(No Model.) 3 Sheets—Sheet 1.

S. B. GRAY.

TRACTION ENGINE.

No. 556,346. Patented Mar. 17, 1896.

Fig. 1.

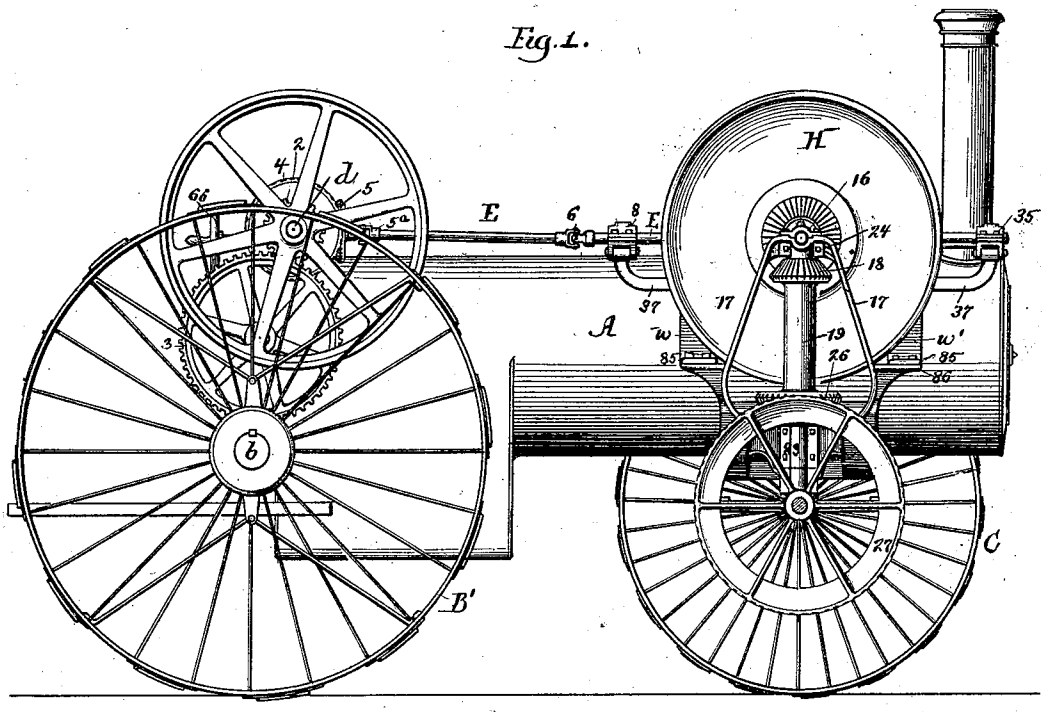
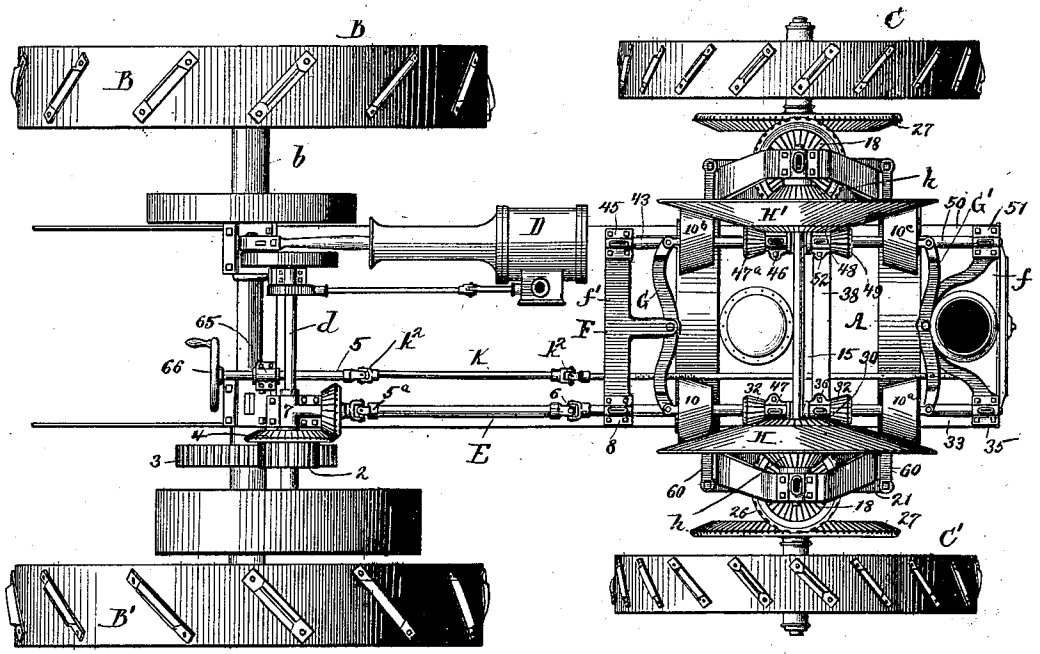


Fig. 2.



