

Oct. 21, 1958

W. P. CHRISTOPH
HYDRAULIC RECTIFYING DEVICE

2,856,962

Filed Feb. 9, 1956

FIG. 1.

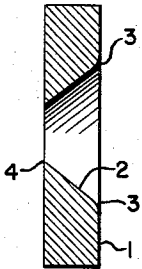


FIG. 2.

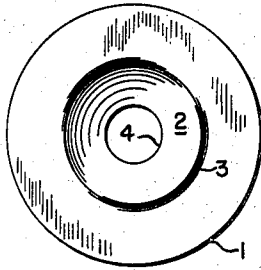


FIG. 3.

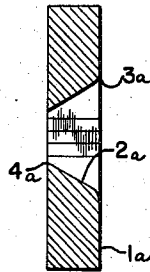


FIG. 4.

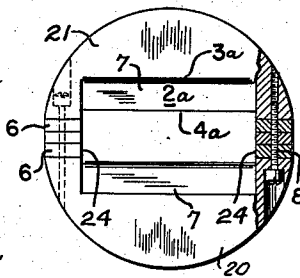


FIG. 5.

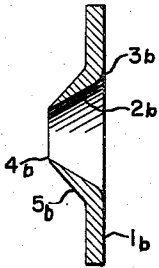


FIG. 6.

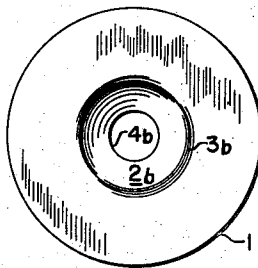


FIG. 7.

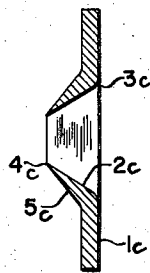


FIG. 8.

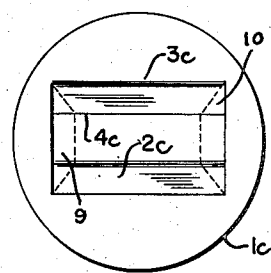


FIG. 9.

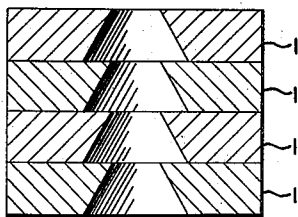
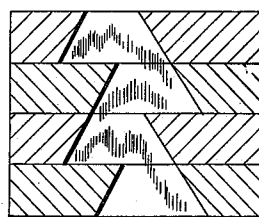


FIG. 10.



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2,856,962

HYDRAULIC RECTIFYING DEVICE

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Application February 9, 1956, Serial No. 564,592

2 Claims. (Cl. 138—42)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to hydraulic rectifying devices of an orifice character for rectifying hydraulically weak alternating hydroacoustic signals at low Reynold numbers in the audio and sub-audio frequency ranges whereby the rectified envelope signals may thereafter be detected by electrolytic flow detecting devices which generally are not suitable for operation at higher frequencies.

It relates to an orifice device providing improved characteristics of asymmetry between the entrance flow in a preferred direction through the orifice and the exit flow or return background flow in the high resistance or nonpreferred direction when the fluid is forced through the orifice by application of sound pressures to the fluid.

The use of orifices of generally conical configuration in hydraulic flow control apparatus and measuring arrangements has been known for some time. The improvements provided by the instant invention reside in improved configurations of the entrance and exit portions of the orifice structure to improve the rectifying characteristics and raise the forward to back flow ratio of the device thereby to render the same useful for hydraulic rectifying application.

A suitable full wave bridge circuit for utilization of the improved hydraulic rectifiers of this invention is shown and described in greater detail in the copending application of Walter P. Christoph, Serial No. 568,683, filed February 29, 1956.

It is an object of the instant invention to provide a rectifying device for hydraulic fluid flows of an alternating nature in the lower audio and sub-audio frequencies.

In correlation with the foregoing object it is a further object to provide hydraulic rectifiers of a character permitting wider frequency response characteristics with the use of an electrolytic detecting device in combination therewith and wherein the electrolytic detecting device, which is normally sensitive to signal frequencies from D.-C. to 10 C. P. S. and therefore is insensitive to the higher audio frequencies which may be utilized for detection of audio signals up to several hundred cycles per second when such signals are rectified by one of the devices of the instant invention.

A further object of this invention is to provide a system of multiple or stacked orifice plates having improved rectifying characteristics over orifice devices heretofore or now in general use.

It is also an object of this invention to provide an improved stacking arrangement of orifice plates for providing a higher forward to back ratio rectifier by utilizing a plurality of stacked asymmetrically conducting orifice devices in laterally displaced or staggered relationship in the direction of flow therethrough and which is of rugged construction and is possessed of simplified manufacturing characteristics.

