April 11, 1950 J. E. BOSH 2,503,541

DEVICE FOR CONTROLLING THE ADJUSTMENT AND OPERATIVE ACTUATION OF IMPULSE CONTACTS IN TELEPHONE DIALS

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Fig. 1.

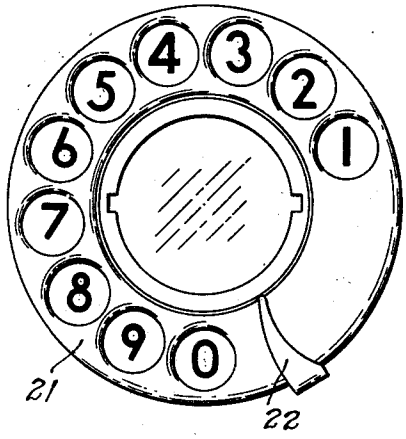


Fig. 2.

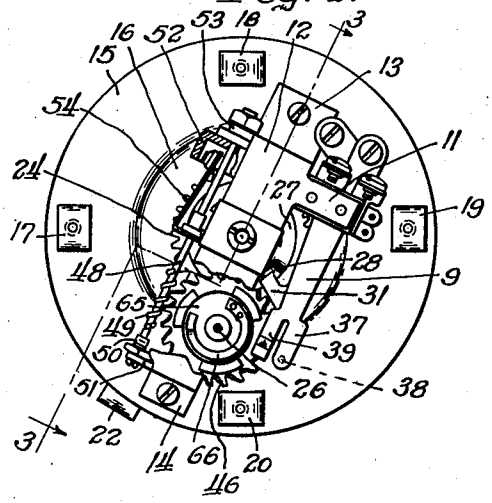


Fig. 3.

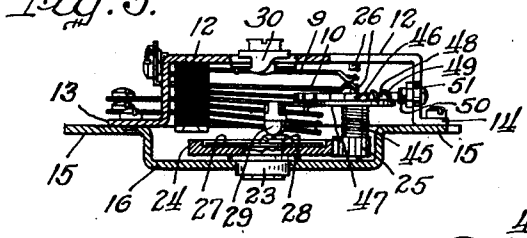
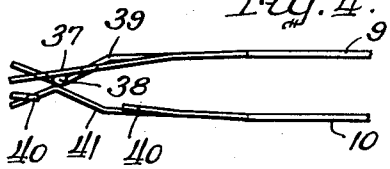


Fig. 4.



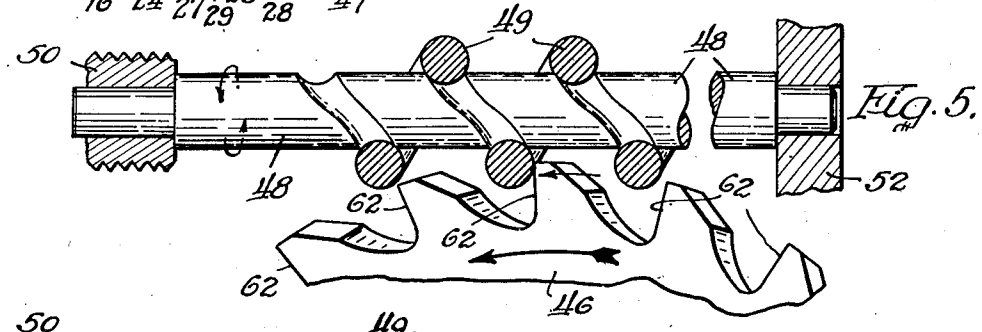


Fig. 5.

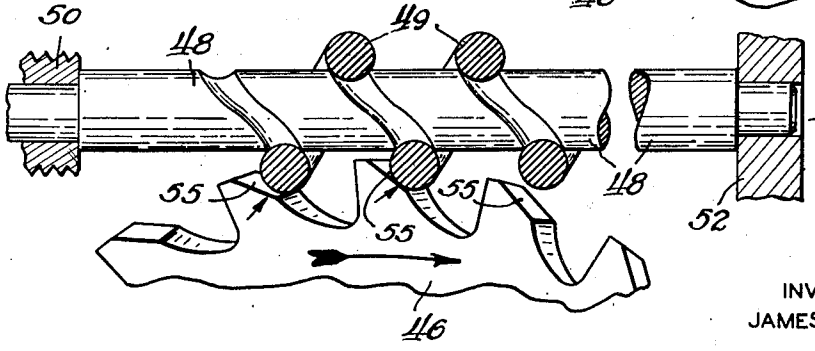


Fig. 6.

