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Darden

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[54] **HUMAN HEAD RESTRAINT SYSTEM**

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[52] **U.S. Cl.** **250/456,** 351/38

[51] **Int. Cl.** **G01n 21/00**

[58] **Field of Search** ..... 351/38; 250/451, 456; 74/568 FS; 297/391, 392, 404

[56] **References Cited**

UNITED STATES PATENTS

2,973,029	2/1961	Schlosstein	297/391
3,594,072	7/1971	Feather	351/38

Primary Examiner—Archie R. Borchelt
Assistant Examiner—D. C. Nelms
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[57] **ABSTRACT**

A human head restraint system for positively restraining the human head in a predetermined position utilizing eccentrically pivoted cams on either side of the predetermined position for engaging various sizes of human heads. The active area of the cam profiles are non-circularly shaped for insuring that the area of actual contact with most human head sizes is close to a line passing through the cam pivot points thus minimizing the effective lever arm available to the restrained head for effecting movement of the restraining cams from the predetermined position.

4 Claims, 4 Drawing Figures

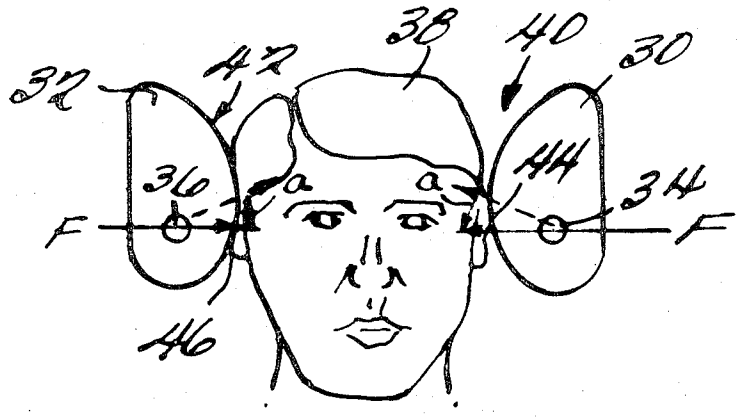


Fig. 1 (PRIOR ART)

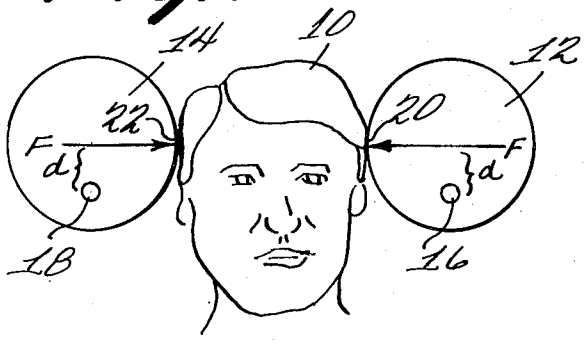


Fig. 2

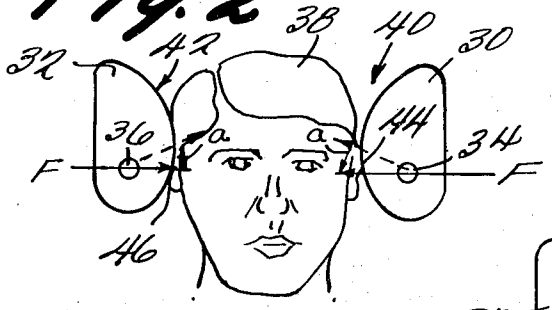
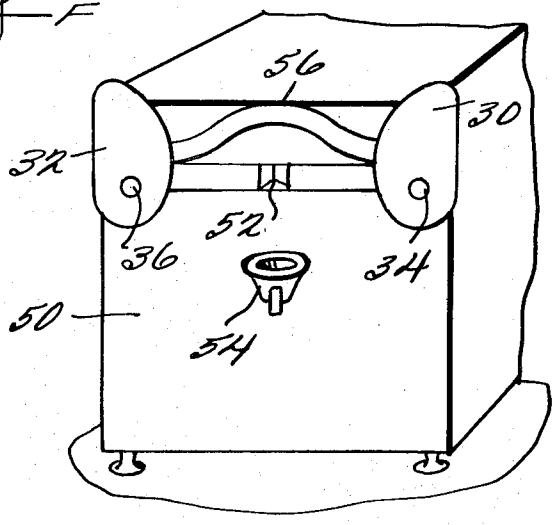


