A method and apparatus for maintaining a ring-like support in a predetermined location are disclosed herein. Both the method and apparatus are especially suitable for maintaining a ring-like luminaire support centered about a post as the luminaire support is moved up or down the latter. This is accomplished by providing a plurality of location maintaining arrangements which apply forces to the support for maintaining it in a centered position. These force imparting arrangements are interconnected to one another such that off-center movement of the luminaire support causes one or more of the arrangements to act in restoring the latter to its original position while, at this time, the remaining arrangements are automatically and temporarily removed so as not to interfere with the recentering function of the acting arrangements.

17 Claims, 7 Drawing Figures
METHOD AND APPARATUS FOR CENTERING A LUMINAIRE SUPPORT

BACKGROUND OF THE INVENTION

1. Field of the Invention
The present invention relates generally to a method and apparatus for maintaining a ring-like object in a predetermined location, and more particularly to an improved method and apparatus for maintaining a luminaire support assembly centered about a support post.

2. Description of the Prior Art
Recently, there has been a large emphasis placed on providing proper lighting on urban streets, roads and highways, thereby resulting in the placement of more and more outdoor luminaires on or near such areas. For obvious reasons, these luminaires are typically mounted high off the ground, generally by suitable support poles or posts. Heretofore, this has, however, resulted in large expenditures and much inconvenience due to the necessity of periodically maintaining the luminaires, especially considering the large number of such luminaires to be maintained.

In the past, each of the aforementioned luminaires was generally maintained, that is, cleaned and/or put in proper working order while the luminaire remained in place at the top of its support post. This, of course, meant that a man had to have suitable equipment to reach the luminaire and take the time to do so, each of which contributed to high maintenance costs. In order to overcome this rather inefficient procedure, the lighting industry has provided ring-like luminaire assemblies which are capable of traveling up and down their respective support posts, thereby allowing the luminaires to be easily and rapidly brought to the ground for maintenance purposes. This, in turn, has simplified the procedure required in maintaining the luminaires and therefore has reduced the cost of such a procedure.

While the utilization of a ring-like assembly, which can be lowered and raised along its support post, is generally a workable and economical feature for maintaining the luminaire, it has not been completely satisfactory for its intended purpose. One particular drawback in the ring-like luminaire assemblies of the prior art is their inability to remain centered around their respective support posts as they travel up and down the latter. This is especially true where the support post tends to bend, which is most often caused by winds and/or warpage of the post or when the wind is sufficiently great to cause direct off-center movement of the assembly.

In any event, if the luminaire assembly does move off center as it is traveling, the assembly can easily get hung up against the post and/or damage the post finish.

One typical suggestion by the prior art in overcoming the aforesaid drawback has been to utilize a ring-like luminaire support including a plurality of independent centering elements, usually three, each of which is individually biased against the post centered by the luminaire support. It has been found by the Applicants of the present invention that this typical assembly does not completely overcome the foregoing drawback. More specifically, as the ring-like support moves off center, one of the centering elements provides a restoring force attempting to recenter the support. However, the remaining centering elements provide counter forces opposing the restoring force and thereby actually aid in preventing the support from being recentered.

OBJECTS OF THE INVENTION

In accordance with the foregoing, an object of the present invention is to provide an improved method and apparatus for maintaining a ring-like object support in a predetermined location.

Another object of the present invention is to provide an improved method and apparatus for centering a ring-like object support about the axis of a longitudinal member, especially as the support travels longitudinally along the member.

Still another object of the present invention is to provide a method and apparatus of the last-mentioned type which does not aid in preventing the restoration of an object to its predetermined location.

Yet another object of the present invention is to provide an improved luminaire assembly featuring the above-stated method and apparatus.

SUMMARY OF THE INVENTION

The foregoing objects as well as other objects and features are achieved and many of the deficiencies of the prior art are eliminated by the present invention which provides a method and apparatus for maintaining a ring-like object support in a predetermined location. This is accomplished in accordance with the present invention, by utilizing a plurality of interconnected location maintaining arrangements which apply appropriately directed forces to the ring-like object support. In the event that the support does move from its predetermined location, at least one of the location maintaining arrangements will act to automatically restore the latter to its predetermined location. However, at the same time, the remaining location maintaining arrangement will simultaneously move in a predetermined fashion. In accordance with the present invention, this simultaneous and predetermined movement prevents the remaining arrangements from providing forces tending to inhibit restoration of the ring-like support to its predetermined location.

