May 17, 1960 R. N. RIGNEY 2,937,053

FRICTIONLESS PIVOT

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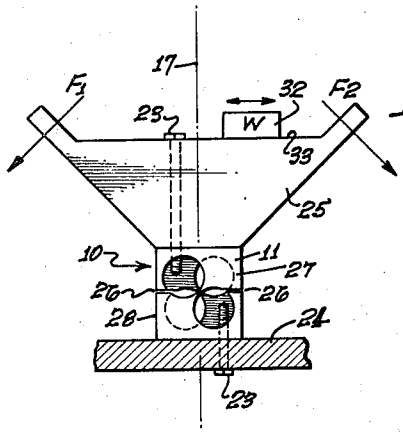


FIG. 1.

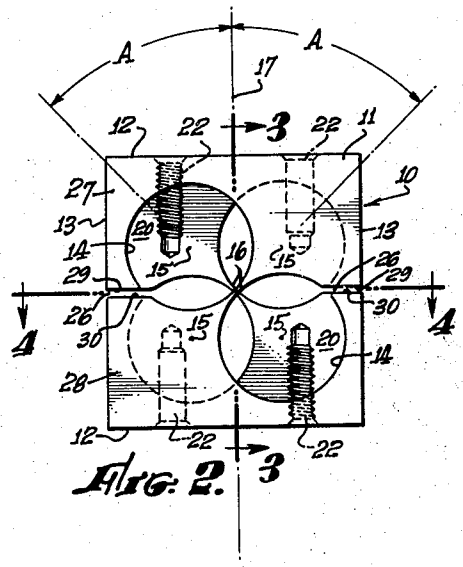


FIG. 2.

FIG. 5.

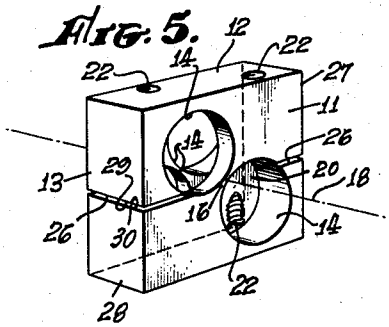


FIG. 3.

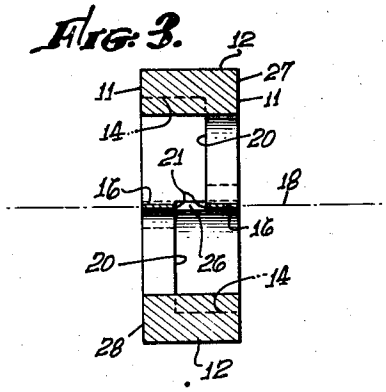
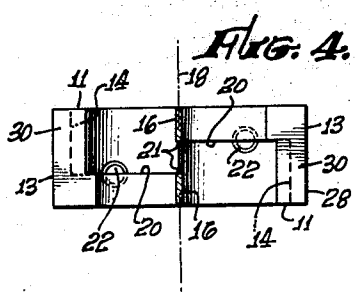


FIG. 4.



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FRICTIONLESS PIVOT

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16 Claims. (Cl. 308—2)

This invention relates generally to pivot mechanisms, and more particularly has to with a novel so called frictionless pivot capable of accurately locating and pivotally supporting a load member with respect to a reference base.

The pivot device is embodied in a body, preferably of one piece design, having opposite ends for receiving endwise application of force such as may be transmitted by a load member through the body to a base. The opposite ends of the body are rigidly connectible with both the load member and base so as to provide an integral connection therewith exactly fixing the location of the load member with respect to the base. At the same time, the body is adapted to pivot frictionlessly and to at least a limited extent about a transverse pivot axis in response to endwise applied loading acting about that axis, while transmitting, without flexing, applied loading acting or directed through the pivot axis, say at a normal thereto.

In accordance with the invention the body includes a pair of flexure parts, typically web shaped, that transversely overlap one another along a transverse pivot axis intersecting the webs, for individually transmitting a portion and collectively transmitting all of the force application acting through that axis. The web parts are relatively angled respecting the direction of force transmission therethrough, and are relatively thin normal to the pivot axis. As a result, the webs are adapted to flex in response to force application to the body acting about the pivot axis, which is substantially exactly defined and located with respect to opposite ends of the body by the very limited extent of transverse overlap of the thin webs.

An important feature of the invention concerns the provision of interengageable stop shoulders located on the body to limit flexing of the thin webs so that the latter will not flex or bend to produce bending stresses in excess of the yield strength in bending of the metal. These shoulders are provided at longitudinally opposite sides of slots extending inwardly from opposite body sides to intersect recesses sunk into opposite body faces at opposite sides of the webs, as will be described in detail.