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(No Model.) 3 Sheets—Sheet 2.

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TRACTION ENGINE.

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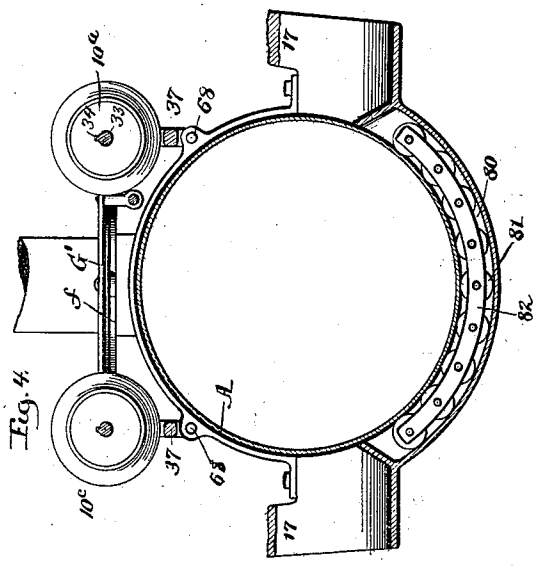

Fig. 4.

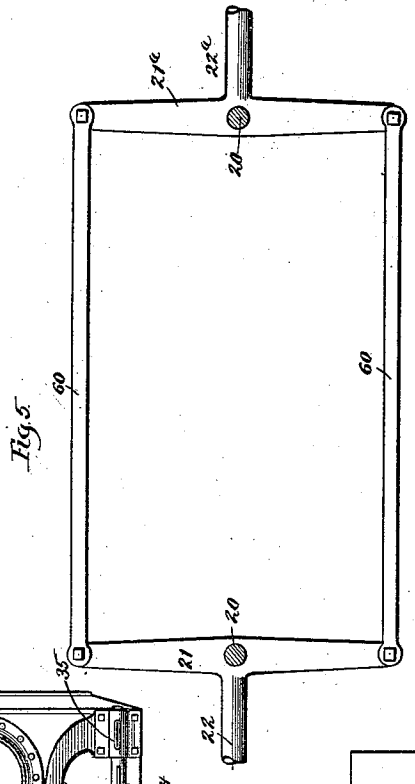

Fig. 5.

