

Feb. 16, 1937.

R. W. GOFF

2,071,202

DEFINITE TIME RELAY

Filed Oct. 2, 1935

2 Sheets-Sheet 1

Fig. 1.

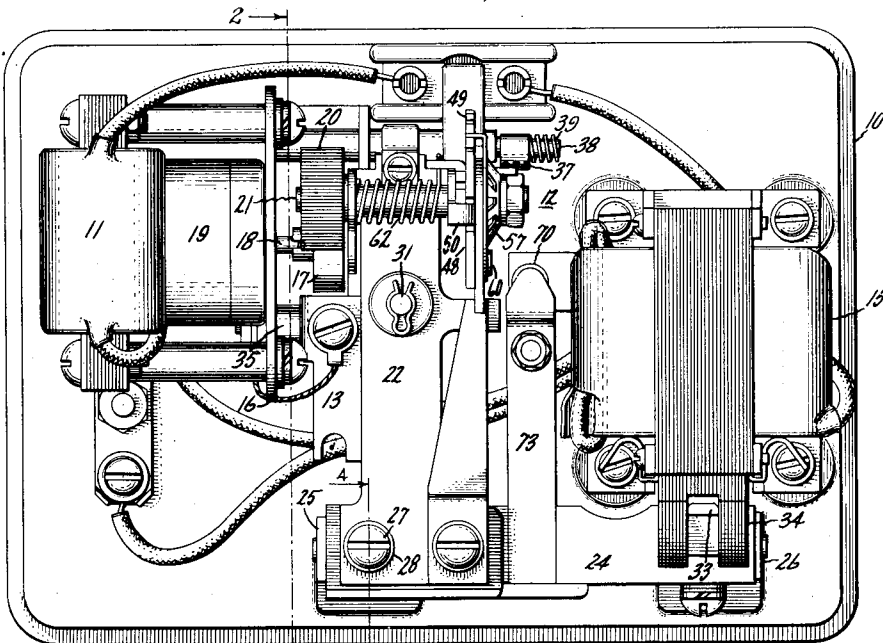


Fig. 3.

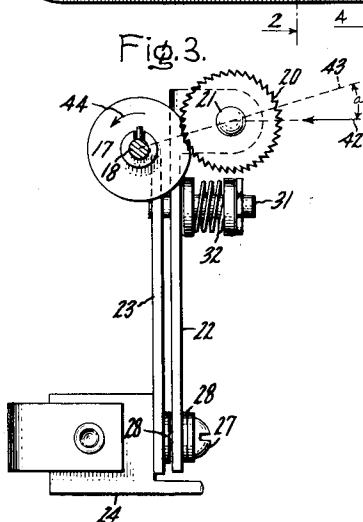


Fig. 4.

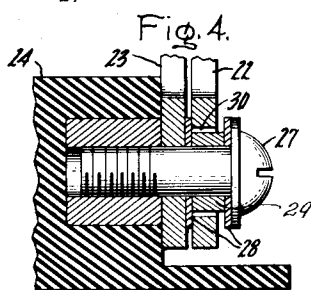
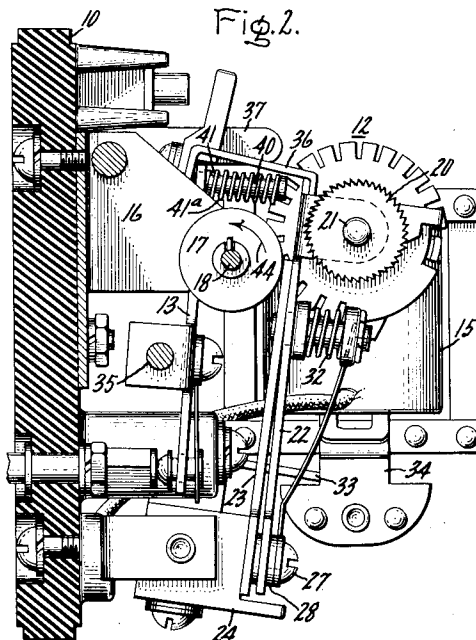


Fig. 2.



Inventor:
Robert W. Goff,
by *Harry E. Dunham*
His Attorney.

Feb. 16, 1937.

