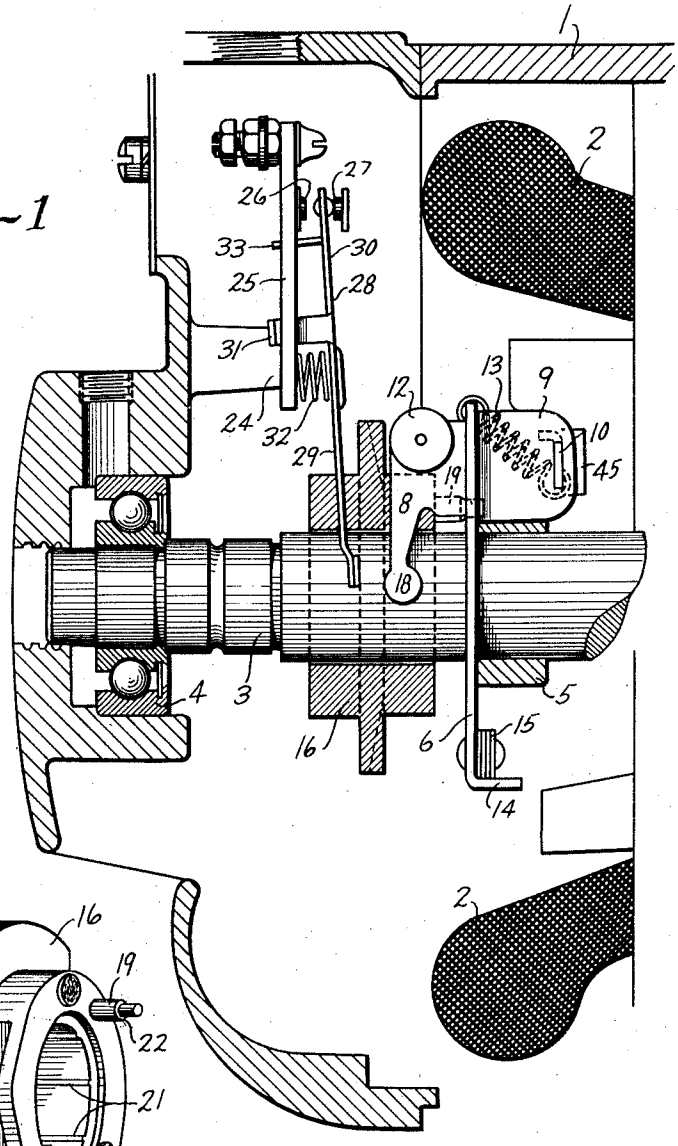
Dec. 15, 1942. J. LEFLAR ET AL 2,305,093

CENTRIFUGAL SWITCH

Filed Dec. 29, 1939 3 Sheets-Sheet 1

Fig.-1



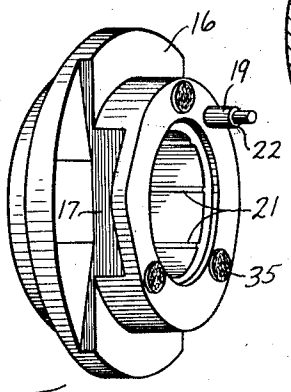


Fig.-6

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Dec. 15, 1942. J. LEFLAR ET AL 2,305,093

