Sept. 20, 1932. C. H. FROELICH 1,878,838

REVERSIBLE AUXILIARY LOCOMOTIVE

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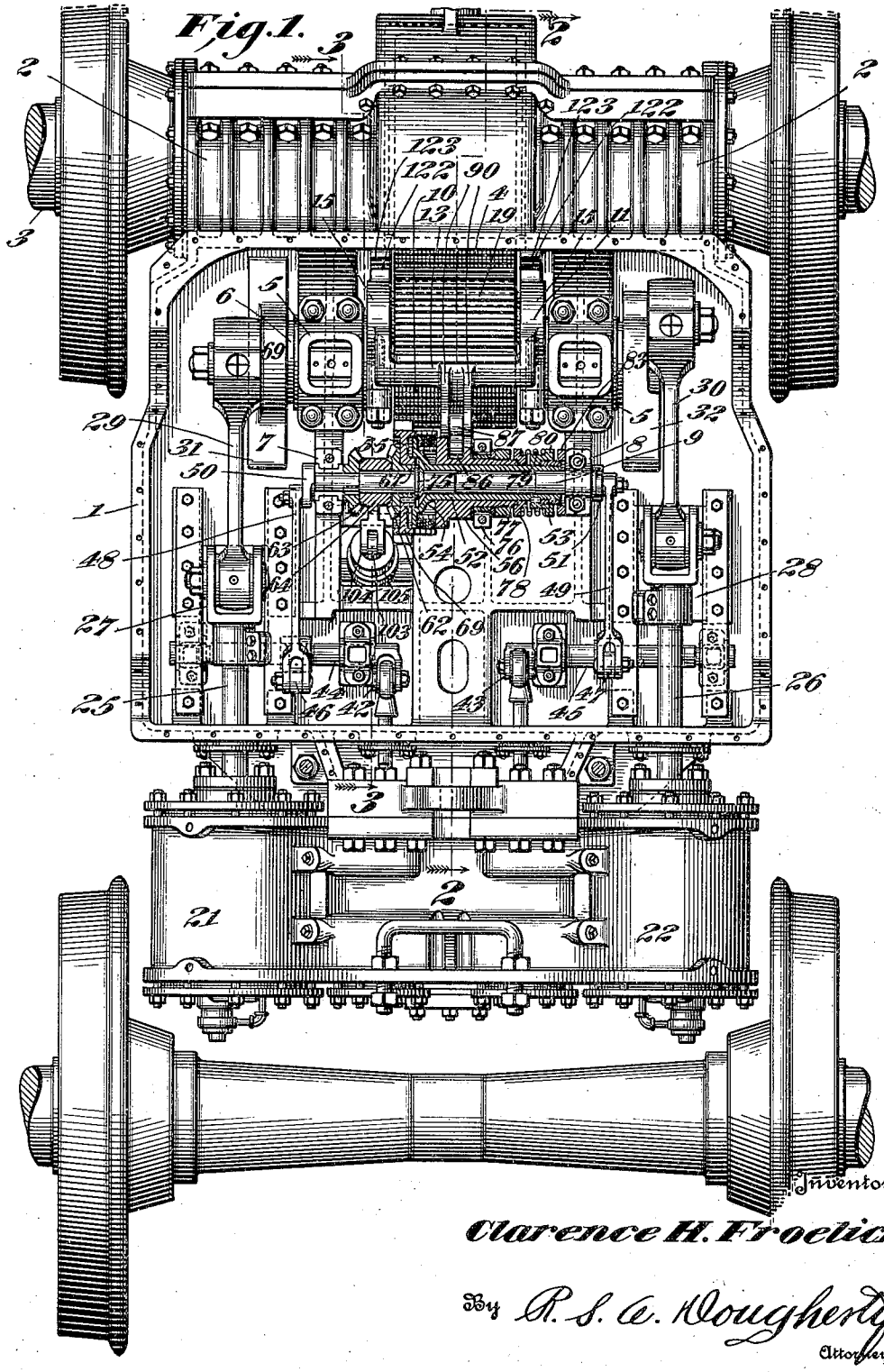
Fig. 1.



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REVERSIBLE AUXILIARY LOCOMOTIVE

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Fig. 2.

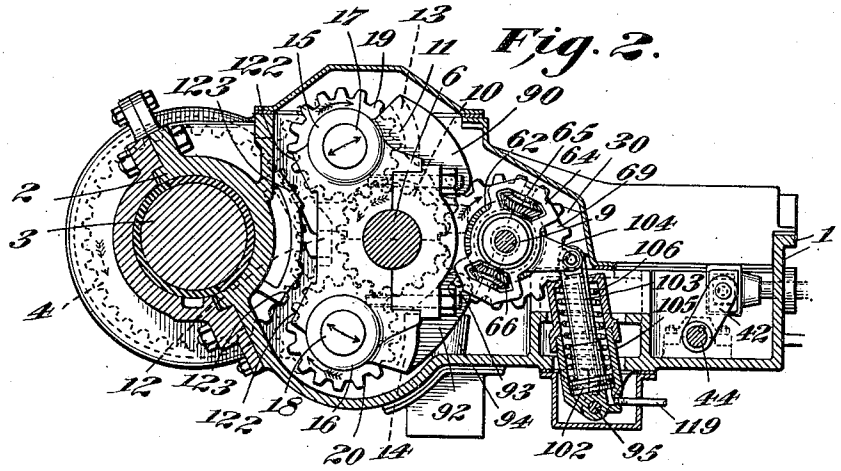


Fig. 3.

