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750,521, Aug. 6, 1968, now abandoned.
This application Mar. 2, 1970, Ser. No.
15,785

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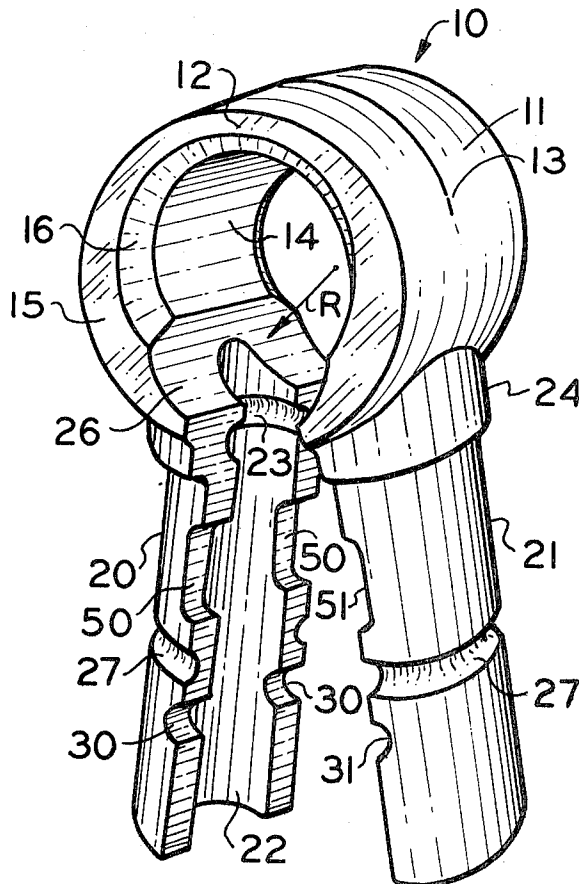
[54] MECHANICAL CONNECTOR SYSTEM INCLUDING BIFURCATE HINGED CONNECTOR MEANS

14 Claims, 35 Drawing Figs.

[52] U.S. Cl..... 24/81 CR,
 16/159, 248/71
 [51] Int. Cl..... A44b 21/00
 [50] Field of Search..... 16/159;
 24/73 SP, 81 LC, 81 CR; 248/50, 71, 74

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ABSTRACT: A connector system for securing a first physical object to a second is based primarily on a one-piece bifurcate connector having a first or head axis and a second or leg axis generally transverse to the first. The connector per se comprises a plastic hinged loop element flexible enough to open and pass astride the first object, and bifurcate leg elements in continuation of the loop, adapted to be closed together along the second axis to engage the second object. Plural cooperating notches, grooves, or cutouts are formed between the legs to engage between them pin, key or other detent means projecting from the second object and preferably parallel to the first axis. Annular grooves or other surfaces of revolution also may be formed inside or outside the legs, as closed, to permit rotation of the second object about its own axis.



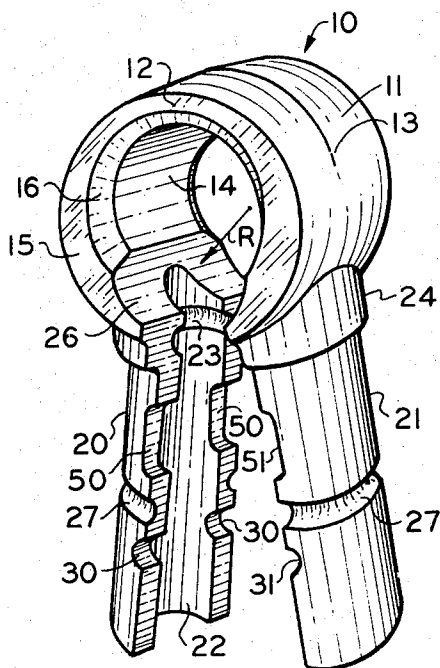


FIG. 1

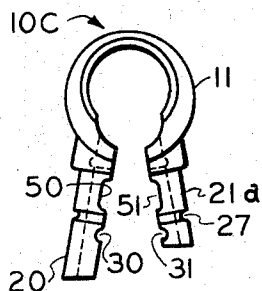


FIG. 5

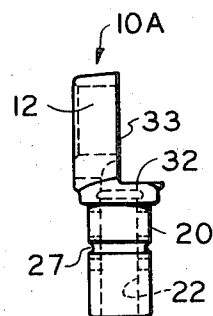


FIG. 2

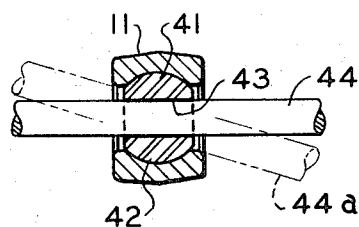


FIG. 3

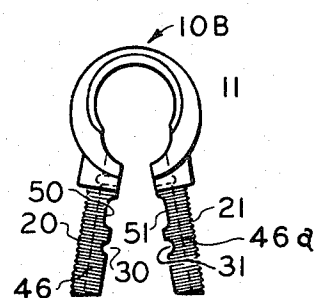


FIG. 4

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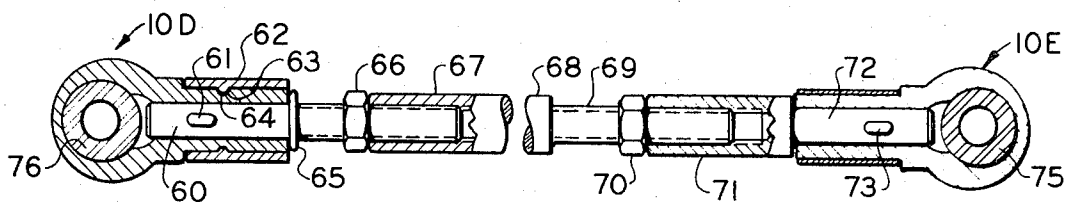


