C. R. UNDERHILL.

GEAR SHIFTING MECHANISM.

APPLICATION FILED APR. 6, 1914.

1,115,878.

Patented Nov. 3, 1914.

2 SHEETS—SHEET 1.

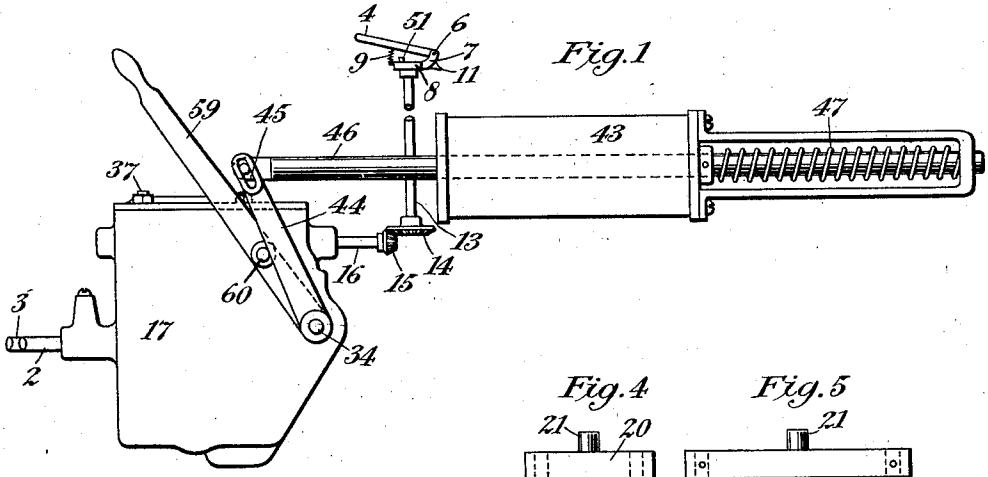

Fig. 1

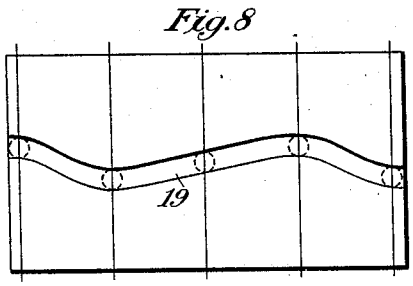

Fig. 8

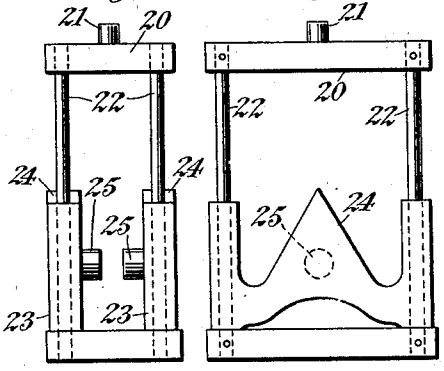

Fig. 4

Fig. 5

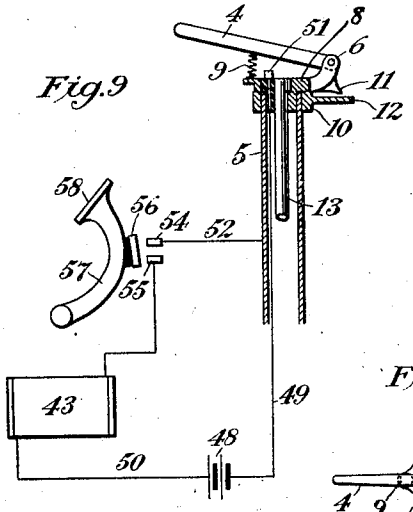

Fig. 9

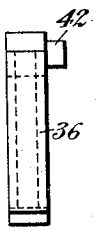

Fig. 6

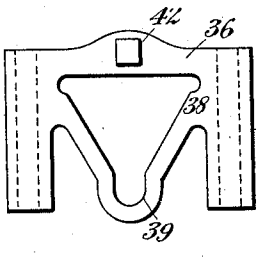

Fig. 7

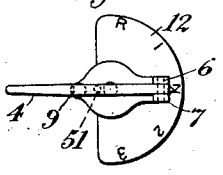

Fig. 10

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2 SHEETS—SHEET 2.

