United States Patent

[11] 3,580,497

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[21] Appl. No. **828,486**
[22] Filed **May 28, 1969**
[45] Patented **May 25, 1971**

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[54] **TAMPER PREVENTION APPARATUS FOR ODOMETER**
20 Claims, 17 Drawing Figs.

[52] **U.S. Cl.** **235/96**
[51] **Int. Cl.** **G01c 22/00**
[50] **Field of Search** 235/95, 96, 1, 117, 131, 91

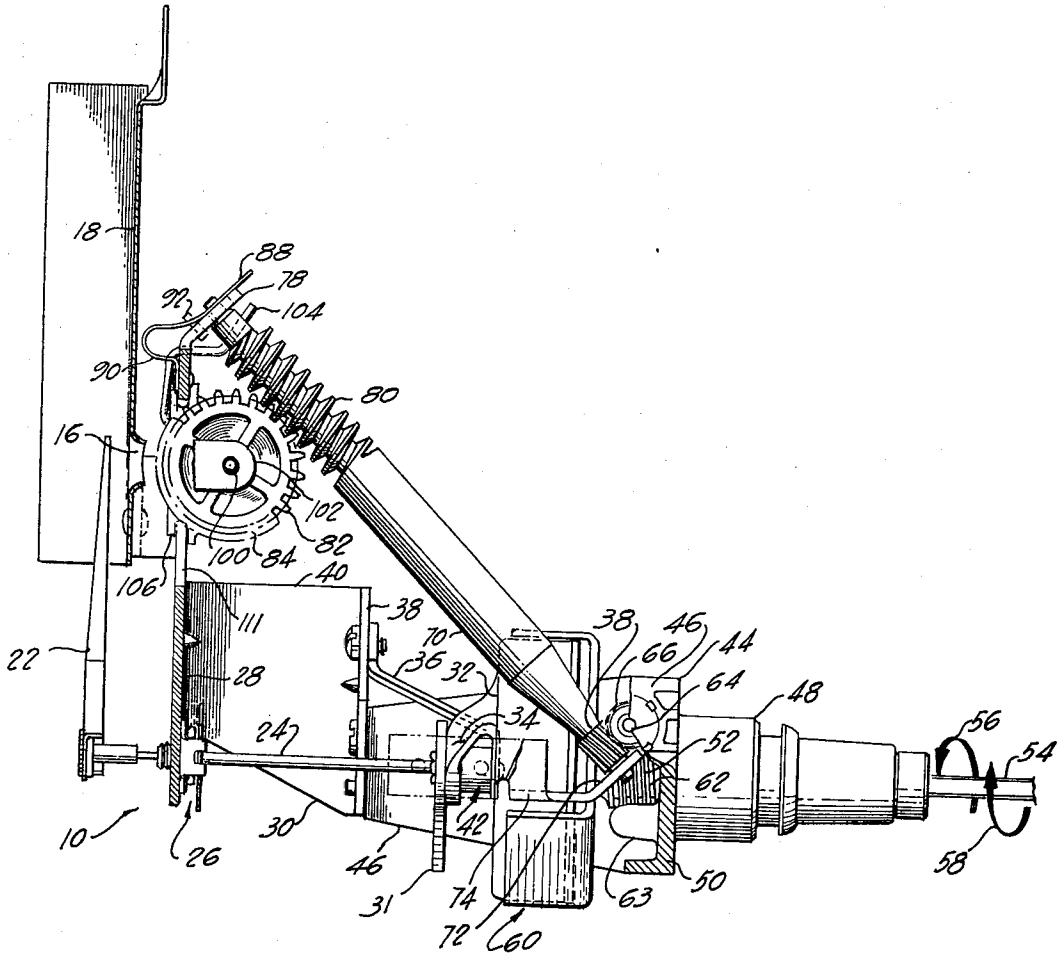
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ABSTRACT: The following specification describes an arrangement for locking a counter or odometer on subtractive operation together with a clutch automatically operated on locking to disengage the gear train and avoid damage to the train and effective on normal or additive operation to engage the gear train. A simple spring biased ratchet arrangement between one of the drive wheels and an adjacent higher digit order wheel is also used to permit additive operation and prevent subtractive counter or odometer operation. An additional feature provides a signal in the event of tampering with the odometer by moving one of the higher digit order dials.



PATENTED MAY 25 1971

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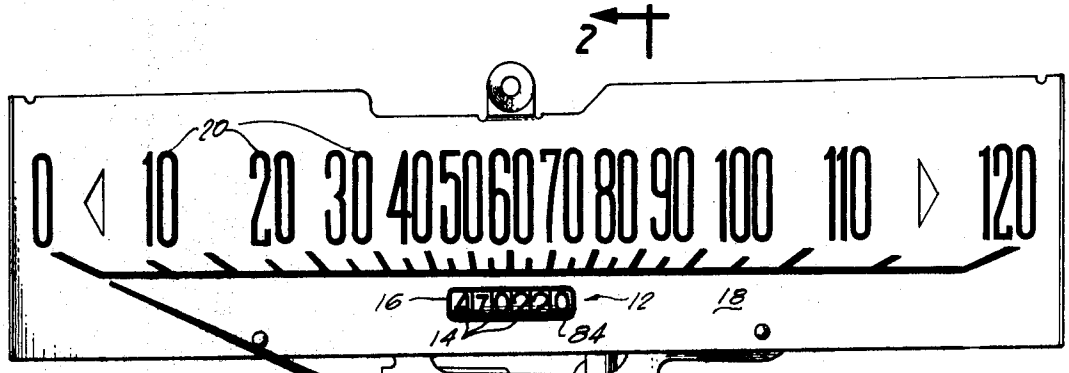


FIG. 1.

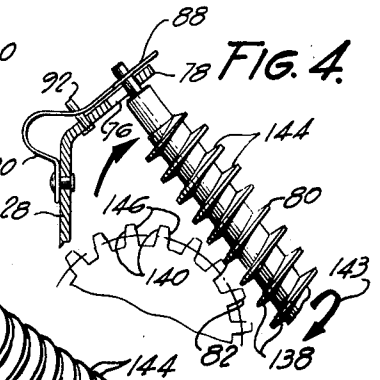


FIG. 4.

FIG. 3.

FIG. 2.

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FIG. 6.