FIG. 6

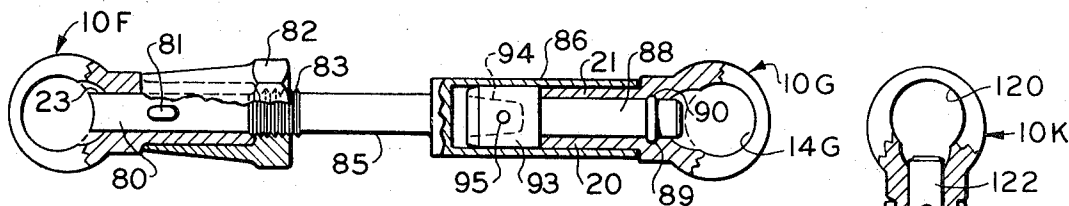


FIG. 7

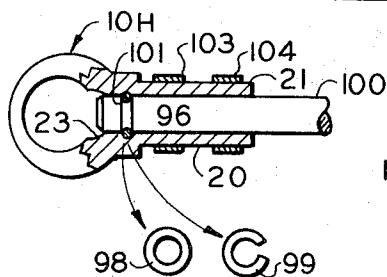


FIG. 8

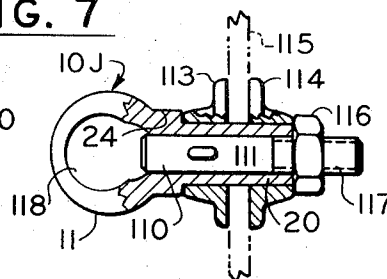


FIG. 9

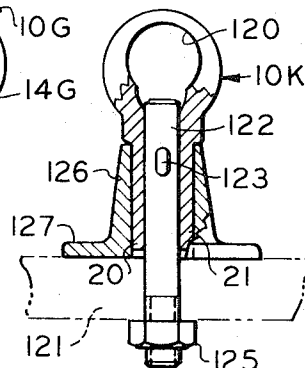


FIG. 10

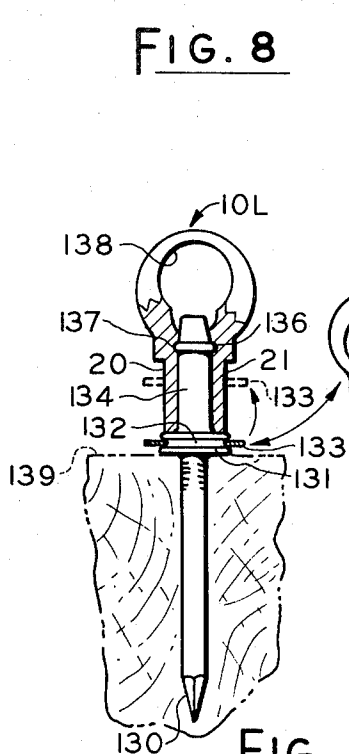


FIG. 11

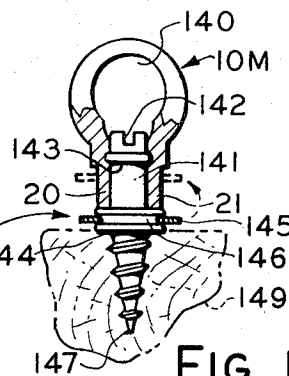


FIG. 12

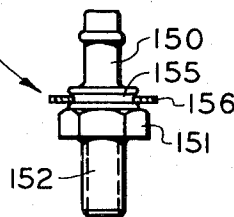


FIG. 13

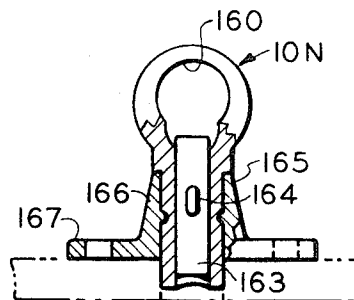


FIG. 14

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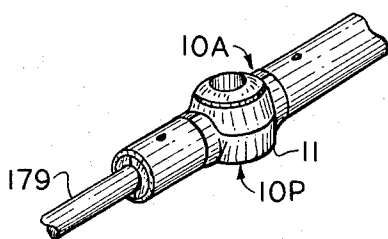


FIG. 15

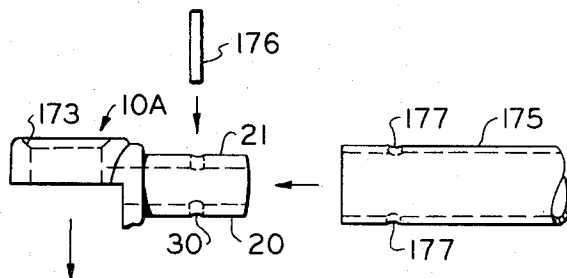


FIG. 16

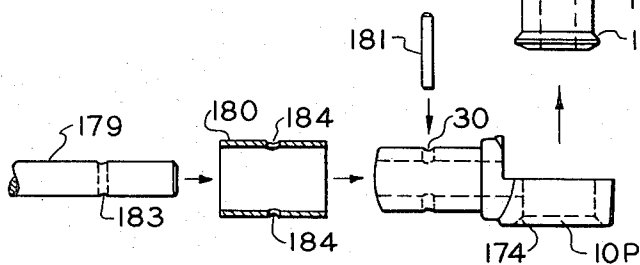


FIG. 17

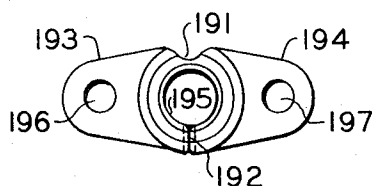


FIG. 18

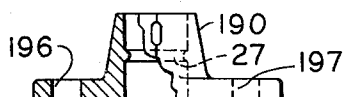


FIG. 19

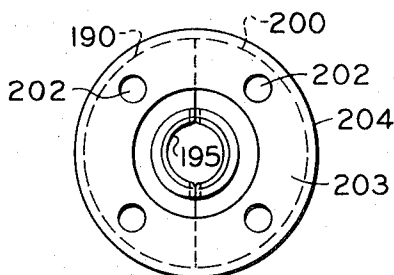


FIG. 20

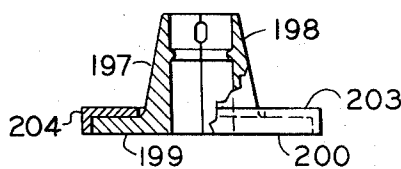
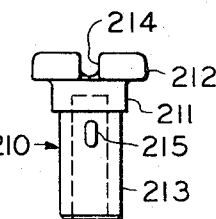