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DEVICE FOR CONTROLLING THE ADJUSTMENT AND OPERATIVE ACTUATION OF IMPULSE CONTACTS IN TELEPHONE DIALS

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4 Claims. (Cl. 179—90)

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This invention relates to dial calling devices, such as are used in subscribers' stations in automatic telephone systems, comprising a finger dial which may be rotated from a normal to a desired numerical position from which it returns to normal to generate impulses, and is particularly concerned with novel means for controlling the adjustment and the operative actuation of the impulse contact springs.

Dial calling devices of the type indicated above are provided with a pair of coacting impulse contact springs arranged for operation by an actuating element which may be a radially lobed impulse cam associated with a cam shaft geared to rotate with the finger dial during the return rotation thereof to normal from any numerical position to which it may have been advanced. The desired series of impulses is generated by successive operative actuation of the impulse contact springs by the radial lobes of the rotating impulse cam. The speed of return rotation of the finger dial, and therewith of the impulse cam, is regulated by a governor carried on a rotatable shaft provided with a worm gear which is actuated by a toothed drive wheel geared to rotate with the finger dial.

It is necessary in such dial calling devices to provide for a correct gap between the contact points of the impulse springs, when the springs are in open or separated condition, and to position the springs properly with respect to the impulse cam so as to obtain the correct dwell of the cam and therewith the desired percentage ratio between open and closed contact condition incident to the operative actuation of the impulse springs by the impulse cam. Prior structures provide for this purpose a special backing or adjusting member associated with the impulse springs for adjusting one spring relative to the other and the position of both springs relative to the impulse cam. Displacement of the backing member affects both impulse springs as a unit, thus limiting the adjustment possibilities.

It is also desirable to keep the governor at rest during the setting or forward rotation of the finger dial and to cause its operative actuation only during the return rotation of the finger dial when the braking function of the governor is needed to regulate the speed of rotation of the impulse cam, thus saving wear and tear on the governor. Prior structures employ for this purpose pawl and ratchet means for causing operatively effective rotation of the worm drive wheel to actuate the worm gear and therewith the governor only incident to the return rotation of the

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finger dial, thereby saving wear and tear on the governor at the expense of added mechanical elements to which the wear and tear is transferred.

The general and principal object of the invention is to provide a dial calling device having simplified means for obtaining the operative actuation of the impulse cam under control of the governor to determine the operative actuation of the impulse contact springs and providing simplified adjusting means associated with the impulse contact springs which coact cooperatively to determine the gap between the contact points and the dwell of the lobes of the impulse cam.

The invention proposes, in accordance with one of its specific objects, to eliminate the special backing and adjusting member associated with the impulse contact springs of prior structures and to provide, instead, individually adjustable forked impulse contact springs forming a pair of individually adjustable coacting extensions or legs carrying the contact points, and also forming a pair of individually adjustable coacting extensions or legs constituting operating members for operative coaction with the radial lobes of the impulse cam, thus reducing the cost and facilitating adjustments.

Another object of the invention is to provide a novel worm drive wheel coacting with the cam shaft in one-way free-wheeling engagement therewith, and means for clutching said worm drive wheel with said cam shaft to rotate therewith only during the return rotation of the finger dial. Separate control means such as pawl and ratchet means, employed in prior structures for keeping the worm drive wheel at rest during the forward setting rotation of the dial, are in this manner likewise eliminated.

Still another object is to provide a new worm drive wheel carrying teeth forming angular surfaces which engage the convolutions of the worm gear, during the forward rotation of the finger dial to a desired numerical position, to exert a lateral blocking pressure thereon in a direction extending radially at an angle to the axis of the worm gear shaft, whereby the worm drive wheel is held against rotation with the cam shaft, thus preventing the operative actuation of the worm gear and therewith operation of the governor. Each tooth of the drive wheel forms a generally radially extending drive surface for driving engagement with the convolutions of the worm gear, during the return rotation of the finger dial when the drive wheel is clutched to rotate with the cam shaft, to exert pressure on the worm gear, which

is effective in a direction extending substantially in parallel with its axis, causing operatively effective rotation of the governor to regulate the speed of the return rotation, thereby controlling the correct successive operative actuation of the impulse contact springs by the impulse cam associated with the cam shaft.