CENTRIFUGAL SWITCH

Filed Dec. 29, 1939 3 Sheets--Sheet 2

Fig.-2

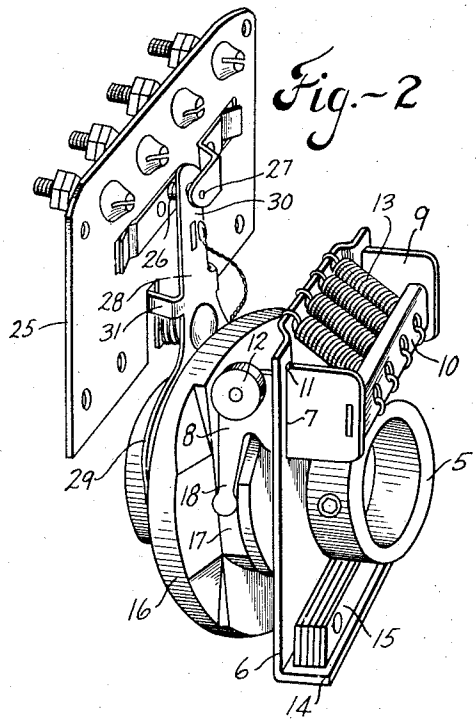


Fig.-3

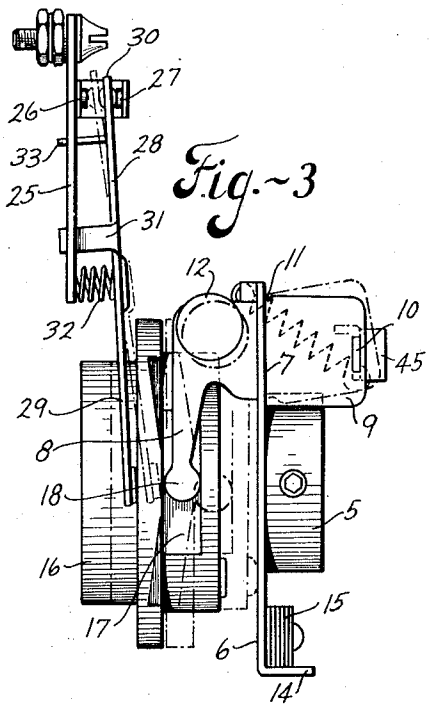


Fig.-4

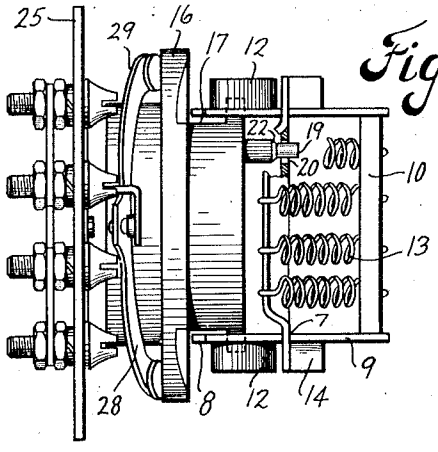
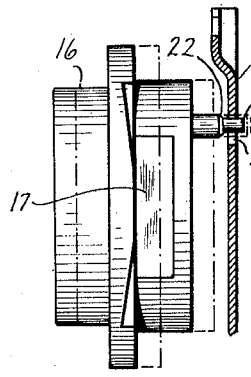