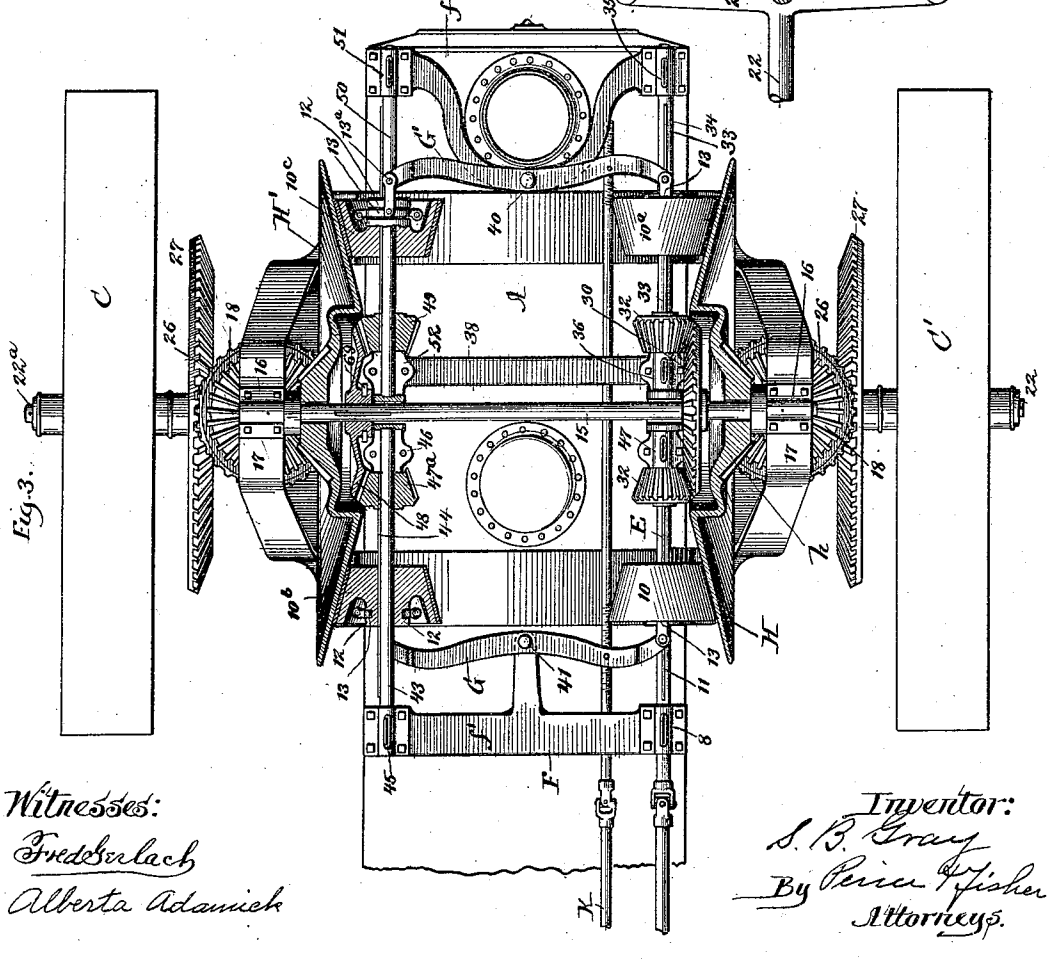

Fig. 3.

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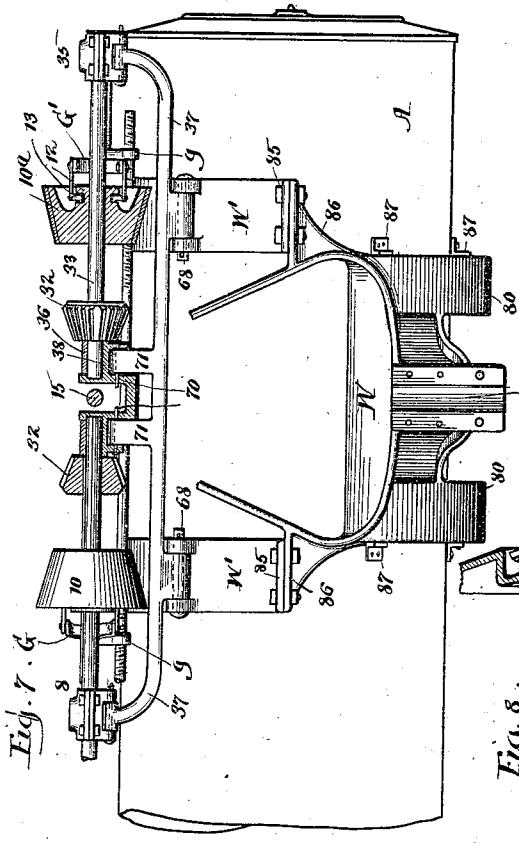

Fig. 7.

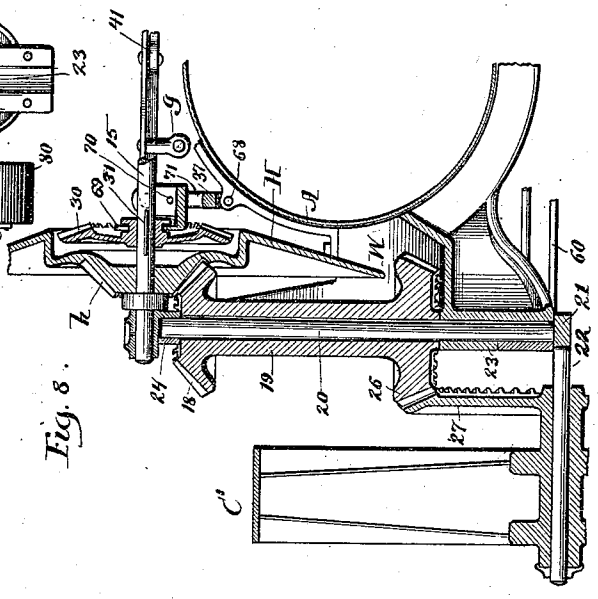

Fig. 8.

