United States Patent

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[45] **June 13, 1972**

[54] AUTOMATIC PARKING DEVICE

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[52] **U.S. Cl.** ..... **180/1 AS,** 340/52

[51] **Int. Cl.** **B62d 5/00**

[58] **Field of Search** ..... 180/1 AS

[56] **References Cited**

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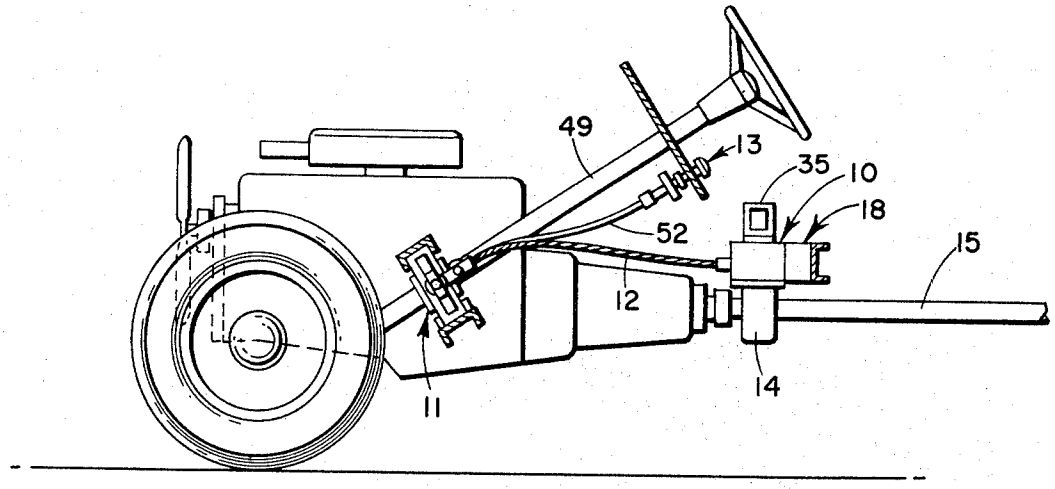
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Primary Examiner—A. Harry Levy
Attorney—Russell J. Egan

[57] **ABSTRACT**

An apparatus for automatically parking automobiles having a steering means including a steering post and a transmission with a reverse gear. The device includes first gear means on the steering post, second axially and transversely displaceable gear means and third gear means operatively connected to be driven by the transmission drive shaft in reverse gear. The second gear means is selectively operatively positioned between the first and second gear means to transmit the rotation of the drive shaft to the steering post to effect turning of the steering wheels. Timing means control the direction of rotation of the third gear means so that the steering wheels of the vehicle are rotated in a first direction and, after a predetermined period of time, rotated in the reverse direction in order to accomplish the desired parallel parking.

