

Nov. 6, 1956

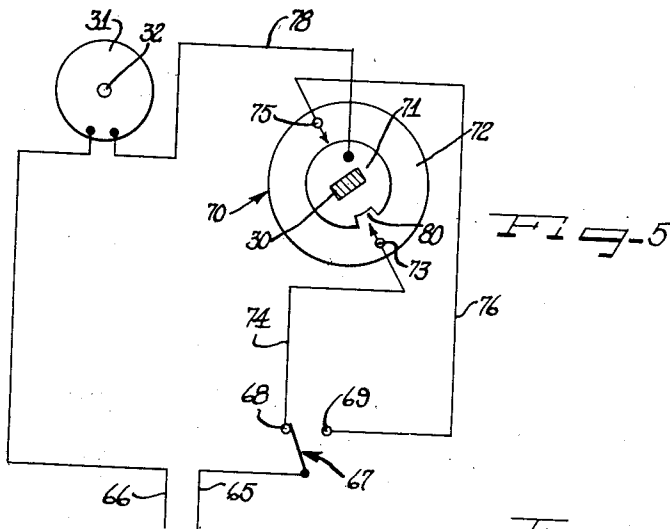
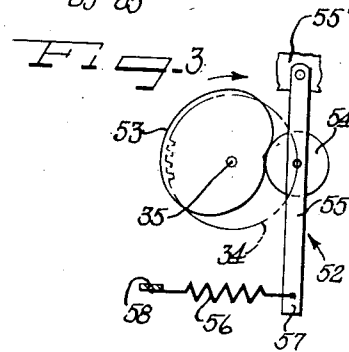
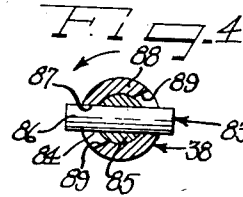
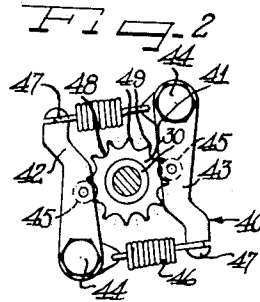
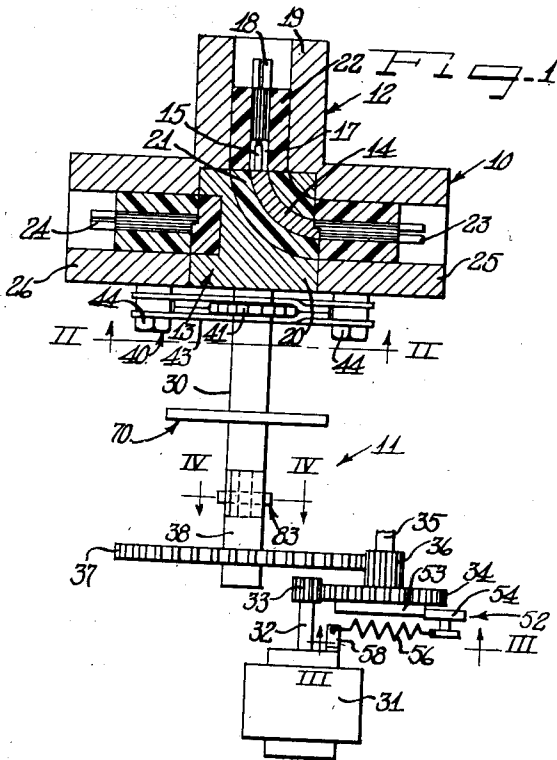
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2,769,941

ROTARY COAXIAL SWITCH ACTUATING MECHANISM

Filed Dec. 5, 1951.

