

Nov. 25, 1958

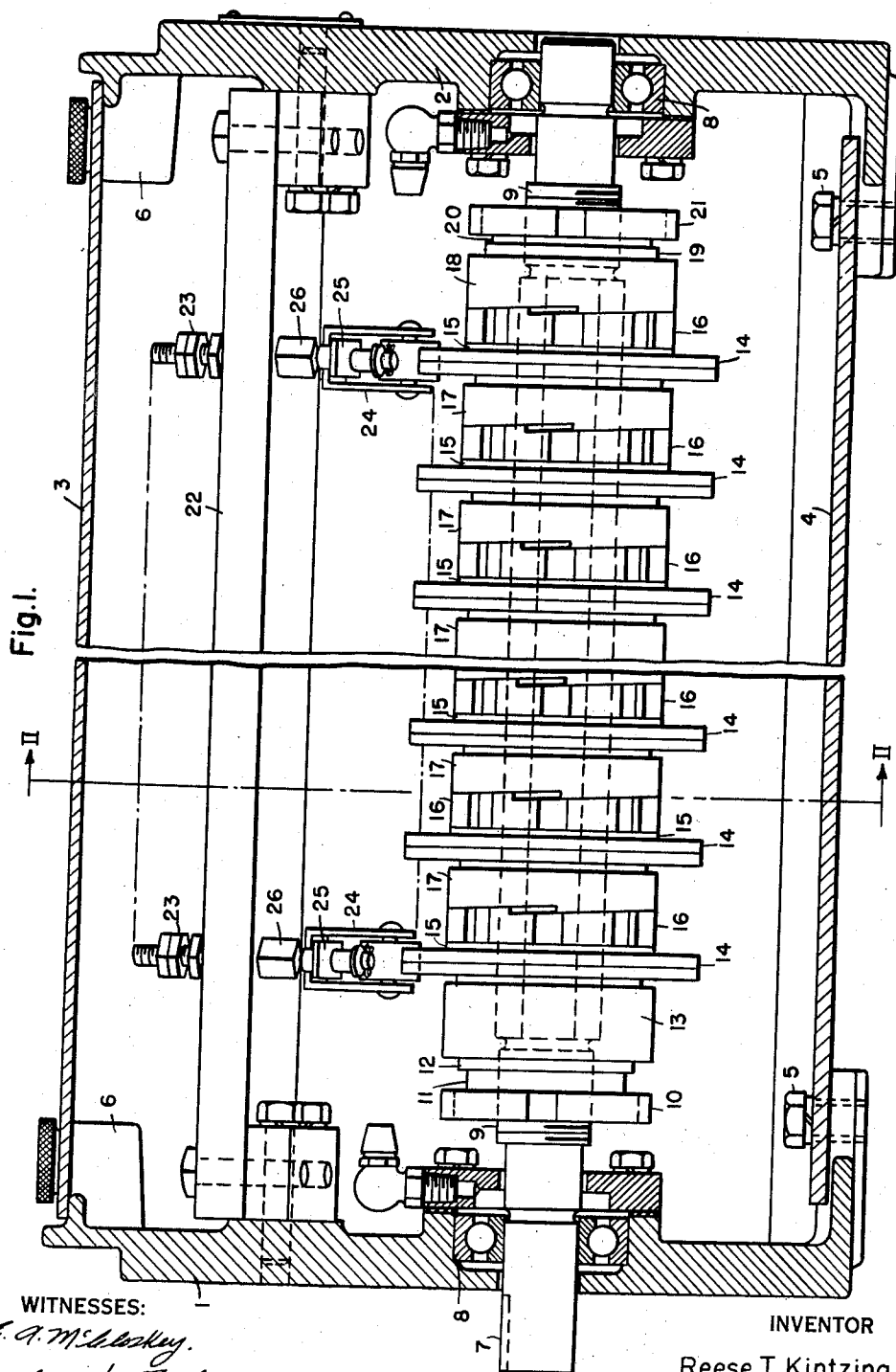
R. T. KINTZING

2,861,469

ADJUSTABLE MULTI-CAM ASSEMBLY WITH REPLACEABLE CAM UNITS

Filed May 27, 1953

3 Sheets-Sheet 1



WITNESSES:

E. A. McSorley.
Walter H. Fausch

INVENTOR

Reese T. Kintzing.

BY
Paul E. Friedemann
ATTORNEY

Nov. 25, 1958

R. T. KINTZING

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3 Sheets-Sheet 2

Fig. 2.