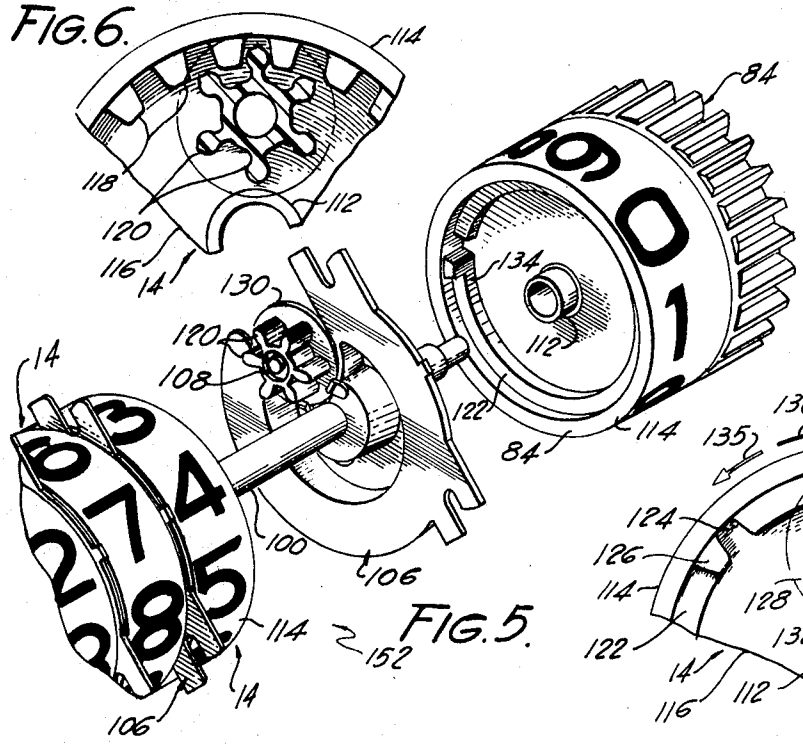


FIG. 5.

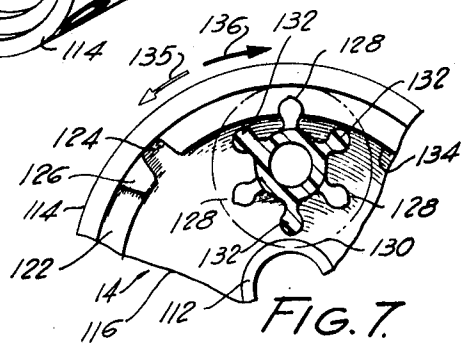
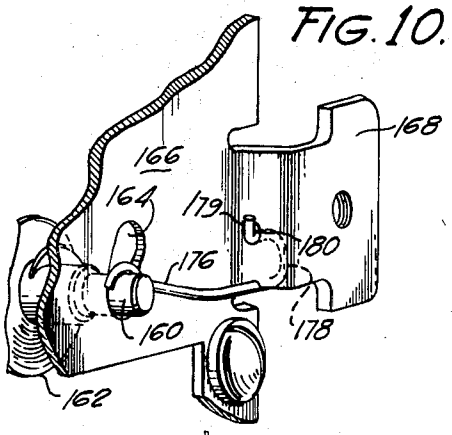


FIG. 7.

FIG. 10.



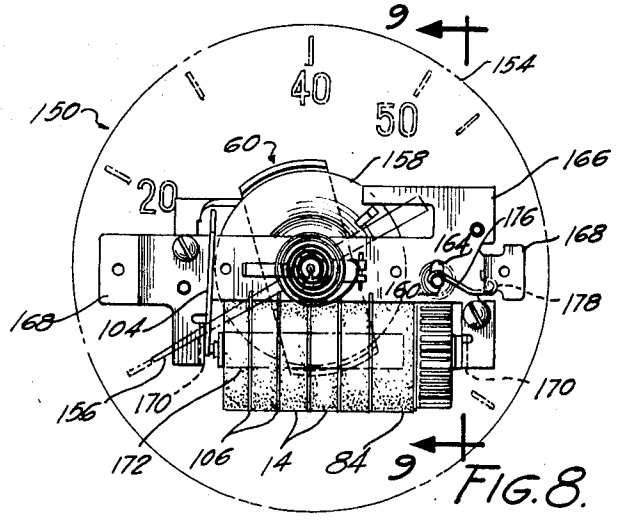


FIG. 8.

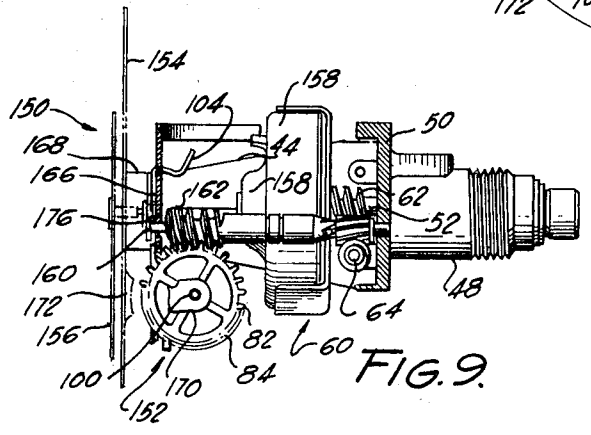


FIG. 9.

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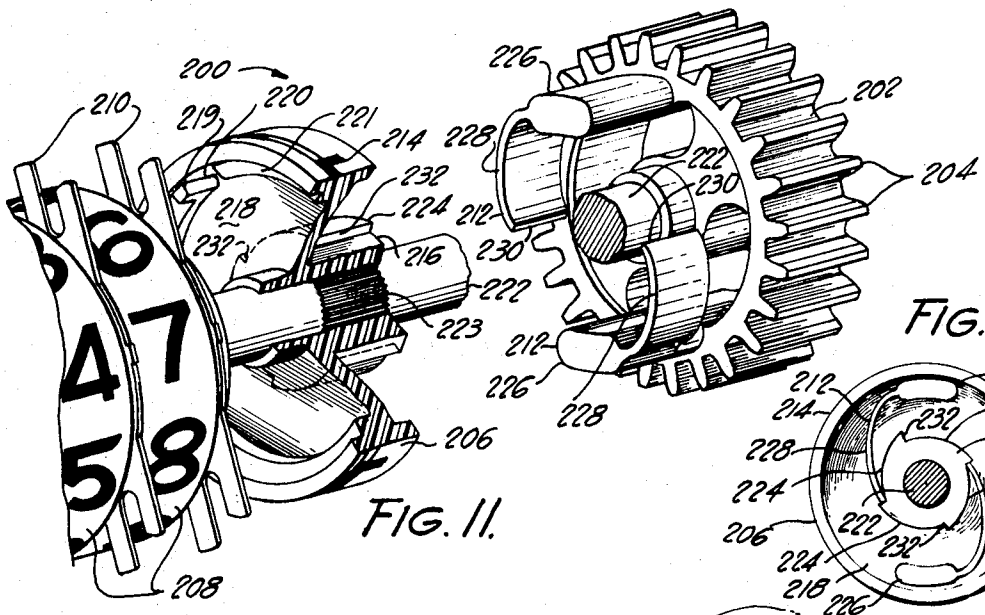
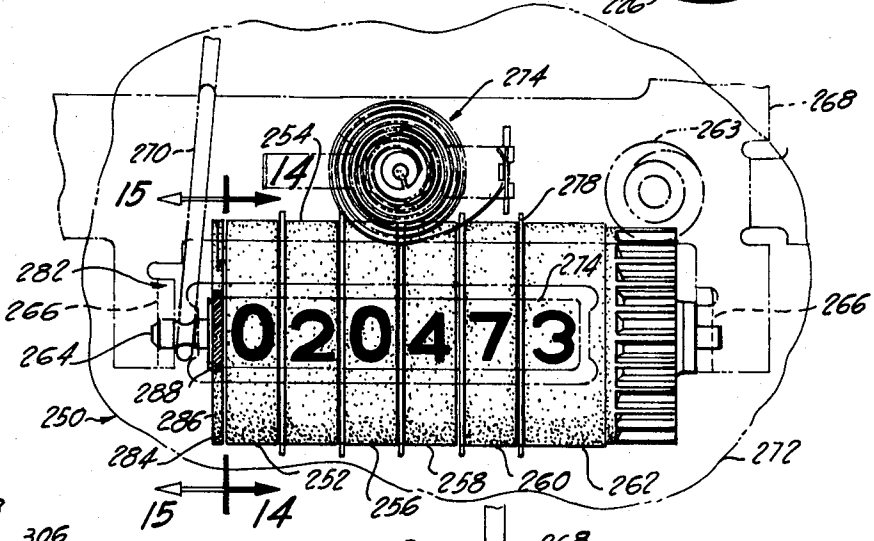


