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[54] **COMPREHENSIVE SUPPORT FOR OPHTHALMIC EXAMINATION APPARATUS AND INSTRUMENTS**
 9 Claims, 8 Drawing Figs.

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250/221

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[50] Field of Search..... **351/38;**
250/219 (RG), 221—224; 108/139; 248/349, 425

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ABSTRACT: Ophthalmic examination apparatus includes a fixed base structure that includes a circular track and a patient support chair positioned within the circular track. A generally cylindrical instrument support structure is supported for rotation on the circular track and has an aperture in it so that a patient may enter and so that the examiner may have direct access to the patient. An electrical motor drives the support structure on the circular track and a position switch and a series of spaced switch actuators control the positioning of particular instruments in proper position for examination purposes.

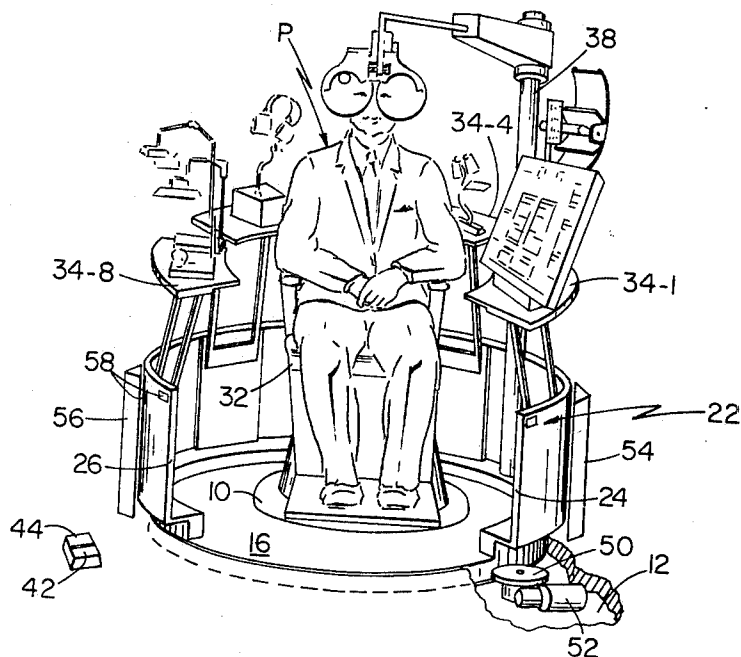


FIG 1

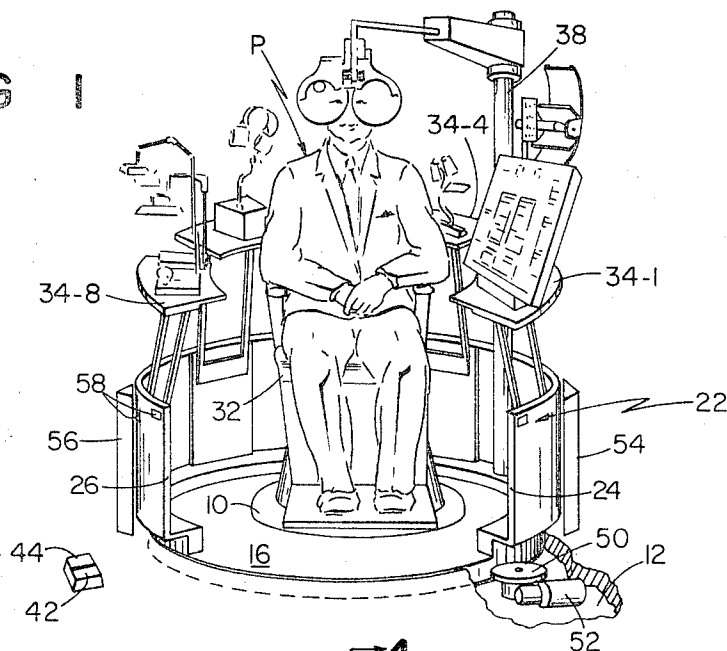
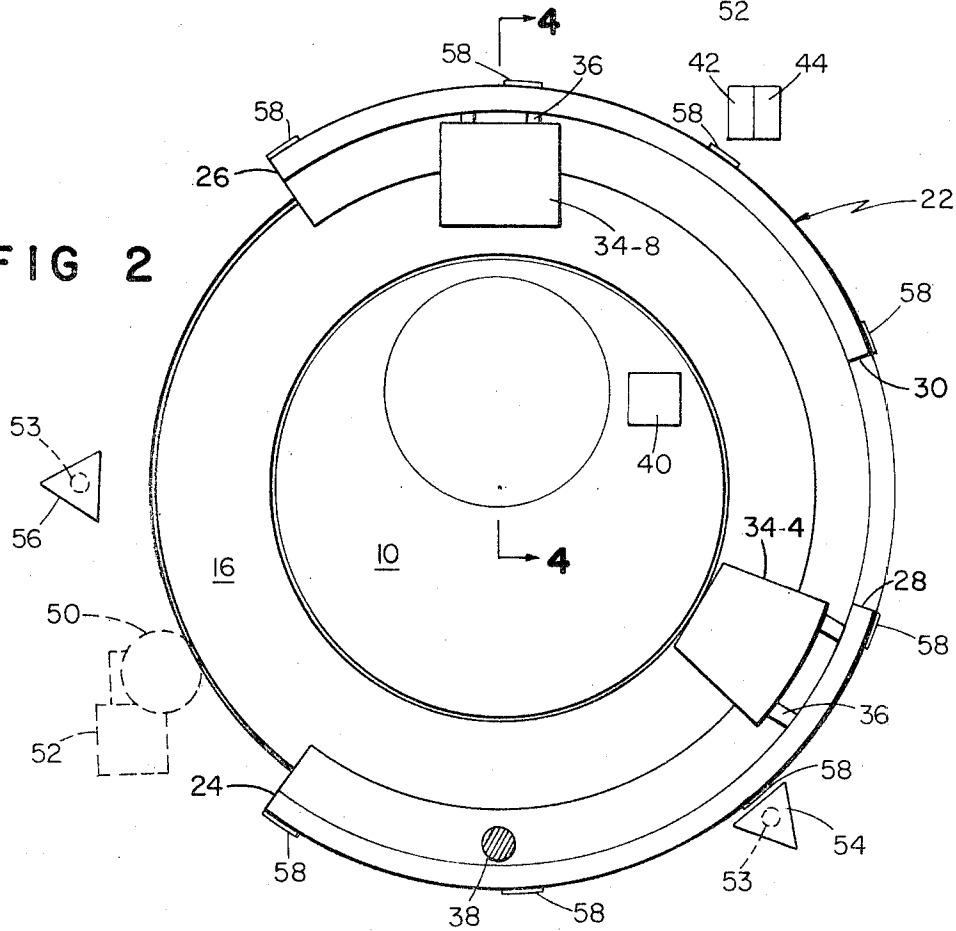