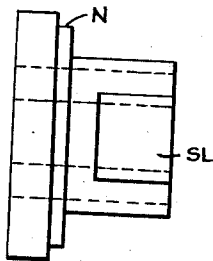
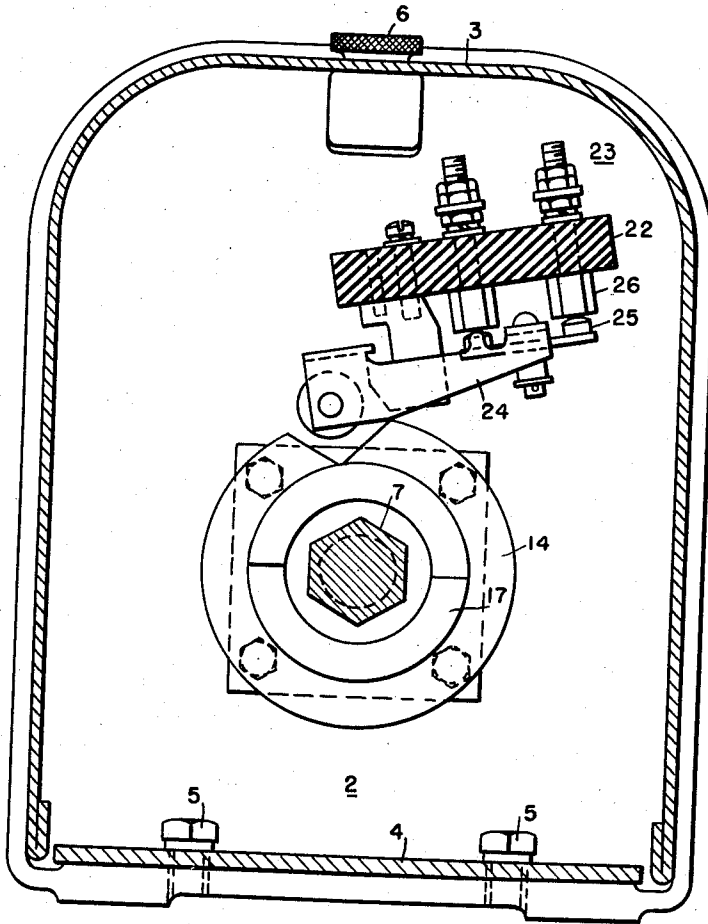


Fig. 10

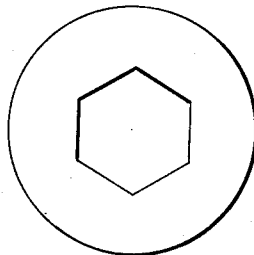


Fig. 11

WITNESSES:

E. A. Miller
Urban A. Paulson

INVENTOR

Reese T. Kintzing.