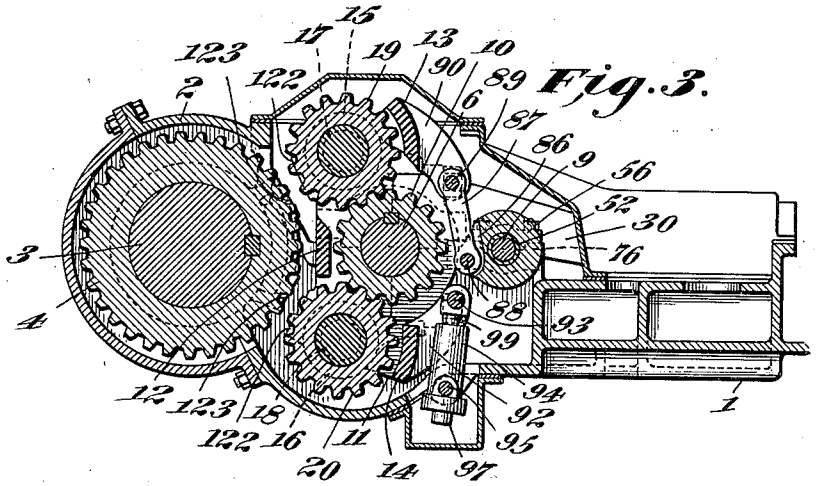


Fig. 5.

Fig. 4.

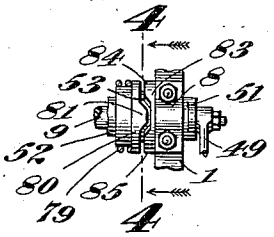
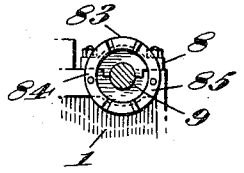


Fig. 6.



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REVERSIBLE AUXILIARY LOCOMOTIVE

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Fig. 7.

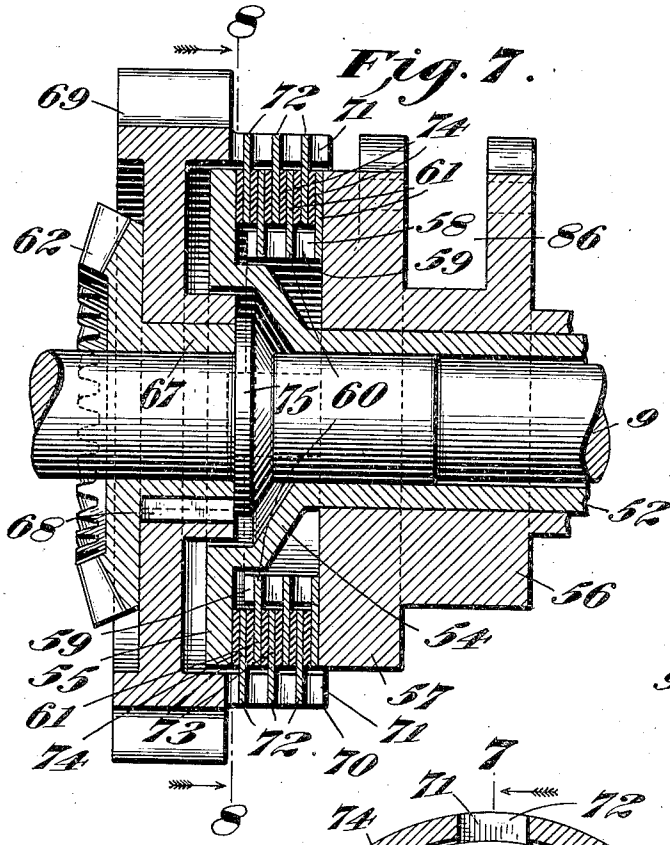


Fig. 9.

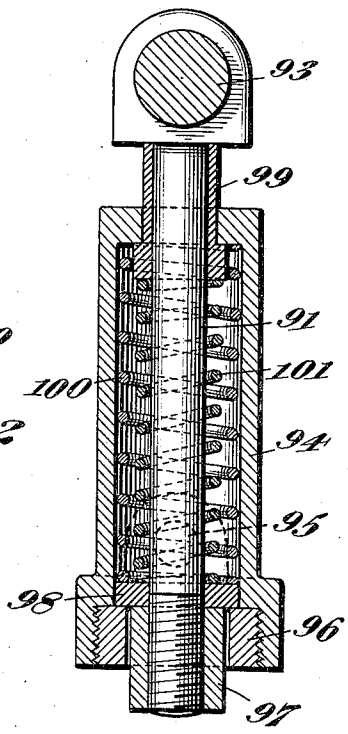
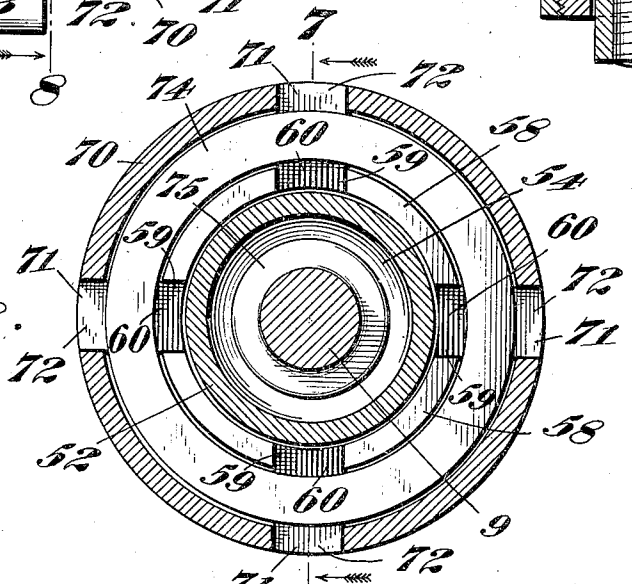


Fig. 8.