Fig. 3



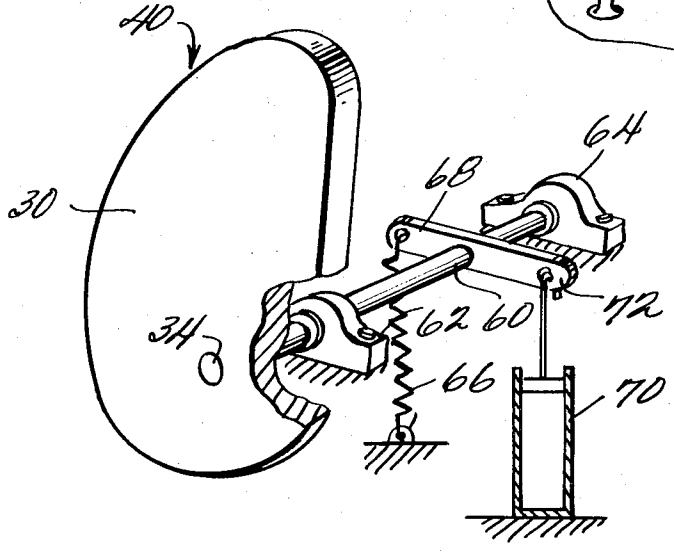


Fig. 4

HUMAN HEAD RESTRAINT SYSTEM

This invention generally relates to apparatus for restraining a human head in a predetermined position. Such human restraint systems are necessary in many medical and research applications, especially in ophthalmology.

Perhaps the most conventional apparatus for restaining human heads is a simple forehead stop or strap combined with a chin rest. However, such arrangements permit easy lateral movements of the head (from side to side) which are unacceptable for some applications such as with automatic refractometers wherein automatic measurements are carried out for analyzing the optical properties of the human eye. In such types of apparatus it is important that the human head be held to the desired predetermined position within a much higher degree of tolerance than is possible with conventional simple restraint systems.

One prior attempt at solving this problem is disclosed in U.S. Pat. No. 3,594,072 — Feather which attempts to stabilize the head against lateral movement by utilizing two eccentrically pivoted circular disks for engaging either side of the head. In this system, the eccentrically pivoted disks do not rotate freely but rather have sufficient friction to prevent free rotation. While the eccentrically pivoted circular disks permit a single system to fit heads of varying sizes, unless the circular disks are actually very rigidly clamped against further pivoting after being positioned, they do not actually constrain the head. Rather, they merely provide the patient with some tactile feedback when his head does move laterally. That is, in general, the area of contact with the restrained head is so far removed from a line connecting the two pivot points that the head is provided with a significant lever arm for moving the disks as a result of any lateral force which the head may exert thereagainst.

It has now been discovered that a significantly improved human head restraint apparatus results from using specially profiled cams in place of the eccentrically pivoted circular disks utilized heretofor. The cams utilized in this invention are also eccentrically pivoted to permit accommodation of different head sizes by rotating the cams about the eccentric pivot axes. However, once the specially shaped cam profiles actually engage opposite sides of the head, they positively constrain it against lateral movements because any such lateral forces that might be exerted by the head are always directed close to a line passing through the pivot axes. In other words, the area of contact with the human is always maintained relatively close to the line passing through the two pivot points such that there is no significant lever arm available about the pivot point to permit substantial lateral head movements.

Further, positive restrainment of the human head may be obtained by spring biasing the cams for engagement with the human head and damping rotation in the opposite direction with dashpots. Typically, in operation, the subject invention is utilized by placing the subject's head approximately in place with the chin on an appropriate chin rest located between two specially shaped or profiled cams which are pivoted on either side of the predetermined position within which the human head is desired to be restrained. Thereafter, the cams are simply released so that they drop into position and engage the head. Because the points of contact are close to a line passing through the two pivot points, the lever arm available to the subject for attempting to move the cams laterally is very short and thus no substantial movement in a lateral direction is possible. This is especially so with respect to the embodiment where the cams are spring loaded for rotation in the direction towards the subject head and where rotation in the opposite direction is damped.

The many advantages and objects of this invention will become more apparent from the following detailed description of the invention in conjunction with the accompanying drawings of which:

FIG. **1** is a schematic depiction of a prior art head restraint system;

FIG. **2** is a similar schematic depiction of an exemplary embodiment of the human head restraint system of this invention;

FIG. **3** is pictorial representation of the exemplary embodiment of this invention attached to an autorefractometer; and

FIG. **4** is a schematic depiction of the mechanical system attached to one of the cams in the exemplary embodiment of this invention.