The objects and features intimated in the foregoing, and additional objects and features, will appear from the detailed description of an embodiment which is rendered below with reference to the accompanying drawings. In these drawings,

Fig. 1 is a front elevational view of an embodiment of the dial calling device in which the improvements forming the subject-matter of the invention are incorporated;

Fig. 2 shows an elevational rear view of the device with some parts broken away and in section, respectively, to indicate details;

Fig. 3 illustrates a sectional view taken approximately along lines 3—3 in Fig. 2 to show the relative position of some of the essential elements of the structure, the finger dial being omitted;

Fig. 4 is an enlarged diagrammatic view of the new impulse contact springs as seen from the right in Fig. 2;

Fig. 5 is an enlarged diagrammatic view showing portions of the governor shaft with its associated worm gear partially in section and fractions of the worm drive wheel illustrating how its teeth coact with the worm gear incident to the operatively effective return rotation of the finger dial; and

Fig. 6 shows a diagrammatic view analogous to Fig. 5, illustrating the blocking coaction of the teeth of the worm drive wheel with the worm gear during the forward rotation of the finger dial to a desired numerical position.

Like parts are numbered alike throughout the drawings. Known details and elements will be discussed only to the extent required for an understanding of the invention.

The improvements forming the subject-matter of the present invention may be incorporated in a dial calling device such as disclosed, for example, in the co-pending application Ser. No. 738,646, filed April 1, 1947.

The new impulse contact springs 9 and 10 are mounted in a pile or stack together with off-normal contact springs on a lateral extension 11 projecting from an angular mounting bracket 12 having legs 13—14 secured to the flange 15 of a cup-shaped housing having the recessed portion 16. The off-normal contact springs are indicated in Fig. 3 underneath the impulse contact springs 9 and 10 but are not marked by reference numerals. Lugs 17—20 are provided for mounting the dial device on a suitable support. Disposed in front of the device is the rotatable finger dial 21 and the finger stop 22. The finger dial is keyed to a main shaft 23 (see Fig. 3) which is journalled in the wall 16 of the cup-shaped housing, its free end being journalled in a suitable bearing in the mounting bracket 12. The main shaft 23 carries a gear wheel 24 which meshes with a pinion 25 associated with the cam shaft 26, and the latter is rotatably suitably journalled at one end in the wall 16 of the cup-shaped housing and at the other end in the mounting bracket 12. Secured to the gear wheel 24 is the stop cam plate 27. This plate carries an arm (not visible in Fig. 3), radially projecting therefrom beyond the gear wheel 24 for engagement, in normal position of the device, with a stop member which projects radially inwardly from the wall of the housing, and also carries a cam projection 28 for coaction with an insulating member 29 secured to an ear 31 projecting from one of the off-normal springs. The off-normal springs are actuated to mark the off-normal position when the finger dial is rotated in forward direction, rotating the stop cam plate and thereby displacing the cam projection 28 with respect to the member 29, allowing this member to drop and thus placing the off-normal contacts into alternate operative position. The function of the off-normal springs is known and need not be further discussed. Associated with the main shaft 23 is a coiled spring (not shown) one end of which is anchored in the mounting bracket 12 by means of the fastening device 30 and the other end of which is anchored in the stop cam plate 27. Accordingly, when the finger dial 21 is rotated in forward clockwise setting direction, as seen in Fig. 1, the shaft 23 will be rotated and will rotate the gear wheel 24, thereby winding its associated coiled spring, storing power which is utilized in well known manner for rotating the finger dial to normal home position.

Each of the new impulse springs 9 and 10 is forked at its free end, as particularly shown in Fig. 2. The spring 9 forms in this manner a longitudinal arm or extension 37 which carries an impulse contact point 38 and a longitudinal extension or arm 39 which is offset transversely inwardly, as particularly shown in Fig. 4, forming a camming or operating member for coaction with the impulse cam. The spring 10 forms in like manner an extension or arm 40 carrying an impulse contact point such as 38, for coaction with the contact point projecting from the arm or extension 37, and a transversely inwardly offset arm or extension 41 forming a camming or operating member for camming coaction with the operating member 39. Each spring 9—10 is individually adjustable and each longitudinal extension or arm projecting therefrom is likewise individually adjustable. The contact springs proper formed by the extensions or arms 37 and 40, which carry the contact points such as 38, can thus be individually adjusted relative to each other, and the coacting camming or operating arms or members 39 and 41 can be individually independently adjusted to determine their mutual coaction and their positional relationship relative to the contact-carrying extensions 37 and 40. The pair of coacting operating or camming arms 39 and 41, as well as the pair of coacting contact-carrying extensions 37 and 40, are thus integral with their respective contact springs 9—10.

