

[54] AIR SUPPLY DEVICE

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[58] Field of Search ..... 417/413; 46/1 R, 7, 221,  
46/243 M, 243 S, 243 P, 223

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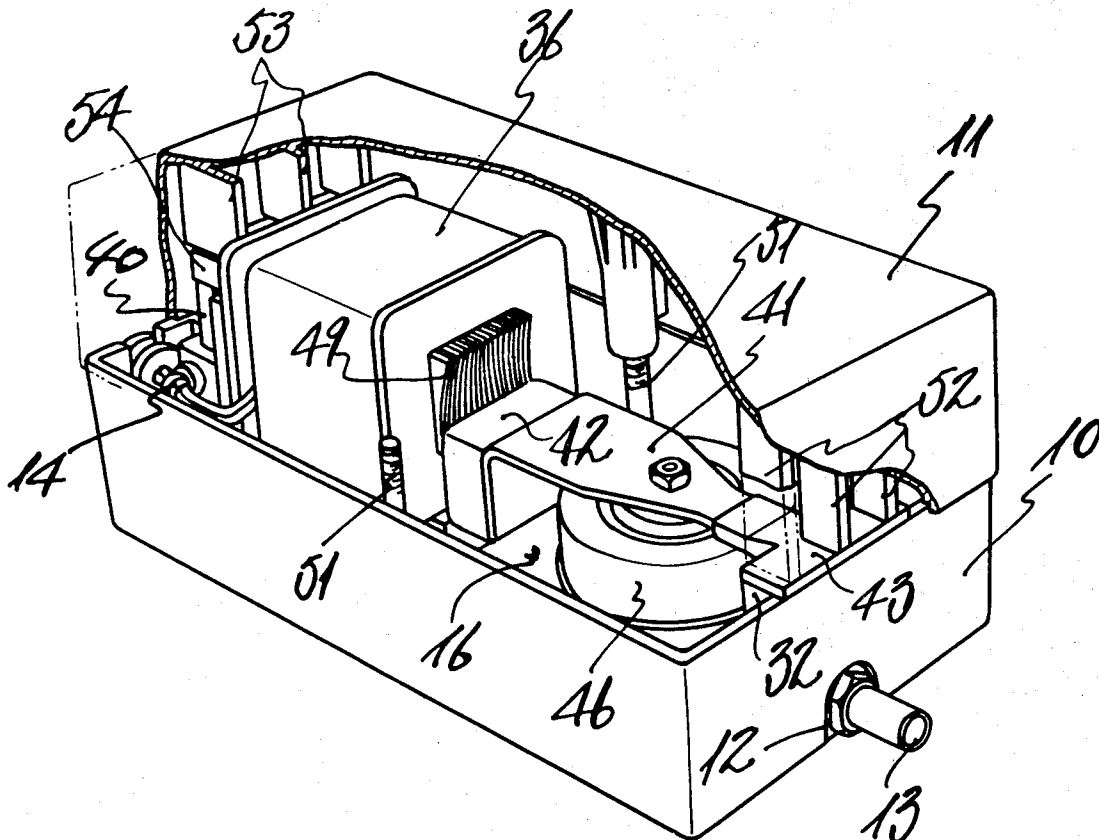