The aforesaid operation is especially suitable for maintaining a ring-like luminaire support centered about the axis of a longitudinal support post as the luminaire support travels longitudinally along the latter. More specifically, the plurality of force imparting location maintaining arrangements are connected with the luminaire support such that corresponding ends of the arrangements are movable in a biased forward direction towards and a rearward direction away from the axis of the support, that is, towards and away from the support post. In addition, the location maintaining arrangements are interconnected to one another, as stated above, such that movement of any one of the corresponding ends in its rearward direction causes substantially simultaneous movement of the other ends in their respective rearward directions.

Hence, in the event that the luminaire support does move off center, at least one of the arrangement ends will move rearwardly while remaining in contact with the post and automatically act to recenter the luminaire support. At the same time, the remaining arrangements will simultaneously move rearwardly and out of contact with the post, thereby preventing these remaining arrangements from providing forces tending to inhibit recentering of the luminaire support.
is preferably circular in cross section. However, it may be of any suitable closed-loop cross-sectional configuration, so long as the present invention functions in the manner set forth herein. Hence, it is to be understood that the term “ring-like” when referring to the luminaire support 16 is intended to describe any suitable closed-loop shaped support and is not intended to limit the support to a circular cross section.

As will be described in more detail hereinafter, apparatus 22 acting on post 12 supplies a plurality of multi-directional forces to the luminaire support 16 (preferably radially) for maintaining the latter in predetermined position and preferably in a centered position with respect to post 12. In the event that the luminaire support does, for example, move radially off center, at least one of those center maintaining forces opposing such movement will automatically work to restore the support to its centered position. At the same time, and in accordance with the present invention, those forces which are provided by apparatus 22 and which otherwise tend to inhibit recentering of the luminaire support are, eliminated. In this manner, the force or forces provided by apparatus 22 for restoring the luminaire support to its centered position are not inhibited from achieving this end by any other forces provided directly by the center maintaining apparatus. This, however, does not mean that the restoring force or forces may be completely free from resistance. The restoring force or forces may, in fact, meet with resistance from external forces such as, for example, wind.

As will also be described in more detail hereinafter, to provide the aforesaid operation, apparatus 22 includes four location, and more particularly center-maintaining arrangements 24a, 24b, 24c and 24d. (See FIG. 2), all of which are connected with the luminaire support 16 for movement along respective predetermined paths relative to the support. More specifically, the center-maintaining arrangements are pivotally mounted to the luminaire support such that a corresponding end of each is movable in a radial direction towards and away from the axis of the support. In addition, each of these center-maintaining arrangements is biased in particular pivotal direction such that its radially movable end is biased towards the center of the luminaire support and in forcible contact with luminaire support post 12. This is preferably accomplished by theutilization of a single compression spring 26, as will become apparent hereinafter.

Also in accordance with the present invention, the four center-maintaining arrangements are interconnected to one another such that movement of any one of the arrangements along its predetermined path causes simultaneous and similar movement of the other arrangements along their respective paths. In this manner, as will be shown below, apparatus 22 both provides and eliminates various ones of the aforesaid forces at the appropriate time so as to maintain the luminaire support in a centered position with respect to the luminaire support post.

Having briefly described apparatus 22, attention is now directed to FIG. 3 in conjunction with FIGS. 1 and 2 for a detailed description of its preferred construction. In this regard, it should be noted that the ring-like luminaire support 16 preferably comprises a central cylindrical portion 28 and annular flanges 30 and 32 connected with the cylindrical portion, preferably integrally so, and extending radially outwardly from oppo-
site ends thereof. As illustrated in FIG. 1, the aforedescribed luminaire or luminaires 18 are preferably mounted, in a conventional manner, to the flange portions 30 and 32 while the lower flange portion 30 also provides support for arrangement 22, as will be shown below.

The center-maintaining arrangement 24a, as illustrated best in FIG. 3 includes a T-bar 34a comprising a leg portion 36a rigidly connected at one end to a head portion 38a, the latter preferably being U-shaped in cross section (at least at opposite ends), as best seen in FIG. 1. The T-bar is positioned directly below the lower annular flange 30 of luminaire support 16 so as to extend radially outwardly therefrom. In this position, the otherwise free end of the T-bar's leg portion 36a is connected with the lower flange 30 by means of a conventional pivot-connecting arrangement 40a so that the entire T-bar is pivotally movable along a predetermined path, as indicated by arrow 42a in FIG. 2.