BY

Paul E. Friedemann
ATTORNEY

Nov. 25, 1958

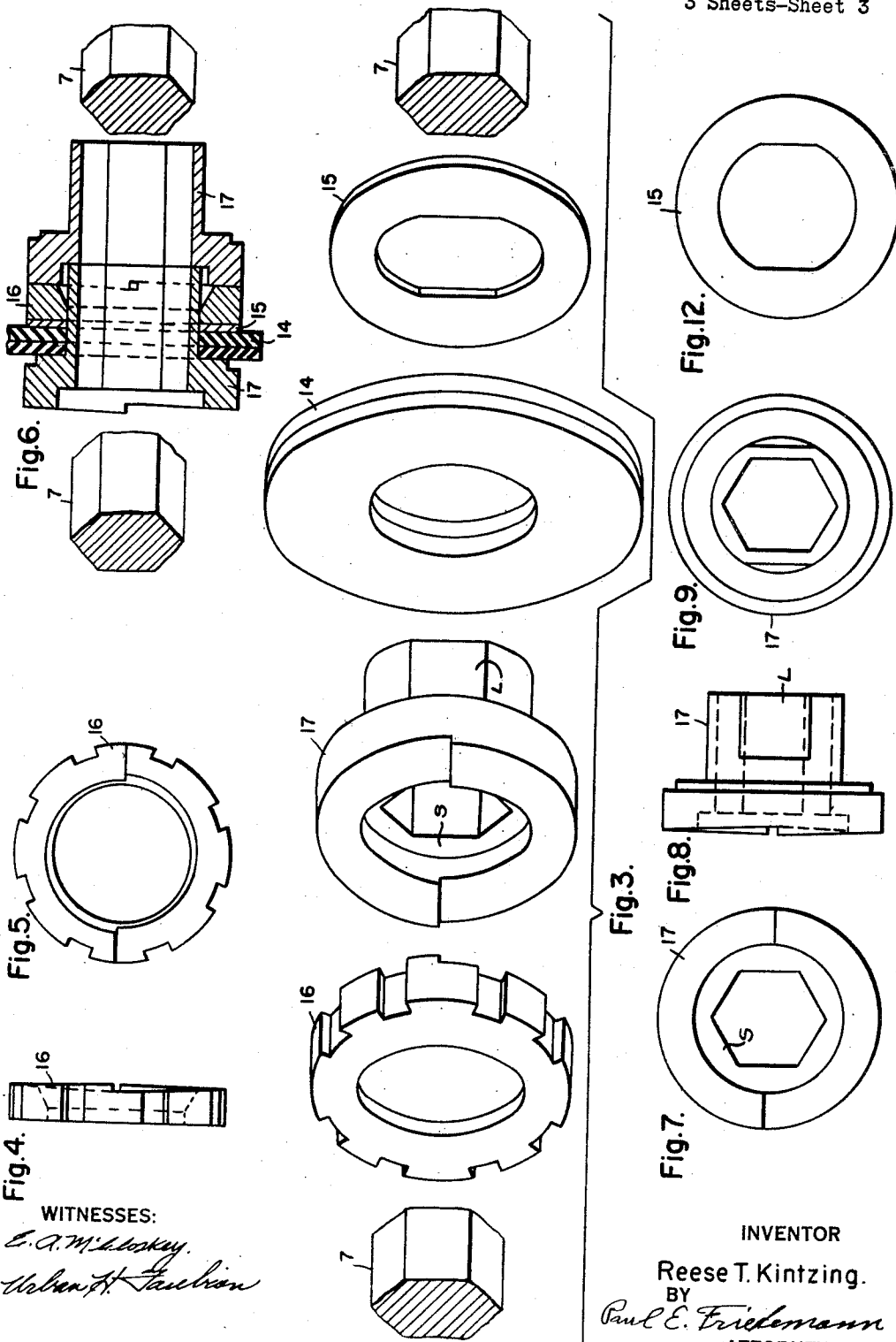
R. T. KINTZING

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ADJUSTABLE MULTI-CAM ASSEMBLY WITH REPLACEABLE CAM UNITS

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3 Sheets-Sheet 3



WITNESSES:
E. A. M. Koskey
Robert H. Tachian

INVENTOR
Reese T. Kintzing.
BY
Paul E. Friedemann
ATTORNEY

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2,861,469

ADJUSTABLE MULTI-CAM ASSEMBLY WITH
REPLACEABLE CAM UNITS

Reese T. Kintzing, Buffalo, N. Y., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application May 27, 1953, Serial No. 357,679

13 Claims. (Cl. 74—568)

This invention relates to a rotor assembly for operating cam followers and more particularly to the rotor assembly for use in rotary circuit controllers.

One major object of this invention is to provide a rotary circuit controller which permits quick and easy readjustment of any one or more of the rotary contact actuating means.

Another object of this invention is to provide a rotary circuit controller which permits adjustment of individual rotary contact actuating means without disturbing the position of other contact actuating means.

The objects recited are merely illustrative. Other objects and advantages will become more apparent from a study of the following specification and the accompanying drawings, in which:

Figure 1 shows a sectional side elevational view of the circuit controller assembly;

Fig. 2 shows a sectional end view of the circuit controller assembly taken along line II—II of Fig. 1;

Fig. 3 shows an exploded isometric perspective view of elements of the rotor assembly;

Figs. 4 and 5 show details of the cam locknut;

Fig. 6 shows a sectional view of a portion of the rotor assembly;

Figs. 7, 8 and 9 show details of the inner spacers;

Fig. 10 is a side view of the first end spacer;

Fig. 11 is an end view of the first end spacer; and

Fig. 12 shows a front view of the thrust washer.

Although the principles of the invention are here applied to a rotor circuit controller, the invention is broadly applicable to rotor assemblies for operating cam followers where it is desirable to adjust a given cam angularly without moving the other cams on the rotor.

Referring to the drawings, a housing is provided with a front wall 1, a rear wall 2, a cover 3 and a bottom 4, which may be assembled in any suitable manner such as by the bolts 5 and the clamp assembly 6. The shaft 7, for rotatable mounting, is provided with suitable bearing means 8 in the front and rear walls of said housing.

The shaft has threaded portions 9 just inside the front and rear walls of the housing. The portion of the shaft between the two threaded portions is shown hexagonal in section, but the shaft 7 may be square in section or have any other polygonal transverse section. Its minimum transverse dimension at the polygonal region is greater than the outside diameter at the threaded portion. This is readily apparent from the showings in Figs. 1 and 2.

A nut 10 is threaded on the shaft 7 inside the front wall of the housing. Adjacent the nut is a lock washer 11 and a flat washer 12. A first end spacer 13, substantially in the shape of a right cylinder, and having an axial hexagonal opening of dimensions to snugly but slidably fit on shaft 7, is disposed on the shaft 7, and at its front end is disposed in abutting relation to the flat washer 12. The portion of the end of the spacer member 13 extending toward the rear, or right, wall is somewhat smaller in outside diameter than the front end portion, i. e. has a cylindrical projection extending toward the

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rear, or right, and of a shape as shown most clearly in Fig. 10. A shoulder, all parts of which, except for a circumferential notch N at its outer periphery, falling in a radial plane, is thus provided between the front portion and the rear cylindrical projection. This projection has two flat surfaces SL, one on each side, spaced equal distances from the axis of the spacer member 13 and parallel to each other. The flat surfaces SL are like the flat surfaces L on the spacer members 17 discussed hereinbelow. A cam member 14, having an outer periphery of a desired shape, is snugly mounted for rotation on the projection to thus be angularly adjustable with respect thereto. A thrust washer 15 and a cam locknut 16 also fit on the projection. The thrust washer has a hole to match the projection at the flat surfaces SL to thus permit axial motion but no rotary motion of the washer 15.