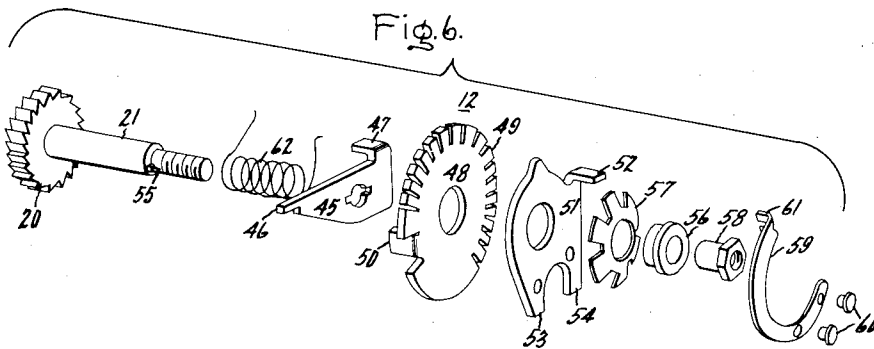
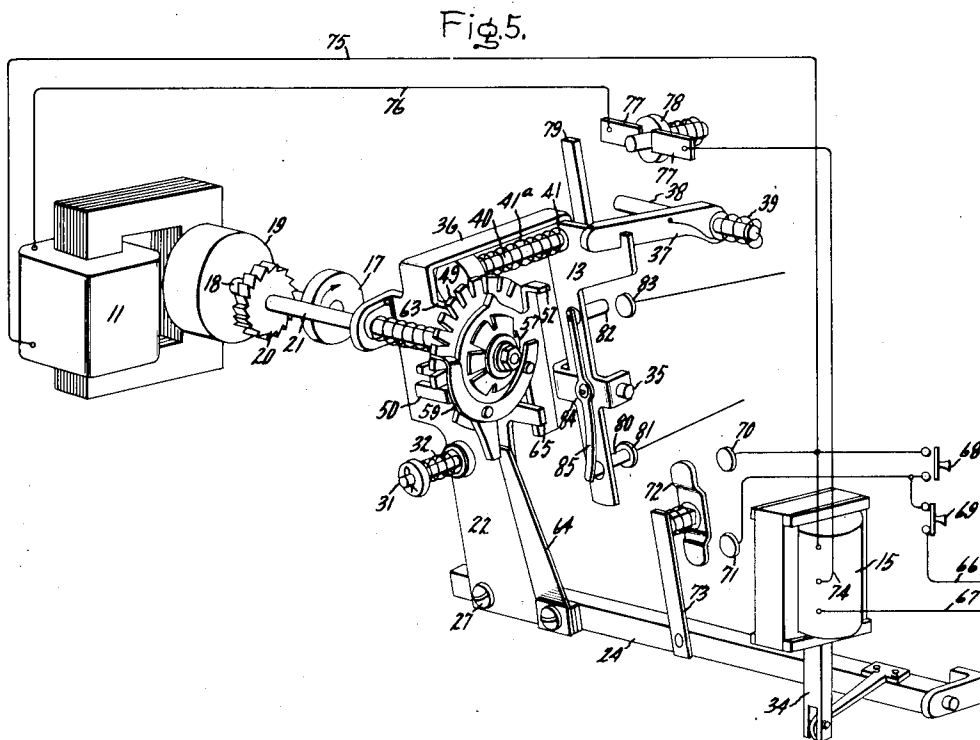
R. W. GOFF

2,071,202

DEFINITE TIME RELAY

Filed Oct. 2, 1935

2 Sheets-Sheet 2



Inventor
Robert W. Goff
by *Harry E. Dunham*
His Attorney.

UNITED STATES PATENT OFFICE

2,071,202

DEFINITE TIME RELAY

Robert W. Goff, Schenectady, N. Y., assignor to
General Electric Company, a corporation of
New York

Application October 2, 1935, Serial No. 43,249

8 Claims. (Cl. 200—97)

My invention relates to relays, more particularly to definite time, motor driven relays, and has for an object the provision of an inexpensive and reliable device of this character.