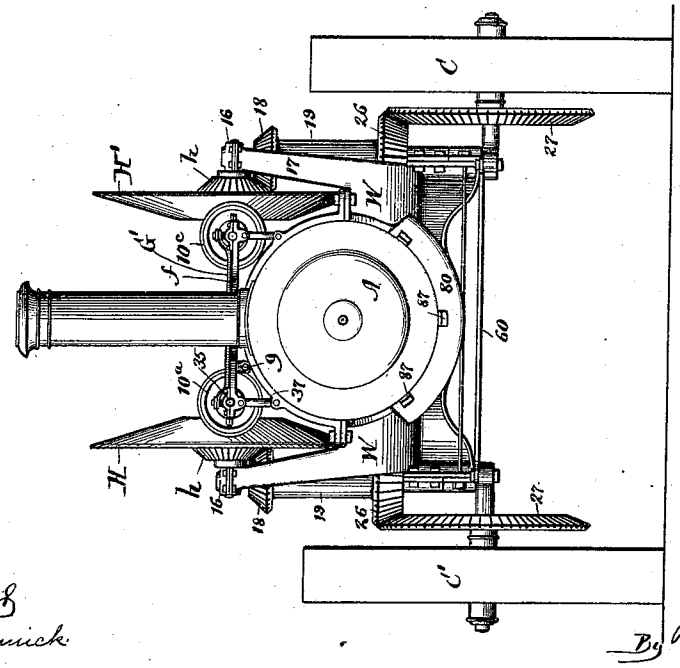

Fig. 6.

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UNITED STATES PATENT OFFICE.

STEPHEN B. GRAY, OF JACKSONVILLE, ILLINOIS.

TRACTION-ENGINE.

SPECIFICATION forming part of Letters Patent No. 556,346, dated March 17, 1896.

Application filed January 21, 1895. Serial No. 535,693. (No model.)

To all whom it may concern:

Be it known that I, STEPHEN B. GRAY, a citizen of the United States, and a resident of Jacksonville, county of Morgan, State of Illinois, have invented certain new and useful Improvements in Traction-Engines, of which I do declare the following to be a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My present invention has for its object, first, to provide improved mechanism whereby the driving and steering of the machine can be effected; secondly, to provide improved means for connecting the driving mechanism and one pair of wheels with a boiler; thirdly, to provide improved connections between the driving mechanism whereby the front and rear wheels are propelled; fourthly, to provide improved means for sustaining the steering-wheels in order that their unison movement may be better effected, and, finally, to provide various subordinate means, all of which will be hereinafter described, illustrated in the accompanying drawings, and particularly pointed out in the claims at the end of this specification.

Figure 1 is a view in side elevation of a traction-engine embodying my invention. Fig. 2 is a plan view. Fig. 3 is an enlarged view, partly in elevation and partly in horizontal section, showing the traction-wheels and driving mechanism at the front of the machine. Fig. 4 is a view in vertical cross-section through the boiler and its sustaining yoke or frame, the section being taken between the rings of the sustaining-frame, looking outwardly. Fig. 5 is a detail plan view of the stub-axles for the steering-wheels and their connections. Fig. 6 is a front view of the traction-engine. Fig. 7 is a view, partly in side elevation and partly in vertical section, of the front part of the machine, certain of the parts being omitted. Fig. 8 is a view in vertical cross-section through one of the steering-wheels and through the adjacent gear mechanism whereby said wheel is driven.

The boiler A is sustained by rear and front traction or carrying wheels B B′ and C C′ of usual or suitable construction. The connection between the rear traction-wheels B, B′, and the boiler, and the mechanism whereby the rear set of traction-wheels is driven, may be of any suitable or usual construction. In the drawings I have shown these traction-wheels as driven from the engine D through a shaft *d*, carrying a pinion 2 that meshes with the gear-wheel 3, which in turn engages by suitable gearing with axle *b*, that carries the wheels B B′. The shaft *d* has keyed thereto a beveled gear-wheel 4, that engages with a correspondingly-beveled gear-wheel 5, mounted upon the rear section of the drive-shaft E, whereby motion is transmitted to the front wheels of the machine. The shaft E is formed of sections, as shown, these sections being connected together by the gimbal-joints 5^a and 6, in order that a degree of flexibility will be given to the shaft incident to the shifting of the front wheels of the system, as will presently more fully appear. The rear section of the drive-shaft E, that carries the bevel gear-wheel 5, is mounted in a suitable bearing 7, while the forward section of the drive-shaft E is mounted in a bearing 8, carried at one side of shifting frame F, the construction of which frame will presently more fully appear.

Upon the forward section of the drive-shaft E is mounted a gear-wheel 10, this gear-wheel being formed with a suitable groove to receive a spline 11 on the drive-shaft E, so as to permit the wheel 10 to be shifted back and forth upon the shaft and be driven thereby in its different positions.

By preference the gear-wheel 10, and each of the corresponding gear-wheels to be presently described, is a conical friction-wheel, and preferably the interior of each of these wheels is cut away to form a hub 12 that is provided with an annular groove to receive a shifting yoke 13, to which is connected a shifting-lever G. By this means the several conical wheels may be shifted back and forth while being driven.