Fig. 2

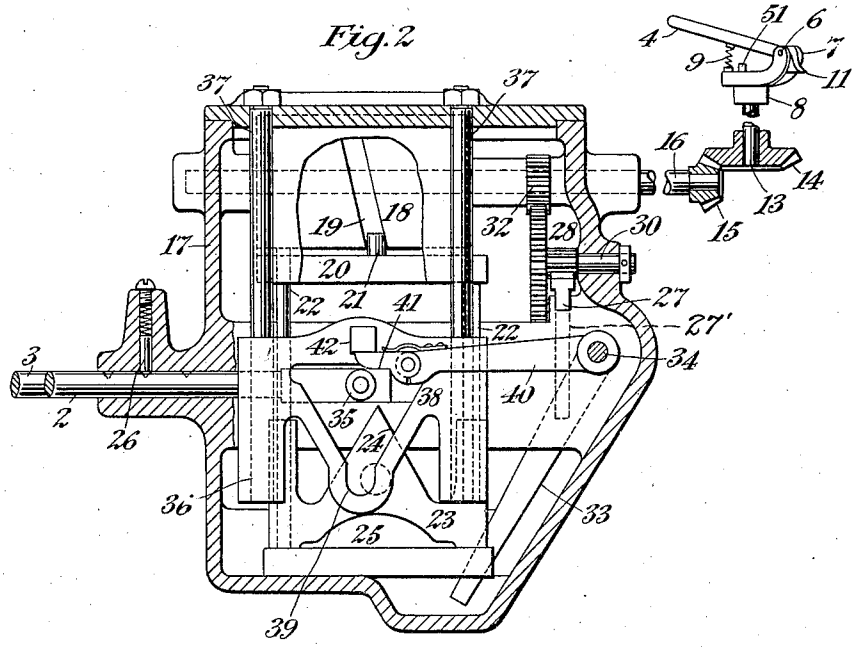
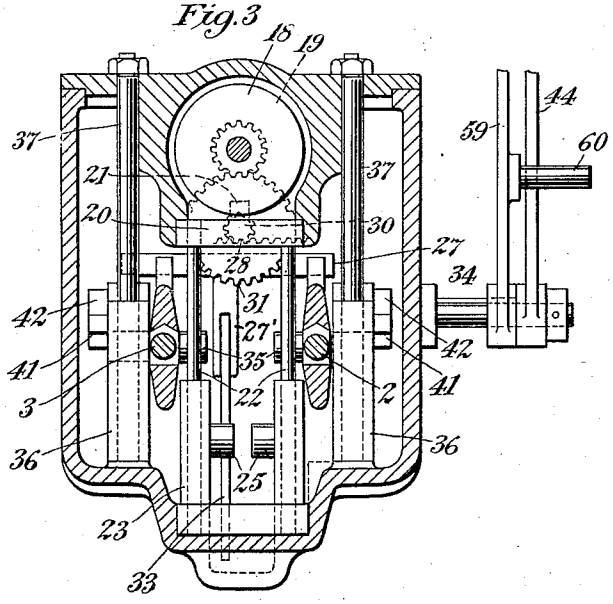


Fig. 3



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UNITED STATES PATENT OFFICE.

CHARLES R. UNDERHILL, OF NEW HAVEN, CONNECTICUT.

GEAR-SHIFTING MECHANISM.

1,115,878. Specification of Letters Patent. **Patented Nov. 3, 1914.**

Original application filed October 8, 1913, Serial No. 793,986. Divided and this application filed April 6, 1914. Serial No. 829,809.

To all whom it may concern:

Be it known that I, CHARLES R. UNDERHILL, a citizen of the United States, and a resident of New Haven, in the county of New Haven and State of Connecticut, have invented certain new and useful Improvements in Gear-Shifting Mechanism, of which the following is a specification.

This invention relates to gear-shifting mechanism, and especially to an apparatus of this type for use on motor-cars, motor-trucks, etc., and the principal object of the invention is to provide an improved and simple type of mechanism by means of which all the movements necessary for selecting and performing the operations necessary for changing the gear connections from one speed to another may be readily accomplished.

The present application which is a division of that filed by me October 8, 1913, Serial No. 793,986, is directed mainly to the electrical features of the mechanism.