FIG 2



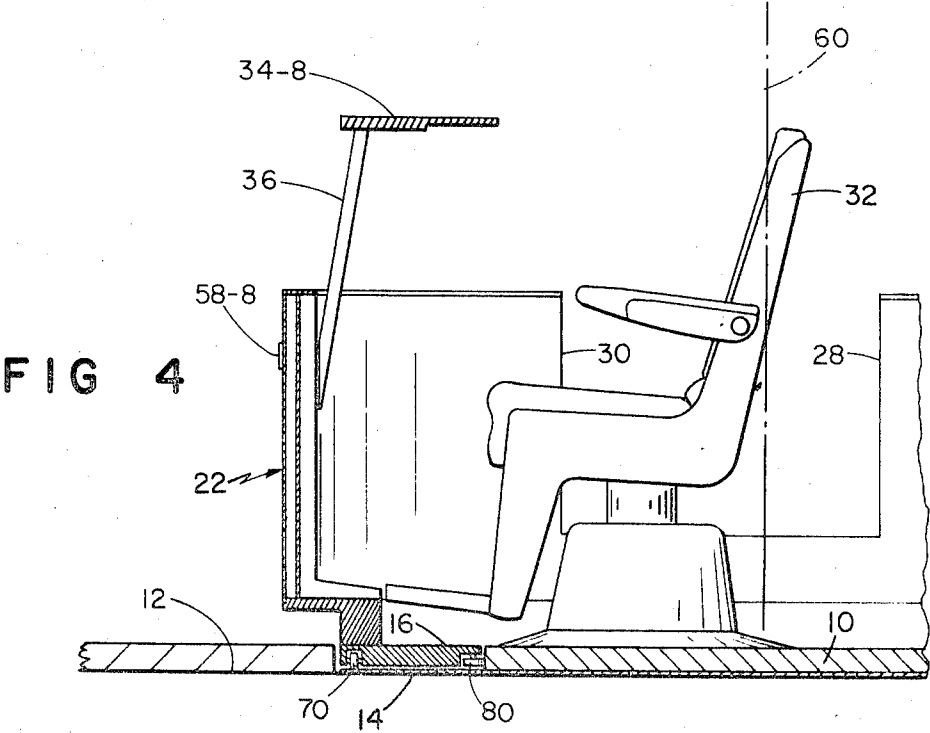
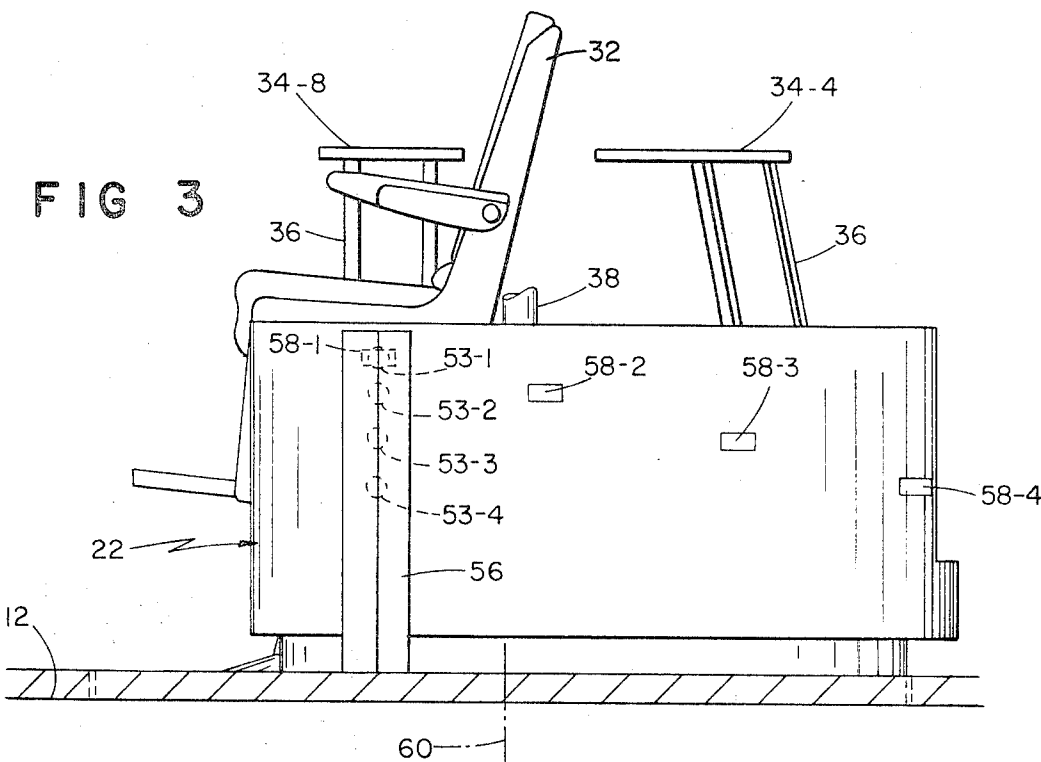