Referring to FIG. **1**, a prior art technique for restraining the human head **10** is depicted. Here, circular disks **12, 14** are pivoted about eccentric axes **16, 18** respectively. Rotation about the eccentric axes causes the circular disks to come into contact with the human head **10** at contact points **20** and **22** respectively. In a typical case as shown in FIG. **1**, the contact points **20** and **22** will result in a significant lever arm d such that the head **10** can easily move the disks **12** and **14** by applying lateral forces thereto unless these disks are physically locked in position after engaging the head **10.**

An exemplary embodiment of this invention is shown in FIG. **2.** Here, specially profiled cams **30, 32** are eccentrically located on either side of the head **38.** Because of the specially shaped cam profile **40** and **42,** the areas of contact **44, 46** respectively with the head **38** will always lie very close to a line connecting the pivot axes **34, 36.** Accordingly, substantially no lever arm is present to permit undesired rotation of the cams **30** and **32** due to lateral head forces exerted by the head **38.**

As should now be appreciated, the exact shape of the cam profile **44, 42** can be varied within reasonable limits so long as the resulting areas of contact **44, 46** for the desired range of head sizes **38** lies reasonably close to a line connecting the two pivot points **34, 36.** One form of cam profile that will provide such a result is a catenary curve. However, more generally, acceptable results should come from using any cam profile having a rise (i.e., an increase in radius per degree of arc) to radius ratio less than 10^{-2} and whose minimum radius exceeds one inch. Such a cam profile will result in contact points with the human head **38** within about 20° of a line connecting the two cam pivot axes **34, 36.** That is, as shown in FIG. **2** the contact points **44, 46** will always lie within the arcs a where the magnitude of a will vary somewhat depending upon the particular profile shapes **40, 42** and/or the range of head sizes **38** with which the restraint system is designed to operate successfully.

For many applications, such as for restraining heads in an automatic refractometer system, the system should be designed to accept a range of head sizes which differs by at least 3 inches in lateral dimensions.

Furthermore, the head should usually also be restrained in the other two dimensions (vertically and frontally) so that the nominal line between the pivotal axes **34, 36** intersects the head at approximately 100 to 130 millimeters behind the vertex of the cornea and approximately 25 to 40 millimeters above the vertex of the cornea. As previously stated, the cam profiles **40** and **42** should be defined to contact the head within an arc a that is within approximately 20° of the line connecting the two pivotal axes.

FIG. **3** shows the exemplary embodiment with cams **30** and **32** mounted on an automatic refractometer **50.** Here, the eccentric pivotal axes **34, 35** are disposed on either side of the predetermined aperture **52** through which the patient is supposed to look and at which position the patient's head is to be restrained. A chin rest **54** is disposed below and between the pivotal axes **34** and **36.** A head strap **56** is also provided for approximately positioning the head in the forward direction while the chin rest positions the head in the vertical direction as previously discussed. Restraint of the head in the lateral direction is, of course, achieved by rotating the cams **30, 32** inward into contact with the human head as shown in FIG. **2.**

Cam **30** is shown again in FIG. **4** together with a schematic depiction of some attached mechanical apparatus which is preferred in the exemplary embodiment. Specifically, the pivotal axis **34** is seen to comprise a shaft **60** which is rotatably mounted within bearings **62, 64.** The shaft **60** is spring biased by spring **66** and lever arm **68** for rotation inwardly in the direction which will result in engagement of the specially shaped cam surface **40** with the human head. At the same time, rotation in the opposite direction is damped with a dash-pot **70** connected to lever arm **72** as should now be apparent. The spring constant and/or damping characteristics of the particular dash-pot (typically an air dash-pot) may be selected for particular applications to result in particular degrees of head restrainment as should now be appreciated by those in the art.

While only one exemplary embodiment of the invention has been specifically discussed in detail above, those in the art will readily appreciate that many modifications may be made in the exemplary embodiment without in any way departing from the spirit and teaching of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention.

What is claimed is:

1. Apparatus for restraining a human head in a predetermined position, said apparatus comprising:

a axis disposed on either side of said predetermined position, and

a cam eccentrically pivoted about each of said axes,

said cams having a non-circular profile for engaging a predetermined range of head sizes at contact points within a 20° arc from a line connecting the two axes, and wherein the non-circular profile of each of said cams has a rise (increase of radius from its axis per degree of arc) to radius ratio which is less than 10^{-2} and a minimum radius exceeding one inch.

2. Apparatus as in claim **1** further comprising means for spring biasing each of said cams to rotate in a direction causing engagement of the cam profile with a human head when disposed in said predetermined position.

3. Apparatus as in claim **2** further comprising means for damping cam rotation opposite to the said direction of spring biased rotation.

4. Apparatus as in claim **1** further comprising a chin rest disposed below and between said pivotal axes.

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