R. & E. P. HOLLIDAY.

CHANGE SPEED GEARING.

APPLICATION FILED APR. 30, 1910.

1,039,745.

Patented Oct. 1, 1912.

7 SHEETS—SHEET 1.

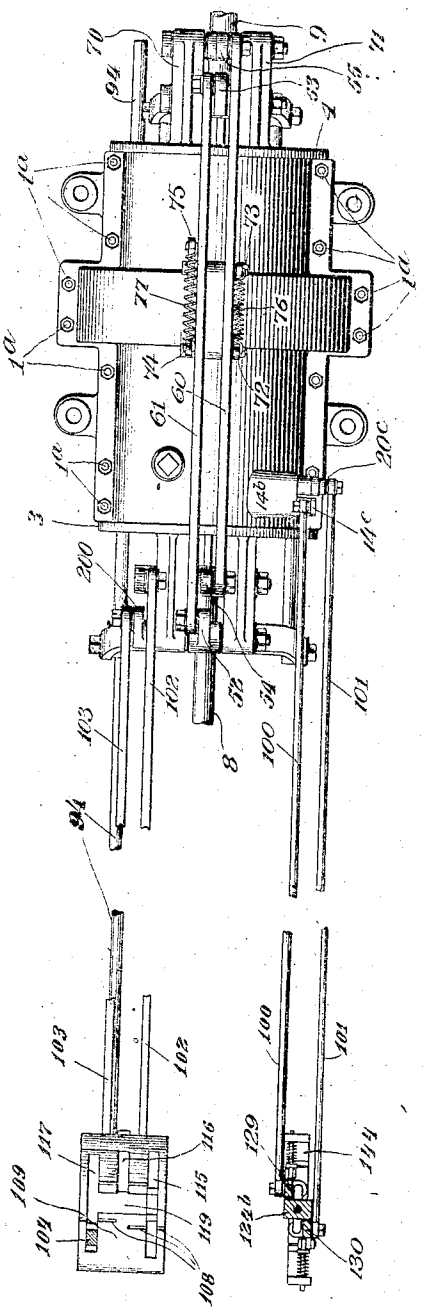


Fig. 1

Witnesses:
C. L. Hubbell
E. A. Pearce

Read Halliday
Edgar Percy Halliday
Inventors

By their Attorney
Henry M. Bugbee

R. & E. P. HOLLIDAY.

CHANGE SPEED GEARING.

APPLICATION FILED APR. 30, 1910.

1,039,745.

Patented Oct. 1, 1912.

7 SHEETS—SHEET 2.

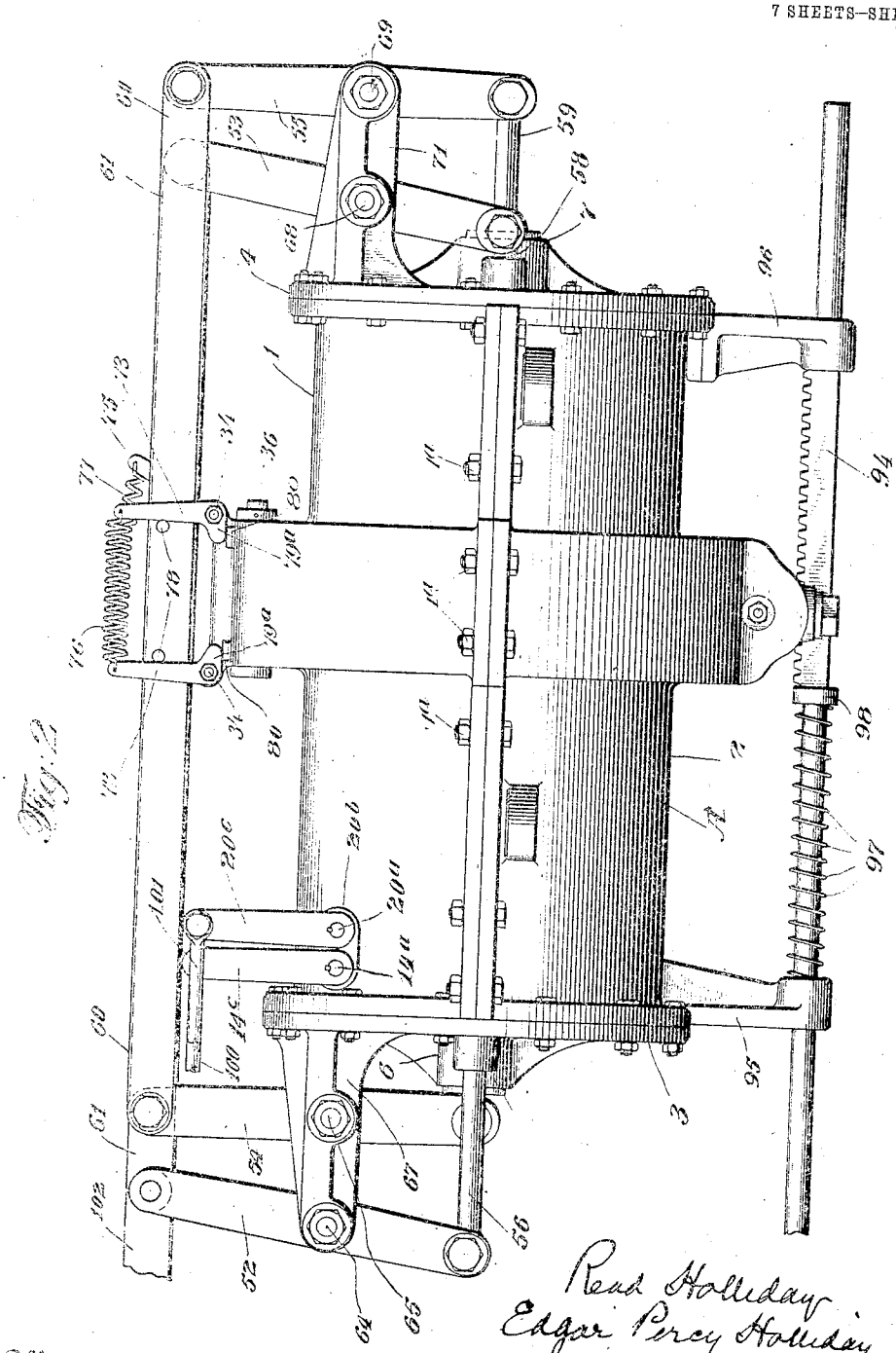


Fig. 2.

Witnesses:
C. L. Hubbell
E. A. Pearce.

Read Holliday
Edgar Percy Holliday
Inventors

By their Attorney
Hewson M. Brigham

R. & E. P. HOLLIDAY.

CHANGE SPEED GEARING.

APPLICATION FILED APR. 30, 1910.

1,039,745.

Patented Oct. 1, 1912.