FIG. 21

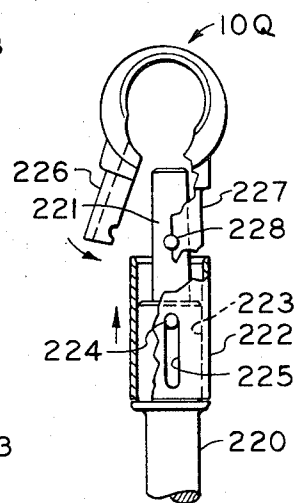


FIG. 22

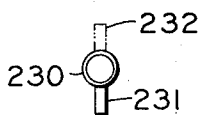


FIG. 23

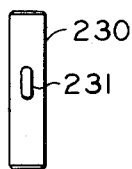


FIG. 24

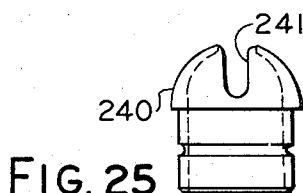
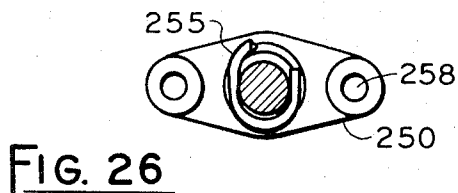
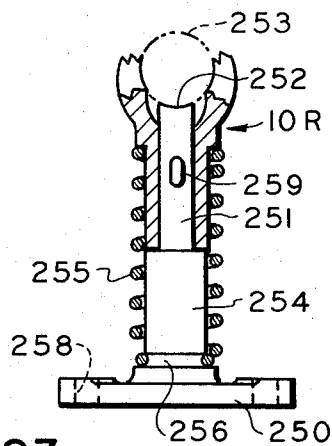
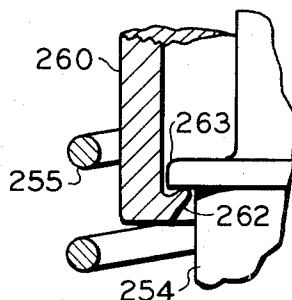
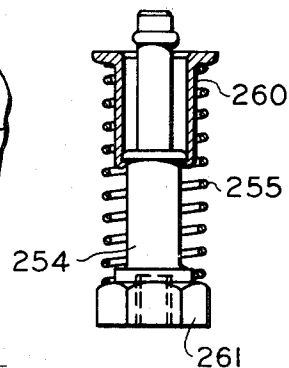
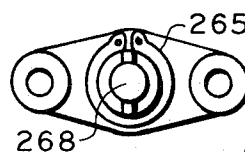
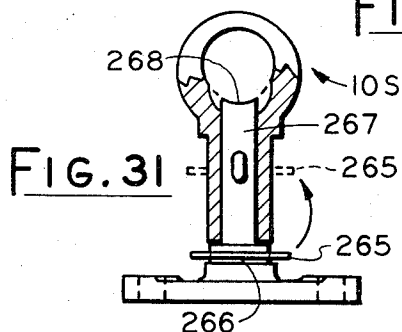
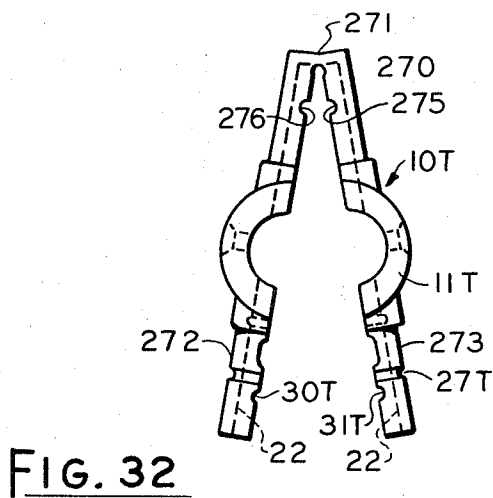
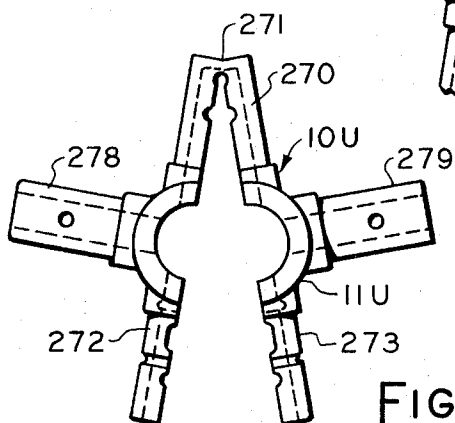
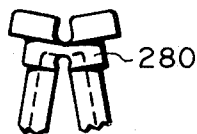
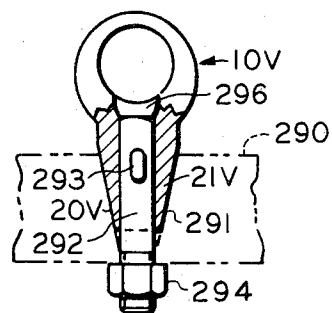


FIG. 25

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MECHANICAL CONNECTOR SYSTEM INCLUDING BIFURCATE HINGED CONNECTOR MEANS

The present application is a continuation-in-part of my application Ser. No. 750,521, filed Aug. 6, 1968 and now abandoned.

BACKGROUND AND PRIOR ART

In securing a first physical object, such as a rod, conduit, glass tube, or the like to other or secondary structural elements, such as frames, walls, bars, etc., it is often desirable to have connectors having an open end or loop adapted to grip the rod or conduit about its circumference but which can still be applied after the rod or conduit is in place. It is often impossible, or at least very inconvenient, to place a closed loop or ring-type connector over such a member. In the past, various suggestions have been made for connections to serve this purpose, such as two-part clamp or loop end members which can be separated into semicircular parts and then bolted around the member; such are commonly used, for example, to mount exhaust tubes in automobiles. Alternatively, U-bolts having two parallel legs joined by rigid or flexible parts are sometimes used: these have a great disadvantage in places where it is not convenient or desirable to have two-bolt elements. In some situations it is desirable to be able to turn the first rod, tube or other physical object, e.g., in its own plane around the bolt or stud element which projects transversely to the axis of the rod, tube, etc. Commonly the axis of the connector is at a right angle to the axis of the elongated tube, conduit, rod, etc. Obviously, it is not possible to turn the latter about the second, axis, e.g., to screw the transversely projecting bolt or screw into a threaded opening or into a wooden support member. It is sometimes necessary, however, to provide for some relative rotation of the main conduit or tube about this transverse or lateral axis.

