United States Patent [19]

Nottingham

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[54] **UNDERWATER SIREN**

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[51] **Int. Cl.** **G10k 7/00**

[58] **Field of Search**..... 116/27, 147; 181/0.5 A, 0.5 AG; 340/5 R, 12 R

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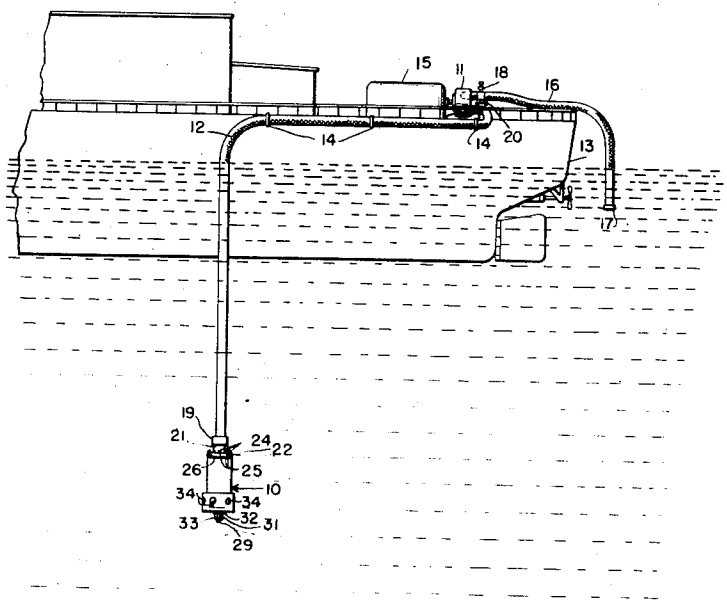
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Primary Examiner—Richard A. Farley
Attorney—R. S. Sciascia and J. A. Cooke

EXEMPLARY CLAIM

In an underwater siren of the character disclosed, the combination of a cylindrical member having a closed end portion and a plurality of ports radially arranged therein, means for supplying hydrostatic pressure to the interior of said cylindrical member, a cup-shaped valve member encircling an end portion of said cylindrical member and having a plurality of apertures adapted to be brought into registered engagement with said ports respectively as the cup-shaped member rotates thereby to interrupt the flow of water through the ports momentarily and repeatedly, means including a flat bearing surface for supporting said cup-shaped valve member for rotation on said cylindrical member with the bottom thereof in closely spaced adjacency with respect to said closed end portion, means responsive to the flow of water through said ports for causing the cup-shaped member to rotate, and means including an annular recess of substantially the same diameter as the outside diameter of said cylindrical member formed in the bottom of said cup-shaped valve member and a plurality of vents in communication therewith for relieving the water pressure between the bottom of said cup-shaped member and said closed end portion of the cylindrical member thereby to reduce the friction of the cup-shaped valve member against said flat bearing surface.

3 Claims, 5 Drawing Figures



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SHEET 1 OF 2

Fig. 1.