2 Sheets-Sheet 1



INVENTOR

William R. Elliott

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Nov. 6, 1956

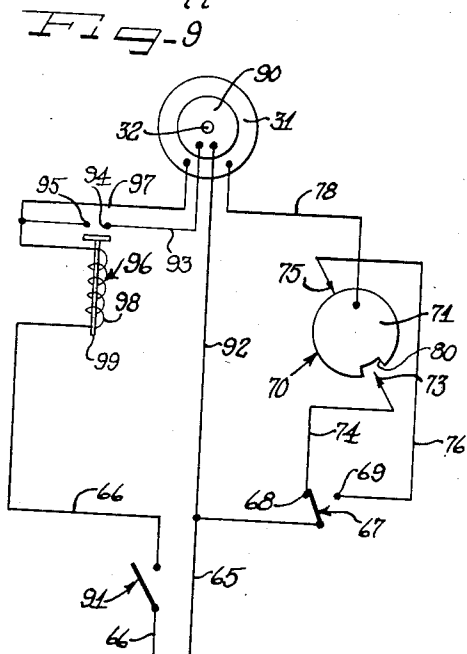
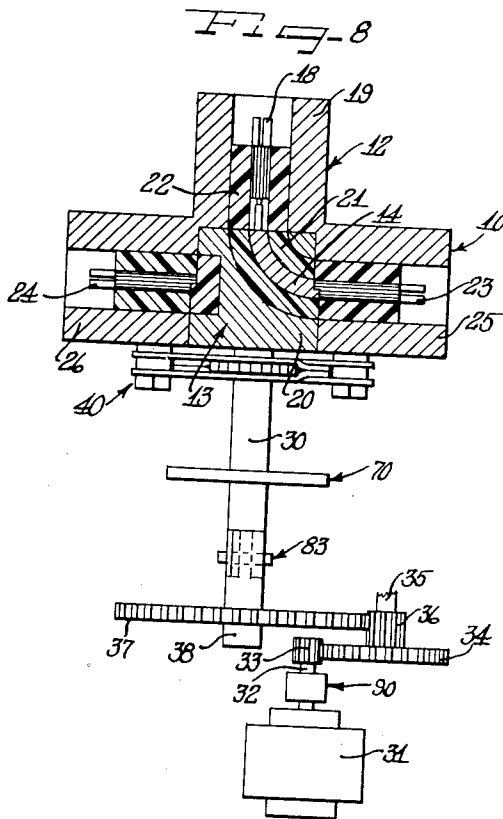
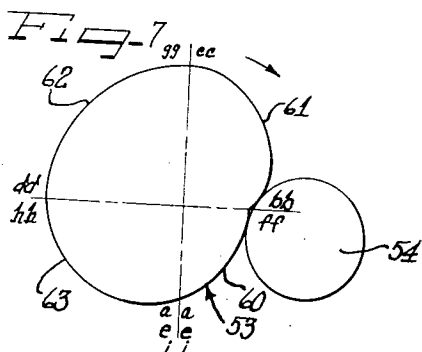
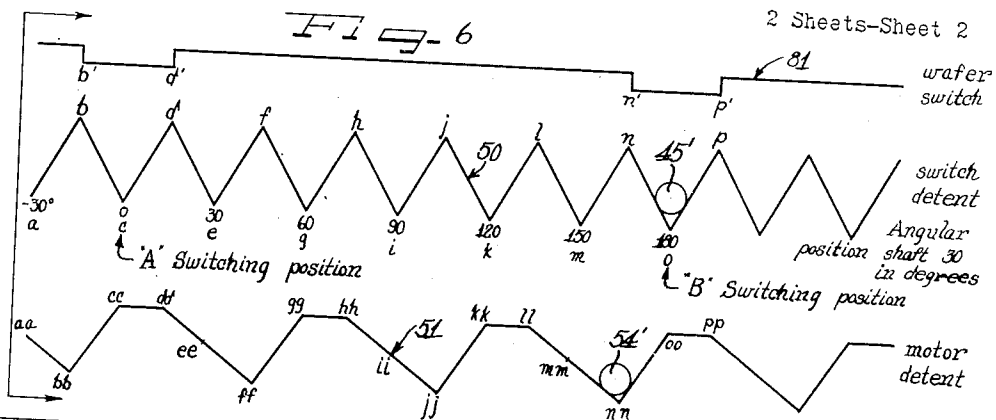
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ROTARY COAXIAL SWITCH ACTUATING MECHANISM

Filed Dec. 5, 1951

2 Sheets-Sheet 2



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2,769,941

ROTARY COAXIAL SWITCH ACTUATING MECHANISM

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Application December 5, 1951, Serial No. 259,979

12 Claims. (Cl. 317—157)

This invention relates to a rotary switch actuating mechanism, and more particularly to an actuating mechanism for moving the rotor of a coaxial switch to one or more preselected positions.

Many of the actuating mechanisms adapted for rotary coaxial switches which have been developed in the past have been of the solenoid operated, ratchet type which provides step-by-step movement of the coaxial switch rotor to one or more preselected positions. Many advantages have been found to result from the utilization of an electric motor to drive a rotary coaxial switch, particularly ruggedness and reliability in use.

It is therefore an object of the present invention to provide a rotary switch actuating mechanism adapted for a rotary coaxial switch which is driven by means of a continuously rotatable driving member rather than by means of a step-by-step driving member.

When a continuously rotating driving member, such as the rotor of an electric motor, is utilized to move a coaxial switch rotor to a preselected position, the angular momentum of the rotor of the electric motor, after the electric motor is deenergized, tends to drive the coaxial switch rotor past the preselected position.