9 Claims, 13 Drawing Figures



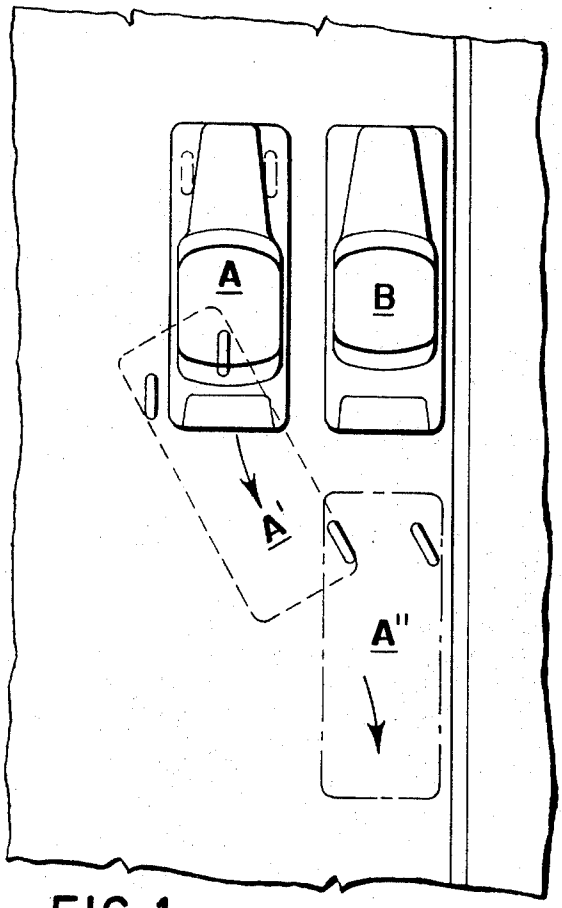


FIG. 1

FIG. 4

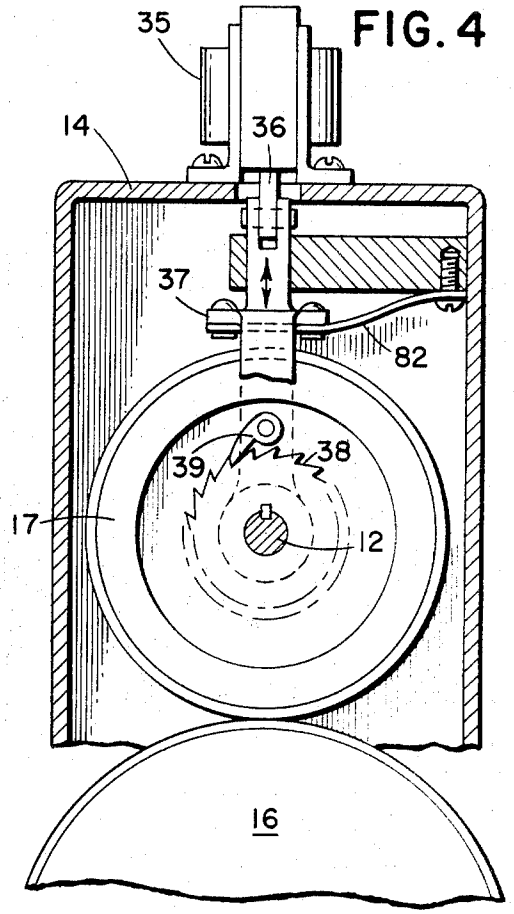
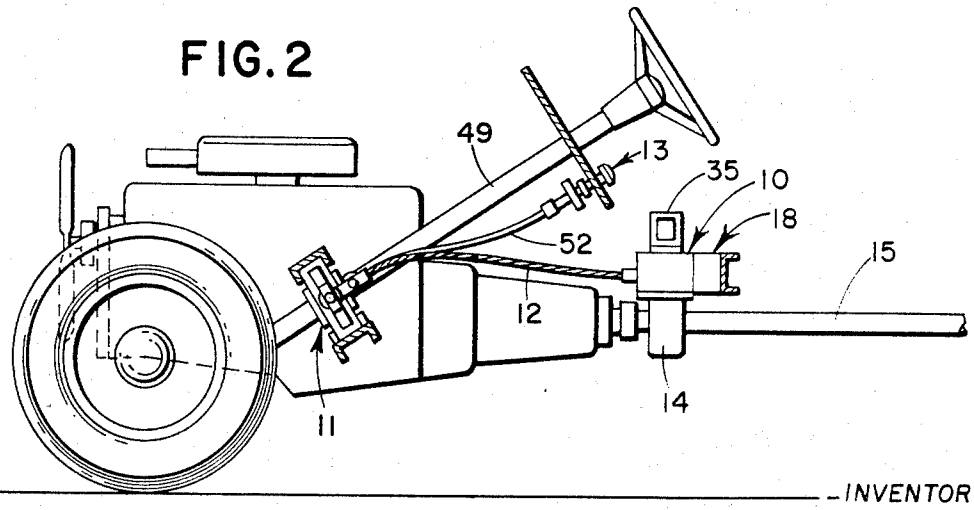