7 SHEETS—SHEET 3.

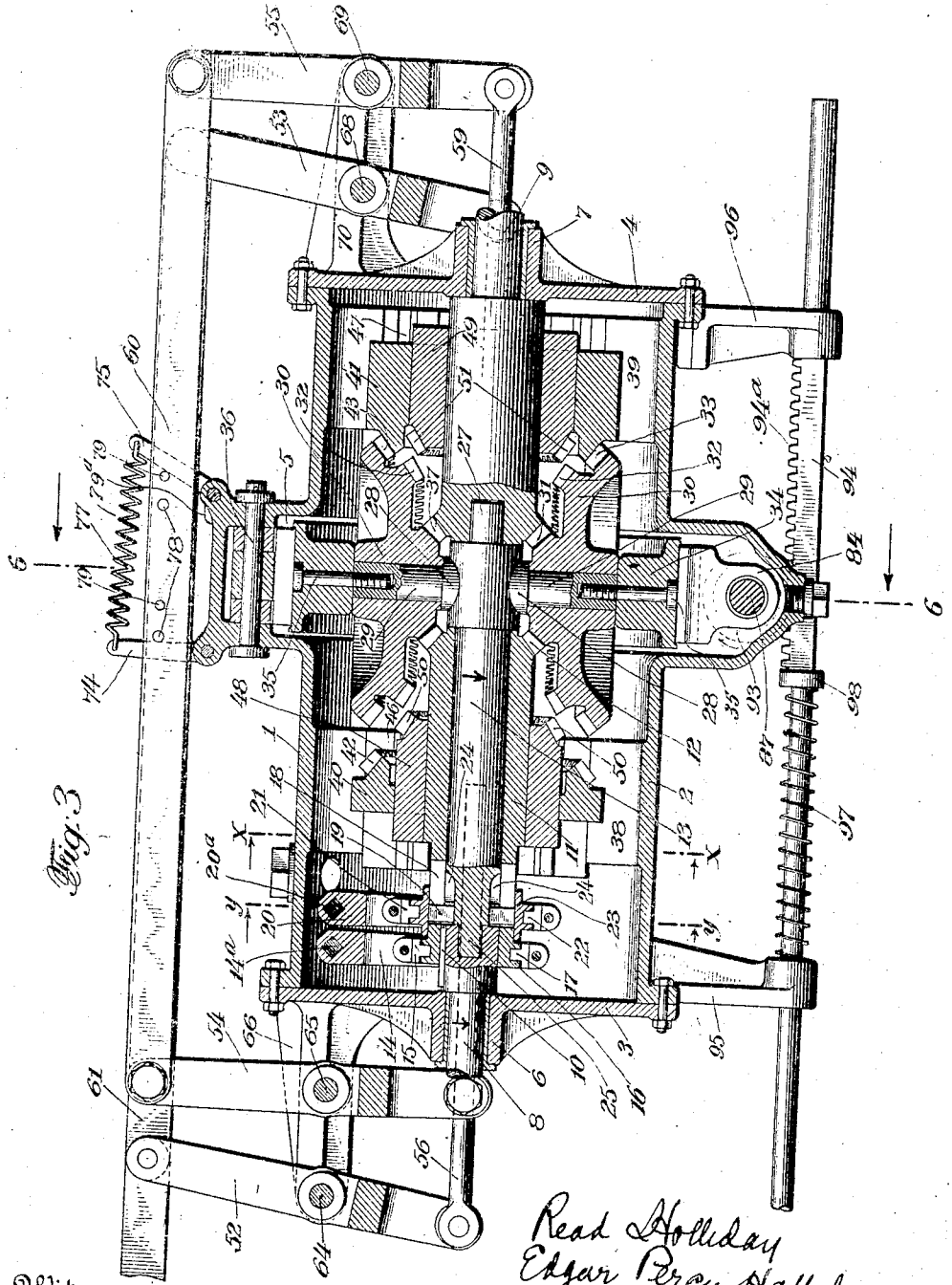


Fig. 3

Witnesses:
C. L. Hubbell
C. W. Pearce

Read Holliday
Edgar Percy Holliday
Inventors
By their Attorney Henry W. Pinkham

R. & E. P. HOLLIDAY.

CHANGE SPEED GEARING.

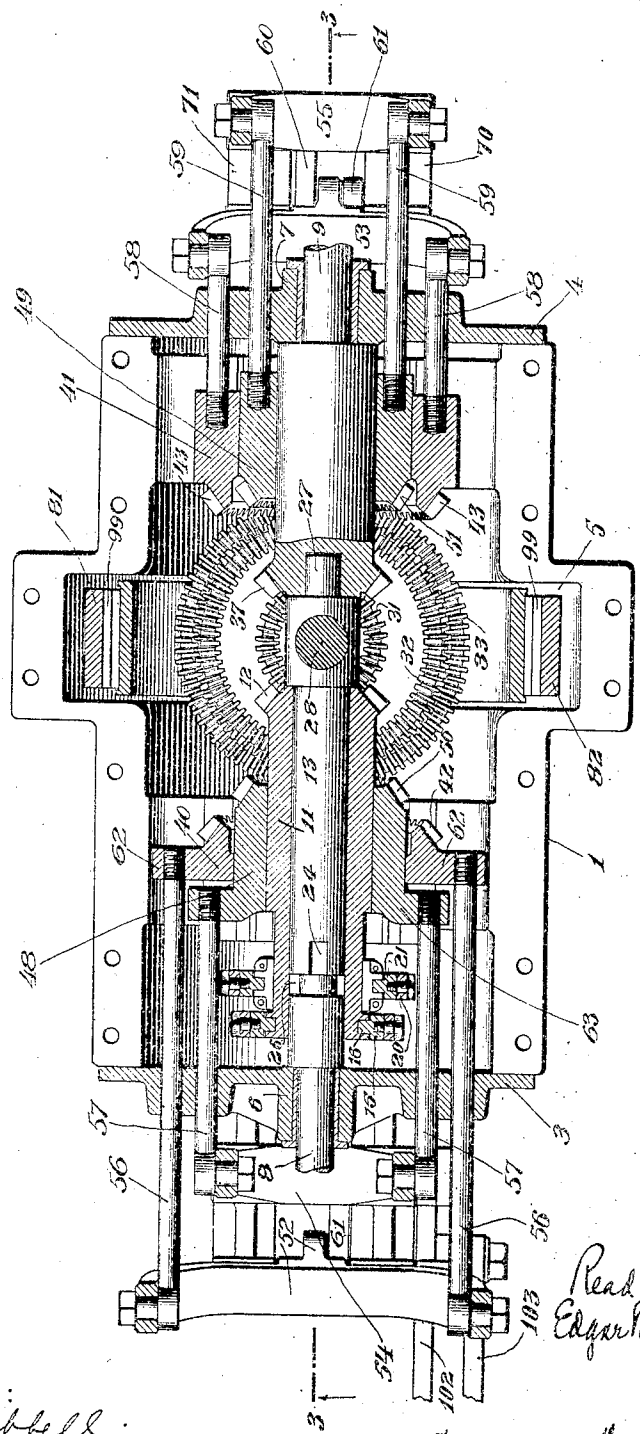
APPLICATION FILED APR. 30, 1910.

1,039,745.