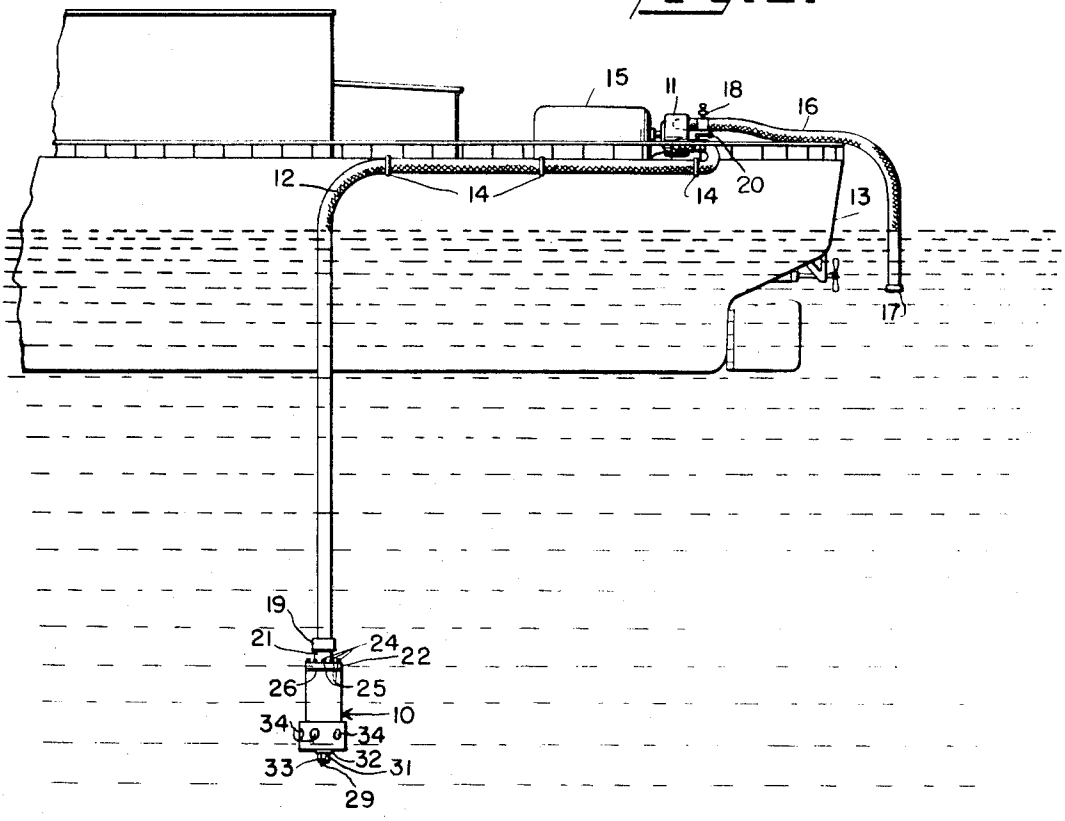
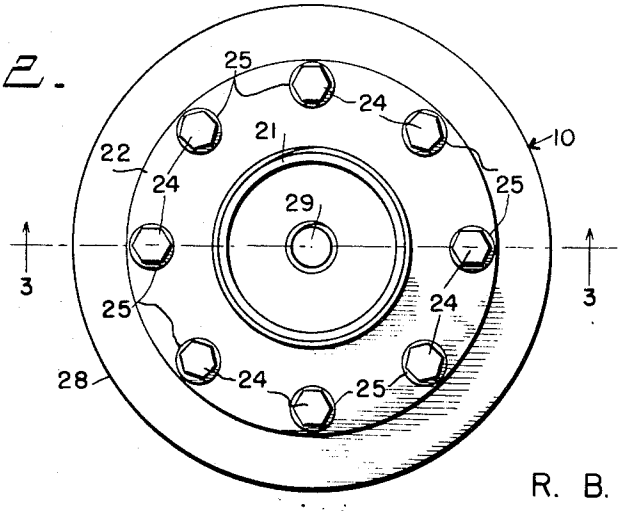


Fig. 2.



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Fig. 3.