FIG. 2



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FIG. 3

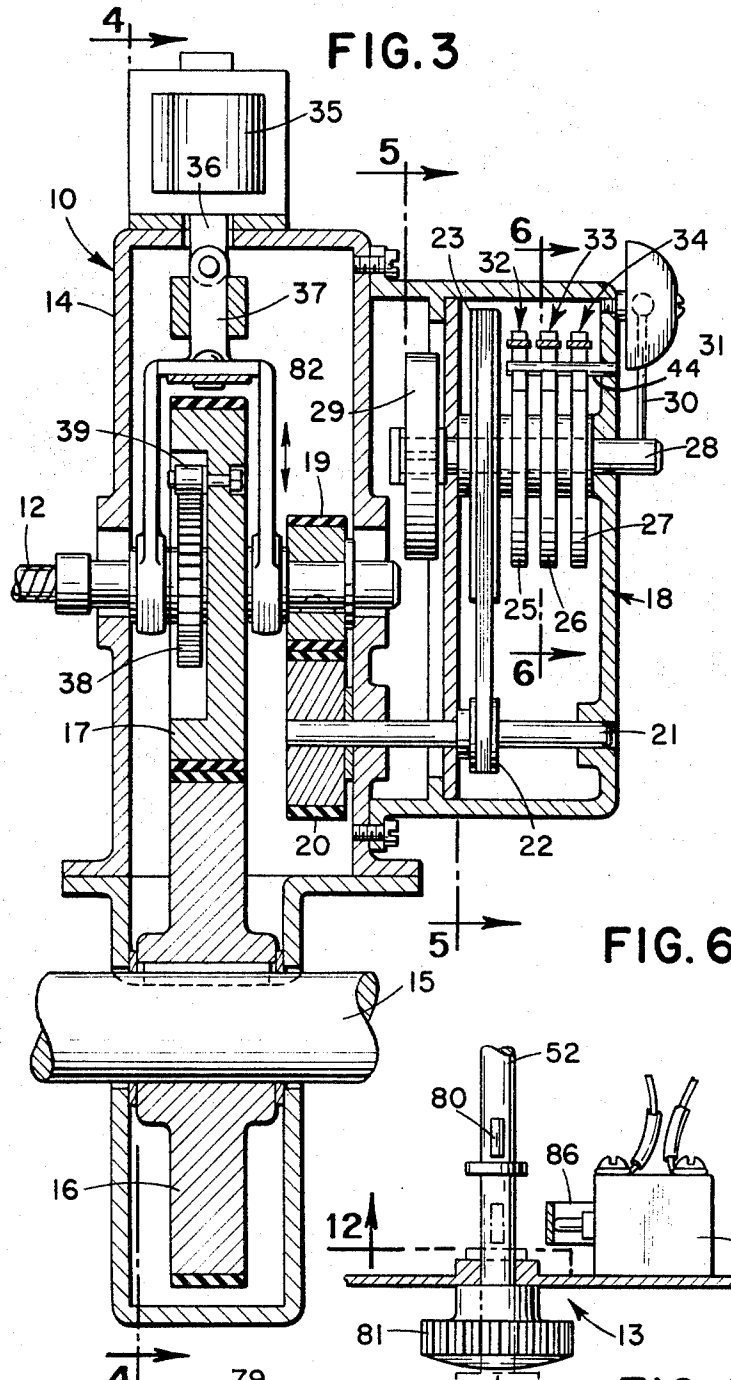


FIG. 5

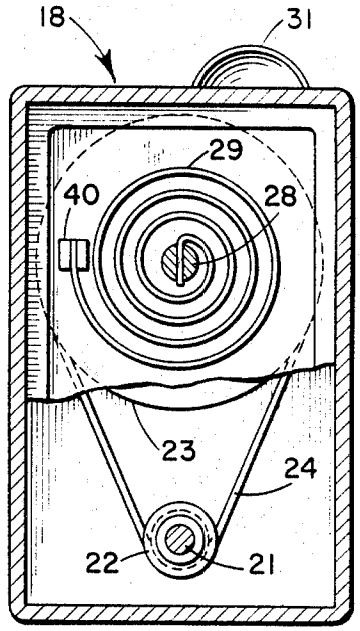


FIG. 6

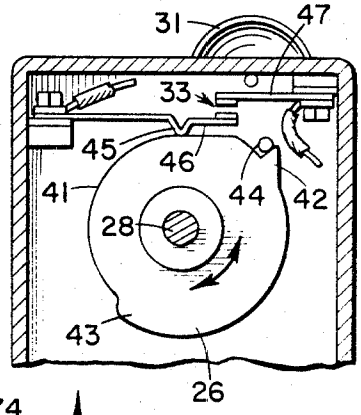


FIG. 11

FIG. 12

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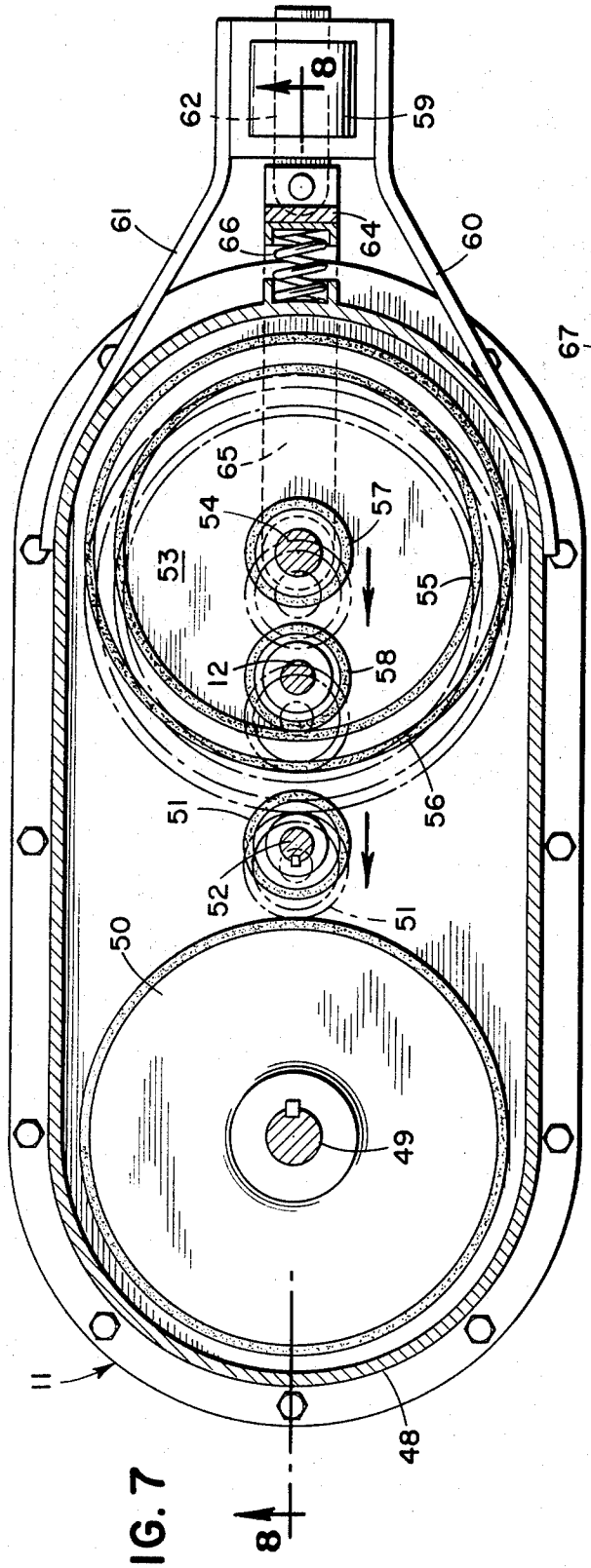