In addition to T-bar 34a, center-maintaining arrangement 24a includes an elongated and rigid extension arm 44a disposed in a substantially the same plane as the T-bar and welded or otherwise fixedly connected at one end to the pivoted end of leg portion 36a. As illustrated best in FIG. 2, the extension arm is sufficiently curvilinear in shape and sufficiently long so that its otherwise free end is positioned to substantially one side of the axis of luminaire support 16 and in a plane approximately 90° around the luminaire support from the T-bar. A roller 46a having its axis oriented in a direction perpendicular to the axis of the luminaire support comprises part of and is suitably mounted to the otherwise free end of extension arm 44a.

It should be readily apparent that both the extension arm 44a and roller 46a of center-maintaining arrangement 24a are movable along with T-bar 36a. In this manner, the roller supporting end of the extension arm as well as the roller itself are movable in a substantially radial path inwardly for forwardly towards and outwardly or rearwardly away from the center of luminaire support 16, as generally indicated by the two-way arrow 48a. In addition, the T-bar is biased in a clockwise direction, as viewed in FIG. 2, as will be described in more detail hereinafter. Hence, the roller is biased inwardly and in contact with one side of luminaire support post 12. The roller will remain in contact with the post as luminaire support 16 travels up and down the ladder, so long as the luminaire support is centered around the post.

The remaining center-maintaining arrangements 24b, 24c and 24d are preferably substantially identical in construction to arrangement 24a, like components of all the arrangements being designated by like reference numerals, with the suffix letters a, b, c, and d designating the components associated with respective arrangements. In addition, the remaining three location maintaining arrangements are preferably positioned in a common plane with arrangement 24a and have their respective T-bars pivotally mounted to the lower flange 30 of luminaire support 16 by respective pivot connecting means 40b, 40c and 40d, all of which are preferably identical to previously described pivot-connecting arrangement 40a. However, as shown best in FIG. 2, the T-bar of arrangement 24c is preferably located approximately 90° to one side of element 24a; the T-bar of arrangement 24d being located approximately 90° to the opposite side of arrangement 24a and the T-bar of arrangement 24c being located directly across from arrangement 24a. In this regard, all four roller preferably intersect a common circle, the center of which lies on the axis of the luminaire support.

As stated hereinabove, the four center-maintaining arrangements are interconnected to one another for substantially simultaneous and similar movement. To accomplish this, arrangement 22 includes four tie rods 50, 52, 54 and 56 interlocking the various T-bars to one another. More specifically, tie rod 50 is connected at opposite ends to adjacent ends of head portions 38a and 38b. Tie rod 52 is connected at opposite ends to adjacent ends of head portions 38b and 38c. Tie rod 54 is connected at opposite ends to adjacent ends of head portions 38c and 38d. Finally, tie rod 56 is connected at opposite ends to adjacent ends of head portions 38d and 38a. Each end of each tie rod may be connected with its associated head portion in any suitable manner. For example, as illustrated best in FIGS. 1 and 3, conventional pivot-connecting arrangements, generally designated by the reference numeral 58, are provided for pivotally connecting the ends of the tie rods to corresponding head portions, thereby allowing the tie rods to pivot at their connected ends.

From the foregoing, it should be readily apparent that pivotal movement of, for example, T-bar 34a in a given direction causes substantially simultaneously and substantially identical pivotal movement of the remaining T-bars 38b, 38c and 38d in the same direction, as generally indicated by the arrows 42b, 42c and 42d, respectively (see FIG. 2). At the same time, the rollers 46a, 46b, 46c and 46d will also move substantially simultaneously and in substantially the same manner.

More specifically, as, for example, roller 48a moves towards or away from the center of luminaire support ring 16, indicated by two-way arrow 48a, the other three rollers will simultaneously move towards and away from the center, as indicated by two-way arrows 48b, 48c and 48d in FIG. 2. Hence, all four rollers will remain on a common circle which expands as the rollers move away from the center and which contracts when the rollers move toward the center.