Patented Oct. 1, 1912

7 SHEETS—SHEET 4.

Fig. 4.



Witnesses:
C. L. Stubbell.
E. A. Pearce.

Read Holliday,
Edgar Percy Holliday
Inventors

By their Attorney Henry M. Pegram

R. & E. P. HOLLIDAY.

CHANGE SPEED GEARING.

APPLICATION FILED APR. 30, 1910.

1,039,745.

Patented Oct. 1, 1912

7 SHEETS—SHEET 5.

Fig. 5

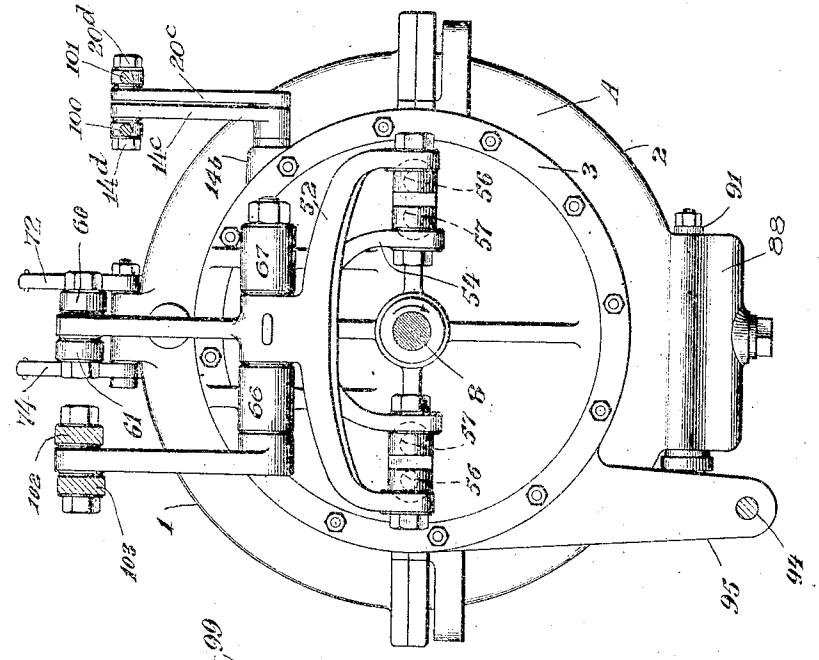
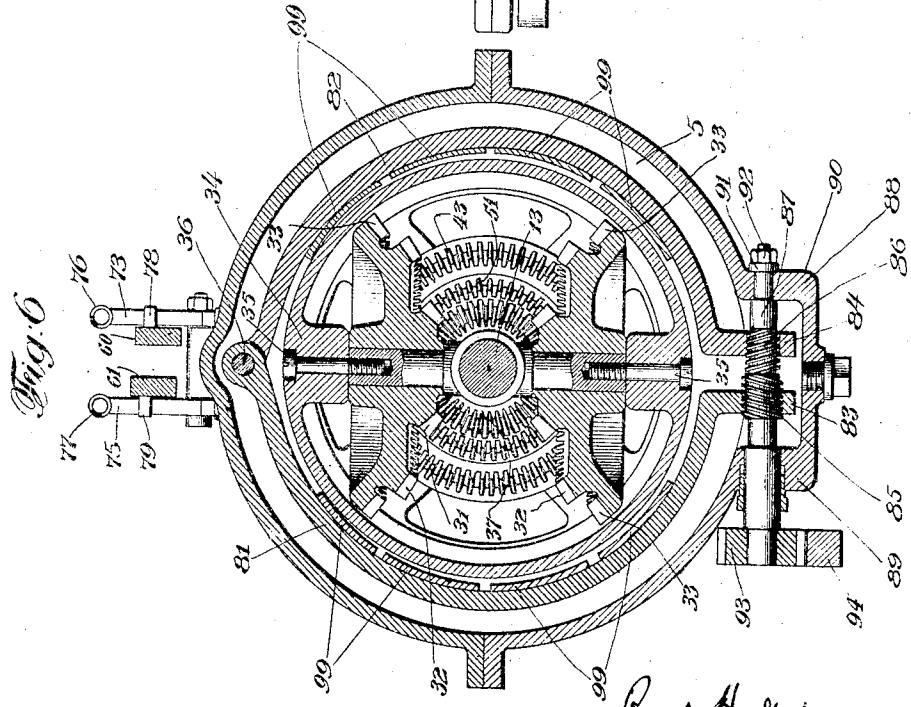


Fig. 6



Witnesses:
C. L. Hubbell
E. A. Pearce

Read Holliday
Edgar Percy Holliday
Inventors
By their Attorney Henry M. Brigham

R. & E. P. HOLLIDAY.

CHANGE SPEED GEARING.

APPLICATION FILED APR. 30, 1910.

1,039,745.

Patented Oct. 1, 1912.

7 SHEETS—SHEET 6.

Fig. 8

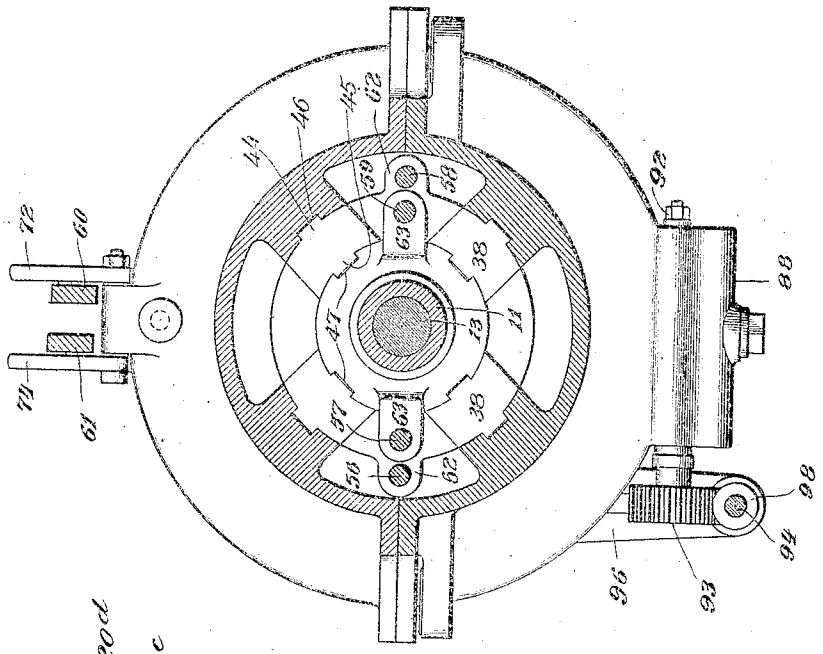
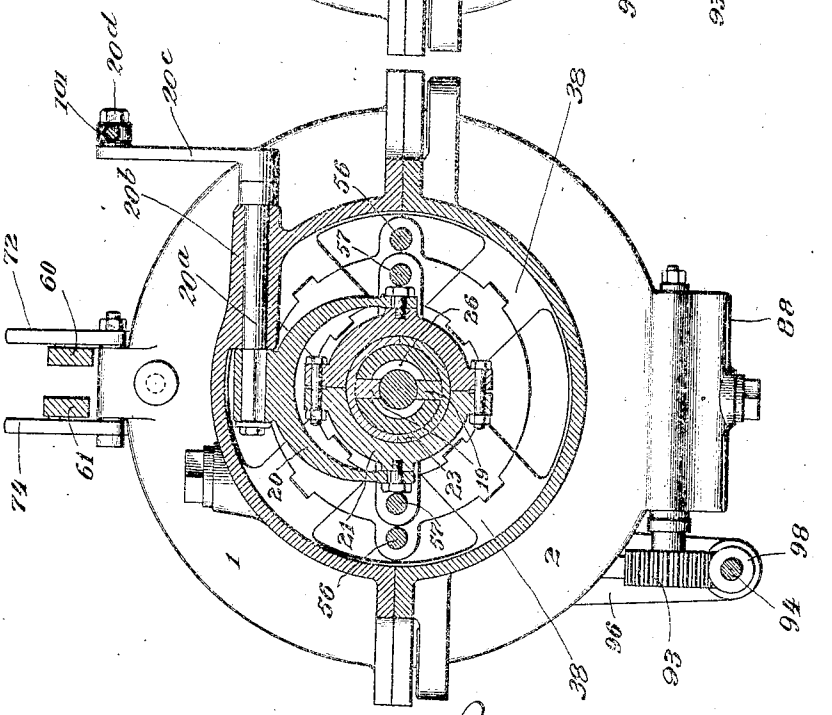


