Dec. 12, 1939. H. THOMA 2,183,372

HYDRAULIC DEVICE

Filed Dec. 24, 1935 4 Sheets-Sheet 1

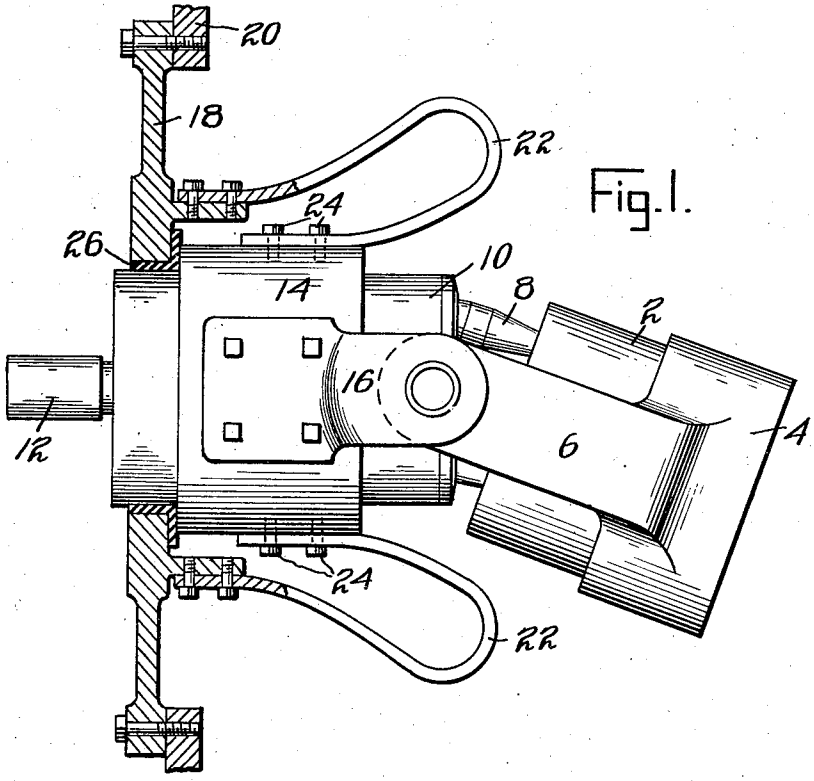


Fig. 1.

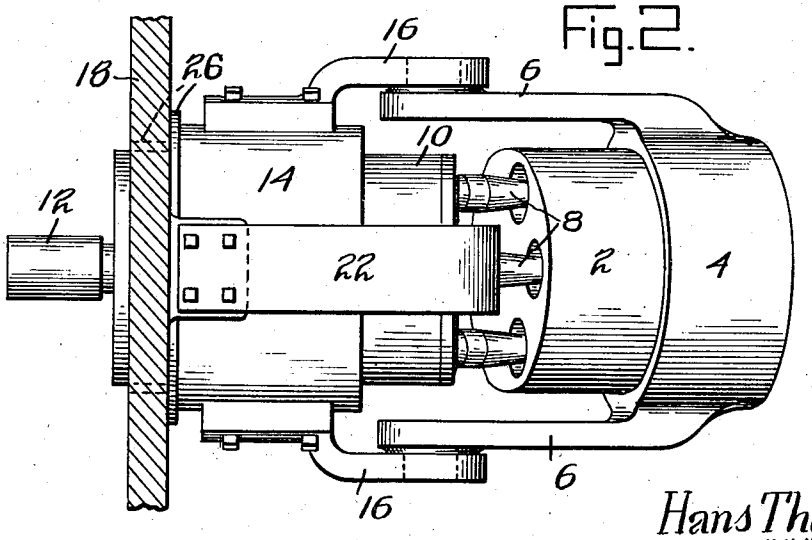


Fig. 2.

Hans Thoma
INVENTOR

BY A. A. Ahlicke
ATTORNEY

Dec. 12, 1939. H. THOMA 2,183,372

HYDRAULIC DEVICE

Filed Dec. 24, 1935 4 Sheets-Sheet 2

Fig. 3.

