rate) until the pressure is the same in the two tanks. If the valve v_2 is opened instead of v_1 there will be a flow from A to the atmosphere, and, since the tendency to flow depends on the difference of pressures, it follows that the tendency to flow from A to the atmosphere, when the valve is first opened, will be three times as great as the tendency to flow from A to B when v_1 is opened. The difference of pressure in one case is $150 - 0 = 150$, and in the other case it is $150 - 100 = 50$. (The pressure of the atmosphere is here taken as zero.) If the valve, v_2, is left open, the pressure in A will gradually fall to that of the atmosphere, which does not change because of its practically infinite volume.

Suppose, now, that C and D (Fig. 2) represent two bodies into which electricity has been pumped (from some other body, such as the earth), so that the potential of C is 150 units and that of B is 100 units. (The unit of

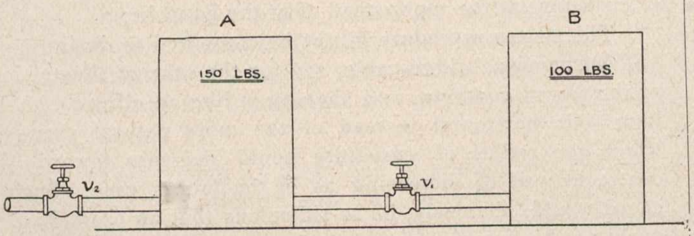

FIG. 1

potential will be defined later.) Let these two bodies be connected by a conductor in which is placed a switch, s_1, and let C be connected to earth by another conductor with switch, s_2, interposed, as shown in the figure. The whole arrangement is thus similar to the arrangement of tanks and pipes shown in Fig. 1, the earth corresponding to the atmosphere, the conductors (wires) corresponding to the pipes, and the switches taking the place of the valves. If, now, the switch, s_1, is closed, electricity will flow from C to D, and the tendency to flow is directly proportional to the "difference of potential" between C and D. Suppose, for example, that the current is five amperes at the instant the switch is closed, with a difference of potential of fifty units, then the current would be ten amperes at the instant the switch is closed, with a difference of potential of 100 units. In either case the flow will continue (at a decreasing rate) until the potential is the same on the two bodies. If the switch, s_2, is closed instead of s_1 there will be a flow of electricity to the earth, the tendency to flow being proportional to the difference of potential between C and the earth. The flow will continue until the potential of C is equal to that of the earth, the potential of which will not be appreciably changed by the addition of the relatively very small quantity which will flow into it from A.

From the above it is seen that a body charged with electricity may be compared to a tank charged with a gas, that electric potential is exactly analogous to the mechanical pressure exerted by the gas, and that the flow of electricity in a wire is exactly analogous to the flow of gas in a pipe. While the analogy is very helpful in assisting the beginner in understanding the laws which govern this mysterious agent, it does not warrant the conclusion that electricity is some kind of material fluid. It **may** be a fluid, or it may be only a condition of the ether, as some physicists are inclined to believe. From the point of view of the practical engineer it makes little difference which is correct. This is a question which he may leave to the physicist. By regarding it as a fluid, however, he can compare it with other things within his experience, and consequently can more easily understand its laws.

In dealing with pressures in practical work it is usual to take the pressure of the atmosphere as the zero of pressure, because of the fact that this pressure is exerted normally in every direction about us, and is, therefore, the most convenient zero. Apart from this, it is not of much importance to the engineer what zero is used, for in most cases he is concerned only with "differences of pressure," just as he is concerned only with "differences of temperature." This is more strictly true in electrical work, for here the engineer deals with differences of potential **entirely**. Notwithstanding this, it is convenient to have some zero of potential for reference, and, just as it is convenient to use atmospheric pressure as zero, so it is convenient to take the potential of the earth as zero. The potential of a body will, therefore, be positive if electricity will flow from this body to earth when the two are connected by a conductor, and negative if electricity will flow in the opposite direction.

When the pressure of the atmosphere is used as a zero the pressure inside a vessel from which the air has been partially pumped is negative. There is a limit, however, to the negative pressure. When the air is all pumped out (and it is possible to do this) the pressure cannot be reduced any further, and the pressure within the vessel is said to be **absolute** zero. If, now, an attempt is made to pump the electricity out of a body (which is insulated to prevent electricity from flowing into it from other bodies) the potential may be reduced as far as possible without any indication that the electricity on the body is approaching exhaustion. This would tend to prove that electricity is infinitely elastic. Even though it were not, it is impossible to remove all the electricity from a body, for when the potential is reduced to a certain point electricity will leak into the body from the air and from other bodies with which it is in contact as fast as it is pumped out—the so-called insulators will become conductors. For this reason an **absolute** zero of potential cannot be reached. If it were possible to perfectly insulate a body, and means were available to reduce the potential indefinitely, it might be found that the body would all disappear; i.e., assume the form of electricity.

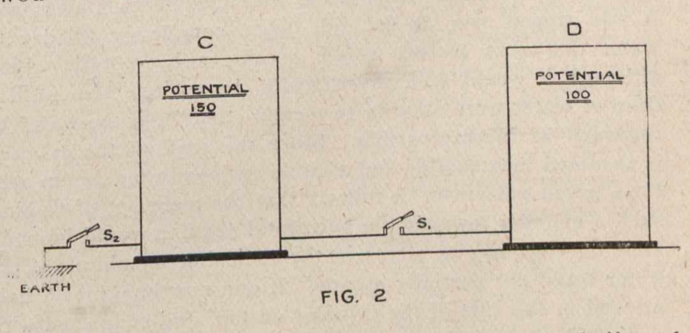

FIG. 2

The practical unit of potential is the "volt," and corresponds to "pressure per square inch" or equivalent "head." It is an arbitrary quantity, and is properly defined in magnetic terms. No attempt will, therefore, be made to define this unit until after the subject of magnetism has been treated. It may be here noted, however, that if the potential of a body is one volt, the energy required to pump one coulomb of electricity from the earth into this body is 10^7 ergs $= .74$ ft. lb.

(To be continued.)