Fig. 7



Witnesses:
C. L. Hubbell
E. A. Pearce.

Read Holliday
Edgar Percy Holliday
Inventors
By their Attorney Henry M. Brigham

R. & E. P. HOLLIDAY.

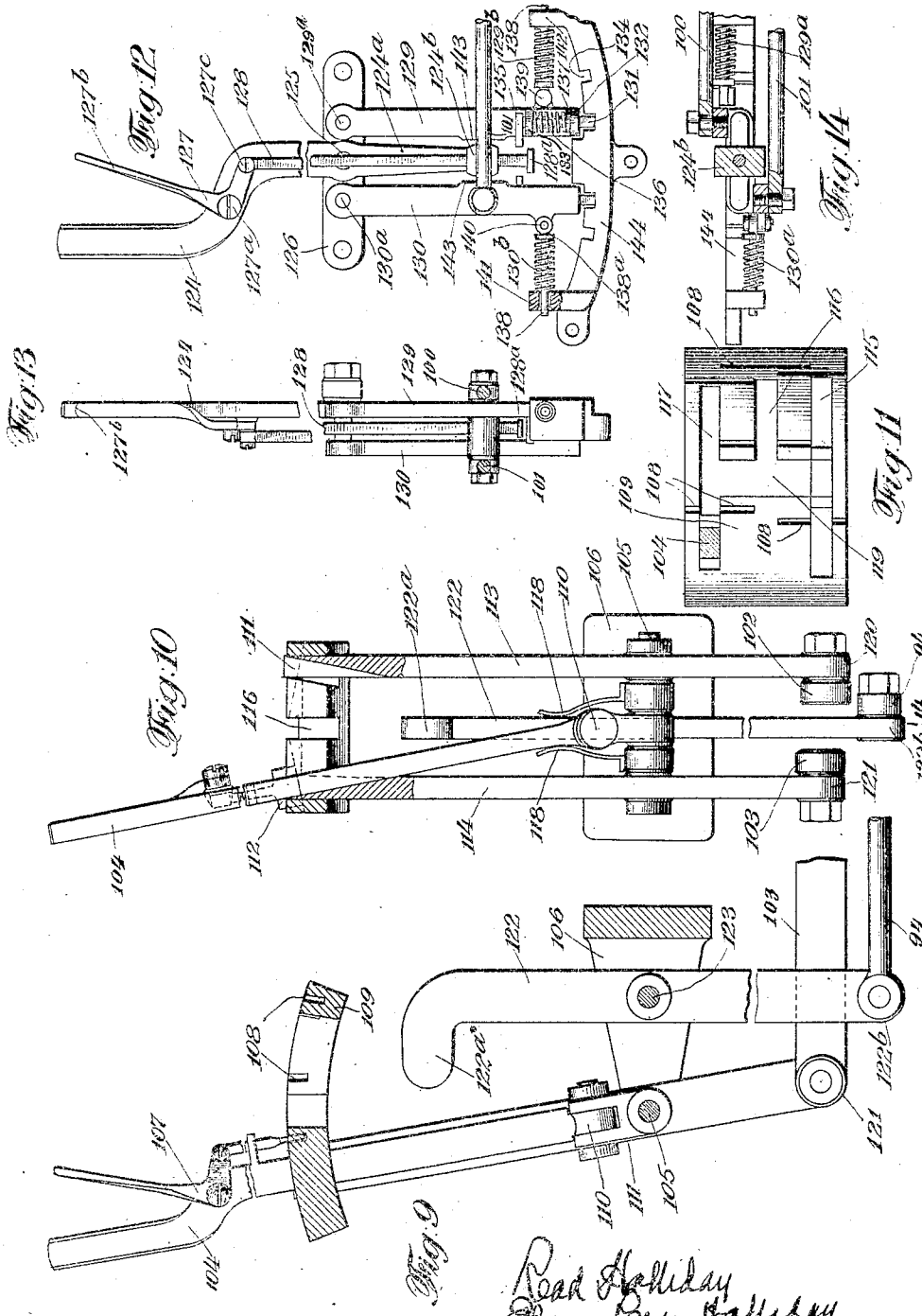
CHANGE SPEED GEARING.

APPLICATION FILED APR. 30, 1910.

1,039,745.

Patented Oct. 1, 1912.

7 SHEETS—SHEET 7.



Witnesses:
C. L. Hubbell
C. A. Pearce.

Read Holliday
Edgar Brey Holliday
Inventors
By their Attorney Harry N. Higham

UNITED STATES PATENT OFFICE.

READ HOLLIDAY AND EDGAR PERCY HOLLIDAY, OF NEW YORK, N. Y.

CHANGE-SPEED GEARING.

1,039,745. Specification of Letters Patent. Patented Oct. 1, 1912.

Application filed April 30, 1910. Serial No. 558,610.

To all whom it may concern:

Be it known that we, READ HOLLIDAY and EDGAR PERCY HOLLIDAY, citizens of the United States of America, and residents of the borough of Brooklyn, in the city of New York, county of Kings, and State of New York, have invented certain new and useful Improvements in Change-Speed Gearing, of which the following is a specification.

This invention relates to improvements in change speed gearing for automobiles and the like mechanisms and has for its object to produce a gearing which shall be strong, simple, compact, light in weight and by means of which the number of rotations from the driving shaft to the driven shaft can be easily increased or decreased and the direction of rotation of the driven shaft reversed.