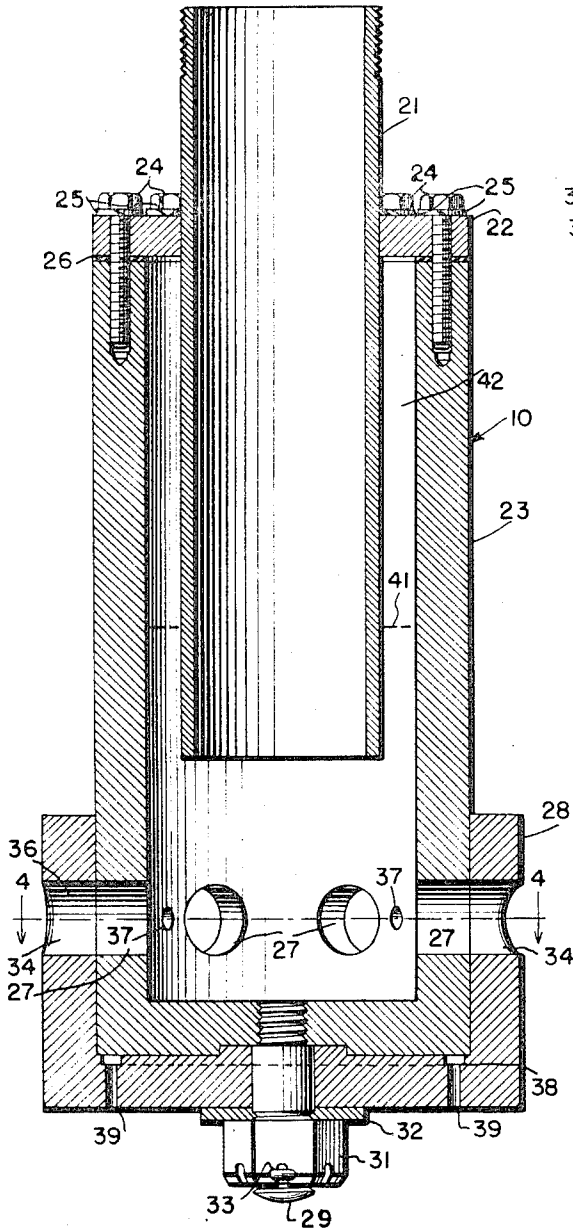


Fig. 4.

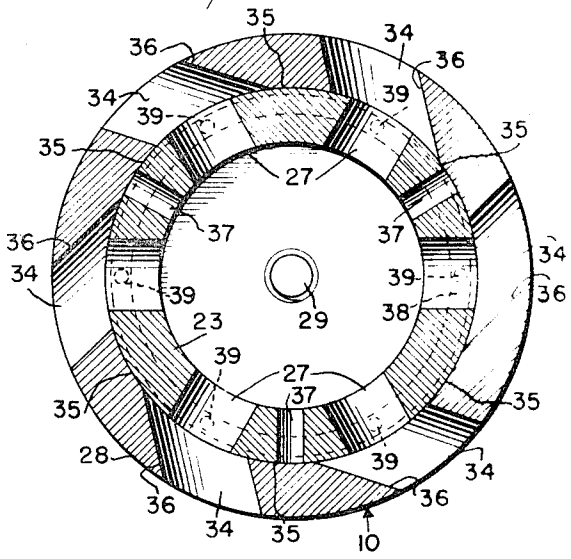
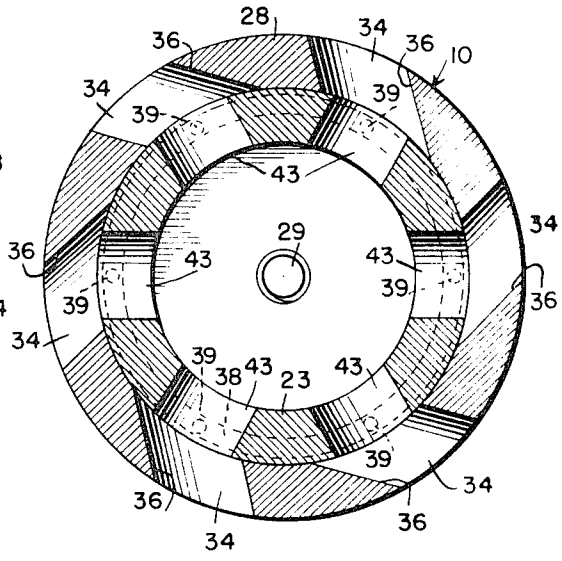


Fig. 5.



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UNDERWATER SIREN

This invention relates to an underwater siren for signaling for control purposes and more specifically to an underwater siren adapted to generate signals of widely varying frequencies for transmission within the audible frequency range through the surrounding water to produce underwater sound energy of high intensity for submarine signaling and for the actuation of acoustically controlled mines and the like.

Various devices for transmitting underwater signals have heretofore been devised, these devices comprising vibratory diaphragms and percussion devices comprising masses adapted to be struck together violently thereby to produce a percussion effect within the water. Such devices have not proved altogether satisfactory for use in mine sweeping operations for the reason that these devices are of great bulk and weight and the signals are relatively weak in strength and, in cases where the signals are produced by percussion, the devices are subject to wear sufficiently to be ineffective after short periods of use, and the character of the signals produced thereby is not closely controlled.

