure an equal pressure on the equalizing-levers of the front and rear trucks, hereinafter described.

I have described how the carrying-wheels C′ and D on each side and on separate trucks are geared to a universally-jointed and extensible shaft E, which is self-adjusting to and continuously driving under all conditions of rocking movement by the trucks whether in longitudinal or lateral directions, as well as in swinging movements. By reference to Fig. 3 I now show how the remaining truck-wheels C and D′ are also included in the gear system.

Journaled in each truck-frame is a bevel-wheel G, which is geared to both truck-wheels by the interposed bevel-gears 16 17, carried by inclined shafts 18, held in bearings 19 on the trucks. Gears 17 engage with the gears of the main truck-wheels. Gears 16 engage with gear G, and all the truck-wheels on a side are therefore geared to the driving-shaft E and are turned in the same direction.

As thus far described, I have a locomotive provided with a plurality of independent self-adjusting trucks, the wheels of all trucks being positively geared to jointed shafting. Up to this point my locomotive has the same efficiency on grades as the geared locomotives now used; but I now proceed to describe the most important feature of my invention, by means of which I am able to enormously increase the effectiveness of such a locomotive and enable it to operate safely on grades of far greater pitch than the geared locomotive is capable of ascending. I do this by employing horizontally-acting frictional-grip wheels operating on a rail or rails, all driven positively by the power. Further, these grip-wheels can be automatically held and maintained in gripping position by the load, whether in ascending or descending, and this being the case it follows that the increase in the load as the grade increases further increases the pressure of the grip-wheels to

such an extent that as a matter of fact the climbing ability of this locomotive is limited only by the power of its engines. I further provide means for releasing these grip-wheels at will and raising them above the track, and hence I have no difficulty with switches, which of course are always on levels or very slight grades, where control of the engine is easy. I can connect my grip-wheels to a sliding draw-bar, to which the load is attached; but I much prefer to utilize the pull or push of the engine boiler and structure, either alone or with an attached load. For this purpose the boiler H is peculiarly supported on the bolsters heretofore described. Mounted upon the bolster-frame of each truck is a bed-plate I, which has a circular dished flange 20, which forms a seat for a circular bearing J, secured to the lower side of the boiler and of curvilinear form, the two forming practically a ball-joint connected loosely by a central king-bolt 21. On the bolster-bars are lugs 22, which fit over the side edges of the plate I and act as guides. Instead of the plain guides shown roller-guides can be used at these points. The construction forms a turn-table on which the boiler rolls in passing curves. The same construction prevails above the other truck, it being understood that in case the boiler does not extend back so far the turn-table construction is applied to any part of the locomotive structure which comes above such truck. In ascending a grade the whole engine structure sags back in these guides by its own weight, aided by whatever load it is pulling, the car or cars composing the load being of course coupled to the engine structure in any suitable way. In descending a grade the same structure sags forward, aided by whatever load may be tending to push or pull it down. This backward or forward movement operates, maintains, and increases automatically the pressure of the grip-wheels referred to, but which have yet to be described. I have shown in the drawings a practical means for communicating this power to the grip-wheels. On the under side of the traveling bed-plate I are two studs 23 24, between which pass transversely two levers 25 26, jointed together at 27 and connected by links 28 to the bolster-frame. The pull or push of the boiler structure will, through one or the other of studs 23 24, act upon the levers at the joint 27, and on account of the reach 21 the pull or push will be equal on both trucks. Jointed to the outer end of each lever is a pitman 29, which, through suitable connections, applies the grip-wheels to the rails.