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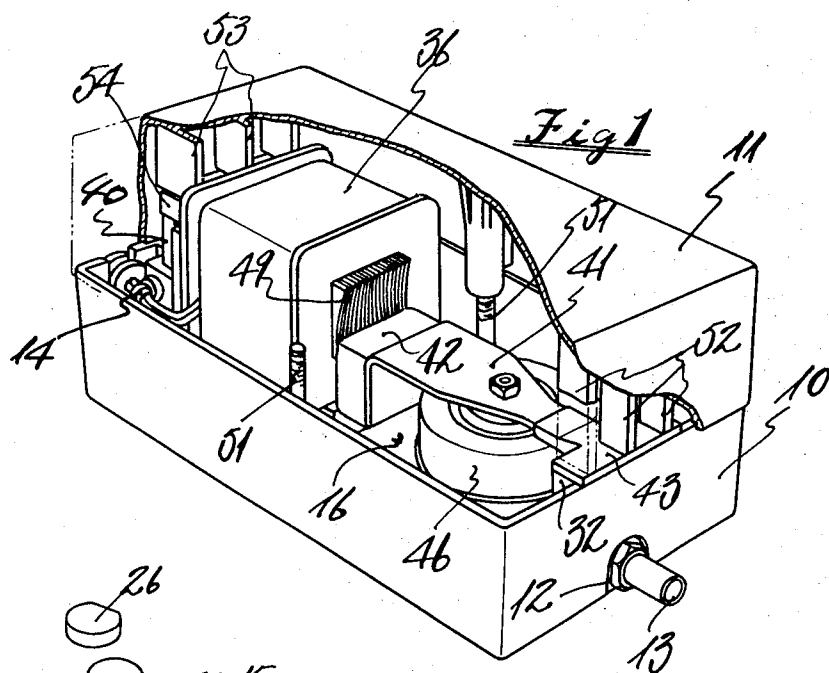
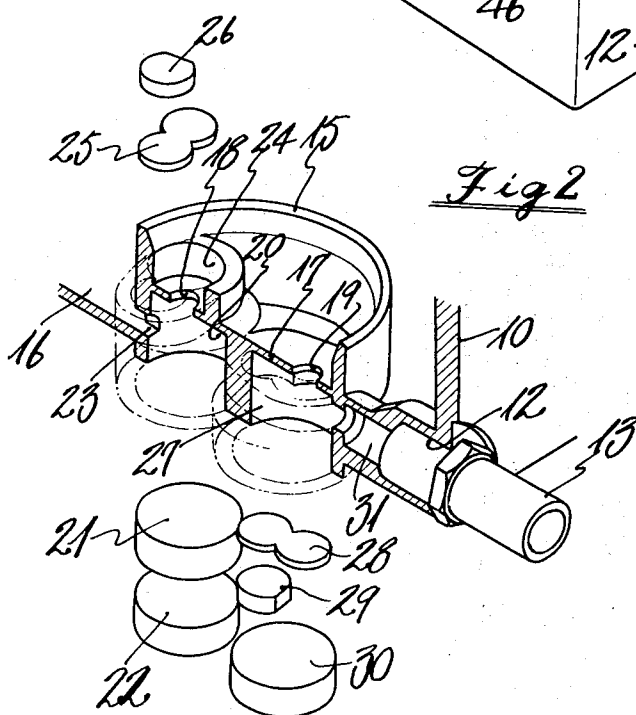
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**ABSTRACT**