The gear-wheel 10 engages with a drum H having its inner face preferably formed with an incline friction-surface corresponding to the face of the gear-wheel 10, this drum H being mounted upon a through-shaft 15 that is journaled in bearings 16 at the top of the standards 17 that rise at each side of the sustaining-frame W. (See Figs. 1, 2, and 6.) The drum H is loosely mounted upon the

shaft 15; but this drum is provided with a series of bevel gear-teeth *h* that engage with a bevel-pinion 18 formed at the upper end of a sleeve 19 (see Fig. 8) that is mounted upon the vertical spindle 20 that rises from the cross-bar 21 of the stub-axle 22. This spindle 20 has its lower end journaled in a bearing 23 at one side of the sustaining-frame W, its upper end being journaled in a bearing 24 immediately beneath the journal-bearing 16 of the shaft 15. The lower end of the sleeve 19 is provided with a bevel-pinion 26 that meshes with a corresponding bevel gear-wheel 27 carried by the hub of the traction-wheel C′ that is journaled upon the stub-axle 22. (See Fig. 8.) It will thus be seen that when rotation is imparted to the drum H from the gear-wheel 10 a corresponding rotation will be given to the traction-wheel C′ through the medium of the gearing last described.

Upon the through-shaft 15 is mounted a bevel gear-wheel 30 that is connected to the shaft 15 by a spline 31 that permits the wheel 30 to be shifted axially upon the shaft, and with this gear-wheel 30 meshes a correspondingly-beveled pinion 32 that is carried by the forward section of the drive-shaft E, (see Fig. 3,) and preferably also a similar bevel gear-pinion 32 engages with this gear-wheel 30, this pinion 32 being mounted upon the shaft 33 in line with the drive-shaft E. The shaft 33 carries a gear-wheel 10^a (preferably a conical friction-wheel) similar to the gear-wheel 10, and this gear-wheel 10^a is axially shiftable upon the shaft 33, being held to rotate therewith by means of a spline 34. The shaft 33 is journaled at its front and rear in the bearings 35 and 36, the bearing 35 being carried by the end bar *f* of the shifting frame, while the bearing 36 is carried at the end of a transverse bar 38 that moves with the shifting frame F. The gear-wheel 10^a is the same in construction as the gear-wheel 10, and its hub is connected by means of a shifting yoke 13 to its shifting-lever G′ that is pivoted, as at 40, to the end bar *f* of the shifting frame F. My purpose in employing a positively-driven gear-wheel 10^a corresponding to the gear-wheel 10 and arranged at the opposite side of the drum H is to insure a more certain driving of this drum and a more uniform distribution of strain thereon.

The mechanism whereby the traction-wheel C is driven is similar to that just described whereby the driving of the traction-wheel C′ is effected—that is to say, the shaft 15 carries a drum H′, similar to the drum H, having an inclined friction-face that is engaged by the conical gear-wheels 10^b and 10^c. The gear-wheel 10^b is connected by a yoke 13 to one end of the shifting-lever G, that is pivoted, as at 41, to an arm projecting from the cross-bar *f*′ of the main shifting frame F. The yoke 13, that is connected to the gear-wheel 10^b, is pivotally connected with the end of the shifting-lever in the same manner as is the yoke 13^a, whereby the opposite end of this lever is connected to the gear-wheel 10. The gear-wheel 10^b is mounted upon a shaft 43 and is connected therewith by means of a spline 44 that enables the wheel 10^b to be shifted axially upon the shaft while still partaking of its motion. The shaft 43 has its rear end journaled in a suitable bearing 45 at the end of the cross-bar *f*′ of the shifting frame F, while the opposite end of this shaft is journaled in a bearing 46, formed by a rearward lateral extension of the cross-bar 38. (See Figs. 3 and 7.) It will be observed also that the forward end of the drive-shaft E, hereinbefore described, is journaled in a similar bearing 47, that is carried by a lateral extension at the opposite end of the cross-bar 38. The shaft 43 has fixed thereto a bevel-pinion 47^a that engages with a bevel-wheel 48 keyed to the through-shaft 15 by means of a spline, so as to permit an axial movement of this gear wheel 48 upon the shaft for the purpose to be presently stated. The bevel gear-wheel 48 engages also a bevel-pinion 49 that is keyed to the shaft 50, this shaft being journaled in the bearings 51 and 52 that are carried respectively by the cross-bar *f* of the shifting frame and by the cross-bar 38. (See Fig. 3.)

