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F. HARDY

2,120,407

TIMING APPARATUS

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FIG. 2

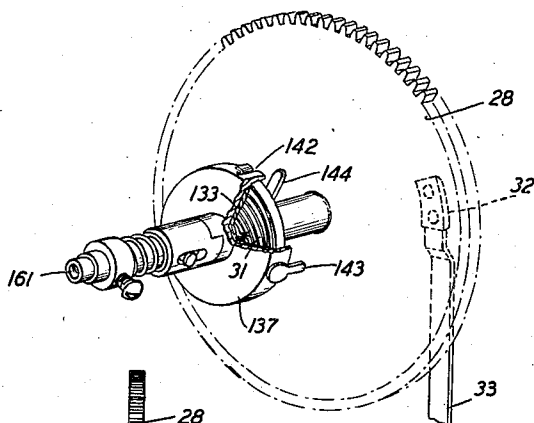


FIG. 4

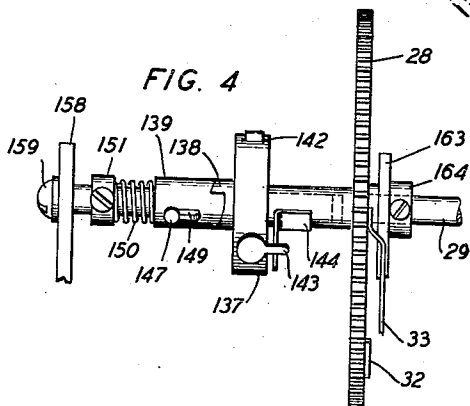


FIG. 5

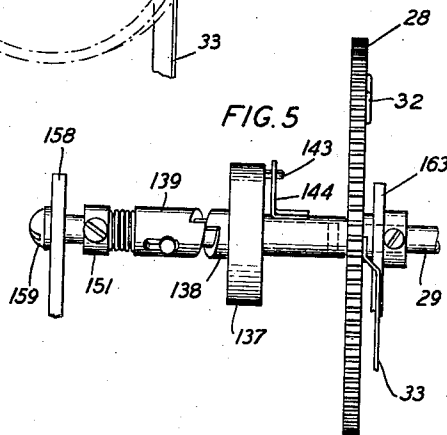


FIG. 3

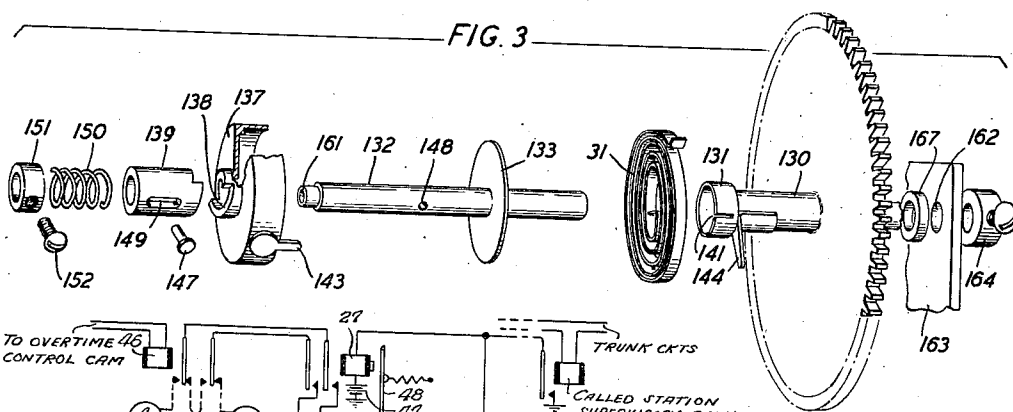
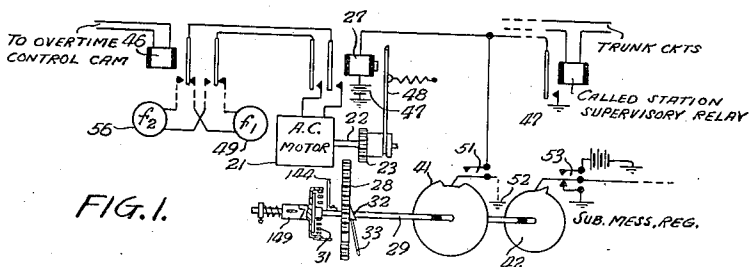


FIG. 1.



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2,120,407

TIMING APPARATUS

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Application September 25, 1936, Serial No. 102,481

7 Claims. (Cl. 192—150)

This invention relates to timing apparatus and particularly to a restoring means for use with such apparatus.