An air supply device for blowing air bubbles into an aquarium. An electro-magnet creating an alternating magnetic field to actuate a vibrating arm is provided with a core having concave poles, and the electromagnet and the vibrating arm which is disposed opposite to the concave poles are held by supporting members integrally molded with an upper and lower casing of the air supply devices.

**8 Claims, 6 Drawing Figures**





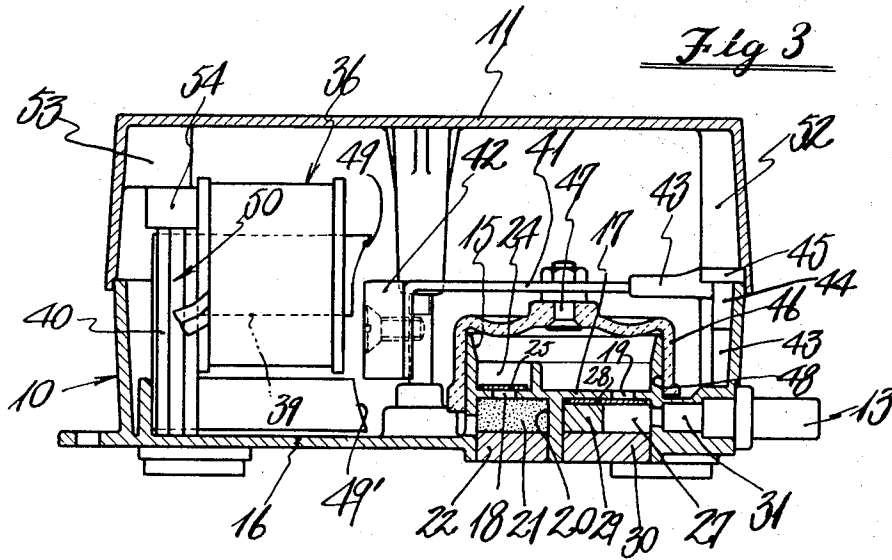
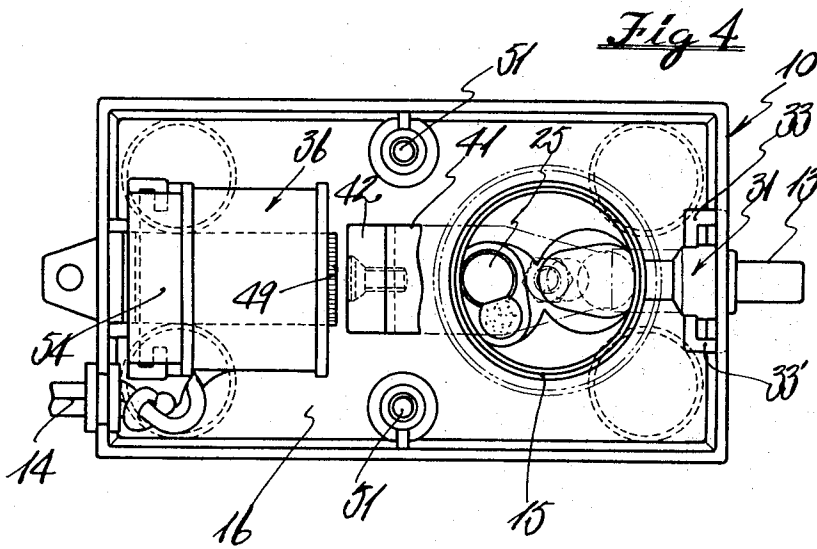


*Fig. 5*

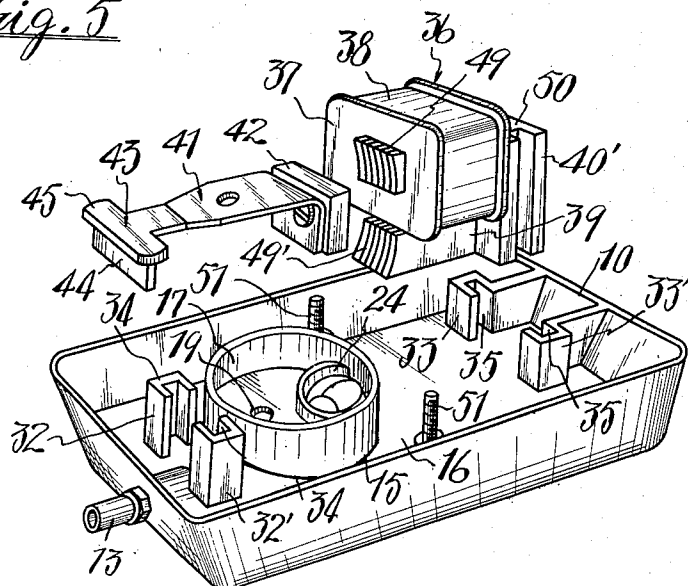
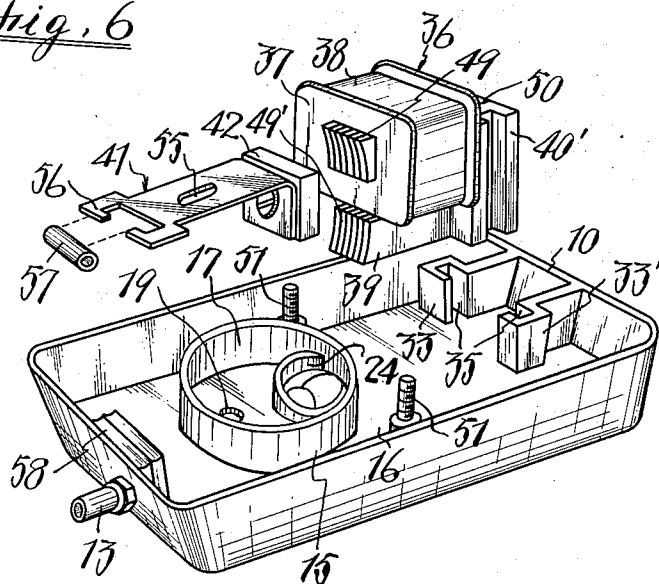


*Fig. 6*



## AIR SUPPLY DEVICE

## BACKGROUND OF THE INVENTION

## 1. Field of the Invention

This invention relates to an air supply device for blowing air bubbles into an aquarium fish tank or tub, and more particularly to an aquarium air pump including an electro-magnet and a vibrating arm which is disposed opposite to the electro-magnet and is associated with a diaphragm to which the oscillation of the vibrating arm caused by an alternating current is transmitted.