The horizontal grip-wheels K K′ are supported below each truck, and I prefer to shape such wheels so as to bear upon and partly surround the ball or head of the track-rail, as shown in Fig. 4. One of these wheels in each truck is mounted upon the vertical shaft 30, which carries the bevel-gear G, before described, and which is operated from the side driving shaft. Above the gear G on shaft 30 is a horizontal spur-gear L, which meshes with a similar spur-gear M on another vertical shaft 31. All these gears are secured to the respective shafts by feathers 32, as it is necessary for a special purpose for the shafts to have a vertical sliding motion without affecting the gears. The grip-wheel K′ is secured to the lower end of shaft 31. Obviously the grip-wheels derive opposite rotations through this gearing and when clamped upon the rail will exert a united tractional pulling effect, at the same time holding the locomotive down to the track. The shafts 30 and 31 are journaled in upper boxes 33 and lower boxes 34. The upper boxes are jointed together, as shown at 35, and have outside curved ends to bear against the truck-frames on each side, so that they can rock and adjust themselves to the slight changes of gage which in roughly-built logging-rail ways frequently occur. The lower boxes 34 are held within a casing 36, fitted between the sides of the truck-frame. This casing also contains bearings 37 for a rock-shaft 38, to which the pitman 29 is connected by a vertical connecting-rod 42 and a crank 39. The connecting-rod 42 extends up as high as the center of the upper boxes and is connected at right angles to the pitman 29. Hence the connection is about at the center of any rocking motion, which consequently can produce no effect on the equalizing-levers 25 and 26. The rock-shaft 38 is intermediate between the boxes 34 and is connected to both of them in such a way that a turning movement of said shaft caused by pitman 29 will draw the boxes toward each other. I prefer to use the double-toggle connection shown, comprising a two-armed lever 40, secured upon the shaft, and links 41, jointed to the said lever and to the boxes 34. Comparing Figs. 3 and 4, it will be seen that the boxes carrying their shafts and the grip-wheels can move freely and transversely in the casing, which forms a guide to hold them always rigidly in line. This transverse movement causes the wheels to grip the ball of the rail firmly on both sides, and it is produced by motion in either direction of the jointed levers 25 and 26, derived, as heretofore described, from the momentum and subsequent inertia of the boiler structure or the equivalent draw-bar, to which I have referred. The upper boxes 33, jointed together, rock on their curved ends against the casing while the lower boxes are being moved. The motion of the lower boxes is, however, so slight (possibly not more than half an inch) that no appreciable effect is produced on the spur-gearing which connects the truck-wheels, such gears being placed so far above that the motion there is imperceptible.

I desire to state here that while I prefer and consider it a highly-important feature of my invention to use the momentum and inertia of the load to maintain the pressure of

my grip-wheels on the rails, yet it is perfectly practicable to connect a power-cylinder using air or steam to such a device as the jointed levers 25 26, and thereby cause them to act upon the grip-wheels in the same manner as before described. Such a device must be controlled by the engineer, however, and necessarily has a limit of effectiveness, whereas when the pull or push of the load is the operating force such force increases automatically as the load exerts more power by an increase in the grade. Further, grip-wheels operated by the load form a perfect safety device under all conditions. Supposing, for instance, that the motive power breaks down on a heavy grade and all wheels stop driving, if ordinary wheel-brakes are applied, so as to stop the revolution of the wheels, the pull or push of the load continues to clamp the grip-wheels upon the rails, and if they are no longer driving they necessarily act as holding-brakes, whose effectiveness increases with the pull or push of the load, and they cannot slip, whatever the grade may be.