The device of the present invention possesses all of the advantages of the devices of the prior art and none of the foregoing disadvantages. The signals produced in accordance with the present invention are of high intensity and predetermined character and because of their far reaching effect the signals are effective over a relatively large submerged area. This is accomplished by forcing a stream of water into a fixed chamber from which the water emerges through a plurality of radially disposed apertures and impinges obliquely against a plurality of outlets arranged in a rotatable valve member disposed thereabout, thereby causing the member to rotate and cut off the flow of water abruptly and rapidly whereby a continuous signal of predetermined frequency and high energy output is radiated therefrom through the surrounding water.

One of the objects of the present invention is the provision of an underwater siren having new and improved means for producing high sound pressure signals.

Another object is an underwater siren in which the rotative power required for operation is obtained from the flow of water therethrough and new and improved means are employed for producing high pressure pulsations within the surrounding water without interrupting the flow of water supplied thereto.

Another of the objects is the provision of an underwater siren having new and improved means for starting the operation thereof.

Still another object is the provision of a new and improved source of underwater signals of high intensity and predetermined frequency in which all of the energy required for producing the signals is obtained from the flow of fluid therethrough.

A still further object is the provision of an underwater siren for the generation of high energy signals of predetermined character and frequency, which is economical to manufacture, reliable in operation and which possesses all the qualities of ruggedness and durability.

Various other objects, advantages and improvements will become apparent from the following description taken in connection with the accompanying drawings, of which:

FIG. 1 shows the device according to a preferred embodiment thereof and connected to a vessel;

FIG. 2 is an enlarged plan view of the device of FIG. 1;

FIG. 3 is an elevational view in section taken along the line 3—3 of FIG. 2;

FIG. 4 is a view taken along the line 4—4 of FIG. 3; and

FIG. 5 is a view similar to FIG. 4 and showing an alternative form of the device.

Referring now to the drawings for a more complete understanding of the invention and more particularly to FIG. 1 thereof, there is shown thereon a device constructed in accordance with the present invention indicated generally by the numeral **10** and connected to a pump **11**, such, for example, as a centrifugal pump, by a length of hose **12**, a valve **20** preferably being arranged between the pump and the hose **12** to control the flow of water therethrough. The hose is secured to a vessel **13** as at **14** in any suitable manner as by clamps or lashings. The pump **11** is adapted to be operated by a suitable source of power such, for example, as by an electric motor or gasoline engine indicated generally at **15**. The inlet to the pump is connected to a length of suction hose **16** extending into the water and preferably provided with a strainer **17** to prevent the entrance of foreign matter into the hose. There is also provided at the inlet of the pump an air valve **18** in communication with the suction hose **16** and adapted to permit a small quantity of air into the inlet of the pump as the pump operates, for a purpose which will become more clearly apparent as the description proceeds.

The connection between the hose **12** and the siren is preferably established by a coupling **19** secured to a tubular member **21** having a circular cap **22** secured thereto in any suitable manner as by welding the parts together, FIG. **3**. The cap **22** is clamped to a cylindrical member or casing **23** by a plurality of bolts **24** preferably having split washers **25** under the heads thereof. An airtight and watertight connection between the cap **22** and the member **23** is maintained by a gasket **26** arranged therebetween. The member **23** is disposed about the lower end of the tubular member **21** and provided with a plurality of apertures or ports **27** extending radially therefrom.

A circular valve member **28** is arranged exteriorly about the lower portion of the cylindrical member **23** and secured thereto by a stud **29** threaded into the end portion of the member **23** and provided with a castellated nut **31** and washer **32** intermediate the nut and the valve member **28**. The nut **31** is adjustable and positioned to provide free rotational movement of the valve member **28** about the member **23** and retained in the adjusted position in any suitable manner as by a cotter pin **33**.

The valve **28** is provided with a plurality of ducts **34** arranged therein and adapted to move into registered engagement repeatedly with the ports **27** within the member **23**. The arrangement of the ducts **34** is such as to provide a solid portion **35** therebetween in abutting relation with the periphery of the member **23** and of substantially the width of each of the ports **27** whereby the ports **27** are alternately closed and opened as the valve member **28** rotates.