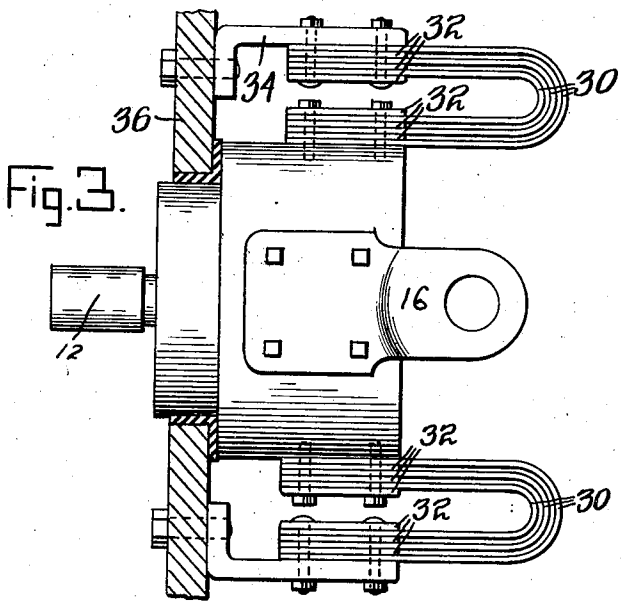


Fig. 4.

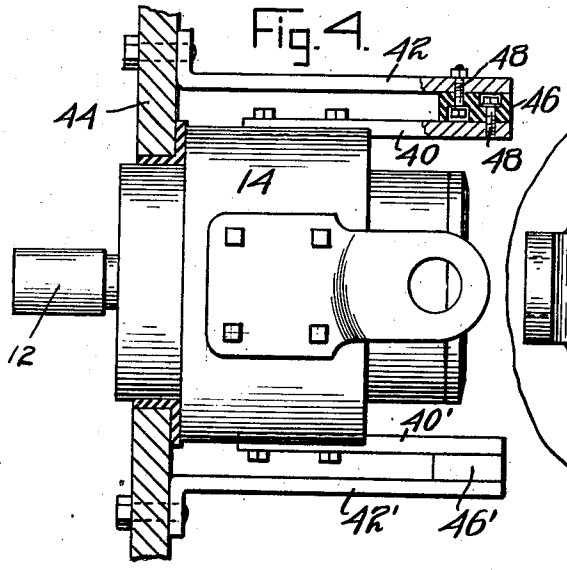
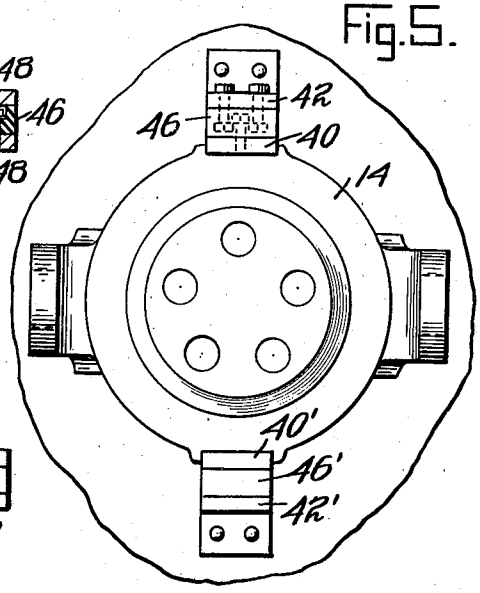


Fig. 5.



Hans Thoma
INVENTOR

BY A. A. Klinke

ATTORNEY

Dec. 12, 1939. H. THOMA 2,183,372

HYDRAULIC DEVICE

Filed Dec. 24, 1935 4 Sheets-Sheet 3

Fig. 6.

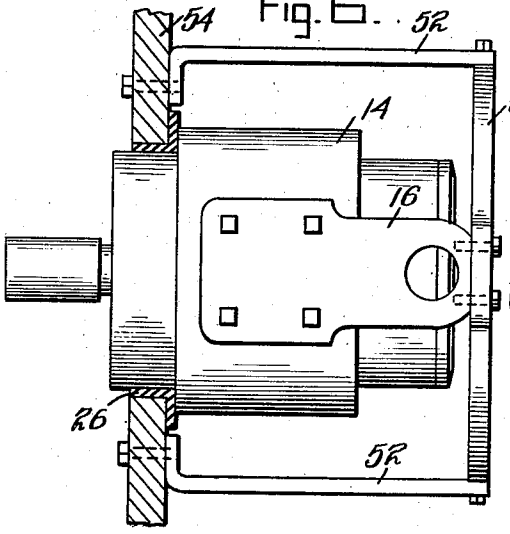


Fig. 7.