Fig.-5



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CENTRIFUGAL SWITCH

Filed Dec. 29, 1939 3 Sheets--Sheet 3

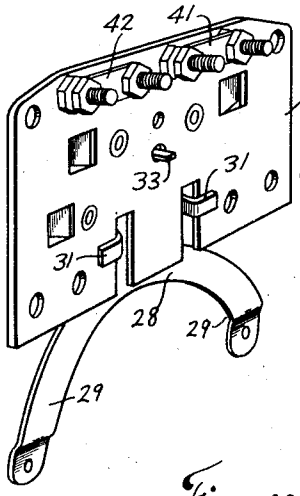


Fig.-8

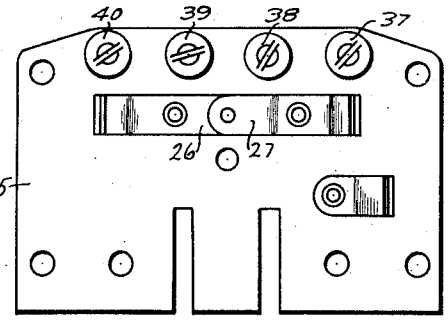


Fig.-9

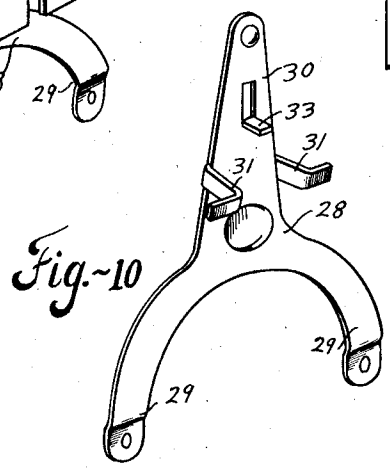


Fig.-10

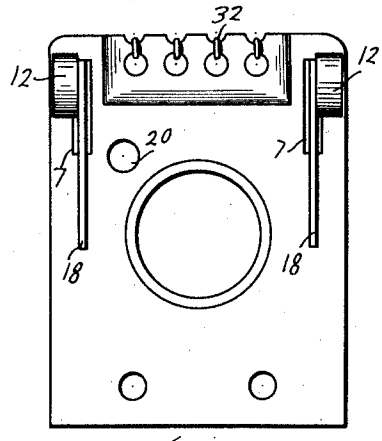


Fig.-7

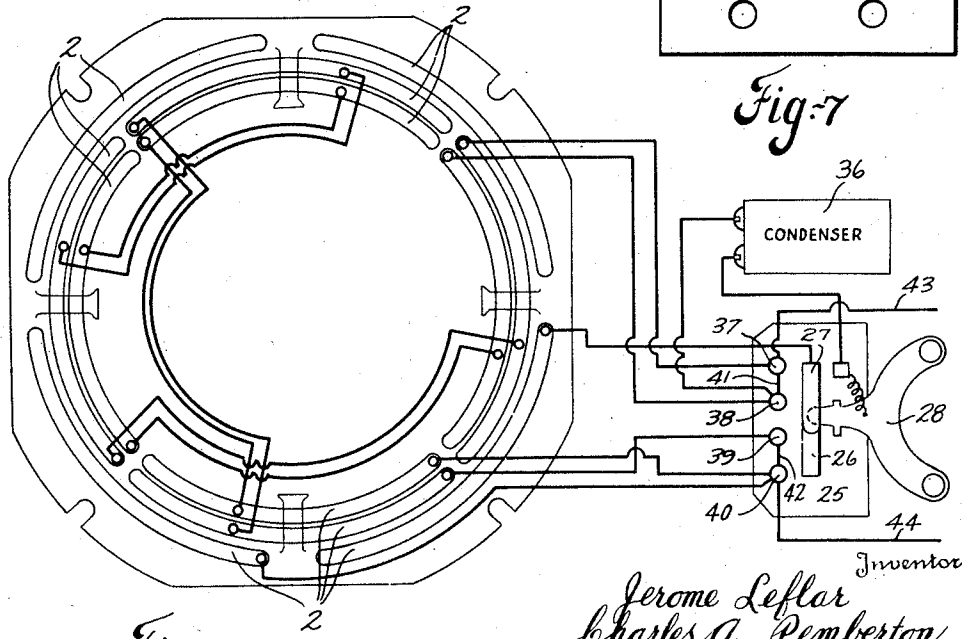


Fig.-11

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UNITED STATES PATENT OFFICE

2,305,093

CENTRIFUGAL SWITCH

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Application December 29, 1939, Serial No. 311,648

14 Claims. (Cl. 200—80)

This invention pertains to centrifugal governors, and more particularly to an automatic, centrifugally actuated alternating device applicable to a variety of purposes for shifting a work member into and out of operative position, or from one such position to another.

For illustrative purpose, but without intent to unduly restrict or limit the invention or its application, it is herein shown and described in its relation to an electric circuit make and break unit, or automatic cut-out as applied to a condenser type motor, for automatically changing the motor operation from a high potential starting condition to a low potential running condition, and vice versa, in accordance with speed variations.

In such motor operation wherein a single phase current is employed, a condenser is connected into the circuit for starting purposes, and is excluded therefrom under running condition. When interposed in the motor circuit, the condenser causes the current in one motor coil to be advanced relative to that of another coil, thus affording some of the advantage and performance of polyphase current. When running condition has been attained, the present cut-out automatically operates under centrifugal influence to short circuit the condenser and thus exclude it from the motor operating circuit.

One of the problems is that of effecting quick, uniform snap-over action, and of delaying such action until sufficient tension is stored to complete the movement instantly.

The primary object of the present invention is to improve the construction, as well as the means and mode of operation, of centrifugally controlled, electrical switches, whereby they may not only be economically manufactured, but will be more efficient in use, automatic in operation, uniform in action, of relatively few parts, and unlikely to get out of repair.

A further object of the invention is to provide in a centrifugally controlled switch definition of movement and a snap-over action.

A further object of the invention is to delay the snap-over action until ample power is stored to effect instantaneous movement through full range.

A further object of the invention is to provide a compact construction suitable for direct embodiment in an electric motor or other mechanism.

A further object of the invention is to provide a universally adjustable contact make and break device, insuring uniform engagement under varying conditions.

A further object of the invention is to provide a centrifugally controlled circuit closer possessing the advantageous structural features and inherent meritorious characteristics herein mentioned.

