Jan. 9, 1940. L. F. WILSON 2,186,355

LOCOMOTIVE GEAR DRIVE

Filed March 28, 1938 2 Sheets-Sheet 1

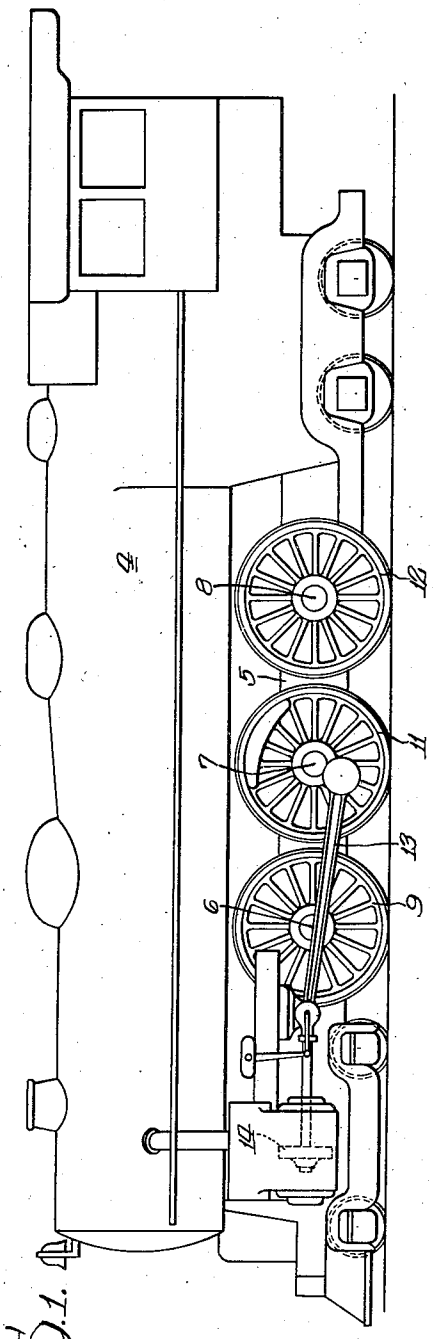

FIG. 1.