FIG. 11.

FIG. 12.

FIG. 13.



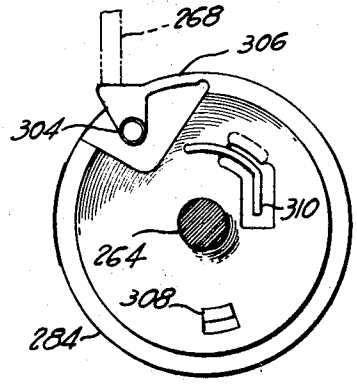


FIG. 15.

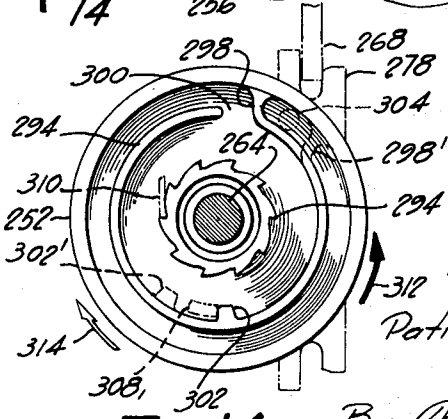


FIG. 14

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FIG. 16.

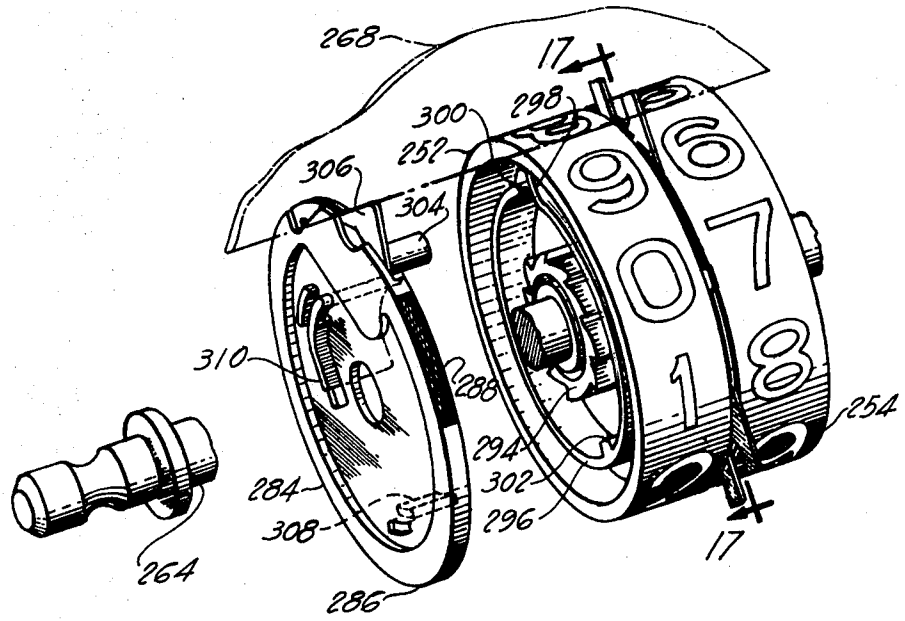
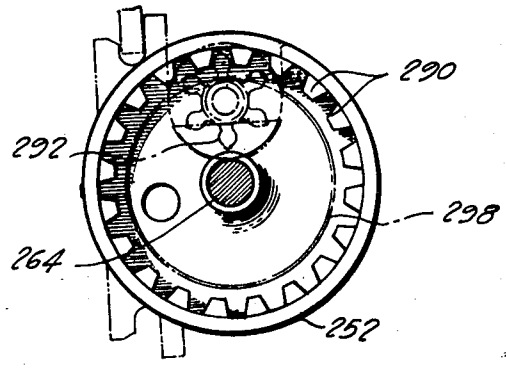


FIG. 17.



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TAMPER PREVENTION APPARATUS FOR ODOMETER

FIELD OF THE INVENTION

This invention relates in general to counters or odometers and more particularly to an improved tamper proof odometer.

Tampering with an odometer, which records the number of miles the associated vehicle has been driven, is commonly done for either enhancing the sales possibilities of the vehicle or to take advantage of the warranty mileage. In either event the odometer is driven in a subtractive or reverse direction to lower the recorded mileage, thereby tampering or falsifying the indicated vehicle use provided by the odometer. Similar situations may arise with other types of counters such as hour meters or just ordinary dial counters. A counter or odometer may be set back by either operating the same in a subtractive or reverse direction as compared with an additive or normal direction. Some counters are normally driven in a subtractive direction and it will be noted that for the purpose of this invention such operation will be considered additive or normal. A counter may also be set back by spreading several of the higher digit order dials to provide access to the pinion therebetween and momentarily disengaging the pinion from the higher digit order dial to permit movement in the reverse direction of the higher digit order dial to indicate a lower digit.

In the case of odometers, operation of the vehicle in reverse normally drives the odometer in the reverse direction. Locking the odometer against reverse operation presents problems in normal operation of the vehicle since either the locked odometer or its drive train may be damaged during reverse operation.

Alternatively, a clutch arrangement which permits the odometer to be driven in the forward or normal direction and which slips on driving of the odometer in the reverse direction is either of uncertain operation or relatively expensive.

SUMMARY OF THE INVENTION

To solve the above problems the present invention proposes a tamper proof odometer in which one of the transfer teeth on the first odometer dial or drive wheel is omitted to prevent the odometer dial train from being operated in the reverse direction. Since this causes both odometer and drive train to lock, a clutch must be provided to disengage the locked odometer from the source of driving power in order to avoid damage either to the odometer or to the drive train.

For this purpose an economical and effective clutch arrangement is provided for automatically disconnecting the drive train on locking of the odometer to prevent damage to the drive train during operation of the vehicle. The clutching arrangement takes advantage of the worm wheel in the odometer drive train by enabling the worm wheel shaft to pivot against a spring bias for allowing the worm wheel to disengage from the odometer drive wheel and, on relief of the reverse driving force, the spring bias is effective to return the worm wheel to its odometer driving position.