Rotation of the member **28** is produced by the force of the water flowing outwardly through the ports **27**

and striking against the inclined portion 36 of the ducts 34.

There is also provided within the member 23 a plurality of apertures 37, each of the apertures 37 being arranged midway between a pair of ports 27 and adapted to permit the flow of water therethrough corresponding to only a small fractional portion of the water flowing through the ports. The apertures 37, it will be understood, are employed to insure starting of the valve member 28, from a position of rest in the event that the rest position of the valve 28 should be a position in which the ports 27 are closed. The starting of the valve 28 is thus accomplished, in the example just recited, by the flow of the water through the apertures 37 and the impingement of this water against the inclined surface 36 of the ducts 34.

The valve member 28 has formed therein an annular recess 38 in communication with a plurality of outlets 39 whereby leakage between the valve 28 and the member 23 while the member 28 is in a state of rest is prevented from exerting an endwise thrust to the valve sufficient to prevent starting.

From the foregoing it will be apparent that with the device 10 arranged in a vertical position within the water, the water will rise within the device to a level such, for example, as the level indicated by the dashed line 41, FIG. 3, and fluctuate about this level as the valve 28 rotates, by reason of the pressure of the air trapped within the chamber 42. As the pump is set in operation, water is drawn in through the suction hose 16 and forced into the siren by way of the valve 20 and the hose 12 and the water is expelled from the siren in sharp forceful pulses controlled by the rotative movement of the valve 28.

By providing an air chamber 42 in the manner herein disclosed, the flow of the column of water within the hoses 12 and 16 and within the pump 11 is not caused to be arrested during each such pulsation but flows smoothly into the siren by reason of the elasticity of the air within the chamber 42. The quantity of water within the siren is thus varied during each pulse transmitted therefrom and the water rises and falls rapidly within the space between the interiorally extending portion of the tubular member 21 and the member 23 as each pulsation is transmitted through the surrounding water. The air valve 18, FIG. 1, supplies a quantity of air continually to the siren sufficient to maintain the air chamber 42 effective in establishing a cushion between the valve and the source of water pressure by replenishing the air within the chamber 42 which would otherwise be exhausted by the outrushing water.

FIG. 5 shows an alternative form of the siren in which the starting apertures 37 are not required. In the arrangement of FIG. 5 each of the ducts 34 subtends a greater peripheral distance along the valve surface than the peripheral distance between a pair of ports or apertures 43 and thus the ports 43 are never completely closed but permit sufficient water to flow therethrough to insure starting of the valve member 28 from a position of rest, regardless of the instant position of the valve member at the time the pressure is first applied to the siren. This may be accomplished either by increasing the size of the apertures 43 in the manner illustrated or, if desired, by increasing the size of the apertures 34.

The device may be set into operation by starting or speeding up the pump 11 or by opening the valve 20, as the case may be, and the sound signal produced by the device may be started and stopped or otherwise varied at will by varying the speed of the pump 15 or by changing the setting of the valve 20. The high intensity sound signals produced by the device under normal operation may be increased momentarily, if desired, by rapid starting of the siren in response to rapid acceleration of the pump 11 or in response to the rapid opening of the valve 20 thereby producing transient sound pressure signals in the surrounding water for a short duration which are greatly in excess of the pressure signals produced under continuous operation of the siren.

The frequency and intensity of the underwater signals may, if desired, be varied within predetermined limits by an automatic control adapted to vary the seed of the pump or the setting of the valve 20, as the case may be.

By employing a structure comprising a rotatable valve member having a plurality of uniformly spaced openings in which the axis of each opening lies in a plane normal to the axis of rotation of the valve member, a device is produced in which the forces are balanced and the pressure and friction of the valve member against the fixed complementary member is substantially eliminated.

