Nov 24, 1953 E. F. GOETZ 2,660,650

RHEOSTAT OPERATING MECHANISM

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Fig.1.

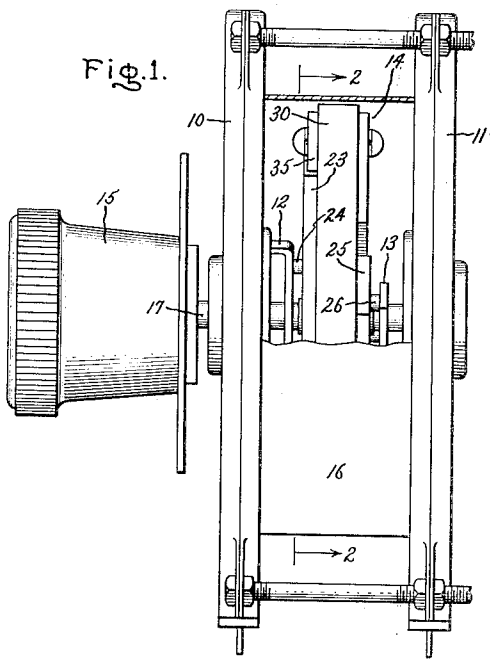


Fig.2.

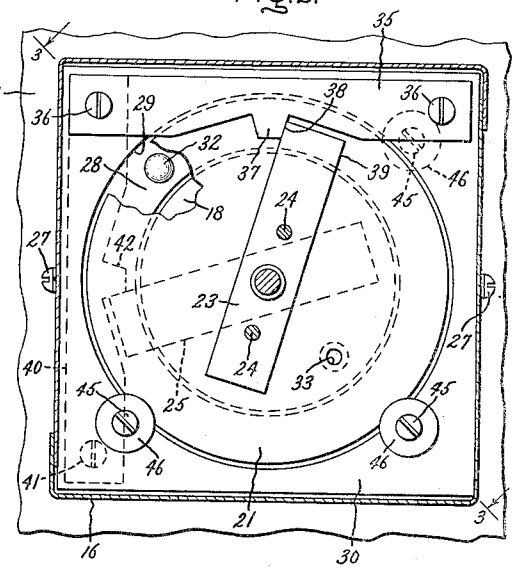


Fig.3.

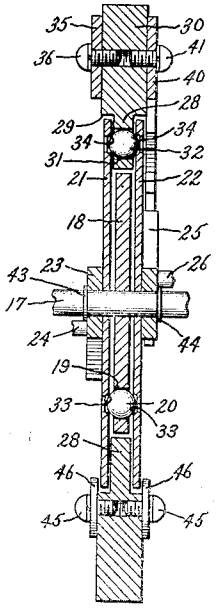
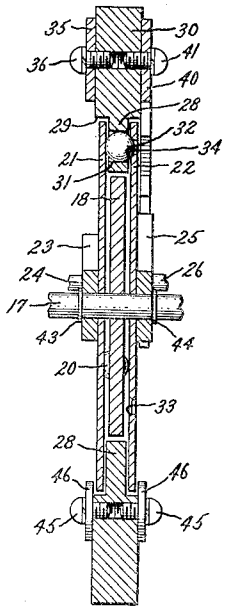


Fig.4.



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RHEOSTAT OPERATING MECHANISM

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13 Claims. (Cl. 201—48)

1

This invention relates to operating mechanisms, and more particularly to sequential operating mechanisms for electrical rheostats and the like.

It is often desirable to operate a plurality of rheostats in sequence by means of a single operating mechanism, in order to provide greater accuracy or greater range of control with a single operating mechanism, in order to control the current in more than one circuit with a single mechanism, and for other reasons. Various operating mechanisms have been used in the past for this purpose, however, such mechanisms generally involve some sort of manual transfer or shift such as pushing a control knob in, pulling it out, changing to a different knob, or in some other manner deliberately transferring operation from one rheostat to another. Furthermore, an interlocking mechanism usually must be provided to prevent one rheostat from being operated until the other has come to the proper transfer point.

It is an object of my invention to provide an operating mechanism which will provide sequential action without a deliberate transferring action on the part of the operator.

It is a further object of the invention to provide a simple and reliable locking arrangement for use with a sequential operating mechanism, for locking one portion while another portion is in operation.

A more specific object of the invention is to provide a concentrically disposed sequential operating mechanism for two circular rheostats which may be interposed between the rheostats in order to provide an efficient and compact arrangement for the sequential operation thereof from a single operating knob.