## 2. Description of the Prior Arts

In general, air pumps of the type as explained above include an electro-magnet assembly having a core and a coil, a vibrating arm having a permanent magnet at its end, which is oscillated within an alternating magnetic field of the electro-magnet, a cup or bowl-shaped elastic diaphragm fixed at the intermediate portion of the vibrating arm, and a valve housing having inlet and outlet one-way valves to open or shut inlet and outlet ports. The ports of this assembly are disposed in a suitable casing in such a manner that the diaphragm is mounted around the top of the valve housing so as to transmit the oscillation of the vibrating arm and to supply air bubbles to the aquarium through a suitable tubing or pipe.

In a conventional air pump, the electro-magnet assembly, the vibrating arm, which is pivotally supported at the opposite of the electro-magnet assembly, and the valve housing are fixed to the casing by means of screws or other fastening means. Thus, air pumps of this type are too expensive or too complicated to manufacture and handle, because the assembly requires a large number of parts and too many steps in the process of producing the air pump.

## SUMMARY OF THE INVENTION

Accordingly, one object of the present invention is to provide a new air supply device which is composed of relatively few assembly parts and is easy to manufacture.

Another object of the present invention is to provide an air supply device which is capable of minimizing the number of parts and steps in the process of manufacturing the air pump in such a manner that the essential parts of the air pump, such as the electro-magnet assembly and the vibrating arm, are firmly mounted in the casing by a simple assembling operation. Also, the valve housing, which is the most complex in structure of the parts in this type of device and includes a number of small parts therein, is integrally molded with a lower casing of the air pump so as to reduce the number of assembly parts and the number of steps for the assembling of the parts.

A further object of the present invention is to provide an air supply device which is capable of supplying a large amount of air to an aquarium tank as compared with conventional devices.

Briefly, the foregoing and other objects are attained in accordance with the present invention by mounting the electro-magnet assembly and the vibrating arm without the use of screws or special fastening means. In the present invention, the core of the electro-magnet is in a concave shape along the oscillation line of the vibrating arm. Thus, the permanent magnet provided at

the end of the vibrating arm is brought extremely close to the poles of the electro-magnet. Accordingly, the vibrating arm can be placed at the region of the strongest alternating magnetic field, and the alternating energy can be effectively transmitted to the vibrating arm.

## BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying Drawings, wherein:

FIG. 1 is a partially cut-away perspective view of the air supply device showing the inside of the valve housing and the arrangement of the parts or elements comprising the air supply device in accordance with the present invention;

FIG. 2 is an exploded perspective view of the assembly parts or elements of the valve housing;

FIG. 3 is a longitudinal sectional view of the air supply device in accordance with the present invention;

FIG. 4 is a plan view of the air supply device with the upper casing removed showing the arrangement of the parts or elements of the air supply device;

FIG. 5 is an exploded perspective view of the air supply device showing the relation between the vibrating arm, the electro-magnet and the lower casing; and

FIG. 6 is an exploded perspective view of the air supply device similar to FIG. 5 showing another embodiment of the present invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the Drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views, and more particularly to FIG. 1 thereof, the air supply device of the present invention comprises a box-shaped lower casing 10 and an upper casing 11, which is mounted above the lower casing. A front surface of the lower casing has an opening 12 into which a nipple 13 is inserted for tubing, and electric wires 14 are led from the opposite side of the lower casing for connecting an electro-magnet assembly 36 in the casing to an AC power source.

As will be apparent from FIGS. 1 and 2, the lower casing 10 is molded from suitable plastic materials, and a cylindrical valve housing 15 is projected upwardly from a bottom surface 16 of the lower casing 10. This valve housing 15 is integrally molded with the bottom surface 16 of the lower casing 10.