The cam lock, or locknut, 16 has a cylindrical hole through its center and fits on the projection so that it may be rotated with respect to the end spacer 13. The locknut 16 has an outside peripheral surface designed to receive a wrench. The front face of the cam locknut 16, that is, the face adjacent the thrust washer 15, is of a flat radial surface and the rear face of the locknut 16 is provided with at least one, but preferably two, axially sloping wedging surfaces such as low pitch ratchet jaws. Detailed views of the cam locknut 16 are shown in Figs. 4 and 5.

The first inner spacer member 17 has at its front axially sloping wedging surfaces, such as low pitch ratchet jaws, which intermesh and match with ratchet jaws on the rear surface of the first locknut 16. The inner spacer member 17, like the first end spacer 13, has a cylindrical outer periphery at its front end portion of substantially the same size as the cam locknut 16 and a rear, or right-hand, projection substantially identical in shape to the rear projection on the spacer 13. The right-hand cylindrical projection of the spacer 17 has the same outside diameter as the right-hand cylindrical projection on the end spacer member 13. Further, the right-hand projection has parallel flat surfaces L, one on each side, spaced equal distances from the axis. The lengths of the surfaces are equal and so disposed that the second thrust washer 15, which is non-rotatably but slidably disposed on the projection, and when a pressure force is exerted on it from the right, will clamp the cam member 14, disposed on the right-hand projection of the first spacer member 17, against the flat shoulder on this spacer member 17. Detailed views of the inner spacer member 17 may be seen in Figs. 7, 8 and 9. The inner spacer member 17 has a hexagonal axial opening to non-rotatably but slidably fit on the shaft 7, and has its front part undercut to form a radially shaped spacer surface S which fits against the end of the preceding inner spacer member. For the first inner spacer member 17, the one at the position directly to the right of the end spacer 13, the surface S fits against the right end of the end spacer 13. The right-hand projection of the end spacer 13 is substantially identical in shape and length to the right-hand projections of the inner spacer member 17. Again reference may be had to Figs. 7, 8 and 9 for a clear showing of this construction.

The second inner spacer member 17 has a cam 14, a thrust washer 15 and a cam locknut 16 on its rear, or right-hand, portion and its rear end abuts against the radial surface on the front undercut portion on the next, or third, inner spacer 17. The spacer members 17 are all identical in shape, all are undercut at the front to provide an overhanging portion and to provide for abutting against the end of the preceding spacer. This construction increases the creepage distance.

Fig. 1 shows a plurality of groups of inner spacer members 17, angularly adjustable cam means 14, thrust

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washers 15 and cam locknuts 16 as just described. A special rear end spacer 18 is provided with two radially sloping wedge surfaces or ratchet jaws to mesh with the wedge surfaces of the cam locknut of the last of the groups of components. The rear surface of the face of the end spacer 18, namely the one opposite the wedging surfaces, is radial. The bore of said end spacer 18 is hexagonal to receive the shaft 7 with a snug but slidable fit and to thus prevent angular movement of spacer 18 with respect to the shaft 7. A flat washer 19 is provided adjacent the radial surface of the rear end spacer 18. A lock washer 20 provided adjacent the flat washer 19 and a nut 21 is threaded on the end of the threaded portion 9 of the shaft 7 inside the rear wall 2 of the housing.

The exploded isometric perspective of Fig. 3 shows how the components fit together on the shaft, and the sectional view of Fig. 6 shows the components assembled on the shaft. The cams 14 and cam locknuts 16 are free to rotate around the rear end portion or minor diameter of the spacers 13 and 17 and the thrust washer 15 is restrained by the lands or flats on the surface of their respective spacers.

Tightening the nuts 10 and 21 on the threaded portions 9 of the shaft 7 will move the components of the rotor assembly axially and thereby tightly compress the spacers 13, 17, and 18 to hold them rigidly together and seal off the electrical creepage path over the ends to the shaft. When the spacers 13, 17 and 18 are held rigidly in position, nonyielding wedge surfaces are provided against which the wedge surfaces of the cam locknuts 16 can react. The spaced notches on the outer periphery of the cam locknuts 16 provide a convenient means of turning with a suitable wrench. Thus with the spacers 13, 17 and 18 held rigidly in position the cam locknuts 16 are turned so that their axially sloped surfaces wedge and compress the cams 14 between the thrust washers 15 and the adjacent spacers. When the cams are held rigidly in position, any particular cam locknut may be rotated to alleviate the pressure on the cam of the particular groups of components and thus the particular cam may be rotated angularly with respect to the shaft 7 without disturbing the other cams on the rotor assembly. It will be noticed from Fig. 4 that the rear portion of the cam locknut 16 is bored out more than the front portion. This increases the electrical creepage distance from the conducting material of the nut, across the surface of the spacers, through the joint between spacers to the shaft 7. Minor irregularities on surfaces of locknuts 16 and spacers 17 also increase the electrical creepage distance and give a better frictional engagement between the surfaces.