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Sept. 20, 1932. C. H. FROELICH 1,878,838

REVERSIBLE AUXILIARY LOCOMOTIVE

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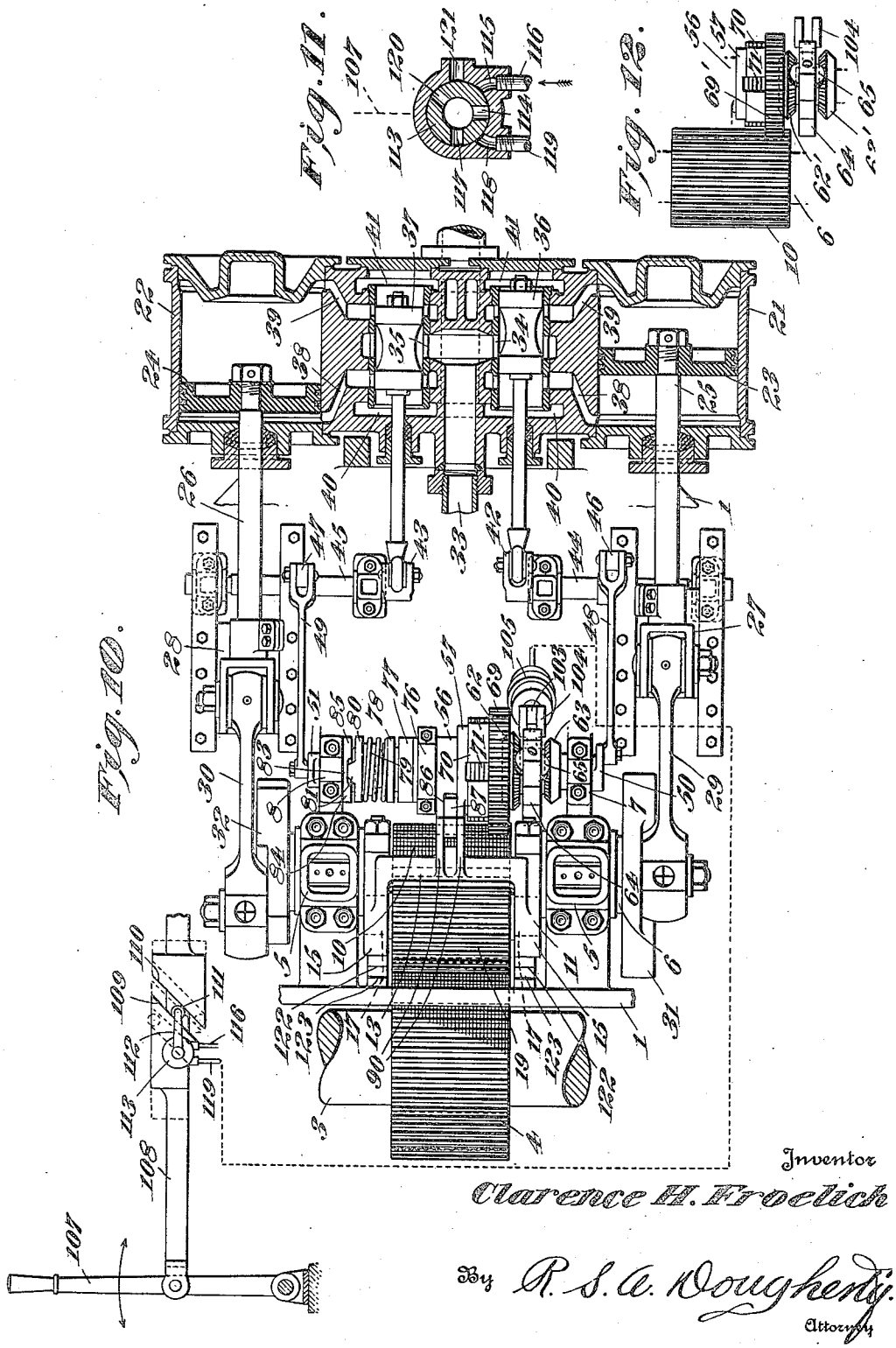

Fig. 10.

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Patented Sept. 20, 1932 1,878,838

UNITED STATES PATENT OFFICE

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REVERSIBLE AUXILIARY LOCOMOTIVE

Application filed March 8, 1929. Serial No. 345,270.

My invention relates to motorized railway trucks, and more especially to auxiliary motors for locomotives and the like in which a truck for the locomotive tender is motorized and adapted to be thrown in, to develop additional tractive force for the locomotive as in the case of making grades or the like.

One of the objects of my invention is to provide an auxiliary motor for a locomotive which is adapted to be controlled from the cab of the engine and can be thrown into or out of working operation when desired either in the forward or reverse travel of the locomotive.

Another object of my invention relates to the manner of operating the slide-valves for reversing the auxiliary motor, by mounting the eccentrics or crank-arms for operating the slide valves on a jack-shaft instead of directly on the crank-shaft. The jack-shaft being driven by the rotation of the crank-shaft in synchronism therewith by means of a gear which is mounted to rotate freely upon the jack-shaft, but driving said jack-shaft through differential gearing.

Another object of my invention relates to the friction throwing device mounted on the jack-shaft which is adapted to operate in both directions and throw either one of the idler gears into mesh with the main driven gear.

Other objects will appear hereinafter.

Referring now to the accompanying four sheets of drawings which form part of this specification and on which like characters represent like parts:

Fig. 1 is a top plan view of a booster motor with parts shown in horizontal section to more clearly illustrate the application of my invention;

Fig. 2 is a vertical longitudinal section taken on the line 2—2 of Fig. 1;

Fig. 3 is a vertical longitudinal section taken on the line 3—3 of Fig. 1;

Fig. 4 is a detail view of the movable cam plate taken on the line 4—4 of Fig. 5;

Fig. 5 is a detail top plan view of the cam plates and adjacent parts;

Fig. 6 is a detail view of the stationary cam plate. The view being taken on the line 4—4 of Fig. 5, but looking in the opposite direction to that shown in Fig. 4;

Fig. 7 is a detail longitudinal section of the friction clutch taken on the line 7—7 of Fig. 8, drawn on a larger scale to more clearly show the manner of construction;

Fig. 8 is a transverse section through the friction clutch taken on the line 8—8 of Fig. 7;

Fig. 9 is a detail section of the compensating spring device;

Fig. 10 is a diagrammatic view of the booster motor and control mechanism, illustrating the relative positions of the pistons and slide valves;

Fig. 11 is a detail section view of the three-way valve; and

Fig. 12 is a detail view illustrating a modified form of construction in which the crank-shaft and jack-shaft are synchronized by means of gearing of uniform size.

