Dec. 28, 1954 S. H. LEE 2,698,071

LIGHT CONTROL FIXTURE

Filed Nov. 14, 1949 2 Sheets-Sheet 1

Fig. 1.

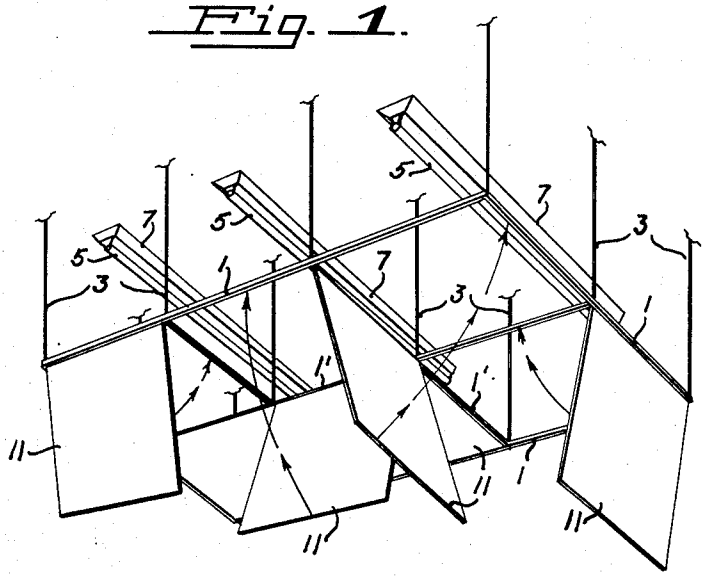


Fig. 2.

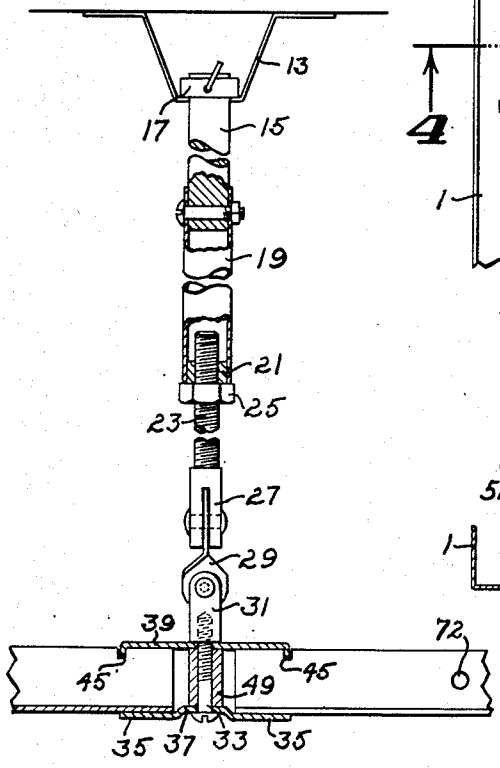


Fig. 3.

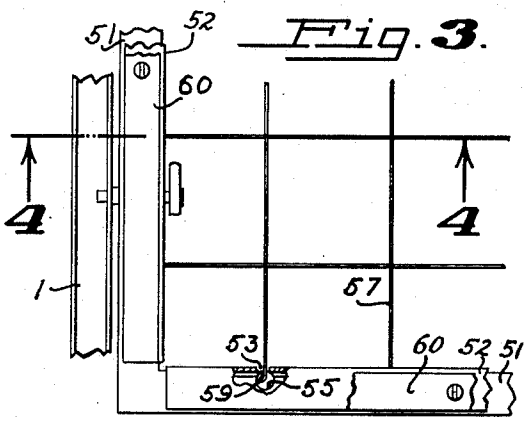
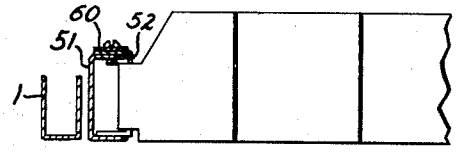


Fig. 4.



INVENTOR,
SHERMAN H. LEE.
BY Lippincott & Smith
ATTORNEYS.

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Fig. 6.