In an alternative or additional arrangement a pair of ratchet arms extending from the first odometer drive wheel drive the odometer through its conventional gear teeth on movement of the drive wheel in one direction, but on reversal of the drive, the ratchet arms act as spring fingers and disengage from the odometer gear teeth to avoid operating the odometer in reverse.

In addition, a ratcheted signal cam is provided adjacent the last dial in the odometer dial train, since this is the dial registering miles in 10,000 units and its position is most often altered. If the last dial or wheel is rotated backwards, the signal cam is rotated a small increment and then disengaged to indicate the tampered condition in the window of the odometer. Likewise, if the fourth digit order or 10,000ths dial was indicating 9, and it were rotated forward to indicate a zero, the signal dial is rotated a small increment to indicate either a tamper condition or that the vehicle is driven, for example, over 99,999 miles.

Accordingly, it is one object of the present invention to provide an odometer having improved means for preventing tamper.

It is another object of the present invention to provide a counter or odometer which is operable in one direction only.

It is another object of this invention to provide an economical clutch between a driving source and a counter for connecting the counter to the driving source for operation in one direction and operable only in response to said counter being driven in the reverse direction.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front elevational view of a speedometer and odometer instrument with the case or housing therefor omitted;

FIG. **2** is a sectional view taken along the line **2–2** in FIG. **1**;

FIG. **3** is a fragmentary isometric view of the transfer shaft worm wheel, drive wheel and clutch arrangement;

FIG. **4** is a fragmentary side elevation illustrating the position of the declutched worm wheel and drive wheel;

FIG. **5** is an exploded isometric view of the drive wheel, associated pinion and bracket and adjacent dials;

FIG. **6** is a fragmentary side elevation illustrating the cooperation of a pinion and adjacent teeth on a higher digit order dial;

FIG. **7** is a fragmentary side elevational view illustrating the cooperation of pinion and the teeth on a lower digit order dial;

FIG. **8** is a front elevational view of a combined speedometer and odometer assembly;

FIG. **9** is a side elevational view taken along the line **9–9** in FIG. **8**;

FIG. **10** is a fragmentary view illustrating the spring clutch for the odometer;

FIG. **11** is an exploded isometric view illustrating a spring ratchet connection between the odometer drive wheel and the adjacent dial;

FIG. **12** is a side elevational view illustrating normal cooperation between the ratchet and teeth shown in FIG. **11**;

FIG. **13** is a front elevational view of an odometer using a signal dial to indicate tampering;

FIG. **14** is a sectional view taken along the line **14–14** in FIG. **13** and looking in the direction of the arrows;

FIG. **15** is a sectional view taken along the line **15–15** in FIG. **13** and looking in the direction of the arrows;

FIG. **16** is an exploded isometric view of the signal dial and related odometer dial; and

FIG. **17** is a sectional view taken along the line **17–17** in FIG. **16** and looking in the direction of the arrows.

In FIG. **1** a speedometer is indicated by the reference character **10** and it has conventionally associated therewith an odometer assembly **12**.

The odometer assembly **12** comprises a series of odometer dials or wheels **14** each marked with digit indicia 0—9 and viewed through a window **16** in a dial **18** for the speedometer. The dial **18** is marked with digit indicia **20** for indicating vehicle speed in accordance with the angular position of a pointer or indicator needle **22** supported on the reduced end of a pointer shaft **24** seen in FIG. **2**. The pointer shaft **24** is journaled adjacent one end and biased toward the zero indicia on the dial by a conventional bearing and torsion spring assembly **26** located in the front wall **28** of U-shaped bracket **30**.

The other end of the pointer shaft **24** supports a counterweight **31** and an aluminum speed cup **32** spaced beyond the shaft end by means of an arm **34** formed on the cup and fastened to the shaft **24**. A second arm **36** extending from a tab **38** on one side leg **40** of the bracket **30** carries a bearing assembly **42** for rotatably supporting the other end of the pointer shaft **24**. The bracket **30** in turn is carried by a U-shaped frame member **44** with side legs **46** of the frame member fastened to respective tabs on the side legs **40** of the bracket **30**.

A boss 48 projects rearwardly from rear leg 50 of the U-shaped frame member 44 and carries a rotatably magnet shaft 52 axially aligned with the pointer shaft 24. Magnet shaft 52 is rotated by the tip of a flexible shaft 54 or coupling element connected from the shaft 54 to the shaft 52 with the forward or additive direction of rotation indicated by arrow 56 and the subtractive or reverse direction indicated by arrow 58, respectively. A magnet assembly 60 is located on the end of magnet shaft 52 between side legs 46 of frame member 44. Magnet assembly 60 includes field poles and a magnet which sandwich the rim of speed cup 32 for conventionally driving the speed cup 32 and the pointer shaft 24 to indicate the speed of the vehicle in which the speedometer is mounted.

The magnet shaft 52 has worm gear teeth 62 formed thereon intermediate the magnet assembly 60 and the rear leg 50 of the frame member 44. Worm teeth 62 engage a helical gear adjacent one end of a cross shaft 64 journaled at the one end in a boss such as 63 projecting from the rear leg of the frame member 44. The other end of shaft 64 is journaled in one of the side legs 46 of frame member 44 and carries a worm gear 66. Worm gear 66 engages a helical gear 68 adjacent one end of a transfer shaft 70.

The end of shaft 70 is journaled in a tab 72 formed on a bracket 74 fixed to the adjacent side leg 46 of bracket 44. The other end of the transfer shaft 70 is journaled in a slot 76 having an elongate axis parallel to the elongate axis of a tab 78 in which the slot 76 is formed. Worm gear teeth 80 are formed on shaft 70 adjacent tab 78 for engagement with pinion teeth 82 formed adjacent one end of a drive wheel 84 to rotate the wheel 84 once for each one-tenth mile traveled by the vehicle.

The tab 78 projects upwardly and rearwardly at about a 45° angle from the upper edge of the front wall 28 of bracket 30 and parallel to the tab 72 so that shaft 70 lies at about a 45° angle to the horizontal and vertical planes passing through the axis of rotation of the drive wheel 84, as seen in FIG. 2. The end of shaft 70 actually projects beyond the tab 78 to engage in a hole 86 of a spring 88 with hole 86 enlarged about a portion of the shaft periphery to minimize wear.

The spring 88 comprises a leg 90 fastened at one end to wall 28 and bent back at the other end so as to lie parallel to and adjacent tab 78. The engagement between the upper edge of the hole 86 and shaft 70 tends to bias the shaft downward for engaging teeth 80 with teeth 82, while upward movement of the shaft is resisted by flexure of leg 90 about its fastened position. A guide pin 92 on tab 78 engages in a slot 94 of the spring 88 to maintain alignment of the spring.