With the above primary and other incidental objects in view as will more fully appear in the specification, the invention intended to be protected by Letters Patent consists of the features of construction, the parts and combinations thereof, and the mode of operation, or their equivalents, as hereinafter described or illustrated in the accompanying drawings.

In the drawings, wherein is shown the preferred but not necessarily the only form of embodiment of the invention,

Fig. 1 is a sectional side elevation of a portion of an electric motor, in which the present invention is embodied.

Fig. 2 is a perspective view of the switch or cut-out device removed from the motor.

Fig. 3 is a side elevation thereof.

Fig. 4 is a top plan view.

Fig. 5 is a detail side elevation of the shift collar and an engaging portion shown in section.

Fig. 6 is a perspective view of the shift collar.

Fig. 7 is a front view of the mounting plate from the left of Figs. 1, 2, 3 and 4.

Fig. 8 is a perspective view of the electrical distribution panel.

Fig. 9 is a front elevation of the electrical distribution panel.

Fig. 10 is a detail perspective view of the oscillatory contact lever.

Fig. 11 is a wiring diagram.

Like parts are indicated by similar characters of reference throughout the several views.

Although the invention is herein shown and described as applied to an electric motor for effecting different operating conditions in accordance with fluctuations of speed thereof, for which purpose it is especially desirable, it is to be understood that it is not limited to such application, but is capable of general use for opening and closing electrical circuits in association with variable speed mechanisms other than electric motors.

Referring to Fig. 1 of the drawings, 1 is a portion of the housing of a conventional electric motor, of which 2 is a portion of the field winding and 3 an end of the rotor shaft mounted in a bearing 4 in the motor housing head.

Fixedly secured upon the rotor shaft 3 is a

collar 5. Attached thereto for unison rotation is a mounting plate 6 having adjacent its opposite corners parallel slots 7. Fulcrumed in the slots 7 is an oscillatory frame comprising relatively spaced bell crank levers 8, the arms 9 of which project through the slots 7 and are interconnected for unison oscillation by a transverse tie bar 10. The tie bar 10 also serves as a weight subjected to centrifugal influence upon rotation of the plate, thereby effecting oscillation of the frame. The arms 9 are marginally notched or shouldered at 11 for fulcrum engagement in the ends of the slots 7.

The respective bell crank levers carry weights 12 attached thereto at the side of their fulcrum opposite the tie bar 10, which under centrifugal influence induced by rotation of the shaft 3 tends to counteract to limited degree the centrifugal effect of the arms 9 and bar 10 and so restrain movement of the frame. The oscillatory frame 8—9—10 rocks about the fulcrum points 11 against the yielding resistance of a plurality of retractile springs 13. These springs 13 are connected with the transverse tie bar 10 and the top of the mounting plate 6. One edge of the mounting plate 6 is laterally flanged at 14 and carries a weight 15 which counterbalances the plate 6 and compensates for the weight of the oscillatory frame 8—9—10.

Slidingly mounted on the shaft 3 adjacent the collar 5 and plate 6 is a circumferentially flanged shift collar 16, having at its opposite sides grooved recesses 17 into which the dependent arms 18 of the oscillatory bell crank levers 8 project.

A driving pin 19 carried by the shift collar 16 projects through a hole 20 in the mount plate 6 and transmits unison rotation to the shift collar, but permits relative axial shifting movement of the collar 16 to and from the driving plate. The construction is such that the oscillatory motion of the centrifugally actuated frame is transmitted by the arms 18 to the sliding collar 16, causing it to move on the shaft to and from the mounting plate 6.

To minimize friction and facilitate easy shifting motion of the collar 16, the bore thereof is provided with spaced bearing ribs 21 which materially reduce the bearing surface.

The pin 19 is provided mid-length with a shoulder 22 which initially engages the margin of the hole 20 in the mounting plate 6 and temporarily resists the approach of the shift collar 16 toward the plate 6.

As the pressure of the arms 18 upon the shift collar 16 increases under centrifugal influence, movement of the collar is temporarily resisted by the engagement of the shoulder 22 of the pin 19 with the margin of the hole 20 in the plate 6. This momentarily prevents further oscillation of the centrifugally operated frame, until under centrifugal influence at increased speed the pressure of the arms on the collar overcomes such resistance. Thereupon the shoulder 22 on the pin 22 exerting a slight camming action effects sufficient differential rotative adjustment between the plate 6 and the collar 16 rotating in unison therewith, to permit the pin 19 to enter the hole 20 bekond its shoulder 22, thereby enabling the shift collar to axially advance toward the plate 6 under the oscillatory pressure of the arms 18 of the centrifugally actuated frame. Upon decrease of speed of rotation and consequent reduction of centrifugal influence the springs 13 retract the oscillatory frame, thereby causing the arms 18 to push the shift collar away from the plate 6, withdrawing the pin 19 from the hole 20 until the shoulder 22 again engages over the margin of the hole.