With a step-by-step actuating mechanism, wherein angular momentum of the driving member is not a problem, detent means have been utilized to center the switch rotor at the preselected position. The detent operates by accelerating the switch rotor toward the preselected position, after the switch rotor has been rotated into a first preselected range in advance of the preselected position and by resisting movement of the switch rotor past the preselected position, within a second preselected range.

If detent means are applied to a switch driven by the rotary driving member of an electric motor, the angular momentum of the driving member combines with the acceleration contributed by the detent means within the first operative range of the detent to drive the switch rotor past the preselected position, and the retarding action of the detent in the second range beyond the preselected position is inadequate to stop the switch rotor and return it to the preselected position.

By way of example, in the case of a simple 30° detent, an accelerating force is exerted on the switch rotor within a 15° range in advance of the preselected position and a retarding force is exerted on the motor for only 15° beyond the preselected position. A detent such as used with a step-by-step drive normally exerts insufficient retarding torque on the motor. If the retarding torque is made sufficiently high to be capable of bringing the motor to a stop within the 15°, it has been found that a practical motor is unable to overcome the retarding torque in starting.

It is, therefore, a further object of the present invention to provide means for rendering the angular momentum of the rotary driving member ineffective to drive the switch rotor beyond the operative range of a detent means, or other means acting to position the switch rotor in the preselected position.

Another object of the present invention is to provide novel indexing mechanism for a coaxial switch in which the driving means is decoupled from the switch rotor at a selected switch position and in which separate and independent position locating means thereafter moves the switch rotor and the driving means to their final respective preselected locations.

It is a still further object of the present invention to provide a retarding torque for the rotary driving member within the operative range of a detent and during the switch rotor accelerating position of the detent range.

It is another and still further object of the present invention to prevent undesirable interaction between the switch rotor detent means and the driving member retarding means.

It is a yet further object of the present invention to provide means affording a free start for the rotary driving member before the switch rotor detent load is applied thereto.

It is yet another and further object of the present invention to provide means for relieving the switch rotor of the driving force of the angular momentum of the rotary driving member when deenergized adjacent a preselected switching position.

Other novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization, manner of construction and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings in which:

Figure 1 is a diagrammatic view partly in section of an actuating mechanism embodying the novel principles and teachings of the present invention as it would be applied to a single pole, double throw rotary coaxial switch;

Figure 2 is a fragmental sectional view taken along the line II—II of Figure 1 and showing the switch detent mechanism in elevation;

Figure 3 is a schematic view taken along the line III—III of Figure 1 and showing the motor detent mechanism in side elevation;

Figure 4 is a cross-sectional view taken along the line IV—IV of Figure 1 illustrating a loose coupling according to the present invention;

Figure 5 is a schematic wiring diagram illustrating the control system for the motor;

Figure 6 is a diagrammatic illustration representing the action of the two detent mechanisms and the wafer switch according to the present invention;

Figure 7 is an enlarged diagrammatic illustration of the detent cam shown in Figure 3;

Figure 8 is a somewhat diagrammatic illustration partly in section of a modified form of actuating mechanism; and

Figure 9 is a schematic wiring diagram illustrating the control system for the mechanism of Figure 8.

The present invention is particularly adapted for use with a rotary coaxial switch having a rotor which is designed to be rotated into one or more preselected positions to complete one or more circuits. It will be readily appreciated that in a coaxial-type switch much more precise positioning of the switch rotor is required than in the ordinary rotary switch. It is the particular problems which are met in the coaxial-type switch which the present invention is specifically designed to meet, and the actuating mechanism according to the present invention is therefore illustrated as it might by way of example be applied to a rotary coaxial switch.

The actuating mechanism of the present invention is also particularly adapted for use with a control system for selectively indexing the switch rotor to one of a plu-

ality of preselected switching positions. The invention is, therefore, illustrated as it might be employed with such an indexing control system by way of example and not by way of limitation.

Referring particularly to Figure 1, by way of example, a single pole, double throw rotary coaxial switch 10 is operated by an actuating mechanism generally designated by the reference numeral 11. The rotary switch 10 comprises a stationary switch body 12 and a switch rotor 13 rotatably mounted therein.

The switch rotor 13 has an inner conductor elbow 14 having a reduced diameter pin 15 at one end extending axially of said switch rotor for continuous contact with prongs 17 of the inner conductor 18 extending axially of the rotor and axially of the main fitting 19. The inner conductor elbow 14 is carried in the rotor 13 and is insulated from the metallic plug 20 of the rotor by means of insulation 21. The inner conductor 18 of the main fitting 19 is centered axially of fitting 19 by means of insulation 22. The switch rotor 13 is turned to selectively establish a circuit between the inner conductor 18 of the main fitting and the inner conductors 23 and 24 of the branch fittings 25 and 26. Each of the coaxial fittings 19, 25 and 26 may be provided with suitable means for connection to coaxial cables, as threads (not shown).