As previously stated, arrangement 22 includes a compression spring 26 provided for biasing the movement of center-maintaining arrangement 24a through 24d. As illustrated, this compression spring is positioned around a center bar 60 which is suitably pivotally connected at one end to the counter-clockwise end of head portion 38a, as viewed in FIG. 2. The other end of the center bar is slidably disposed through a washer eye 62, which is conventionally mounted to the bottom of the ring-like luminaire support and which acts as a stopper for one end of the compression spring. This latter end of center bar 60 is preferably threaded so as to receive a nut 64 or other such means for preventing the center rod from slipping out of the washer eye. In addition, the other end of the center rod is also preferably threaded so as to receive a second nut 66 which provides an adjustably positioned stopper for the other end of compression spring 26. By adjusting the position of nut 66, the amount of pressure exerted by this spring on the center-maintaining arrangements in the biasing direction can be regulated.

From the foregoing, it should be readily apparent that all four T-bars are biased in the clockwise direction, as viewed in FIG. 2. Hence, all four rollers associated with these T-bars are inwardly biased towards the
center of luminaire support ring 16 and therefore engage against the luminaire support post 12. While a single compression spring 26 is preferable to achieve this end, it is to be understood that other arrangements for achieving the same end may be provided. For example, a single tension type spring or individual compression or tension springs may be provided so long as they are suitably located for appropriately biasing the T-bars.

Having described the construction of apparatus 22, attention is now directed to the manner in which it maintains the ring-like luminaire support 16 centered about post 12, whether the luminaire support is stationary or travels along the post. In this regard, it will first be assumed that the luminaire support is, in fact, centered as illustrated in FIG. 4. In this position, all four rollers maintain the support 16 on center by engaging against the post at four equally circumferentially spaced points and preferably with equal force, as shown best in FIG. 2. This is illustrated best in FIG. 5 which shows vectorially the forces exerted by apparatus 22 and particularly the rollers on the luminaire support when the latter is maintained on center. In this regard, apparatus 22 preferably includes conventional means (not shown) which adjustably limits the radially inward movement of the rollers so as to define a circle having a minimum diameter preferably slightly larger than the diameter of post 12 at the top thereof. Hence, since the post generally tapers inwardly from its bottom end to its top end, the rollers are automatically removed from the post as support ring 16 approaches and engages with the locking mechanism at head frame 14. This, in turn, allows the support ring to align properly with the locking mechanism, especially since there might be a slight twisting movement of the ring as it moves up the post.

Turning to FIG. 5, it can be seen that the roller 46a exerts a force on the luminaire support in the direction of arrow F1 for preventing the luminaire support from moving in an opposing direction. In the same manner, the rollers 46b, 46c and 46d respectively exert forces in the direction of arrows F2, F3, and F4 for preventing the luminaire support from moving in directions opposing these forces. Hence, the ring-like luminaire support is held on center with respect to support post 12.

Let it be assumed for the moment that the luminaire support does, in fact, move radially off center. As stated above, this can happen for many reasons. For example, the wind, if sufficiently great, can directly move the luminaire support off center. More than likely, however, the ring-like luminaire support will tend to move off center as it travels up or down the support post if the latter is not completely straight. This can be caused by, for example, the wind bending the post or, for example, due to warpage of the latter.

As illustrated in FIG. 6, the support post is shown slightly bent to the left and the luminaire support is shown moving up the post causing the support to move off center to the right, as viewed in the FIGURE. In this case, movement of the luminaire support off-center causes the roller 46d to move radially away from the center of the luminaire support while remaining in contact with the post. This, in turn, causes the associated T-bar 38d to pivot counterclockwise, as viewed in FIG. 2. Hence, since all of the T-bars are interconnected by tip rods 50 through 56, the remaining T-bars simultaneously pivot counter-clockwise for moving their respective rollers away from the center of the luminaire support and out of contact with the support post 12. Therefore, the only roller engaging against the post is roller 46d and therefore only this roller exerts a force on support 16. This force, in fact, is a restoring force for restoring the support to its center position. This is shown vectorially in FIG. 7 by the force vector F1'. In this regard, it should be noted that the restoring force F1' is greater than the original force F1 provided for maintaining the support on center. The reason for this is that the spring 26 compresses even further from its initial position as the T-bars pivot counterclockwise. Hence, the spring exerts a greater force to move the T-bars clockwise.