These and other objects will be apparent from the subsequent detailed description of a preferred embodiment of the invention, while the scope of of the invention is defined in the appended claims.

In carrying out my invention in one form, I provide an operating mechanism which has a flat rotatable member mounted on an operating shaft with a ball receiving opening through the member. A pair of flat rotatable disks are positioned respectively adjacent opposite surfaces of this member including the portion having the ball receiving opening. A stationary member which is positioned in part between these disks has a second ball receiving opening which likewise communicates with the disks. Each of the disks has a pair of indentations on the inner surface which register respectively with the ball receiving openings in the rotatable member and the stationary member at a transfer position of the mechanism. Means are provided for connecting a pair of rheostats respectively to the two disks. By means of a suitable stop the angular movement of the operating member of each rheostat is limited to somewhat less than 360°. When the operating shaft is moved in one direction from the transfer position, one of the rheostats is operated due to the action of the balls on the disks, while when the operating shaft is moved in the other direction the other rheostat is operated. To obtain sequential operation, the operating shaft is started from some predetermined position other than the transfer position and is moved continuously in the proper direction to operate one rheostat throughout all or part of its range of movement and then the other rheostat throughout all or part of its range of movement. When the mechanism is in position for operating one of the rheostats the other rheostat is locked in position and cannot be rotated.

2

For a clearer and more complete understanding of my invention, reference should be had to the accompanying drawing, Fig. 1 of which is a side elevation view partly in section showing a pair of rheostats arranged for operation by a preferred form of the invention; Fig. 2 is a sectional view along the line 2—2 of Fig. 1; Fig. 3 is a diagonal sectional view of the operating mechalism along the line 3—3 of Fig. 2; while Fig. 4 is another view along the line 3—3 of Fig. 2 showing the operating mechanism in a different rotational position.

Referring to Fig. 1 of the drawing, there is shown a pair of circular type rheostats 10 and 11 which are operated respectively by a pair of rotatable operating arms 12 and 13. The sequential operating mechanism for the rheostats is designated generally by the numeral 14 in this figure. An operating knob 15 is provided by means of which the rheostats 10 and 11 can be operated in sequence by turning the knob through more than a complete revolution. If desired, the operating mechanism may be provided with an enclosure 16 between the rheostats to provide mechanical protection and aid in preventing the accumulation of dirt and other foreign material on the operating mechanism.

The operating mechanism is shown in greater detail in Figs. 2, 3 and 4 of the drawing. The mechanism in the preferred form illustrated includes a shaft 17 which is connected to knob 15 and passes through a suitable central opening in rheostate 10. There is positioned on the shaft

and connected thereto in a suitable manner such as by welding or brazing a flat circular disk or rotatable member 18 of uniform thickness. Near its outer edge member 18 is provided with a detent receiving opening 19 which extends through the rotatable member. In this opening is positioned a detent 20 which in this preferred form of the invention is a spherical ball of metal or other wear resistant material. The ball 20 is of greater diameter than the thickness of member 18, while opening 19 is circular and of slightly greater diameter than ball 20 so that the latter is movable within the opening.

A pair of flat circular rotatable disks 21 and 22 are positioned respectively adjacent the opposite flat surfaces of rotatable member 18. Disks 21 and 22 are of greater diameter than member 18 and are rotatable about shaft 17. Disks 21 and 22 preferably have inner surfaces which are parallel to each other and are parallel to and equidistant from the surfaces of rotatable member 18. The distance between disks 21 and 22 is somewhat less than the diameter of ball 20.

Disks 21 is provided with a rectangular projection 23 which is connected to the operating arm 12 of rheostat 10 in a suitable manner such as by a pair of pins 24. Disk 22 has a similar rectangular projection 25 which may be connected to operating arm 13 of rheostat 11 by means of pins 26.

A stationary member 30 is positioned concentrically around rotatable member 18. The outer surface of stationary member 30 is rectangular, corresponding to the cross-section of enclosure 16, and may be secured to the enclosure by means of a pair of machine screws 27 in order to provide support for the operating mechanism. The inner edge of member 30 is circular, and has a radially inwardly extending flange 28, the inner surface of which forms a circle which is slightly greater in diameter than member 18. Flange 28 forms a pair of circular shoulder portions 29 on stationary member 30 which are of slightly greater diameter than disks 21 and 22 and slightly deeper than the thickness of disks 21 and 22 so that the latter are nested within stationary member 30. Flange 28 is preferably of approximately the same or slightly greater thickness than member 18.