The rotor 13 is, therefore, intended to be moved to accurately determine angular positions. One such predetermined switching position, which may be designated the "A" predetermined switching position, is shown in Figure 1. The other "B" predetermined switching position is with the rotor turned through 180° to make contact between the inner conductor elbow 14 and the inner conductor 24 of the branch fitting 26 to establish a closed circuit from main inner conductor 18 to branch inner conductor 24.

The actuating mechanism 11 is designed to accurately move the switch rotor 13 selectively into the "A" and "B" predetermined switching positions.

In the first embodiment of the invention, the switch rotor 13 is directly connected to a shaft 30 which is adapted to be driven by means of a rotary driving member such as the rotor of an electric motor 31. The drive connection between the motor 31 and the shaft 30 includes a motor shaft 32, pinion 33, driving gear 34, shaft 35, associated pinion 36, driving gear 37 and shaft 38.

In order to accurately position the switch rotor 13 in the preselected switching positions, a first switch detent mechanism indicated generally by the reference numeral 40 is provided. In general, the switch detent mechanism has a central position which corresponds with the desired predetermined switching position and an effective range of angular positions in which it is operative to move the switch rotor to the central predetermined switching position desired.

By way of definite example, the detent may have an over-all range of 30°, with a range in advance of the predetermined switching position of 15° and a range beyond the predetermined switching position of 15°. By way of example, this range of detent action may be accomplished by means of a detent gear 41 fixed to the shaft 30 and having twelve peripheral teeth.

As illustrated in Figure 2, the detent gear 41 is controlled by a pair of opposed arms 42 and 43 illustrated as being pivotally mounted on the coaxial switch housing 12 by means of bolts 44. The arms 42 and 43 carry rollers 45 which are urged against the gear by means of springs 46 anchored at one end on the bolts 44 and at the other end on the free ends 47 of the arms 42 and 43. The springs 46 urge the rollers 45 into the bottom of the grooves 48 between the teeth 49 of the gear 41. Thus, when the motor 31 turns the shaft 30 to such a position that the rollers 45 are in overbalanced relation to the centers of a pair of opposed teeth, the springs 46 will tend to accelerate the shaft 30 by camming the rollers 45 inwardly along the sloping faces of the teeth and to

hold the rollers at the bottom of the grooves 48 in the positions shown in Figure 2.

This action is indicated diagrammatically in Figure 6 by means of the saw tooth designated by the reference numeral 50 which is intended to represent the roller contacting faces of the gear 41, linearly developed. Thus, movement of one of the detent rollers 45 up the sloping face of a tooth 49 is represented by movement from *a* to *b*, from *c* to *d*, and from *e* to *f*, etc., while travel down one of the sloping faces of one of the teeth 49 is represented by movement from *b* to *c*, from *d* to *e*, and from *f* to *g*.

It will thus be seen that in the case of a simple 30° detent, such as illustrated in Figure 2, a retarding force is exerted on the motor for 15° beyond a predetermined switching position, i. e., from *c* to *d* for predetermined switching position "A." In order to stop the motor so that the switch rotor 13 can return to its desired position, such as its "A" position (corresponding to point *c* in the diagram of Figure 6), the retarding torque must be sufficient to overcome the angular momentum of the system and bring the shaft 30 to rest before position *d* is reached. If the retarding torque is made sufficiently high to accomplish this purpose, it has been found that no conveniently small size motor is able to overcome this retarding torque. It will be apparent, however, that if a retarding torque is applied for 30° instead of the 15° between *c* and *d* provided by the detent 40, the retarding torque need only be half of its former magnitude and still stop the motor.

According to the present invention, the angular range over which a retarding torque is exerted on the motor is increased by providing a second detent-type mechanism which will be operative to exert a retarding torque on the rotor of the motor 31 in advance of the predetermined switching position "A" corresponding to *c* in Figure 6. A possible manner of operation of this second detent means is indicated by the line 51 of Figure 6.