In the accompanying drawings in which like letters and numerals of reference indicate like parts, Figure 1 represents a plan view showing the gear casing on the right and the controlling levers on the left, with parts broken away for the sake of clearness. Fig. 2 is a side view of the gear box on a larger scale. Fig. 3 is a longitudinal vertical section on line 3—3 of Fig. 4. Fig. 4 is a bottom plan of the gear box with the bottom half of the shell removed, showing mechanism partly in section. Fig. 5 shows an end view of the gear box with driving shaft and lever bars in section. Fig. 6 is a vertical cross section through the gear box on line 6—6 of Fig. 3. Fig. 7 is a vertical cross section on line *y*—*y* of Fig. 3. Fig. 8 is a vertical cross section on line *x*—*x* of Fig. 3. Fig. 9 is a side elevation partly in section of the lever mechanism controlling the operation of the bevel gear rings. Fig. 10 is a front view of the lever mechanism controlling the bevel gear rings. Fig. 11 is a plan view of the lever mechanism controlling the bevel gear rings, showing the selecting and locking plate. Fig. 12 is a side view of the lever mechanism controlling the shifting and interlocking of the bevel gear sleeve 11 with the driving and intermediate shafts. Fig. 13 is an end view of the lever mechanism shown in Fig. 12. Fig. 14 is a plan view partly in section of the lever mechanism of Fig. 12.

The casing or shell of the gear box A is composed of two semi-cylindrical sections 1 and 2 which are firmly secured together by bolts 1^a passing through corresponding flanges formed on said sections. The open ends of the cylindrical portion are closed by two heads 3 and 4 which are connected to the cylindrical portion in a suitable manner, providing tight joints. The cylindrical portion of the casing is provided near its center with an annular or ring shaped chamber 5 projecting outwardly from its circumference. The heads 3 and 4 are provided in their central portions with suitable outwardly projecting hubs 6 and 7 forming bearings for the passage and support of the driving shaft 8 and driven shaft 9. The driving shaft 8 which passes from the outside through bearing 6 into the casing, is connected at its outside end to any suitable source of power.

The inner end of shaft 8 connects by means of a feather or sliding key 10 to the sleeve 11 of bevel gear 12. The bevel gear 12 with its sleeve 11 is through the feather 10 always connected with the driving shaft 8 and must therefore rotate with it whenever the driving shaft is rotated. The sleeve 11 with its bevel gear 12 is arranged to be moved horizontally back and forward on the driving shaft 8 and intermediate shaft 13 thus rendering it possible to throw the gear 12 into and out of engagement with the gear 31. This operation of sleeve 11 and bevel gear 12 is controlled by means of fork shaped lever 14, and ring 15, provided with an annular projection 17 which is fitted into a groove 16 formed on the end of sleeve 11. The fork shaped lever 14 is mounted on the square end of a horizontal shaft 14^a placed at right angles to the central axis of the cylindrical portion of the gear case. Shaft 14^a extends from the inside of the gear casing to the outside of same through a sleeve 14^b forming a part of the gear casing. To the outwardly projecting end of shaft 14^a is fixed a crank lever 14^c whose upper end is provided with a pivotal connection 14^d to a connecting bar 100. Sleeve 11 is also provided with longitudinal slots 18, 18 for the passage of pins 19 forming means for connecting or disconnecting sleeve 11 with intermediate shaft 13. This operation is controlled by fork shaped lever 20, ring 21 engaging with its central inward projection 22 a corresponding groove in a ring 23 slidably mounted on sleeve 11 and carrying

firmly attached to its inner face the pins 19. Fork shaped lever 20 is mounted on the square end of a horizontal shaft 20^a placed at right angles to the central axis of the cylindrical portion of the gear case. Shaft 20^a extends from the inside of the gear casing to the outside of same through a sleeve 20^b forming a part of the gear casing. To the outwardly projecting end of shaft 20^a is fixed a crank lever 20^c whose upper end is provided with a pivoted connection 20^d to a connecting bar 101. By shifting ring 23 toward the center of the gear casing, the pins 19 will be moved into the slots 18 of sleeve 11 until they engage suitable recesses 24 provided in the intermediate shaft 13 and in this manner lock the sleeve 11 and the intermediate shaft 13 together, compelling them to rotate in unison.

The intermediate shaft 13 is reduced at the end nearest to the driving shaft to a smaller diameter to provide a suitable pivot 25 which is inserted in a corresponding recess in the driving shaft 8, thus forming a suitable support and bearing for this end of the intermediate shaft 13. At the shoulder formed by pivot 25 on the intermediate shaft 13 another reduction in the diameter of shaft 13 is provided. This reduction of diameter forms a ring shaped space 26 which communicates with the recesses 24 and allows the pins 19 when same are moved to their normal position in the slots 18 of sleeve 11 to rotate with said sleeve, without rotating intermediate shaft 13. The end of shaft 13 nearest to the driven shaft 9 is provided with a suitable pivot 27 inserted in a corresponding recess in driven shaft 9 forming a support and bearing for this end of the shaft 13. At this end the shaft 13 is enlarged in its diameter and provided with hubs 28.

Projecting from hubs 28 at right angles to shaft 13 and firmly secured to the hubs 28 are two studs 29, 29. The hubs 28 and the studs 29 are placed on opposite sides on the circumference of the enlarged portion of the shaft 13 and carry bevel gear disks 30, each provided with three sets of gear faces 31, 32, and 33, each gear face having a different diameter. The bevel gear disks 30 are kept in their respective position on the studs 29 by a ring 34 suitably secured to the studs 29 by means of screws 35. The inner face of the ring 34 prevents the bevel gears from sliding from the studs 29, and the outer face provides a friction surface for a friction brake secured at 36. The driven shaft 9 which passes from the outside through bearing 7 into the casing is inside of the casing of the same diameter as sleeve 11, and carries at the end nearest to the intermediate shaft 13 a bevel gear 37 corresponding in diameter to bevel gear 12. The bevel gear 37 on driven shaft 9 connects with bevel gear 12 on sleeve 11 through the intermediate gear faces 31, 31, of the bevel gear disks 30, 30, and as sleeve 11 is connected to the driving shaft 8 through the feather 10, a connection between the driving shaft 8 and the driven shaft 9 is established, which connection of course will undergo a number of changes which the further description of the devices will explain. On each side of the ring shaped outwardly projecting chamber 5 guide supports 38, 39 are provided on the inner face of the cylindrical portion of the gear casing, forming a part thereof, and projecting a short distance radially toward the center of the casing. Slidably mounted in the guide supports 38, 39, are bevel gear rings 40 and 41 provided with gear faces 42, 43.

The inner and outer faces of the gear rings 40 and 41 are provided with projections 44 and 45 as shown in Fig. 8. The projections 44 on the outer faces of the gear rings 40, 41 fit into the corresponding recesses 46 and 47 provided in the guide supports 38 and 39. The projections on the outer face of the gear rings 40 and 41 and the corresponding recesses in the guide supports 38 and 39 permit a horizontal sliding movement of the gear rings 40 and 41 but prevent any rotary movement of the same. The projections on the inner faces on the gear rings 40 and 41 fit into corresponding recesses provided on the outer faces of the smaller gear rings 48, 49.

