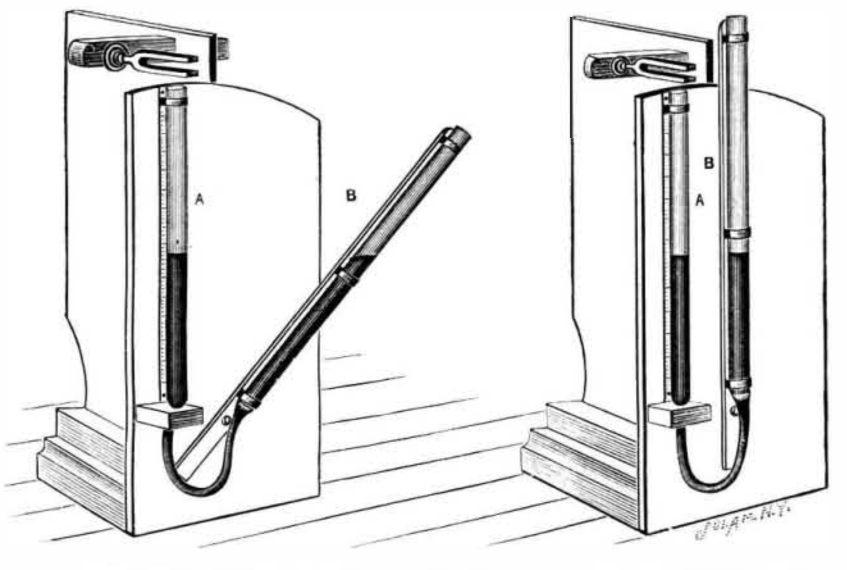
A CONVENIENT FORM OF RESONANCE TUBE FOR DETERMINING THE VELOCITY OF SOUND.

One of the essentials for securing fullness of tone in a musical instrument is that there should be as large a volume of air put in vibration by the sounding body as is possible. The difference between putting a small amount of air into vibration and a large amount may be readily shown by playing a common toy musical box, first when holding it in the hand, and again when resting it upon a suitable box.

In the first instance the result is a delicate tinkling produced by the vibration of the steel comb alone, while in the second this tone is enriched and rounded out by the vibrations of the air in the supporting box.

In studying this subject by the use of a tuning fork for the vibrating body and a glass or pasteboard tube for the resonator, it is found that the column of air in a tube of a fixed length will be put into vibration by a fork of a certain pitch, and, also, that the higher the pitch of the fork—and consequently the greater the rapidity of its vibration—the shorter must be the tube to produce resonance.



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This fact being established, the possibility of using the tuning fork and its resonance tube to determine the velocity of sound in air at once suggests itself.

The air space around any sounding body is thrown into alternate condensations and rarefactions, the condensations being separated by the length of the sound wave produced by the sounding body. Then if N represents the number of vibrations made by a tuning fork, L the wave length, and V the velocity of sound in air, the velocity will be given by the formula V = N L.

Now, in order that a tube may be a resonator for a certain fork, it must be of such a length that the pulse of the sound wave, which is put in motion when the fork starts on its path toward the tube, shall pass to the closed end of the tube, be reflected, and reach the fork just as it is beginning its movement in the opposite direction. In order to do this, the pulse of air must pass through twice the length of the tube while the fork is making half of a complete vibration, and hence must pass through four times the length of the tube for each vibration of the fork.

From this, if l represents the length of the tube, the velocity will be given by the formula $V = 4\ N\ l$.

It is found, however, by experimenting with tubes of different diameters, that a connection must be made for the open end of the tube; in other words, that to obtain a correct result, a certain fractional part of the diameter must be added to the value of l.

Lord Rayleigh gives this value as one-half, so that the formula will now read :

$V = 4\ N\ (l + r)$, in which r is the radius of the tube.

It is better to use the formula $V = 4\ N\ (l + k\ d)$, in which k is the constant required, and then determine its value at 0° experimentally. In one tube used this value was 0·56.

A form of tube by which this method of measurement can not only be readily demonstrated for class use, but the value of V accurately determined, is shown in the accompanying figures.

In Fig. 1, A is the resonance tube of 11 mm. internal diameter. This is drawn out at the lower end and connected by flexible rubber tubing to a similar glass tube which is fastened to a wooden arm, B. This arm is movable about a point at the lower end, the pivot being formed of a bolt passing through the vertical support.

Back of the tube, A, is a paper scale graduated in mm. with the scale division numbered from the position of the fork.

At a right angle to the main vertical support is another, which is so arranged that forks of different lengths may be held in position.

By filling the tubes with water to a convenient height, the length of the air column can be varied by moving the arm, B, from its vertical position as in Fig. 2, and, on putting the fork in vibration, a position can readily be found in which the resonance is a maximum.

Knowing, then, the vibration frequency of the fork, finding the value of d by measurement and the value of l by the experiment, a substitution in the above formula for V will, on reduction, give the velocity of sound in air at the temperature of the room in which the experiment was made. GEO. A. HOADLEY.

Physical Laboratory of Swarthmore College.

Photographs in Colors.

The method adopted by Mr. Ives for photographing in colors is, says the *British Architect*, another instance of American ingenuity. Acting on Helmholtz's theory that the nerves of the eye respond to wave vibrations corresponding to light of red, green, and bluish violet, and that all tints are made up of combinations of these light waves, he takes three photographs of a scene or object, screening off from the first sensitized plate all but the red rays, from the second all but the green rays, and from the third all but the blue-violet rays. Then he places the photographs on celluloid obtained from these negatives in a three-lens lantern, and projects these so that they coincide in one picture, screening his lenses with glass of red, green, and blue-violet color. The result is a large photograph in all the actual colors of nature, both landscapes, photographs of pictures or of flowers. A still more striking effect is produced by placing the treble-celluloid positives in a kind of stereoscope lantern with prisms, when the photograph of a geranium or other flower stands out with the vivid colors of nature. Of course Mr. Ives' results are very different from the colored photographs often put forward as examples of actinic power, but in which all colors but one are produced mechanically. It is remarkable that M. Lippmann, one of the professors at the Sorbonne, has also succeeded in photographing colors. At the last meeting of the French Academie des Sciences he exhibited several examples of plates from colored objects, one being taken from the national flag.