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Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing wherein:

Fig. 1 is a sectional view through a rectifier device of one embodiment of the instant invention;

Fig. 2 is a plan view of the rectifying orifice device of Fig. 1;

Fig. 3 is a sectional view of a hydraulic rectifier of a slot configuration which permits the simultaneous adjustment of the exit and entrance areas of the orifice;

Fig. 4 is a plan view with parts broken away and in section of the rectifying orifice of Fig. 3;

Fig. 5 is a rectifier device of a preferred embodiment of the invention which provides improved performance over the device of Fig. 1;

Fig. 6 is a plan view of the orifice device of Fig. 5;

Figs. 7 and 8 are elevation and plan views respectively, of a parallel slot orifice having an opening of the general character of Figs. 3 and 4, but providing improved front to back ratios similarly as the hydraulic rectifier of Figs. 5 and 6;

Fig. 9 is a view in section of a stacked hydraulic rectifying device utilizing stacked orifice elements of the character of Figs. 1, 2 or 3, 4 wherein the orifices of the individual orifice devices are disposed in axial alignment; and

Fig. 10 is an improved hydraulic rectifying device utilizing orifice elements of the character of Figs. 1, 2 or 3, 4 and in which the orifice device elements are staggered in a manner to provide an irregular flow path therethrough to provide an improved forward to back ratio relationship over the stacking arrangement of Fig. 9.

Referring now to Figs. 1 and 2, there is shown a hydraulic rectifying device 1 in which the annular orifice 2 is of a frustoconical concave configuration and in which the entrance area is smoothed to a radius at 3 and the exit area is terminated in a sharp edge at 4.

In the modification shown in Figs. 3 and 4 the rectifying device 1a takes the form of a split disc having complementary sections 20 and 21 which define a central tapered slot-like orifice 2a having inclined internal faces 7 and surfaces 24 to provide a rectangular orifice opening. Two pairs of mating holes are formed in these sections 20 and 21 and the appropriate hole in each of the sections is threaded while the mating hole in the complementary section is counterbored to accommodate locking screws 8 which secure the sections in proper alignment. In the event that it is desired to alter the area of the orifice, the screws 8 may be withdrawn, the requisite number of punched shims 6 inserted between the mating sections 20 and 21 and the screws 8 reinserted through the punched holes in these shims thereby forming an orifice of increased area as shown in Figs. 3 and 4. As is apparent from the drawing, the internal edges of shims 6 are coplanar with the inner surfaces 24 of the orifice to present a smooth flow path through the rectifier.

Referring now to Figs. 5 and 6, the orifice device 1b is configured as by dimpling or puncturing a hole through a thin sheet of material and thereafter providing a frustoconical orifice concavity in the preferred direction of fluid flow and having the rounded transitions at 3a from the front surface of the sheet or plate to the conical surface. The orifice exit terminates in a sharp edge at 4b. The surface 5b in the back-resistance direction of flow is tapered away from the sharp edge 4b to provide an improved rectifying ratio.

The hydraulic rectifying device of Figs. 7 and 8 provides an improved rectifying ratio over the device of Figs. 3 and 4 since the cross section of the orifice portion

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is substantially the same as that shown on Fig. 5. The rectifier of Figs. 7, 8 differs from that of Figs. 5 and 6 in that the orifice is rectangular. If desired, the end surfaces 9 of Fig. 7 may be inclined as shown by the dashed line portion 10 of Fig. 8.

The stacked rectifying devices of Figs. 9 and 10 comprise a plurality of individual orifice devices according to the cross section of Fig. 1. In the arrangement of Fig. 9, the axis of each individual orifice coincides with the axis of the assembled rectifier. The arrangement of the rectifying device of Fig. 10 differs from that of Fig. 9 in that the orifices of pairs of laminations are in axial alignment while the several pairs of aligned orifice devices are assembled with the axis thereof displaced with respect to that of the mutually adjacent pair.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A hydroacoustic circuit element of a character providing rectification of low frequency sound signals in a liquid medium which comprises a pair of plate members, means including a plurality of shims for providing a predetermined adjustable area orifice disposed to extend transversely through said plate member, retaining means for clamping said shims between said pair of plate members, said orifice extending transversely of the faces of said plate members, said plate members having at least one edge thereof inclined from the front face thereof to the back face thereof, and further configured to provide a smooth transitional curvature from said front face to said inclined face and a sharp line of intersection between said inclined face and said rear face.

2. An hydraulic circuit rectifier component for presenting low resistance to fluid flow therethrough in a

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preferred direction and greater resistance to fluid flow in the reverse direction which comprises; a plurality of barrier wall members arranged in stacked relationships, each of said barrier wall members having an orifice extending therethrough, each orifice having a greater area of fluid entrance in the preferred direction of flow than the area of fluid exit to provide a plurality of tapering fluid passages each extending through a respective barrier wall member from the fluid entrance to the fluid exit thereof whereby the cross section of each orifice taken in a selected plane coincident with the centers of the fluid entrance and fluid exit is trapezoidal and has two converging edges disposed between the fluid entrance and the fluid exit of said orifice, the orifice in each barrier member being displaced in a direction normal to the fluid flow path with respect to the orifice in the next succeeding barrier member in such a manner that one of said cross-sectional converging edges is colinear with the corresponding cross-sectional edge of the orifice in the next succeeding barrier wall member and is displaced from the corresponding cross-sectional edge of the next preceding barrier wall member, and the other cross-sectional edge is displaced from the corresponding cross-sectional edge of the next succeeding barrier wall member and is colinear with the corresponding cross-sectional edge of the next preceding barrier wall member thereby providing a tortuous fluid flow path through said rectifier component.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,856,962

October 21, 1958

Walter P. Christoph

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 14, for "barirer" read -- barrier --; line 17, for "manenr" read -- manner --.

Signed and sealed this 10th day of February 1959.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON
Commissioner of Patents