The small gear rings 48, 49 are provided with gear faces 50, 51 and their inner faces respectively form supports or bearings for the driving gear sleeve 11 and driven shaft 9 preventing any vibration and undue bending strains on those rotating parts. The longitudinal sliding motion of the gear rings 40, 41 and 48 and 49 is for the purpose of bringing them into and out of mesh with the gear faces 32 and 33 on the bevel gear disks 30 and is controlled by levers 52, 53, 54 and 55, connecting rods 56, 57, 58, 59, see Fig. 4 and connecting links 60, 61.

The gear rings 40 and 48 are provided with outwardly projecting extensions 62, 63 placed on a horizontal plane with the center line of the case. Threaded holes are provided in the extensions 62, 63 of the gear rings for securing the threaded ends of the connecting rods 56 and 57 to the gear rings 40 and 48. The connecting rods 56 and 57 pass from the interior of the gear case to the outside through guide openings provided in head 3. The outside ends of the connecting rods 56, 57 are suitably connected to the lower fork shaped portion of the levers 52, 54 which levers are pivoted at 64, 65 on brackets 66, 67 projecting from the gear case head 3 forming a part thereof. The upper ends of the levers 52 and 54 are connected by links 60 and 61 to the upper ends of the levers 53 and 55. The levers 53 and

55 are pivoted at 68 and 69 to brackets 70 and 71 projecting from gear case head 4 and forming a part thereof. The lower portions of levers 53, 55 are fork shaped and connected to the outside ends of connecting rods 58 and 59 and the connecting rods 58 and 59 passing through guide openings provided in gear case head 4 to the inside of the gear case where their threaded ends are secured to the gear rings 41 and 49.

In order to keep the gear rings in their normal position, that is out of mesh with bevel gears 32 and 33 levers 72, 73, 74, 75, see Figs. 5 and 6 are pivoted to the uppermost portion of the outer face of the ring shaped chamber 5. Two such levers are provided for each of the connecting links 60, 61 and are placed close to the outer sides of such connecting links. Each corresponding pair of levers is connected on its upper end through coil springs 76 and 77 so that 72 and 73 are kept in a normal vertical position through their spring 76, while 74 and 75 are kept in a similar position by their spring 77. Each pair of levers engages a corresponding pair of pins 78 and 79 secured to the outside of the corresponding connecting link engaging the surfaces facing each other on the corresponding levers 72, 73, 74, and 75. Each of the levers, 72, 73, 74, and 75 has on its pivoted end a short arm 79^a extending at right angles from it and engaging a corresponding stop 80 provided on the casing. Short arm 79^a and stop 80 prevent the levers in each corresponding pair from being rocked toward each other by their connecting spring to a position beyond the vertical, as clearly shown in Fig. 2. In this position each pair of pins 78, 79 will hold its corresponding connecting link in a normally central position secured therein by the tension of the springs 76 and 77 which hold their corresponding levers with the short arm 79^a engaging the respective stops 80. In this position the connecting links 60, 61 and levers 52, 53, 54 and 55 are holding the gear rings 40, 41, 48, 49 with their respective gear faces out of mesh with the corresponding gear faces on the gear disks 30.

If as shown in Figs. 2 and 3, the connecting link 61 is moved to the right, it will through its connecting parts bring the gear ring 41 into mesh with the corresponding gear faces 33 on bevel gear disks 30, at the same time moving gear ring 40 an equal distance from its normal disengaged position. The same operation only reversed, that is bringing the gear ring 40 into mesh with its corresponding gear faces 33, and moving gear ring 41 farther away from its normal position, will take place if link 61 with its engaging parts is moved to the left. The movement of link 61 to the right will through the pin 79 engaging its corresponding lever 73, pull this lever against the tension of the spring 77 toward the right, moving the lever 73 to an angular position as clearly shown in Figs. 2 and 3. Through this movement, pin 79 is moved from lever 74, said lever being prevented from following the pin by its short arm 79^a engaging its corresponding stop 80 on the casing. If the force which moved the link 61 to the right is released, the spring 77 will through its contraction bring lever 75 and link 61 with pin 79 to their normal positions. Link 60 with its connecting parts operates exactly in the same manner.

Mounted in the ring shaped chamber 5 of the gear casing is a friction brake. This friction brake consists of two semi-circular arms 81 and 82 see Fig. 6 conforming to the outer surface of ring 34; arms 81 and 82 form a hinge and are secured together through a hinge pin 36. To the sides of the upper portion of the ring chamber 5 on the lower ends of the arms 81, 82 are formed two vertical downward projecting ears 83, 84. The ears 83, 84 are pierced and provided with right and left hand threads corresponding with the right and left hand threads 85 and 86 on the spindle 87. The threaded holes in the ears 83 and 84 and the corresponding threaded portion of the spindle 87 are of different diameters for construction purposes. The spindle 87 is mounted in a suitable shaped downwardly projecting extension 88 of the ring shaped chamber 5. The spindle 87 is arranged at right angles to the cylindrical portion of the gear casing and is conveniently supported by bearings in the walls 89 and 90 of the extension 88. The end portion of the spindle 87 entering into and passing through the bearing in the wall 90 is reduced to a smaller diameter and has a shoulder formed thereon which butts against the inner surface of the wall 90, preventing any shifting of the spindle 87 to the right. A shifting of the spindle in the opposite direction is prevented by washer 91 and locknut 92 on the end of the reduced portion of the spindle projecting through the outside face of the wall 90. Through this means a shifting of the spindle 87 in the direction of its horizontal axis is prevented, as is clearly shown in Fig. 6. To the other end of spindle 87 is attached a gear 93 which engages a rack 94 slidably mounted in brackets 95 and 96. The brackets 95 and 96 project downward from the lower half of the cylindrical portion of the gear case and are part thereof. The rack 94 consists of a square portion the upper face of which is provided with teeth. Attached to the ends of the square portion of the rack and forming parts thereof, are round extensions. These round extensions constitute the support of the square portion of the rack 94 and are slidably mounted in corresponding bearing

holes provided in brackets 95, 96. The round extension of the rack 94 passing through bracket 95, carries between the square portion and the bracket the coil spring 97, one end of which butts against the bracket 95 the other against the collar 98 fixed to the square portion of the rack 94. The round portion of rack 94 carrying the spring 97 is suitably extended to form connections with controlling levers conveniently placed. The inner faces of the circular arms 81, 82 of the friction brake are provided with friction blocks 99 of suitable material for the purpose of engaging the friction surface on the outer face of ring 34.

Whenever the rack 94 is moved toward the driving end of the gear case, the teeth on the square portion will rotate gear 93 in the direction of arrow indicated in Fig. 3, thereby turning spindle 87 with its right and left hand threads in the same direction, thus closing the brake arms 81, 82 and bringing friction blocks 99 in contact with the friction surface on ring 34, preventing ring 34 from rotating. The movement of the rack 94 in the direction just described will compress spring 97 between the collar 98 and the bracket 95. The compressed spring 97 will force the rack 94 back to its normal position as soon as the controlling lever is released. This movement of the rack 94 will rotate the gear 93 in the opposite direction to that indicated by the arrow in Fig. 3, releasing the friction of the brake shoes 99 on the friction surface of ring 34, permitting ring 34 intermediate shaft 13 and bevel gear disks 30 to rotate.