5 The invention is applicable particularly to timing apparatus for measuring intervals of conversation in a telephone system to determine there-
by the appropriate charges for the service rendered, such apparatus being described, for ex-
10 ample, in Patent 2,094,060 issued September 28, 1937 to A. J. Busch entitled "Timing apparatus."

An object of the invention is the simplification and improvement of devices for measuring and indicating intervals of time.

15 A more specific object of the invention is to provide a restoring force effective upon occasion to return the rotating member of timing apparatus to its normal position, which restoring force shall be substantially uniform regardless of the
20 amount of movement of said rotating member from its normal position.

In accordance with the arrangement disclosed in the Busch patent, referred to above, means are provided for operating the calling subscriber's
25 register the desired number of times for the initial period and the desired number of times for each overtime period in accordance with the requirements for the zone called and the duration of the call. Each timing unit preferably
30 comprises an alternating current motor suitably coupled to a shaft carrying means for operating in sequence a series of electrical contacts.

The motor is preferably of the type whose speed depends upon the frequency of the power
35 supply. By selecting the frequency of the power supply the shaft controlling the contacts may be caused to make one complete revolution in the time interval equal to the initial period for the zone called and at the termination of the initial
40 period another frequency may be selected to rotate the shaft one complete revolution for each overtime period so that all of the charging contacts will be operated once for the initial period regardless of its duration and will be operated
45 once during each overtime period.

It will be apparent from the above that in registering the duration of a call the shaft or other driven means controlling the contacts may be
50 be rotated only a part of a complete turn or it may be rotated several complete turns. It is necessary to provide some means for restoring the shaft to its normal position upon release from the driving force, an obvious means of providing the desired force being to provide a coiled leaf
55 spring, one end being attached to the shaft and

the other end being attached to a stationary member. However, a simple expedient of this nature is not entirely satisfactory for timing arrangements of the nature referred to above in view of the fact that if the spring is so tensioned
5 as to provide a sufficient restoring force when the shaft has been rotated only a part of a complete turn, several turns of the shaft will cause an undesirable amount of tension in the spring and may result in breakage thereof.

10 According to a feature of the present invention, the restoring spring is tensioned only during a part of the first rotation of the shaft, means being provided whereby this force is stored in the spring during continued rotation of the shaft.

15 In accordance with a specific embodiment of the invention, one end of the coiled leaf restoring spring is attached to the shaft while the other end is attached to a casing which encloses the spring. When the shaft starts its first rotation, the casing remains stationary, resulting,
20 of course, in an increase in the tension of the spring. However, as rotation of the shaft continues, an arm carried thereby comes in contact with an arm projecting from the casing, this engagement being effective to cause the casing to
25 be rotated with the shaft whereby additional tension is not added to the spring. A special adjustable connection between the casing and its support permits this rotation but at the same
30 time provides sufficient restraint to maintain the casing stationary during the initial part of the rotation of the shaft.

A complete understanding of the operation of the arrangement contemplated by the invention
35 as well as an appreciation of the various advantageous features will be gained from consideration of the following description in connection with the drawing, in which:

Fig. 1 shows schematically a timing arrangement of the type contemplated by the invention
40 as well as a part of a dial telephone system with which the invention may advantageously be used;

Fig. 2 is a perspective view of the driven gear and the restoring means of a timing unit of the
45 nature contemplated by the invention, a part of the spring casing being broken away to disclose the restoring spring;

Fig. 3 is an exploded view of the assembly shown in Fig. 2;

Fig. 4 is a front elevation of the unit, the driven gear having been rotated a part of one complete rotation from normal retracted position; and

Fig. 5 is a view similar to that of Fig. 4, the gear having been rotated an additional amount.

Referring now to the drawing, Fig. 1 shows schematically a portion of a dial telephone system of the cross-bar type utilizing a universal timing mechanism of the general type, described in the Busch patent referred to above, the arrangement utilizing the restoring means of the present invention. For a more detailed disclosure of the circuits involved in such a system reference may be had to Patent 2,089,438 issued August 10, 1937, to F. J. Scudder, entitled "Telephone systems."