FIG 5

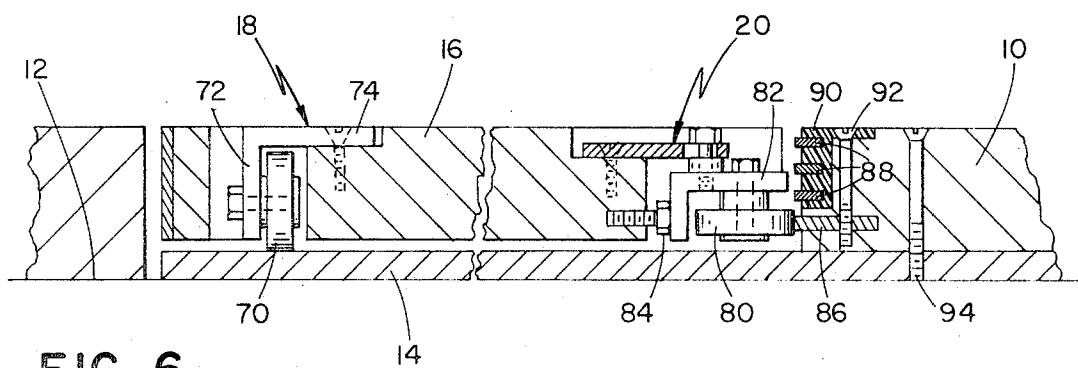
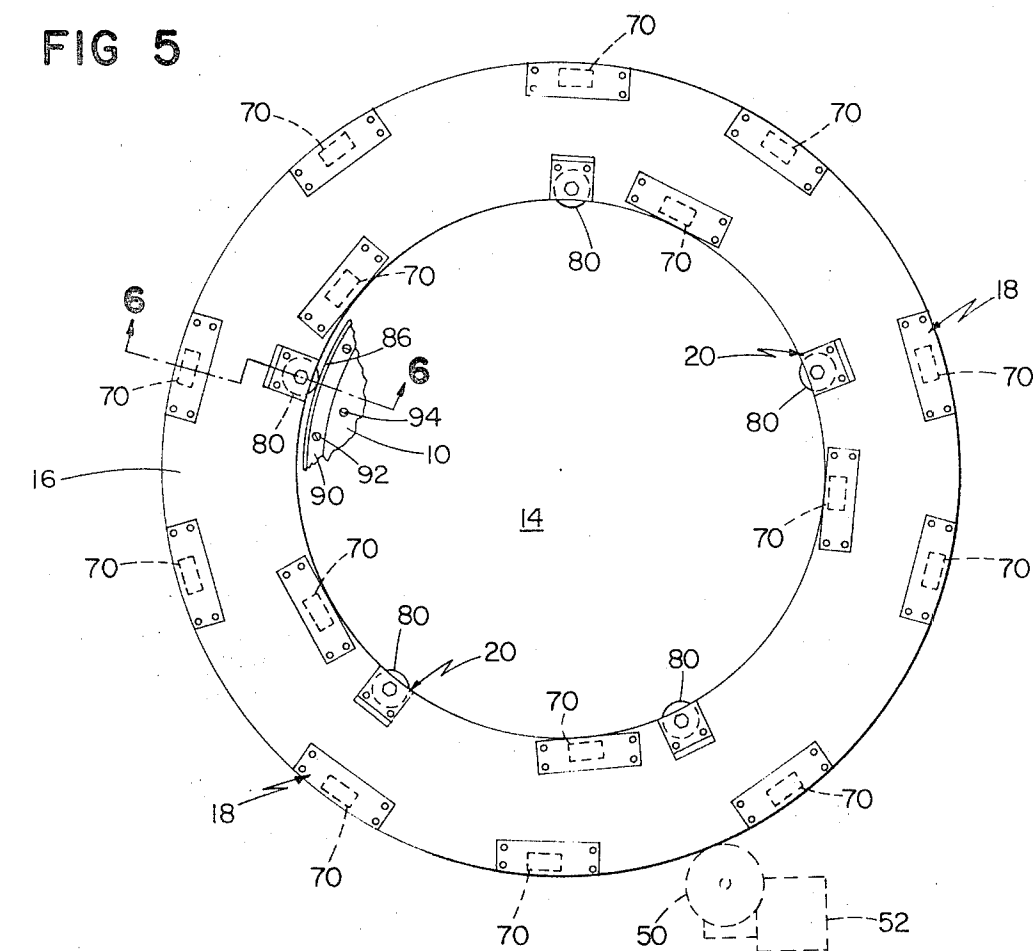