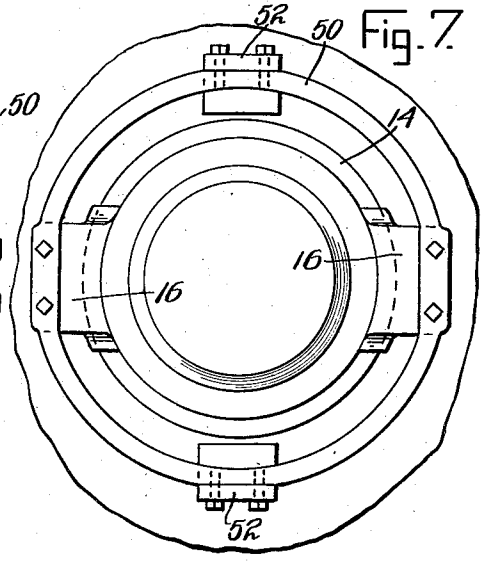


Fig. 8.

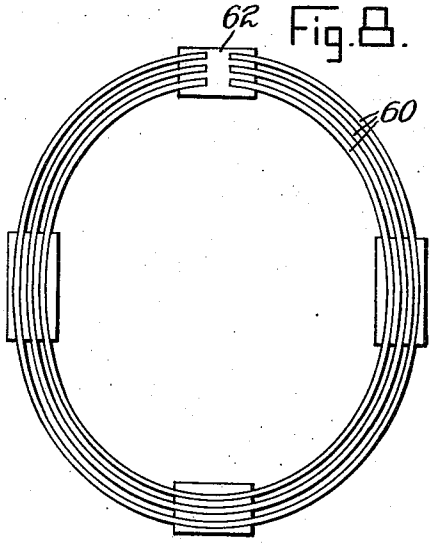


Fig. 9.

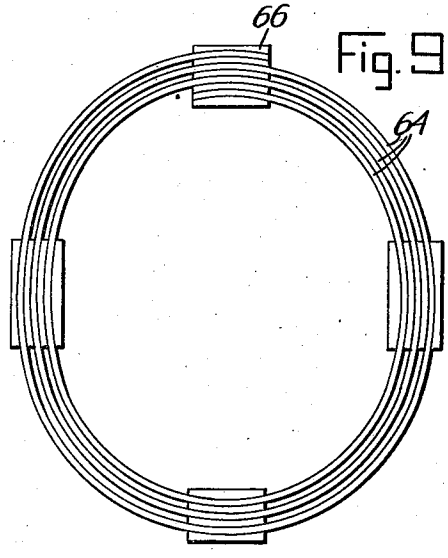


Fig. 11.

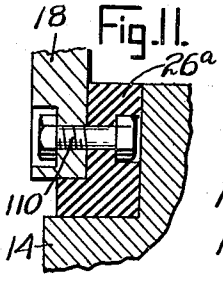
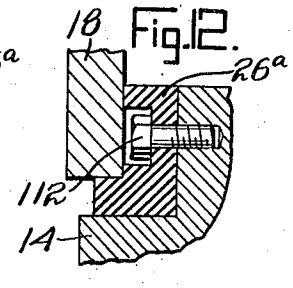


Fig. 12.



Hans Thoma
INVENTOR

BY A. A. Ulrich

ATTORNEY

Dec. 12, 1939. H. THOMA 2,183,372

HYDRAULIC DEVICE

Filed Dec. 24, 1935 4 Sheets-Sheet 4

Fig. 10.