A contact support means 22 is mounted in the housing and is supported at the front and rear walls 1 and 2, respectively. The contact support means 22 carries contact assemblies 23 and the cams 14 are disposed to actuate the contact assemblies 23. The contact assemblies 23 in the particular illustration consists of the pivotally mounted cam follower arms 24 with movable contact bridging arms 25 and stationary contacts 26. It may be seen that the number of contacts which are actuated will be determined by the number of contacts provided on the contact support means, the length of the shaft, and the size of the components for mounting the cams, and that the sequence of operation of the contacts will be determined by the shape of the cams.

It will be recognized that the objects of the invention have been achieved by providing a rotor assembly for operating cam followers which permits quick and easy readjustment of any one or more of the rotary cam means and more specifically by providing a rotary circuit controller which permits adjustment of individual rotary contact actuating means without disturbing the position of other rotary contact actuating means.

While in accordance with the patent statutes, one best known embodiment of the invention has been illustrated

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and described in detail, it is to be particularly understood that the invention is not limited thereto or thereby but that alternative structures and substitutions are clearly within the inventive scope.

I claim as my invention:

1. A rotor assembly for operating cam followers comprising, a shaft, a first nut threaded on one end of said shaft, a first end spacer, said first end spacer being fixed against rotation on said shaft, but adapted to slide along the shaft longitudinally, a first angularly adjustable cam member on a portion of said first end spacer and having one face abutting a radial surface on said first end spacer, a first cam locknut on said mentioned portion of said first end spacer, said cam locknut having a radial surface for the face adjacent the first cam member and at least two axially sloped wedging surfaces forming the face opposite the first cam member, a second end spacer similarly mounted on the shaft with axially sloped wedging surfaces at its left end which inter-mesh with the wedging surfaces of the cam locknut and having a spacing surface which abuts a part of the first end spacer and allows the wedging surfaces to overhang a portion of the first end spacer, the surface of the face of said second end spacer opposite the wedging surfaces being radial, and a second nut threaded on the end of said shaft opposite said first nut for together securing between them said end spacers firmly on said shaft.

2. A rotor assembly for operating cam followers comprising, a shaft threaded at both ends, a first nut threaded on the left end of said shaft, a left-hand end spacer disposed directly to the right of the nut, said end spacer being fixed against rotation on said shaft and being disposed against the right surface of said nut and adapted to slide along said shaft longitudinally when operatively acted upon by the positioning of the nut on the shaft, a first angularly adjustable cam means on a right-hand portion of said first end spacer and having its left face abutting a radial surface on said first end spacer, a first cam locknut on a portion of said first end spacer to the right of said cam means, said cam locknut having a radially shaped face on the side adjacent said cam means, said cam locknut having right face composed of at least two axially sloped wedging surfaces, an inner spacer member having at its left end axially sloped wedging surfaces which intermesh with the wedging surfaces of said first cam locknut and having a spacing surface which engages with said first left-hand end spacer, second angularly adjustable cam means on a right-hand portion of said inner spacer and abutting a radial surface on said inner spacer, a second cam locknut to the right of the second cam means having a face opposite the second cam means provided with at least two axially sloped wedging surfaces; a plurality of groups of components as hereinabove recited, each group comprising, an inner spacer member, an angularly adjustable cam means, and a cam locknut; a second end spacer member with axially sloped wedging surfaces which inter-mesh with the wedging surfaces of the cam locknut in the last of the plurality of groups of components and which has a spacing surface which engages a portion of the inner spacer of the last of the plurality of groups of components, the surface of the face of said second end spacer opposite the wedging surfaces being radial, and a second nut threaded on the right end of said shaft opposite said first nut for securing said spacers on said shaft.

3. A rotor assembly for operating cam followers comprising, a shaft, a first nut threaded on the shaft near its left end, a lock washer, a flat washer, and a first end spacer on said shaft, mounted on the shaft in the order named to the right of said nut said first end spacer being fixed against angular rotation on said shaft, a first angularly adjustable cam means on a right-hand portion of said first end spacer and having one face abutting a radial surface on said first end spacer, a first thrust