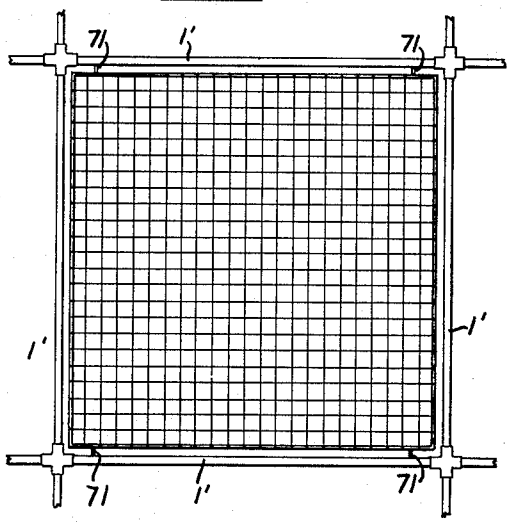


Fig. 5.

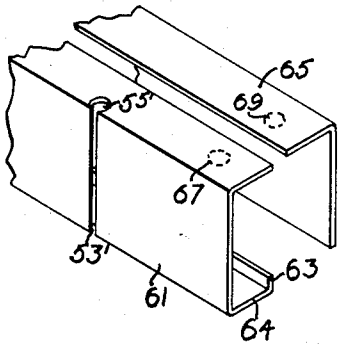


Fig. 9.

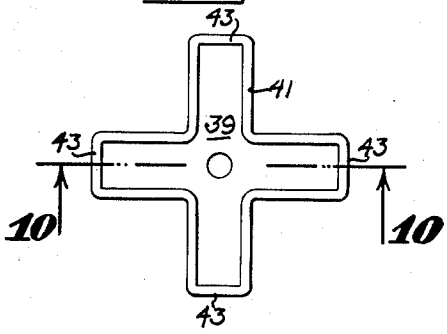


Fig. 7.

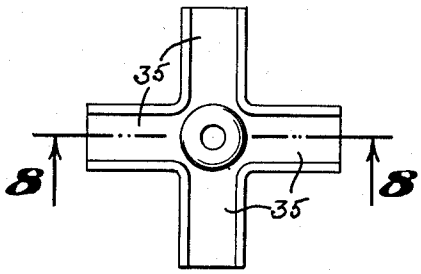


Fig. 10.

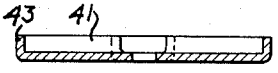


Fig. 8.

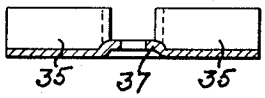
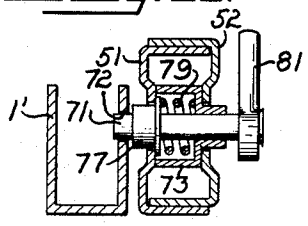


Fig. 11.



INVENTOR,
SHERMAN H. LEE.
BY Lippincott & Smith
ATTORNEYS.

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2,698,071

LIGHT CONTROL FIXTURE

Sherman H. Lee, San Francisco, Calif., assignor of one-half to Cepco, Inc., San Francisco, Calif., a corporation of California

Application November 14, 1949, Serial No. 126,991

5 Claims. (Cl. 189—62)

This invention relates to light control units of the louver type, adapted to be mounted below a light source and direct the light downwardly while preventing direct view of the light and glare from any normal point of view. Particularly the invention relates to such units as are intended to cover an entire ceiling.

Among the objects of the invention are to provide a light control system constructed in modular units which can be adapted to cover a ceiling of any area and substantially any shape; to provide a system wherein the modular units can be shipped in knocked-down form and erected at the site at which they are to be used; to provide a system wherein each unit is hinged so that it may be swung out of the way to permit access to the lights at any part of the main ceiling or roof above the fixture, or can, at will, be removed entirely for cleaning or any other purpose; and, ancillary to the above mentioned objects, to provide a form of construction for the modular units of the frame upon which the grids are hung which, when erected, are rigidly dimensioned so that the grids will swing freely, although closely fitted within the frame; to provide a grid frame which, while extremely light in construction and offering a minimum degree of interception to the infalling light, is itself rigidly dimensioned and resistant to distortion; and to provide a suspension system which can be accommodated to irregularities in the roof or other structure from which it is supported and hold the fixture level and free from distorting strains or stresses.