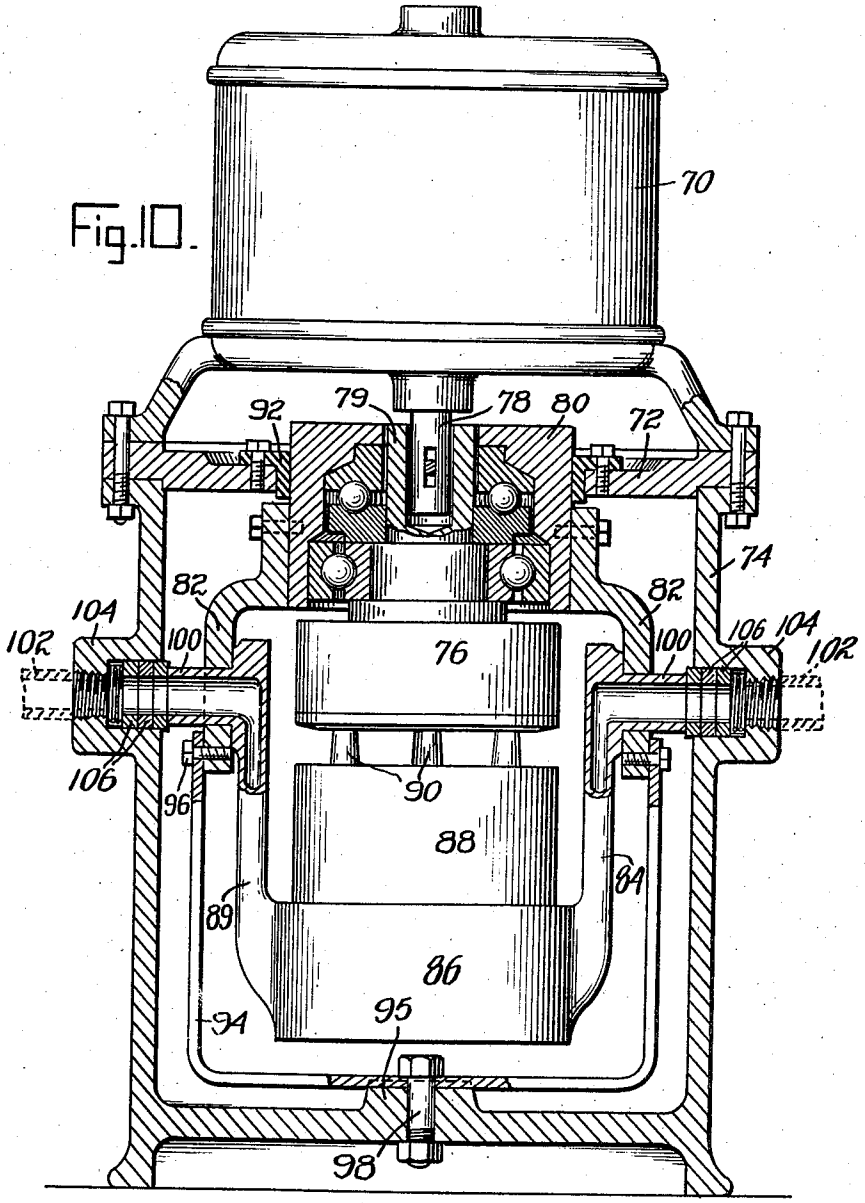
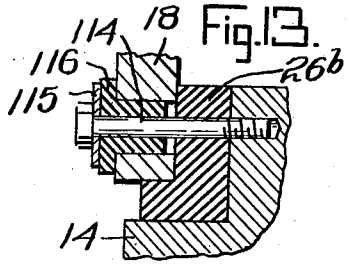


Fig. 13.



Hans Thoma
INVENTOR

BY A. A. Hicks

ATTORNEY

Patented Dec. 12, 1939

2,183,372

UNITED STATES PATENT OFFICE

2,183,372

HYDRAULIC DEVICE

Hans Thoma, Karlsruhe-Baden, Germany

Application December 24, 1935, Serial No. 55,959
In Germany June 28, 1935

5 Claims. (Cl. 248—2)

This invention relates to hydraulic devices such as pumps, motors and the like, and particularly to the reduction or elimination of sounds and noises incident to the operation thereof.