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washer on a portion of said first end spacer adjacent the right of said first cam means, a first cam locknut on a portion of said first end spacer adjacent the right of said thrust washer, said cam locknut having a face opposite the thrust washer provided with at least two axially sloped wedging surfaces, an inner spacer member with axially sloped wedging surfaces which inter-mesh with the wedging surfaces of said first cam locknut, second angularly adjustable cam means on a right-hand portion of said inner spacer abutting a radial surface on said inner spacer, a second thrust washer on a portion of said first inner spacer adjacent the right of said second cam means, a second cam locknut to the right of the second thrust washer having a face opposite the thrust washer with at least two axially sloped wedging surfaces; a plurality of groups of components, each group comprising an inner spacer member, an angularly adjustable cam means, a thrust washer, and a cam locknut; a second end spacer member with axially sloped wedging surfaces which inter-mesh with the inner surfaces of the cam locknut of the last of the plurality of groups of components and having a spacing surface which engages a right-hand portion of the inner spacer in the last group of plurality of groups of components and allows the wedging surfaces to overhang a portion of said last inner spacer, the surface of the face of said second end spacer opposite the wedging surfaces being radial, a flat washer adjacent the radial surface of said second end spacer, a lock washer adjacent said flat washer, and a second nut threaded on the shaft near the right end, whereby said nuts secure the spacers on said shaft.

4. A rotor assembly for operating cam followers comprising, a shaft having a threaded portion near its left end and a threaded portion near its right end, a first nut threaded on the left threaded portion of said shaft, a lock washer and a flat washer on said shaft adjacent the right of said first nut, a first end spacer, said first end spacer being fixed against angular rotation on the shaft, a first angularly adjustable cam means on a right-hand portion of said end spacer and having one face abutting a radial surface facing toward the right on said first end spacer, a first thrust washer on said portion of said end spacer to the right of said first cam means, a first cam locknut on a portion of said first end spacer to the right of said thrust washer, said cam locknut having a face adjacent the thrust washer with a radial surface, the right face of said cam locknut opposite the thrust washer having at least two axially sloped wedging surfaces, a second end spacer member with axially sloped wedging surfaces facing to the left to inter-mesh with the wedging surfaces of said cam locknut and having a spacing surface which abuts the right end of said first end spacer member, the surface of the face of said second end spacer opposite the wedging surfaces being radial, a flat washer adjacent the radial surface of said second end spacer, a lock washer adjacent said flat washer, and a second nut threaded on the right-hand threaded portion of said shaft, whereby said nuts lock the lock washers, flat washers and spacers on said shaft.

5. A rotor assembly for cam operated devices, in combination, a base, a rotatably mounted shaft on said base, a cam support non-rotatably but slidably supported on the shaft and having a major outside dimension transverse the shaft and a projection at the right having a minor transverse dimension the construction being such that a shoulder having a radial surface facing the right is disposed between the two dimensions, a cam member rotatably and slidably disposed on the right-hand projection of the cam support against the shoulder, a cam lock rotatably and slidably on said right-hand projection just beyond the cam member, said cam lock having a flat radial surface facing the cam member and having a ratchet jaw facing to the right, a cooperating locking member slidably but non-rotatably mounted on the shaft

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and engaging the right end of the right-hand projection of the cam support and having a ratchet jaw facing the left to coact with the ratchet jaw on the cam lock, means for rigidly holding the cam support and the cooperating locking member against slidable movement on the shaft and in fixed relation to each other, whereby the cam member may be locked against said shoulder by merely rotating the cam lock in a direction of disengagement of the ratchet jaws.

6. A rotor assembly for cam operated devices, in combination, a base, a shaft rotatably mounted in the base, a cam support non-rotatably but slidably supported on the left end of the shaft, said cam support having a left-hand part having a given outside dimension transverse the shaft and a right-hand projection having a lesser outside transverse dimension with a flat shoulder facing the right between the right-hand projection and the left-hand part, a cam member rotatably and slidably disposed on the projection against the shoulder, a cam lock slidably and rotatably mounted on the projection and having a flat left-hand surface for engaging the cam member and having a ratchet jaw facing the right, a second cam support similarly supported on the shaft and having a cam member against its shoulder and a similar cam lock on its right-hand projection, said second cam support having a ratchet jaw at its left end facing the left and abutting against the right end of the first mentioned projection and being disposed to coact with the ratchet jaw on the cam lock on the first cam support, a cooperating locking member on the shaft engaging the right end of the right-hand projection of the second cam support and having a ratchet jaw facing the left and being disposed to coact with the ratchet jaw of the cam lock on the second cam support, means for rigidly holding the cam supports and cooperating locking member on the shaft and in fixed relation to each other, any one of said cam members may thus, by operation of the associated cam lock, be fixed or adjusted angularly with respect to the shaft without disturbing the position of the other cam members.

7. A rotor assembly for cam operated devices, in combination, a base, a shaft rotatably mounted in the base, a cam support non-rotatably but slidably supported on the shaft and having a left-hand cylindrical part of a given diameter and a right-hand cylindrical part with lesser diameter and having a flat shoulder surface facing the right between the parts, means for locking the cam support against slidable movement toward the left on the shaft, a cam member disposed on the cam support against the shoulder, a cam lock on the right-hand part having a flat surface facing the left and ratchet jaw facing the right, a second generally similar cam support similarly supported with its left end abutting against the right end of the right-hand cylindrical part having similarly mounted thereon a similar cam member, and a similar cam lock, said second cam support having a ratchet jaw facing the left to coact with the ratchet jaw on the cam lock on the first cam support, a cooperating locking member non-rotatably but slidably mounted on the shaft engaging the right end of the second cam support and having a ratchet jaw facing the left to coact with the ratchet jaw of the cam lock on the second cam support, means for holding the cam supports and cooperating locking member rigidly on the shaft, whereby any one of said cam members may thus, by operation of the associated cam lock, be fixed or adjusted angularly as desired with respect to the shaft without disturbing the position of the other cam members.