As stated above, during application of restoring force F1', the forces F2, F3 and F4 provided to maintain the luminaire support on center are automatically eliminated or removed. This is important feature of the present invention. If, in fact, the forces were not removed, which is generally the case in many prior art centering devices, these forces would actually inhibit or prevent the restoring forces F1' from accomplishing its intended purpose. This is illustrated in FIG. 7 wherein the forces F1, F2, F3 and F4 are shown by dotted lines. It can be seen that these latter forces if not removed would tend to prevent restoration of the luminaire support. In addition, if the rollers 46a and 46c were allowed to remain in engagement with the post, these rollers would create frictional forces Ff which also would oppose restoration of the luminaire support. Hence, in accordance with the present invention, these interfering forces are temporarily removed or eliminated.

The foregoing was a description of how the location maintaining arrangements 24d and, particularly, its associated roller 46d provide a restoring force for restoring the luminaire support 16 to a central position. It should be apparent that the other location maintaining arrangements will operate in the same manner, depending upon the direction of movement of the luminaire support off center.

Apparatus 22 and its operation have been described in accordance with a preferred embodiment of the present invention. It is, however, to be understood that various modifications could be made to the apparatus so long as the modifications or within the principals of the invention and spirit of the claims. For example, apparatus 22 preferably includes four equally circumferentially spaced center-maintaining arrangements and therefore for equally spaced rollers. The apparatus could, however, be modified to include more or less of these arrangements and therefore more or less rollers. However, it should be obvious that at least two location-maintaining elements are necessary.

What is claimed is:

1. An apparatus for maintaining a ring-like object support in a predetermined location around the external surface of a post, said apparatus comprising:
   a. a plurality of location maintaining arrangements connected with said object support and movable relative to said support along respective predetermined paths;
   b. means connected with said location maintaining arrangements for biasing all of said arrangements in corresponding directions along their respective paths; and
   c. a plurality of rod means substantially disposed within a common plane and interconnected said arrangements to one another such that movement
of any one of said arrangements along its predetermined path causes said plurality of rod means to substantially simultaneously move all of said other arrangements along their respective paths in a direction corresponding to the movement of said one arrangement.

2. An apparatus according to claim 1 wherein said biasing means includes a single biasing member for simultaneously biasing all of said elements.

3. An apparatus according to claim 1 wherein said biasing means, said plurality of rod means and said arrangements are connected together such that movement of any one of said arrangements causes said interconnecting means and said biasing means to move in parallel planes.

4. An apparatus according to claim 1 wherein each of said interconnecting means is a rod interconnecting one arrangement with an adjacent arrangement.

5. An apparatus according to claim 4 wherein said biasing means includes a longitudinal spring, said spring being disposed within a plane parallel with the common plane of said rod means.

6. An apparatus according to claim 1 wherein all of said arrangements are interconnected by said plurality of rod means to move substantially equal amounts in response to movement of any one of said arrangements.

7. An apparatus according to claim 6 wherein said arrangements include corresponding ends each of which, at substantially any given point along its path, intersects a circular path intersecting all of said corresponding ends.

8. An apparatus according to claim 7 wherein said circular path contracts in size as said arrangements move in the biasing direction along their respective paths.

9. An apparatus for maintaining a ring-like object support in a predetermined location around the external surface of a post, said apparatus comprising:
   a. a plurality of location maintaining arrangements connected with said object support and including corresponding ends disposed in a common plane and substantially intersecting a common circular path within the plane, said arrangements being connected with said object support such that said corresponding ends are movable along respective predetermined paths within said plane and relative to said support;
   b. means connected with said location arrangements for biasing all of the ends of said arrangements in corresponding directions along their respective paths; and
   c. a plurality of rod means substantially disposed within a common plane and interconnecting said arrangements to one another such that
      i. movement of any one of said arrangements in the biasing direction along its predetermined path causes substantially equal and simultaneous movement of the other arrangements in the biasing direction along their respective predetermined paths, said last-mentioned substantially equal and simultaneous movement causing said common circular path to expand in size.