Flange 28 has a detent receiving opening 31 in which a detent 32 is movably positioned. In this case, as with the rotatable member 18, the detent is preferably a spherical ball. Ball 32 is of greater diameter than the thickness of flange 28 and also of greater diameter than the distance between the inner surfaces of disks 21 and 22. The opening 31 is preferably circular and is of slightly greater diameter than ball 32 to enable the latter to move within opening 31.

Each of disks 21 and 22 is provided with a pair of detent engaging means such as indentations 33 and 34 on the inner surface thereof at a distance from shaft 17 which will cause them to be in register respectively with openings 19 and 31 at predetermined rotational positions of the disks and member 18. These indentations are positioned on the disks so that at a predetermined transfer position all four are in register respectively with the corresponding detent openings in members 18 and 30, and two indentations 33 being adjacent or in register with opening 19, while indentations 34 are both adjacent opening 31. Each of the indentations 33 and 34 is deep enough to receive a portion of one of the balls 20 and 32, and these balls and members 18 and 30 and the disks 21 and 22 are so proportioned that when a ball is positioned in engagement with an indentation in one of the disks it does not interfere with the movement of the other disk. That is, the depth of the indentations is approximately equal to or slightly greater than the difference between the diameter of the balls and the distance between the inner surfaces of disks 21 and 22.

As shown, indentations 33 and 34 are provided with openings extending entirely through disks 21 and 22. Such openings are not essential for the operation of the mechanism but reduce the likelihood of foreign material accumulating in the indentations 33 and 34 and interfering with the operation of the mechanism.

The operating mechanism is provided with a stop member 35 for rheostat 10. As shown, this stop member is generally rectangular in configuration and is secured to stationary member 30 along the top thereof on the surface nearer to rheostat 10 in a suitable manner such as by a pair of machine screws 36. Stop member 35 has a projection 37 which is arranged to engage projection 23 on disk 21 at both extremes of rotation of the rheostat operating arm so that the rheostat and the disk 21 may be rotated slightly less than a complete revolution. In the position shown in Fig. 2, projection 37 engages a surface 38 of projection 23, while at the other extreme of rotation projection 37 engages surface 39.

The operating mechanism also includes a second stop member 40 which, as shown, is identical with stop member 35. Stop member 40 is positioned on the surface of stationary member 30 which is nearer rheostat 11 along one side of the stationary member, being secured thereto in a suitable manner such as by machine screws 41. Stop member 40 acts as a stop for rheostat 11 at both extremes of its travel of a little less than a complete revolution in the same manner as stop 35 does for rheostat 10. As shown by the dashed lines in Fig. 2, stop 40 has a projection 42 which engages projection 25 on disk 22 and thereby limits the motion of this disk which is connected to rheostat operating arm 13 of rheostat 11 by means of pins 26.

Disks 21 and 22 are retained on shaft 17 in rotatable relation therewith in a suitable manner such as by a pair of rings 43 and 44. As illustrated, additional retaining means for aiding in maintaining alignment of disks 21 and 22 are provided by a plurality of machine screws 45 and washers 46 which are positioned on both surfaces of stationary member 30. Additional retaining means for the disks are also provided by stop member 35 for disk 21 and stop member 40 for disk 22 along the top and side respectively of the mechanism. Flange 28 may also be made slightly greater in thickness than member 18, as mentioned previously, to aid in maintaining the alignment of disks 21 and 22.

The operating mechanism is illustrated in Figs. 2 and 3 in what may be termed the transfer position. In this position, a rotation of knob 15 in one direction results in a movement of one rheostat while the movement of knob 15 in the opposite direction moves the other rheostat operating arm. Referring to Fig. 2, if operating knob 15 is turned clockwise so that shaft 17 is rotated clockwise, disk 21 will be rotated clockwise so that surface 38 of the projection on this disk leaves stop pro-

jection 37. Rotation can be continued in this direction until surface 39 on the projection 23 engages stop projection 37 after almost a complete revolution. In the meantime, rheostat 11 is prevented from moving by the engagement of projection 25 with stop projection 42, and the engagement of ball 32 with indentation 34 in disk 22.

The operation of rheostat 10 described in the preceding paragraph occurs because of the action of ball 20 on disk 21. As soon as clockwise rotation is begun from the position shown in Fig. 2, ball 20 moves into engagement with indentation 33 in disk 21 and thereby causes disk 21 to rotate in unison with rotatable member 18. After a rotation of approximately 90° the position of ball 20 will be as illustrated in Fig. 4 where it can be seen that the ball 20 is in engagement with the indentation in disk 21, but is in a position to move freely along the surface of the other disk 22. As stated above, the motion of disk 22 is prevented by the engagement of the projection 25 with stop projection 42. This forces ball 20 into the position illustrated in Fig. 4 in operative engagement with indentation 33 in disk 21 when clockwise rotation begins from the transfer position.