8. A rotor assembly for cam operated devices, in combination, a base, a shaft rotatably mounted in the base, a cam support non-rotatably but slidably supported on the shaft and having a left-hand cylindrical part of a given diameter and a right-hand cylindrical part with lesser diameter and having a flat shoulder surface facing the right between the parts, means for locking the cam support against slidable movement on the shaft, a cam mem-

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ber disposed on the cam support against the shoulder, a washer on the cam support just to the right of the cam member, said washer being mounted on the right-hand part for axially slidable movement thereon but fixed against rotation thereon, a cam lock on the right-hand part having a flat surface facing the left and a ratchet jaw facing the right, a second generally similar cam support its left end abutting against the right end of the right-hand cylindrical part similarly mounted on the shaft and having similarly mounted thereon a similar cam member, a similar washer, and a similar cam lock, said second cam support having a ratchet jaw facing the left to coact with the ratchet jaw on the cam lock on the first cam support, a cooperating locking member on the shaft engaging the right end of the second cam support and having a ratchet jaw facing the left and being disposed to coact with the ratchet jaw of the cam lock on the second cam support, means for holding the cam supports and cooperating locking-member rigidly on the shaft, whereby any one of said cam members may thus, by operation of the associated cam lock, be fixed or adjusted angularly as desired with respect to the shaft without disturbing the position of the other cam members, with the cam locks through the non-rotatable washers providing axial thrust only on the cam members.

9. In a rotor assembly for operating cam followers, in combination, a housing, a shaft rotatably mounted in the housing, means fixed against rotation on the shaft providing a radial shoulder facing the right, said means having a generally cylindrical sleeve-like projection to the right of the shoulder disposed about the shaft, a cam member mounted on the projection adjacent the shoulder, a cam lock to the right of the cam member, said cam lock having a smooth radial surface facing the cam member and having a low pitch ratchet jaw facing the right, an annular member mounted fixed against rotation on the shaft to the right of said means, said annular members having a low pitch ratchet jaw at its left end matching the ratchet jaw on the cam lock, and means for rigidly holding the said means and annular member in fixed relation to each other and the shaft, whereby rotation of the cam lock on the projection will selectively lock, or release, the cam member depending on the direction of rotation of the cam lock.

10. In a rotor assembly for operating cam followers, in combination, a housing, bearings in the housing, a shaft disposed for rotation in the bearings in the housing, said shaft having a polygonal sectional shape intermediate the bearings, a sleeve mounted slidably on the polygonal section of the shaft, said sleeve having a shoulder facing the right and a generally cylindrical projection to the right of the shoulder, cam means mounted on the projection and being disposed against the shoulder, a cam lock in the shape of an annulus having a smooth radial surface at its left end and a low pitch ratchet jaw at its right end, a second similarly shaped sleeve disposed on the polygonal section of the shaft to the right of the first sleeve, said second sleeve abutting the right end of the first sleeve and having a low pitch ratchet jaw at its left end matching with the ratchet jaw on the cam lock on the first sleeve and having cam means and a cam lock on its right-hand projection, an annular member mounted on the polygonal section of the shaft to the right of the second sleeve and abutting thereagainst, said annular member having a low pitch ratchet jaw at its left end matching the low pitch ratchet jaw on the cam lock on the second sleeve, and means for rigidly locking the sleeves and annular member against each other to hold them in a selected fixed longitudinal position on the shaft, whereby each cam means by operation of the associated cam lock may be selectively locked on the shaft or released for angular adjustment without disturbing the position of the other cam means.

11. A rotor assembly for operating cam followers, as electric switch actuating means, in combination, a shaft having threaded portions near its ends as, for example,

