ELECTRO-PNEUMATIC VALVE.

It is impracticable to open and close valves such as are used upon steam pipes by the direct agency of electricity. Many appliances have been used to close valves on air pipes or the draughts of furnaces by clockwork set in motion by electricity, but these have proved unsuccessful for the reason that only small and easily moved valves could be operated, and the mechanism was large, complicated, and expensive. The device herewith illustrated—the invention of Prof. W. S. Johnson, an electrician of Milwaukee—makes use of compressed air which acts directly upon a piston, or its equivalent, and actuates the valve, which may be of any size. Since the electricity only performs the simple duty of admitting or releasing the compressed air from the chamber that operates the piston, a very feeble current is all sufficient, and, what is more important, the same quantity of electricity will move the largest valve in the world as readily as it will move the smallest, in other words, a single cell of any battery will stop the largest engine. The air is stored in a small tank, that is filled as occasion requires by means of a small air pump.

The valve shown in the sectional view, Fig. 1, is used on all pipes of steam, water, or brine systems. Fastened to the upper end of the stem is a saucer-shaped piece, H, above which the umbrella-shaped piece, J, is held by standards. Upon the under side of the piece, J, and fastened firmly to its edges to produce an air tight joint, is a flexible diaphragm, K, made of cloth and rubber. There is an opening through the pipe, M, into the chamber formed between the piece, J, and the diaphragm. It is easily seen that if air under pressure be admitted through the opening, M, the valve will be pushed downward to its seat; when the air is allowed to escape from the chamber, the spring, *b*, will open the valve to its full extent. The force with which the valve is seated will be quickly perceived, when it is remembered that the area of the diaphragm is much greater than that of the valve. When the area of the valve is 0 78 of an inch and the steam pressure 60 pounds per square inch, the pressure upon the valve disk is 47 pounds. The area of the diaphragm is 9 inches. If the air pressure should be 10 pounds per square inch, the valve would be seated with a force of 90 pounds, or 43 pounds in excess of the steam pressure. Since the area of the diaphragm may be increased at pleasure, it is evident that the valve can be operated against any pressure of steam.

The compressed air is admitted to the chamber by the electro-pneumatic valve shown in side elevation in Fig. 2. The pipe, M (Fig. 1), is attached to nipple F, while a nipple on the opposite side and not shown in cut is connected by a short rubber tube to the iron gas pipe that leads to the reservoir of compressed air. When the valve operates, the compressed air passes freely through it from nipple 1 to 2, and thence to the diaphragm valve. When the electric circuit is broken, the valve closes the outlet to the compressed air reservoir, and opens the outlet to the diaphragm valve, which, being relieved from pressure, opens again. The engraving shows the electro-magnets, the armature, the lever moved by the armature, and the piston valve, which is lifted by the armature when the valve moves.

By means of a thermostat, the electric valve may be used to control temperatures, the electric circuit being closed when the apartment reaches the desired temperature. The valve permits the compressed air to enter the diaphragm valve and shut off the steam, hot air, circulation of water, or whatever is the source of heat. Common gravity batteries are employed to operate the device, or it can be arranged so as to be worked by an open circuit battery like the Leclanche. But a few minutes' work each week are required to keep the pressure in the reservoir up to 10 pounds. This system is simple, automatic, and noiseless, and the many uses to which it may be put will be evident to our readers. When placed upon the heating pipes of a building it insures not only a temperature just warm enough, but one in which there are no fluctuations beyond the fraction of a degree. When applied to heating apparatus, the same battery and air reservoir answer for all the valves, a small gas pipe conveying the compressed air from the reservoir to all parts of the building. These devices are made by the Milwaukee Electric Mfg. Co., of Milwaukee, Wis., and will be exhibited at the International Electrical Exhibition to be held under the auspices of the Franklin Institute, Philadelphia.