After rheostat 10 has been rotated to its extrem clockwise position in which surface 39 is in engagement with stop projection 37, or through a portion of such a rotation, operating knob 15 may be turned in the counterclockwise direction to move rheostat 10 back toward its initial position. During such counterclockwise rotation disk 22 and rheostat 11 are still prevented from moving by ball 32 which is engaged with indentation 34 in disk 22, while at the same time stationary ball 32 allows free movement of disk 21 due to the spacing between the disks in relation to the diameter of the ball. This arrangement is also illustrated in Fig. 4 of the drawing. It will be understood that the engagement of ball 32 with indentation 34 in disk 22 took place simultaneously with the engagement of ball 20 with the indentation in the other disk at the start of the clockwise rotation. Inasmuch as member 30 in which ball 32 is retained is stationary, disk 22 is prevented from moving until the mechanism has been returned by counterclockwise rotation to the transfer position.

If counterclockwise rotation is continued beyond the transfer position, the balls 20 and 32 reverse simultaneously at the transfer position and engage respectively indentation 33 in disk 22 and indentation 34 in disk 21. This locks disk 21 thereby preventing the movement of rheostat 10 and at the same time allows rheostat 11 to be rotated counterclockwise almost one complete revolution and back again to the transfer position. The reversal of the balls at the transfer position during rotation in the counterclockwise direction is caused by the engagement of surface 38 with stop projection 37 which stops the motion of disk 21. The locking action provided by ball 32 in engagement with indentation 34 in disk 21 then prevents the motion of rheostat 10 during continued counterclockwise rotation of knob 15 and during the reverse clockwise motion to the transfer position.

It will be understood that the angular positions of openings 19 and 31 are not critical, and they can have any relative angular relation providing the four detent engaging means on the disks are arranged to be in register simultaneously with their respective openings at the transfer position

of the mechanism. As shown in Fig. 2, the two detent openings are disposed on opposite sides of the axis of rotation at the transfer position. This arrangement, while providing for effortless transfer of the balls from disk to disk, has the advantage of equalizing the axial stresses on the disks at the transfer position.

If operation is begun at either extreme of rotation of knob 15, or at an intermediate point other than the transfer position, it will be seen that the mechanism will operate the two rheostats in sequence without any sort of manual adjustment or shift at the transfer point. A smooth effortless transfer from one rheostat to the other at the transfer position is automatically effected merely by continued rotation of the knob. At the same time, one rheostat is locked and cannot be moved while the other is in operation.

While I have illustrated and described my invention in a preferred form for the operation of a pair of rheostats in sequence, it will be readily understood that it is not limited thereto but may be used with equal facility for the operation of other devices. It will be understood, therefore, that modifications may be made in my invention, and I intend to cover by the appended claims any such modifications which fall within the true spirit and scope of my invention.

What is claimed is:

1. An operating mechanism comprising, a rotatable member having a detent opening therethrough, a pair of rotatable disks positioned respectively adjacent opposite surfaces of said member in substantially parallel relation therewith, detent engaging means positioned on the inner surface of each of said disks in position to register with said detent opening at a predetermined position of said mechanism, stop means preventing one disk from rotating in one direction beyond said position and the other disk from rotating in the other direction beyond said position, and a detent movably positioned in said opening for engaging either of said detent engaging means for rotating said one disk when said member is rotated in one direction and said other disk when said member is rotated in the other direction.

2. A sequential operating mechanism for two devices comprising, a flatly disposed rotatable member having a detent opening therethrough, a pair of flatly disposed disks rotatable about the same axis as said member positioned respectively adjacent opposite surfaces of said member in substantially parallel relation therewith, a pair of detent engaging means positioned respectively on the inner surfaces of said disks at a distance from said axis equal to the distance from the axis of said detent opening, the detent engaging means on both disks being positioned so that both are in register with the detent opening at a predetermined transfer position of said mechanism, a detent movably positioned in said opening for operatively engaging either of said detent engaging means to cause the rotation of the disk associated therewith when said member is rotated, and means connecting said disks respectively to said two devices for the sequential operation thereof.