Referring to the drawings,

Fig. 1 is a perspective view of a number of modular units embodying my invention as suspended from a roof or ceiling, and illustrating generally the method of support of the system and the lighting fixtures to be controlled by it, and the freedom of hinging of the light control units themselves;

Fig. 2 is a detailed view showing an intermediate corner between four of the modular units of a hanger frame, and illustrating the method of assembly and support of said frame;

Fig. 3 is a plan view of a section of the grid frame, portions of the structure being cut away to show its construction;

Fig. 4 is a fragmentary vertical section through the louver grid and frame, the plane of section being indicated by the lines 4, 4 in Fig. 3;

Fig. 5 is an exploded view showing another method of constructing the frame of the louver grid;

Fig. 6 is a plan view of one modular unit of the structure, indicating the location of the hinge pins;

Fig. 7 is a plan view of a support saddle for holding the side members at an intermediate corner of the hanger frame;

Fig. 8 is a cross sectional view of the saddle of Fig. 7, the plane of section being indicated by the line 8, 8 in the former figure;

Fig. 9 is a plan view of the cover or clamp member fitting over the saddle of Fig. 7;

Fig. 10 is a cross sectional view of the clamp of Fig. 9; and

Fig. 11 is a cross sectional view through hanger and grid frames, showing a hinge pin.

To provide an adequate light control system of the louver type which will cover an entire ceiling a number of mutually incompatible factors must be reconciled. Practically, it is necessary to make the system in modular units of standardized size and shape, since the cost of tailoring

to order the fixtures for a complete ceiling would result in prohibitive expense, whereas almost any ceiling can be fitted by properly designed modular units. The units must be of adequate size since otherwise their assembly and maintenance would be a long and expensive procedure, but, on the other hand, they must not be heavy and clumsy to handle since this again would lead to undue maintenance expense. Free access must be offered to the lights themselves to permit them to be serviced, which means that the grids must be readily removable, which again demands lightness of construction, but since they must fit accurately when in place they must be highly resistant to distortion. A maintenance worker caring for a lighting system of this type is always working overhead and frequently upon a ladder; therefore if the louver grid is to be removed entirely he must handle a structure of considerable size—say on the order of four feet square—which is essentially frail in construction and yet is clumsy and heavy, and this presents accident hazards.

My invention obviates the necessity of complete removal, permitting the grids to be swung out of the way to give full access without ever requiring that their entire weight be lifted or that the worker descend a ladder carrying the same. Furthermore, since the grid frames can be made weighing half or less than half of those of the prior art the entire problem is greatly simplified.

Fig. 1 shows the general makeup of a section of a system comprising six modular units in accordance with my invention. A hanger frame comprising side members **1** and transverse members **1'** is suspended from a roof or ceiling by means of vertical hanger rods **3** secured at each corner of the hanger frame. Fluorescent or other lamps **5**, mounted on fixtures **7**, may be mounted directly on the ceiling or may be supported on stretcher bars (not shown) secured to the hanger rods, as circumstances dictate.

The cross members **1'** divide the rectangular hanger frame into similar rectangular units, preferably square, and within each of these square units is fitted a grid frame and louver assembly **11**, each of the grid frames being supported in the hanger frame by two pairs of retractable pins positioned near the ends of opposite sides of the frame which engage holes in the frame members (as will be described later), the pins acting both as latches and hinges, so that when either pair is retracted the section can swing down upon the other pair of hinges as is shown in the figure. Since the grid units are square it is necessary to provide only two pairs of pins, since the units can be rotated 90° within the hanger frames to swing in any direction desired.

The detail of the hanger frames and their supports is shown in Fig. 2. A suitable angular roof or ceiling bracket **13** is fastened to the ceiling or other structure from which the entire assembly is to be suspended. In the present instance this bracket is shaped like a flat-bottomed V having a hole in the flat-bottomed portion through which passes a support stem **15** having a flattened head **17** from which the support stem hangs. The stem **15** is here shown as short, but if the hanger frame is to be supported some considerable distance below the roof it may be made as long as desired.

Bolted or pinned to the lower end of the stem **15** is a tubular thimble **19**, carrying, at its lower end, an internally threaded bushing **21**. Threaded into this bushing is a screw **23**, preferably provided with a lock nut **25** to maintain its adjustment within the bushing, and the lower or head end of the screw is provided with a deep slot forming a yoke **27** within which a universal link **29** is pivoted. The ends of this link are twisted to a 90° angle with respect to each other and the lower end of the link is in turn pivoted within a similar yoke **31**, the bottom of which is threaded to form a cap nut.