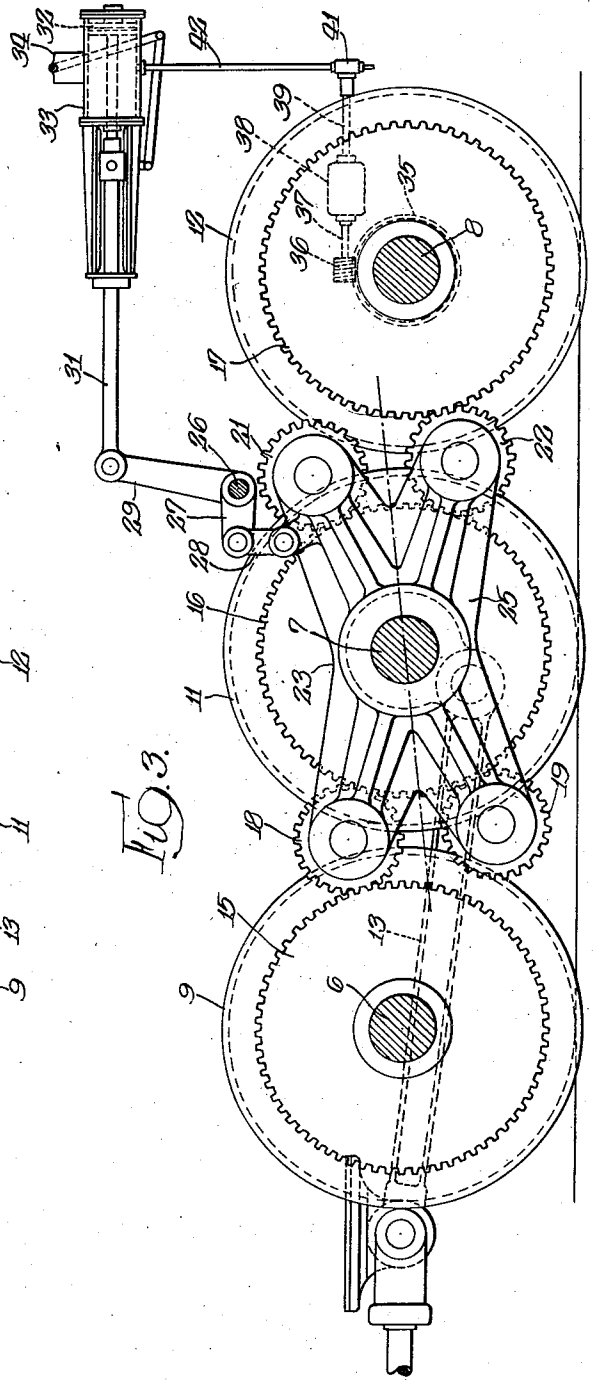

FIG. 3.

INVENTOR.
Lyndon F. Wilson,
BY
ATTORNEY.

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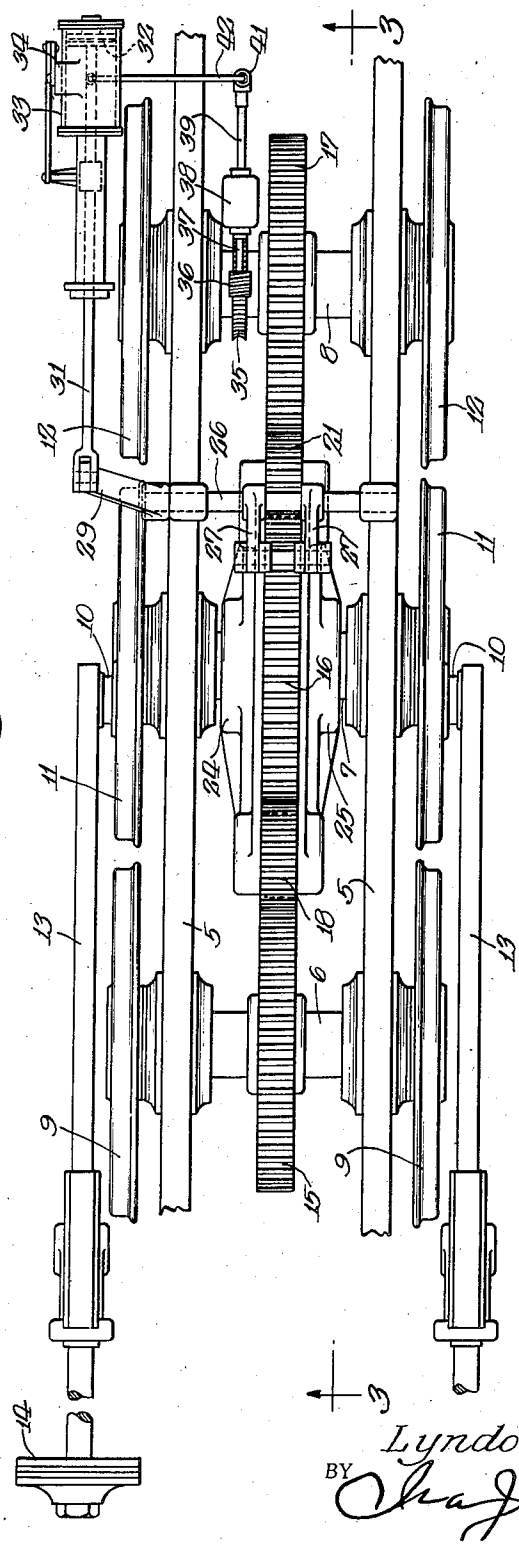

Fig. 2.

INVENTOR.
Lyndon F. Wilson,
BY
ATTORNEY.