In apparatus of this type as commonly constructed it is the custom to set the gears to the neutral position when the clutch is thrown out. In case of the failure of power for operating the gear-shifting mechanism there would under the circumstances be no way to control the movement of the car. In the present case I have provided means for preventing the changing of the gear connections from one speed to the neutral position through which they must pass unless the actuating means employed is in condition and operative for completing the action necessary to pass at once to the new speed relation without stopping at the neutral position. In order to accomplish this result I employ selecting means for selecting the gear shift to be effected, and suitable actuating means is then operated to effect the necessary change of gearing by a substantially instantaneous movement that shifts a gear out of mesh with the one with which it is in engagement and shifts a gear through the neutral position into mesh with another gear corresponding to the different speed.

In the usual operation of my improved gear-shifting mechanism electric energy will be employed for effecting the described changes in the relations of the gears, and in the preferred type of apparatus a single electromagnet serves to supply energy to perform all of the operations required for shifting the gears to change from one relation to any other corresponding to the speed or position desired. A simple type of manual device is used for selecting the position or speed desired and for setting the selecting mechanism in a relation corresponding to such position or speed of the gearing and a single electromagnet operates upon the set parts to shift the speed changing parts from the position in which they are to the new position corresponding to the desired speed.

These and other features of my invention not hereinbefore referred to but which will be hereinafter described and claimed are illustrated in the accompanying drawings, in which—

Figure 1 is an elevation of one type of gear-shifting mechanism embodying my present invention; Fig. 2 is an enlarged vertical, longitudinal section of the same; Fig. 3 is an enlarged, vertical, transverse section of the same with the parts in the same positions; Figs. 4 and 5 are respectively an end and a side elevation of one of the main portions of the setting mechanism controlling the changes in the gear connections; Figs. 6 and 7 are similar views of the other main part of the setting mechanism which controls the setting of the gear-shifting mechanism in the neutral position; Fig. 8 is a detail showing the development of a cam for controlling the principal parts of the setting mechanism; Fig. 9 is a diagrammatic view illustrating an electric circuit and the principal elements of the selecting and actuating means controlling the changes in the positions of the gears, and Fig. 10 is a detail illustrating in plan the manual selecting or controlling lever for selecting the gear changes to be made.

Similar characters designate like parts in all the figures of the drawings.

In carrying my invention into effect I may make use of any well-known or suitable type of gearing capable of being shifted to different positions corresponding to the various positions or speeds in or for which such gearing may be set. As the particular type of gearing used forms no part of my present invention I have not illustrated the gears themselves but merely gear-shifting

mechanism by means of which the desired changes in the positions and in speed relations of the gears may be made.

The drawings illustrate a gear-shifting mechanism comprising two principal elements, one of which is suitable selecting means for determining the change to be made in the relations of the gears and the other of which is suitable actuating means for performing the operations determined by the selecting means. The selecting means in the present construction is a sub-mechanism adapted to be set in various ways corresponding to the speed changes to be made, the setting of the parts being under manual control and the setting operations being in this case performed by manual action. The actuating means is intended to come into operation only after the placing of the selective mechanism in a condition or position corresponding to the speed or position of gearing to which it is desired to change. This actuating means may be either under manual control and operated manually or it may be under proper control and operated by power. The construction illustrated is one in which a single electromagnet is employed for supplying energy for shifting the gearing or gears to a position corresponding to the speed desired, though the bringing of the power device into action is shown as under manual control.