In order to operate on switches, it is necessary to release the grip-wheels from the rails and to lift them sufficiently to pass the switch. For this purpose the grip-wheels, their shafts and lower boxes, and their guiding-casing are capable of being bodily lifted. As before explained, the grip-wheel shafts 30 and 31 are feathered in the gears which they carry, and each shaft has an enlargement or collar 43 above its lower bearing-box. Bolted to the truck-frame, Fig. 5, are vertical guides 44 for the lower boxes and casing. For the lifting power I prefer to use a cylinder O, mounted upon the top piece P, which connects the side pieces of the truck-frame. The piston of this cylinder may be operated, like those of brake-cylinders, by steam or air in well-known ways, and all the cylinders can be connected so as to be simultaneously or separately operated at will. The piston-rods 45 extend downwardly and are suitably guided—as, for instance, in the guides 46 on the casing 36. These piston-rods pass through and are secured to a cross-head 47, from which pitman connections extend to cranks 48 on the shaft 38, which latter, it will be remembered, has the toggle connection to the lower grip-wheel shaft-boxes. The lift of the piston turns the shaft 38 in an opposite direction to that already described, and the first effect is to act on the toggle and spread the lower shaft-boxes, which are provided with lugs 49, which take under the casing 36. As the lift continues, the grip-wheels, shafts, lower boxes, and guiding-casing are raised enough to bring the wheels above the track. The shafts can project through openings, as 50, in the top piece of the truck-frame. In operating this part of the device on coming to a switch or a railway-crossing, for instance, I first admit steam or air to the cylinder O, which tends to lift the grip-wheels; but the pull of the load is sufficient to resist this tendency. Therefore I reverse slightly, so as to check the trucks and wheels, which allows the boiler and load to push forward. When the jointed levers 25 26 have been pushed to a straight line or dead-center, the grip-wheels are released from the rail, and at that instant cylinder O exerts its lifting power, raises the grip-wheels clear of the track, and holds them there as long as the pressure is on in said cylinder. After making the crossing I shut off the pressure in cylinder O, which allows the grip-wheels to lower gradually onto the rail. I now reverse again slightly, throwing the boiler ahead and again bringing levers 25 and 26 into line and so spread my grip-wheels enough to clear the rail and drop farther to position for gripping, and the gripping action takes effect as soon as the pull or push of the load is restored. In order to limit the possible movement of the boiler structure in either direction in its guides, I provide stops of any suitable construction, such as the lugs 52 at the bottoms of the bed-plates I, between which and the bolsters F^2 may be interposed yielding springs 53.

I have illustrated in dotted lines in Fig. 1 a pair of grip-wheels K K′, supported in each of the four separate wheel-trucks shown. I may, however, use only one pair of grip-wheels on each side or only one pair of such grip-wheels on a single rail, and, indeed, having reference to my improvements in controlling such wheels and especially in raising them it is evident that such improvements could, if desired, be applied to the gripping of a third rail, if it were desired to use them in that way. It is also evident that grip-wheels constructed and operated as I have described might be employed upon one side only to ordinary trucks, with continuous transverse axles connecting two carrying-wheels; but for reasons heretofore given I prefer to use independent trucks, as shown, which can adjust themselves to all inequalities of track and can rock freely longitudinally and transversely while the grip-wheels maintain their pressure.

I do not limit myself to details of construction herein described, and shown in the drawings, as I desire to avail myself of such modifications and equivalents as fall properly within the spirit of my invention.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A locomotive having a plurality of trucks upon one side, carrying-wheels running therein and geared to a driving-shaft, independent trucks upon the other side, a bolster-frame extending from side to side and loosely connecting opposite independent trucks together, and a boiler structure pivotally supported by said bolsters.

2. A locomotive provided with one or more pairs of grip-wheels adapted to grip a rail, in combination with means for rotating said grip-wheels, means for engaging said grip-

wheels with and releasing them from the rail, and means for lifting them in the line of their axes above the rail.

3. A locomotive having truck-wheels, a pair of horizontal grip-wheels, means for causing said grip-wheels to grip a rail of the track upon which the truck-wheels run, means for causing said grip-wheels to release the track, and means for raising said grip-wheels above the track.

4. A locomotive having truck-wheels geared to a driving-shaft, in combination with a pair of grip-wheels for gripping a rail, such grip-wheels being geared to each other and to said driving-shaft.

5. A locomotive having carrying-wheels geared to a driving-shaft, a pair of grip-wheels geared to each other and to the carrying-wheels and adapted to grip a rail, means for causing said grip-wheels to engage and to release said rail, and means for lifting said grip-wheels without affecting their driving-gearing.

6. A locomotive having grip-wheels arranged in pairs on both sides of the structure, and adapted to grip both track-rails horizontally, and an intermediate mechanism connected to the grip-wheels on both sides for operating said grip-wheels on both sides simultaneously to cause them to grip both track-rails and also to release said track-rails.

7. In a locomotive, a wheel-truck, a pair of horizontal grip-wheels journaled in said truck and having their shafts geared together, a driving-shaft, and gearing between said driving-shaft and a grip-wheel shaft.

8. In a locomotive, wheel-trucks having carrying-wheels, a driving-shaft, gearing connecting the driving-shaft to said carrying-wheels, gearing connecting the carrying-wheels of each truck together, so that all carrying-wheels on one side are in a system of gearing with the driving-shaft, a pair of horizontal grip-wheels journaled in a truck and geared to each other, and to said system of gearing, and means for causing said grip-wheels to engage with a track-rail.