FIG 6

FIG 8

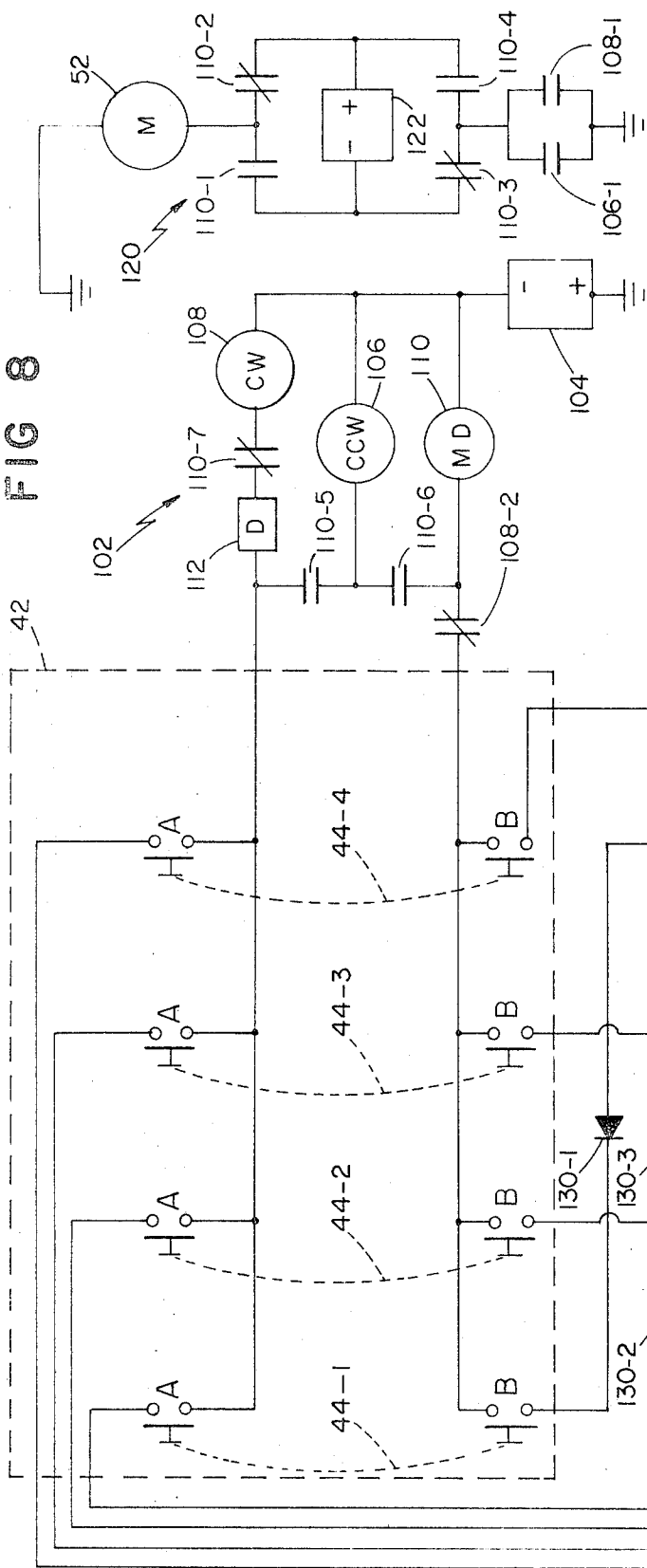
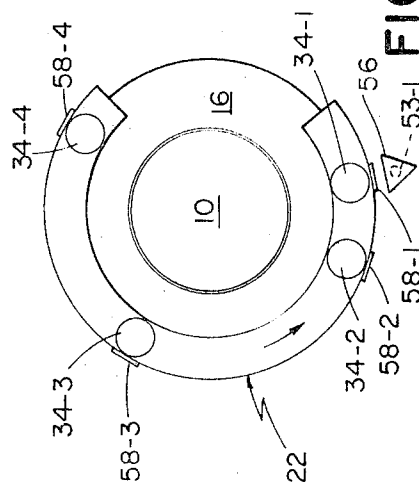


FIG 7



COMPREHENSIVE SUPPORT FOR OPHTHALMIC EXAMINATION APPARATUS AND INSTRUMENTS

SUMMARY OF INVENTION

This invention relates to apparatus for examining eyes and more particularly to a comprehensive support for ophthalmic examination apparatus and instruments.

In ophthalmic examinations, particularly where both pathology and refraction are involved in the investigation, a number or relatively massive yet delicate instruments are frequently utilized. This usually necessitates movement of the patient to a number of instrument locations or alternatively movement of several such instruments to the patient. In addition to the obvious inconvenience of such an arrangement to both patient and examiner, valuable time is wasted in such procedures. Furthermore, under such conditions it is difficult for the examiner to maintain desired environmental conditions during examination and it is difficult to perform procedures in rapid sequence where desirable, as in fitting contact lenses.

It is therefore a principal object of this invention to provide a support structure for a plurality of ophthalmic instruments which permits their positioning relative to a fixed patient position. Another object is to provide such a support which can be actuated for selective powered movement to position particular instruments on said surface at an examination position. Still further objects are to provide such a structure which minimizes time of examination, facilitates access of the examiner to the patient, enhances patient comfort, and assures maintenance of predetermined environmental conditions such as light characteristics.

The invention features an ophthalmic examination apparatus for supporting a plurality of ophthalmic examination instruments relative to a predetermined patient position and includes a base structure for receiving a patient support which defines the patient's predetermined position and an arcuate track which is adjacent the base structure. A substantially cylindrical instrument support structure is rotatable on the track about an axis of the track which in a particular embodiment is coincident with the patient's eyes when he is in position so that any instrument may be easily brought around to its proper position vis-a-vis the patient. The structure has an opening for the patient's entry and a drive under the control of the examiner moves the support structure along the track to selectively and properly position ophthalmic instruments for use in examination of the patient.