Referring to Figs. 1 and 2, 2 and 3 represent gear-shifters in the form of rods, suitably connected to the usual shifting-gears (not shown). These gear-shifters are under the control of both the selecting means and the actuating means, the selecting means being in this case wholly mechanical and interposed between the gear-shifters 2—3 and the power device from which power is transmitted through the selecting means to said gear-shifters. The movements of the selecting mechanism are preferably determined, and are also here shown as effected, by a suitable manual device, such as a selecting lever 4, which may be mounted at the upper end of a suitable rod or post, 5. In this case said lever is pivoted at 6 on an extension, 7, of an annular member, 8, mounted to turn at the upper end of the post 5 to various positions, and a spring, such as 9, will preferably hold the selecting lever 4 up in the positions shown in Fig. 9. Just below the annular support 8 for this selecting lever there is shown secured to the post 5 in a suitable fixed position an index-head and plate, 10, having a plurality of indications corresponding respectively to the various relations in which the gears may be put. Here there are five such positions or relations shown corresponding respectively to the first, second and third speeds ahead, the reverse speed and the neutral position of the gears. On the part 7 there is also a pointer, 11, adapted to swing over the various indications shown on the segment, 12, extending from and forming part of the index-head 10. The horizontal turning movement of the selecting lever 4 about the post 5 may be transmitted by any suitable means to the principal portion of the selecting mechanism. Here this movement is illustrated as transmitted mechanically through suitable transmitting connections, such as the vertical shaft, 13, within the post 5 and having at its lower end a bevel-gear, 14, meshing with a bevel-gear, 15, at one end of a horizontal shaft, 16, mounted in the upper part of a casing or housing, 17, which is intended to inclose the main parts of the selecting mechanism by means of which the various positions shown in Fig. 10 are selected and through which movement is transmitted to the gear-shifters 2—3 by suitable actuating means. Here the movements of the vertical shaft 13, the bevel-gears 14 and 15 and the horizontal shaft 16 are utilized to turn more or less a primary selector, which is shown as a barrel-cam, 18, secured to said horizontal shaft 16. This barrel-cam has a circumferential cam-groove, 19, which in this instance follows the course indicated in the developed view in Fig. 8. As the barrel cam is not intended to rotate but merely to oscillate through an arc corresponding to the range of horizontal movement of the selecting lever 4, the ends of the cam-groove 19 are located at different points in the length of said barrel-cam. The cam-groove 19 is intended, in this construction, to determine the position of a selecting frame, such as 20, which is mounted to slide in suitable parallel guide-ways in the upper and lower parts of the housing, as shown in Fig. 3. It will be seen that this sliding movement of the selecting frame 20 is in the direction of movement of the gear-shifters or rods 2—3. At its upper end the selecting frame 20 has a pin, 21, that works in the cam-groove 19 and through which the walls of the cam-groove operate to slide said frame 20 to any one of five main positions lengthwise of the gear-shifters 2—3, these positions being respectively the central or neutral point of the cam-groove and two other positions at each side thereof corresponding respectively to the four active or working positions of the gearing to be controlled, that is, the first, second and third speeds ahead and the reverse speed.

The slide-frame 20 shown comprises a pair of slides connected by four rods, 22, forming a rectangular skeleton frame. On these rods actuating slides are mounted by means of which movement is intended to be imparted to one or the other of the two gear-shifters 2—3 shown. There are two of these actuating slides, each of which is designated by 23, and from the center of each of which

rises an actuating cam, 24, with its apex uppermost and located in vertical alinement with the center of the stud, 21, that works in the cam-groove 19. Each of these actuating-cams 24 has at its inner side in this case a projection or stud, such as 25, by means of which said cams may be raised vertically. Each of these actuating-slides and its cam 24 corresponds to one of the gear-shifters 2—3, one of said cams 24 being intended to coöperate with one of said gear-shifters and the other of said cams with the other gear-shifter. According as one or the other of these slides 23 is raised to the proper extent one or the other of the gear-shifters 2—3 will be moved lengthwise. As shown, each of said gear-shifters has three positions in any one of which it may be held by a suitable spring-pressed detent, such as 26, (see Fig. 2) the construction shown being one in which either gear-shifter is moved when selected from a central or neutral position to the right or to the left, as the case may be, according to the position of the point of the corresponding actuator cam 24, to an active or working position controlling a corresponding position of the gearing.

Which one of the two actuating cams 24 will be raised to move its gear-shifter 2 or 3 to one side or the other of the central neutral position will depend upon the positions of certain other parts of the selecting means. Here not only is the primary selector or barrel-cam 18 operated by the turning of the horizontal shaft 16 when the selecting-lever 4 is turned but a second selector for determining which one of the two actuating cams 24 shall be brought into action is also operated. This second selector is illustrated in this case as a rack, 27, mounted in guides and meshing with a spur-pinion, 28, secured to a stud, 30, journaled in a wall of the housing and also having in fixed relation therewith a relatively large spur-gear, 31, meshing with a spur-pinion, 32, on the shaft 16. Through this gearing 32, 31 and 28 turning movement of the shaft 16 by the selecting lever is transmitted to the rack 27, which may take any one of five different positions lengthwise of the rod 28 and corresponding to the five positions indicated in Fig. 10 on the index-plate. Each one of these five positions of the rack 27 controls in turn a corresponding position of an actuating member, such as a lever 33, splined on a shaft, 34, so as to be movable lengthwise thereof but adapted to turn in unison therewith the movement of this lever along said shaft being derived from the rack through a long fork 27′ secured to said rack and depending therefrom and straddling said lever near the shaft 34 in all positions of the lever. The lower end of this actuating lever 33 works in the space between the inner sides of the actuating-slides 23 and under the studs 25 and the space between them. In two of its positions the actuating lever is under one of said studs and in two other positions it is under the other of said studs, and in all of these positions said lever is operative for raising said actuating slides and cams. In the fifth position the lower end of said actuating lever is in line with the space between the studs 25 and is not operative to actuate either of the cams 24. This intermediate position corresponds to the neutral position of the gear-shafts 2—3 and the gears operated thereby.