5 In my copending application Serial No. 748,839, filed October 18, 1934, entitled "Definite time relay" which application is assigned to the same assignee as the present invention, I have disclosed a definite time relay comprising a timing
10 motor, time adjustable means for operating a contact member a definite time after the motor is energized, and normally disengaged driving means for establishing a driving relationship between the motor and the time adjustable means.
15 The driving means comprises a pair of normally disengaged gears, and a solenoid is provided for operating these gears into engagement upon energization of the relay.

Although definite time relays constructed as
20 shown in my above referred to application are entirely satisfactory for practically all conditions of operation, I have found that for special applications requiring an extremely high degree of accuracy in timing or involving unusually frequent
25 operations of the relay, something is yet to be desired. For example, I have found that the life of these relays is somewhat less than one million operations due to the fact that the repeated impact of the driven gear on the driving gear each
30 time that the relay is operated eventually causes excessive wear or breakage of the gears. Likewise I have found that the gears may not always mesh exactly, and accordingly, the time interval of the relay will be affected, the width of one
35 tooth being sufficient to appreciably change the time interval for which the relay is set. Accordingly, it is a further object of my invention to provide a definite time relay of the above type which will repeatedly reproduce a definite time interval
40 with extreme accuracy and which has an extremely long life.

In carrying out my invention in one form, I provide a definite time relay comprising normally
45 disengaged driving means for connecting the timing motor to the time adjustable means and means for operating the driving means into engagement to establish a driving relation. The driving means includes a wheel formed of yieldable friction material, and means are provided
50 for varying the engaging pressure on the friction wheel as the load on the motor increases so as to prevent slippage. More specifically, I provide a driving member comprising a wheel of yieldable friction material such as soft rubber, connected
55 through suitable reduction gearing to the

driving motor and a driven member comprising a toothed gear secured to the timing shaft of the time adjustable means. The timing shaft and the driven gear are resiliently mounted for movement in a fixed path transversely of the shaft
5 into engagement with the driving wheel, the axis of which is slightly offset from the path of movement. Means are provided for moving the timing shaft in its fixed path and for stressing the resilient mounting means to exert a predetermined
10 initial engaging pressure between the gear and the wheel so that the teeth on the gear are pressed into the wheel. As the driving wheel is rotated by the motor, the teeth on the driven gear bite into the yieldable material of the wheel
15 and the offset relation of the respective axes of the wheel and the gear produces a force which tends to move the wheel and its shaft in a direction to further stress the resilient mounting
20 means and thus increase the engaging pressure between the wheel and the gear as the load on the motor increases.

Since the pressure between the wheel and the gear varies with the load, slippage between the wheel and the gear is eliminated and the smooth
25 curved engaging surface of the wheel eliminates the possibility of improper meshing. Therefore, the time interval produced by the relay is extremely accurate. Furthermore, the resilient material forming the wheel absorbs the shock of
30 the initial engagement between the wheel and the gear so as to provide for long life of the relay.

For a more complete understanding of my invention reference should now be had to the drawings in which Fig. 1 is a front view in elevation
35 of a relay embodying my invention; Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1; Fig. 3 is a fragmentary detailed view showing the driving means in engaging relation; Fig. 4
40 is a detailed sectional view taken along the line 4—4 of Fig. 1; Fig. 5 is a somewhat diagrammatical view of the relay in perspective; and Fig. 6 is a view in exploded perspective of the timing shaft and the time adjustable means carried
45 thereby.

Referring now to the drawings, I have shown a definite time relay of the type described and claimed in my above referred to application, comprising a base 10 for supporting the timing motor
50 11, time adjustable means indicated generally by the reference numeral 12 for operating a contact member 13 a definite time after the motor 11 is energized, and a solenoid 15 for operating the time adjustable means into driving relationship
55

with the motor. As shown, the motor 11 which is preferably of the self-excited synchronous type, is supported on a bracket 16 secured to the base 10 and is arranged to rotate a driving member or wheel 17 formed of suitable yieldable friction material such, for example, as soft rubber. The driving wheel 17 is mounted on a shaft 18 which is connected to the motor shaft through suitable reduction gearing (not shown) contained in a housing 19.