The invention may be used in connection with any of various types of hydraulic devices but as herein shown and described is applied to hydraulic pumps and motors of the type disclosed in my United States Patent 1,931,969 and in my co-pending application for Letters Patent Serial No. 17,409 filed April 20, 1935, entitled "Hydraulic motors and pumps which has matured to Patent No. 2,155,455 dated April 25, 1939."

Hydraulic devices of this character embody a plurality of cylinders and pistons which serve to pump oil or to utilize oil under pressure upon power output members such as those which rotate about axes disposed at an angle to each other. The number of pistons and cylinders employed and the speed of rotation of the input and output members may be varied considerably but in a typical case wherein seven cylinders are used and the speed of rotation is 1,200 R. P. M. there are 8,400 successive impulses or oil pressure periods per minute or 140 impulses per second. Since the pressure applied to the oil or liquid used may be as much as 4,000 pounds per square inch or even more, the pump parts are stressed in rapid succession. The amplitude of the resulting strains is small due to the rigidity of construction and the strained members are of rather small area and, therefore, the resulting vibrations do not produce any objectionable noise. However, the device is necessarily mounted on a support and is often housed within a casing which is relatively large and of less rigid construction. The support or casing therefore frequently serves as a resonator which receives the impulses or vibrations of the device and amplifies the same, producing objectionable sounds or noises.

In accordance with the present invention this objection to previous constructions is overcome and the noises or sounds incident to operation of such devices are avoided. This result may be attained by preventing a vibration coupling to other members having larger areas and/or less rigidity. This may be done by providing a flexible or yielding connection between the motor or pump and the support or casing therefor. The form and construction of the connection used will, of course, be varied considerably in applying the invention to different installations and to different devices to adapt it for use under different conditions of operation.

When using a flexible or yielding connection between the motor or pump and its support, or the casing surrounding the device, it may be desirable or necessary also to provide a flexible or yielding connection between the oil flow conduits leading to and from the device and the casing in which the device is housed in order that relative movement of the device and casing will not produce undesirable strains in the conduits and in order that the impulses of the device may not be transmitted to the casing through the conduits.

One of the objects of the invention is to reduce or eliminate sounds or noises incident to the operation of hydraulic motors, pumps, and other devices.

Another object of the invention is to provide a flexible or yielding sound connection between a hydraulic device and the casing or support therefor.

A further object of the invention is to avoid the transmission of impulses or vibrations from a hydraulic pump or motor to the support or casing therefor.

Another object of the invention is to provide novel type of support for hydraulic devices.

A further object of the invention is to provide a novel connection between the conduits leading to and from the hydraulic device and the casing within which the device is housed.

Another object of the invention is to provide an effective seal between connecting portions of a conduit carrying fluid under high pressure.

These and other objects and features of the invention will appear from the following description thereof in which reference is made to the accompanying figures of the drawings illustrating various alternative types of construction embodying the invention.

In the drawings:

Fig. 1 is an elevation partly in section illustrating one form of support for a hydraulic pump or motor in accordance with the present invention;

Fig. 2 is a view taken at right angles to that of Fig. 1 illustrating the same construction;

Fig. 3 illustrates an alternative form of support for use with a pump or motor and embodying the present invention;

Fig. 4 shows another alternative form of pump support embodying the invention;

Fig. 5 is a view of the construction shown in Fig. 4 as seen from the right thereof;

Figs. 6 and 7 are views similar to Figs. 4 and 5 illustrating a further alternative form of support for a pump or motor in accordance with the present invention;

Figs. 8 and 9 illustrate additional alternative forms of supporting means adapted for use in eliminating sound in hydraulic pump or motor installations; and

Fig. 10 is a vertical sectional view of a pump and motor installation with the housing therefor illustrating another type of support for a motor by which the pump is driven and a typical form of connection between the oil flow conduits and the housing for the pump; and

Figs. 11, 12, and 13 are cross-sectional views showing alternative means for connecting a pump housing to a casing.