Referring now to the various characters of reference on the drawings. 1 indicates the frame or bed-plate of the auxiliary motor having journal bearings 2—2 by means of which it is supported at its forward end on the load bearing axle 3, upon which is mounted centrally the main driven gear 4. The rear end of the frame being suspended in any approved manner as from the truck frame (not shown) or it may be supported on the rear axle if desired. The frame 1 is also formed at intermediate points with spaced bearings 5—5 for the crank-shaft 6, and bearings 7 and 8 for the jack-shaft 9.

A gear 10 is mounted centrally on the crank-shaft 6 within a rocker-frame 11, which is journalled to the crank-shaft 6 on each side of the gear 10. The sides of the rocker-frame being connected together by means of ribs 12, 13 and 14. The two sides of the rocker-frame are formed with upwardly and downwardly extending portions 15 and 16 within which is journaled as at 17 and 18 the ends for the shafts of idler gears 19 and 20 meshing with, and driven by the gear 10 on the crank-shaft 6.

The auxiliary motor preferably consists of a pair of cylinders 21 and 22 in which reciprocating pistons 23 and 24 connected by means

of piston rods 25 and 26 to cross-heads 27 and 28 and operating pitmans 29 and 30 the latter being connected to cranks 31 and 32 keyed on the outer ends of the crank-shaft 6.

The fluid pressure supplied to the cylinders 21 and 22 which may be controlled in any approved manner by the engineer in the cab, enters the cylinder casing through the supply pipe 33, thence it passes through ports 34 and 35 to the slide-valves 36 and 37 which control the supply and exhaust to the cylinders through the ducts 38 and 39, and channels 40 and 41 respectively. The slide-valves are connected through piston-rods to rocker-arms 42 and 43 on the rock-shafts 44 and 45, which are journaled in bearings mounted on the frame 1. Similar rocker-arms 46 and 47 are attached at intermediate points to the rock-shafts 44 and 45 and are connected by means of pitmans 48 and 49 to crank-arms or eccentrics 50 and 51, keyed to the outer ends of the jack-shaft 9.

A friction clutch throwing device which operates in both directions is mounted on the jack-shaft 9, comprising a tubular clutch quill 52 rotatably mounted thereon, having a nut 53 secured to one end while the opposite end is formed with an offset as at 54 and an annular flange as at 55.

Freely mounted on the clutch quill is a tubular clutch member 56 having a head 57 flanged as at 58 with notches 59 formed therein for receiving projections 60 formed integral with the friction plates 61.

A differential gearing is mounted on the jack-shaft 9, opposite the head of the tubular clutch member 56 comprising beveled gears 62 and 63 separated by a spider 64 and geared together by means of idler beveled gear 65 and 66 journaled in the spider at opposite sides thereof. Beveled gear 63 is keyed to the jack-shaft 9, while beveled gear 62 and spider 64 are rotatably mounted on the jack-shaft. Gear 62 has a collar extending therefrom as at 67 upon which is mounted and keyed as at 68 the hub of a gear 69 which meshes with gear 10 mounted on the crank-shaft 6. The gear 69 has an annular flanged edge 70 which projects over the flange 58 of the head 57 and has notches 71 formed therein in radial alignment with the notches 59, for receiving the projections 72 of friction plates 73. These plates 73 are adapted to extend between the friction plates 61. The friction plates 61 and 73 are further spaced apart by means of friction rings 74. The differential gearing and gear 69 are held against longitudinal movement by means of the journal bearing 7 and an annular flanged abutment 75 formed integral with the jack-shaft 9.

The tubular clutch member 56 is journaled centrally in a bearing 76 and is held against longitudinal movement by means of the head 57 which engages one side of the bearing and a nut 77 at the opposite side thereof. A cap 78 is seated on the outer tubular end of the clutch member having an offset for receiving one end of a helical spring 79, the opposite end of the spring engaging a flange formed on the movable cam-plate 80, having cams 81 and 82 projecting therefrom for engaging a stationary cam-plate 83 attached to one side of the bearing 8, said cam-plate having cam surfaces 84 and 85 on its inner side face.

The head 57 of the clutch member is formed with a kerf 86, in which is pivoted one end of a link 87 as at 88. The opposite end of the link being attached as at 89 to ears 90, which extend outwardly from the rib 13 of the rocker-frame 11.

In order to automatically return and hold the idler gears in the neutral position out of engagement with the main driven gear after the fluid pressure admitted to the supply pipe 33 is cut off as illustrated in Figs. 2 and 3 and to balance or correct the preponderance of weight of the two over-hung idler gears, a compensating device comprising a spring actuated rod 91, the head end of which is attached to outwardly extending ears 92 formed on the rib 14 of the rocker-frame 11, by means of a pin 93. This rod extends through a casing 94 which is pivoted near its lower end to the motor frame 1 as at 95 and has a ring 96 screwed into its lower end as indicated in Fig. 9. A nut 97 and washer 98 are secured to the lower end of the rod and a bushing 99 is mounted on the upper end of the casing adapted to engage the head of the rod. Helical springs 100 and 101 are interposed between ring 98 and the bushing 99, and the upper end of the casing. With this construction when the rod is pulled out as is the case when the idler gear 19 is thrown into mesh with the main driven gear 4, as is the case when running forward both springs are compressed, but when the motor is reversed and the idler-gear 20 meshes with the main driven gear only the inner spring 101 is compressed.