For the case where the gearing has a reduction ratio of 6 to 1, a suitable motor retarding detent is indicated generally by the reference numeral 52 in Figure 3. This second detent comprises a cam 53 mounted with the gear 34 on the shaft 35. The cam 53 is controlled by means of a cam follower 54 rotatably carried by an arm 55 pivoted at one end to a fixed support 55'. The cam follower 54 is resiliently urged against the face of the cam 53 by means of a spring 56 secured at one end to the free end 57 of the arm 55 and at the other end to a mounting strip 58 which is illustrated as being secured to the housing of the motor 31. It will be observed from Figure 7 that the cam 53 has a diminishing diameter indicated by the reference numeral 60 through a sector of about 90°, corresponding to the lines *aa* to *bb*, *ee* to *ff*, etc. in Figure 6, an increasing diameter for a further 90° sector indicated generally by the reference numeral 61 corresponding to the lines *bb* to *cc*, *ff* to *gg*, etc. in Figure 6, a 90° sector of maximum and constant diameter indicated generally by the reference numeral 62 and corresponding to the lines *cc* to *dd*, *gg* to *hh*, etc. in Figure 6, and region of gradually decreasing diameter 63 corresponding to the lines *dd* to *ee*, *hh* to *ii*, etc. in Figure 6. In Figure 6 the lines *ee* to *ff* correspond to the lines *aa* to *bb* and is the beginning of a second cycle, and lines *ff* to *gg* correspond to lines *bb* to *cc* in Figure 6. It will be understood that one complete revolution of the cam 53 corresponds to 60° of angular rotation of shaft 30 and detent gear 41 thereon, due to the reduction gearing ratio of 6:1 between the shaft 35 and the shaft 30.

The operation of the actuating mechanism 11 will now be readily understood with the aid of the wiring diagram in Figure 5 which illustrates a pair of supply conductors 65 and 66 leading from a suitable source of voltage (not shown). The supply conductor 66 leads directly to the motor and the supply conductor 65 leads to a double throw switch 67 having a pair of contacts 68 and 69 connecting to a wafer switch 70 which, as shown in Fig. 1,

may be mounted on the shaft 30. The inner member 71 of the switch 70 is adapted to rotate with the shaft 30 while the outer member 72 is stationary. A stationary contact 73 is connected to switch contact 68 by means of a conductor 74 and stationary contact 75 of the wafer switch is connected by means of conductor 76 to the switch contact 69. The position of the switch 67 shown may correspond to the preselected switching position "A" shown in Figure 1 with the inner conductor elbow 14 making circuit with the inner conductor 23 of the branch fitting 25. This corresponds generally with position *c* on line 50 and *cc* on line 51 in Figure 6 and is arbitrarily designated the 0° position of shaft 30. If the switch 67 is now actuated to make contact with the contact 69 and close a supply circuit to the stationary contact 75 of the wafer switch 70, the motor 31 will be energized to turn the shaft 30. The circuit extends from supply conductor 65, through switch 67, conductor 76 to stationary contact 75, and through the inner member 71 of the wafer switch to conductor 78 and through the motor 31 to the supply conductor 66. As the shaft 30 is turned through the first 15°, a roller 45 of the first detent travels up the face of a tooth from *c* to *d* and the cam follower 54 travels over the maximum diameter sector 62, from *cc* to *dd* in Figure 6. The switch detent roller 45 is then accelerated down the sloping face of the tooth, from *d* to *e* in Figure 6.

When the shaft 30 has turned to 45°, the roller 45 and cam follower 54 will have reached a point corresponding to points *f* and *ff* in Figure 6. An accelerating force is exerted on the first detent roller 45 and a retarding force is exerted by the cam follower 54, but since the motor has not yet been deenergized, the switch rotor continues to rotate. When the shaft 30 has rotated through 165°, it will be appreciated that the arcuate slot 80 on the periphery of the inner member 71 is now approaching the stationary contact 75. If the slot subtends an angle of substantially 30°, by the time the shaft has turned through 165°, contact will be broken between the stationary contact 75 and the inner member 71 to disconnect the supply conductor 65 from the motor 31 to deenergize the motor. The point of motor shut-off is indicated by the sharp fall at *n'* in the line 81 in Figure 6. Because of the 30° slot 80, it will be understood that the motor cannot be again energized until the shaft 30 has turned to 195°, or 15° beyond the predetermined switching position "B."

In the present case, the rotary driving member or rotor of the electric motor 31 will continue to rotate due to its angular momentum. It is desired to stop the shaft 30 at the position "B." As the detent wheel of the switch detent reaches position *n*, the shaft 30 is pulled ahead while the motor detent cam follower 54 is exerting a retarding force from *nn* to *oo*, corresponding to selector 61 of the cam in Figure 7. If the motor is stopped before position *p'* on line 81 in Figure 6, when the stationary contact 75 would again contact the inner switch member 71 of the wafer switch 70, the springs 46 and the rollers 45 of the first detent would be operative to return the shaft 30 to the central position *o* corresponding to the preselected switching position "B" of the coaxial switch rotor 13. It will be appreciated that since a retarding torque is exerted by the motor detent 52 from 165° to 180° and since the switch detent means is operative from 180° to 195° to retard the rotary driving member, only one-half of the retarding torque is necessary to stop the shaft 30, as compared with the torque which would be necessary without the motor detent means. It has been found that a suitable motor is available to overcome this reduced retarding torque in starting.