The timing unit disclosed comprises a synchronous motor 21 capable of operating with a power supply varying in frequency with the speed of the motor being directly proportional to the applied frequency. The motor shaft 22 has a slidable driving pinion 23 adapted when relay 27 is energized to engage gear 28 to rotate the cam shaft 29 counter-clockwise. Shaft 29, due to suitable means which will be described later and which includes a spiral spring 31 is biased to a definite zero position with lug 32 on gear 28 pressed against the spring stop 33. Motor 21 and the gearing between shafts 22 and 29 are chosen so that, for a typical example, shaft 29 makes one complete revolution in five minutes when the motor is supplied with a frequency of twelve cycles per second and one revolution in four minutes with a power supply frequency of fifteen cycles. Other frequencies may of course be employed to give other desired time intervals.

Shaft 29 carries the necessary cams for controlling the various timing and registering circuits, two of these cams, 41 and 42, being shown. Relay 43 is associated with the trunk circuits and operates, as explained in the Busch patent above referred to, upon response of the called subscriber. Relay 46 is adapted to operate after the timing arrangement has been in operation for a predetermined period of time; this relay may be controlled, as described in the Busch patent, through an overtime cam carried by shaft 29.

The manner in which the timing unit operates for timing a particular telephone call will now be explained in connection with the portion of a cross-bar dial telephone system disclosed in Fig. 1.

Operation of relay 43 upon response of the called subscriber completes an energizing circuit for relay 27 traced from battery 47, winding of relay 27, make contact of relay 43 to ground 47, relay 27 operating over this circuit. Operation of relay 27 (1) moves armature 48 to slide pinion 23 into engagement with gear 28 and (2) connects frequency source 49 (f_1), which we will assume to be twelve cycles per second, to driving motor 21. Motor 21, therefore, starts rotating shaft 29 at the initial rate (one rotation in five minutes) to measure the duration of the telephone connection.

As soon as shaft 29 begins to turn to time the initial period of five minutes, holding cam 41 on shaft 29 closes contacts 51 to establish an obvious holding circuit for relay 27, which holding circuit is due to ground 52 under the control of the calling subscriber.

Each rotation of cam 42 causes, through operation of contacts 53, transmission of a current impulse to the calling subscriber's message register.

After operation of the arrangement for a predetermined time, relay 46 is operated under control of a suitable time measuring device, for example, a cam carried by shaft 29, thereby disconnecting frequency source 49 from motor 21

and connecting frequency source 56 (f_2) thereto, it being assumed that the frequency of this source is fifteen cycles per second. The shaft will now be rotated at the rate of one revolution in four minutes therefore.

When the telephone connection has ceased and the calling party has hung up, the called station supervisory relay 43 will be released and the holding circuit for motor relay 27 will be opened since the ground over contacts 51 is under the control of the calling party. The consequent release of relay 27 opens the power supply circuit for motor 21, and disengages pinion 23 from gear 28 allowing shaft 29 to rotate clockwise under the action of restoring spring 31 to cause shaft 29 to assume its normal position with lug 32 against spring stop 33. The timing unit is now ready for use for another call either to the same zone or a different zone and further details of the operation of the timing unit may be secured by reference to the above-mentioned patent of A. J. Busch.

The action of restoring spring 31 and associated parts of the restoring mechanism with which the invention is particularly concerned will now be described with reference to Figs. 2, 3, 4 and 5.

Referring now to Figs. 2 and 3, a hollow shaft 130 is, as shown, attached to gear wheel 28, this shaft terminating in a round shouldered portion 131. Shaft 29 is attached to the opposite side of gear wheel 28. A shaft 132 is adapted to fit within hollow shaft 130, a portion of it projecting therefrom at the end remote from gear wheel 28. A disc 133 is rigidly attached to shaft 132.

Spring casing 137, in the form of a shallow cylinder closed at one end, is adapted to be positioned on shaft 132 with its closed end abutting disc 133 as shown most clearly in Fig. 2. A toothed coupling 138 is attached to the closed end of casing 137 and cooperates, in a manner to be described subsequently, with a second toothed coupling 139 which is mounted on shaft 132.

A coiled spring 31 is adapted to be positioned within casing 137, one end of the spring being positioned in slot 141 provided in shouldered portion 131 and the other end of the spring being positioned in slot 142 provided in casing 137. An arm 143 is attached to casing 137 and projects therefrom, being engaged upon occasion by arm 144, which is carried by shaft 130.

Toothed coupling 139 is attached to shaft 132 by means of pin 147, which is adapted to be positioned in hole 148 provided in shaft 132. By virtue of the elongated aperture 149, lateral movement within limits of toothed coupling 139 is permitted, it being normally held in engagement with toothed coupling 138, however, due to the biasing action of coiled spring 150. A collar 151 adjustably held on shaft 132 by screw 152 serves to hold spring 150 in place on the shaft and to regulate the biasing force of the spring.