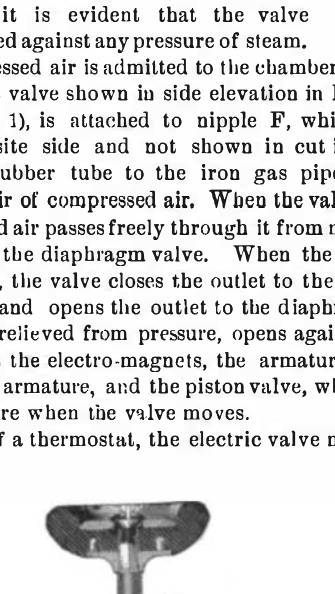
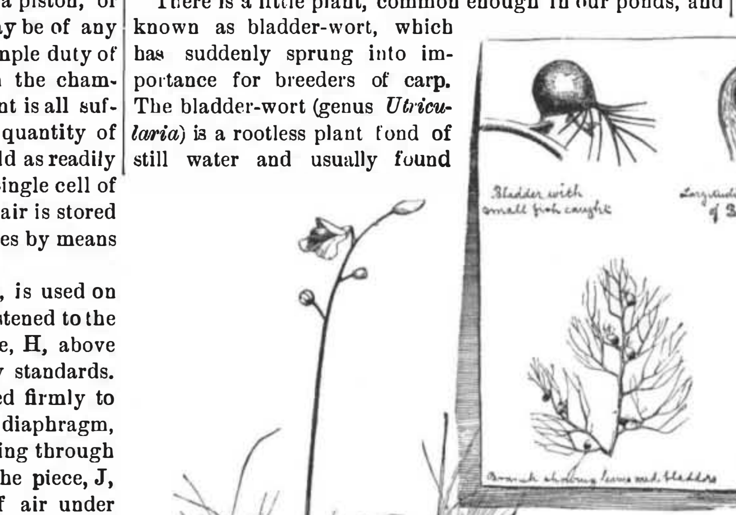


Fig. 1.—SECTIONAL VIEW OF DIAPHRAGM VALVE.

HOW OUR CARP ARE DESTROYED.

There is a little plant, common enough in our ponds, and known as bladder-wort, which has suddenly sprung into importance for breeders of carp. The bladder-wort (genus *Utricularia*) is a rootless plant fond of still water and usually found floating half in and half out of water, the branching and stem-like leaves forming the submerged float from which rises the flower stem. To the leaves are attached curiously insect-like bladders filled with water, and varying in size in the different species, reaching at times a diameter of one-fifth of an inch.



FISH EATING PLANT—UTRICULARIA.

It was formerly, and with much probability, supposed that these bladders served the purpose of floats; for until a few years ago it was taken for granted that air and not water filled them. It is now known, however, that the bladders serve a more useful purpose than merely to keep the head of the plant above water; they are the digestive organs of the *Utricularia*, and at the same time are so constructed as to form a very ingenious but extremely simple trap for catching food. It is into these bladders that thousands of carp eggs find their unwitting way, together with many insects, crustacea, and other tiny objects, both animate and inanimate.

It is only recently that the *Utricularia* has been accused of destroying carp eggs, but for nearly thirty years it has been known as a receiver of small insects and crustaceans, and it has been known as an insect feeder for atleast twenty years. Mrs. Treat, of this country, in 1875 gave a full and interesting description of the habits of one species (*Utricularia clandestina*), and Darwin and others, of Europe, studied the habits of other species in Europe and elsewhere.

In its character as an insectivorous plant the bladder-wort might fail to arouse general interest, but as a destroyer of carp it has a commercial as well as botanical and scientific character. The common bladder-wort (*Utricularia vulgaris*) affords the easiest subject for study, inasmuch as its bladders reach the largest size and may be satisfactorily examined with a moderate magnifier.

The bladder is pear-shaped, with an opening at the small end. Around the mouth are antennæ-like projections or bristles, which, according to Darwin, are for the purpose of warding off and keeping out insects of too great size. The mouth is closed by a valve which yields readily to light pressure, but offers an immovable barrier to the once captured creature. The utmost strength compatible with such a structure has apparently been attained. The valve is a thin and transparent plate, and by means of the water behind it, is made to stand out a bright spot, which Darwin thinks may attract prey. Something certainly attracts the tiny denizens of the water, for they swim up to the mouth and crawl into the bladder by the readily yielding door. As there is no seductive secretion here, as in the case of many insect destroying plants, the great naturalist's surmise is probably correct.