It will be observed that at positions *e*, *i* and *m* in Figure 6, which correspond to angular positions of the shaft 30 which are odd multiples of 30°, the second detent 52 does not exert a retarding torque on the shaft 35. For example, from *dd* to *ff* in Figure 6 the second detent is continuously tending to accelerate the shaft 35. Thus,

only the retarding torque exerted by the upwardly sloping teeth 49 of the detent 40 from *e* to *f* exerts a retarding force on the motor. This retarding torque is insufficient to stop the motor, even if it should be deenergized for some reason. The stopping points are thus located 60° apart as a result of the shape of the second detent cam 53.

One of the principal features of the present invention is the provision of a "sloppy" or loose coupling indicated generally by the reference numeral 83 between shafts 35 and 30. This coupling is designed to allow some free play between the action of the switch detent 40 and the motor detent 52. As shown in Figure 4, in the particular construction illustrated, the shaft 38 has at its end a pair of arcuate slots 84 lying on diametrical sides of a longitudinal cylindrical bore. The shaft 30 has a reduced diameter end portion 85 rotatably disposed within the cylindrical bore of the end of the shaft 38. A pin 86 extends transversely through the reduced cylindrical end portion 85 of the shaft 30 to couple shaft 30 with the shaft 38.

With the shaft 38 rotating counter-clockwise, as seen in Figure 4, it will be appreciated that the shoulders 87 afforded by the slots 84 will bear against the pin 86 and thus drive the shaft 30 through the reduced cylindrical portion 85 thereof.

When at the 165° position of the shaft 30, adjacent point *nn* on line 51 in Figure 6, the retarding force is exerted on the shaft 35, the shaft 30 is free to continue accelerating to the point *o* on line 50 under the action of the springs 46 and rollers 45 of the switch detent 40, the pin 86 moving counter-clockwise relative to the slotted end 88 of the shaft 38. It will be appreciated that 15° of play between the shafts 30 and 38 will be sufficient to accommodate the maximum desired relative rotation of the two shafts to permit movement of the switch rotor 13 to the preselected position "B" before shaft 38 reaches position *oo*. If the motor is completely stopped before the shaft 38 has achieved an angular position corresponding to *oo* on line 51, the shaft 38 is returned to the position *nn* by the action of the motor detent 52, the loose coupling 83 allowing this reverse rotation as the shaft 30 centers at the position corresponding to *o* and the switch rotor position "B." If the motor has not stopped rotating before the shaft 38 has reached the position *oo*, the switch detent action between *o* and *p* tends to resist rotation of the shaft 30 and the shaft 38. If the motor stops before shaft 30 reaches *p*, the switch detent is effective to return the shaft 38 from position *pp* to position *oo*, with the pin 86 of the loose coupling bearing against the shoulders 87, and then the motor detent means is effective to return the shaft 38 through a further 15° from *oo* to *nn*, the shaft 38 turning clockwise to move shoulders 87 away from pin 86 and shoulder 89 toward pin 86. It should be understood that with a loose coupling the switch 70 in the embodiment illustrated is responsive to the angular position of the shaft 30 and not to the angular position of the shaft 38. The final rest positions of the rollers 45 and cam follower 60 54 are indicated in Figure 6, the cam follower circle being designated 54' and the roller circle being designated 45'.

If the switch is moved to again close the contact 68 with the conductor 65, the coupling being in its loose non-driving relation affords a 15° free acceleration to the motor 31 before a firm driving connection is established between the shaft 38 and the shaft 30 with the pin 86 again bearing against shoulders 87. The loose coupling between the shafts therefore not only improves the action of the switch and motor detents, but also affords a relatively free starting period for the motor, permitting a still larger retarding torque when desired.

The second embodiment of the invention illustrated schematically in Figures 8 and 9 utilizes a magnetic brake 90 instead of the motor detent 52. This embodiment

7 otherwise has the same parts as the embodiment of Figure 1, and the similar parts have been designated with similar reference numerals.

The brake 90 is illustrated schematically as being applied to the motor shaft 32 and may be of any suitable conventional design, such as a solenoid brake.