In the inside of the valve housing 15, the valve housing is divided by a generally flat and horizontally extending partition wall 17, and a pair of openings 18 and 19 are provided in the partition wall 17.

The opening 18 is an inlet hole for air, and an inlet chamber 20 for air is formed at the underside of the hole. In this chamber 20, a filter disk 21 such as a felt pad is embedded, and the filter disk 21 is supported by a rubber pad 22 which is also embedded in the chamber 20 to accomplish an air-tight seal.

The inlet chamber 20 is communicated with the air within the casing by a suction hole 23 horizontally provided at the side face of the cylindrical wall.

At the top of the inlet hole 18, a valve recess 24 is formed for seating a rubber sheet one-way valve 25, which will open in one direction, and an end of the

valve 25 is held by a packing 26 so as to be able to actuate the other end of rubber valve 25.

An outlet chamber 27 for air is formed at the under side of the outlet hole 19 for air. In this chamber 27, a sheet valve 28 is seated, and an end of the valve 28 is held by rubber pads 29 and 30 so as to be able to actuate the other end.

The numeral 31 designates an outlet port for air which communicates the connector nipple 13 to the outlet chamber 27.

As will be apparent from FIG. 5, two pairs of supports 32, 32', 33 and 33', which vertically extend from the bottom surface 16 of the lower casing 10 and are integrally molded with the lower casing 10, are provided at each side of the lower casing 10, and vertical recesses 34 and 35, having a certain width and depth, are formed at each of the vertical surfaces of the supports 32, 32', 33 and 33'.

The electro-magnet 36 includes a bobbin 37 and windings 38, and a core 39 with negative and positive poles 49 and 49' which are projected slightly beyond the front surface of the bobbin 37.

The bobbin may be molded of a plastic, and includes at least a pair of vertically projected members 40 and 40' at the rear side of the bobbin. These members are designed to be inserted into the recesses 35 of the pair of supports 33 and 35 as described above so as to hold the electro-magnet assembly in the casing.

The numeral 41 designates a vibrating arm having a permanent magnet 42 at one end and a pivoting member 43 made of elastic materials such as a rubber and the like at the other end.

The pivoting member 43 may be of T-shape in the cross section, and includes a vertical tongue 44 and a horizontal platform 45 which is positioned above the tongue 44. The tongue 44 is vertically inserted into the recesses 34 provided in the pair of the supports 32 and 32', while the horizontal platform 45 is fitted to the top of the supports 32 and 32'.

A cup-shaped rubber diaphragm 46 as shown in FIG. 3, is secured at the middle of the vibrating arm 41 by fastening means in the form of a bolt 47 or the like. An opening 48 around the lower periphery of the rubber diaphragm 46 is fitted to cover the circular top opening of the valve housing 15.

The vibrating arm is oscillated in the alternating magnetic field of the electro-magnet assembly 36 making the pivoting member 43 a fulcrum. Thus, the permanent magnet 42 is oscillated and swings in a vertical direction and in an arc.

The negative and positive poles 49 and 49' of the core of the electro-magnet are concave in shape correspondent to the arc of movement of the permanent magnet 42. Thus, the permanent magnet 42 can be placed at the closest distance from the poles so that the vibrating arm can be oscillated effectively by the influence of an alternating magnetic field.

The electro-magnet 36 is disposed in the lower casing 10 by inserting the tail portion 50 of the bobbin 37 into the supports 33 and 33' having the recesses 35, and also the vibrating arm 41 is disposed in the lower casing by inserting the pivoting member 43 into the supports 32 and 32' having the recesses 34. After this arrangement, the upper casing 11 is placed on the lower casing 10 as shown in FIGS. 1 and 3, and both the upper and lower casings 10 and 11 are assembled by a pair of screws 51. Then, a supporting rib 52 projecting down-

ward from the inner top surface of the upper casing 10 presses on the horizontal platform 45 of the pivoting member 43, and the vibrating arm 41 is pivotally fastened between the supports 32 and 32' and the supporting rib 52 of the upper casing 12 without the use of a screw or other fastening means.

Also, the electro-magnet 36 is secured in the casing without the use of a screw or other fastening member by pressing a supporting rib 53 of the upper casing on a flat top portion of the bobbin tail 50 on which a cushion member 54 such as a sponge is disposed. (see FIG. 3). Thus, the electro-magnet assembly is not loosened or moved during the operation of the air supply device.