Patented Jan. 9, 1940 2,186,355

UNITED STATES PATENT OFFICE

2,186,355

LOCOMOTIVE GEAR DRIVE

Lyndon F. Wilson, Chicago, Ill., assignor to Wilson Engineering Corporation, Chicago, Ill., a corporation of Delaware

Application March 28, 1938, Serial No. 198,438

13 Claims. (Cl. 105—48)

This invention pertains in general to locomotives and more particularly to the mechanism for driving or propelling the same, its primary purpose being to provide a drive mechanism which will reduce, if not entirely eliminate, the pounding on the rails incident to and inherent in the operation of locomotives as at present constructed, and will permit free wheeling of the locomotive by disconnecting certain of the drive wheels from the power when, as the result of high speed, the tractive adhesion of said drive wheels is no longer convertible into tractive effort.

In a steam locomotive of conventional design, the number of pairs of drivers or drive wheels is determined by the adhesion between the drivers and the track necessary to produce the required tractive effort or draw bar pull. The tractive effort of a locomotive is of course greatest at slow speeds, and the tables upon which computations for locomotive designs are based consider 10 M. P. H. as the basis of computation for maximum draw bar pull or tractive effort. As the speed of the locomotive is increased, the tractive effort decreases rather rapidly and at a rate, roughly speaking, of nearly 20 per cent for each 10 M. P. H. increase in speed. If, therefore, the tractive effort is 100 per cent at 10 M. P. H., it will be, roughly speaking, 20 per cent at 50 M. P. H. and zero per cent at 60 M. P. H., at which speed all the power developed by the locomotive will be used in driving itself and maintaining its speed without exerting any tractive effort.

It should be understood, of course, that the above exemplification is illustrative merely for one design of locomotive with drive wheels of a certain size and that considerable variations from the above figures occur in the operation of locomotives having different size drivers and in which other features of design may become influencing factors in the modification of the illustration given. That such modifications do occur is obvious from the fact that many locomotives are capable of delivering tractive efforts at speeds far in excess of 60 M. P. H., but on the other hand, in some designs of locomotive with small drivers, the tractive effort delivered becomes zero when a speed of approximately 40 M. P. H. is reached. In any event, however, the tractive effort diminishes with considerable rapidity as the speed of the locomotive increases, and in all designs the tractive effort becomes zero at some relatively high speed.

The primary purpose of my present invention is to provide for the discontinuation of the application of power to certain of the drivers at a speed beyond which the adhesion of these drivers produces no further tractive effort, and to thereafter apply power to only one pair of drivers, the adhesion of which will be sufficient to furnish all the tractive effort producible by the locomotive at such speeds.

In conventional locomotives, all of the drivers at each side are connected together by side rods, the weight of which is proportionate to the power requirements. To offset the weight of these rods, the drivers are provided with counterweights, but since the counterbalancing can be theoretically correct for one speed only, the drivers are unbalanced at all other speeds with the result that hammer blows of considerable magnitude are imparted to the track at each revolution of the drivers. Furthermore, the reciprocation of the heavy side rods at high speeds requires the expenditure of tremendous energy and in conjunction with the internal friction of the locomotive consumes so much power that the remainder available for tractive effort is rapidly decreased as the speed of the locomotive is increased.

The side rods connecting the drivers are undesirable for the further reason that the main driving rods between the driving pistons and the pair of drivers to which they are directly connected must necessarily be located outside of the side rods. The main rod pins on the drivers must therefore extend outwardly from the faces of the drivers a distance at least as great as the combined thicknesses of a side rod and a main rod. The power consequently must be applied through the main rods to the pins at such a distance from the base of each pin that the pin is subjected to heavy bending stresses. Adequate resistance to such bending stresses necessitates a pin of large diameter which, in turn, necessitates a correspondingly large and heavy main rod bearing. Both the pin and the bearing add to the unbalanced weight and involve a corresponding increase in the counterbalancing weight, with the result that still heavier blows are delivered to the track and road bed at each revolution of the drivers.