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the left end and right end, and an intermediate portion polygonal in transverse section, an end nut on each of the threaded portions, an end sleeve having a radial end-surface at its left end to be operatively acted upon by the nut near the left end of the shaft, said sleeve having a polygonal axial opening to slidably fit on the polygonal portion of the shaft and having a generally cylindrical right-hand projection of smaller outside diameter than the left-hand portion of the sleeve, the boundary between the projection and the left-hand portion being defined by a radial shoulder facing to the right, a cam disposed for rotation on the projection and disposed against the shoulder, a thrust washer to the right of the cam, the internal configuration of the thrust washer and the outer configuration of the projection being such that the washer may move longitudinally on the projection but not rotate on the projection, a cam locknut disposed to the right of the thrust washer, said locknut having a ratchet jaw type of construction at its right end, a first spacer sleeve on the shaft, said spacer sleeve having a polygonal axial opening to slidably fit on the polygonal portion of the shaft and having a right-hand projection substantially exactly like the right-hand projection of the end sleeve having mounted thereon a cam, a thrust washer, and a locknut, all three being substantially identical in configuration to the first cam, first thrust washer, and first locknut, said spacer sleeve having a ratchet jaw type of construction at its left end at the outer radial face and being undercut next to the shaft at its left end to receive in abutting relation at an inner radial face the right end of the end sleeve, the ratchet jaws on the left end of the spacer sleeve matching the ratchet jaw type of construction of the right end of the first locknut, a second end sleeve substantially identical in configuration at its left end to the left end of the spacer sleeve and thus matching the locknut on the projection of the spacer sleeve and receiving the right end of the spacer sleeve in abutting relation, said second end sleeve having a radial end-surface at its right end to be operatively acted upon by the end nut near the right end of the shaft, whereby the end sleeves and spacer sleeve may be clamped by the clamping nuts in fixed relation to the shaft but any one of the cams may be individually angularly adjusted on the projection on which it is disposed without disturbing the locked angular adjustment of any other cam.

12. A rotor assembly for operating cam followers, as electric switch actuating means, in combination, a shaft having threaded portions near its ends as, for example, the left end and right end, and an intermediate portion polygonal in transverse section, an end nut on each of the threaded portions, an end sleeve having a radial end-surface at its left end to be operatively acted upon by the nut near the left end of the shaft, said sleeve having a polygonal axial opening to slidably fit on the polygonal portion of the shaft and having a generally cylindrical right-hand projection of smaller outside diameter than the left-hand portion of the sleeve, the boundary between the projection and the left-hand portion being defined by a radial shoulder facing to the right, a cam disposed for rotation on the projection and disposed against the shoulder, said projection having parallel lands spaced equal distances from the shaft axis, a thrust washer to the right of the cam, the internal configuration of the thrust washer being such that the washer may move longitudinally on the projection but not rotate on the projection, a cam locknut disposed to the right of the thrust washer, said locknut having a radial surface facing to the left but having a ratchet jaw type of construction at its right end, a first spacer sleeve on the shaft, said spacer sleeve having a polygonal axial opening to slidably fit on the polygonal portion of the shaft and having a right-hand projection substantially exactly like the right-hand projection of the end sleeve having mounted thereon a cam, a thrust washer, and a locknut, all three being substantially identical in configuration to the first cam, first thrust

washer, and first locknut, said spacer sleeve having a ratchet jaw type of construction at its left end at the outer radial face and being undercut next to the shaft at its left end to receive in abutting relation at an inner radial face the right end of the end sleeve, the ratchet jaws on the left end of the spacer sleeve matching the ratchet jaw type of construction of the right end of the first locknut, a second end sleeve substantially identical in configuration at its left end to the left end of the spacer sleeve and thus matching the locknut on the projection of the spacer sleeve and receiving the right end of the spacer sleeve in abutting relation, said second end sleeve having a radial end-surface at its right end to be operatively acted upon by the end nut near the right end of the shaft, whereby the end sleeves and spacer sleeve may be clamped by the clamping nuts in fixed relation to the shaft but any one of the cams may be individually angularly adjusted on the projection on which it is disposed without disturbing the locked angular adjustment of any other cam.

13. A mounting structure for operating, for example, the switch actuating means of a controller, in combination, a shaft having a portion polygonal in transverse section, a sleeve having a polygonal axial opening to fit on the shaft, whereby said sleeve is restrained against angular movement on the shaft but free to slide longitudinally of the shaft, said sleeve having a generally cylindrical right-hand projection of smaller outside diameter than the left-hand portion of the sleeve, the boundary between the projection and left-hand portion being defined by a radial shoulder facing to the right, a cam disposed for rotation on the projection and disposed against the shoulder, a thrust washer to the right of the cam, the internal configuration of the thrust washer and

the outer configuration of the projection being such that the washer may move longitudinally on the projection but not angularly about the projection, a cam locknut disposed to the right of the thrust washer, said locknut having a radial surface facing the washer but having a ratchet jaw type of construction at its right end, a second sleeve on the shaft, said second sleeve having an axial polygonal opening to fit on the shaft against angular movement but free to slide longitudinally on the shaft, said second sleeve having a ratchet jaw type of construction at its left end matching the ratchet jaw type of construction on the right face of the locknut, the projection of the first sleeve abutting against the left end of the second sleeve, means for locking the two sleeves fixedly on the shaft, the length of the projection of the first sleeve with respect to the abutting end of the second sleeve, the thickness of the cam and thrust washer, and the effective thickness of the locknut, when the ratchet jaws on the nut and second sleeve are in full engagement, is such that the cam is just free to be rotated on the projection but upon rotation of the locknut to move the ratchet jaws out of full engagement will lock the cam against the radial shoulder on the first sleeve.

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2,791,916	Kintzing	May 14, 1957