In that form of the invention chosen for purposes of illustration in Figs. 1 and 2 of the drawings, the invention is shown as applied to a pump of the type described in my patent and co-pending application referred to above. In this form of mechanism the cylinder block 2 is carried by a generally U-shaped body 4 provided with arms 6 through which oil or other liquid is passed to and discharged from the pump cylinders. The cylinder block 2 is formed with any suitable number of cylinders within which pistons reciprocate, the pistons being provided with connecting rods 8. The body 4 and cylinder block 2 are mounted for pivotal movement with respect to a driving flange 10 to which the connecting rods 8 are attached as by ball joints. Considered as a pump the driving flange is driven by a power input shaft 12 carried by a bearing block 14 which is provided with ears 16 in which the arms 6 on the body 4 are journalled whereby pivotal movement of the body and cylinder block is permitted for varying the stroke of the pistons and the output of the pump. The cylinder block is connected for rotation with the shaft 12 and flange 10 as by a universal joint.

When the cylinder block is rotated about an axis disposed at an angle to the drive flange 10, the pistons are caused to reciprocate within their respective cylinders with each rotation of the drive flange and cylinder block, the length of the stroke being dependent upon the angle of inclination of the axis of the cylinder block with respect to the axis of the drive flange.

The elements above described and the operation thereof are more fully set forth in my copending application referred to above and do not of themselves form any part of the present invention except as employed in combination with the support for the device and the connections for the conduits leading to and from the device through the casing surrounding the same.

The device described above, or any other form of hydraulic mechanism with which the invention is used, is mounted upon a support 18 and within a casing 20. In order to provide means to transmit the torque reaction to the support and/or casing while preventing the impulses or vibrations of the device from being transmitted to the support and the casing, flexible strips 22 formed of metal or other suitable material are secured to the bearing block 14 as by bolts 24 and to the support 18 by similar bolts or other suitable means. In addition thereto, a yielding or resilient packing member 26 is preferably provided between the bearing block 14 and the support 18 to prevent the transmission of vibrations of the device to the support while providing the necessary support or connection between these elements.

The packing member 26 may be of any suitable shape or construction and may be formed of rubber, leather, fibrous material, or any other suitable composition adapted for preventing or reducing the transmission of vibrations from the pump to the support 18. Similarly, the strips 22 may be of any suitable shape or configuration and may be formed of any suitable material serving to provide adequate support for the device while preventing vibrations or impulses thereof from being transmitted to the support and casing. As illustrated, the strips 22 curve or flare outwardly and away from the pump and bearing block so that movement of the bearing block radially or axially thereof will cause the strips to bend transversely and avoid the transmission of movements or impulses to the support.

With this construction the impulses incident to the operation of the device and any vibration thereof resulting from these impulses are confined to the pump or motor itself and are not transmitted to the casing. The exposed area of the hydraulic device is small and its strength and rigidity so great that it has been found in actual practice that most of the noise formerly incident to the operation of devices of this character can be eliminated in this way.

The form of the supporting and vibration eliminating means employed may be varied greatly to adapt the invention to alternative constructions.

In that form of the invention illustrated in Fig. 3 the connection between the bearing block and support or casing is in the form of a plurality of strips or bands of material 30 preferably separated by rubber, metal, or other similar material 32. The strips are connected to the bearing block and to a bracket 34 mounted on the casing 36 but act substantially independently due to the spacing thereof and the difference in the length of the strips and natural periods of vibration thereof. Since these periods are different and the strips themselves are separated by vibration damping material, the transmission of vibration or impulses from the pump or motor to the casing is effectively avoided.

In the construction shown in Figs. 4 and 5, two spaced strips 40 and 42 are mounted on the bearing block 14 and the casing 44 respectively and are connected by means of a yielding or resilient member 46 by means of spaced bolts 48 bearing against the yielding member 46 so that impulses or vibrations are not transmitted directly from the bearing block to the bracket by which it is supported. While the cushioning member 46 between the strips 40 and 42 may be secured thereto by bolts as shown in the upper portion of Figs. 4 and 5, the member 46 may in the alternative be vulcanized or otherwise bonded directly to the strips without the use of bolts. Such a construction is shown at 46' between the strips 40' and 42' in the lower portion of Figs. 4 and 5. In this connection it will be noted that the construction of the supporting elements on the opposite sides of the bearing block are not identical and they may, if desired, be of altogether different type and construction in order that the most effective vibration eliminating effect may be obtained in any particular installation. If the flexible inserts 46 are relatively thin and rigid, the strips 40 and 42 may be made relatively thin and flexible but if the inserts 46 are made sufficiently thick and elastic the strips 40 and 42 may be made quite stiff and may, in fact, be integral extensions from the members 14 and 44 respectively.