AN IMPROVED TRACTION ENGINE.

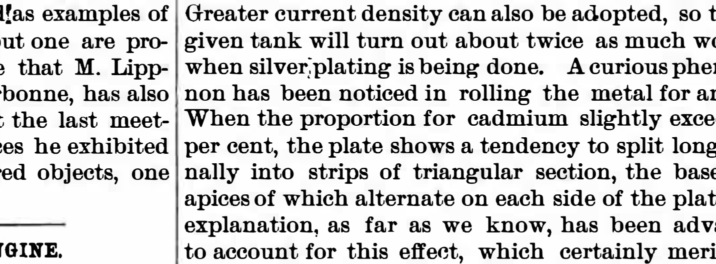
The engine shown in the illustration, while being a compact and efficient machine, is designed to travel without difficulty over uneven roads, to be run with a relatively small amount of fuel and carry a heavy load, and is also provided with means for changing its speed without changing the stroke of the engine. It has been patented by Mr. John R. Hatch, of Sugar Lake, Mo. The cylinders, supported on a suitable framework, are arranged at slightly different angles, so that there will be no dead center, and receive direct steam by a pipe leading through the smoke stack, and not exposed to the air. The valves, of the common slide valve form, are operated through a link pivoted at its ends to connecting rods extending rearward and terminating in eccentrics on a countershaft over the boiler. The link is also centrally pivoted to a rod pivoted to an elbow lever on a shaft in front of the dome, the two links being similarly connected to a lever on each end of the shaft, the shaft being also connected by a rearwardly extending rod with a lever in convenient reach of the operator, for changing or reversing the stroke in the ordinary way. The upper end of the main supply pipe in the dome has a common throttle valve, a rod from which terminates in a handle within convenient reach. On the countershaft over the boiler are disks which have a crank connection with pitman rods pivoted to the crossheads, and near the center of this shaft are different sized gear wheels meshing with similar gear wheels on a parallel shaft just to the rear, in hangers on the top of the boiler, the latter gear wheels being keyed to the shaft but adapted to slide thereon, so that, by means of a lever, the different sized wheels of the two shafts may be brought into mesh with each other to change the speed of the machine, causing it to run slowly, with increased power, as may be desired, in going up a hill, or with greater speed when the pull is less. On the rear shaft is the usual fly wheel, from which power may be taken by a belt in the ordinary way, the shaft being likewise connected with the governor, and on one end is a gear wheel meshing with a lower pivoted gear wheel at the side of the boiler, the latter wheel meshing with a compound gear wheel on a shaft below the boiler. This shaft has at each end a gear connection with the rear wheels of the machine, the axle resting in socketed heads in which are spiral springs to prevent jar, and beneath the center of the boiler in front is a depending socketed head, in which is a strong spring, and through which a king bolt extends, passing through the front axle. Each end of this axle is connected by a chain in which is a spring with a steering shaft in front of the firebox, the shaft having on one end a worm wheel meshing with a worm on a shaft extending diagonally upward and carrying a crank disk, by revolving which the front axle is turned as desired to steer the machine.

Electroplating with Silver Alloys.

The alloy now deposited is one of cadmium and silver, or of zinc, cadmium and silver. The percentage of cadmium used is from 25 to 35 per cent, although for common work a much larger proportion of the cheaper metal may be employed. The bath is made by dissolving cadmium cyanide in a solution of potassium cyanide, and adding a small quantity of the double cyanide of potassium and silver. The anode consists of an alloy of cadmium and silver of about the same composition as the deposit required. The bath is worked cold, and the electrodes are kept in motion, in order to prevent the formation of layers in solution of different densities. For this purpose the plates are carried on a frame, to which motion is communicated from a shaft running parallel to the end of the bath, by means of a rod and eccentric, and at the same time a vertical movement is obtained by causing the frame to ride up short inclined planes placed at the side of the bath. The alloy can be deposited on such metals as form a suitable substratum for silver plating, either direct upon white metal alloys, or on a previously coppered surface in the case of iron. A weight of an ounce to a square foot gives a good coating, and, like the original alloy, there is said to be less tendency to tarnish than when silver alone is used. Greater current density can also be adopted, so that a given tank will turn out about twice as much work as when silver plating is being done. A curious phenomenon has been noticed in rolling the metal for anodes. When the proportion for cadmium slightly exceeds 35 per cent, the plate shows a tendency to split longitudinally into strips of triangular section, the bases and apices of which alternate on each side of the plate. No explanation, as far as we know, has been advanced to account for this effect, which certainly merits investigation. The process as a whole is chiefly interesting from the fact that it adds another to the scanty list of those in which an alloy is successfully deposited. It may be that in time alloys will hold as useful a position in commercial electrolysis as they already do in other industrial arts.

Iceberg Bears.

The steamship Ems arrived recently at New York from Bremen. Captain Sanders reported that on



HATCH'S TRACTION ENGINE.

May 21, just to leeward, a large iceberg was sighted about sunset. Such a sight is not often witnessed by passengers, and every one crowded to the bulwarks.

After watching some minutes, all agreed they saw human beings on the ice, and the steamer's course was changed so as to bear closer on. It was then discovered that two large polar bears were pilots of the iceberg, which was traveling to warmer seas. No attempt was made to rescue the adventurous voyagers.