The spider 64 is rotatably mounted on the jack-shaft, but is prevented from rotating while the motor is running forward by means of a piston 102, the upper end of the rod 103 of which is pivoted on an outwardly extending arm 104 formed integral with the spider 64. This piston is adapted to reciprocate within a casing 105 which is pivotally attached to the frame 1 and is held against movement when the motor is running forward by means of a spring 106, which is interposed between the piston and the upper end of the casing. When it is desired to reverse the motor, the engineer swings the lever 107 to the left reciprocating the locomotive reversing rod 108 having the inclined ways 109 and 110 thereon. The inclined way 110 engaging the roller 111 mounted on the outer end of the arm 112 attached to the stem of a three-way valve 113, rotating the same until valve port 114 registers with the

air port 115 of a pipe connection 116, leading to an air reservoir or the like, while the valve port 117 registers with the port 118 in the valve casing, having a pipe connection 119 leading to the piston casing 105, thereby reciprocating the piston 102 and rotating the spider 64. When the lever 107 is moved to the extreme right position past the vertical center line the inclined way 109 will engage roller 111 thereby rotating the valve so that the port 120 will register with the exhaust port 121 thereby allowing the fluid pressure to be exhausted from the piston casing 105 while the supply of air from the reservoir will be cut off.

In order to limit the forward movement of the idler gears 19 and 20 the rocker-frame 11 has contact projections extending from the sides thereof as at 122 for engaging abutments formed on the bed-frame 1 as at 123.

In Figs. 1, 2 and 10 I have illustrated the gear 10 which is mounted on the crank-shaft 6, of smaller size than the gear 69 on the jack-shaft 9, while the beveled gear 63 keyed to the jack-shaft is of smaller diameter than the bevel gear 62. The beveled gears being so proportioned as to size that when gear 63 is rotated through the beveled idler-gears 65 and 66 the jack-shaft 9 will rotate at the same angular rate of speed. In this manner a larger friction clutch may be used.

In Fig. 12 I have shown another way by means of which the crank-shaft 6 may be synchronized with the jack-shaft 9, in which gear 69′ is of the same diameter as gear 10, while beveled gear 62′ and 63′ of the differential will also be of the same diameter and driven by idler beveled gears 65 and 66. Otherwise the differential and structure is the same as above described and the same reference numerals will apply thereto.

The operation of my auxiliary motor is as follows: Assuming that the locomotive is traveling forward and the parts of the motor are in the position indicated in Figs. 1, 2, 3 and 10 of the drawings, which is the neutral position when the auxiliary motor is out of operation and it is desired to cut in the motor to develop additional tractive force for the locomotive. The engineer opens a valve (not shown) admitting steam into the supply pipe 33 thence it passes through ports 34 and 35 to the slide-valves 36 and 37 which control the supply and exhaust to the cylinders 21 and 22 through the ducts 38 and 39, and channels 40 and 41 respectively.

As the pistons 23 and 24 are reciprocated by the fluid-pressure they transmit rotary movement to the crank-shaft 6 through their piston-rods, cross-heads pitmans and crank-arms. As the crank-shaft rotates, the gear 10 keyed thereto transmits rotary motion to the idler gears 19 and 20, and jack-shaft 9 through the gear 69 and the differential gearing, comprising beveled gears 62 and 63 and idler gears 65 and 66. The crank-shaft 6 and jack-shaft 9 are synchronized to rotate together at the same angular rate of speed, while the spider 64 is prevented from rotating by means of the connecting rod 103 and the piston 102 which is retained against the closed end of the cylinder 105 by the spring 106. As shown in the figures the friction disks are in frictional engagement with each other. As the jack-shaft 9 rotates in the direction indicated by the arrows in Fig. 2 the friction disks being in frictional engagement the outer plates held by the notches 71 of flange 70 formed integral with gear 69 transmit any torque to the clutch quill 52 and the tubular clutch member 56 which is connected by the link 87 to the rocker-frame 11, rocks the frame and throws the idler gear 19 into mesh with the main driven gear 4. At the same time the rotation of the quill 52 with the movable cam-plate 80 keyed thereto carrying cams 81 and 82 will be brought into engagement with cams 84 and 85 on fixed cam plate 73, thereby pushing the quill 52 longitudinally and releasing the friction plates from engagement with each other so that the quill 52 and clutch member 56 will remain stationary, while gear 69 through the differential gearing will rotate the jack-shaft 9 with the eccentrics or crank-arms 50 and 51 mounted on the outer ends thereof and connected to the slide-valves 36 and 37 for operating the same.

When the locomotive is traveling backward and it is desired to throw in the axiliary motor in the reverse direction to add additional tractive force for the locomotive, the engineer swings the lever 107 to the left thereby reciprocating the locomotive reversing rod 108 with the inclined ways 109 and 110 carried thereby and in so doing the inclined way 110 engages the roller 111 on the arm 112 attached to the stem of valve 113 thereby rotating the valve until ports 114 and 115, and 116 and 117 respectively register with each other. Fluid pressure from the air supply reservoir through pipe 116 will then be admitted through pipe 119 to the reversing cylinder 105 reciprocating the piston 102 and rod 103 thereby rotating the spider 64 of the differential. The rotation of the spider 64 produces a multiplied rotation in relation to the crank-shaft 6 of the gear 63, hence jack-shaft 9, displacing the relative position of the eccentric or crank-arms 50 and 51. By limiting the amount of travel of the piston 102 the eccentrics or crank-arms can be displaced through an angle sufficient to shift the slide-valves from their proper positions for running forward, to their positions for running backward.

After the slide-valves 36 and 37 have been reciprocated to the reverse position, steam is admitted to the inlet supply pipe 33, after which the action of the auxiliary motor will be

similar to the operation for running forward above described, except that as the crank-shaft 6 and jack-shaft 9 will rotate in the opposite direction to the arrows as indicated in Fig. 2 the idler gear 20 will be thrown into engagement with the main driven gear 4 thereby driving it in the reverse direction.