The shaft 50 has mounted thereon the conical friction gear-wheel 10^c that engages with the friction-face of the drum H′, and this wheel 10^c has its hub encircled by a yoke 13, the link of which is pivotally connected, as at 13^a, to one end of the shifting-lever G′. The drum H′ is like in all respects unto the drum H hereinbefore described, and is provided with gear-teeth *h*, from which rotation is imparted to the traction-wheel C through the medium of gear mechanism, the same as that whereby rotation is imparted to the traction-wheel C′. (See Fig. 8.) The traction-wheel C is journaled upon the stub-axle 22^a, the cross-bar 21^a of which is connected by the links 60 to the cross-bar 21 of the stub-axle 22, (see Fig. 5,) the links 60 being pivoted to the ends of the cross-bars 21 and 21^a to permit freedom of movement.

In order to effect the operation of the shifting-levers G and G′ for the purpose of varying the points of engagement of the gear-wheels 10, 10^a, 10^b and 10^c with the drums H and H′, I prefer to employ a screw rod or shaft K, although manifestly other suitable forms of shifting mechanism might be employed for this purpose. The rod K has threaded portions *k* and *k*′ that engage respectively with threaded eyes or loops *g* depending from the under side of the shifting-levers G and G′, and the rear portion of the rod or shaft K is journaled in a suitable bearing 65 and is provided with a hand-wheel 66, whereby it can be conveniently manipulated. The several sections of the screw rod or shaft K are connected together by gimbal-joints k^2 in order to give the required flexibility to this shaft.

From the construction of parts thus far defined it will be seen that when the screw rod or shaft K is turned to the left the ends of

shifting-levers G and G′ adjacent the right-hand side of the machine will be drawn together, and consequently the conical gear-wheels 10 and 10^a will be moved axially toward the center of the drum H, while a reverse movement will be imparted to the opposite ends of the levers G and G′ and to the gear-wheels 10^b and 10^c, which latter will be moved axially toward the periphery of the drum H′. Hence, inasmuch as the same speed of rotation is imparted to the several gear-wheels 10, 10^a, 10^b, and 10^c, it is obvious that the drum H, and consequently the traction-wheel C′, will be driven more rapidly than the drum H′ and the adjacent traction-wheel C. The greater speed thus given to the traction-wheel C′, causing this wheel to advance more rapidly than the wheel C, will force the wheel C′ to turn toward the wheel C; but inasmuch as the stub-axles 22 and 22^a of the traction-wheels C and C′ are connected together for unison movement by the links 60 (see Fig. 5) it will be readily seen that the wheel C, although moving at a slower speed than the wheel C′, will be turned to the new direction and will thus shift or turn the machine.

My purpose in employing the shifting frame F is to afford a means whereby the several gear-wheels 10, 10^a, 10^b, and 10^c will be maintained in engagement with the drums H and H′ notwithstanding the axial shift of these wheels, and it is obvious that inasmuch as the drums H and H′ remain in fixed position upon the through-shaft 15, if no provision were made for the lateral shift of the gear-wheels 10, 10^a, 10^b, and 10^c, it would be impossible to shift these gear-wheels in axial direction along the inclined faces of the drums H and H′ and maintain the engagement of the wheels with the drums; but inasmuch as the shifting frame F has its side bars 37 pivotally mounted, as at 68, (see Fig. 7,) upon the sustaining-frame W it will be readily perceived that the inward movement of the gear-wheels 10 and 10^a toward the center of the drum H will crowd or force over the shifting frame, thereby causing the gear-wheels 10^b and 10^c to remain in engagement with the drum H′ notwithstanding the fact that these wheels 10^b and 10^c have been moved by the shifting-levers G and G′ toward the periphery of the drum. Inasmuch as it is necessary that a corresponding lateral shift shall be imparted to the gear mechanism whereby the shafts E and 33 and the shafts 43 and 50 are connected together, I not only connect the gear-wheels 30 and 48 to the through-shaft 15 by means of splines, as shown, but I provide the hubs of these wheels with annular grooves that are engaged by forks or yokes 69 (see Figs. 3 and 8) that project from the lateral extensions formed at the ends of the cross-bar 38.

By reference more particularly to Fig. 7 of the drawings the precise construction of the lateral projections at the ends of the cross-bar will appear, and it will be seen that these projections are formed with sunken portions to permit the passage of the through-shaft 15 and that they are connected by pivot-pins 70 with short arms 71 projecting upward from the side bars 37 of the shifting frame.

It will be readily understood that the side bars and end bars of the shifting frame F will be pivotally connected, (see Fig. 7,) so as to permit this frame to be freely shifted in lateral direction.

The sustaining-frame W, whereby the forward portion of the boiler A is connected with the front pair of traction-wheels, is preferably of the construction next to be described. This sustaining-frame comprises a lower portion having curved channels 80 wherein are mounted a series of friction-rolls 81, these rolls being preferably connected together by curved bars 82 that are joined to the axles of the rolls. It is manifest, however, that other forms of rolls or ball-bearings may be employed without departing from my invention.