The drive wheel 84 is provided with digit indicia from 0—9 along its outer periphery adjacent the end opposite the teeth 82 and functions as the lowest digit order dial for registering one-tenth mile increments. The dials 14 and 84 are assigned successively higher digit orders from right to left, as seen in FIG. 1, and are rotatably carried on a shaft 100, with the dial 14 to the far left as seen in FIG. 1 registering each 10,000 miles traveled by the vehicle by displaying a corresponding digit 0—9 in window 16. The shaft 100 is supported at one end by an inwardly extending tab 102 with a conventional spring clip 104 holding the opposite end of shaft 100 in a slot formed in another tab.

A bracket 106 and a pinion 108 seen in FIG. 5 rotatably supported on the bracket 106 are located between each pair of dials 14 and between the drive wheel 84 and the adjacent dial 14 for transmitting movement between adjacent dials. The brackets 106 each have one or more recessed ears with either one of the recessed ears engaged over the respective edge of an elongate slot 111 in the wall 28 to align one digit on each dial with the window 16.

The odometer dials 14, pinions 108 and brackets 106 are either conventionally formed or, for example, as shown in U.S. Pat. No. 3,432,096, issued Mar. 11, 1969 to Powell. Each dial 14 and drive wheel 84 are conventionally formed with a hub 112 rotatable about shaft 100 and a rim 114 interconnected with the hub 112 by a disc 116 intermediate the rim ends. The outer surface of each rim 114 is marked with the digit indicia and the inner surface of each rim is provided with two sets of gear teeth.

One set of 20 gear teeth 118 extends circumferentially around the inner surface of the respective dial rim 114 and lies on the side of the respective disc 116 facing the adjacent lower digit order dial or the drive wheel 84. Teeth 118 engage with axially extending teeth 120 on the associated pinion 108 adjacent the lower digit order side of the respective dial. The side of each disc 116 facing the higher digit order dial is provided with a circumferential ridge such as ridge 122 on drive wheel 84 adjacent the junction with rim 114 and the other gear teeth for each dial are formed by a recess, such as recess 124, in the ridge 122 and an axially extending tooth such as 126 on each side of the recess 124.

For drive wheel 84 only one axially extending tooth 126 is formed adjacent the recess 124 in the ridge 122; however, for each of the dials 14, an axially extending tooth such as 126 is conventionally formed at each side of recess 124. Each tooth such as 126 is adapted to engage any one of three axially extending short teeth 128 on pinion 108. Teeth 128 are located opposite teeth 120 on each pinion with a flange 130 intermediate the teeth and pinion ends. The short teeth 128 terminate adjacent the radial surface of the ridge 122 and alternate with long axially extending teeth 132.

Teeth 132 ride on the inner circumferential face 134 of the ridge and engage in recess 124 only after tooth 126 engages one of teeth 128 to thereby rotate the pinion 108 a predetermined increment. Rotation of the pinion 108 in turn rotates the higher digit order dial 14 through teeth 120 and 118 a predetermined increment all in a conventional manner.

It will be noted that as between dials 14 and the associated pinions 108 that the dials and pinions can be rotated in either a forward or reverse direction since a tooth 126 on either side of recess 124 can engage with a short pinion tooth 128 to rotate the pinion in either direction. The drive wheel 84 rotating in the forward or normal direction indicated by arrow 135 in FIG. 7 causes tooth 126 to engage the short axially extending tooth 128 adjacent ridge 122 and rotates the pinion to in turn cause tooth 132 to engage in the recess 124 for additional rotation as the drive wheel rotates to bring the next short tooth 128 into the position shown in FIG. 7. However, if the drive wheel 84 is rotated in a reverse direction, as shown by arrow 136 in FIG. 7, there is no tooth 126 for engaging tooth 128 until the recess 124 has passed one of the long teeth 132. Tooth 126 on the drive wheel then engaging one of the short teeth 128 simply applies torque to the pinion for holding the adjacent long tooth 132 against the circumferential ridge surface 134. Since the pinion tooth 128 cannot rotate from the path of tooth 126, the drive wheel 84 is caused to lock and rotation thereof terminates.

The operation of the speedometer 10 including the odometer assembly 12 proceeds as normal when the flexible shaft 54 is operating in the normal or forward direction, as indicated by arrow 56, to in turn rotate the cross shaft 64 and the transfer shaft 70. The transfer shaft 70 rotates counterclockwise as indicated by arrow 137 in FIG. 3, and inclined radial faces 138 on teeth 80 cooperate with radial faces 140 on the pinion teeth 82 to rotate the drive wheel 84 in a clockwise direction, as indicated by arrow 142 in FIG. 3. The magnet assembly 60 in the meantime rotates in the direction corresponding to arrow 56 to move the speed cup 32, pointer shaft 24 and pointer 22 to a position relative indicia 20 corresponding to the vehicle speed.

Each time the drive wheel 84 rotates through a complete revolution in the normal direction, tooth 126 engages one of the short pinion teeth 128 to initiate rotation of the pinion 108 and adjacent higher digit order dial 14. As the pinion 108 rotates one of the long teeth 132 engages in the recess 124, and the rotation of the pinion continues while the pinion teeth 120 engaged in the teeth 118 incrementally rotate the adjacent higher digit order dial 14. Tooth 132 is rotated to bring the succeeding tooth 128 adjacent the radial surface of ridge 122, but since tooth 126 has already passed, rotation of the

pinion is terminated as soon as tooth 132 disengages from recess 124. Tooth 128 is then not in position to be engaged by tooth 126 until the drive wheel 84 completes the next revolution, and the pinion and succeeding dial remain stationary until the drive wheel completes that revolution. Thus, each of the drive wheel 84 and each dial 14 on completion of one revolution incrementally advances the succeeding dial one-tenth of a revolution so that the dials are advanced in the normal manner.

In order to alter or lower the odometer reading and thereby indicate the vehicle has been driven less mileage than is actually the case, it is customary to rotate the magnet shaft 52 in the subtractive or reverse direction as indicated by arrow 58. This may be done, for example, with an electric drill or other implement suitably coupled to the magnet shaft 52 or flexible shaft 54.

The torque in the reverse or subtractive direction is applied from the magnet shaft to the transfer shaft 70, which is rotated opposite from its normal direction of rotation and in the direction of arrow 142 to bring respective inclined radial faces 144 on teeth 80 against respective faces 146 on teeth 82 to in turn rotate the drive wheel 84 in the reverse direction. As the drive wheel 84 rotates in the reverse direction as indicated by arrow 136 in FIG. 7, the recess 124 in the ridge 122 moves past the short tooth 128 on pinion 108. The short tooth 128 then engages against the axially extending dial tooth 126. This engagement tends to rotate the pinion 108, but since the adjacent axially extending long tooth 132 is then engaged against the circumferential ridge surface 134, the pinion 108 cannot rotate and tooth 128 blocks rotation of the drive wheel 84. None of the odometer dials are therefore rotated.

With the drive wheel 84 locked against rotation, the inclined radial surface 144 of the worm gear teeth 80 acts against the adjacent drive wheel pinion tooth surface 146 to move the shaft 70 radially outwardly of wheel 84. Since the journal in tab 72 exercises greater restraint than slot 76, the shaft 70 pivots about an axis perpendicular to the elongate shaft axis passing through the lower pivot in tab 72. The pivoting movement moves the projecting end of shaft 70 against the edge of the opening 86 in spring 88 to flex the leg 90 and tension the spring 88.