Some of the insectivorous plants, on catching their prey, at once pour out a digestive fluid analogous to the gastric juice of the human stomach, but with the *Utricularia* it is not so. The insects or other food when caught in the bladder are merely captives, and swim about in their confined quarters with eager activity in their endeavor to find an outlet, until asphyxia for lack of oxygen comes on. Even now the plant makes no effort to digest the animal food, but waits patiently until decay takes place, and the animal matter is by putrefaction resolved into fluids which the numerous papillæ lining the bladder can absorb.

Darwin's experiments showed not only that living animals could make their way into the bladder, but that inanimate objects falling on the valve would be engulfed with lightning-like rapidity. With all this information to begin with, it is not strange that naturalists should turn to the bladder-wort to seek a solution for the great destruction of the carp, for the carnivorous plant was known to possess facilities not only for the capture of floating spawn, but even of the newly hatched fish. Examination and repeated experiment proved conclusively that the greedy little bladders were making sad havoc with the fish, and in consequence carp breeders are bidden to open war vigorously on *Utricularia* and all its species. It may seen at a hasty glance that the small bladders can hardly be responsible for any very extensive destruction of eggs or small fish, but the doubters of the ability of insignificant agents, acting together, to produce stupendous effects may be referred to the microscopic rhizopods or the earth worms, each in their own way performing wonderful feats in the way of earth building and earth preserving.

Apple Tree Borer.

In answer to correspondent respecting tree borers, the Albany *Cultivator* states as follows: The apple tree borer, known as the *round headed borer*, in its perfect state is a beetle three-fourths of an inch long, with two broad whitish stripes running the whole length of its back, with rather long and curved horn-like antennæ. This beetle lays its eggs in the bark of the tree near the ground early in summer, and on till midsummer. These soon hatch, and the young larvæ begin to gnaw their way inward, cutting gradually into the solid wood. They are about three years in reaching maturity, when they come out in the form of the beetle already described. Their presence in the tree may be readily detected by the fine sawdust-like castings from the holes. They are easily reached and killed by clearing away the openings of the holes with the point of a knife, and then punching them with a flexible wire or small twig. We have never found anything better than a small flexible twig from which the bark has been stripped to make it small enough to enter the holes. The operator knows when he reaches them by the peculiar touch. It is better to examine the trees often enough to find the larvæ when they are young, and before they have penetrated far into the solid wood. A partial remedy for preventing the laying of the eggs, is coating the bark from the ground well up with soft soap, or soap made as soft as thick paint, with washing-soda and water. If applied in fair weather, it becomes dry and will not so soon wash off. It may be applied two or three times from the first to the end of June. This insect attacks the pear, quince, mountain-ash, and thorn. The *flat headed borer* is half an inch long, more or less, of a shining greenish-black color. It is very common in the Western and Southwestern States, and is also found far north. It attacks the trunk of the tree from the ground up to the limbs, and lays its eggs at the South late in May, and in Canada in June and July. The eggs soon hatch, and the worms bore through the bark into the sapwood. It is much shorter-lived than the round headed borer. Sickly trees are more liable to its attacks than strong and healthy ones. The larvæ are easily found by using the knife, and are destroyed; and the eggs may be mostly excluded with the soap and soda already mentioned. This insect attacks the oak, soft maple, and several other trees.

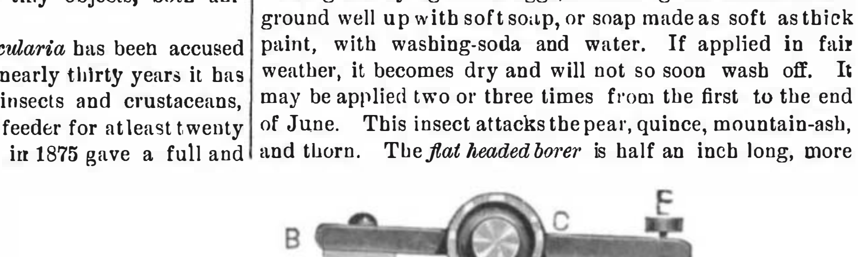


Fig. 2.—SIDE ELEVATION OF ELECTRO-PNEUMATIC VALVE.