The time adjustable means 12 which is normally out of driving relationship with the motor, includes a toothed gear 20 secured to a timing shaft 21 journaled in suitable supporting ears extending from a floating member 22. As shown, the floating member 22 is resiliently supported on a tiltable arm 23 (Figs. 2 and 3) which is secured to a beam 24 mounted for rotary movement on brackets 25 and 26 fastened to the base 10. As shown best in Fig. 4, the tiltable arm 23 is rigidly secured to the beam 24 by means of a screw 27 carrying a pair of washers 28 and a spacing bushing 29. This bushing 29 extends loosely through an aperture 30 in the lower end of the floating member 22 and is somewhat thicker than the floating member. The lower end of the floating member is therefore free to move relative to the tiltable arm 23 between the washers 28, and a pin 31 adjacent the upper end of the arm 23 extends through a suitable aperture in the floating member 22 and is provided with a spring 32 for resiliently supporting the floating member 22 relative to the tiltable arm.

The beam 24 is provided adjacent its other end with an extending finger 33 which is pivotally connected to a plunger 34 constituting the operating member of the solenoid 15. It will be seen that the solenoid plunger 34 and the tiltable arm 23 are mounted off center with respect to the beam 24 and therefore, the beam 24 is normally biased by gravity to the positions shown in Figs. 1, 2 and 5.

It will be understood of course that the time adjustable means 12, the details of which will be more fully described hereinafter, is arranged to operate the contact member 13 a definite time after energization of the motor 11. As shown, the contact member 13 is pivotally mounted for movement between two positions on a fixed pin 35 supported by the bracket 16 and is normally biased to the position shown by engagement with a finger 36 which extends outwardly from the upper end of the floating member 22. A latch 37 which is pivoted on a pin 38 and biased to latching position by a spring 39, serves to retain the contact member in its normal position. Carried by the movable contact member 13, is a normally ineffective biasing means, the operation of which will be more fully described later, comprising a headed pin 40 slidable through a journal 41 in the contact member 13 and carrying a normally unstressed spring 41a, the ends of which respectively bear against the contact carrying member 13 and the head of the pin 40.

Referring now to Figs. 2 and 3, when the solenoid 15 is energized, it will be apparent that the beam 24 and the tiltable arm 23 will be moved from the position shown in Fig. 2 to the position shown in Fig. 3 and by means of the resilient connection of the floating member 22 to the arm 23, the timing shaft 21 will be moved in a fixed path transversely of its axis to engage the toothed gear 20 with the driving wheel 17. The strength of the solenoid 15 and the tension of the spring 32 are so related as to exert an initial predetermined

pressure between the wheel 17 and the gear 21, which pressure is sufficient to press the teeth of the gear into the yieldable material of the wheel, as shown in Fig. 3.

I have found that the load imposed on the motor 11 by the time adjustable means 12 is sufficiently great to produce a considerable tendency towards slippage between the wheel and the gear. In order to prevent the occurrence of slippage between the wheel and the gear, the shaft 18 and the wheel 17 are arranged slightly off center from the path of movement of the shaft 21 and the gear 20. In Fig. 3, the arrow 42 represents the path of movement of the shaft 21 and it will be seen that a line taken through the centers of the shafts 18 and 21, as represented by the broken line 43, forms a substantial angle α with the path of movement. Accordingly, when the wheel 17 is rotated in a direction indicated by the arrow 44, a force will be exerted on the toothed gear 20 which is substantially tangential to the engaging surfaces of the wheel 17 and the gear 20, i. e. the force will be exerted in a direction substantially perpendicular to the line 43. It will be apparent therefore, that a force will be exerted on the shaft 21 and the wheel 20 which will tend to move the shaft and gear toward the wheel 17. Accordingly, the engaging pressure between the wheel and the gear will increase substantially in proportion to the increase of load on the motor. I have found that for the best operation, the shaft 18 should be offset from the path of movement of the shaft 21 sufficiently so that the angle α is substantially 25 degrees upon initial engagement of the wheel 17 and the gear 20. As the shaft 21 moves toward the wheel 17 in accordance with the component of force exerted on the shaft, this angle α will of course increase, and it will be apparent upon inspection of Fig. 3 that the arrangement of the tiltable arm 23 and the floating member 22 is such that the tiltable arm 23 acts as a stop to prevent too great a movement of the floating member 22 and the shaft 21 in the direction of the wheel 17. I have found that if the toothed gear 20 is permitted to move too far around the wheel 17 so that the angle α approaches 45 degrees, there will be a tendency for the gear and the wheel to remain in engagement after the relay is deenergized.