The boiler A rests upon the rolls 81 and is held in position thereon by means of the yokes *w* and *w′* that pass over the top of the boiler and have their flanged ends bolted, as at 85, to suitable extensions 86 projecting from the main frame W. The main frame W is held in position with respect to the boiler A by means of suitable angular brackets or guide-plates 87. (See Fig. 7.)

My purpose in providing a sustaining-frame for the front end of the boiler having a swivel connection with the boiler is to allow for the rise of either of the wheels C or C′ owing to irregularities in the ground without throwing undue strain upon the machine, and it is obvious that with my improved construction either of the wheels C or C′ is free to rise or fall without throwing strain upon the boiler or without straining or disturbing its relation with the driving mechanism.

From the foregoing description it will be seen that when it is desired to change the direction of travel of the engine either to the right or left this can be readily effected by changing the position of the gear-wheels 10 10^a, &c., with respect to the drums H and H′, thereby causing these drums and their corresponding traction-wheels to move at different rates of speed.

It will be seen also that my invention insures a positive and effective means for driving both of the traction-wheels C and C′ notwithstanding the shifting of the gear mechanism as above indicated.

It is manifest that the precise details of construction may be varied by the skilled mechanic within wide limits without departing from the spirit of my invention.

So far as I am aware my invention presents the first instance of a traction-engine or analogous machine having a pair of wheels combined with differentially-operative driving mechanism whereby said wheels may be caused to rotate at different relative rates of

speed, and while I have described what I regard as the preferred embodiment of the invention I do not wish the invention to be understood as restricted to the specific construction shown.

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

1. In a traction-engine provided with a pair of main driving-wheels and with a pair of steering-wheels one located on each side of the engine and connected in manner permitting their plane of rotation to be shifted with respect to the engine in order to change its direction of travel, the combination of a common source of power for driving both of said wheels, and differentially-operative driving mechanism connecting said common source of power with said steering-wheels, said differentially-operative driving mechanism comprising variable gearing intermediate said common source of power and said steering-wheels whereby said steering-wheels can be caused to rotate at different relative rates of speed in order to change the direction of travel of the engine, substantially as described.

2. In a traction-engine, the combination with a pair of steering-wheels, one located on each side of the engine and connected in manner permitting their plane of rotation to be shifted with respect to the engine, of variable individual gear mechanism for said wheels and whereby said wheels may be caused to rotate at different relative speeds and shifting mechanism for simultaneously varying said individual gear mechanisms in order to impart different rates of speed to the wheels, substantially as described.

3. In a traction-engine, the combination with a pair of steering-wheels, one located on each side of the engine and connected in manner permitting their plane of rotation to be shifted with respect to the engine, of differentially-operative individual gear mechanism for said wheels and whereby said wheels may be caused to rotate at different relative speeds and shifting mechanism connecting the individual gear mechanism of said wheels whereby a simultaneous shift of said gear mechanism may be effected to impart different rates of speed to the wheels, substantially as described.

4. In a traction-engine, the combination with a pair of wheels, one located on each side of the engine and connected in manner permitting their plane of rotation to be shifted with respect to the engine, of mechanism for driving said wheels comprising individual drums suitably connected to said wheels, gear-wheels engaging said drums and shifting mechanism connecting the gear-wheels of the individual drums, whereby a simultaneous shift of said gear-wheels may be effected to impart different relative speeds to said drums in order to change the direction of travel of the engine, substantially as described.

5. In a traction-engine, the combination with a pair of wheels, one located on each side of the engine, of mechanism for driving said wheels comprising two drums, one of said drums being connected to the adjacent traction-wheel, a drive-shaft and gear-wheels for transmitting movement from said drive-shaft to said drums, said gear-wheels being radially adjustable with respect to said drums in order to vary the speed at which said drums are driven, substantially as described.

6. In a traction-engine, the combination with a pair of wheels, one located on each side of the engine, of mechanism for driving said wheels comprising individual friction-drums, one located at each side of the engine and connected with its adjacent traction-wheel, a shaft for sustaining said friction-drums and friction gear-wheels engaging said individual friction-drums, a drive-shaft connecting and simultaneously driving the gear-wheels engaging both of said drums and suitable mechanism whereby said gear-wheels may be shifted radially of said drums, to vary the speed at which said drums are driven, substantially as described.

7. In a traction-engine the combination with a pair of traction-wheels, of gear mechanism for driving said wheels at relatively different rates of speed, said driving mechanism comprising a pair of drums, each one of said drums being suitably connected with the adjacent traction-wheel, and gear-wheels engaging said drums and movable radially thereof and shifting mechanism whereby the movement of said gear-wheels radially with respect to said drums can be effected.