In preferred embodiments the instruments are placed on instrument support pallets mounted on vertically and circumferentially adjustable arms which are supported by the structure so that adjustments of the instruments may be made. Also a sound, stable structure is provided by including a fixed position base structure for supporting a patient's chair and rollers of the support structure engage the arcuate track. Sets of electrical contacts on both structures provide electrical connections between the base and instruments on the rotatable support structure. The drive control includes photoelectric position switch and light reflective strip switch actuators for determining the position of the support structure and signal switches for signalling new positions. To minimize time of rotation of the support structure from one position to another a direction switch and direction switch actuator means are provided, the drive means rotating the structure in one direction when the switch is not actuated and in the opposite direction when it is. The direction switch actuator means includes a diode circuit connected to the position switches and signal switches so that when one of the signal switches is actuated the signal switch is or is not actuated depending on what direction of rotation will provide the shortest distance between the desired position and the current position.

Other objects, features and advantages will appear from the following description of a preferred embodiment of the invention, taken together with the attached drawings thereof, in which:

FIG. 1 is a perspective view of apparatus embodying the invention;

FIG. 2 is a plan view of the apparatus of FIG. 1 (with the chair removed and the support structure rotated 90°), showing only two instrument supports for clarity;

FIG. 3 is an elevation view of the apparatus in the position of FIG. 1, showing only the same two instrument supports;

FIG. 4 is a partial sectional view of the apparatus, taken along the line 4-4 of FIG. 2;

FIG. 5 is a diagrammatic plan view of the bearing and support wheel structures employed in the apparatus;

FIG. 6 is a partial sectional view of the bearing and support wheel structures of the apparatus, along the line 6-6 of FIG. 5;

FIG. 7 is a diagrammatic plan view of the support structure, showing four instrument positions; and

FIG. 8 is a schematic wiring diagram of a control system for the motor drive of the support structure shown in FIG. 7.

DESCRIPTION OF PARTICULAR EMBODIMENT

The apparatus includes a fixed circular base 10 mounted on a circular track plate 14 on floor 12. Supported for rotational movement on track plate 14 is a rotating base member 16 that includes fifteen support wheel assemblies 18 and five radial thrust bearing assemblies 20 (FIGS. 5 and 6).

Secured to moving base 16 and upstanding therefrom is a cylindrical wall structure 22. This cylindrical wall 22 extends 250° between vertical walls 24, 26 which define an opening to permit access to the patient P. Generally opposite walls 24, 26 is an upper opening in cylindrical wall 22 which has vertical walls 28, 30 to provide a space through which the patient's feet may extend when the chair 32, mounted on fixed base 10, is in the reclining position. Upstanding from cylindrical wall 22 are series of individual instrument support pallets 34-1, 34-2, et seq., mounted on vertical adjustable arms 36. The radial positions of the pallets 34 may be adjusted to provide desired relative positioning of the instruments on the several pallets. In the embodiment shown in FIG. 1, nine stations are provided, eight pallets and a phoropter mounted on pole 38. An illustrative utilization of the apparatus would have the following instruments:

Pallet	Instrument
34-1	Test lens case
34-2	Overhead projector
34-3	Telebinocular
34-4	Perimeter
34-5	Stereocampimeter
34-6	Slit lamp
34-7	Keratometer
34-8	Equipment storage unit

An instrument and lighting control console 40 is provided at fixed position on base 10 adjacent chair 32. A second control console 42 is provided outside track 14 on floor 12 from which duplicate instrument and lighting controls and drive controls 44 for the support structure 22 may be operated.

Support structure 22 is rotated by a drive wheel 50 which engages the outer surface of base 16, wheel 50 being powered by motor 52. Photoelectric control sensors 53 mounted in housings 54, 56 sense reflective strips 58 secured to the outer wall of structure 22 and provides signals to control the positioning of the support structure 22 in response to signals from consoles 40 or 42.

The chair 32 is mounted on baseplate 10 is placed so that the location of the patient's eyes may be positioned by the headrest of the chair 32 substantially coincident with the centerline 60 about which structure 22 rotates. This arrangement permits prepositioning of the instruments with minimal adjustments as they are brought into position for use during examination or treatment. The chair is also vertically adjustable so that the patient's eyes may be positioned at a predetermined location relative to the instruments.

Referring to FIGS. 5 and 6, each support wheel structure 18 includes a wheel or roller 70 mounted on bracket 72 which is

secured to rotating base 16 by means of plate 74. The bearing structures 20 include rollers 80 mounted on brackets 82. The rollers 80 are radially adjustable by means of screws 84 to provide proper radial positioning of the rollers relative to the fixed ring 86 on base 10. Conductor slip rings 88 separated by insulator spaces 90 are stacked above bearing ring 86 to connect electric power from stationary base 10 to support structure 22 for operation of instruments as necessary. The assembly of bearing ring 86, slip rings 88 and spacers 90 are secured to base 10 by bolts 92 and that base in turn is secured to the track plate 41 by bolts 94.