The pinion 25 is integral with or keyed to the cam shaft 26 and is provided with a hub axially extending therefrom to which is secured the coiled spring 45. The new worm drive wheel 46, which may be made of suitable material, is provided with a disklike member 47 carrying a short hub which extends axially toward the pinion 25 and is frictionally engaged by the convolutions of the coiled spring 45 at the free end thereof. The arrangement operates in the manner of a free-wheeling one-way clutch which clutches the new worm drive wheel 46 with the cam shaft 26 or, rather to say, with the pinion 25, only during the operatively effective return rotation of the finger dial 21 to normal from any numerical position to which the dial may have been advanced. The coaction is such that the convolutions of the coiled spring 45 are tightened radially around the hub of the disk 47 secured to the worm drive wheel 46, during the return rotation of the finger

dial, while such convolutions are effected in reverse direction, tending to open radially around the hub when the dial is rotated in setting or forward direction. It will be observed, however, that during such forward setting rotation of the finger dial a slight torsional force is applied to the worm drive wheel 46 by slight frictional engagement of the clutch spring 45 with the hub of the drive wheel tending to rotate the drive wheel.

The governor comprises the shaft 48 carrying a worm 49. The worm is formed by a coiled wire disposed in spiral grooves cut on the governor shaft 48; that is, the wire forming the worm is disposed on the shaft in the manner of a thread, as indicated particularly in Figs. 5 and 6. The governor shaft is rotatably journalled at one end in a bearing 50 secured to the ear 51 projecting laterally from the mounting bracket 12, and at the other end in a bearing recess provided in the governor cup 52 which is secured to an ear 53 projecting laterally from the mounting bracket 12 at the opposite end thereof. Weighted resilient members 54 are provided on the governor shaft, and when the shaft is rotated the free ends of these members are forced radially outwardly and exert a braking force on the inside of the cup 52, thereby regulating the speed of the return rotation of the finger dial and parts actuated thereby.

It will be seen from the foregoing description of the governor that the sides of the worm 49, being formed of a wire, are identical. A substantially identical driving force applied to either side of the worm would therefore cause rotation of the worm shaft, that is, of the governor, and such rotation would result during rotation of the finger dial in either direction. The rotation of the governor during the forward setting rotation of the finger dial is undesirable because it would cause additional wear and thus shorten the life of the device. In order to avoid such undesired governor action, the teeth of the new worm drive wheel 46 are cut so as to form angularly extending surfaces 55 for engagement with the convolutions of the worm 49 during the initial forward setting rotation of the finger dial 21, when the pinion 25 and therewith the clutch spring 45 and the cam shaft 26 are rotated in clockwise direction, as seen in Figs. 2 and 6. As mentioned before, the slight frictional engagement of the clutch spring 45 with the hub of the disk 47, during the forward setting rotation of the dial, tends to rotate the worm drive wheel 46. The angle of the surfaces 55 of the teeth is such that, when the slight frictional force attempts to rotate the worm drive wheel, these surfaces press against the convolutions of the worm from the side, radially and angularly inwardly, as indicated by arrows in Fig. 6, thus exerting an angular lateral thrust which tends to wedge the worm gear shaft in its bearings, diagrammatically indicated at 50 and 52, thereby opposing the slight frictional torsion force of the clutch spring 45. This force therefore is without effect, and the toothed drive wheel 46 and, with it, the governor remain at rest. The pinion 25 and, with it, the cam shaft rotate in free-wheeling operation with respect to the worm drive wheel with its teeth in engagement with the worm gear, as shown in Fig. 6. This condition persists throughout the forward rotation of the finger dial until it has been operated to the desired numerical position.

The pinion 25 and with it the cam shaft 26 rotate in free-wheeling operation with respect to the worm drive wheel which remains at rest, with its teeth in engagement with the worm gear, as shown in Fig. 6. This condition persists throughout the forward rotation of the finger dial until it has been operated to the desired numerical position.