The to and fro axial shifting motion of the flanged collar 16 thus effected is utilized to oscillate a contact arm into and out of circuit closing relation.

Mounted on a suitable bracket or arm 24 within the motor housing is a panel 25 of insulating material carrying sundry electrical connections, including a pair of overlapping relatively spaced contact fingers 26 and 27. Flexibly mounted on the panel 25 for universal rocking motion is an inverted Y shaped work member 28, the bifurcated end 29 of which straddles the shift collar 16 and bears at diametrically opposite points against the flange of said collar. The work member is oscillated to and fro into alternate positions in accordance with variations of speed above and below a predetermined range. The upturned single arm 30 in the present instance carries an electrical contact interposed between the spaced contact fingers 26 and 27, with which it engages alternately as the shift collar is moved to and fro.

The member 28 is flexibly fulcrumed for free variable movement upon a pair of spaced fingers 31 carried by the switch member 28 and which project through a pair of spaced slots in the panel 23, beyond which the ends of the fingers are outturned into overlapping engagement with the rear side of the panel. Beneath the fulcrum fingers an expansion spring 32 is interposed between the switch member and the panel, tending to rock the upper end of the member into engagement with the contact 26 and away from the contact 27. However, in the normal position of the shift collar when the motor shaft is at rest or rotating at low speed, the engagement of the flange of the collar 16 with the bifurcated end 29 of the circuit make and break lever 28 holds the latter in closed engagement with the contact 27 against the yielding resistance of the spring 32. The oscillatory contact member 28 is quite flexibly mounted on said spring 32, its fulcrum fingers 31 permitting some range of transverse tilting motion in addition to its to and fro motion intermediate the contacts 26 and 27. The contact member 28 is yieldingly supported upon the panel 25 and guided relative to the contacts 26—27 by a stud or tongue 33 carried by the arm 28 and having loose engagement in a hole in the panel. Felt or rubber pads 35 on the shift collar 16 cushion its impact engagement with the mounting plate 6 upon the snap-over movement when the resistance of the pin shoulder 22 against the edge of the hole 20 has been overcome. The engagement of the contact arm 28 with the contact 27 includes the governing condenser in the motor circuit for starting purpose. However, upon attaining speed the centrifugal actuation of the oscillatory frame 8—9—10 by retracting the shift collar 16 relaxes its pressure upon the bifurcated end 29 of the circuit closing lever 28. The spring 32 thereupon moves the lever into engagement with the contact 26 and short circuits or excludes the governing condenser from the motor circuit. By varying the weights 12, the timing of the device may be varied to effect earlier or later response to centrifugal influence. Likewise, a similar effect may be achieved by varying the tension of the springs 13.

While in the present instance the oscillations of the work lever 28 incident to fluctuations of speed of rotation controls an electrical switch, it is to be understood that the assembly may be

mounted upon a rotary shaft of a mechanism other than a motor and the movement of the work lever **28** incident to speed fluctuations may be utilized for opening and closing a valve, operating a shutter, setting a signal, or performing other mechanical operations.

In the particular disclosure the contact **26** is not electrically connected, but is a mere limiting stop for the oscillatory arm **30**. Referring to the wiring diagram Fig. 11, the several stator windings are connected with the terminals **37, 38, 39** and **40** on the top of the panel **25**, except one which is connected with the contact **27**. The terminals are interconnected into pairs **37—38** and **39—40** by the jumpers **41** and **42**. The power supply lines **43** and **44** are connected with the respective interconnected pairs of terminals **37—38** and **39—40**. The condenser **36** is bridged between the main line connection **43** by being connected at **38**, and to the oscillatory contact lever **28—30** which in turn has intermittent engagement with the contact **27**. When so engaged the condenser **36** is included in the circuit and temporarily effects a phase change of the stator windings for starting purpose. However, as the speed increases the centrifugal influence causes a reversal of the lever **28—30** out of engagement with the contact **27** to thereby exclude the condenser from the circuit.