It will be apparent now that I have provided a simple, self-tightening arrangement for varying the engaging pressure between the wheel 17 and the gear 20 as the load on the motor increases. In addition, the arrangement of the wheel 17 and the gear 20 in offset relation provides means for permitting the motor 11 to start under substantially no load. It will be understood that the motor 11 rotates at a relatively high speed, for example, 3600 revolutions per minute, and that in order to reduce the speed of the shaft to approximately one revolution per minute, a large number of reduction gears must be provided within the housing 19. It will be understood by those skilled in the art that such a train of reduction gearing will have an appreciable amount of back-lash. Referring to Fig. 3, when the gear 20 initially engages the wheel 17, there will be exerted on the wheel 17 a force tending to rotate the wheel in the direction of the arrow 44, and accordingly, all of the back-lash which exists in the reduction gear train will be inserted between the shaft 18 and the shaft of the motor 11. Thus the motor in starting must rotate sufficiently to take up this back-lash before the load imposed thereon by the time adjustable mechanism is applied. Accord-

ingly, the motor may start and come up to substantially synchronous speed under substantially no-load conditions.

The time adjustable mechanism 12, as hereinbefore mentioned, is of the type described and claimed in my above referred to application. For the purposes of the present application, this mechanism may be described as comprising a timing arm 45 provided with an operating finger 46 and a stop finger 47, a time adjusting or calibrating disk 48 having a plurality of slots 49 spaced about the periphery thereof and provided with an extending portion 50 disposed in the path of the operating finger 46, and a tripping arm 51 shaped to provide an outwardly extending finger 52 and a pair of downwardly extending legs 53 and 54.

As shown best in Figs. 5 and 6, the time adjustable mechanism is assembled on the timing shaft 21 with the timing arm 45 keyed to the shaft by means of a pin 55 for rotation therewith, and with the calibrating disk 48 and the tripping arm 51 arranged for rotation with respect to the timing shaft 21 on a bearing member 56. In order to maintain the three operating elements 45, 48 and 51 in face-to-face engagement on the shaft 21, a spring washer 57 is provided and the entire assembly is positioned on the shaft 21 by means of a nut 58 which threadedly engages the end of the shaft 21. In addition to the above elements, the time adjustable means includes a locking spring 59, one end of which is fastened to the tripping arm 51 as by rivets 60 and the other end of which is provided with a detent finger 61 for selectively engaging the slots 49 arranged about the periphery of the calibrating disk 48.

In order to bias the timing arm 45 and the tripping arm 51 to their respective initial positions, a coil spring 62 is provided having its ends respectively fastened to the floating member 22 and to the timing arm 45. This spring 62 normally holds the stop finger 47 against a shoulder 63 on the floating member 22, and a spring finger 64 is fastened to the beam 24 with its free end bearing against the leg 53 on the tripping arm 51 to hold the leg 54 of the tripping arm in contact with a stop finger 65 extending from the floating member 22.

As fully described in my above referred to application, the time setting of the relay is controlled by varying the position of the finger 50 relative to the initial positions of the arms 46 and 52. In other words, to vary the time setting of the relay, the locking spring 59 is bent outwardly from the calibrating disk 48 so that the detent 61 is free of the notches 49, and the calibrating disk 48 is then rotated until a desired one of the slots 49 corresponding to the desired time interval is in alignment with the detent 61. The spring finger 59 is then released and the detent 61 cooperates with the aligned slot 49 to lock the finger 50 in a position relative to the timing arm and the tripping arm, which position corresponds to the desired time interval.