Another purpose of my invention, therefore, is to entirely eliminate the objectionable side rods connecting the drivers and also the counterbalancing weights necessitated by the use of such side rods. The elimination of the side rods eliminates the counterbalancing of all the drivers except that pair to which the main rods are connected. The counter-balancing required

on this pair of drivers is, however, much reduced because: first, counterbalancing for the weight of the side rod is entirely eliminated; secondly, the weight of the rod pin is reduced since the pin is both shorter and smaller. Its reduction in length is equal to the thickness of the eliminated side rod, and its reduction in diameter is substantial because the driving force of the main rod is applied close to the base of the pin as a shearing stress, and the pin material heretofore required to resist the bending stresses is eliminated; thirdly, the size and weight of the main rod bearing is reduced in conformity with the reduction in the diameter of the main pin.

The elimination of the side rods and all counterweights of all drivers except one pair and the reduction of the counterweights on that pair eliminates to a large degree the hammer blows delivered to the track, conserves the power heretofore required in reciprocating the heavy side rods, and reduces the internal friction of the locomotive, with the result that the locomotive is enabled to run at higher speeds with less power consumption and with less injury and deterioration to the track and road bed.

Other objects and advantages of my invention will be readily appreciated as the same becomes better understood by reference to the following description when considered in connection with the accompanying drawings.

Referring to the drawings:

Fig. 1 is a side elevation of a locomotive embodying the principles of my invention;

Fig. 2 is a fragmentary plan view of the locomotive frame and running gear; and

Fig. 3 is a sectional view on the line 3—3 of Fig. 2.

On the drawings, reference character 4 indicates the boiler carried upon the frame structure including the side frame members 5, which in turn, is supported upon the solid axles 6, 7 and 8 to which are respectively fixed the pairs of drivers 9, 11 and 12.

The locomotive here disclosed for illustrative purposes is of the 4—6—4 type comprising three pairs of drivers, but it should be understood that the principles of my invention are applicable to other types of locomotive equipped with a greater or smaller number of drivers.

In the present instance, the connecting or drive rods 13 driven by the pistons 14 are connected with the intermediate pair of drivers 11 through the rod pins 10 which, as will be observed, are quite short so that they are subjected to but slight, if any bending stresses, as practically all of the power delivered through the connecting rods is resisted by shear stresses on the pins. This result is attained by eliminating the side rods by which the drivers 9, 11 and 12 at each side of the locomotive are customarily connected.

Since my invention contemplates direct driving from the engine's locomotive cylinders to the intermediate pair of drivers only, I have made provision for driving the remaining drivers from the intermediate driven drivers at such times as the adhesion of these remaining drivers can be utilized for the production of tractive effort. With this purpose in view I have fixedly mounted upon each of the axles 6, 7 and 8 the gear wheels 15, 16 and 17, respectively, which are of uniform diameter and provided with an equal number of teeth. A driving connection between these gear wheels through which the front and rear pairs of drivers may be positively driven from the intermediate drivers is established by driving pinions or intermediate gears, each arranged to be disposed in meshing relation with a pair of said gear wheels.

These driving pinions or intermediate gears which are designated on the drawings as 18, 19, 21 and 22, respectively, are carried by a cradle 23 comprising two side members 24 and 25 straddling the gear 16 and supported for rotatable adjustment upon the intermediate axle 7. The pinions are so positioned that they are all continuously in mesh with the gear wheel 16, and pinions 18 and 19 may also be alternately meshed with gear wheel 15, while, similarly, pinions 21 and 22 may be alternately meshed with gear wheel 17. The meshing relation of the pinions is determined by the adjusted position of the cradle 23, and this cradle is so constructed and the pinions are so arranged thereon that one pair of pinions, namely, 18 and 22 may be positioned to establish a driving connection between gear wheel 15 and the gear wheels 16 and 17, or the other pair of pinions 19 and 21 may be brought into position to establish such driving connection, or in an intermediate position of adjustment of the cradle all of the pinions will be out of mesh with gear wheels 16 and 17, thereby disrupting the driving connection and thereby permitting the pairs of drivers 9 and 12 to run freely without connection to the power of the locomotive. In other words, when the driving connection is broken, free wheeling of all the drivers except one pair is attained.