These and other features and objects of the invention, as well as the details of an illustrative embodiment will be more fully understood from the following detailed description of the drawings, in which:

Fig. 1 is an elevation showing a frictionless pivot supporting and locating a load member with respect to a bore for limited pivoting of the load member;

Fig. 2 is an enlarged elevation showing the appearance of one outer face of the frictionless pivot body;

Fig. 3 is a section taken on line 3—3 of Fig. 2;

Fig. 4 is a section taken on line 4—4 of Fig. 2; and

Fig. 5 is a perspective illustration of the frictionless pivot body.

In the drawings the frictionless pivot body **10** is shown to have generally rectangular faces **11**, rectangular opposite ends **12** and opposite sides **13**, the thickness of the body between opposite faces **11** being considerably less than the lengths of the opposite sides and ends of the body.

Sunk into each face of the metallic body is a pair of cylindrical recesses **14** having transversely extending parallel axes **15**, the locations of the recesses being such that each recess sunk into either body face overlaps and openly communicates with both recesses sunk into the opposite body face. The equal radii of the two recesses sunk into each body face are each slightly shorter than one-half the distance between the parallel transverse axes **15**, whereby thin flexure parts or webs **16** of metal remain extending normal to lines between the axes **15** and also at angles to the longitudinal axis **17** of the body. The two webs **16** between the pairs of recesses overlap one another along a transverse pivot axis **18**, as seen in Figs. 3 and 4, the axis intersecting the webs along their transverse widths. The two webs **16** are also relatively angled respecting the direction of force transmission therethrough, and being very thin along the pivot axis **18** they substantially exactly locate that axis. As viewed in the drawings, the webs have lengthwise extent making equal and opposite angles A with the lengthwise axis **17** of the body and at opposite sides thereof. Since the recesses **14** are cylindrical, the webs have rapidly increasing thickness in lengthwise directions extending normal to axis **18**, and as a result, the axis of pivoting or flexure is substantially exactly located at the transverse overlap of the two webs.

As partly viewed in Figs. 3 and 4, the two webs are transversely spaced apart by virtue of the fact that each pair of the recesses is formed as by drilling into a body face to equal depths greater than one-half the transverse thickness of the body, the inner terminal face **20** of each recess defining a longitudinal plane at which the opposite webs **16** terminate at **21**. After the recesses are drilled, the transverse extent of web metal between planes **20** may be removed to separate the flexure parts **16** at their transverse overlap location, as seen in Figs. 3 and 4.

Drilled into each opposite end **12** of the body is a pair of fastener openings **22** provided with screw threads for receiving fasteners **23** rigidly connecting one end of the body with the base **24** and the opposite end of the body with a load member **25**. The threaded openings are transversely staggered as viewed in Fig. 4 so as to intersect the inner faces **20**, thereby providing screw threads sunk into those faces as viewed in Fig. 2. Thus, the fasteners may grip the body throughout the major extent of the threaded openings for rigidly connecting the body with the base **24** and load member **25**.

One form of load member **25** is illustrated in Fig. 1 as receiving eccentric loads F_1 and F_2 acting at angles to the longitudinal axis **17** of the body **10**. In general, any such loading can be resolved into a load acting through and angularly relative to the pivot axis **18** of the body and transmitted by the webs **16**, and a load acting about that axis. The latter force will produce flexing of the webs **16** if the latter are free to bend. This freedom is provided by the slots **26** extending inwardly from opposite body sides **13**, each slot intersecting two of the recesses sunk respectively into opposite body faces, thereby separating the body into similar upper and lower sections **27** and **28**.

respectively. Section 27, being rigidly connected with load member 25, is free to pivot in opposite directions about axis 18 with respect to the lower body section 28 rigidly connected to the base 24. Such pivoting is limited, however, by alternate interengagement of stop shoulders 29 and 30 at longitudinally opposite sides of the slots. Preferably the equal thickness dimensions of the slots in the longitudinal direction and when the webs are not flexed is such as to interrupt bending of the webs before the stresses produced therein by bending and load transmission therethrough exceed the yield strength of the material. Thus, for the Fig. 2 body configuration, the slots may be several times thicker than the webs, which would normally have minimum thickness of a few thousandths of an inch at their intersections with axis 18.

It will be understood that where a load member such as 25 is to be pivotally supported for load testing purposes, interengagement of the stop shoulders 29 and 30 would defeat the ends sought to be gained by such pivotal supporting. Therefore, some means is provided for loading member 24, as by a known weight 32 shiftable along horizontal surface 33 of the body toward and away from axis 17, so as to cause the stop shoulders 29 and 30 to disengage or separate by a predetermined amount indicating that the load member 24 is exactly pivotally supported without any flexure of the webs 16. For this purpose, the distance between the stop shoulders 29 and 30 may be predetermined as by introduction of gauges therebetween prior to loading of member 25. After such loading the weight may then be shifted until insertion of gauges between the shop shoulders indicates that the webs are unflexed. At this point, the webs do not exert any torque or moment of force upon the member 25, and the latter is then frictionlessly pivotally supported.