As will be seen upon reference to Fig. 5, the operating solenoid 15 is connected to the supply leads 66 and 67 for energization from a suitable source of alternating current by a conventional push button station comprising a start button 68 and a stop button 69. An interlock contactor comprising the contacts 70 and 71 and a bridging member 72 resiliently mounted on the finger 73 carried by the beam 24, is arranged to by-pass the start button 68 when the solenoid is energized in order that the relay when once energized

by pushing the start button, will remain energized until its complete cycle of operation has taken place. As described in my above referred to application, the solenoid is provided with an intermediate tap 74 for supplying an intermediate voltage to the timing motor 11 through the conductors 75 and 76. Arranged in the motor supply conductor 76, is a normally closed switch comprising a pair of fixed contacts 77 and a spring pressed bridging member 78 arranged to be operated by a finger 79 extending from the contact carrying member 13. It will be apparent that when the movable contact member is actuated from its latched position to its other circuit controlling position, the movable bridging member 78 will be operated to deenergize the motor 11.

Although any suitable contact arrangement may be provided for operation by the movement of the contact carrying member 13, I prefer to provide a pair of normally closed contacts 80 and 81 and a pair of normally open contacts 82 and 83 arranged to operate as a single-pole, double-throw switch in which the movable contacts 80 and 82 are electrically connected to a common terminal 84 and resiliently supported on the contact carrying member 13 by a leaf spring 85.

It is now believed that a complete understanding of my invention may be had from a description of the operation. With the start button 68 in its open circuit position and the various elements of the relay in the deenergized position shown in Figs. 1, 2 and 5, the time setting of the relay may be adjusted to the desired value in the manner hereinbefore described. When the start button is actuated to energize the solenoid 15 and the motor 11, the consequent movement of the solenoid plunger 34 rotates the beam 24 about its axis to close the interlock contacts 70 and 71 and to operate the time adjustable mechanism 12 into driving relationship with the motor 13, the toothed gear 20 engaging the driving gear 17, as shown in Fig. 3. As the time adjustable mechanism is moved to the position shown in Fig. 3, the trip finger 52 is moved to a position immediately below the latch 37, and the slidable pin 40 is moved through its journal 41 to compress the spring 41a and apply to the contact carrying member 13 a biasing force which tends to move the contact member from its latched position.

As hereinbefore explained, the initial engagement of the gear 20 with the wheel 17 is effective to press the gear teeth into the wheel 17 and is also effective to rotate the wheel 17 so as to interpose all of the back-lash in the reduction gearing between the wheel 17 and the shaft of the motor 11. Accordingly, the motor 11 comes up to speed under substantially no load and as the wheel 17 begins to rotate the gear 20, a force is exerted which increases the engaging pressure between the wheel 17 and the gear 20 as the load on the motor increases.

As the gear 20 and the timing shaft 21 are rotated, the timing arm 45 is moved to engage the operating finger 46 with the finger 50 carried by the disk 48. Continued movement of the timing arm 45 rotates the disk 48, and the locking spring 57 transmits the motion of the disk 48 to the tripping member 51 so as to move the tripping member against the bias of the spring 64. As the tripping member 51 rotates, the trip finger 52 carried thereby moves upwardly and raises the latch 37 so as to release the contact carrying

member 13 for movement from its normal, latched position under the force exerted by the spring 41a to open the contacts 80 and 81 and close the contacts 82 and 83. Simultaneously, the extending finger 79 on the contact carrying member 13 operates the bridging member 78 to deenergize the motor 11.

The operating cycle of the relay having now been completed, the relay will remain in its operated position until the stop button 69 is actuated to deenergize the solenoid 15. Upon deenergization of the solenoid 15, the beam 24 and the time adjustable mechanism will be returned to their normal positions and the interlock contacts 70 and 71 will be opened. When the time adjustable mechanism moves out of driving relationship with the motor, disengaging the gear 20 and the wheel 17, the timing arm 45 and the tripping member 51 will be returned to their respective initial positions by the biasing springs 62 and 64. Likewise, the arm 36 extending from the floating member 22 will engage the contact carrying member 13 and return it to its normal position for engagement by the latch 37. It will be apparent that the relay is now in its normal reset position and the above cycle may again be initiated by actuating the start button 68.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made and I, therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A definite time relay comprising a motor, a contact member, time adjustable means for operating said contact member a definite time after said motor is energized, normally disengaged driving means for establishing a driving relationship between said motor and said time adjustable means, means for operating said driving means into engaging relation to establish said driving relationship, said operating means exerting a predetermined engaging pressure on said driving means, and means for varying said engaging pressure in accordance with the load on said motor.