When the locomotive is going forward, that is, to the left viewing Figs. 1 and 2 at speeds at which the adhesion of drivers 9 and 12 can be utilized, the pinions 18 and 22 are utilized to establish the driving connection and, by the rotation of the gear wheels with which they are in mesh, these pinions will be urged into driving relation with these gear wheels. In other words, the rotation of the gear wheels themselves is utilized in maintaining the pinions in driving relation so that the force required to maintain them in driving relation is less than it would be if the gears were rotating in the opposite direction. Likewise, pinions 19 and 21 are employed for the driving connection when the locomotive is running in reverse, thereby utilizing the same tendency and obtaining the same advantageous results.

While manually operable means may be employed for adjusting the position of the cradle to establish a forward or reverse driving connection between the drivers or to permit free wheeling of all the drivers except one pair, I prefer to employ automatic mechanism for this purpose controlled by the speed of the drivers so that the locomotive will be automatically thrown into free wheeling when a predetermined speed has been attained and will be automatically returned to a direct drive of all the drivers when the speed is reduced to a point where the adhesion of all the drivers can be utilized for tractive effort.

The mechanism here illustrated as an exemplification of means for adjusting and controlling the cradle comprises a cross shaft 26 journalled on the side frame members 5 and provided with levers 27 connected by links 28 with the side members 24 and 25 of the cradle. In any convenient position, preferably at one end, the shaft 26 is provided with an arm 29 which is connected by a link 31 with the operating mechanism, which, in this instance, is illustrated as a piston 32 reciprocable in a cylinder 33 to one end or the

other of which fluid such as air or steam under pressure is admitted through a control valve 34 controlled by the engineer from the locomotive cab in any suitable manner. This operating mechanism is not illustrated in detail, because any standard power operated locomotive reverse gear may be employed for the purpose.

When the valve 34 is set as shown in Fig. 2, the piston 32 is held under the pressure of the operating fluid in the position shown, thereby establishing a driving connection between the various drivers through the driving pinions 18 and 22. For reverse purposes, the fluid is admitted to the opposite face of piston 32 forcing it to the extreme left of the cylinder, which will bring pinions 19 and 21 into driving relation with gear wheels 15 and 17, respectively, under which condition power will be delivered to all of the drivers to propel the locomotive in a reverse direction. The valve 34 may also be manually set to maintain the piston 32 in an intermediate position to maintain the cradle in neutral position, that is, with none of the pinions in mesh with the gear wheels 15 and 17.

For the purpose of automatically establishing a driving connection between the drivers when the locomotive is operating below a predetermined speed and for disrupting the connection to permit free wheeling when the locomotive is operating above a predetermined speed, an automatic control is provided which is driven from one of the indirectly driven axles. From the drawings it will be observed that axle 3 is equipped with a helical gear 35 adapted to mesh with and drive a gear 36 connected by a shaft 37 with a governor 38 of a flyball or other preferred type. Through a suitable stem or other connecting means housed in a sheath 39, this governor opens or closes, at a predetermined speed for which the governor is set, a vent valve 41 which is connected by a pipe 42 with the interior of the cylinder 33 of the operating gear. The valve 41 will remain closed at all speeds below that for which the governor is set, but when that predetermined speed is reached, the valve 41 will be opened, thereby relieving the pressure in the cylinder so that the piston 32 will assume a neutral position, thereby maintaining the cradle in neutral position with none of the drive pinions in mesh with gear wheels 15 or 17. Under these conditions, drivers 9 and 12 will roll freely and power will be applied only to drivers 11 which will at such high speeds provide all the adhesion that can be converted into tractive effort. When the speed is again reduced to the predetermined point, valve 41 will close, the pressure will be reestablished in the cylinder 33 at one side of the piston, and the piston will be moved thereby into an extreme position to reestablish the driving connection between the drivers.