For convenience of illustration, the assembled unit is shown mounted on a suitable upright 158, screw 159 passing through an aperture therein and engaging threaded end portion 161 of shaft 132. Shaft 29 which is attached to wheel 28 extends through aperture 162 provided in upright 163. A bushing 164 is positioned on shaft 29 and serves to retain the parts in proper assembled position on shaft 132. A washer 167 may be provided to eliminate friction between gear wheel 28 and upright 163 and to provide proper spacing. Shaft 132 and parts integral therewith are therefore rigidly attached to support 158, while gear wheel 28 and parts integral therewith are rotat-

able about shaft 132. The supporting arrangement actually used may be, however, of any type consistent with the operation of other parts of the mechanism.

5 In order to further describe the restoring arrangement, let us assume, referring to Fig. 2, which shows the parts in their normal position, that gear wheel 28 be engaged by drive gear 23 (Fig. 1) and rotated in a clockwise direction. 10 Shaft 130 being integral with gear wheel 28 is, of course, rotated also and, as one end of spring 31 is attached to shouldered portion 131 through engagement in slot 141 rotation of the gear wheel winds up the spring, the other end of which is attached to spring casing 137 which is restrained 15 from rotation at this time due to the frictional engagement of toothed couplings 138 and 139. The tension of spring 150 is so fixed by adjustment of collar 151 that there is sufficient friction 20 between the adjacent edges of the two toothed couplings to hold the spring casing against rotation.

However, after rotation of gear wheel 28 for a predetermined distance, for example, three-quarters of a rotation, the position illustrated in Fig. 4 25 is reached wherein arm 144, which is rotated with shaft 130, is brought into engagement with arm 143 attached to spring casing 137. During this time the tension of spring 31 had been increased 30 from the predetermined initial tension to the maximum desired tension, a range which may be, for example, from an initial tension of 40 inch grams to a maximum tension of 60 inch grams. Should the gear wheel be released from the driving force during any part of this rotation, therefore, spring 31 has sufficient tension to restore the mechanism to normal position. On the other 35 hand at no time, even when the maximum of 60 inch grams has been reached, is the tension objectionably large. However, a substantial increase over this maximum value would be objectionable from a friction standpoint and might result in breakage of the spring, and as the gear wheel 28 may be rotated several turns before 40 completion of the call, it is desirable that means be introduced for preventing further increase in the tension of spring 31, retaining at the same time the tension already stored therein against the time at which the energy will be needed for restoring the mechanism to normal position. 45

Referring again to Fig. 4, as rotation of gear wheel 28 continues, engagement of arm 144 with arm 143 will be effective to cause rotation of spring casing 137, toothed coupling 139 being 50 cammed back against the force of spring 150, as shown in Fig. 5, and allowing relative rotation of the two toothed couplings 139 and 138. 55

In this manner after the desired maximum tension of spring 31 has been attained, continued rotation of gear wheel 28 results merely in corresponding rotation of spring casing 137, thereby preventing any increase above the maximum point in the tension of the spring regardless of the number of rotations of the gear wheel. Immediately upon release of the mechanism, however, the energy stored in the spring is effective 60 to restore the parts to normal position. 65

While a specific embodiment and one particular application of applicant's invention have been described, the invention is not limited to the specific embodiment nor to the specific application described. For example, while a shaft has been disclosed for operating the timing contacts other contact operating means may be used such 70 as cams on the face of the gear wheel of the 75

general nature described in the copending application of E. D. Mead, Serial No. 68,073 filed March 10, 1936. Further, the invention may be used in connection with other types of telephone call timing systems or in connection with timing arrangements for general use, so that the embodiment and application described should be taken as illustrative of the invention and not as restrictive thereof. 5

What is claimed is:

1. A timing mechanism comprising a rotatable driven member biased to a definite normal position, a driving member, means for engaging said driven member and said driving member, a coiled spring effective after disengagement of said members for restoring said driven member to its normal position, one end of said coiled spring being fastened to said driven member, rotatable means fastened to the other end of said coiled spring, means for preventing said rotatable means from 10 rotating to any substantial extent in one direction while permitting its rotation in the other direction when the applied force exceeds a definite minimum, the rotation of said driven member tending through said spring to rotate said rotatable means in said other direction and positive driving means carried by said driven member for causing rotation of said rotatable means in said other direction. 15 20 25