FIG. 7

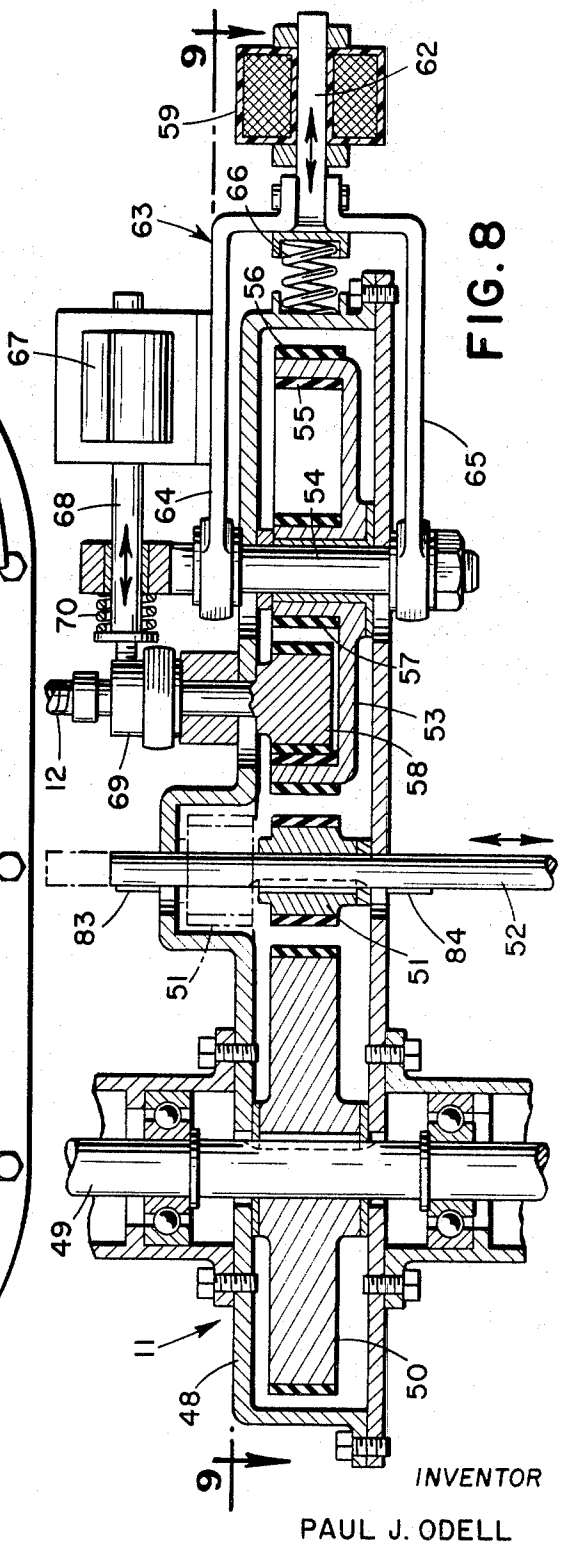
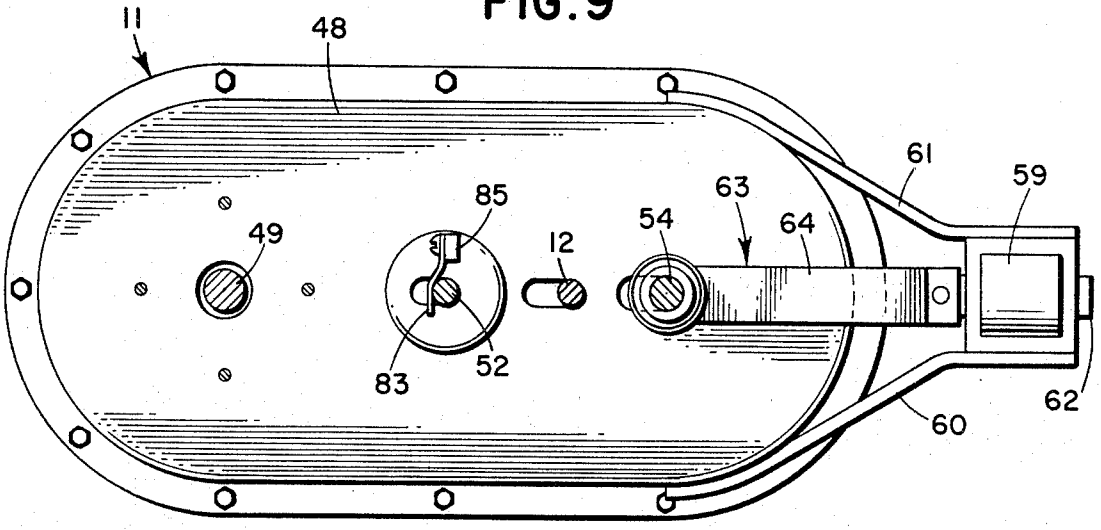


FIG. 8

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FIG. 9



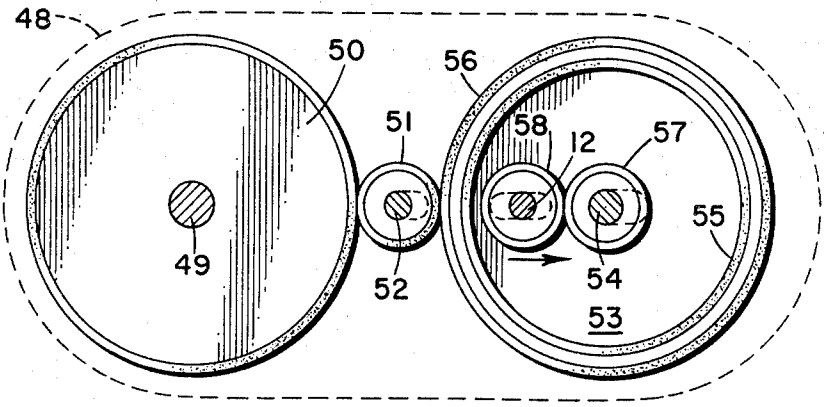
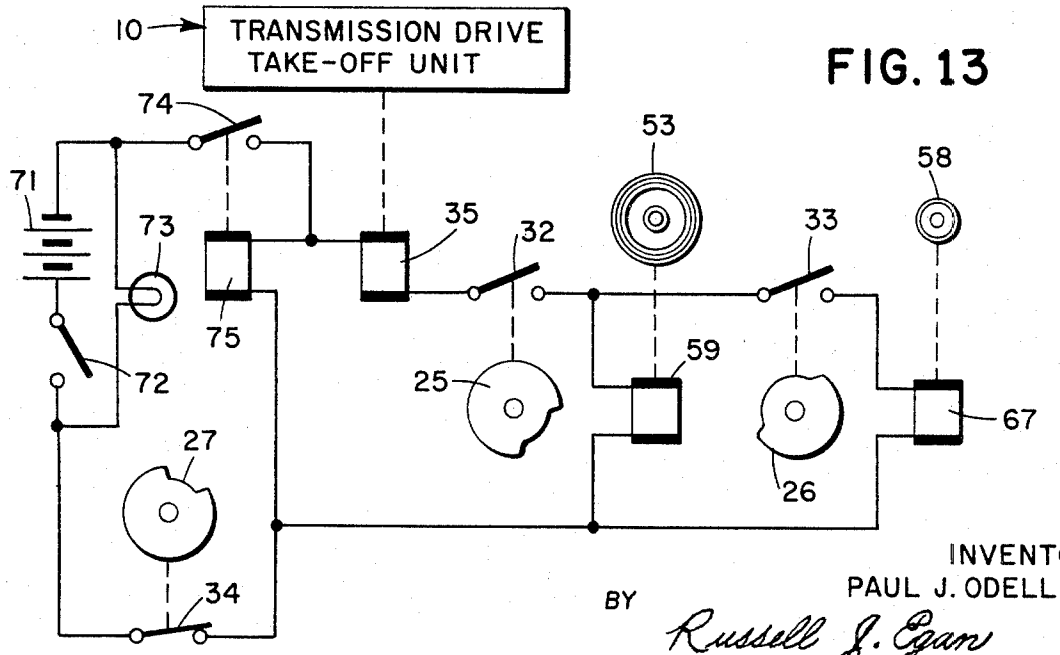