The parts just described as controlled and operated from the selecting-lever 4 and the actuating-lever 33 when swung up by the turning of the shaft 34, are sufficient to effect the selection of a gear-shifting movement for bringing the gears into operative relation corresponding to any one of the four active positions shown on the index-plate in Fig. 10, and are also sufficient, when power is applied to the shaft 34 to swing said arm 33 up as described, to bring about the necessary shifting of the parts 2—3 and the gearing corresponding to the desired speed. It being understood that suitable means will be employed for applying power to turn the shaft 34, it will be seen that these parts control the selection of two speed positions through one of the cams 24 and the gear-shifter 2, and of the other two speed positions through the other cam 24 and the gear-shifter 3; and it will also be seen that one or the other of said gear-shifters will be moved endwise in one direction or the other according as one or the other of the studs 25 of the actuating cams 24 is over the lower end of the actuating lever 33 and according as the point of such cam is at the right or at the left hand side of a stud or antifriction roller, 35, one of which is secured to the end of each gear-shifter in order that said gear-shifter may be properly actuated by its respective cam 24.

For the purpose of controlling the neutral position of the gear-shifters 2—3 and the gearing operated thereby I have shown within the housing 17 additional selecting and actuating means by means of which both gear-shifters may be moved to the neutral position in advance of the actuation of the gear-shifters to a new speed position. It is important, however, that the gears be maintained in mesh in one working position unless power is available for shifting the gears from that position to a working position representing another speed, as otherwise if the gears were shifted out of mesh and left out of mesh and no power were available for shifting them into mesh again a condition of danger would exist. For this reason I employ actuating means common to the means for shifting to the neutral position

and to the means for shifting to each of the working positions, this common actuating means being a single actuator, either an electromagnet or a manual device, for supplying energy for positively and substantially instantaneously moving the gear-shifters from one working position through the neutral position to another working position without stopping at the neutral point. In this case the specific means illustrated for restoring the gear-shifters to the neutral position is a pair of resetting slides, such as 36, vertically movable on guides, such as the long smooth shanks of the threaded tie-rods, 37, by means of which the cover and the body portion of the housing 17 are securely fastened together. Each of these resetting slides has a substantially triangular opening constituting a substantially triangular cam, 38, with a locating recess, 39, at the bottom thereof, for locating the studs or antifriction rolls 35 on the gear-shifters 2—3 in the central or neutral position. These resetting slides and cams are intended to be raised by suitable means such as a resetting lever, 40, secured to the same shaft 34 as the actuating lever 33, and having at its outer end a spring-pressed by-pass pawl, 41, which on the rise of the resetting lever engages the under side of a suitable projection or stud, 42, on said resetting slide and raises the same on the rods 37 to its uppermost position, it being understood that both of the resetting slides are raised in unison by the two arms of the resetting lever 40. On reaching the top of its stroke the stud 42 slips off the end of the by-pass device 41 and thereupon the resetting slides are returned to their lowermost positions, as, for example, by gravity. In their extreme upper positions these resetting slides of course locate the gear-shifters 2—3 in their neutral positions in which they are held by the spring-pressed pins 26. On the descent of the resetting lever 40 each by-pass device 41 turns about its pivot when it strikes the projection or stud 42 and passes on to its lowermost position.

From the foregoing it will be clear that when power is applied to the shaft 34 to swing the levers 33 and 40 upward the resetting lever 40 will first raise the resetting slides 36 and restore the gear-shifters 2—3 and the gears controlled thereby to the neutral position, whereupon the slides 36 will be released by the resetting lever and will return to their lowermost positions while said lever continues to travel upward until it reaches the limit of its movement. After the resetting of the gear-shifters 2—3 in said neutral position the actuating arm 33, previously positioned in the direction of the axis of the shaft 34 by the manual selecting lever 4, will engage the under side of the stud 25 on one or the other of the actuating cams 24 and will raise said cam and cause it to operate the corresponding gear-shifter in the one direction or the other, according as the point of the cam 24 is at one side or the other of the roll 35, which position is determined by the extent and direction of the shifting movement of the slide-frame 22, which in turn, as before stated, is controlled by the cam-groove 19. It will be noticed that this cam-groove has a gradual inclination from the first to the second speed ahead through the neutral position, while the angle of the cam-groove from the second to the third and from the first to the reverse position is considerably greater. The object of this is to produce a substantial dwell in passing through the neutral point.