It will be manifest, therefore, that in accordance with my invention all of the drivers will be positively driven at low speeds to produce all available tractive effort but that when a speed has been reached beyond that at which the adhesion of some of the drivers can be utilized, these drivers are disconnected from the power and are permitted to free wheel until a lower speed is resumed, whereupon the driving connection thereto will be automatically reestablished. It should be noted that at all speeds of the locomotive whether power be applied to all of the drivers or whether some of them be permitted to free wheel, the speed of rotation of all the drivers will be equal. Consequently, the driving pinions may be moved into meshing driving relation with the gear wheels 15 and 17 or withdrawn from meshing relation therewith without clashing of the gears or danger of injury thereto.

It is believed that my invention, its mode of operation, and many of its inherent advantages will be understood and appreciated from the foregoing without further description, and while I have shown and described that embodiment of my invention which at present seems preferable, it will be manifest that the structural details may be modified within wide limits without departing from the essence of the invention as defined in the following claims.

I claim:

1. In a locomotive having a plurality of pairs of drive wheels, the combination of means permanently connected to one pair of wheels to drive said pair of wheels, a disconnectible connection for transmitting power from said one pair of drive wheels to the remaining drive wheels, said connection including a plurality of alternately operable gears, and means for positioning said gears in operative and inoperative positions.

2. In a locomotive including a plurality of pairs of drive wheels, the combination of means permanently connected to one pair of said wheels, gear wheels to drive the same fixed with respect to and rotatable with each pair of drive wheels, intermediate gears for establishing a driving connection between said gear wheels to drive all of said drive wheels, an adjustable member upon which said intermediate gears are mounted, and means for adjusting the position of said member to dispose said intermediate gears in driving or non-driving relation with respect to certain of said first-mentioned gears.

3. In a locomotive having a plurality of pairs of drive wheels, the combination of driving means permanently connected for driving one pair of said wheels, gear wheels concentric with, fixed with respect to, and rotatable with each pair of drive wheels, a supporting member mounted concentrically with said driven pair of drive wheels, intermediate gears carried by said supporting member each adapted to mesh with a plurality of said gear wheels to establish a driving connection between said pairs of drive wheels, and means whereby said supporting member may be adjusted to establish or disconnect said driving connection.

4. In a locomotive having a plurality of axles and a pair of drive wheels fixed on each axle, the combination of driving means permanently connected to drive one pair of said drive wheels, a gear wheel fixed on each of said axles, a cradle mounted for rotative movement upon the axle of said driven pair of drive wheels, a plurality of gears carried by said cradle, and means for rotatably adjusting the position of said cradle for establishing or disestablishing a driving connection between said axles through the intermediary of said intermediate gears.

5. In a locomotive having a plurality of axles and a pair of drive wheels fixed upon each axle, the combination of driving means permanently connected to drive one pair of said drive wheels, a gear wheel fixed upon each of said axles, an adjustably mounted cradle, a plurality of intermediate gears carried by said cradle, and means controlled by the speed of the locomotive for adjusting the position of said cradle to thereby establish or disestablish through said intermediate gears a driving connection between said

axles in accordance with the speed of said locomotive.

6. In a locomotive having a plurality of pairs of drive wheels, the combination of driving means permanently connected to drive one pair of said wheels, means including a disconnectible gear train for driving the remaining drive wheels from said one pair of driven wheels, and means controlled by the speed of the drive wheels not directly connected to said driving means for automatically establishing and disconnecting said driving connection.