FIG. 10

FIG. 13



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AUTOMATIC PARKING DEVICE

The present invention is related to a device for automatically parallel parking an automobile vehicle.

It is well known that one of the most difficult maneuvers to effect accurately in driving an automobile is parallel parking. This maneuver is considered sufficiently difficult so that several states require the ability to parallel park in order to obtain a driver's licence.

The existing prior art devices have proved to be quite unsatisfactory. They generally have consisted of a fifth wheel mounted transverse to the other wheels. This wheel is selectively raised and lowered. It is driven in the lowered position to move one end of the car in relation to the curb. Such devices have been expensive and have greatly reduced the available space in the trunk.

Further parking devices have been proposed regarding power steering for cars. These devices will not operate on cars without power steering and generally merely provide selective control of the power steering device to execute the desired parking maneuver. These devices are also quite expensive.

It is therefore an object of the present invention to provide a device which will accurately and automatically effect parallel parking of an automobile vehicle with the minimum of assistance by the driver.

It is a further object of the present invention to provide an automatic parking device which will, upon actuation, effect the automatic and proper rotation of the steering wheels of the vehicle as the vehicle drives in a reverse direction to thereby automatically effect the parallel parking of said vehicle.

It is still another object of the present invention to provide a device which requires the driver to only pull the car even with the car immediately in front of the parking place, place the transmission into reverse, actuate the device, and depress the accelerator in order to effect automatic parking without manually turning the steering wheel.

It is still a further object of the present invention to provide a device which will effect automatic parallel parking of an automobile with or without power steering.

It is still a further object of the invention to provide an automatic parallel parking device which may be readily and economically produced.

The means for accomplishing the foregoing objects and other advantages, which will be apparent to those skilled in the art, are set forth in the following specification and claims, and are illustrated in the accompanying drawings dealing with a basic embodiment of the present invention. Reference is made now to the drawings in which:

FIG. 1 is a schematic plan view showing the steps of parallel parking an automobile;

FIG. 2 is a side schematic representation of the invention as it is associated with an automobile;

FIG. 3 is a vertical section through the drive shaft take-off unit of the invention;

FIG. 4 is a vertical section taken along line 4—4 of FIG. 3;

FIG. 5 is a vertical section taken along line 5—5 of FIG. 3;

FIG. 6 is a vertical section taken along line 6—6 of FIG. 3;

FIG. 7 is a plan view of the steering column control member;

FIG. 8 is a sectional view taken along line 8—8 of FIG. 7;

FIG. 9 is a view taken along line 9—9 of FIG. 8;

FIG. 10 shows the gear means connected to operatively drive the wheels in one direction;

FIG. 11 is a section through the dashboard of the automobile showing the actuating means;

FIG. 12 illustrates the actuating means and the manner of actuating the electrical system; and

FIG. 13 is a schematic diagram of the electrical system utilized with the present invention.

Turning now to FIG. 1, the steps of parallel parking involve first positioning car A with respect to car B so that they are substantially parallel with their rear bumpers in substantial alignment. The car A is then placed in reverse gear and the steering wheels thereof are rotated toward the right. As the car is backed to the position A', the rear end thereof is directed into the parking place at an angle with respect to the curb. After the car has travelled a distance which the driver feels is sufficient, the steering wheels are turned in the opposite direction, namely to the left, in order to complete the maneuver and swing the front end of the vehicle past the rear of vehicle B, with proper clearance, so that the car finally assumes a position shown in A'' with the car in substantial parallel relationship with and close to the curb. At this point the steering wheels are straightened to a forward position and the car is centered in the parking space. However, drivers rarely accomplish this maneuver accurately because of the problem of judging distances, etc. The present invention will accomplish all of the above maneuvers except for the final straightening to center the car in the parking space.

FIG. 2 shows the major components of the invention as they are attached to the vehicle. The major components are the drive shaft take-off unit **10**, the steering column control member **11** and a flexible drive cable **12** interconnecting said unit and said member. An actuating means **13** is provided on the dashboard for manually activating the system.

Turning now to FIG. 3, the drive shaft take-off unit **10** is enclosed in a housing **14** through which the drive shaft **15** passes. A drive shaft gear **16** is fixedly mounted on the drive shaft and selectively engages with a gear **17** which is fixedly attached to the flexible drive cable **12**. It should be noted here that all the gears of the invention have been shown as friction gears, that is, smooth surfaced gears covered with a suitable high friction material. Many materials are readily available to fulfill this purpose. Of course, toothed gears and the like can also be used.