As the shaft 70 continues to rotate the peripheral edge of teeth 80 shift axially relative teeth 82. Therefore, as the face 144 continues to lift the shaft 70, the peripheral edge of one worm gear tooth 80 may ride up on the peripheral edge of the associated pinion tooth 82; however, as rotation continues, the peripheral edge of the worm tooth 80 disengages from the peripheral edge of tooth 82 and face 144 will again engage against the pinion tooth face 146 under the influence of spring 88 to repeat the procedure for pivoting the transfer shaft out of driving engagement with the drive wheel. In this manner the transfer shaft 70 and the preceding portions of the gear train may operate or continue to rotate, while the odometer dials 14 and the drive wheel 84 remain motionless.

When the reverse or subtractive driving force is removed and the shaft 70 rotated in the normal direction, the spring 88 pivots the shaft 70 to reengage the worm wheel teeth 80 with the drive wheel gear teeth 82 and normal operation resumes.

In FIGS. 8 and 9 another speedometer 150 is illustrated utilizing an odometer assembly 152. The speedometer 150 and assembly 152 are basically similar to speedometer 10 and assembly 12 and accordingly identical or similar parts where feasible are given identical reference characters.

The speedometer in this case utilizes round dial 154 marked with speed indicia to indicate vehicle speed in accordance with the position of a pointer dial indicated by broken lines 156. The pointer dial has a shaft and speed cup 158 controlled by a conventional magnet assembly 60 supported on the end of a magnet shaft 52. The magnet shaft is rotatably supported in the boss 48 of a U-shaped frame member 44. The frame member 44 also rotatably supports a cross shaft 64 coupled to worm teeth 62 on the magnet shaft 52.

The cross shaft 64 carries a worm gear which is coupled to a helical gear on a transfer shaft 160 similar to shaft 70, but somewhat shorter and with an axis of rotation generally parallel to the magnet shaft. The transfer shaft has worm teeth 162 thereon and is journaled at one end in the rear wall 50 of the frame member 44 and at the other end in a slot 164 formed in a front plate 166.

The front plate 166 is located at the ends of the side legs 46 of the frame member 44 and behind dial 154, which it supports by means of L-shaped tabs 168. The front plate 166 also has rearwardly extending tabs 170 for receiving shaft 100 of the odometer assembly 12 with a spring clip 104 for holding the shaft 100 in position.

The odometer assembly comprises the drive wheel 84, brackets 106 and pinions, such as 108, between dials 14. The brackets engage against an edge of the plate 166 to prevent bracket rotation with the digits on the dials being visible through a window 172 formed in dial 154.

A spring clip 174 comprising an elongate wire leg 176 having an arcuate end engaging over the end of shaft 160 projecting through slot 164, serves to bias the teeth 162 of shaft 160 into engagement with teeth 82 of drive wheel 84. The leg 176 extends parallel to the front surface of plate 166 and through a slot beneath one leg of an adjacent L-shaped tab 168, whereafter it is provided with a reverse bend 178 and a hook 179 on the bend end connects into an aperture 180 in the adjacent tab 168, as best seen in FIG. 10, so that a downward bias, as seen in the drawings, is exerted on shaft 160.

In normal operation the shaft 160 is rotated by the magnet shaft 52 to rotate the drive wheel 84 and move the odometer in the normal or additive direction as described. When the magnet, cross and transfer shafts are driven in reverse the drive wheel 84 locks against rotation as before described. The worm gear teeth 162 act against the pinion teeth 82, therefore, to pivot the shaft 160 about an axis perpendicular to the shaft axis and passing through the pivot in rear leg 50 of the frame member 44. This disengages the worm gear teeth 162 from the drive wheel teeth 82 to permit rotation of the magnet, cross and transfer shafts without damage, while the odometer dials 14 and wheel 84 remain locked to prevent subtractive or reverse operation.

Since there is a slight skew in the pivoting movement of shaft 160 on disengaging teeth 162 from teeth 82, the axis of slot 164 is slightly offset from a vertical plane passing through the axis of shaft 160 to accommodate this skew. The spring clip 174 biases the shaft 160 downward toward engagement with the drive wheel 84. When the reverse rotation of the gear 162 is terminated and normal rotation ensues, the worm gear teeth simply reengage the drive wheel teeth 82 under the influence of spring 174 to move the odometer dials in the normal direction in a manner previously described.

In FIG. 11 another arrangement for preventing reverse or subtractive odometer or counter operation is illustrated by the reference character 200. The arrangement 200 includes a drive wheel 202 driven in a conventional manner through pinion teeth 204. Drive wheel 202 operates or rotates a first dial 206, which in turn operates successive dials such as 208, each assigned a successively higher digit order through a conventional pinion between each dial rotatably carried by a respective bracket, such as 210.

The drive wheel 202 in this case is not marked with digit indicia and instead drives the first odometer dial 206 through a clutch ratchet 212 in a one-to-one relationship. Instead dial 206 provided with a conventional rim 214 is marked with digit indicia to indicate mileage in one-tenth mile increments. The rim 214 is conventionally interconnected with a hub 216 by means of a disc portion 218 and a single tooth 219 together with the conventional recess 220 are provided in the rim ridge 221 to cooperate with a pinion for driving the adjacent dials 208 normally on additive or normal operation. On reverse or subtractive rotation of dial 206, the dial 206 and adjacent pinion lock as previously explained for drive wheel 84 and associated pinion 108, since only a single tooth 219 is provided

on dial 206. Hub 216 is provided with a thickened portion extending toward wheel 202 and is fixed to a shaft 222 by means of knurling 223, while the other dials 208 and the drive wheel 202 rotate freely on shaft 222.

The outer periphery of the thickened portion of hub 216 is provided with teeth 224 extending axially in the direction of wheel 202 for engagement with the ratchet clutch 212. The ratchet clutch 212 comprises a pair of circumferentially spaced axially extending arms 226 integrally formed on the wheel 202 radially outwardly of the shaft 222 and overlapping the teeth 224. Integrally formed spring ratchet pawls 228 extend from respective arms 226 in a radially inward spiral direction relative the shaft 222. The pawls 228 are cantilever supported from the arms 226 and are self-biased radially inwardly so that the leading edge 230 on each pawl normally engages a respective front radial face 232 of a respective tooth 224 on the dial 206.

When the drive wheel 202 is rotated in the normal or additive direction, the leading edge of each pawl drives against a respective tooth 224 to rotate the dial 206 with the drive wheel 202. The dial 202 in turn advances each of the other dials normally.

When the drive wheel 202 is driven in the reverse or subtractive direction, the dial 206 and its associated pinion lock against rotation in a manner previously explained while wheel 202 continues to rotate. Since the peripheral surface of the teeth 224 are spiraled radially outwardly from the leading face 232 of the adjacent tooth, each pawl 228 is moved radially outwardly, thereby in response to the reverse rotation of wheel 202. The pawls therefore simply ride on tooth 222, while the retarding force exerted by the shaft 222 fixed to dial 206 prevents movement of the dial 204. The drive wheel 202 thus rotates in the reverse direction without moving any of the dials 206 or 208. When normal rotation of the drive wheel is resumed, the spring bias of the pawls 228 causes the leading edge to engage the teeth 222 and normal rotation of dial 206 resumes.