10. An apparatus adapted for centering ring-like object support about the axis of a longitudinal member, said apparatus comprising:
   a. a plurality of location maintaining arrangements connected with said object support and including corresponding ends, said arrangements being connected with said support such that said ends are movable in a forward direction towards and a rearward direction away from the axis of said support;
   b. means connected with said location maintaining arrangements and applying force against said arrangements in a direction parallel to a plane defined by the direction of movement of said ends for biasing each of the ends of said arrangement in said forward direction and in contact with said longitudinal member when said support is positioned around the latter, and
   c. means interconnecting said arrangements to one another such that movement of any one of said ends in its rearward direction causes substantially simultaneous movement of the other ends in their respective rearward directions, whereby movement of at least one of said ends in its rearward direction while remaining in contact with said longitudinal member causes at least one other of said ends to move out of contact with said longitudinal member when said support is positioned around the latter.

11. A luminaire assembly comprising:
   a. a post;
   b. a ring-like support member concentrically disposed around said post and movable along the length thereof;
   c. at least one luminaire connected with and supported by said support member;
   d. a plurality of location maintaining arrangements connected with said support member and including corresponding ends adapted to engage against said post, said arrangements being connected with said object support such that said corresponding ends are movable in a forward direction towards and a rearward direction away from said post;
   e. a longitudinal spring connected with said location maintaining arrangements for biasing each of the ends of said arrangements in said forward direction and in contact with said post;
   f. a plurality of rods substantially disposed within a common plane which is parallel with said spring, said rods interconnecting said arrangements to one another such that movement of any one of said ends in its rearward direction causes substantially simultaneous movement of the other ends in their respective rearward directions, whereby movement of at least one of said arrangements in its rearward direction while remaining in contact with said post causes at least one other of said ends to move out of contact with said post.

12. An assembly according to claim 11 wherein:
   a. the corresponding ends of said arrangements lie in a common plane and substantially intersect a common circular path extending around said post, and
b. said rearward movement of any one of said ends
causes a substantially equal amount of rearward
movement of said other ends such that said circular
path intersected by said ends expands in size.

13. An assembly according to claim 12 wherein:
a. said location maintaining arrangements are pivot-
ally connected with said support member for pro-
viding said movement of said ends.

14. An assembly according to claim 13 wherein:
a. said arrangements comprise at least four arrange-
ments substantially equally circumferentially
spaced about said circular path, and
b. the corresponding ends of each of said arrange-
ments including wheel means adapted to be biased
in contact with said post.

15. An apparatus adapted for centering a ring-like
object support about the axis of a longitudinal member,
said apparatus comprising:
a. a plurality of location maintaining arrangements
connected with said object support and including
their corresponding ends, said arrangements being con-
nected with said support such that said ends are
movable in a forward direction towards and a rear-
ward direction away from the axis of said support,
said ends being movable in a common plane;
b. means including a longitudinal spring connected
with said location maintaining arrangements for bi-
asing each of the ends of said arrangements in said
forward direction and in contact with said longitudi-
nal member when said support is positioned around said longitudinal member, said spring extending in a direction parallel to said common plane; and
c. a plurality of rods having opposite end portions re-
spectively pivotally connected to adjacent sides of
adjacent position location maintaining arrange-
ments, said rods interconnecting said arrange-
ments to one another such that movement of any one of said ends of said arrangements in its
rearward direction causes substantially simulta-
neous and substantially equal movement of the
other ends in their respective rearward directions.

16. An apparatus adapted for centering a ring-like
object support about the axis of a longitudinal member,
said apparatus comprising:
a. a plurality of circumferentially spaced location
maintaining arrangements pivotally connected with
said object support and including corresponding ends, said arrangements being connected with said
support for pivot movement in a common plane
perpendicular to the axis of said member such that
said ends are movable in a forward direction to-
wards and rearward direction away from the axis of
said member;
b. means connected with said location maintaining
arrangements for biasing each of the ends of said
arrangements in said forward direction and in
contact with said longitudinal member when said
support is positioned around said longitudinal member; and
c. a plurality of rods having opposite end portions re-
spectively pivotally connected to adjacent sides of
adjacent position location maintaining arrange-
ments, said rods interconnecting said arrange-
ments to one another such that movement of any one of said ends of said arrangements in its
rearward direction causes substantially simulta-
neous and substantially equal movement of the
other ends in their respective rearward directions.

17. An apparatus according to claim 16 wherein:
a. said biasing means includes a spring connected
with one of said arrangements and said object sup-
port and extends parallel with said common plane
and
b. said rods lie in a common plane perpendicular to
the axis of said member.