The operation of this modification will be apparent from Figure 9 where the magnetic brake 90 is represented by the inner circle and the motor 31 by the outer circle. The operation of the wafer switch 70 is the same as previously. The magnetic brake is normally in braking position when deenergized and remains in braking deenergized position when the switch 91 is closed. The circuit extends through supply conductor 65, conductor 92, the magnetic brake 90, conductor 93, and open contacts 94, 95 of solenoid switch 96 to supply conductor 66. When switch 67 is thrown to index the switch rotor, circuit is closed from supply conductor 65 through conductor 76 to contact 75 of switch 70 and through conductor 78, motor 31, conductor 97 and the solenoid coil 98 of solenoid switch 96 to supply conductor 66. The solenoid coil 98 is then effective to raise armature 99 and close contacts 94, 95, and release the brake, thus allowing the motor to start. Some free starting time may be afforded by the loose coupling 83. However, only the resistance of the switch detent is to be overcome, so that it is not necessary to stop the motor 15° before the rotor has reached the preselected switching position, as would be required to give a 15° free start for the motor.

With switch 67 thrown to make circuit through contact 69, when the slot 80 has reached contact 75, the motor circuit is opened. The solenoid switch 96 is then deenergized to drop the armature 99 and open contacts 94 and 95 and thus to cause the brake 90 to be applied to shaft 32 to stop the motor. The switch detent is free to move the rotor to the preselected position by virtue of the loose coupling 83 as before.

While I have shown certain particular embodiments of my invention, it will, of course, be understood 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 all such modifications as fall within the true spirit and scope of my invention.

I claim as my invention:

1. Indexing mechanism for selectively positioning a rotor with respect to a plurality of surrounding stations comprising a rotatable drive member, means for actuating said drive member, means loosely coupling said drive member to said rotor for affording only a predetermined amount of relative rotation between said drive member and said rotor and for thereafter affording a direct positive drive therebetween, means for deenergizing said actuating means when said rotor has angularly moved to a preselected relative general position with respect to said station, means for thereafter moving said rotor to a precise relative position with respect to said station, and separate means for applying a braking force to said rotatable drive member, said loose coupling means affording sufficient relative rotation between said braking means and said rotor to accommodate positioning of said rotor independent of the action of said braking means.

2. Indexing mechanism for selectively positioning a rotor with respect to a plurality of surrounding stations comprising a rotatable drive member, means for actuating said drive member, means loosely coupling said drive member to said rotor, means for deenergizing said actuating means when said rotor has angularly moved to a preselected relative general position with respect to said station, means for thereafter moving said rotor to a precise relative position with respect to said station, and separate means operative over a range of positions on either side of a central position for applying a braking force to said rotatable drive member, and for thereafter returning it to a predetermined relative position with respect to said rotor, said loose coupling means accommodating relative

rotation between said separate braking means and said rotor positioning means for accommodating the return of said rotatable drive member to said predetermined relative position independent of the rotor positioning means.

3. Indexing mechanism for selectively positioning a rotor with respect to a plurality of surrounding stations comprising a rotatable drive member, means for actuating said drive member, means loosely coupling said drive member to said rotor including a pin and slot connection, means for deenergizing said actuating means and substantially simultaneously applying a braking force thereto, and separate means for advancing said rotor to a precise relative position with respect to said stations and bringing said rotor to rest at such precise position, said pin and slot connection affording sufficient relative rotation between said drive member and said rotor to accommodate independent positioning of said rotor after the braking of said drive member.

4. An actuating mechanism for moving a rotor to a preselected position, comprising a rotary member, means for driving said rotary member, means for energizing said driving means, a shaft driven by said driving member to move the rotor toward the preselected position, means responsive to the angular position of said shaft to disengage said energizing means to deenergize said driving means at a preselected angular position of said shaft in advance of the preselected position of the rotor, detent means for moving said shaft from deenergized position to the preselected position, means for retarding said rotary driving member in advance of the preselected position to resist the angular momentum thereof, and a loose coupling comprising a pin and slot connection between said shaft and said driving member to permit the detent means to move the rotor to preselected position in spite of retarding of said driving member in advance of said preselected position.

5. In combination in a rotary switch, a switch rotor in an actuating mechanism for moving the switch rotor to a preselected switching position, said actuating mechanism comprising a first detent means operative to center said switch rotor on the preselected angular position and operative when said switch rotor is within a preselected angle in advance of said position to move the switch rotor to said preselected position, a rotary driving member for moving said switch rotor toward said preselected position, means for energizing said rotary driving member, and means for disengaging said energizing means when said switch rotor has reached a preselected angular position within the range between the preselected advance angle of operation of said first detent means and the switch rotor preselected switching position, and second detent means operative between switch rotor rotary-driving-member-deenergized position and switch rotor preselected switching position to resist the angular momentum of said rotary driving member.