In FIG. 13 the relevant portion of an odometer assembly is indicated by the reference character 250. The odometer assembly 250 may employ, for example, a drive wheel, worm gear and clutch similar to those described in conjunction with FIGS. 1 and 9 or a drive wheel and dial such as that described in conjunction with FIG. 10, to prevent reverse or subtractive operation of the odometer dials. Alternatively, apparatus for preventing reverse dial movement may be omitted and the odometer driven for either normal or reverse operation.

In any event, odometer assembly 250 includes a series of odometer dials 252, 254, 256, 258 and 260 and a drive wheel 262, each assigned a respective digit order and operated from a suitable source of power transferred through a worm wheel 263. A shaft 264 rotatably supports the dials and wheel between tabs 266 of a front plate 268. The shaft 264 is held in a slot in the left tab by a spring clip 270 seen in FIG. 13. A dial shown in part by broken lines 272 is located in front of the plate 268 and a conventional window 274 therein permits one digit on each dial to be viewed. A speedometer pointer shaft bearing and torsion spring bias assembly 276 supported by plate 262 is shown directly above the odometer assembly. The odometer assembly 250 includes brackets 278 each having recessed ears for engaging the edge of a slot in the plate 268 directly behind the window 274.

Each dial is moved one-tenth of a revolution for each complete revolution of the preceding dial so that the last dial 252 is moved one-tenth of a revolution for each 10,000 miles traveled by the vehicle in which the odometer is mounted. Dial 252, therefore, displays indicia corresponding to the number of 10,000 mile increments the vehicle is driven. When the dial 252 displays the digit 9, indicating the vehicle has traveled at least 90,000 miles, the vehicle owner often desires to move the dial 252 backwards to indicate the digit 8 or less. To provide a signal in the event of this type of tampering, an assembly 282 is provided.

The assembly 282 comprises a signal dial 284, whose periphery is marked with different colored indicia 286 and 288, and is spaced adjacent the highest digit order dial 252 in this arrangement. The dial 252 has the conventional 20 teeth 290 formed on lower digit order side thereof adjacent the internal periphery of the rim, as seen in FIG. 17. The teeth 290 cooperate with the adjacent pinion 292 to enable the dial 252 to be moved incrementally in response to each complete revolution of the adjacent lower digit order dial 254. The higher digit order side of dial 252 does not have the conventional rim ridge and axially extending teeth thereon, but instead is provided with a plurality of axially projecting ratchet teeth 294 encircling the hub portion. An axially projecting arcuate wall 296, spaced radially intermediate the inner surface of the dial rim and the teeth 294, is also provided on the higher digit order side of the dial. At one end the wall 296 is joined to the inner rim surface of dial 252 at a position intermediate the digits 8 and 9 on the rim to form a cam lobe 298, spaced from the opposite end of wall 296 by a short distance to form a passageway 300. A second radially inwardly projecting cam lobe 302 is provided on wall 296 spaced arcuately between the digits 2 and 3 on the dial rim. An axially extending post 304 carried adjacent one end of a circumferentially extending spring member 306 integrally formed on disc 284 projects toward dial 252.

The disc 284 is held stationary during rotation of dial 252 from 0 to 9 since the spring member 306 is depressed to engage the flat upper surface thereon with the edge of the recess in plate 268, as seen in FIG. 15, to display the black indicia 288 in the window 274. The post 304 is located between the wall 296 and the rim of dial 252 and just to the right of the cam 298, as indicated in FIG. 14, when dial 252 displays zero in the window 274. A second axially extending post 308 on the disc 284 extends in the direction of dial 252 and is located circumferentially and radially just to the left and adjacent the radially inwardly directed cam 302 on the wall 296 when the dial 252 is displaying zero, as indicated by broken lines 308 in FIG. 14. A pawl 310 also extends axially from the disc 284 for engaging one of the ratchet teeth 294 on dial 252.

Normally the odometer dial 252 displays a zero when the vehicle in which it is mounted is driven less than 10,000 miles and the disc 284 correspondingly displays the black indicia 288 in the window 274. When the dial 252 is rotated in the normal direction noted by the arrow 312 in FIG. 14 in response to vehicle travel, the ratchet teeth 294 slip past the pawl 310 on the disc 282. The cams 298 and 302 rotate from the respective posts 304 and 308 until dial 252 is stepped from the digit 9 to the digit zero. At that time, whether the movement is accomplished normally by operation of drive wheel 262 through the flexible shaft, or by tampering with the odometer through direct operation of dial 252, the cam 298 then in the position shown at 298' in FIG. 14 engages post 304 while cam 302 then in the position shown at 302' engages post 308. The spring 306 is forced radially inwardly by engagement of cam 298 with post 304 to depress the spring below the edge of the slot in plate 268 and move the post 304 radially inward of wall 296. Cam 302 can therefore rotate the disc 284 by driving post 308. As the disc 284 rotates, it removes the black indicia from the window and the red-colored indicia 286 appears in the window 274. The red indicia 286, together with the zero indicia on the dial 252, indicates the vehicle is driven over 100,000 miles.

When dial 260 displays the digit 9, for example, indicating the vehicle has traveled at least 90,000 miles, an attempt may be made to move the dial 252 backwards to indicate some lower figure of vehicle usage. Such an attempt may of course be made if dial 252 displays a lower digit but the result will be the same as will be described. To alter the position of dial 252, the usual technique is to pass a tool through the case opening accepting the instrument light and insert the tool between the dials 252 and 254 to disengage the pinion therebetween and simply move the dial 252 in the desired direction.

As the dial **252** then moves in the direction indicated by arrow **314** as seen in FIG. **14**, the ratchet teeth **294** engage the leading edge of pawl **310** to rotate the disc **284** in the same direction. Since the upper surface of spring **306** presents a decreasing radius when the disc **284** is moved in the direction of arrow **314**, its pressure against the edge of plate **268** decreases to permit the disc movement and the disc now displays the red-colored indicia **286** in the window **274**, indicating the tampered condition.

I claim:

1. A gear assembly including a pair of gears in driving relationship for moving a dial in response to movement in one direction of one of said gears for moving the other gear with said other gear rendered stationary in response to movement of said one gear in another direction, the improvement comprising means for disengaging said gears from said driving relationship in response to said other gear being rendered stationary and movement of said one gear in said one direction, and means reengaging said gears in said gear relationship in response to movement of said one gear in said one direction.

2. An odometer having a series of dials for registering vehicle mileage by movement in one direction in response to movement in a corresponding direction by means for driving said odometer dials and rendered stationary in response to the operation of said driving means in another direction, the improvement comprising means automatically disengaging said driving means from said odometer in response to said odometer being rendered stationary, and means for reengaging said driving means with said odometer in response to operation of said driving means in said corresponding direction.