Suitable controlling devices are provided for the shifting and locking in place of the different operating parts contained in the gear casing as will be hereinafter described in detail.

Connections between the operating parts of the gear case and suitable controlling lever devices are established by means of connecting bars and connecting links, all of which are clearly shown in Fig. 1. The connection between ring gears contained in the gear case and their respective controlling levers, so placed as to enable a convenient and easy manipulation of same is established by the connecting links 102 and 103. The connection between the friction brake and its corresponding controlling lever is established by means of the connecting bar 94. The connection between the shifting mechanism of the sleeve 11 with its bevel gear 12 contained in the gear box and its corresponding controlling lever is established by means of the connecting bar 100. The connection between the locking mechanism of the intermediate shaft 13 and the sleeve 11 with its corresponding controlling lever is established by means of the connecting bar 101. The controlling lever for these two operating parts is also placed where it can be most conveniently and easily manipulated.

The controlling lever mechanism for the shifting and locking of the gear rings 40, 41, 48, 49 and the friction brake is shown in Figs. 9, 10, and 11. A hand lever 104 pivoted at 105 to a suitable bracket 106 is provided at its upper end with a convenient handle and the usual type of locking mechanism 107 which makes it possible to retain the hand lever in any required position through the means of the locking device 107 and locking recesses 108 provided on a suitable selecting plate 109. Just above the pivot point 105, a hinge 110 is inserted in the lever 104 allowing a swinging movement of that portion of the hand lever which extends from the hinge 110 to its upper end. This swinging of the lever permits its engagement with recesses 111, 112 provided in the upper portions of levers 113 and 114 and also a placing and moving of the hand lever 104 in any of the selecting slots 115, 116, 117, of the selecting plate 109. The hinged portion of the lever 104 is normally kept in a vertical position by two springs 118 placed so as to force the hinged portion of the lever to a vertical central position whenever brought in the connecting space 119 which establishes communication between the selecting slots of the selecting plate. The levers 113 and 114 which are placed on each side of the lever 104 and are also pivoted at 105 on the bracket 106 are each provided with a corresponding recess 111 and 112 on their uppermost ends for the reception of the hand lever 104 whenever placed therein for operating and locking either of the levers 113 or 114 independently. The upper ends of levers 113 and 114 are at all times in their respective guide slots 115, 117 of selecting plate 109, and can only be engaged by the hand lever 104 one at a time when in their normal position opposite the connecting space 119. Whenever one of the levers 113 and 114 is operated or locked in any operative position by hand lever 104, the other remains in its normal position opposite connecting space 119 as clearly shown in Fig. 10. The levers 113 and 114 are extended below the pivot point 105 and are pivotally connected at their respective ends 120 and 121 to their respective connecting links 102 and 103 through which they operate their respective gear rings in the gear case. The hand lever 104 is also adapted to operate the friction brake situated in the gear casing through the medium of the lever 122 pivoted at 123 to the bracket 106. The lever 122 is placed just back of the hand lever 104 so that whenever the hinged portion of the hand lever 104 is in its normal central position, it is in front of and exactly in line with lever 122. The lever 122 is provided

on its upper end with a horizontal extension 122ª projecting toward the hand lever 104. The lever 122 is also extended below its pivot 123 and the end 122ᵇ, of this extension is pivoted to connecting bar 94 which operates the friction brake contained in the gear casing. Whenever the hinged portion of the hand lever 104 is moved from its normal vertical position in the connecting space 119 into the central selecting slot 116, it will engage the horizontal projection 122ª on the upper end of lever 122 and rocking lever 122 on its pivot 123 will shift the connecting bar 94 and operate the friction brake in the gear casing.

The controlling lever mechanism for shifting and locking in place the sleeve 11 with its bevel gear 12, and for the operation of the connecting and disconnecting devices between sleeve 11 and intermediate shaft 13 is shown in Figs. 12, 13 and 14. Hand lever 124 pivoted at 125 to a plate 126 is provided with a bell crank 127 pivoted to the hand lever 124 at 127ª. One arm of the bell crank 127 forms a handle 127ᵇ, the other arm connects through a pivot pin 127ᶜ, to a vertical downwardly extending bar 128 provided at its lowest end with a horizontal flange 128ª. Hand lever 124 is provided at the end of its downward extending part 124ª with a guiding and engaging block 124ᵇ, for guiding and supporting the lower portion of the bar 128 and for the engagement of the raised portions 143 on levers 129 and 130. The uppermost portion of the lever 124 is formed into a handle. Two levers 129 and 130 are placed front and back and also a little to each side of the downward extending portion 124ª of the hand lever 124. Levers 129 and 130 are held in their respective position by pivot pins 129ª and 130ª secured in a suitable manner to the plate 126. The pivot pins 129ª and 130ª are situated on a horizontal plane with the pivot 125 of hand lever 124. Near their lower ends the levers 129 and 130 are provided with extended portions 143 for the purpose of engaging block 124ᵇ on the lower end of hand lever 124. Both levers 129 and 130 are provided at their lower ends with locking devices. As the locking devices on levers 129 and 130 are exactly alike I will only describe the locking device on lever 129.

The locking device consists of a vertical locking bar 131 slidably mounted in suitable supports 132 and 133 projecting at right angles from the side of lever 129 and forming a part thereof. The sliding bar 131 is provided with a square portion at its lower end adapted to engage suitable recesses 134 provided in a locking segment 144. The upper end of the locking bar 131 is provided with a horizontal projecting arm 135 extending with its free end toward the bar 128. The locking bar 131 is kept in a downward position with its lower end inserted in a corresponding recess, by a spring 136, which is placed over the central portion of locking bar 131 between the projections 132 and 133 on lever 129. The upper end of the spring 136 rests against the lower face of the projection 133 and the lower end of said spring presses against a collar 137 fixed on the locking bar 131, said collar resting normally on the upper face of the projection 132. The projecting arm 135 will engage the flange 128ª on the end of the bar 128 whenever the bar 128 is raised by means of the bell crank handle 127ᵇ with lever 124 brought to a position in which the engaging block 124ᵇ is resting against the raised portion 143 of lever 129. After flange 128ª has with its upper face engaged the underside of the projecting arm 135 said arm and its locking bar 131 are raised by the flange 128ª during the further upward movement of flange 128ª with bar 128. The raising of locking bar 131 out of its locking recess compresses the spring 136 which compression will force the locking bar back into the locking recess whenever the locking bar is released from its upper position through the releasing of the lifting bar 128. The levers 129 and 130 are provided near their lower ends with horizontal springs 129ᵇ and 130ᵇ adapted to bring the levers 129 and 130 and hand lever 124 back to their respective normal vertical positions. Each of the springs 129ᵇ and 130ᵇ is provided with a guide-bolt 138 pivoted at one end each to one of the levers 129 and 130 at 139 and 140. The other end of each guide-bolt 138 is slidably mounted in suitable supports 141 and 142 provided on the locking segment. Each of the springs 129ᵇ and 130ᵇ is placed on its corresponding guide-bolt with one end pressing against one of the supports 141, 142 and the opposite end pressing against a collar 138ª fixed on each guide-bolt near its pivoted end.