A timing unit **18** is operatively connected to be activated by the flexible drive shaft as it is driven. The timing unit includes gears **19** and **20** which are connected to the flexible drive shaft and a shaft **21**, respectively. A pulley **22** is also fixedly mounted on the shaft **21**. The pulley **22** cooperates with a second pulley **23** by means of a flexible band **24** to rotate a series of at least three cams **25** to **27** which are mounted coaxially on a shaft **28** and spring-biased to a rest position by a coil spring **29** mounted on one end of shaft **28**. On the opposite end of the shaft **28** there is a clapper **30** which cooperates with a bell **31** in a manner which will be explained later. A series of electrical contacts **32** to **34** are mounted to be actuated by cams **25** to **27**, respectively. A solenoid **35** is mounted on the housing **14** with its armature **36** connected to a bracket member **37** for transversely moving the assembly comprising gear **17**, flexible drive shaft **12**, and gear **19** so that the gears **17** and **19** selectively engage with gears **16** and **20**. Bracket **37** and gears **17** and **19** are held up from contact with gears **16** and **20** by leaf spring **82** (FIG. 4) until solenoid **35** is activated. Also included in the gear **17** is a ratchet **38** and pawl **39** assembly, the operation of which will be described below.

FIG. 4 illustrates an end view of the embodiment of FIG. 3 showing the ratchet **38** and pawl **39** assembly. The purpose of this assembly is to insure that the flexible drive cable **12** will rotate in only one direction. namely only when the vehicle is being driven in reverse. The pawl **39** engages with the ratchet **38** to prevent a clockwise rotation of the flexible drive shaft.

FIG. 5 shows the coil spring **29** with one end fixed to the shaft **28** and the other end fixed by means **40**. The purpose of this spring is to insure repositioning of the cams to a neutral position when the drive of shaft **28** is discontinued.

FIG. 6 shows only the middle cam **26** and electrical contact **33** but is representative of each of the cams. Each cam **25** to **27** is fixedly mounted on the shaft **28** to rotate therewith and includes particular portions such as the profiled surface **41** and projections **42** and **43**. The cam is rotated in either direction until projection **42** or **43** engages with the stop bar **44** to prevent further rotation of the cam. A projection **45** on movable contact **46** rides on the profiled surface **41** and selectively raises and lowers to make and break contact with the stationary contact **47**. When the movable and fixed contacts are engaging, then a solenoid will be energized to effect the desired control. This will be further explained later in connection with the electrical circuit shown in FIG. **13**.

Turning now to the steering column control member of the invention, FIG. 7 shows a section view through the housing **48** and includes the steering column **49** with a steering gear **50** fixedly mounted thereon. A connecting gear **51** is mounted on a shaft **52** for manual axial movement and automatic transverse movement. Main gear **53** is mounted on a shaft **54** and has an inner driving surface **55**, an outer driving surface **56**, formed on respective sides of an upstanding peripheral flange, and a hub driving surface **57**, which constitutes an enlarged portion of the hub of the main gear **53**. A driving gear **58** is mounted on the flexible drive shaft **12** and is selectively transversely movable to engage with either inner driving surface **55** or hub driving surface **57** of the main gear **53**. Since the flexible drive shaft **12** is driven in rotation in only one direction, it is clear that the selective engagement of the driving gear **58** with driving surfaces **55** and **57** will effect rotation of the gear **53** in either direction as necessary. The outer driving surface **56** selectively engages with the connecting gear **51** and through said connecting gear effects rotation of steering gear **50** in a direction according to the selective contact of the drive gear **58** with driving surfaces **55** and **57**.

FIG. **8** shows a section view of the steering column control member and the manner in which the gears **50, 51, 58** and **57** selectively contact one another. The connecting gear **51** has three positions, the first of which is shown in broken lines in FIG. **8** and represents a disengaged position wherein the parking device is deactivated. The second position is shown in solid lines and represents the positioning of the connecting gear after the manual control has been pulled to initiate actuation of the parking device. The connecting gear **51** is normally held away from contact with steering gear **50** by leaf springs **83** and **84** bearing against shaft **52** and suitably fixed by means **85** on opposite sides of housing **48**. The third position is shown in broken lines in FIG. **7** and represents the position assumed when main gear **53** has been moved to the left by energization of solenoid **59** thus causing a frictional engagement of gears **50, 51** and **53**.

The transverse movement of the main gear **53** is accomplished by means of the solenoid **59** which is mounted on the housing **48** by means of braces **60** and **61**. The armature **62** of the solenoid is connected to a bracket **63** having arms **64** and **65** through the ends of which the shaft **54** passes. The main gear **53** is mounted on the shaft **54** so that when the armature **62** of the solenoid **59** is moved to the left, the main gear **53** is accordingly moved to the left till its outer driving surface **56** engages with the connecting gear **51**. The return movement of the main gear to the position shown is effected by means of the compression spring **66** which biases the bracket to the position shown in FIG. **8**.

The transverse movement of driving gear **58** is accomplished by means of the solenoid **67** which is fixedly mounted on one arm **64** of the bracket **63** so as to be moved transversely therewith. The armature **68** of the solenoid **67** is connected through a bearing **69** to the flexible drive shaft **12** on which the drive gear **58** is mounted and effects transverse movement of this gear with respect to the driving surfaces **55** and **57** of the main gear **53**. Return movement of the drive gear **58** is effected through means of the compression spring **70**. Since the solenoid **67** and its associated parts are fixedly mounted with respect to the axis of the main gear **53**, as the main gear is moved transversely with respect to its own axis, the drive gear **58** will likewise be moved without losing its relative position to the main gear driving surfaces **55** and **57**.

FIG. **9** shows the housing **48** and the manner in which the housing is slotted to allow the transverse movement of the various shafts supporting the gears.