3. An odometer having a plurality of dials each moved in a forward direction for registering the distance traveled by a vehicle in which said odometer is mounted, the improvement comprising spring means, gear means biased by said spring means for driving engagement with one of said dials and moved in response to movement of said vehicle for moving said dial in either said forward or in a reverse direction, and means disengaging said engaged gear means from said driving engagement in response to movement of said engaged gear means for moving said dials in said reverse direction with said spring means engaging said engaged gear means in said driving engagement with said dial in response to movement of said engaged gear means for moving said dial in said forward direction.

4. For use with a counter including a plurality of dials each assigned a respective digit order with a pinion gear between each pair of dials and between one dial and a drive wheel for incrementally advancing each dial in response to a complete revolution of the dial assigned an adjacent lower digit order with said drive wheel having circumferentially spaced radially extending gear teeth for driving engagement with the teeth of a worm gear for rotating said drive wheel in response to rotation by said worm wheel, the improvement comprising means for preventing movement of said drive wheel and adjacent pinion gear in response to movement in the reverse direction of said wheel to a predetermined position by said worm gear, means for thereafter enabling said worm gear to disengage from said driving engagement with said drive wheel in response to termination in movement of said wheel while said worm gear rotates, and means effective in response to rotation of said worm gear in a direction for driving said wheel in said one direction for reengaging said worm gear in driving relationship with said drive wheel to rotate said drive wheel for advancing said dials.

5. An odometer having a plurality of dials and a gear movable in one direction for controlling said odometer to register vehicle mileage with said gear rendered stationary in response to movement of said gear in another direction to one position, the improvement comprising means in driving engagement with said gear and moved in a corresponding direction for moving said gear in said one direction and disengaged from driving engagement with said gear in response to said means moving in a direction opposite said corresponding direction to move said gear in said other direction and render said gear stationary, and means operated in response to movement of said driving means in said corresponding direction for reengaging said driving means in driving engagement with said gear.

6. In the odometer claimed in claim **5**, a signal arrangement comprising a disc associated with one of said dials and having means on the periphery thereof to indicate normal movement of said dial and abnormal movement of said dial respectively in accordance with the position of said disc, and means coupling said one dial and disc only in response to movement of said dial in said other direction for altering the position of said dial to indicate said abnormal movement of said dial.

7. In the odometer claimed in claim **5**, means coupling said disc and one dial only in response to said dial moving in said one direction past a predetermined position to move said disc for indicating abnormal movement of said dial.

8. An odometer having a gear for moving a dial in one direction to register vehicle mileage with said one gear moved in said one direction by driving means in driving engagement with said gear and moved in a corresponding direction in response to movement of said vehicle in a respective direction with said gear having means for rendering said gear stationary in response to the movement of said driving means in a direction other than said corresponding direction, the improvement comprising means disengaging said driving means from driving engagement with said gear in response to said gear being rendered stationary and said driving means moving in said other direction, and means operated in response to movement of said driving means in said corresponding direction for reengaging said driving means in driving engagement with said gear.

9. The odometer claimed in claim **8** in which said reengaging means comprises a cantilever supported spring.

10. For use with an odometer having a first dial rotatable in a forward direction to register the distance traveled by a vehicle in which said odometer is mounted and rotatable in a reverse direction to subtract from the registration, the improvement comprising first means adapted to be placed in driving engagement with said first dial and movable in one direction for rotating said first dial in said forward direction in response to movement of said vehicle in a corresponding direction, means for disengaging said first means from said driving engagement with said first dial in response to movement of said first means in a direction opposite said one direction whereby the transfer of a load between said first dial and first means is avoided in response to movement of said first means in said reverse direction, and spring means effective for placing said first means in driving engagement with said first dial in response to movement of said first means in said one direction.

11. The improvement claimed in claim **10** in which said first means includes a gear tooth for rotating said first dial in said forward direction, and said disengaging means comprises a pinion engaged with said first dial for terminating rotation of said first dial in response to rotation of said first dial in said reverse direction, and means for pivoting said gear tooth against the bias of said spring means in response to the retarding torque exerted by said first dial on said tooth in response to termination of said first dial rotation and the movement of said tooth in said opposite direction.

12. In the improvement claimed in claim **10**, a plurality of other dials and a signal disc associated with one of said dials, each of said other dials being coaxial with the first dial with each dial assigned a respective digit order and rotated in said forward direction by said first dial incrementally for each revolution of a dial assigned an adjacent lower digit order, and means interconnecting said signal disc and one of said other dials for rotating said signal disc in response to rotation of said one other dials in said reverse direction.

13. The improvement claimed in claim **10** wherein each of said dials includes a plurality of teeth extending radially of the axis of rotation of said dials, and said first means includes a pawl adapted to be rotated about said axis for driving engage-

ment with one of said teeth in response to rotation of said pawl in said forward direction to rotate said dials in said forward direction.

14. For use in an odometer including a plurality of dials adapted to be rotated in one manner in response to movement of a vehicle in which said odometer is mounted, the improvement comprising a signal disc associated with one of said dials and having a plurality of different indicia thereon with one of said indicia normally displayed by said disc during movement of said dial in one direction, and means coupling said disc and one dial for driving said disc to display another of said indicia only in response to said dial moving in a direction opposite said one direction.

15. The improvement claimed in claim 14 in which said coupling means comprises ratchet teeth, and a pawl for engaging said teeth to move said disc with said teeth and pawl integrally formed on either said dial and disc respectively.

16. In the improvement claimed in claim 14 means coupling said disc and dial for moving said disc to display another of said indicia only in response to said dial moving in said one direction past a predetermined position.

17. In an odometer including a plurality of dials each representing a respective digit order and marked with digit indicia to indicate the mileage of a vehicle in which said odometer is mounted in response to said dials each being moved in one direction to indicate said mileage, the improvement comprising a disc associated with one of said dials and having different indicia on the periphery thereof, means for positioning said disc to display one of said indicia, and means coupling said disc and dial for movement of said disc only in response to said dial being moved in a direction opposite side one direction to thereby position said disc to display said other indicia.

18. In an odometer as claimed in claim 17, means coupling said disc and dial only in response to said one dial moving past a predetermined position for moving said disc to display indicia other than said one indicia.

19. In an odometer as claimed in claim 18 in which said coupling means comprises a pawl on one of either said disc or dial and a plurality of teeth on the other of either said disc or dial for engagement by the leading edge of said pawl only in response to movement of said dial in said other direction.

20. In an odometer as claimed in claim 17 in which said means for positioning said disc comprises a spring member integrally formed on said disc and biased radially outwardly, and an edge of an adjacent bracket wall engaged by said outwardly biased spring member, and said means coupling said disc and dial in response to said dial moving past a predetermined position includes a post on said member extending in the direction of said dial, and a cam on said dial engaging said post in response to movement of said dial past said predetermined position for moving said post and spring member radially inwardly of said disc to disengage said spring member from said edge and enable said disc to move with said dial.