3. An operating mechanism comprising, a rotatable member having a detent opening therethrough, a pair of rotatable disks positioned respectively adjacent opposite surfaces of said member in substantially parallel relation therewith, a second member positioned at least in part between said disks and having a second detent

opening through said part, two detents movably positioned respectively in said openings, and a pair of detent engaging means on the inner surface of each said disk in position to register respectively with said detent openings at a predetermined relative position of said rotatable member and each said disk.

4. An operating mechanism comprising, a rotatable member having a detent opening therethrough, a pair of rotatable disks positioned respectively adjacent opposite surfaces of said member in substantially parallel relation therewith, a second member positioned in part between said disks and having a second detent opening through said part, and two detents movably positioned respectively in said openings, each of said disks having a pair of detent engaging indentations on the inner surface thereof for engaging respectively the two detents, all four indentations being positioned to register simultaneously with the corresponding detent openings at a predetermined position of said operating mechanism.

5. An operating mechanism comprising, a flatly disposed rotatable member having a detent opening therethrough, a pair of flatly disposed disks rotatable about the same axis as said member positioned respectively adjacent opposite surfaces of said member in substantially parallel relation therewith, a second member positioned in part between said disks and having a second detent opening through said part at a greater distance from said axis than the opening in said rotatable member, two detents movably positioned respectively in said openings, a pair of detent engaging means on the inner surface of each said disk at distances from said axis equal respectively to the distances from said axis of said detent openings, the detent engaging means on both disks being positioned so that all four such means are in register with the corresponding detent openings at predetermined positions of said disks and said members corresponding to a predetermined transfer position of said mechanism.

6. An operating mechanism comprising, a flatly disposed rotatable member having a detent opening therethrough, operating means connected to said rotatable member, a pair of flatly disposed rotatable disks positioned respectively adjacent opposite surfaces of said rotatable member for rotation about the same axis as said member, a second relatively fixed member positioned in part between said disks and having a second detent opening through said part at a greater distance than said first detent opening from said axis, two detents movably positioned respectively in said openings, each of said disks having a pair of detent engaging means on the inner surface thereof at distances substantially equal respectively to the distances of said detent openings from said axis, said engaging means being positioned on said disks so that all four such means are in register simultaneously with their respective detent openings at a predetermined position of said mechanism, and stop means for said disks preventing one disk from rotating in one direction beyond said position and the other disk from rotating in the other direction beyond said position.

7. An operating mechanism comprising, a flatly disposed rotatable member of substantially uniform thickness having a substantially circular opening therethrough of greater diameter than said thickness, a pair of flatly disposed rotatable disks positioned respectively adjacent opposite surfaces of said rotatable member in substantially parallel relation therewith, a second member of approximately the same thickness as said rotatable member positioned at least in part between said disks and having a second substantially circular opening of greater diameter than said thickness through said part, two balls of greater diameter than said thickness but of smaller diameter than said openings movably positioned respectively in said openings, a pair of indentations on the inner surface of each disk each for receiving a portion of a ball, each such pair being arranged to register respectively with said two openings at predetermined positions of the disk and said members.

8. An operating mechanism comprising, a flatly disposed rotatable member of approximately uniform thickness having a substantially circular opening therethrough of greater diameter than said thickness, a pair of flatly disposed rotatable disks positioned respectively adjacent opposite surfaces of said rotatable member in substantially parallel relation therewith for rotation about the same axis as said member, a second member of approximately the same thickness as said first member positioned in part between said disks and having a second substantially circular opening of greater diameter than said thickness in said part at a greater distance from said axis than said first opening, two substantially spherical balls of greater diameter than said thickness but smaller diameter than said openings positioned respectively in said openings, each of said disks having a pair of indentations on the inner surface thereof at distances from said axis substantially equal respectively to the distances of said openings from the axis, each of said indentations being suitable for receiving a portion of one of said balls, said indentations being positioned on said disks so that all four indentations are in register simultaneously with their respective openings at a predetermined position of said mechanism.