Obviously, the response of the device to centrifugal tendency at different speeds may be varied through a considerable range by removing one or more springs **13**, thus weakening the resistance to movement. In event further change of response is required, additional weights **45** (Figs. 1 and 3) may be attached to the tie bar **10** of the oscillatory frame to increase the weight thereof and thereby the centrifugal influence.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute, the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise the preferred form of several modes of putting the invention into effect, and the invention is therefore claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

Having thus described our invention, we claim:

1. In an electric motor having an energizing electrical circuit, a pair of relatively spaced contacts connected in the motor circuit, a movable contact element alternately engageable with the respective contacts to change the characteristics of the motor circuit, a rotor shaft, a plate carried by the shaft, an oscillatory centrifugally actuated frame carried by the plate comprising a pair of relatively spaced bell crank levers fulcrumed on the plate, a tie bar interconnecting corresponding arms of the bell crank levers, a retractile spring connecting the tie bar with the plate and against the yielding resistance of which the frame is movable under centrifugal influence, a thrust collar mounted on the shaft for to and fro axial movement and limited rotative adjustment independently of the shaft and plate, and having operating engagement with the bell crank levers of the oscillatory frame and having operative connection with the movable contact, a shouldered stud carried by the collar and having driving engagement in a recess in the plate for rotating the collar in unison with the shaft with its shoulder engaging the margin of the recess to limit the approach of the collar toward the plate, and thereby retard the reaction of the centrifugally actuated frame, the increasing influence of which exerts camming pressure of the shoulder against the margin of the recess to effect relative rotative adjustment of the collar sufficient to disengage the shoulder of the pin from the margin of the recess and thereby free the collar for movement under influence of the centrifugally operated frame.

2. An electric motor of the type wherein a condenser is alternately included in and excluded from the motor circuit, a motor housing, a rotor shaft therein, a centrifugally actuated governor carried by the shaft, a thrust collar axially movable on the shaft under influence of the centrifugally operated governor, an electrical motor control circuit, a pair of relatively spaced contacts included therein, an oscillatory contact lever engageable alternately with the respective contacts to alternately include and exclude a condenser from the motor control circuit, said oscillatory contact lever extending into the path of movement of the thrust collar, and actuated thereby from engagement with one contact into engagement with the other contact, and a detent for temporarily retarding the movement of the collar while the centrifugal influence of the governor is being increased sufficiently to overcome the retarding influence of the detent.

3. In a centrifugal governor, a rotary shaft, a centrifugally operated actuator, a mounting therefor carried by the shaft, a shift collar mounted on the shaft and operatively connected with the centrifugally operated actuator for to and fro axial movement in accordance with fluctuations of speed of rotation of the shaft, a stud carried by the collar and having engagement with the centrifugal actuator mounting to initially limit the approach of the collar under influence of the centrifugal actuator, said stud being releasable upon increase of influence of the centrifugally operated actuator thereon to permit further approach of the collar and a work member movable into alternate positions by the to and fro motion of the collar.

4. In a centrifugal governor, a shaft, a shift collar mounted thereon for axial movement, a centrifugally operated actuator therefor, a work member alternated by to and fro movement of the collar, a stop member carried by the shaft relative to which the collar is movable by the centrifugal actuator, a stud carried by one of said members and having initial engagement with the other member to limit the approach of the collar toward the stop member, and yielding under increase of motive influence, the construction and arrangement being such that the engagement of the stud will resist the influence of the centrifugally operated actuator until a degree of energy sufficient to overcome the resistance of the stud is stored by increase of speed of rotation, whereupon the collar is permitted to move to effect corresponding movement of the work member.

5. In a centrifugal governor, a rotary shaft, a shift collar axially adjustable thereon, a cen-

trifugally operated actuator operatively connected with the shift collar to effect to and fro movement thereof in accordance with fluctuations of speed of rotation of the shaft, a work member movable to alternate positions by the to and fro movement of the collar, a stop member on the shaft toward and from which the collar is adjusted by action of the centrifugally operated actuator, and detent means initially resisting the approach of the collar toward the stop and yielding under increased motive influence of the centrifugally operated actuator to subsequently permit approach of the collar toward the stop by energy stored during the period of initial resistance of the detent.