In the construction illustrated in Figs. 6 and 7 of the drawings the bearing block 14 is shown

provided with an annular strip or ring 50 secured to the ears 16 of the bearing block by which the cylinder block yoke 4, 6 is pivotally supported. The annular ring 50 is also secured to brackets 52 carried by the casing 54 but the points of connection thereto are located in spaced relation to the points at which the ring is secured to the ears 16. In this way vibrations or impulses of the pump are not transmitted to the support due to flexing of the metal strip 50, causing it to periodically assume oval or distorted shapes. Axially directed impulses of the pump with respect to the casing are also prevented from being transmitted thereto by flexing of the annular strip 50 with respect to the plane thereof and by the provision of the packing member 26 between the bearing block 14 and the casing. Surges of the liquid or sudden variations in the load or output on the pump or motor therefore do not result in noise or excessive hum of the mechanism since the changes in torque are taken up by the annular ring 50.

In the construction of Figs. 8 and 9, the supporting means for the bearing block and pump are in the form of similar annularly arranged strips, the strips 60 of Fig. 8 being separately formed and secured at their ends to a retaining member 62 which may be one of the brackets by which the pump is supported. The adjacent strips 64 of Fig. 9 are in reality one continuous strip wound in spiral form with the ends thereof secured to a block 66 or to one of the bracket members supporting the hydraulic device. These constructions have the advantage of providing a firm but substantially vibrationless support for the pump or motor, thus permitting the mechanism to be subjected to vibrations and to frequent and substantial variations in operation without injury to either the device or its support and without the transmission of sound producing vibrations or impulses from the device to the casing or support therefor.

In the construction of Fig. 10 a further alternative form of support is illustrated and the mechanism is shown as employed with a preferably vertical motor 70 mounted on the cover 72 of casing 74. The motor serves to drive the operating flange 76 of the pump through a shaft 78. The bearing block 80 of the pump is provided with downwardly extending ears 82 which serve as pivotal supports for the arms 84 of the yoke 86. The cylinder block 88 is mounted on the yoke 86 for rotation with the shaft 78 and is formed with cylinder bores having pistons located therein and actuated from the operating flange 76 by means of connecting rods 90.

A suitable packing 92 or other yielding or resilient member is located between the bearing block and the cover 72 of the casing while the pump itself is supported by a U-shaped strip 94 connected to the ears 82 on the bearing block as by means of bolts 96 and secured to the lower portion of the casing 74 by means of a bolt 98 or other suitable means. As shown, the strip 94 is located within a recess in the boss 95 so that it is held against rotation, thus supporting the torque reaction. If desired, rubber or the like may be interposed between the strip 94 and the boss 95 and the head of the bolt 98. The strip 94 serves as a yielding device which prevents both axial and rotary impulses of the pump from being transmitted to the casing so that the device is substantially noiseless in operation.

The limited movement permitted by the yielding support for the pump within the casing renders it desirable to provide a lengthwise yielding connection between the shaft 78 and the shaft 79, as shown, and also between passages 100 of the pump and the casing 74. These passages communicate with the fluid circuit with which the pump is used by means of piping 102 secured to bosses 104 in the walls of the casing 74. The inner surface of the casing is provided with recesses on the inner side of the bosses in which are positioned a plurality of packing rings 106, preferably made of metal, which fit rather closely therein and are provided with smooth adjacent faces contacting each other and abutting the ends of the conduits 100 formed in the arms 84 of the pump body. A strong spring urges the packing rings against the adjacent end of the conduit so as to normally provide a closed passage for the flow of oil or liquid from the conduit 100 through the packing rings 106 to the pipe 102.