The hanger frame is secured to the yoke or cap nut **31** by means of a screw **33** which also serves rigidly to secure the corner clamps holding the hanger frame together and rigidly determining its dimensions. The details of one of these clamps are shown in Figs. 7 to 10, inclusive. The clamp shown is an X type, designed for an intermediate junction of the frame where four units come together. Similar clamps of both L and T types are provided for the outer corners of the hanger frame and

for the intersections of cross members with the outer sides of the frame respectively; as it is believed that the structures of these will be apparent from that of the X clamp, they are not shown in detail.

The clamp comprises a saddle member having rectangularly disposed arms **35** of channel section, as is shown in Figs. 7 and 8. A boss **37** projecting upward and inwardly at the junction of the arms **35** may be provided to form a recess for the head of the screw **33**. Alternatively, the screw **33** may be of the flat head type and the saddle merely countersunk to receive it.

Fitting over the saddle is a cover or clamp plate **39**, conforming in shape to the plan of the saddle, and provided with a downwardly turned edge **41**. This edge, of course, serves to stiffen the entire clamp, but it may be omitted with the exception of the portions **43** at the ends of each arm of the clamp, since this part acts as a lip for positioning positively the channels forming the sides **1** and **1'** of the hanger frame.

The channels are preferably of aluminum, having ends which are milled down by an amount equal to the thickness of the material of the hanger saddle within which the channel side members rest, so that the lower surface of the channel member and the saddle member are substantially continuous. This is merely a refinement, however; channel members **1** may be formed of steel instead of aluminum, and their outer dimensions, throughout, may be such as to permit them to nest within the saddle without constricting the ends. In any case they are mounted within the saddles with their open sides up, as shown in Fig. 2. A notch **45** is formed in the edges of the webs of each channel member. The distance between the notches at the two ends of each channel is the most critical dimension of the entire hanger frame, since it determines the exact size of each modular unit of the system. The channels are accurately formed at the factory. The notches **45** are engaged by the depending lips **43** of the clamps **39**, and since the latter are punch-press parts, by preference, they are all alike. A tubular bushing **49** surrounds the screw **33**, the length of this bushing being such that it permits the clamps to engage the channels firmly but will not permit the screw to be set up so tightly as to deform the parts of the clamp.

The brackets **13** are secured to the ceiling or roof as nearly as possible vertically above the corners of the hanger frame units. The inaccuracies of building construction and the necessity for a firm support for the brackets may, however, prevent their being spaced with the accuracy desired. The universal joint comprising the link **29** pivoted between the yokes **27** and **31** permits the hanger rod to accommodate any inaccuracy of the placing of the brackets. I am aware that it has been customary to provide fixture hangers with ball and socket joints, these joints usually being mounted at the point of suspension of the hanger. A universal mounted in this position will not, however, serve in the case of a system as here described, since any departure from verticality due to misplacement of the hanger is communicated to the entire hanger stem. In this case the portion of the stem connecting with the frame can always be vertical, thus preventing any warping of the frame. This would not be the case with the universal joint positioned only at the top of the hanger rod. It will be apparent that the level and angularity of the frame can be adjusted by turning the screw **23** in its threaded bushing **21**.

The rectangular grid frames are hung within each unit of the hanger frame. The grid frame itself is of a closed or box section. These sections can be formed in a number of ways, one such formation being shown in Figs. 3 and 4. In this method of construction the frame consists of two channels **51** and **52** nested together to form a closed section of the "box girder" type, the channels being firmly secured by spot welding or otherwise to form a unitary structure. Vertical slots **53** are formed in the inner face of the frame at intervals corresponding to the spacing which is to be used for the elements of the louver grid. Communicating with each slot is a hole **55** formed in the upper horizontal webs of both channels.