FIG. **10** shows the driving gear **58** in contact with hub driving surface **57** of main gear **53**; thereby reversing the rotation of steering column **49** from that shown in broken lines in FIG. **7**.

FIGS. **11** and **12** show the actuating means **13** mounted on the dashboard of the vehicle. The knob **81** is mounted on the end of shaft **52** and is moved axially to displace connecting gear **51**. The dashed line position of knob **81** corresponds to the solid line position of connecting gear **51** in FIG. **8** and vice versa. After the knob and shaft have been pulled axially, they are rotated until arm **80** depresses switch lever **86** of switch **74** and thereby closes the electrical circuit of the device. A compression spring **79** normally biases the lever away from the switch which will normally be in an open position.

The knob **81** preferably should have some marking on its face to indicate to the driver its relative angular positioning. The actuating means can further include a safety switch, preferably mounted to the driver's left, and status light. These elements are both shown in the electrical schematic in FIG. **13**.

The operation of the inventive device will be explained with respect to the electrical schematic shown in FIG. **13**. The source of current is the battery **71** and the system is initially energized by closure of a safety switch **72** preferably located on the instrument panel to the left of the driver as mentioned above. When the switch is turned on it preferably should light a status warning light **73** to inform the driver that the system is energized.

As soon as the car has been positioned at A, as shown in FIG. **1**, with the rear bumper in substantial alignment with the rear bumper of parked car B, the knob **81** of the actuating means **13** is pulled out about an inch and turned to the right as seen in dotted lines in FIGS. **11** and **12**, respectively. As the actuating means is turned it closes main switch **74** which is held closed by a holding solenoid **75** until said solenoid is deenergized by opening contact **34**, the working of which will be explained later. When the actuating means is pulled out it also brings the connecting gear **51** into position for contact with the main gear and the steering gear (FIG. **8**). The current passes through solenoid **35** which moves the bracket **37** to place the gear **17** in contact with the drive shaft gear **16**. The transmission is then placed in reverse so that, as the car is driven in reverse, the drive shaft **15** will turn the drive shaft gear **16** and gear **17** to likewise drive flexible drive cable **12** and connecting gear **51**. As the flexible drive cable **12** turns it also drives the timer through gears **19** and **20** in a manner similar to timers of automatic washing machines and the like. The first cam **25** closes contact **32** to energize solenoid **59** which pushes the main gear **53** transversely against the connecting gear **51** which in turn is pushed against the steering gear **50**. The second cam **26** closes contact **33** to energize solenoid **67** which pulls the driving gear **58** against the hub driving surface **57** of the main gear **53** causing it to drive in one direction. The third cam **27** opens contact **34** to cut off current to the holding solenoid **75** which releases the main switch to return to its normally open position. The current is now cut off, except for light **73**, and the coil spring **29** rotates shaft **28** to return the three cams to their original position and cause bell **31** connected to the housing **14** to be struck by the clapper **30**, secured to shaft **28** (see FIG. **3**), thus audibly indicating to the driver that the current has been shut off and that the safety switch **72** should now be turned off to completely de-energize the system.

In order to completely explain the operation of the parking device, it is necessary to go into the details concerning the mathematics involved, the diameters of the various gears, and the distance the car will travel when the steering wheel is turned to the right and the distance when turned to the left to put the car into its ultimate parking position.

A car with a gear ratio of 3:1 is used in the example. The wheels are 26 inches in diameter and in one rotation of the wheels the car travels 6.81 feet. The distance the car will travel backward as it is parked will be around 20 feet and three rotations of the wheels add up to 20.40 feet. This figure of 20.40 feet will be used to show the distance the car is backed in the process of parking. The drive shaft revolves three times in order to rotate the rear wheels once. Therefore the flexible drive cable will make four revolutions to three revolutions of the drive shaft. Since the rear wheels will have to make three complete revolutions in order to go the full distance of 20.40 feet, the flexible shaft will revolve 12 times.

Therefore, for each rotation of the flexible drive cable, the car will move approximately 1.7 feet.

The main gear in the steering gear has an outside diameter of five inches and the hub within the main gear is one and one half inches in diameter. The drive gear on the end of the flexible drive cable is also one and one half inches in diameter and it is spring biased against the inner driving surface of the main gear. Since the steering gear has the same outside diameter as the main gear, it is readily seen that as the main gear makes one complete revolution, the steering gear also makes one revolution.

To turn the front wheels of the car in one direction from center, the steering gear has to make two revolutions. In order to avoid jamming of the steering wheel, one and three fourths turns should e sufficient. With these measurements in mind, it will take five and five sixths revolutions of the flexible drive cable to turn the steering gear one and three fourths turns to the right in order to back the car 9.92 feet. When this is accomplished, the steering gear has to be turned one and three fourth turns in the opposite direction to straighten the front wheels. This is accomplished by solenoid **67** connected to the drive gear. This solenoid pulls the drive gear against the hub driving surface and turns the main gear in the opposite direction. The drive gear and steering gear turn one and three fourths turns and the car travels 2.975 feet.

The car then backs 4.53 feet in a straight line. This is accomplished by solenoid **59** which disengages the main gear from the steering gear. The straight movement of the car takes two and two thirds revolutions of the drive gear. As the car reaches this phase of the parking cycle, the front of the car should clear the rear bumper of the car B in front of the parking space. The steering gear is then turned to the left one and three fourths turns and the car backs an additional 2.975 feet. This is accomplished by the solenoid **59** which engages the main gear and the steering gear. This is the end of the parking cycle and the mechanism will shut itself off and the gears and cams will return to their original positions. All that remains for the driver to do is to manually turn the steering wheel to a center position and center the vehicle in the parking space. Also the knob must be depressed to remove the connecting gear **52** from a connecting position with the other gears.