2. A definite time relay comprising a motor, a contact member, time adjustable means for operating said contact member a definite time after said motor is energized, a driving member associated with said motor, a driven member associated with said time adjustable means, said driving member and said driven member being normally out of driving relationship, means for operating said driven member into engaging relation with said driving member to establish said driving relationship, said operating means exerting a predetermined engaging pressure between said driving and driven members, and means for varying said engaging pressure in accordance with the load on said motor.

3. A definite time relay comprising a motor, a contact member, time adjustable means for operating said contact member a definite time after said motor is energized, a driving member comprising a wheel formed of yieldable friction material associated with said motor, a driven member comprising a toothed gear associated with said time adjustable means, said wheel and said gear being normally out of driving relationship, means for operating said gear into engagement with said yieldable wheel, said operating means

exerting a predetermined engaging pressure between said wheel and said gear to establish a driving relationship, and means for increasing said engaging pressure as the load on said motor increases to prevent slipping between said wheel and said gear.

4. A definite time relay comprising a motor, a contact member, time adjustable means including a timing shaft for operating said contact member a definite time after energization of said motor, a driving wheel formed of yieldable friction material associated with said motor, a toothed gear carried by said timing shaft normally out of driving relationship with said motor driven wheel, resilient means mounting said timing shaft for transverse movement in a fixed path to engage said gear with said wheel, operating means for moving said timing shaft in said fixed path, said operating means and said resilient mounting means cooperating to exert a predetermined initial engaging pressure between said wheel and said gear, the axis of said wheel being offset from said fixed path whereby rotation of said wheel by said motor is effective to exert on said gear and said timing shaft a force in a direction to increase said engaging pressure in accordance with the load on said motor.

5. A definite time relay comprising a motor, a contact member, time adjustable means including a timing shaft for operating said contact member a definite time after energization of said motor, a driving wheel formed of yieldable friction material, means including a train of reduction gearing having an appreciable back-lash therein for connecting said driving wheel to said motor, a toothed gear carried by said timing shaft normally out of engagement with said motor driven gear, resilient means mounting said timing shaft for movement in a fixed path to engage said gear with said wheel, means including a solenoid energizable simultaneously with said motor for moving said timing shaft in said fixed path, the axis of said wheel being offset from said fixed path so that initial engagement of said gear with said wheel rotates said wheel in a direction to insert all of said back-lash in said gear train, whereby said motor is started at substantially no load.

6. In combination, a driving member comprising a wheel formed of yieldable friction material, a driven member comprising a toothed gear normally disposed in disengaged relationship with said driving member, yieldable means for moving said driven member toward said driving member in a fixed path peripherally to engage said members, the axis of said driving member being offset from the path of movement of the axis of said driven member, and means for rotating said driving member in a direction to exert on said driven member a force which increases the engaging pressure between said driving and driven members as the load on said driven member increases.

7. In combination, a pair of substantially parallel relatively movable shafts, a driving member and a driven member respectively mounted on said shafts out of driving relationship with each other, yieldable means for moving one of said shafts toward the other of said shafts in a fixed path to engage said driving and driven members, said yieldable means exerting a predetermined initial engaging pressure on said members, said other shaft being offset from said fixed path of movement, and means for rotating the shaft

carrying said driving member to rotate said driven member and to exert on said relatively movable shafts a force proportional to the load on said driven member, said force being in a direction
5 to increase the engaging pressure between said members as said load increases.

8. In combination, a pair of substantially parallel shafts one of which is mounted for movement transversely of its axis in a fixed path, said
10 other shaft being offset from said path of movement, a driving member and a driven member respectively mounted on said shafts, one of said members comprising a wheel formed of yield-
15 able friction material and the other of said members comprising a toothed wheel, yieldable means

for moving said one shaft in said fixed path peripherally to engage said driving and driven members with each other, said yieldable means exerting a predetermined initial engaging pressure on said members, whereby said teeth are
5 pressed into said yieldable material, and means for rotating the shaft carrying said driving member to effect rotation of said driven member and to exert on said movable shaft a force proportional to the load on said driven member, said
10 force being in a direction to increase the engaging pressure between said driving and driven members as said load increases.

ROBERT W. GOFF. 15