In the parent application, Ser. No. 750,521, mentioned above, there is described a hinged bifurcate connector of the general type to which this invention particularly pertains as used in a pack frame. The latter is of the type used by hikers, hunters, and other outdoors men for carrying camping, fishing, and other types of equipment. In said application, the connectors disclosed are used to connect vertical rods or bars, i.e., members having a second axis, also as referred to herein, to transverse or horizontal tubes having a first axis, also as referred to herein. One of the latter is surrounded and gripped by the loop-shaped part which is formed as a resilient hinge. The loop part is flexible enough, when properly molded, and especially when relieved at critical inside corner elements, that it can be opened up by spreading its bifurcate legs apart, far enough to place it over a tube, e.g., one which has both ends inaccessible and hence does not permit sliding the loop member onto it in an axial direction. The connector may be considered a sort of Tee joint; it is particularly adapted to secure a laterally projecting rod to a primary axially extending frame element. In some cases the second axis member, i.e., the rod, may be secured between the bifurcate legs by notching the legs at a common point to form a cooperative two-part pin receiving opening and inserting a pin through the rod, in a direction parallel to the other or first axis and through this opening. To prevent the legs from separation which would free the transverse pin, a ring, band, ferrule or piece of tubing or the like may be placed over them; resilient C-rings, elastic O-rings, horseshoe-shaped retainers and the like also may be used.

In one example in the aforesaid application, relatively smaller vertically extending rods are thus connected to larger transversely extending tubes where they are held against forces that might be exerted axially along the rods to displace them. In another example, the rods are replaced by tubular elements which are secured to the connectors, again by pin means inserted through a hole or holes in the tubular elements, and into notches formed in opposed loci between the bifurcate legs. As long as the legs cannot separate, and are formed of material of adequate strength, this arrangement

gives adequate support for normal loads applied along the second axis.

In a German Pat. No. 530,012, there is disclosed a fastener which is intended to be useful for fastening plumbing pipes and analogous conduits to various structures, such as walls of buildings and the like which, superficially, has some resemblance to the present invention. The patent discloses ring or loop elements, both one-piece and two-piece, designed to surround the pipe and having laterally extended means, including bifurcate means, for attaching to the structure. In one example, retention of the connector to a structure is provided for by means of a pin placed between the legs or bifurcations and through holes in a tubular element which surrounds the legs. The latter of course holds the legs against separation. These parts which are made of metal or other relatively unyielding material, obviously cannot grip the conduit with a firm elastic hold, unless sized with extreme accuracy; moreover they do not permit of the hinge action necessary for installing the connector by spreading its legs to go over and around a pipe already in place. The patent solves the latter problem when it arises, by making the ring and the legs in two separate parts; these are installed separately and then joined together and pinned to the tube (see FIG. 8 of the patent). This device would be quite unsuitable, e.g., for fastening glass tubes to a base support because of difficulty of getting an optimum elastic gripping fit.

The present invention differs from the German disclosure in the following respects: (a) it has a built-in flexibility which enables it to grip the main or loop encircled, first axial member (tube or conduit, for example) firmly enough to hold it securely, e.g., against axial or other displacement; (b) it can be installed around a pipe or analogous object already in place (or around any analogous structural element similarly situated); (c) it can hold to a laterally extending or second axis object, pipe, conduit, etc. or rod, i.e., extending like the stem of a tee and placed inside the bifurcations, as well as to a tubular side member; (d) for applications where the side or lateral member must be free to rotate with respect to its own axis, the German device has no application at all.

The device of this invention, by suitable application, can permit such rotation readily while still retaining the parts against relative displacement along the second axis, i.e., along T-stem member. In this discussion, the term "side member" or "lateral" member will be understood in general to refer to the "second axis," i.e., the member whose axis is at a substantial angle, like the stem of a T, typically at a right angle though not always necessarily so, with respect to the first axis.

As described in the parent application, Serial No. 750,521, and referred to above the connector is used in one case to secure a vertical rod or second axis member placed inside the connector, that is between its legs or bifurcations, to a horizontal tubular or first axis member which is surrounded and gripped frictionally by the loop part of the connector, (especially its thinner part). The latter is the flexible or "hinged" element of the connector and will be referred to as such.

In another case described in said application, the connector of identical structure to the first mentioned, is used to secure a more or less vertical element, which surrounds and holds together the legs or bifurcations of the connector to a horizontally disposed tubular member which is not very tightly gripped by the loop part. This arrangement can permit rotation of the leg elements and attached parts around the axis of the looped horizontal member. Often the loop part of the connector will grip the part it surrounds with sufficient tension to prevent unintentional axial displacement; it may, however, be designed to permit rotation that may be either quite free or quite restricted, as desired.

Functionally the connector of this invention may be considered to be essentially a Tee joint element, with the respective parts it is to hold normally extending along intersecting or first and second axes. However, the axes need not always actually be intersecting and they may be somewhat offset in space and thus in different planes. The connector is designed

to permit the following classes of relationships and others that will be obvious or that will appear below, between the parts it connects together;

A. Transverse or Tee-head members, e.g., for connecting first axis tubes, rods, conduits and other shapes, to second axis or stem members of rod type. These are for:

1. Holding against displacement relatively along the stem axis while permitting relative rotation of the stem-aligned member around its own axis. They may involve flanged heads, ribs, or O-rings on the stem member;
2. Holding as above and also preventing relative rotation between bifurcate elements and then stem rod; these may involve pins or lugs, extending from the second axial objects and between the legs of the connector;
3. The rod or second axial member also may be connected indirectly to the legs through a sleeve, i.e., a sort of combination with the next group.

B. With the sleeve or tubular connector, for:

- 1 Holding either or both members in tension or compression, without permitting relative rotation of the second axial member. To prevent relative rotation of the second axis member may require use of a pin or key between the bifurcations.

C. The loop end for holding the first axial member provides support for and permits rotation of this member, for:

1. Free rotation, as in a conventional journal bearing, i.e., rotation about its own first axis;
2. Restrained rotation e.g., by braking action, with rotation about the first axis;
3. Mounting for rotation in various ways not restricted to turning about the Tee head axis, e.g., by using an adapter for enclosing spherical or other specially shaped surfaces, as in rod end bearings, to give flexibility and freedom of movement in certain planes or direction.

D. The loop end holds the first axial member against relative rotation, by:

1. Clamping firmly, or braking;
2. Permitting the first axial or elongated member in the Tee head to slide along its axis without rotation, e.g., the head loop can involve angular or splined elements so that the first axial member it holds can slide but not rotate within the loop.

Other arrangements and functions will appear in detail in connection with the detailed description that follows

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a perspective of a preferred plastic connector per se.

FIG. 2 is a side elevational view of a modified plastic connector having part cut away to form part of a hinge joint or the like.

FIG. 3 is a detail sectional view illustrating use of a spherical adapter in connector of the type shown in FIG. 1.

FIG. 4 shows a modified connector having external threads on the legs.

FIG. 5 shows a further variation with one leg shorter than the other.

FIG. 6 shows an adaption of the connectors to rod end bearing units.