The louver grid **57** of mutually intersecting strips joined in the well-known "egg crate" manner is preferably formed of much thinner material than is customary for this purpose, the material used being not over twenty-five thousandths of an inch thick while it may be as thin as five-thousandths of an inch. The ends of each strip are rolled as is shown at the reference character **59** and the rolled ends are inserted through the holes **55** so that the strips **57** project out through the slots **53**. The distances between the rolled portions **59** at opposite ends of each strip are accurately determined so that the entire grid may easily be slipped into place and there is normally no tension on the frame imposed by the louver strips. Anything which tends to skew or distort the frame will, however, impose tension on the louver strips and supply a restoring force which opposes the skew. The same is true of anything which tends to bend or otherwise displace the louver strips themselves. It is this which permits of the use of a light material for the louvers. Past practice has been to use open side frames with the ends of the louvers merely projecting into a channel shaped section so that the louvers are supported only by their own rigidity. This has necessitated the use of material of approximately 16 B and S gage, which is fifty-one-thousandths of an inch thick and, accordingly, if made of the same material as used in louvers constructed in accordance with my invention weighs anywhere from about two to five times as much. The weight of the frame which holds the louvers will not be greatly different in either case, and in any event it forms but a small fraction of the weight of the assembled grid. The lighter weight of the grids formed in accordance with my invention leads to saving in cost of original manufacture and in handling and shipping as well as economy of maintenance.

In order to retain the grids in place a cover strip **60** is preferably screwed or otherwise secured over the upper webs of the frames and the holes **55**.

Fig. 5 shows a modified form of grid frame which permits of even cheaper and lighter construction. In this case the inner element of the grid frame comprises a channel **61** having an upwardly extending lip **63** from the lower web **64** of the channel. Slots **53'** in the inner web, communicating with holes **55'** in the upper web, are formed as before, but the box section of the frame is closed by a simple angle **65**, the upper leg of which serves in place of the cover plate **60** while the rear leg closes the section. Parts of the frame may be joined by spot welding positioned, for example, as indicated by the dotted circles **67** and **69**.

The grid frames are suspended within the hanger frames on retractable hinge pins **71**. Pairs of these pins are mounted at each end of opposite sides of the grid frame adjacent the adjoining sides, and engage holes **72** (see Fig. 2) formed in the hanger frames and positioned accurately with relation to the notches **45**. The position of the hinge pins is not of critical importance. They should be fairly close to the ends of the grid frame sides so as to make the full area of each modular section available for work above, but they should also be easily reached from below. A convenient position is between the first and second louver considered from either end of the grid frame.

Each pin is mounted within the box section of the grid frame, in an assembly comprising a thimble **73** having an internal and external shoulder formed by construction **75** formed at one end, the external shoulder abutting against the inner face of the grid frame. The hinge pin **71** is provided with a collar **77** located perhaps one-quarter of an inch from the projecting end of the pin which engages the hole **72** in the hanger frame. A spring **79** abuts against this shoulder and the inner shoulder **75** of the bushing **73**, urging the pin outward into engagement with the hanger frame. The pin extends inwardly of the frame, and may be provided with a button or a handle **81** for retracting the pin. Either pair of oppositely positioned pins may be considered the hinge on which the grid frame swings, while the other pair can be considered as latches which hold it in its normal position. All of the hanger frame members **1** and **1'** are provided with the holes **72**. Square grid frames may therefore be mounted to swing in any direction which may be most convenient for servicing; the outer units normally will be so hung as to swing down nearest an adjoining wall while centrally positioned units will be positioned to swing so as to leave aisles clear for servicing or to permit a service ladder to be set in the most convenient position. One of the most valuable features of the arrangement is that a man on a ladder can swing the louver grid out of the way without having to dismount his ladder, and he need not find a clear place to stack the grids while the servicing is in process.

On the other hand, if it is desired to remove the grids entirely for cleaning this merely means the release of both sets of pins instead of only one.

The cleaning of the grid itself is rendered easy because of the fact that the frame section is entirely closed and there is no open channel section for dust to settle in.

While I have described in detail only the normal or standard square modular unit, it will be apparent that as in all types of modular construction fractional units may be provided. In these cases the hanger frame dimensions will normally be either one-half or one-quarter of whatever size may be adopted as the standard modular unit. Such sections require a certain amount of "hand tailoring" and will not usually permit the convenience of swinging on either of two 90° axes as does the square unit. It will ordinarily be found more convenient, however, to have oblong rectangular sections turn on axes in their long dimensions, and swinging in this manner can be considered a "semi standard."