9. In a locomotive, a pair of grip-wheels adapted to grip a track-rail sidewise, and journaled in a supporting-truck of the locomotive, in combination with means operated by the pull or push of the load, independently of the locomotive-trucks, for moving such grip-wheels toward each other and the rail and away from each other and the rail.

10. In a locomotive, a pair of grip-wheels, adapted to grip a track-rail sidewise, and journaled in a supporting-wheel truck, in combination with a movable part on the locomotive structure, and a connection to said grip-wheels operated in both directions by said movable part for causing said grip-wheels to engage and release the track-rails.

11. In a locomotive having carrying-trucks, a pair of grip-wheels adapted to grip a track-rail sidewise, and another pair of grip-wheels for similarly gripping the opposite rail, in combination with a movable part on the locomotive structure, connections to both pairs of grip-wheels operated simultaneously by said movable part in both directions for causing both pairs of grip-wheels to engage and release the rails.

12. In a locomotive, wheel-trucks, a pair of grip-wheels journaled in a truck and adapted to grip a rail sidewise, a boiler structure supported by said trucks so as to have a limited longitudinal movement, and means operated by said movement for causing said grip-wheels to engage said rail.

13. In a locomotive, wheel-trucks, pairs of grip-wheels journaled in said trucks so that each pair grips a rail sidewise, a boiler structure supported by said trucks, so as to have a limited longitudinal movement and connections to all the pairs of grip-wheels operated simultaneously by said longitudinal movement for causing the grip-wheels to engage both rails.

14. In a locomotive, opposite forward trucks and opposite rear trucks, bolsters loosely connecting the opposite trucks and a longitudinal reach jointed to said bolsters, all forming a connected supporting structure; in combination with a boiler and engine frame mounted pivotally upon said bolsters and capable of a limited longitudinal movement, rail-gripping wheels journaled in pairs in forward and rear trucks, independent connections to the forward and the rear grip-wheels, and means for causing the said longitudinal movement of the boiler to cause the said forward and rear grip-wheels to simultaneously engage the rail.

15. In a locomotive, supporting-trucks connected by transverse bolsters, a bed-plate supported in guides upon said bolsters so as to be movable longitudinally, a boiler supported pivotally upon said bed-plate, a transverse lever adapted to derive motion from said longitudinal movement in either direction, and a pair of rail-gripping wheels connected to said lever.

16. In a locomotive, supporting-trucks connected by transverse bolsters, a bed-plate supported in guides upon said bolsters, so as to be movable longitudinally, a boiler supported pivotally upon said bed-plate, two transverse levers jointed together and adapted to derive simultaneous motion from said longitudinal movement in either direction, and a pair of rail-gripping wheels journaled in opposite trucks, and connected to said levers.

17. In a locomotive, a pair of grip-wheels for gripping a rail sidewise, shafts journaled in movable bearings and carrying said grip-wheels, connections between said shafts, and means for operating said connections to cause said grip-wheels to approach each other and to recede from each other.

18. In a locomotive, a pair of grip-wheels for gripping a rail sidewise, shafts journaled in movable bearings and geared together car-

rying said grip-wheels, connections between said shafts, and means for operating said connections to cause said grip-wheels to approach each other and to recede from each other.

19. In a locomotive, a pair of grip-wheels for gripping the rail sidewise, means for supporting said grip-wheels whereby they can approach and recede from each other, and can also move vertically and a power-cylinder having its piston connected to said grip-wheels for imparting to them the said vertical movement.

20. In a locomotive, a pair of grip-wheels for gripping a rail sidewise, loosely-supported shafts on which said grip-wheels are mounted, a connection between said shafts, means for operating said connection in order to cause the grip-wheels to approach and recede from each other, a power-cylinder, and a connection between the piston of said cylinder and both grip-wheel shafts whereby said grip-wheels can be vertically and simultaneously moved.

21. In a locomotive, a pair of grip-wheels for gripping a rail sidewise, shafts on which said wheels are mounted, gearing feathered upon said shafts and connecting them together, means for operating said gearing, a power-cylinder and piston, and a connection from the piston for raising both shafts independently of the said gearing.