The clutch device, including the coiled spring 45, becomes operatively effective during the return rotation of the dial, when the braking and speed-regulating action of the governor is required. At the inception of the counter-clockwise rotation of the finger dial and therewith of the pinion 25, the new worm drive wheel 46 will initially tend to rotate in counter-clockwise direction by frictional tension transmitted thereto by the spring 45, and the radially extending surfaces 62 of its teeth will engage the convolutions 49 of the worm gear, as shown in Fig. 5, exerting pressure thereon which is effective in a plane generally paralleling the axis of the governor shaft 48. The engagement of the driving surfaces 62 of the teeth of the worm drive wheel with the convolutions of the worm gear, as shown, supports the frictional force of the clutch spring 45, causing such spring to tighten radially around the hub extending from the worm drive wheel 46, thereby positively clutching the drive wheel with the pinion 25 and rotating it coincident with the counter-clockwise rotation of the cam shaft 26 to rotate the worm gear shaft and therewith the weighted members 54. The governor is thus operatively effective to regulate the speed of the return rotation of the finger dial and therewith the speed of the cam shaft 26.

Associated with the cam shaft 26 is the non-metallic impulse cam 65 carrying a number of radial lobes, as shown in Fig. 2. The impulse cam carries an arcuate resilient spring pawl at its under side for driving engagement with a ratchet plate keyed to the cam shaft, to rotate with the cam shaft when such shaft is rotated in counter-clockwise direction coincident with the return rotation of the finger dial. On its upper side the impulse cam 65 carries a similar arcuate resilient pawl spring 66, shown in Fig. 2, which coacts, in the nature of a detent, with apertures provided in the corresponding overlying portion of the mounting member 12.

The lobes of the impulse cam 65 upon operatively effective rotation thereof, pass in counter-clockwise direction as seen in Fig. 2, through the transversely inwardly offset extensions or arms forming the pair of coacting camming or operating members 39 and 41 of the impulse springs 9 and 10, thus successively forcibly spreading these operating members and again returning them to normal. The pair of coacting extensions 37 and 40, carrying the impulse contact points such as 38, are thereby likewise successively spread apart and returned to normal, thus successively opening and closing the impulse contact points and generating the desired series of impulses in accordance with the initial numerical setting of the finger dial.

The initial adjustment of the pair of coacting operating arms or members 39 and 41 and of the pair of coacting contact-carrying extensions 37 and 40 is such as to produce a desired correct gap between the contact points when the contact springs are in spread-apart or open position. This gap and the dwell of the actuating lobes of the impulse cam determine the relative percentage ratio between open and closed contact condition incident to each operative actuation of the contact springs. For example, a given gap between the contact points in open position of

the impulse springs may produce a percentage ratio of 38.5% and 61.5%; that is, in each operative actuation of the impulse contact springs the contact points will be closed 38.5% and open 61.5% of the time. It will be understood that, if the gap between the contact points is changed, such percentage ratio will likewise be affected. For example, if the gap is increased, the dwell of the lobes of the impulse cam is correspondingly increased, the time of contact closure is shortened, and the time when the contacts are separated is lengthened. The initially adjusted gap may be changed by the wear and tear on the contact points, increasing the gap, or by the wear and tear on the lobes of the impulse cam or on the camming surfaces of the pair of coacting operating or camming members 39 and 41.

If the initially adjusted correct gap between the contact points is changed, due to any cause, which may be established by proper tests at the exchange, the required adjustment may be quickly and effectively restored either by correcting the angle of the contact-carrying extensions 37 and 40 or by correspondingly correcting the angle at which the inwardly offset camming extensions or arms 39 and 41 project from the bodies of their associated impulse springs 9—10. The correct position of the operatively effective forward portions of the impulse contact springs relative to the impulse cam 65 may be determined by properly adjusting the springs 9—10. Such springs may also be adjusted for the purpose of providing proper contact pressure between the contact points carried by the extensions 37 and 40 and proper camming pressure between the inwardly offset coacting extensions or arms 39 and 41.

It will be seen from the foregoing description of the embodiment shown in the drawings, that the invention contributes toward facilitating manufacture by eliminating parts, thereby decreasing the cost of the unit product, and at the same time lengthening its useful life and facilitating adjustments that may be required.