FIG. 7 shows another modification for swivel connections between two loop held objects.

FIG. 8 shows a modification using an annular detent for holding against secondary axial displacement while permitting relative rotation about the secondary axis.

FIG. 9 is another adaption for securing to a grommet held structure.

FIG. 10 is an elevational view, partly in section, of an arrangement for securing a primary axial structure such as a rod, to a base structure.

FIG. 11 and 12 are similar views showing adaptations for nail-type and screw-type fasteners respectively.

FIG. 13 shows a bolt or rivet-type connection.

FIG. 14 illustrates a method and structure for keying the adapter to a hinged surface element.

FIG. 15 illustrates a joint made by use of a pair of connectors of the type shown in FIG. 2.

FIG. 16 is an exploded view of the joint of FIG. 15 showing component modifications and method of assembly.

FIG. 17 is a plan view of FIG. 18 a side view, partly in section, of a hinged or spring collar or ring member for securing secondary axis elements with a connector of the general type shown in previous figures.

FIG. 19 and 20 show in a plan and vertical section a split two-part ring and adapter baseplate assembly for uses similar to those of FIG. 17 and 18.

FIG. 21 shows an alternative insert or secondary axis member for the structures of FIG. 19 and 20.

FIG. 22 shows another type of connection made by using a bifurcate connector having legs of different lengths, as in FIG. 5.

FIG. 23 and 24 are detail end and side views of an internal rod element suitable for use in systems of the types shown in FIGS. 18, 20, and others.

FIG. 25 shows another type of element adapted for use in connecting structures such as FIGS. 17 to 20 for securing rope slashings and the like.

FIG. 26 is a top view and FIG. 27 is a side view of another modification using a coil spring for securing parts together by keeping the bifurcate legs held together.

FIG. 28 is a large scale sectional detail and FIG. 29 a sectional view on smaller scale of an arrangement employing a coil spring and ferrule arranged to hold the bifurcations together.

FIG. 30 is a plan view with parts omitted, and FIG. 31 a side view of another modification, using a retaining or spring ring of split type to hold the legs together.

FIG. 32 is a modification of a hinged bifurcate structure adapted for dual secondary axial connections.

FIG. 33 shows another modification adapted for multiple connections.

FIG. 34 is a fragmentary view illustrating a modification of a hinge end of a branched structure such as in FIGS. 32 and 33.

FIG. 35 shows still another modification showing tapered bifurcated ends held together in an opening in a supporting structure.

DESCRIPTION OF PREFERRED EMBODIMENT

A basic element 10 of present invention is the tough, plastic elastic bifurcated connector element shown in detail in FIG. 1. This is made of a suitable high-strength resilient material such as nylon, "Delrin," or other material of similar properties. These elements are stiff and strong and have some resilience but will yield slightly under pressure. The material selected should be such that it can be bent, in thin sections, without breaking. The device of FIG. 1 has a head or loop element 11 which is formed rather thin around the upper part of the loop to increase flexibility as indicated at 12 so as to serve as a hinge. It is wide enough to have requisite strength and the loop is thicker at its sides than at the top "hinge" part 12, FIGS. 1, 10, 11, 12, 14, 4, 5; see also FIGS. 22, 31 and 35, and others. The article has a more or less convex surface 13 at its top and a cylindrical hole or passage indicated at 14 aligned along a first axis. The latter may be widened at either end 15 by flared or conical annuli 16.

The loop 11 terminates in two legs 20 and 21. Normally these legs tend to stand apart more or less as shown in FIG. 1, due to the way in which the product is formed by molding or machining. Each of these legs is formed inside with a semicylindrical or passageway indicated at 22 so that when closed together the two surround a circular cylindrical area having its centerline along a second axis transverse to the axis first mentioned and suitable for receiving a vertical rod or other object of similar shape. Surfaces 22 terminate at the top in a frustoconical enlargement 23 which joins the main or first axial bore 14. Externally each leg is reinforced at its upper part with an enlarged flange or shoulder 24 and is cut away or relieved internally on a radius R from the circular bore 14 as

indicated at 26. The reason for this cutaway is to facilitate the passing the connector 10 over a long conduit, rod, or the like which cannot be inserted into loop 11 endwise. The legs 20 and 21 are spread apart, thus bending the portion 12 and then the connector can be pushed over such a rod, conduit, pipe, or the like, without breaking. The flexibility of the plastic material permits this much bending.

Each of the legs preferably is provided with an annular external channel, a surface of revolution, indicated at 27. When the legs are closed together this forms a continuous groove around the composite circular structure because legs 21 and 22 when closed tightly together form essentially a right circular cylinder. Each leg also is grooved or cut out at mating edges as shown at 3 and 31 so that when closed together these cutouts define a pair of circular openings aligned with each other. These notches or openings are adapted to receive a pin, not shown in FIG. 1, see FIGS. 15, 16 and 22, for holding a rod or equivalent inserted between the legs, in place when the legs are held tightly together. This will be explained more fully below.

As shown in FIG. 2, part of the head or loop 12 of connector 10A may be cut away so that two similar parts together as shown in FIG. 15 and 16 can be assembled as a pivoted hinge joint. The part 32 cut away includes a plane face 33 aligned with the axis of the cylindrical member 22. This also will be referred to further below.

In FIG. 3, head 11 is not bored with a cylindrical bore 14 as in FIG. 1 but rather is formed with a spherical inner surface 41. The latter is shaped to receive a spherical surfaced adapter 42 bored in the center 43 to receive a rod 44. This permits the insert to shift to various angles as indicated by dotted line 44a.

FIG. 4 shows a connector 10B similar to that in FIG. 1 except that the legs 20 and 21 are threaded externally as at 46 and 46a so that when the legs are held tightly together they form in effect a bolt that can be threaded into a nut or other threaded receptacle.

In addition to the grooves, 30, 31, adapted to receive the transverse pin as already described, the legs 20 and 21, FIG. 1 are provided also with matched wide notches 50 and 51. These are so arranged that when the legs are closed tightly together a key member, bar or stud extending from one or both sides of a rod or like element included in the bore 22 can project through these slots or through one of them and prevent relative rotation between the rod and the connector. This arrangement is shown also in FIGS. 4, 5, 6, 7, 9 and others.

FIG. 5 shows a connector 10C similar in other respects to that of FIG. 1 as having one leg 21a shortened with respect to the other. This will be mentioned further on.