9. An operating mechanism comprising, a flatly disposed rotatable member of approximately uniform thickness having a substantially circular opening therethrough, operating means connected to said rotatable member, a pair of flatly disposed rotatable disks positioned respectively adjacent opposite surfaces of said rotatable member in substantially parallel relation with said member and with each other for rotation about the same axis as said member, a second relatively fixed member of approximately the same thickness as said first member positioned in part between said disks and having a second substantially circular opening through said part, said second opening being at a greater distance than said first opening from said axis, the two openings having approximately equal diameters and said diameters being greater than the distance between said disks, two substantially spherical balls of greater diameter than said distance between disks but of smaller diameter than said openings positioned respectively in said openings, each of said disks having a pair of indentations on the inner surface thereof at distances substantially equal respectively to the distances of said openings from the axis, each of said identations being suitable for receiving a portion of one of said balls, said openings being positioned on said disks so that all four indentations are in register simultaneously with their respective openings at a predetermined position of said mechanism, and stop means for said disks preventing one disk from rotating in one direction beyond said position and

the other disk from rotating in the other direction beyond said position, said balls moving into engagement respectively with different disks when said mechanism is moved from said position whereby when said member is rotated in one direction by said operating means one of said disks is rotated in one direction and the other disk is locked against movement and when said member is rotated in the other direction said other disk is rotated in the other direction and said one disk is locked against movement.

10. A rheostat operating mechanism comprising, a flatly disposed rotatable member having a detent opening therethrough, a pair of flatly disposed rotatable disks positioned respectively adjacent opposite surfaces of said member, a detent movably positioned in said opening, each of said disks having detent engaging means on the inner surface thereof positioned to register with said detent opening at a predetermined position of said mechanism, stop means for said disks preventing one disk from rotating in one direction beyond said position and the other disk from rotating in the other direction beyond said position, said detent moving into engagement with one disk for the rotation thereof when said member is rotated in one direction from said position and with the other disk for the rotation thereof when the member is rotated in the other direction, and means for connecting a pair of rheostats respectively to said disks.

11. A rheostat operating mechanism comprising, a rotatable member having a detent opening therethrough, a pair of rotatable disks positioned respectively adjacent opposite surfaces of said member, a second member positioned at least in part between said disks and having a second detent opening through said part, two detents positioned respectively in said openings, each of said disks having a pair of detent engaging means on the inner surface thereof arranged to register respectively with said detent openings at a predetermined relative position of the disk and said member, and means for connecting a pair of rheostats respectively to said disks.

12. A rheostat operating mechanism comprising, a flatly disposed rotatable member having a detent opening therethrough, operating means connected to said rotatable member, a pair of flatly disposed rotatable disks positioned respectively adjacent opposite surfaces of said rotatable member for rotation about the same axis as said member, a second member positioned in part between said disks and having a second detent opening through said part at a greater distance than said first detent opening from said axis, two detents movably positioned respectively in said openings, each of said disks having a pair of detent engaging means on the inner surface thereof at distances substantially equal respectively to the distances of said detent openings from the axis, said receiving means being positioned on said disks so that all four such means are in register simultaneously with their respective detent openings at a predetermined position of said mechanism, stop means for said disks preventing one disk from rotating in one direction beyond said position and the other disk from rotating in the other direction beyond said position, and means for connecting a pair of rheostats respectively to said disks for sequential operation by said mechanism.

13. A rheostat operating mechanism comprising, a flatly disposed rotatable member of approximately uniform thickness having a substantially circular opening therethrough of a greater diameter than said thickness, an operating shaft connected to said member and containing the rotational axis thereof, a pair of approximately circular flatly disposed rotatable disks of approximately equal diameters positioned in substantially parallel relation adjacent respectively the opposite surfaces of said rotatable member for rotation about the same axis as said member, a second relatively fixed member of approximately the same thickness as said first member positioned in part between said disks and having a second substantially circular opening of approximately the same diameter as said first opening through said part at a greater distance than said first opening from said axis, two substantially spherical balls having a greater diameter than said thickness but a smaller diameter than said openings movably positioned respectively in said openings, each of said disks having a pair of indentations on the inner surfaces thereof at distances substantially equal respectively to the distances of said openings from said axis, each of said indentations being suitable for receiving a portion of one of said balls, said indentations being located on said disks so that all four such indentations are in register simultaneously with their respective openings at a predetermined transfer position of said mechanism, a stop for one of said disks preventing it from rotating in one direction beyond said transfer position, a second stop for the other disk preventing it from rotating in the other direction beyond said transfer position, and means for connecting a pair of rotatable rheostat operating arms respectively to said disks whereby as said operating shaft is turned in one direction from said transfer position a first one of said rheostat operating arms is rotated by the engagement of the ball in said first opening with the corresponding indentation on the disk connected to said first arm while the second ball positioned in said fixed member engages the corresponding indentation in the second disk and locks it and the second arm, and when said shaft is rotated in the other direction from said transfer position said first ball engages said second disc and thereby rotates it and said second rheostat operating arm while said second ball engages the first disk thereby locking it and said first rheostat arm.

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