As can clearly be seen in Fig. 12 the levers 129 and 130 are placed in such a relation to lever 124 that when the lever 124 is shifted to engage one of the levers 129 and 130 it will not disturb the position of the other lever. Whenever hand lever 124 is to change the position of one of the levers 129 and 130 its downwardly projecting portion 124ª with its guiding and engaging block 124ᵇ is moved toward that lever until the engaging block 124ᵇ strikes the projection 143 provided on levers 129 and 130 for that purpose and as soon as this has taken place the bar 128, with its flange 128ª is raised by means of the bell crank handle 127 engaging the arm 135 on the locking bar 131, raising the locking bar from its locking recess, allowing the engaged lever to be rocked on its pivot until its locking bar 131 is permitted to drop in the next locking recess. Lever 130, through connecting bar 101, crank lever 20ᵉ, shaft 20ª, connects to the fork shaped lever

20, the latter lever operating the connecting and disconnecting device of sleeve 11 on intermediate shaft 13 situated in the gear case. Lever 129 connects through the connecting bar 100, crank lever 14^c, shaft 14^a to fork shaped lever 14 which operates the device for shifting and locking in place sleeve 11 with its bevel gear 12.

The operation of our improved mechanism is as follows:—When the parts are locked by the mechanisms already explained in the positions shown in Fig. 3 viz., gear 12 in mesh with the gear face 31 on the gear disk 30, the gear face 33 in mesh with the stationary gear face 43 and the gear face 31 in mesh with the gear 37 and the other parts in the gear case are in inoperative positions, and the driving shaft 8 is rotated in the direction of the arrow shown in Figs. 3 and 5, the sleeve 11 and its gear 12 will through the feather 10 be compelled to rotate in unison with it and the gear face 33 on the disk 30 being in mesh with the stationary gear face 43, a rotary and revolving motion will be communicated to the gear disk 30 and a rotary motion to the intermediate shaft 13 because the gear face 33 will be compelled to creep over the face of the stationary gear face 43 which being stationary controls the movements of the gear disk 30 and as the gear face 31 on the gear disk 30 is also in mesh with the gear 37 on the driven shaft 9, the rotation of the gear 37 and the driven shaft 9 are controlled by the movements of the gear disk 30.

In the drawing the diameter of the gear face 43 is four fifths of the diameter of the gear face 33 and therefore the gear 37 and the driven shaft 9 will be rotated in the same direction as the driving shaft but their speed will be reduced to one ninth the speed of the driving shaft because the diameter of the gear face 43 being four fifths of the diameter of the gear face 33 and the gear 12 being of the same diameter as the gear face 31 and the gear 37 one revolution of the shaft 8 will cause the gear disk 30 to revolve five ninths of a revolution about the stationary gear face 43 and at the same time four fifths of its revolving motion will be neutralized by its enrolling over the face of the gear 37 and the other one fifth or one ninth of a revolution will be communicated to the gear 37 compelling it and its driven shaft 9 to rotate one ninth of a revolution or at one ninth the speed of the driving shaft 8 and in the same direction. If the diameter of the stationary gear face 43 were greater than the diameter of the gear face 33, then the rotation of the gear 37 and the driven shaft 9 would be reversed and in a direction opposite to the rotation of the driving shaft. It is also evident that the ratio of rotation between the driving shaft 8 and the driven shaft 9 is determined in part by the relative diameters of the gear face on the disk 30 and of the stationary gear face with which it is in mesh.

It is apparent that the ratio of rotation of the driven shaft, when the gear faces on the gear disks 30 are out of engagement with all of the stationary gear faces on the gear rings, and the friction brake is not set, the mechanism is in the neutral position and no motion will be imparted to the driven shaft when the driving shaft is rotated.

Having described our invention what we claim as new and desire to secure by Letters Patent is:—

1. In a change-speed gearing, the combination with a driving shaft and a driven shaft a gear mounted upon each shaft to rotate therewith, of an intermediate rotary shaft section, gear disks mounted to independently rotate relatively to and also to revolve with said intermediate shaft section, gear rings locked against rotation and provided with gear faces, means for throwing said gear faces into and out of engagement with the gear disks.

2. In a change-speed gearing, the combination with a driving shaft and a driven shaft, a gear mounted on each shaft, of an intermediate shaft section, right angularly disposed shaft members carried by the intermediate shaft section, gear disks mounted to rotate on said shaft members and adapted to engage with the gears on the driving and driven shafts, a gear ring locked against rotation, and means for throwing said gear ring into and out of engagement with said gear disks.

3. In a change-speed gearing, the combination with a driving shaft and a driven shaft, a gear carried by each shaft, of an intermediate shaft, separate shaft members carried by the intermediate shaft and right angularly disposed to its axis, gear disks mounted to rotate on said shaft members and having gear faces adapted to mesh with the gears on the driving and driven shafts, a gear ring locked against rotation, means for throwing the said gear ring into and out of mesh with the faces of the said gear disks, means for locking the intermediate shaft against rotation, and means for releasing such locking device.

4. In a change-speed gearing, the combination with a driving shaft and a driven shaft, a gear carried by each shaft and rotating therewith, of an intermediate shaft, separate shaft members carried by the intermediate shaft and right angularly disposed to its axis, gear disks mounted to rotate on said shaft members and adapted to mesh with the gears on the driving and driven shafts, gear rings locked against rotation, and means for throwing said gear rings into and out of mesh with said gear disks.

5. In a change-speed gearing, the combi-

nation with a driving shaft and a driven shaft, a gear carried by each shaft and rotating therewith, of an intermediate shaft, separate shaft members carried by the intermediate shaft and right angularly disposed to its axis, gear disks mounted to rotate on said shaft members and adapted to mesh with the gears on the driving and driven shafts, gear rings locked against rotation, means for throwing the gear rings into and out of mesh with the gear disks, and means for locking the driving shaft with the intermediate shaft and for releasing the same.

6. In a change-speed gearing, the combination with the driving shaft and a driven shaft, a gear carried by each shaft and rotating therewith, of an intermediate shaft section, separate shaft members carried by the intermediate shaft section and right angularly disposed to its axis, gear disks mounted to rotate on said shaft members and adapted to mesh with the gears on the driving and driven shafts, gear rings locked against rotation, manually operated means for throwing the gear disks and locking them in their engaged position, and automatic means for throwing the gear rings out of engagement with the gear disks when said locking means are released.

READ HOLLIDAY.
EDGAR PERCY HOLLIDAY.

Witnesses as to Read Holliday:
CLARENCE W. FRANCIS,
EVANGELINE PEARCE.

Witnesses as to Edgar Percy Holliday:
LOUIS BELROSE,
AMEEN ABADEER.