When the locomotive reversing lever 107 is moved forward again to the right past the center or neutral position the roller 111 engages the inclined way 109 rotating the valve 113 until ports 114, 118, 120 and 121 register, and at the same time closes the supply line 116. The entrapped air in the reversing cylinder 105 will then be permitted to escape to the atmosphere. Piston 102 will then reciprocate backward under the pressure of spring 106 and acting through the differential returns the eccentrics or crank-arms to their original positions for the forward running direction.

When the supply of fluid pressure is cut off from the supply pipe 33, the compensating device comprising the spring actuated rod 91, the upper end of which is pivotally attached to the ears 92 which are formed integral with the rib 14 of the rocker frame 11, and extends downwardly therefrom through the casing 94, the lower end of said casing being pivoted to the motor frame 1 as at 95 the construction of which is illustrated more clearly in Figs. 3 and 9, will automatically return the idler gears 19 and 20 to the neutral position out of engagement with the main driving gear 4.

It will be noted that the engagement of the cam surfaces 81 and 82 with the cam surfaces 84 and 85 moves the quill 52 inward and removes the pressure of the clutch spring 79 from the friction plates allowing the outer plates of the clutch to rotate freely, the reaction of the clutch spring 79 being then against the bearing 76 fixed on the frame 1. The position of the cam surfaces with relation to each other can be so adjusted that as they engage the inclined surfaces of the cams the release of the pressure on the friction plates will preferably take place just after the teeth of the idler-gears 19 or 20 have engaged those of the main driven gear 4, but before the gears are fully in mesh. Further rotation of the rocker-frame 11 is obtained from the tooth pressure whose direction and rotation tends to draw the gears further into mesh.

It will be understood that although I have described the auxiliary motor as being cut into operation while traveling forward, or backward it could be accomplished in the same manner while the locomotive is stationary, or at the same time the locomotive is started, if desired.

Although I have shown and described my invention in considerable detail, I do not wish to be limited to the exact and specific details shown and described, but may use such substitutions, modifications or requivalents thereof as are embraced within the scope of my invention or as pointed out in the claims.

Having thus described my invention what I claim and desire to secure by Letters Patent is:

1. In an auxiliary locomotive, comprising an axle having a gear mounted thereon, a crank-shaft having means mounted thereon for rotating the axle, a motor for rotating the crank-shaft, a jack-shaft geared to the crank-shaft and adapted to rotate in synchronism, and means coacting with the jack-shaft for reversing the rotation of the crank-shaft.

2. In a reversing mechanism for auxiliary locomotives, the combination of a motor, a driven-axle, a crank-shaft, means carried by the crank-shaft for rotating the driven-axle in one direction, means mounted on the crank-shaft for driving the axle in the reverse direction, and fluid-pressure means for reversing the motor.

3. In a reversing mechanism for auxiliary locomotives, the combination of a motor, a driven-axle, a crank-shaft rotated by the motor, a jack-shaft geared to the crank-shaft and adapted to rotate in synchronism therewith, fluid-pressure means for reversing the motor, means carried by the crank-shaft for rotating the driven-axle and means mounted on the jack-shaft for reversing the rotation of the driven-axle.

4. In a reversing mechanism for auxiliary locomotives, the combination of a motor, a main driven-axle, a crank-shaft rotated by the motor having means carried thereby normally out of engagement with the main driven-axle for rotating the axle, a jack-shaft geared to the crank-shaft and adapted to rotate in synchronism therewith, means on the jack-shaft for throwing the driving means mounted on the crank-shaft into engagement with the main driven-axle, and means mounted on the jack-shaft for reversing the rotation of the driving means.

5. In a reversing mechanism for auxiliary locomotives, the combination of a motor, a main driven-axle, a crank-shaft rotated by the motor, having means carried thereby for rotating the axle, and a jack-shaft having means mounted thereon for reversing the rotation of the axle.

6. In a reversing mechanism for auxiliary locomotives, the combination of a motor, a crank-shaft rotated by the motor, an axle driven by the crank-shaft, and a jack-shaft having friction means mounted thereon for reversing the rotation of the axle.

7. In a reversing mechanism for auxiliary locomotives, the combination of a motor, a crank-shaft rotated by the motor, an axle adapted to be driven by the crank-shaft, a jack-shaft geared to the crank-shaft and adapted to rotate in synchronism therewith,

means connected with the jack-shaft for reversing the motor, and means mounted on the jack-shaft for reversing the rotation of the axle.

8. In a reversing mechanism for auxiliary locomotives, the combination of a motor, a crank-shaft rotated by the motor, an axle driven by the crank-shaft, a jack-shaft constantly geared to the crank-shaft and adapted to rotate in synchronism therewith, friction means mounted on the jack-shaft for reversing the rotation of the axle.

9. In a reversing mechanism for auxiliary locomotives, the combination of a motor, having a reciprocating piston, a slide-valve for controlling the supply of fluid-pressure to the piston, a crank-shaft rotated by the motor, an axle driven by the crank-shaft, a jack-shaft geared to the crank-shaft and adapted to rotate in synchronism therewith, friction-means mounted on the jack-shaft for reversing the rotation of the axle, and fluid-pressure means for reversing the position of the slide-valve.

10. In an auxiliary locomotive propulsion unit, the combination of a driving-gear, a driven-gear, a rocker-frame, a pair of idler-gears mounted in the rocker-frame constantly meshing with the driving-gear and movable towards the driven-gear, means for limiting the forward movement of the rocker-frame, means for normally holding the idler-gears out of mesh with the driven-gear, and means for entraining one of the idler-gears with the driven-gear for driving the unit forward and means for entraining the other idler-gear for the reverse movement of the unit.