In the operation of this type of packing the force of the spring 108 is sufficient to urge the packing rings into intimate contact, preventing flow of oil between the rings except in very minute amounts sufficient to lubricate the connection, while oil or liquid is prevented from leaking out between the rings and the inner surface of the boss by the close fit of the rings. Upon the application of pressure from within the conduit, the oil tends to expand the packing rings, improving the seal between the rings and the inner surface of the boss, preventing leakage about the same. Further, the application of pressure to the outermost ring adjacent the spring within the boss 104 urges the rings inwardly against each other and against the abutting surface of the conduit 100, thus supplementing the action of the spring in maintaining a sealing engagement between the innermost packing ring and the conduit and between the rings themselves. At the same time, vibrations or movement of the pump with reference to the casing are permitted since the joints between the packing rings and the conduit in the arms of the pump body are lubricated and the amount of movement in any case is extremely small. In this way a flexible but oil or liquid tight connection is provided between the pump and the casing eliminating the transfer of impulses from the pump to the casing and avoiding injury or destruction to the connections between the oil flow conduits and the piping of the system in which the device is employed.

In the form shown in Figs. 11, 12 and 13, the cushioning element between the bearing housing 14 and the cover or casing 18 not only supports radial and axial forces but also serves to resist the reaction torque. To this end the cushioning ring 26a (of rubber or the like) may be held in place upon 14 by a series of bolts or screws 112 and the cover or casing 18 is attached to the cushioning ring 26a by a series of bolts or screws 116 preferably arranged in alternation with the bolts or screws 112. Thus a resilient connection is provided which permits slight relative radial, axial and rotary movements but resists more extensive rotary movement and thus provides an abutment resisting torque reaction.

In the form shown in Fig. 13 the parts 14, 18 and the intermediate cushioning ring 26b are held together by a single series of bolts 114. As shown, each bolt is surrounded by a flanged sleeve 118 of rubber or the like. Preferably a washer 115 is provided under the head of the bolt 116. This arrangement, like that of Figs. 11 and 12, provides a mounting which permits slight relative radial, axial and rotary movements but resists more ex-

tensive rotary movement and thus resists the torque reaction.

The construction of Figs. 11, 12 and 13 may be used in combinattion with one of the metallic spring supports as **22** of Figs. 1 and 2, **30** of Fig. 3, **40**, **42**, **46** of Figs. 4 and 5, **50** of Figs. 6 and 7, **60** of Fig. 8, **64** of Fig. 9, or **94** of Fig. 10, but it is to be understood that these constructions may, particularly in small size pumps, etc., be used without any other holding device.

The several forms and types of embodiment of the invention illustrated and described may be used in other relations and combinations than those herein specifically referred to and with other types and forms of hydraulic devices. In view thereof it should be understood that the forms of the invention herein described and illustrate typical embodiments of the invention and are not intended to limit the scope thereof.

I claim:

1. In combination, a supporting panel having an opening therein, a device having movable elements capable of producing periodic impulses in a plurality of directions partially positioned within said opening, and means for supporting said device on said panel and preventing transmission of such impulses to said panel comprising a flanged-shaped member of resilient material positioned within said opening and on one face of said panel intermediate said device and said panel, a pair of brackets each attached at one end to said panel and resilient means interconnecting said brackets and said device at a substantial distance from said panel.

2. The combination according to claim 1 in which said last resilient means comprises a metal spring formed of a plurality of concentric metal rings all of which are connected to said brackets and to said device.

3. In combination, a supporting panel having an opening therein, a device to be supported by said panel, one end of which device has a perimeter of smaller dimensions than the remainder thereof, said smaller end being positioned within said panel opening, resilient means within said opening intermediate said small end and said panel and having a flange portion intermediate said panel and the larger portion of said device, the resilient means within said opening thereby resiliently supporting one end of said device and preventing the transmission of transverse impulses between said end of said device and said panel, the flange portion of said resilient means intermediate said panel and the larger portion of said device serving to absorb the longitudinal impulses between said device and said panel, a bracket attached to said panel, and further resilient means interconnecting said bracket and the other end of said device.

4. The combination according to claim 3 in which said last resilient means comprises a metal spring formed of a plurality of concentric metal rings all of which are connected to said brackets and to said device.

5. The combinattion according to claim 3 in which said last resilient means comprises a spring composed of a plurality of metal bands.

HANS THOMA.