FIGS. 7 and 8 illustrate the control system for driving support structure 22. Only four instrument positions 34-1 to 34-4 and a single photoelectric sensor housing 56 are shown for the purposes of clarity. FIG. 7, shows, besides the support structure, instrument positions and photoelectric sensor housing, four reflective strips 58-1 to 58-4 corresponding to the instrument positions. The orientation of the structure is shown with the sensor housing just opposite instrument position 34-1 and reflective strip 58-1.

FIG. 8 shows the four photoelectric switches 53-1 to 53-4 present in sensor housing 56, switch 53-1, being activated by its proximity to reflective strip 58-1. Control console 42 includes four pushbutton switches 44-1 to 44-4. Two sets A and B of contacts are closed by the switches, and for purposes of clarity each set of contacts in the diagram has shown next to it the appropriate pushbuttons. Physically, however, only one pushbutton is needed for each two pair of contacts.

There is shown a direction circuit 102 including a DC relay power source 104, relays including a counterclockwise relay 106, a clockwise relay 108 and a motor direction relay 110, and delay element 112 (such as an auxiliary relay) which delays the passage of current for a short time after its terminals are energized.

There is also shown a motor circuit 120 including the support structure drive motor 52 and a DC motor power source 122.

The circuits shown include relay controlled switches 106-1, 108-1, 108-2 and 110-1 to 110-7, controlled by relays 106, 108 and 110, respectively, and they are shown in the diagram in their deenergized positions.

Diodes 130-1 to 130-6 are shown in branches from certain of the photoelectric switches 53 to certain of the switches controlled by pushbuttons 44.

In operation, the examiner's normal position is just outside the path of structure 22, as for example, to the left of the patient as viewed in FIG. 1. In this position, the control unit 42 may be actuated to move the support unit to properly position any of the pallets 34 to the desired position and in addition the console may include controls for varying the lighting environment for the patient. The patient enters the chair 32 through the opening between walls 24, 26 and is positioned with his eyes at the predetermined height by adjustment of the vertical position of the chair, his eye position being substantially coincident with axis 60. From this position the patient may be requested to lean forward or the chair may be placed in a more reclining position for various procedures or treatments, which positions are established relative to the instrumentation on the support structure 22. In a second position the examiner may station himself inside the instrument support structure and control lighting and instruments from console 40. Thus the apparatus of the invention enables the examiner to remain at a fixed position for a variety of types of examination and procedures and to move the instruments into proper position promptly and efficiently. A variety of instruments are readily accessible for examination procedures and treatments without requiring the patient to move. These instruments are stored in a compact relation which does not interfere with one another and which are positioned in known position relative to a preestablished lighting environment. For example, control unit 42 may incorporate automatic correlation of the lighting system with a selected position of the support structure 22 for a particular examination procedure. Also the track 16 may be

vertically adjustable to facilitate use by examiners of different heights.

The operation of the motor drive will be illustrated by referring to FIGS. 7 and 8 where support structure 22 is shown with photoelectric sensor switch 53-1 activated by reflective strip 58-1.

It is desired, for example, to move support 22 from instrument position 34-1 to instrument position 34-2 around, pushbutton 44-2 is depressed and corresponding contacts A and B close. Contacts 44-2-A are connected to ground through released sensor switch 53-2 and contacts 44-2-B are closed to ground through actuated sensor switch 53-1. Delay element 112 delays the energization of clockwise relay 108. In the meanwhile the energization of motor direction relay 110 occurs via the circuit through contacts 44-2-B, diode 130-2 and switch 53-2. Relay contacts 110-1 to 110-4 reverse the positions shown in the diagram so that the positive terminal of DC motor supply 122 is grounded and the negative terminal connected to motor 52. Relay contacts 110-5 and 110-6 close (energizing counterclockwise relay 106) and 110-7 open (preventing energization of clockwise relay 108), 106-1 close and energize motor 52 to move support structure 22 in the counterclockwise direction. Photoelectric switch 53-1 changes position as soon as strip 58-1 moves from proximity with it. When position 2 is sensed by photoelectric switch 53-2 being opposite reflective strip 58-2 the switch will change positions, counterclockwise relay 106 and motor direction relay 110 will be deenergized, stopping motor 52 and returning all relay controlled switches to the normal positions shown in the diagram.