6. In a centrifugal governor, a rotary carrier, an oscillatory member pivotally mounted on the carrier in laterally offset relation with the axis of rotation for oscillation under centrifugal influence about an axis transverse to the axis of rotation of the carrier, a thrust member operatively connected therewith for to and fro motion in accordance with variations of the speed of rotation, a detent for the thrust member yieldingly resisting movement thereof under influence of said centrifugally operated member, and responsive to increased influence thereof incident to increased speed of rotation to permit further movement of the thrust member, and a work member actuated into alternate positions of adjustment by the to and fro movement of said thrust member.

7. In a centrifugal governor, an axially movable collar, a plate relatively to which the collar is movable and having a hole therein, a shouldered stud carried by the collar and projectible within the hole in the plate with the margin of which the shoulder on the stud engages to temporarily resist movement of the collar, centrifugal means for actuating the collar toward the plate under pressure sufficient to overcome the resistance of the shoulder engagement of the pin with the plate, and a work arm shifted to and fro by movement of the collar.

8. In a centrifugal governor, a rotary shaft, a carrier mounted thereon for unison rotation, a pair of relatively spaced interconnected bell crank levers fulcrumed on the carrier for oscillatory motion under centrifugal influence, a thrust collar mounted on the shaft for relative to and fro axial motion and limited rotative adjustment relative to the shaft and carrier, and to which the bell crank levers transmit unison movement, retarding means for restraining the movement of the collar and centrifugally operated bell crank levers while the energy due to increased centrifugal influence is stored and means operated by the increased centrifugal influence for effecting a limited rotative adjustment of the thrust collar to counteract the retarding means and release the collar for axial movement under influence of the centrifugally operated bell crank levers, and a work member adjusted by the axial movement of the collar.

9. In a centrifugal governor, a rotary shaft, a centrifugally operated actuator carried thereby, a thrust collar mounted on the shaft for to and fro axial movement and for limited rotative adjustment relative to the shaft under influence of the centrifugally operated actuator, detent means restraining the axial movement of the collar, camming means imparting to the collar a limited rotative adjustment under increased influence of the centrifugally operated actuator to permit further axial movement thereof, and a work member operated by to and fro movement of the collar.

10. In a centrifugal governor, a rotary shaft, a centrifugally responsive unit, a thrust collar mounted on the shaft for to and fro axial movement and limited rotative adjustment under influence of the centrifugal unit, a detent retarding initial axial movement of the collar and compelling initial rotative adjustment thereof and a sequential axial movement under influence of increased influence of the centrifugal unit, and a work member operated by the axial movement thereof.

11. In a centrifugal governor, a rotary shaft, a centrifugally operated unit carried thereby, a thrust collar mounted on the shaft for to and fro axial movement and limited rotative adjustment relative to the shaft, stop means temporarily resisting the initial axial movement of the collar under influence of the centrifugal unit, the construction and arrangement being such that upon increased influence of the centrifugal unit the stop means will be disengaged by a rotative adjustment of the collar after which it will be moved axially, and a work member controlled by the axial motion of the collar.

12. In a centrifugal governor, a rotary shaft, a centrifugally operated unit carried thereby, a thrust collar mounted on the shaft for to and fro axial movement and limited rotative adjustment relative to the shaft, retarding means resisting initial axial movement thereof under influence of the centrifugal unit, the construction and arrangement being such that upon increased influence of the centrifugally operated unit the collar is initially rotatively adjusted and subsequently moved axially of the shaft, and a work member controlled by such axial movement of the collar.

13. In a centrifugal governor, a rotary shaft, a centrifugally operated unit carried thereby, a work member movable to alternate positions under influence of the centrifugally operated unit, and a motion transmission device operatively connecting the centrifugal unit and work member and capable of reciprocatory motion and limited rotative adjustment, the reciprocatory motion of which is temporarily resisted under influence of the centrifugally operated unit, and means responsive to increased influence of the centrifugally operated member compelling initial rotative adjustment and subsequent reciprocatory motion of the motion transmission device.

14. In a centrifugal governor, a rotary shaft, a centrifugally operated unit carried thereby, a work member movable to alternate positions under influence of the centrifugally operated unit, and a motion transmission device operatively connecting the centrifugal unit and work member and capable of reciprocatory motion and limited rotative adjustment, initially locked against reciprocatory motion under influence of the centrifugal unit, said transmission device being initially rotatively responsive to increased influence of the centrifugal unit into release position and subsequently subject to further reciprocatory motion thereof under said increased influence by which the work member is alternated.

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