Whereas a device has been illustrated as having six uniformly spaced outlets for the production of underwater sound signals of high intensity, it will be understood that this is by way of example only as the number of outlets may be increased or decreased without departing from the invention and, furthermore, the number of starting apertures 37 may be increased or decreased to achieve the desired result. Also, if desired, the outlets may be arranged in different planes. The frequency of the underwater signal may also be changed by varying the number of outlets of the device, the angle of the ducts 34 with respect to the direction of flow of water thereagainst and the pressure applied to the device by the pump. Furthermore, the harmonic components of the generated signal may be varied by control of the size of the annular space between the tubular member 21 and the cylindrical member 23 or by variation of the amount of air admitted to the system by the valve 18.

By abruptly starting and stopping the flow of water through the siren in the manner herein disclosed, a high intensity underwater signal of predetermined frequency is produced. The particular character of the signal may be brought to conformance with any desired characteristic by employing a valve member having ducts formed to effect the desired result or by employing suitably formed ports within the member 43.

While the invention has been described with reference to two specific examples which give satisfactory results, it will be understood by those skilled in the art, after understanding the invention, that various changes and modifications may be made without departing from the spirit and scope of the invention and it is intended therefore in the appended claims to cover all such changes and modifications.

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

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

1. In an underwater siren of the character disclosed, the combination of a cylindrical member having a closed end portion and a plurality of ports radially arranged therein, means for supplying hydrostatic pressure to the interior of said cylindrical member, a cup-shaped valve member encircling an end portion of said cylindrical member and having a plurality of apertures adapted to be brought into registered engagement with said ports respectively as the cup-shaped member rotates thereby to interrupt the flow of water through the ports momentarily and repeatedly, means including a flat bearing surface for supporting said cup-shaped valve member for rotation on said cylindrical member with the bottom thereof in closely spaced adjacency with respect to said closed end portion, means responsive to the flow of water through said ports for causing the cup-shaped member to rotate, and means including an annular recess of substantially the same diameter as the outside diameter of said cylindrical member formed in the bottom of said cup-shaped valve member and a plurality of vents in communication therewith for relieving the water pressure between the bottom of said cup-shaped member and said closed end portion of the cylindrical member thereby to reduce the friction of the cup-shaped valve member against said flat bearing surface.

2. In an underwater signalling device, in combination, a cylindrical casing having a plurality of uniformly spaced radial apertures and one end thereof closed by an end wall integrally formed therewith, a cover sealed to said casing at the other end thereof, a tubular inlet member secured to said cover and centrally disposed within said cylindrical casing in spaced relation with respect thereto for providing an air chamber between said member and the casing, means operatively connected to said member for supplying a mixture of water and air under pressure to said tubular member, a cup-shaped signalling valve in engagement with said casing and rotatably supported on said end wall said valve having a plurality of obliquely arranged complementary apertures therein for producing underwater signals as the valve is rotated by said mixture, a stud shaft threaded in said end wall and having an end thrust bearing member thereon for rotatably supporting the valve on one end of said casing, and means including a plurality of vents in the valve for relieving the axial pressure of the water in the bottom of said cup-shaped valve member thereby to reduce the friction between the value and said end thrust bearing member.

3. In an underwater signalling device, in combination, a cylindrical casing having a plurality of uniformly apertures therein an end wall formed on said casing for closing one end thereof, a cover sealed to the other end of the casing, means including a plurality of fasteners for sealing said cover to the casing, a tubular inlet member secured to said cover and centrally disposed within the casing in spaced relation with respect thereto and with the end wall thereof for providing an air chamber between said casing and member, means including a pump operatively connected to the member for supplying a mixture of water and air to the member, a signalling valve rotatably supported on the casing and comprising a flanged portion in engagement with the outer surface of the cylindrical casing and a base plate in closely spaced adjacency with said end wall for producing underwater signals as the valve is rotated by said mixture, said valve having a plurality of obliquely arranged complementary apertures therein in registry with said first named apertures, said base plate having a centrally disposed opening formed therein, a stud shaft threaded in said end wall, a bearing on said shaft and arranged in said opening for rotatably supporting the valve on one end of the casing, means including a lock nut threaded on said stud shaft and a washer between said nut and said end wall for maintaining the valve in engagement with said cylindrical casing and the base plate thereof in said closely spaced adjacency with said end wall, and means including an annular groove formed in the base plate for relieving the pressure of the water between the valve and said base plate thereby to reduce the friction between the valve and said washer.

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