The purpose of the timer is to activate the two solenoids **59** and **67** and to shut the current off at the end of the cycle. When the current is shut off, spring **29** on the timer brings the three cams back to their initial position and also rings the bell as mentioned. The timer is geared to the flexible drive shaft so that when the cable makes twelve revolutions, a three and one half inch diameter wheel is rotated **309°**. Dividing 309° by 12, the number of times the flexible cable rotates, gives 25.75°. This represents the number of degrees the three disks will travel in one revolution of the flexible drive cable. When the switch is turned on by turning the knob to the right, after it has been pulled out and the car starts to move backwards, the first cam will energize the solenoid **59** which pushes the main gear against the connecting gear and the steering gear. The steering gear should then turn to the right one and three quarter turns. The rear wheels of the car travel 9.92 feet backwards and the flexible drive cable turns five and five sixths revolutions and the cam disks turn 150.21°. At this point the steering gear has to turn one and three quarter turns in the opposite direction. This is accomplished by the second cam which energizes the solenoid **67** which pushes the drive gear against the hub of the main gear and causes the main gear to be rotated in the opposite direction. During this part of the operation the car will back up 2.975 feet. The drive gear will turn one and three fourths turns and the timer cams will move through an arc of 45.06°. During this time the front wheels of the car should be straight, since the main gear and the steering gear are disconnected so that the car backs straight. This is accomplished by the first cam which controls solenoid **59**. The third part of the operation will be to back the car in 4.53 feet, the flexible drive cable will make two and two thirds revolutions and the timer cams will rotate 68.67°.

At this point the front bumper of the car A should miss the rear bumper of the car B in front of the parking space. The steering gear is again turned to the left one and three quarter turns to place the car against the curb. In doing so the rear wheels travel an additional 2.975 feet, the flexible drive cable revolves one and three quarter turns and the timer cams revolve through an arc of 45.06°. The cycle is now ended and the mechanism is in its original position. This is accomplished by the third cam on the timer which shuts off the current to the holding coil which holds the spring part of the main switch **74** closed.

The current to the mechanism is now shut off and the knob, which activates the main switch, is rotated and pushed in, making sure that the arrow points straight up. The connecting gear is now pushed out of alignment with the other gears and the steering wheel is ready for manual operation. Last of all the safety switch on the dashboard should be switched off.

Appearing herebelow is a chart which represents the above hypothetical case showing the direction of rotation of the steering wheel together with the number of turns of the individual components. It must be realized there are many different cars on the market having different gear ratios, wheel bases, diameter of tires, steering wheel ratios, etc. and that the above example is used for illustrative purposes only.

DATA CHART

Direction of Steering Wheel	No. of Turns	Timer Travel No. of Deg.	Rev. of Cable	Distance Car Travels
To Right	1¾	150.21°	5 5/6 times	9.92 Ft.
To Left	1¾	45.06°	1¾ "	2.975 "
On Center		68.66°	2⅔ "	4.53 "
To Left	1¾	45.06°	1¾ "	2.975 "

The present invention may be embodies in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore to be embraced herein.

I claim:

1. A device for automatically parallel parking automotive vehicles having a steering means including steering wheels, a steering post controlling said steering wheels and a transmission means having a reverse gear and drive shaft, said device comprising first gear means fixedly mounted on said steering post, second gear means operatively connected to be driven by said drive shaft, means to operatively connect said second gear means to drive said first gear means, and timing means controlling the direction of rotation of said first gear means, said first gear means comprising a main gear means having an upstanding peripheral flange forming an outer driving surface and an inner driving surface and a hub driving surface, all of said driving surfaces being co-axial, a drive gear means mounted to selectively engage with said inner driving surface and said hub driving surface and being driven in a single direction by said means connecting said first and second gear means so that upon selective engagement of said drive gear means with said inner driving surface and said hub driving surface, said main gear means will be driven in either direction, a steering gear means fixed to said steering post, and connecting gear means selectively positioned to contact said steering gear means and the outer driving surface of said main gear means, whereby upon placing said connecting gear means in driving connection with said steering gear means and said main gear means and said transmission in reverse gear, the steering wheels of said vehicle are rotated in a first direction as said vehicle is backed up and then rotated in the opposite direction to complete parallel parking of said vehicle.

2. A device according to claim 1 wherein said connecting gear means is both selectively axially movable to be positioned between said main gear means and steering gear means and transversely movable to provide a driving connection between said main gear means and said steering gear means.

3. A device according to claim 1 further comprising selectively energized solenoid means operatively connected to effect contact of said drive gear means with said inner and hub driving surfaces and effecting driving contact between said steering gear means, connecting gear means and outer driving surface of said main gear means.

4. A device according to claim 3 wherein each said gear means and driving surfaces are covered with a friction drive surface.

5. A device according to claim 4 further comprising warning lamp means connected to said solenoid means and energized when said device is operative.

6. A device according to claim 3 wherein said timing means comprises a plurality of cam means spring-biased to a rest position, drive means connected to and driven by said means operatively connecting said first and second gear means, said drive means driving said cam means in rotation against said spring-biasing, switching means responsive to said cam means and operatively connected to energize said solenoid means.

7. A device according to claim 6 further comprising audio means responsive to said cams returning to their rest position thus indicating the end of the automatic parking maneuver.

8. A device according to claim 1 wherein said second gear means comprises a first gear fixedly mounted on said drive shaft, second gear movably mounted to selectively drivingly engage with said first gear, and said means operatively connecting said first and second gear means comprises a flexible shaft connected to and driven by said second gear.

9. A device according to claim 8 further comprising solenoid means operatively connected to effect driving connection of said first and second gears.

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