8. In a traction-engine the combination with a pair of traction-wheels, of mechanism for driving said wheels at relatively different rates of speed, said mechanism comprising a pair of drums, a shaft whereon said drums are loosely mounted, said drums being each geared to its adjacent traction-wheel and suitable gear-wheels connected together and with a drive-shaft for imparting revolution to said drums, said gear-wheels being adjustable with respect to said drums.

9. In a traction-engine the combination with a pair of traction-wheels, one located on each side of the engine, of gear mechanism for driving said wheels at different rates of speed, said driving mechanism comprising a pair of drums, each of said drums being suitably connected with the adjacent traction-wheel, gear-wheels engaging said drums and movable radially thereof, a shifting frame whereby said gear-wheels are carried and whereby they may be laterally shifted, and a drive-shaft for imparting revolution to said gear-wheels.

10. In a traction-engine the combination with a pair of traction-wheels, one located on each side of the engine, of gear mechanism for driving said wheels at different rates of speed, said driving mechanism comprising a pair of drums each one of said drums being suitably connected with the adjacent traction-

wheel, gear-wheels engaging said drums and movable radially thereof, a shifting frame whereby the lateral movement of said gear-wheels is allowed, a drive-shaft for imparting revolution to said gear-wheels and a suitable shifter for varying the position of said gear-wheels with respect to the drums.

11. In a traction-engine the combination with a pair of wheels, of gear mechanism for differentially rotating said wheels comprising vertically-arranged friction-drums, each one of said drums being in gear with the corresponding traction-wheel, friction-wheels separately engaging said friction-drums and shifting mechanism whereby said friction-wheels may be simultaneously shifted to vary their relative positions with respect to the disks.

12. In a traction-engine the combination with a pair of wheels, of gear mechanism whereby said wheels may be driven at different relative rates of speed, said gear mechanism comprising two friction-drums, each one of said drums being suitably geared with the adjacent traction-wheel and friction-wheels movable radially of said friction-drums and shifting mechanism whereby said wheels may be simultaneously shifted in reverse direction in order to vary the speed with which said friction-drums are driven.

13. In a traction-engine the combination with a pair of wheels, of gear mechanism whereby said wheels may be driven at different rates of speed, said gear mechanism comprising vertically-arranged friction-drums, each one of said drums being suitably geared to the adjacent traction-wheel and friction-wheels movable in the direction of the axes of drums and movable in the direction of the radii of said drums, and shifting mechanism whereby said friction-wheels may be shifted to vary their points of engagement with the drums.

14. In a traction-engine the combination with a pair of traction-wheels one located on each side of the engine, of gear mechanism for driving said wheels at different rates of speed, said driving mechanism comprising two friction-drums having inclined friction-faces and conical friction-wheels for engagement with said drums, said conical friction-wheels being radially adjustable with respect to said drums and shifting mechanism for effecting said radial movement of the conical wheels to vary their relative positions of engagement with said drums.

15. In a traction-engine the combination with a pair of wheels, of gear mechanism for driving said wheels at different rates of speed, said gear mechanism comprising vertically-arranged friction-drums, each one of said drums being in gear with the adjacent traction-wheel, friction-wheels engaging said drums and movable radially with respect thereto, shifting mechanism whereby the radial shift of said friction-wheels with respect to the friction-drums is effected and a laterally-shifting frame whereby a simultaneous lateral shift is imparted to said friction-wheels.

16. In a traction-engine, the combination with the boiler and one pair of sustaining-wheels, of a suitable frame connecting said wheels with the boiler, said frame being provided with a series of friction-rolls whereon said boiler is sustained.

17. In a traction-engine, the combination with a boiler and one pair of sustaining-wheels, of a suitable frame connecting said wheels with the boiler, said frame being revolubly mounted with respect to said boiler, driving mechanism for imparting rotation to said wheels and a shaft for operating said driving mechanism supported by said frame and a universal joint connecting the sections of said drive-shaft.

18. In a traction-engine the combination with the boiler and one pair of traction-wheels, of a suitable frame connecting said wheels with the boiler, said frame being revolubly mounted with respect to the boiler and gear mechanism for imparting rotation to said pair of traction-wheels mounted in said sustaining-frame.

19. In a traction-engine, the combination with a pair of traction-wheels and means for imparting rotation to said wheels and a pair of stub-axles for sustaining said wheels, said stub-axles being pivoted and being connected together for unison movement about their pivot-points whereby the parallelism of the wheels is maintained, a drive-shaft and individual variable-gear mechanism connecting said drive-shaft with the wheels whereby said wheels may be driven at different speeds and in different positions, substantially as described.

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