I claim:

1. A frictionless pivot, comprising a body having opposite ends for receiving endwise application of force and including a pair of variable thickness flexure parts transversely overlapping one another along a transverse pivot axis intersecting said parts for transmitting force through said axis and angularly relative thereto, said parts being relatively angled respecting the directions of force transmission therethrough and being relatively thin along said axis at said intersections whereby said parts are adapted to flex in response to force application to the body acting about said axis, and closely spaced interengageable stop shoulders on said body for limiting flexing of said parts.

2. A frictionless pivot, comprising a body having opposite ends for receiving endwise application of force and including a pair of flexure parts transversely overlapping one another along a transverse pivot axis intersecting said parts for transmitting force through said axis and angularly relative thereto, said parts being relatively angled respecting the directions of force transmission therethrough and being relatively thin along said axis at said intersections whereby said parts are adapted to flex in response to force application to the body acting about said axis, said body containing circular recesses at opposite sides of said parts normal to said pivot axis, and closely spaced interengageable stop shoulders on said body for limiting flexing of said parts.

3. A frictionless pivot, comprising a body having opposite ends for receiving endwise application of force and including a pair of flexure parts transversely overlapping one another along a transverse pivot axis intersecting said parts for transmitting force through said axis and angularly relative thereto, said parts being relatively angled respecting the directions of force transmission therethrough and being relatively thin along said axis at said intersections whereby said parts are adapted to flex in response to force application to the body acting about said axis, said body containing recesses at opposite sides of said parts, and said opposite sides of said parts being concave and spaced interengageable stop shoulders on said body for limiting flexing of said parts.

4. A frictionless pivot, comprising a body having opposite ends for receiving endwise application of force and including a pair of flexure parts transversely overlapping one another along a transverse pivot axis intersecting said parts for transmitting force through said axis and angularly relative thereto, said parts being relatively angled respecting the directions of force transmission therethrough and being relatively thin along said axis at said intersections whereby said parts are adapted to flex in response to force application to the body acting about said axis, said parts having increasing thickness in directions extending away from said intersections and normal to said pivot axis, and spaced interengageable stop shoulders on said body for limiting flexing of said parts.

5. A frictionless pivot, comprising a body having opposite ends for receiving endwise application of force and including a pair of flexure parts transversely overlapping one another along a transverse pivot axis intersecting said parts for transmitting force through said axis and angularly relative thereto, said parts being relatively angled respecting the directions of force transmission therethrough and being relatively thin along said axis at said intersections whereby said parts are adapted to flex in response to force application to the body acting about said axis, said body containing recesses at opposite sides of said parts, and spaced interengageable stop shoulders on said body for limiting flexing of said parts, said body containing slots extending between said recesses and opposite sides of said body.

6. A frictionless pivot, comprising a metallic body having opposite ends for receiving longitudinally endwise application of force and including a pair of flexure webs transversely overlapping one another along a transverse pivot axis intersecting said webs for individually transmitting a portion of the applied force through said axis and angularly relative thereto, said webs being relatively angled respecting the directions of force transmission therethrough and being relatively thin along said axis at said intersections whereby said webs are adapted to flex in response to force application to the body acting about said axis, said body containing cylindrical recesses at opposite sides of said webs, and longitudinally closely spaced interengageable stop shoulders on said body for limiting flexing of said webs.

7. The invention as defined in claim 6 comprising two pairs of recesses respectively sunk into opposite faces of said body.

8. The invention as defined in claim 7 in which each recess sunk into either body face overlaps and openly communicates with both recesses sunk into the opposite body face.

9. The invention as defined in claim 8 in which said body contains a pair of slots extending inwardly from opposite body sides, each slot intersecting two of said recesses respectively sunk into opposite body faces.

10. The invention as defined in claim 9 in which said webs are transversely spaced apart.

11. The invention as defined in claim 7 comprising a one-piece body.

12. The invention as defined in claim 11 in which said body faces are rectangular in outline.

13. The invention as defined in claim 12 in which opposite ends of said body contain openings for receiving fasteners connecting a load member to the body.

14. A frictionless pivot, comprising a metallic body having opposite ends for receiving longitudinally endwise application of force and including a pair of flexure webs transversely overlapping one another along a transverse pivot axis intersecting said webs for individually transmitting a portion of the applied force through said axis and angularly relative thereto, said webs being relatively angled respecting the directions of force transmission therethrough and being relatively thin along said axis at said intersections whereby said webs are adapted to flex

in response to force application to the body acting about said axis, said body containing two pairs of substantially cylindrical recesses respectively sunk into opposite body faces at opposite sides of said webs.

15. The invention as defined in claim 14 in which each recess sunk into either body face overlaps and openly communicates with both recesses sunk into the opposite body face.

16. The invention as defined in claim 15 in which said body contains a pair of slots extending inwardly from

opposite body sides, each slot intersecting two of said recesses respectively sunk into opposite body faces.

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