If instrument position 34-4 is desired when the structure is at position 34-1, pushbutton 44-4 is depressed. Contacts 44-4-A are closed to ground. No connection with ground is made via contacts 44-4-B. After a delay caused by delay element 112, clockwise relay 108 is energized. Relay contacts 108-1 close to ground the negative terminal of DC motor power source 122 and relay contacts 108-2 open to isolate contacts 44-4-B. Motor 52 is energized, turning the support structure in the clockwise direction, however, because the polarity of the motor terminals is the opposite of what it was when pushbutton 100-1 was pushed in the prior example. It can be seen that the direction is determined by the diode network which only allows the contacts B of any of the pushbuttons to close to ground in certain orientations of the support structure. This diode logic network thus controls motor 52 to rotate the support structure in the direction that will most quickly reach the selected instrument position.

The motor turns the support structure until reflective strip 58-4 is opposite sensor switch 53-4, which causes the deenergization of clockwise relay 108, the stopping of motor 52 and the return of all relay controlled contacts to their normal positions. During the turning of support structure 22 in the clockwise direction described above, contacts 108-2 are open, thus preventing energization of counterclockwise relay 110 accidental depression of one of the other buttons.

While a particular embodiment of the invention has been shown and described, various modifications thereof will be apparent to those skilled in the art and therefore it is not intended that the invention be limited to the disclosed embodiment or to details thereof and departures may be made therefrom within the spirit and scope of the invention as defined in the claims.

We claim:

1. Ophthalmic examination apparatus for supporting and positioning ophthalmic examination instruments relative to a predetermined patient position comprising:

- a fixed position base structure including an annular drive surface, said base structure receiving a patient support means defining said predetermined patient position;
- a generally cylindrical support structure axially extending above said drive surface and having a wall aperture therein for entry of a patient to said base structure;

a plurality of wheels, having axes radially extending from an axis perpendicular to said drive surface, connected to said support structure and engaging said drive surface for rotation of said support structure about said perpendicular axis, said perpendicular axis being located at the position of a patient's eyes in aid predetermined patient position;

an annular support surface on said support structure spaced above said base structure and having an opening at a position corresponding to said aperture;

a drive for rotating said support structure;

guide means interconnected between said base and said support structure for guiding rotation of said support structure; and

a position switch and a plurality of spaced switch actuators positioned about said support structure for actuating said position switch at each of several predetermined support positions of said support structure relative to said predetermined patient position for detection and signalling of support structure position.

2. The ophthalmic examination apparatus of claim 1 further including instrument support pallets mounted on vertically adjustable arms supported by said support structure, said arms being circumferentially adjustable on said support structure.

3. The ophthalmic examination apparatus of claim 1 wherein said base structure further includes first electrical contacts for connection to a power supply and said support structure includes second electrical contacts for connection to electrically operated instruments, said first and second electrical contacts being mounted for movable, electrical contact therebetween.

4. The ophthalmic examination apparatus of claim 1 wherein said position switch is a photoelectric switch and said position switch actuators are light reflective strips.

5. The ophthalmic examination apparatus of claim 4 and further including at least one direction switch and a direction switch actuator means for signalling the direction of rotation

of said support structure providing the shortest distance of rotation of said support structure moving from one said support position to another.

6. The ophthalmic examination apparatus of claim 5 wherein said drive means rotates said support structure in a preferred direction when said direction switch is not actuated, and in the opposite direction when said direction switch is actuated, said direction switch actuator means including a diode circuit connected to said position switches and signal switches so that when one of said signal switches is actuated said direction switch is not actuated when said preferred direction of rotation provides the shortest distance of rotation of said support structure moving from one said support position to another, and is actuated when the opposite direction of rotation provides the shortest distance.

7. The ophthalmic examination apparatus of claim 1 and further including at least one direction control and a direction control actuator for causing said support structure to rotate in the direction providing the shortest movement from one said support position to another.

8. The ophthalmic examination apparatus of claim 7 wherein said drive means rotates said support structure in a first direction when said direction control is not actuated, and in the opposite direction when said direction control is actuated, said direction control actuator including a diode circuit connected to said position sensors and circuitry for actuating said direction control to provide the shortest distance of rotation of said support structure moving from one said support position to another.

9. The ophthalmic examination apparatus of claim 8 wherein said base structure includes first electrical contacts for connection to a power supply and said support structure includes second electrical contacts for connection to electrically operated instruments, said first and second electrical contacts being mounted for movable, electrical contact therebetween.

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