11. In an auxiliary locomotive, the combination of a crank-shaft, a motor for rotating the crank-shaft, a gear mounted on the crank-shaft, a driven-gear mounted on an axle, a rocker-frame pivoted on the crank-shaft, a pair of idler-gears journaled in the rocker-frame constantly meshing with the driving-gear and movable towards the driven-gear, means for limiting the movement of the rocker-frame, a compensating device for normally holding the idler-gears out of mesh with the driven-gear, and friction-means for entraining the idler-gears with the driven-gear.

12. In an auxiliary locomotive, the combination of a crank-shaft, a motor for rotating the crank-shaft, an axle, a driven-gear mounted thereon, a rocker-frame pivoted on the crank-shaft having upwardly and downwardly extending sides, an idler-gear constantly in mesh with the driving-gear journaled in each of the extending sides of the rocker-frame, means for limiting the movement of the rocker-frame, friction-means for entraining one of the idler-gears for driving the locomotive forward and to entrain the other idler-gear for driving the locomotive backward, and a compensating device for normally holding the idler-gears out of mesh with the driven-gear.

13. In an auxiliary locomotive, the combination of a motive power means, an axle, and a train of gears for providing a releasable driving connection between the power means and the axle for driving the locomotive forward or in the reverse direction, and adapted to be automatically disconnected from the axle when the motive power is discontinued, and fluid-pressure means for reversing the drive of the motive power.

14. In an auxiliary locomotive, the combination of motive power means, an axle normally disconnected from said power means, and means dependent upon the action of the power means to establish a driving connection between said power means and the axle for driving the locomotive forward or in the reverse direction, and adapted to be automatically disconnected from the axle when the motive power is discontinued, and fluid-pressure means for reversing the drive of the motive power.

15. In an auxiliary locomotive comprising an axle having a main driven-gear mounted thereon, a crank-shaft having a gear mounted thereon, a motor for rotating the crank-shaft, a jack-shaft geared to the crank-shaft and adapted to rotate in synchronism therewith, a rocker-frame pivotally mounted on the crank-shaft, idler-gears carried by the rocker-frame constantly in mesh with the gear on the crank-shaft and driven thereby, and means mounted on the jack-shaft for throwing the idler-gears into mesh with the main driven-gear.

16. In an auxiliary locomotive, comprising a main driven-axle having a gear mounted thereon, a crank-shaft, means for rotating the crank-shaft, a jack-shaft, means for rotating the jack-shaft in synchronism with the crank-shaft, a rocker-frame mounted on the crank-shaft, idler-gears carried by the rocker-frame, and means mounted on the jack-shaft for throwing the idler-gears into mesh with the gear on the main driven-axle.

17. In an auxiliary locomotive, the combination of a motor, a main driven-axle having a gear mounted thereon, a crank-shaft, means for rotating the crank-shaft, a jack-shaft geared to the crank-shaft and adapted to rotate at the same angular rate of speed, a rocker-frame mounted on the crank-shaft, idler-gears carried by the rocker-frame, and means mounted on the jack-shaft adapted to throw an idler-gear into mesh with the main driven-gear on the axle in the forward or reverse rotation of the motor.

18. In an auxiliary locomotive comprising an axle having a gear mounted thereon, a crank shaft, means for rotating the crank-shaft, driving means carried by the crank-shaft for rotating the axle, but normally out

of engagement with the gear on the axle, and a friction clutch mounted independent of the crank-shaft for throwing the driving means carried by the crank-shaft into or out of engagement with the gear mounted on the axle.

19. In an auxiliary locomotive, comprising an axle having a gear mounted thereon, a crank-shaft, means for rotating the crank-shaft in the forward or reverse directions, means carried by the crank-shaft for rotating the axle in the forward or reverse directions, a jack-shaft, and means mounted on the jack-shaft for throwing the driving means carried by the crank-shaft into or out of engagement with the gear mounted on the axle with each direction of rotation.

20. In an auxiliary locomotive, comprising an axle having a gear mounted thereon, a crank-shaft, a motor for rotating the crank-shaft, a jack-shaft geared to the crank-shaft and adapted to rotate in synchronism therewith, means for reversing the motor, means carried by the crank-shaft for engaging the gear on the axle and rotating the axle in either direction, and means mounted on the jack-shaft for throwing the driving means carried by the crank-shaft into or out of engagement with the gear mounted on the axle in each direction of rotation.

21. In a reversing mechanism for auxiliary locomotives, the combination of a motor, a main driven-axle, a crank-shaft rotated by the motor having means carried thereby for rotating the axle, and a jack-shaft having fluid-pressure means connected therewith for reversing the motor.

22. In an auxiliary locomotive, the combination of a motor, a main driven-axle having a gear mounted thereon, a crank-shaft rotated by the motor, gearing mounted on the crank-shaft adapted to be thrown into meshing and demeshing position with the gear on the driven-axle, a jack-shaft geared to the crank-shaft adapted to rotate in synchronism therewith, and fluid-pressure means connecting with the jack-shaft for reversing the motor.

23. In an auxiliary locomotive, the combination of a motor, a main driven-axle having a gear mounted thereon, a crank-shaft rotated by the motor, a driving-gear mounted on the crank-shaft, a rocker-frame pivotally mounted on the crank-shaft, an idler-gear journaled in the rocker-frame meshing with the driving-gear on each side of the center line of the crank-shaft, a jack-shaft geared to the crank-shaft, means mounted on the jack-shaft for throwing the idler-gears into mesh with the driven-gear, and fluid-pressure means for reversing the motor.

24. In an auxiliary locomotive, the combination of a motor, a main driven-axle having a gear mounted thereon, a crank-shaft rotated by the motor, a driving-gear mounted on the crank-shaft, a rocker-frame pivotally mounted on the crank-shaft, an idler-gear constantly in mesh with the driving-gear journaled in the rocker-frame on each side of the center line of the crank-shaft, means for normally holding the idler-gears out of engagement with the gear on the driven-axle, a jack-shaft geared to the crank-shaft and adapted to rotate in synchronism therewith, friction means mounted on the jack-shaft for throwing idler-gears into mesh with the driven-gear mounted on the axle, and fluid-pressure means for reversing the motor.