6. In combination in a rotary switch, a switch rotor and an actuating mechanism for moving the switch rotor to a preselected switching position, said actuating mechanism including a first detent operative to center said switch rotor on the preselected angular position and operative when said switch rotor is within a preselected angle in advance of said position to move the switch rotor to said preselected position, a rotary driving member for moving said switch rotor toward said preselected position, means for energizing said rotary driving member, means for disengaging said energizing means when said switch rotor has reached a preselected angular position in advance of said preselected switching position of the switch rotor, a second detent means operative in advance of switch rotor preselected switching position to resist the angular momentum of said driving member, and a loose coupling between the rotor and said first detent means to facilitate operation of said first detent means.

7. In combination, a first shaft, a second shaft for driving said first shaft, means for driving said second

shaft having considerable angular momentum in operation, detent means operative within a preselected range of angular positions of said first shaft to accelerate the shaft in its direction of rotation to a preselected angular position of said shaft, means for deenergizing said driving means prior to the preselected angular position of said first shaft, and means for applying a retarding force to said second shaft while said driving means is deenergized to resist the angular momentum of said driving means, said retarding force applying means being capable of exerting a greater torque on said rotor than said detent means, and a loose coupling between said first shaft and said second shaft to allow said detent means to accelerate the first shaft toward said preselected angular position, while said second shaft is being retarded.

8. In combination, a first shaft mounted for rotation, a second shaft loosely coupled to said first shaft for driving said first shaft in one direction toward a preselected angular position of said first shaft, and permitting rotation of said first shaft relative to said second shaft in the direction of rotation of said first shaft, detent means active on said first shaft and operative over a preselected range of positions of said first shaft on opposite sides of said preselected angular position to center said first shaft at said preselected angular position and continuously acting on said first shaft during rotation thereof to alternately resist and accelerate motion thereof, and detent means active on said second shaft to retard said second shaft in advance of the first shaft reaching said preselected angular position to resist the angular momentum of the driving means for said second shaft.

9. Indexing mechanism for selectively positioning a rotor with respect to a plurality of surrounding stations, comprising a rotatable drive member, means for actuating said drive member, means loosely coupling said drive member to said rotor for affording only a predetermined amount of relative rotation between said drive member and said rotor and for thereafter affording a direct positive drive therebetween, means for applying a retarding force to said rotatable drive member, means for thereafter moving said rotor to a precise relative position with respect to said station, and said loose coupling affording sufficient relative rotation between said retarding means and said rotor to accommodate positioning of the rotor independent of the action of said retarding means.

10. An actuating mechanism comprising a first shaft for precise positioning in a preselected angular position, a second shaft, means loosely coupling said second shaft to said first shaft for affording a predetermined amount of relative rotation between said second shaft and said first shaft and for thereafter affording a direct positive drive therebetween, means for driving said second shaft, first detent means acting on said first shaft within a predetermined range of positions on either side of said preselected angular position of said first shaft to move said first shaft to said preselected angular position, second detent means for acting on said second shaft and having an operative range on either side of a central position and arrange to resist rotation of said second shaft for a preselected range of positions in advance of the first shaft preselected angular position, said second detent means acting to retard said second shaft in advance of said first shaft reaching said preselected angular position, and said first detent means being arranged to resist rotation of said first shaft beyond said first shaft preselected angular position, said loose coupling means

affording sufficient relative rotation between said first and said second shafts to accommodate positioning of said first shaft independent of the action of said second detent means.

11. An actuating mechanism for moving a rotor from an initial rest position to a preselected new position comprising a rotary member, a driving member for driving said rotary member between an initial rest position and an advanced new position and imparting a substantial angular momentum to said rotary member, a retarding unit operative to apply a retarding force to said members in the general angular area of said new position, and separate precise positioning means operative on said rotary member in positions in advance of and behind said new position to rotate the member to accurately position it in said new position, said separate precise positioning means similarly operative on said rotary member in a series of new positions within one revolution of the rotary member and having an operative element at each new position whereby the rotary member is generally positioned by the same retarding unit in each new position and accurately positioned by the element of the precise positioning means corresponding to the particular position.

12. An actuating mechanism for moving a rotor from an initial rest position to a preselected new position comprising a rotary member, a member for driving said rotary member between an initial rest position and an advanced new position imparting to said rotary member a substantial angular momentum, means mechanically interconnecting the driving member and the rotary member to drive the rotary member, retarding means operative to apply a retarding force to said driving member when the rotary member is in the general angular area of said new position, and separate precise positioning means operative to apply a centering force to said rotary member to accurately center said rotary member in said preselected new position whereby said retarding means stops the driving member and rotary member in the general area of said new position and said positioning means thereafter accurately positions the rotary member at said new position.

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