A useful adaptation of connectors 10D and 10E similar to those of FIG. 1 is illustrated in FIG. 6 where a rod end bearing structure is built up of two such connectors combined with linkage to hold the parts together. At the left the first connector 10D is secured to a rod 60 by a key 61 which projects through slots in member 10D similar to slots 50 and 51 in FIG. 1. An elastic sleeve or ferrule 62 having a small inward annular projection 63 fitting in a shallow groove 64 which may be like groove 27 in FIGS. 1 and 5 or smaller, holds the legs together. Since the legs cannot separate the key 61 locks rod 60 to connector 10D. A snap ring or spring ring 65, fitted in a groove in rod 60, holds the parts against longitudinal displacement. The right-hand portion of rod 60 is threaded to receive a nut 66 and a threaded female connection 67 on the other rod 68. The latter has a shank 69 of reduced diameter threaded into a nut 70 and into another female internally threaded member 71. The latter is connected or integral with a rod extension 72 which bears a key element 73 projecting into the notch 50, 51 in the member 10E in the same manner as already described. The bearing element 75 which may be a fine ball bearing, is enclosed or encircled in the loop portion of connector 10E. Likewise a ball bearing 76 is shown at the left end of the assembly. The actual bearing arrangement may involve a spherical surface adapter fitted smoothly into ap-

propriately concaved loops of elements 10D and 10E in the manner described in FIG. 3.

FIG. 7 shows a swivel-type connection wherein a plastic connector 10F at the left is locked to a rod 80 through a key 81 in the manner described above. A nut 82 threaded internally fits on a threaded portion 83 of rod 80. It has a projecting hollow sleeve at the left sized to fit and hold tightly together the bifurcate legs 20 and 21; compare FIG. 1. With this arrangement, the key 81 fits in the slot 50, 51 (see FIG. 2) tightly so that the rod 80 must rotate or shift with the connector 10F or be held against rotation if the latter is not turned. Rod 80 extends at 85 to the right and terminates in a hollow sleeve member 86. The latter is sized to surround and enclose the legs 20, 21 of another connector 10G. These legs when closed together surround and confine a rod element 88 having an annular groove in which is fitted an O-ring 89. The latter fits into a groove 90 formed internally in the legs near the loop N. Rod 88 has an enlarged left end portion 93 which is cut out to receive a tongue 94 on the end of rod 80, 85. A pin 95 secures these parts together against longitudinal displacement.

With this arrangement just described the head 10G or the rod, tube or other object which passes through or is held in its opening 14G can be rotated with respect to the other end of the assembly; members 89 and 90 permit this relative movement.

FIG. 8 shows a somewhat similar arrangement where the connector 10H has an annular groove 96 in which may be placed either an O-ring 98 or a spring C-ring 99. The rod 100 is grooved at 101 to accommodate the O-ring or C-ring or similar part. The legs 20 and 21 of the connector are held tightly together by two bands or rings 103 and 104 which may be either solid or split and are spaced apart. In this manner the rod 100 is keyed and locked to the connector 10H but can be rotated about its own axis with respect thereto.

FIG. 9 shows an arrangement where a connector 10J has its legs formed to receive between them a rod element 110 along the secondary axis. Rod 110 carries a key 111 which projects into the notch between the legs as at 50, 51, FIG. 1. Disc or grommet members 113, 114 are formed, either as a unitary structure or as a composite structure, to grip between them a plate, sheet of fabric or the like, indicated at 115. A nut 116 on the threaded right end 117 of rod 110 can be tightened to hold the grommet firmly against the shoulder 24 of the head 11 of the connector 10J. This provides a convenient method for attaching a conduit, rod or the like, indicated graphically at 118, to a sheet 115 or plate of metal, fabric, wood or the like, as will be obvious.

In FIG. 10 is shown an arrangement including a connector 10K for securing a conduit, rod or the like 120 to a beam, bar, plate, wall or other base member 121. The arrangement here involves the plastic connector 10K, a rod 122, and a key 123 projecting from the rod into a notch between the legs of connector 10K, such as shown at 50, 51, FIG. 1. The rod 122 terminates in a threaded lower end on which a nut 125 is placed. This bolt passes through base member 121. A flanged ring or ferrule 126 having a flat base 127 resting on the member 121 is sized to receive the legs 20, 21 of the connector 10K and hold them firmly together. Thus the key 123 cannot escape from the notch 50, 51. Assembly is made by inserting the bolt through base 121 from the top and simultaneously closing and inserting the legs of plastic connector 10K into the cup or ring member 126. This is an excellent way to attach a conduit or tube, etc., to a wall or other structural member. It can be used for attaching glass tubes on neon signs or in laboratory apparatus etc., as will be obvious. The resilient character of the loop part of connector 10K is very suitable for holding glass firmly without breaking it.

For securing conduits, pipes, rods and the like, also glass tubes as in neon signs, laboratory apparatus used in chemical operations etc., the driven screw bolt or rivet type fastenings of FIGS. 11, 12 and 13 are very useful. In FIG. 11 a nail 130 is provided with a grooved flange or second head 131 adapted to receive in a groove 132 a stiffly resilient constricting split

retaining ring or "grip ring" 133 of well-known type as illustrated. The upper part 134 of nail 130 is sized to fit between the closed legs 20 and 31 of the connector 10L. The latter may have an internal groove 136 adapted to receive a small annular flange 137 forged on the nail body near its upper end so that as the legs of member 10L are brought tightly together, any conduit, rod or other object held inside the loop at 138 will be retained in place with respect to the base 139 by the nail which is driven into it. The retaining ring or grip ring 133 is normally supplied with the nail and stored in the groove 132. When the device is put in use the ring is removed from this groove, which is only a temporary holder, and is moved up to surround and tightly confine the legs 20 and 21 of the connector 10L. This holds the legs tightly constrained around the nail head and retains the assembly in place. The arrangement in FIG. 12 is exactly the same. Connector 10M holds a pipe, rod or conduit or other object 140. The screw part of rod 141 is driven into a base 149. Its upper end is then inserted between the legs of the connector, while they are somewhat separated and they are closed on it afterwards. The head of the screw is provided with a screwdriver slot 142 and a retaining rib or flange 143 is formed on it which fits into the groove between the legs 20 and 21. The screw or rod also embodies the grooved annular enlargement 144. A retaining ring of "Grip ring" 145 fits temporarily, for storage purposes only, into the groove 146 in this element. The rod includes wood screw structure 147 adapted to be driven into the beam, floor, ceiling, wall or other base structure 149.