FIG. 6 shows the air supply device of another embodiment of the present invention. This embodiment is almost the same as the preceding embodiment, except that the vibrating arm 41 is supported in a different manner within the casings 10 and 11. In the preceding embodiment, the pivoting member 43 is fixed to the vibrating arm 41 by the application of heat so as to be welded to the vibrating arm 41 which may be made of a stamped metal. However, this welding process is somewhat complicated and expensive, which results in the increase of overall cost of the air pump. According to the embodiment shown in FIG. 6, the vibrating arm 41 is provided with an elongated hole 55 at its midway and bifurcated arms 56 at its end. The arms 56 support a cylindrical tube or bar 57 which may be made of rubbers, plastics or the like and acts as the pivoting member.

The vibrating arm 41 is mounted within the casing by having the elastic tube 57 of the vibrating arm 41 held between supporting members 58 which are provided with the upper and lower casings 11 and 10. The supporting members 58 include concave recesses on its top surface to receive the cylindrical tube or bar 57. The concave recesses may be made parallel as shown in FIG. 6 so as to be able to adjust the gap between the permanent magnet 42 and the pole 49. This arrangement is effective when the thickness of the permanent magnet 42 secured to the vibrating arm is irregularly manufactured. The elongated hole 55 is provided to adjust the fastening position of the rubber diaphragm 46 with respect to the vibrating arm 41 in accordance with the position of the cylindrical tube 57 placed on the concave recesses.

Obviously, numerous additional modifications and variations of the present invention are possible in 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 herein.

What is claimed is:

1. An air supply device for an aquarium comprising an electro-magnet including a bobbin, a core associated with said bobbin and having negative and positive poles, and windings on said bobbin to be connected to an AC power source for creating an alternating magnetic field, a valve housing including a diaphragm, a vibrating arm disposed opposite to said poles oscillated within said alternating magnetic field for actuating said diaphragm, and upper and lower casings including supporting members integrally molded with said casings, said supporting members having vertically extending recesses for receiving and for holding said electro-

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magnet and said vibrating arm within said casings when the upper and lower casings are assembled.

2. An air supply device for an aquarium as claimed in claim 19, wherein said electro-magnet includes vertically projecting members attached to said bobbin engaged by a supporting members.

3. An air supply device for an aquarium as claimed in claim 19, wherein said vibrating arm includes an elastic pivoting member acting as a fulcrum of said vibrating arm, said pivoting member being held by a supporting member of one of said casings.

4. An air supply device for an aquarium as claimed in claim 1, wherein said valve housing is integrally molded with said lower casing.

5. An air supply device for an aquarium as claimed in claim 1, wherein said poles are concave in shape.

6. An air supply device for an aquarium comprising an electro-magnet including a bobbin, a core associated with said bobbin and having negative and positive poles, and windings on said bobbin to be connected to an AC power source for creating an alternating magnetic field, a valve housing including a diaphragm, a vibrating arm disposed opposite to said poles oscillated within said alternating magnetic field for actuating said diaphragm, and upper and lower casings including supporting members integrally molded with said casings for holding said electro-magnet and said vibrating arm

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within said casings when the upper and lower casings are assembled, said vibrating arm including bifurcated arms at an end thereof for supporting a pivoting member acting as a fulcrum of said vibrating arm.

7. An air supply device for an aquarium as claimed in claim 6, wherein said pivoting member is a cylindrical bar of an elastic material.

8. An air supply device for an aquarium comprising an electro-magnet including a bobbin, a core associated with said bobbin and having negative and positive poles, and windings on said bobbin to be connected to an AC power source for creating an alternating magnetic field, a valve housing including a diaphragm, a vibrating arm disposed opposite to said poles oscillated within said alternating magnetic field for actuating said diaphragm, said vibrating arm pivoting on a pivoting member, and upper and lower casings including supporting members integrally molded with said casings for holding said electro-magnet and said vibrating arm within said casings when the upper and lower casings are assembled, one of said supporting members provided in said lower casing including a vertically extending recess into which a projecting member of said bobbin is inserted and another of said supporting members having a concave recess to receive said pivoting member.

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