I consider one of the principal advantages of a light control system made in accordance with my invention to be the fact that the elements can be constructed with a greater degree of accuracy than is customary in sheet metal work of this class. All measurements and fittings can be accomplished at the factory and although the parts are shipped in disassembled form factory accuracy is automatically obtained when they are erected. The hinging of the grid units requires that the grid frames fit closely but freely within the hanger frames, with tolerances held within one-thirty-second of an inch, an accuracy not usually obtainable in sheet metal work. The various features here described all contribute to this accuracy and make the system workable.

A fairly wide choice of materials is available for construction. The hanger stem assembly will normally be of steel, but the hanger frames may be of either steel or aluminum and so may the grid frames. For the louvers themselves plastic may be added to the materials mentioned for the frames. I prefer, however, to use metal louvers, since metal is fireproof and not subject to major deformations under unusual conditions of temperature or moisture. Since the louvers can be formed of thin aluminum or thinner steel, however, the fully assembled frame can be made as light as it could be with plastic louvers of ordinary construction and this posseses the additional advantage that the light intercepted is less than when thicker and heavier construction is used. The effect of the light construction is cumulative, since lighter louvers require lighter grid frames and these, in turn, permit the use of lighter hanger frames. Using the maximum thickness of metal here suggested the percentage of directly downwardly projected light intercepted by the louvers is less than three per cent. Angularly directed light will, of course, be intercepted in part by any louver system and the proportion of this light which is made effective for actual use by reflection depends upon the finish applied to the louvers. With polished steel or aluminum up to ninety-eight per cent of the obliquely directed light may be used, whereas if the louvers are finished in dead black, as may be required for some specialized installations, the proportion of obliquely directed light made available may drop to three or four per cent. In normal applications the figures will lie somewhere between these extreme values.

Polished metal louvers will give specular reflections from some angles. The most useful finishes are matte surface aluminum and white enamel, both of which give a high degree of utilization of oblique light. Colored enamels may be used for decorative purposes or for color correction. Such modifications are not peculiar to the equipment of my invention, but the invention does permit their utilization to the fullest extent.

I claim:

1. A light control system comprising a rectangular hanger frame including at least one intermediate cross member for dividing said frame into a plurality of similar units; a grid frame fitting closely within each unit of said hanger frame; a grid of mutually intersecting louvers within said grid frame, the end of said louvers being interlocked with said grid frame whereby said grid reinforces said grid frame against distorting forces; and pairs of retractable pins mounted in the sides of said grid frame in laterally opposed positions and coacting with holes formed in said hanger frame whereon said grid frame can hinge upon retraction of all but one pair of pins.

2. A light control system in accordance with claim 1 including means for suspending said hanger frame from above comprising approximately vertical hanger rods connected at each angle of said hanger frame, means for adjusting the length of said hanger rods to level said frames, and universal joints in each of said hanger rods adjacent the junction thereof with said hanger frames, each said universal joint including two sections and a link connection therebetween, said sections and link connections constituting a part of the hanger rod and said link being pivotally attached to each section and connected to rotate at each point of pivotal attachment about axes normal to each other to relieve the frame of warping stresses when leveled.

3. A light control system comprising a rigid rectangular hanger frame including at least one cross member for dividing said frame into a plurality of similar units, and a closely fitted grid frame provided with intersecting light controlling louvers pivotally supported within each unit, the supports for said grid frame comprising pairs of laterally projecting pins mounted adjacent the ends of opposite sides of said grid frames, and springs for urging said pins outwardly into coacting holes in said hanger frames, said pins projecting inwardly into said grid frames to provide means for retracting said pins against the action of said springs to permit said grid frame to swing on an unretracted pair of pins.

4. A light control system comprising a rigid rectangular hanger frame composed of similar modular units, and a grid frame provided with intersecting louvers pivotally suspended within each unit, each of said units comprising angular corner members including a base of channel section having at least two rectangularly disposed arms and a cover plate conforming to said base and having a downwardly turned lip at the end of each arm, side members of channel section nesting within the channel section arms of said base and notched to engage said lip of said cover plate, a clamp screw passing through said base and said cover plate, and means for supporting said hanger frame engaged by said clamp screw, the channel side members of adjacent units being common to both.

5. A light control system in accordance with claim 4 including in said supporting means a universal joint, said universal joint including two sections and a link connection therebetween, and said link being pivotally attached to each section and connected to rotate at each point of pivotal attachment about axes normal to each other.

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