Similarly, in FIG. 13, the rod member 150 which corresponds generally to members 134 and 141 already described is provided with a nut or flange 151. The lower end of this member may be threaded to form a bolt 152 or it may be a rivet adapted to be battered in place in an appropriate base or holding member. The connector is not shown in this figure but is identical with connector 10L or 10M and the other parts are the same. In using the devices of FIG. 11, 12 and 13, the nail, screw, bolt, or rivet is first fastened to the base member and thereafter the conduit or other object to be held in place is attached by simply placing over it the bifurcate connector member 10L or 10M, squeezing the connector legs together around the head of the nail, screw etc., removing the retaining ring from its temporary storage groove and moving it up on to the bifurcate legs to hold the parts in proper assembled position. In FIG. 13 an annular grooved flange 155 holds the retaining ring 156 temporarily.

In FIG. 14 an arrangement is shown for securing a physical object 160 of any suitable type to a base or support 161 through means of a plastic connector 10N, the legs of which surround a short rod member 163. The latter has a key 164 projecting from at least one side into and beyond the slot formed by notches 50, 51, see FIG. 1, and into an opening in the leg-confining collar 165. The latter is sized to fit around and hold together the legs of the bifurcate member 10N in the manner described in connection with FIG. 11, 12 and 13. The annular member 165 is flanged and has a flat base 167 which may be bolted or otherwise secured to the base member 161 in an obvious manner. The key 164 is the part that holds connector 10N to member 165.

Referring next to FIG. 15, it will be recalled that FIG. 2 shows a connector member 10A cut away to match another so as to form a hinge joint. As shown in FIG. 16 two such devices 10A and 10P are used. The hinge pin here consists of a spool shaped member 170 having small frustoconical flanges 171 and 172 adapted to fit within similar surfaces 173 and 174, respectively in the loop parts 11 of connectors 10A and 10P. The connector 10A has its legs directed to the right as indicated at 20, 21 and a sleeve 175 having aligned pin holds may be slid over these and secured in place by a spring pin 176. The latter is inserted through holds 177 and into notches such as 30, 31, FIG. 1. As long as the legs 20 and 21 are held tightly together the pin securely fastens the sleeve or tube 175 to the connector 10A. Likewise the other connector 10P which is similar to 10A, is secured through connections comprising a rod 179

and a sleeve 180. The latter holds the legs of connector 10P around rod 179. A pin 181 is passed through the connector legs at 30, through an opening 183 in rod 179 and through openings 184 of sleeve 180.

This arrangement is convenient for making joints which may be loaded frictionally as needed by carefully matching the inside dimensions of the loop parts 11 of connectors 10A and 10P, and of spool 170, particularly the beveled parts. A relatively stiff or relatively free-moving joint may thus be produced.

By using a tapered sleeve 180 or tube 175 and tapered leg parts on connectors 10A and 10P, the friction in the joint, FIGS. 15 and 16, may be varied. By forcing the sleeve on the legs to various distances on connectors 10A and 10P or by using a threaded ferrule which is somewhat tapered, see FIG. 4, the degree to which the legs of the plastic connector are forced together may be varied somewhat. By This means the pressure between the flared spool elements 171 and 172 and the cooperating frustoconical surfaces 174 and 173 may be varied. This affords an excellent hinged joint structure for parts that are to be movable but which normally are to stay in position until shifted intentionally, as in hinged arms for supporting lamps, laboratory apparatus and other light weight equipment.

FIG. 17 and 18 show a hinged, flanged base adapter for connecting the connectors such as 10, FIG. 1, to a flat base. This adapter consists of a split-walled cup or ring member having an upstanding annular portion 190 which is purposely made thin at 191 to serve as a plastic resilient hinge. The ring is split open on the other side, as indicated at 192. By bending the thin hinge part 191, as by applying manual force to base flange elements or wings 193 and 194, to open the gap 192, this ring 190 may be slipped over legs of a connector such as 20, 21. Internal annular rib 195 can then engage the groove 27, see also FIG. 1. After this groove is engaged the wings 193 and 194 of the base are released to tightly close the gap 192. The wings then are secured to the base by appropriate screws or other holding means inserted through openings 196, 197.

In FIGS. 19 and 20a somewhat similar arrangement is shown, except that in lieu of a spring split ring there are two support parts made in two halves. The half circular ring members 197 and 918 have base flange elements 199 and 200. These may be secured to an appropriate base, not shown, by screws inserted through holes 202, FIG. 19. For further security, an inverted one-piece cup 203 having matching holes to 202 and having an outer rim 204 which surrounds the flanges 199 and 200 can be applied to prevent separation of these parts. Such separation would of course allow legs 20, 21 of the connector 10 (FIG. 1) to separate and release the latter.

Instead of connectors such as 10 being used in the holders of FIGS. 17 to 20, a headed post 210 particularly adapted for holding small ropes, large cords, etc., may be inserted. As shown in FIG. 21, such a post has an enlarged collar 211 and a still wider head 212 above a body 213 adapted to fit in the members of FIGS. 18 or 20. The head 212 is slotted at 214. The cord or rope may be looped around shoulder 211 under head 212 and/or passed through slot 214. Such a device is useful, for example, in pack carrier frames as shown in more detail in the parent application, Ser. No. 750,521. A key 215 projecting into a suitable slot in parts 191 or 197, 198 holds member 210 in place.

FIG. 22 shows a rod member 220 having an upper stud part 221 sized to fit between the bifurcate legs 226 and 227 of a connector 10Q when these legs are closed together. A slidable sleeve 222 is adapted to ride freely on an enlarged part 223 of rod 220, being held against removal therefrom by a pin 224 which projects from part 223 through a slot 225 in the sleeve. One leg 226 of connector 10Q is shorter than the other leg 227. The latter is first inserted in the sleeve 222, then the short leg 226 is closed against it and the sleeve is moved up into locking position. Another pin 228 may be put through notches such as 30, 31, FIGS. 1 and 5, to hold the sleeve up and secure the parts together more fully.

FIG. 23 is a top end view of a rod or stud element 230 showing laterally extending key elements 231 and 232 adapted to be engaged in slots such as 50, 51, of FIGS. 1, 4, 5 and others. Only one of these key elements will be used in some cases. This is applicable to numerous ones of the various modifications described above and below. FIG. 24 is a side view.

FIG. 25 shows another part in the form of a slotted cap or head member 240, suitable for securing ropes and the like. This is adapted to be secured in place by members such as 190, FIG. 18 or 197, 198, FIG. 20, in the same manner as describe in connection with the part of FIG. 21. A rope knot can be placed in the cap through the slot 241. See also, the parent application, for application to pack frames.