7. In a locomotive having three axles and a pair of drive wheels fixedly mounted upon each axle, the combination of means permanently connected to the intermediate pair of drive wheels for driving the same, a gear wheel fixed upon each of said axles, a cradle rotatably mounted upon the intermediate axle, a plurality of pinions carried by said cradle, and means for rotatably adjusting the position of said cradle to thereby establish a driving connection between said axles through the intermediary of said gear wheels and pinions.

8. In a locomotive having three axles and a pair of drive wheels fixedly mounted on each axle, the combination of means permanently connected to the intermediate drive wheels for driving the same, a gear wheel fixed on each of said axles, a cradle rotatably mounted upon the intermediate axle, a plurality of pairs of pinions carried by said cradle in position to permanently mesh with the gear wheel on said intermediate axle, and means for adjusting the position of said cradle to bring either pair of pinions into meshing or non-meshing relation with the gear wheels on the end axles.

9. In a locomotive having a plurality of axles and a pair of drive wheels fixedly mounted on each axle, the combination of means permanently connected with one pair of drive wheels for driving the same, a gear wheel fixed upon each of said axles, a cradle adjustably mounted on the axle of the permanently driven wheels, a plurality of driving pinions carried by said cradle in position to permanently mesh with the gear wheel concentric with the cradle, means for moving said cradle to position said pinions in meshing or non-meshing relation with the other gear wheels, and means controlled by the speed of said non-permanently driven drive wheels for causing the actuation of said last-mentioned means so as to establish or disrupt the driving connection between said axles through the intermediary of said pinions at predetermined locomotive speeds.

10. The combination of a locomotive having a plurality of pairs of drive wheels, of driving means permanently connected to one pair of said wheels, and means controlled by the speed of the locomotive independently of the speed of said permanently connected drive wheels for transmitting power when in operative position from said one pair of wheels to the remainder of said wheels.

11. In a locomotive having a plurality of pairs of drive wheels, the combination of means for driving one pair of said wheels, disconnectible driving means for transmitting power from said one pair to the remainder of said wheels, and means controlled by the speed of said remaining wheels for connecting and disconnecting said driving means.

12. In a locomotive having three axles and a pair of driving wheels fixedly mounted on each axle, the combination of means permanently connected to the intermediate pair of drive wheels for driving the same, a gear wheel fixed upon each of said axles, means cooperable with said gear wheels for causing all of said drive wheels to rotate at the same speed for driving purposes, and means for disrupting the driving connection between said intermediate wheels and the remaining wheels.

13. In a locomotive having three axles and a pair of drive wheels fixedly mounted on each axle, the combination of means permanently connected to the intermediate pair of drive wheels for driving the same, a gear wheel fixed upon each of said axles, means cooperable with said gear wheels for causing all of said drive wheels to rotate at the same speed for driving purposes and means for disrupting the driving connection between said intermediate wheels and the remaining wheels, said last mentioned means including mechanism controlled by the speed of one or more of said remaining wheels for automatically effecting said disruption.

LYNDON F. WILSON.

CERTIFICATE OF CORRECTION.

Patent No. 2,186,355. January 9, 1940.

LYNDON F. WILSON.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 44, for the word "efforts" read effort; page 3, second column, line 28, claim 2, strike out "to drive the same" and insert the same after "wheels" and before the comma in line 27, same claim; page 4, second column, strike out lines 24 to 34 inclusive, comprising claim 12, and insert instead the following —

> 12. The combination in a locomotive having a plurality of axles and a pair of drive wheels fixed on each axle, of driving means permanently connected to drive one pair of said drive wheels, a gear wheel fixed on each of said axles, a cradle carried by the axle upon which said driven wheels are mounted, a plurality of intermediate gears mounted on said cradle each in position to mesh with a plurality of said gear wheels whereby to establish a driving connection between said axles, and means for adjusting the position of said cradle so as to withdraw said gears from driving relation with one of said gear wheels. ;

and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of February, A. D. 1940.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)