25. In an auxiliary locomotive, the combination of a motor, a main driven-axle having a gear mounted thereon, a crank-shaft rotated by the motor, a driving-gear mounted on the crank-shaft, a rocker-frame pivotally mounted on the crank-shaft, an idler-gear constantly in mesh with the driving-gear and journaled in the rocker-frame on each side of the center line of the crank-shaft, compensating means for normally holding the idler-gears out of mesh with the driven-gear mounted on the axle, a jack-shaft, geared to the crank-shaft by means of a differential and adapted to rotate in synchronism therewith, a friction-clutch member mounted on the jack-shaft, a connection between the friction-clutch member and the rocker-frame, means for rotating the friction-clutch member in one direction, means for rotating the crank-shaft for throwing one of the idler-gears into mesh with the gear on the driven-axle, fluid-pressure means for reversing the motor and rotating the friction-clutch member in the reverse direction, means for reversing the rotation of the crank-shaft to throw the other idler-gear into mesh with the driven-gear on the axle for the reverse drive, and means for releasing the clutch.

26. In an auxiliary locomotive, the combination of a motor, a driven-axle having a gear mounted thereon, a crank-shaft rotated by the motor, a driving-gear mounted on the crank-shaft, a rocker-frame pivotally mounted on the crank-shaft, an idler-gear constantly in mesh with the driving-gear and journaled in the rocker-frame on each side of the center line of the crank-shaft, compensating means for normally holding the idler-gears out of mesh with the driven-gear mounted on the axle, a jack-shaft driven from the crank-shaft by means of a differential gearing and adapted to rotate in synchronism therewith, a spider for the differential gearing, a quill rotatably mounted on the jack-shaft, a cam secured to one end of the quill, a friction-clutch member mounted on the quill and engaging the differential gearing, a link connection between the friction-clutch member and the rocker-frame, means for rotating the friction-clutch member in one direction, means for rotating the crank-shaft for throwing one of the idler-gears into mesh with the gear on the driven-axle, fluid-pressure means for rotating the spider of the

differential for reversing the motor and rotating the friction-clutch member in the reverse direction, means for reversing the rotation of the crank-shaft to throw the other idler-gear into mesh with the driven-gear on the axle for the reverse drive, and a stationary cam for engaging the cam on the quill for releasing the clutch.

27. In an auxiliary locomotive, the combination of a motor, a driven-axle, a crank-shaft, means carried by the crank-shaft for rotating the axle, a jack-shaft, a differential gearing mounted on the jack-shaft for driving the jack-shaft in synchronism with the crank-shaft, and fluid-pressure means for producing a multiplied relation between the jack-shaft and the crank-shaft for reversing the drive of the motor.

28. In an auxiliary locomotive, the combination of a motor having a reciprocating piston, a slide-valve for controlling the supply and exhaust thereto, a driven-axle, a crank-shaft driven through connections by the reciprocating piston, means carried by the crank-shaft for rotating the driven-axle, a jack-shaft having an eccentric or crank-arm attached thereto and connected to the slide-valve for controlling the supply and exhaust to the piston, a differential gearing having a spider mounted on the jack-shaft for driving the jack-shaft in synchronism with the crank-shaft, fluid-pressure means for rotating the spider of the differential thereby producing a multiplied relation between the jack-shaft and the crank-shaft thereby reciprocating the slide-valve for reversing the drive of the motor.

29. In an auxiliary locomotive, the combination of a motor, a driven-axle, a crank-shaft, means carried by the crank-shaft for rotating the axle, a jack-shaft, a differential gearing mounted on the jack-shaft and geared to the crank-shaft for driving the jack-shaft in synchronism with the crank-shaft, fluid-pressure means for producing a multiplied relation between the jack-shaft and the crank-shaft for reversing the drive of the motor, and means for controlling the fluid-pressure.

30. In an auxiliary locomotive, the combination of a motor, a driven-axle, a crank-shaft, means carried by the crank-shaft for rotating the axle, a jack-shaft, a differential gearing mounted on the jack-shaft and adapted to rotate the jack-shaft in synchronism with the crank-shaft, said differential gearing comprising a pair of spaced gears mounted on the jack-shaft one of which is keyed to the jack-shaft and the other gear being free to rotate thereon and geared to the crank-shaft, a spider rotatably mounted on the jack-shaft between the spaced gears carrying idler-gears meshing with the spaced gears for rotating the same, means for normally holding the spider against rotation, fluid-pressure means for rotating the spider for producing a multiplied relation between the jack-shaft and the crank-shaft for reversing the drive of the motor, and means for controlling the fluid-pressure.

31. In an auxiliary locomotive, the combination of a motor having a reciprocating piston, a slide-valve for controlling the supply and exhaust to the piston, a driven-axle, a crank-shaft driven through connections by the reciprocating piston, means carried by the crank-shaft for rotating the driven-axle, a jack-shaft having an eccentric or crank-arm attached thereto and connected to the slide-valve for controlling the supply and exhaust to the piston, a differential gearing having a spider mounted on the jack-shaft for driving the jack-shaft in synchronism with the crank-shaft, a reversing cylinder having a reciprocating piston, a connection between the reversing piston cylinder and the spider, fluid-pressure means for advancing the reversing piston cylinder for rotating the spider of the differential thereby producing a multiplied relation between the jack-shaft and the crank-shaft and adapted to reciprocate the slide-valve for reversing the drive of the motor, resilient means for returning the piston in the reversing cylinder to its original positions, and means for controlling the fluid supply and exhaust to and from the reversing cylinder.

In testimony whereof I hereunto affix my signature.

CLARENCE HERVY FROELICH.