22. In a locomotive, means for securing increased traction comprising truck-wheels, one of which is geared to a driving-shaft, a pair of horizontal side gripping-wheels located between two adjacent truck-wheels, grip-wheel shafts geared together, a bevel-gear on one grip-wheel shaft, and other bevel-gearing connecting said bevel-gear to both of said truck-wheels.

23. In a locomotive, the combination with a wheel-truck of two substantially vertical shafts, journaled respectively in upper and lower boxes or bearings; the upper boxes being rocking boxes, and the lower boxes being sliding boxes, grip-wheels secured to said shafts and adapted to clamp a rail between them, connections between said sliding boxes, means for rotating said grip-wheels, and means for operating said connections, in order to cause said sliding boxes to approach and recede from each other.

24. In a locomotive, a pair of wheels for gripping a rail sidewise, shafts for said wheels journaled in a wheel-truck in upper rocking boxes and in lower sliding boxes, a rock-shaft connected to both of said sliding boxes, a lever controlling said grip wheels pivoted independently of the wheel-truck and having a connection with said rock-shaft for moving said sliding boxes, such connection comprising substantially a vertical rod connected to a crank on said rock-shaft and a horizontal rod connected to said lever; the two rods meeting and being jointed together at approximately the level of said rocking boxes; whereby the grip-wheels, while gripping a rail, can follow a change in track-gage without affecting said controlling-lever on account of the location of the joint between said rods at about the center of oscillation, viz., said rocking bearings.

25. In a locomotive, a wheel-truck, a pair of grip-wheels, sliding boxes forming journals for the shafts of said wheels, a rock-shaft having connections to both boxes so as to make them simultaneously movable toward each other to engage said wheels with a rail, and a casing for guiding the boxes and holding them in line during such movement.

26. In a locomotive, a wheel-truck, a pair of grip-wheels, sliding boxes forming journals for the shafts of said wheels and movable toward each other to engage said wheels with a rail, a casing for guiding the boxes and holding them in line during such movement, a power-cylinder for lifting said grip-wheels above the track, and vertical guides in the truck-frame for guiding said casing and boxes during the movement resulting from said power-cylinder.

27. In a locomotive, two opposite independent wheel-trucks in combination with a transverse bolster-frame extending continuously across the trucks and having downwardly-extending arms on both sides of each truck, whereby said trucks are held loosely together.

28. In a locomotive, two opposite independent wheel-trucks having raised side pieces, provided with oppositely-placed slots, a bolster passing loosely through the slots in both side pieces, and having downwardly-projecting arms on both sides of each truck, whereby the trucks are held loosely together, but are completely independent as to individual rocking movements.

29. In a locomotive, carrying-wheels, one or more pairs of grip-wheels for gripping each track-rail sidewise, a separate driving-shaft for driving the carrying-wheels and the grip-wheels on each side, and one or more engine-cylinders for operating each shaft separately; whereby the grippage is maintained on curves, and each engine automatically adjusts itself to the required speed.

30. In a locomotive, wheel-trucks having transverse bolsters, a bed-plate mounted on said bolsters and movable thereon, an engine and boiler structure supported by said bed-plate, and a stop on said plate for limiting its sliding motion.

31. In a locomotive, front and rear trucks, connected by transverse bolsters, a longitudinal reach connecting said front and rear bolsters, a sliding bed-plate supported respectively by the front and rear bolsters, and a stop on each bolster for limiting its sliding motion.

32. In a locomotive, opposite wheel-trucks, a pair of track-gripping wheels mounted in each truck, a sliding bed-plate supporting the engine-boiler and carried by said trucks, a pair of horizontal levers jointed together and having connections to said grip-wheels, and

two studs on each bed-plate located respectively in front and in rear of said levers, whereby sliding motion of said bed-plate either forwardly or rearwardly will cause a stud to bear upon and operate said jointed levers.

In testimony whereof I have affixed my signature, in presence of two witnesses, this 31st day of October, 1899.

GEORGE S. FOUTS.

Witnesses:
L. W. SEELY,
GEO. T. KNOX.