Certain features of the invention may be useful in devices other than calling dials, and modifications may be made. It will therefore be understood that a specific example has been disclosed for illustrative purposes only, and that changes may be made within the scope and spirit of the appended claims.

I claim:

1. In a dial calling device having a finger dial which may be rotated from a normal to a desired numerical position from which it returns to normal to generate impulses and having a governor carrying a worm formed by a wire having identical sides, a shaft geared for rotation with said finger dial and carrying a toothed worm drive wheel for driving said worm, the teeth of said worm drive wheel being beveled to exert a lateral thrust upon the convolutions of said worm during rotation of said shaft which corresponds to forward setting rotation of said finger dial so as to lock said worm against rotation and to inhibit thereby rotation of said governor during such forward setting rotation of said finger dial, and clutch means effective during the return rotation of the finger dial for positively clutching said worm drive wheel with said shaft to effect rotation thereof so as to rotate said worm to rotate said governor.

2. In a calling device of the class described having a finger dial which may be rotated forwardly from a normal to a desired numerical position from which it rotates to normal and a governor comprising a shaft carrying a worm and including a pinion geared for rotation with said finger dial in either direction of rotation thereof and a toothed drive wheel for driving said worm, clutch means disposed between said pinion and said toothed drive wheel for positively rotating said toothed drive wheel to drive said worm responsive to rotation of said pinion during the return rotation of said dial, said clutch means exerting a slight torsional force on said toothed drive wheel responsive to rotation of said pinion during the forward rotation of said finger dial to a desired numerical position which attempts to rotate such drive wheel, the teeth of said drive wheel forming angularly extending surfaces for engagement with the convolutions of said worm on one side thereof incident to rotation of said pinion responsive to the forward rotation of said finger dial, to exert a lateral thrust on said worm which locks it against rotation to inhibit rotation of said governor during such forward rotation of said finger dial.

3. In a calling device of the class described having a finger dial which may be rotated forwardly from a normal to a desired numerical position from which it returns to normal and a governor comprising a shaft carrying a worm having convolutions forming identical sides and including a pinion geared for rotation with said finger dial in either direction of rotation thereof and a toothed drive wheel for driving said worm, a clutch spring disposed between said toothed drive wheel and said pinion and rotatable with said pinion for positively rotating said toothed drive wheel to drive said worm responsive to rotation of said pinion during the return rotation of said finger dial, said clutch spring exerting a slight torsional force on said toothed drive wheel responsive to rotation of said pinion during the forward rotation of said finger dial which attempts to rotate such drive wheel, the teeth of said drive wheel forming angularly extending surfaces for engagement with the convolutions of said worm on one side thereof, incident to rotation of said pinion during the forward rotation of said finger dial, to exert a lateral thrust thereon which locks said worm against rotation to inhibit rotation of said governor during such forward rotation of said finger dial.

4. In a calling device of the class described having a finger dial which may be rotated forwardly from a normal to a desired numerical position from which it returns to normal position to generate impulses and having a pinion geared to rotate with said finger dial in either direction of rotation thereof and including a shaft extending axially from said pinion, a toothed drive wheel rotatably disposed on said shaft, a hublike extension projecting axially from said drive wheel in the direction of said pinion, a governor having a shaft carrying a worm for driving coaction with said toothed drive wheel, a coiled clutch spring extending from said pinion and being rotatable therewith, the convolutions at the free end of said coiled clutch spring surrounding the hublike extension of said toothed drive wheel in relatively loose frictional engagement therewith and exerting slight torsional force thereon responsive to rotation of said pinion during forward rotation of said finger dial which attempts to rotate said toothed drive wheel while tightening around said hublike extension responsive to rotation of said pinion during return-to-normal rotation of said finger dial

for positively rotating said toothed drive wheel to rotate said worm so as to actuate said governor, the teeth of said drive wheel forming angular surfaces for engagement with the convolutions of said worm incident to angular displacement of the drive wheel in response to the slight torsional force exerted by said coiled clutch spring responsive to rotation of said pinion during forward rotation of said finger dial whereby a lateral thrust is exerted on the convolutions of said worm which opposes the slight torsional force exerted by said coiled clutch spring to lock the worm against rotation so as to inhibit rotation of the governor during the forward rotation of said finger dial.

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