FIGS. 26 and 27 show another arrangement similar to FIG. 22, where a flanged base member 240 is adapted to be secured through an upstanding post or stud 251 to a fastener 10R, shown only fragmentarily. Stud 251 is formed with a concave cylindrical top surface 252 to cradle or fit neatly and firmly against a cylindrical object 253 held in the loop part of connector 10R. Post 251 has an enlarged lower portion 254 adapted to receive and guide a coil spring 255. The bottom loop of this spring is held in a groove 256 at the base 250 which is flat and is adaptable to be secured to a support by screws or the like through holes 258. The upper coils of spring 256 are arranged to surround and hold together the legs of connector 10R. A key 259 projects from stud 251 and into slots between such legs. This holds the parts together as long as the legs are held together by the coils of the spring.

A similar arrangement is shown in FIGS. 28 and 29, except that a separate ferrule of sleeve member 260 fits within the spring 255 and the base is replaced by a nut 261. The ferrule 260 has an intumed bottom rim or flange 262 adapted to rest against a stop flange 263 formed at the top of enlarged part 254. This holds the parts together and keeps the spring and associated parts from coming apart during storage.

FIGS. 30 and 31 show another arrangement rather similar to FIGS. 26 and 27, except that a split-spring ring 265 of well-known type is used to hold the legs of plastic connector 105 together. For temporary storage, this ring snaps into a groove 266 formed in post 267 near its bottom. The upper end 268 of post 267 is formed to fit or cradle a round object, as in the case of stud 251 at 252, FIG. 26.

FIGS. 32 and 33 show modified plastic connector members 10T and 10U, respectively, adapted to secure additional parts. In FIG. 32, the connector 10T is not hinged on the loop itself but is hinged on an extension 270 in the form of two half circular leg elements joined at 271 by a flexible hinge structure. Legs 272 and 273 are dependent from the opposite sides of the loop 11T proper. When legs 272 and 273 are closed, the loop is essentially circular (in the form shown) and is adapted to hold a pipe, rod, glass tube, etc., in the manner described above. The legs 270, 272, 273, above and below the loop are hollowed out at 22, as in FIG. 1, to form a rod-engaging enclosure in the same manner.

Notches 275, 276 for a pin, not shown, are provided in each of the upper leg elements 270 for the same purpose as notches 30T, 31T in lower legs 272 and 273 and as described above in connection with FIG. 1. Also, wider notches 50T, 51T and annular groove elements 27T are similarly provided. These are used in the manner already amply described. FIG. 33 shows added side studs 278, 279 on structure otherwise as in FIG. 32.

FIG. 34 shows a detail variation. Instead of the top leg member being of simple rod shape, when closed, a hinged head construction 280 formed with a thin cross section along the hinge line; compare 12, FIG. 1 is shown. The parts 270, 271, FIGS. 32 or 33 may be thus shaped, to perform the function of part 210, FIG. 21, as described above.

FIG. 35 shows another arrangement where instead of using a special flanged base and sleeve, as in FIGS. 17 and 20, or in FIGS. 26 to 31, the structural member 290 is itself bored to hold the bifurcate legs together and thus lock all the assembled parts in the desired relationship. Member 290 is shown as

provided with a conical bore 291 and the legs 20V and 21V are tapered to fit it. A rod or post 292 with a key 293 extending into slots (such as 50, 52, FIG. 1) has a threaded lower end adapted to receive a nut 294. Tightening this nut squeezes legs 20V and 21V of connector 10V together. Obviously, it is not always necessary that bore 291 and legs 20V and 21V be tapered. The cylindrical legs of FIG. 1 secured in a cylindrical bore will suffice in most situations. However, the conical arrangement is useful where a particularly tight assembly is needed. The head of rod 292 is enlarged at 296 to fit in the bowl-shape recess 297 (see element 23, FIG. 1) which gives additional support to hold rod 292 in place. In fact, other rods such as 179, FIG. 15 100 FIG. 8, etc., may bear heads and be similarly held in seats such as 23.

It will be obvious that many other variations, arrangements and permutations may be made within the scope of the invention. It is intended by the claims which follow to cover these as broadly and comprehensively as the state of the prior art properly allows.

What is claimed is:

1. Connection apparatus which comprises an elastic hinged bifurcate connector formed of tough elastic material with a first object-encircling loop having a first axis, and legs formed along a second axis and in continuation of said loop and transverse to the first axis, the loop having a relatively thinner hinge portion opposite the legs and being relieved internally at the junction between loop and legs, said loop being flexible enough by reason of said thinner portion and said relief to be opened up and passed over a said first object large enough to substantially fill the loop when closed thereon, said legs being hollowed to form between them a receptacle for a rod or shaft-like second object lying along said second axis, said legs also being formed with a pair of cooperating detent notches in matching edges of said legs to receive and retain a radially projecting lock element on a said second object.

2. Apparatus according to claim 1 secured to a second physical object in the form of a shaft disposed along the second axis and a transverse pin in said shaft disposed in at least one of said pair of notches.

3. Apparatus according to claim 1 which includes an inner rod member between said legs, an annular outer member surrounding said legs and holding them together, and pin means passing through at least one pair of detent notches and through at least one of said outer and inner members.

4. Apparatus according to claim 3 in which the rod is a driven fastening.

5. Apparatus according to claim 3 in which the rod is a threaded member.

6. Apparatus according to claim 3 in which the annular leg surrounding member is movably attached around said rod.

7. Apparatus according to claim 3 in which the annular outer member is a spring.

8. Apparatus according to claim 1 which comprises an annular member surrounding said bifurcate legs to hold them together and flat base-engaging means attached to said annular member.

9. Apparatus according to claim 8 in which the annular member is split.

10. Apparatus according to claim 1 which comprises at least one additional article-engaging element projecting radially from said loop.

11. Apparatus according to claim 1 which includes plural pairs of detent notches and additional openings to receive a pin projecting radially from the second axis and transverse to the leg junctures.

12. Apparatus according to claim 1 in which two pairs of notches are provided between said legs, one set being rounded for closely engaging a round pin and the other set being wider for engaging a transverse detent member having greater width along the second axis than transverse thereto.

13. Apparatus according to claim 1 in which the bifurcate member has an internal detent in the form of a surface of revolution formed collectively between and in said legs to hold

said second object for rotation about said second axis while retaining said second object against displacement along the second axis when said legs are closed together around said second object.

14. Apparatus according to claim 1 wherein said loop is formed internally to accommodate a spherical surface on a first object, thereby to permit angular shifting of said first object with respect to said first axis.

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