2. A timing mechanism comprising a rotatable driven member biased to a definite normal position, a driving member, means for engaging said driven member and said driving member, a coiled spring effective after disengagement of said members for restoring said driven member to its normal position, one end of said coiled spring being fastened to said driven member, a drum, mounting means for said drum preventing rotation of said drum to any substantial extent in one direction while permitting its rotation in the other direction when the applied force exceeds a definite minimum, the other end of said coiled spring being fastened to said drum, the rotation of said driven member tending through said spring to rotate said drum in said other direction and positive driving means carried by said driven member for causing rotation of said drum in said other direction. 30 35 40 45

3. A timing mechanism comprising a rotatable driven member biased to a definite normal position, a driving member, means for engaging said driven member and said driving member, a drum mounted for rotation in one direction while incapable of being rotated in the opposite direction to any substantial extent, spring means mounted on a fixed axis for resisting the rotation of said drum in said one direction until the applied force has exceeded a definite minimum, a spiral spring effective after the disengagement of said members for restoring said driven member to its normal position, one end of said spiral spring being rotatable with said drum and the other end being rotatable with said driven member and positive driving means carried by said driven member for causing rotation of said drum in said one direction. 50 55 60 65

4. A timing mechanism comprising a rotatable driven member biased to a definite normal position, a driving member, means for engaging said driven member and said driving member, a drum mounted for rotation in one direction, a toothed coupling carried by said drum, a second toothed coupling, means for normally holding said second toothed coupling in engagement with said first toothed coupling, engagement of the two toothed 70 75

couplings being effective to yieldably restrain said drum from rotation in said one direction and to prevent rotation of said drum in the opposite direction to any substantial extent, a spiral spring effective after the disengagement of said driven and driving members for restoring said driven member to its normal position, and positive driving means effective after rotation of said driven member for a predetermined amount for causing rotation of said drum in said one direction against the yieldable restraint of said couplings.

5. A timing mechanism comprising a rotatable driven member biased to a definite normal position, a driving member, means for engaging said driven member and said driving member, a drum mounted for rotation in one direction, a toothed coupling carried by said drum, a second toothed coupling, means for urging said second toothed coupling into engagement with said first toothed coupling, engagement of said couplings being effective to yieldably restrain said drum from rotation in said one direction and to prevent rotation of the drum in the opposite direction to any substantial extent, a spiral spring effective after the disengagement of said driven member and said driving member for restoring said driven member to its normal position, one end of said spring being fastened to said driven member and the other end being attached to said drum whereby relative rotation of said driven member and said drum tends to add tension to said spring, and means effective upon said spring reaching a predetermined tension for providing a positive drive connection between said driven member and said drum whereby additional rotation of said driven member will cause rotation of said drum against said yieldable restraining force.

6. A timing mechanism comprising a rotatable driven member biased to a definite normal position, a driving member, means for engaging said driven member and said driving member, a drum mounted for rotation in one direction, a toothed coupling carried by said drum, a second toothed coupling, means for urging said second toothed coupling into engagement with said first toothed coupling, engagement of said couplings being effective to yieldably restrain said drum from rotation in said one direction and to prevent rota-

tion of the drum in the opposite direction to any substantial extent, a spiral spring effective after the disengagement of said driven member and said driving member for restoring said driven member to its normal position, one end of said spring being fastened to said driven member and the other end being attached to said drum whereby relative rotation of said driven member and said drum tends to add tension to said spring, means effective upon said spring reaching a predetermined tension for providing a positive drive connection between said driven member and said drum whereby additional rotation of said driven member will cause rotation of said drum against said yieldable restraining force, and means for adjusting said yieldable restraining force.

7. A timing mechanism comprising a rotatable driven member biased to a definite normal position, a driving member, means for engaging said driven member and said driving member, a drum mounted for rotation in one direction, a toothed coupling carried by said drum, a second toothed coupling, means for urging said second toothed coupling into engagement with said first toothed coupling, engagement of said couplings being effective to yieldably restrain said drum from rotation in said one direction and to prevent rotation of the drum in the opposite direction to any substantial extent, a spiral spring effective after the disengagement of said driven member and said driving member for restoring said driven member to its normal position, one end of said spring being fastened to said driven member and the other end being attached to said drum whereby relative rotation of said driven member and said drum tends to add tension to said spring, an arm carried by said driven member, an arm carried by said drum, said arms being so positioned with respect to each other that they are brought into engagement after relative rotation of said driven member and said drum of a predetermined amount, engagement of said arms being effective to provide a positive drive connection between said driven member and said drum whereby additional rotation of said driven member will cause rotation of said drum against said yieldable restraining force.

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