Suitable primary actuating means will be employed to operate the parts before described located in the selected gear-shifting positions. I prefer to use a single actuator for supplying energy for operating all of the gear-shifting devices, this actuator, in the present case, being operated by electric energy. I have illustrated an electrical gear-shifting mechanism having a single electromagnet of the solenoid type, such as 43, connected in any suitable manner to the shaft 34, as, for example, by a lever, 44, secured to said shaft and having a pin and slot connection, 45, with the core, 46, of said solenoid. A strong spring, 47, is illustrated for the purpose of pushing out the core when the circuit through the solenoid is broken. In the present case this circuit is a simple one comprising a source of energy, 48, and conductors, 49 and 50, leading respectively to the solenoid 43 and to a contact terminal, 51, supported and insulated on the annular support 8 for the selecting lever 4, conductors 52 and 53 being shown as passing respectively from the post 5 to a contact, 54, and from the other side of the solenoid 43 to a contact, 55, the conductor 52 being grounded on said post. The selecting lever 4 is also grounded on the post 5 so that when said lever is brought into engagement with the contact 51 the circuit will be closed at that point. At the contacts 53 and 54 the circuit may be closed by a switch, 56, secured, for example, to a clutch lever or other device, 57, this construction being such that when the pedal, 58, is depressed to throw out the clutch the circuit will be closed at the contacts 54 and 55. This method of control of the gear-shifting electromagnet 43 is similar to that heretofore employed. By providing a selecting lever 4 having both horizontal and vertical swinging movements it will be seen that the selection of the desired gear-shifting operation will be determined by the horizontal swing of said lever on the post 5, the gear-shifting operation itself being effected ordinarily by power, and when so effected being due to the de-

pression of the selecting lever 4 into engagement with the contact 51. Of course in the construction shown in Fig. 9 this circuit is not actually closed until the pedal 58 is depressed. In case the source of energy or battery 48 should fail, however, the necessary gear-shifting operations may be performed by a single actuator in the form of a manual device, such as the lever 59. This lever is splined on the shaft 34 (see Fig. 3) and has a relatively long pin, 60, extending therefrom constantly in engagement with one edge of the power lever 44. This manual lever 59 is shiftable along the shaft 34 to the five positions of the actuating lever 33 and is connected to said lever so as to locate it in any one of said positions as desired.

The object of making the lever 59 shiftable along the shaft 34 is to provide an alternative way of selecting a new speed, this mode of operation corresponding to that heretofore generally used in changing from one speed to another by a sidewise shift of a lever.

What I claim is:

1. Electric gear-shifting mechanism, comprising gear-shifting means having a plurality of gear-shifting movements, and means including a source of electric energy and a single electromagnet for supplying energy for effecting all of said movements.

2. Electric gear-shifting mechanism, comprising gear-shifting means having a plurality of gear-shifting movements, electrical means for supplying energy for bringing about all of said movements, and a combined manual selector and circuit-controller movable into and out of position for controlling said gear-shifting movements selectively and into and out of position for influencing the circuit of said electrical means.

3. Electric gear-shifting mechanism, comprising gear-shifting means having a plurality of gear-shifting movements, electrical means for supplying energy for bringing about all of said movements, and a combined manual selector and circuit-controller movable in one path for controlling said gear-shifting movements selectively and movable in another path for influencing the circuit of said electrical means.

4. Electric gear-shifting mechanism, comprising gear-shifting means, an electric circuit including a source of energy and an electromagnet for supplying energy for operating said gear-shifting means to different positions representing different speed relations, and a clutch-operating device for controlling said circuit.

5. Electric gear-shifting mechanism, comprising gear-shifting means having a plurality of gear-shifting movements, and means including a source of electric energy, an electromagnet and a single circuit-closer for supplying energy for effecting all of said movements.

Signed at New Haven in the county of New Haven and State of Connecticut this 30th day of March A. D. 1914.

CHARLES R. UNDERHILL.

Witnesses:
EVA M. VISEL,
MARY A. MURPHY.