from this torch is directed upon the joint of the aluminium bars to be welded at *B*, a box being provided on the top of the platform for catching any molten metal.

The flame from the benzine lamp, *C*, is projected against the aluminium joint to be welded between the clamps at *B*, and when the necessary temperature has been reached by the rods to be welded, a slight pressure is applied to the levers *D*, causing them to unite, and the metal is squeezed out in the shape of a ring, as shown in Fig. 2. It is stated by Mr. Cowper-Coles that this ring of metal is largely composed of aluminium oxide, which acts as an insulating and supporting collar, the molten metal being retained within this collar. The tank, *F*, having previously been supplied with water, and charged with a considerable air pressure by means of the pump located under the upper platform and operated by handle *E*, is ready for supplying through *A* the necessary cooling liquid when the handle controlling the same is moved.

The aluminium bars to be welded, having been placed in the jaws, raised to the proper welding temperature by the flame from the lamp, and pressed together at the proper moment by the levers *D*, a perfect weld is formed at the joint, and as soon as the weld is made, it is rapidly cooled by turning the handle attached to the screen *A*, which allows water under pressure to be projected from the reservoir *F*. The screen, *A*, is placed in front of the heating flame by the same handle which turns on the water, and the water pressure is maintained by the hand pump *F*, which supplies compressed air to the tank. After the rod has been removed from the machine and the collar filed off, it is claimed that the joint is as strong as the rest of the rod.

It is well known that soldered aluminium joints have not been found satisfactory, as they do not stand a great length of time, on account of the galvanic action which takes place between the solder and the aluminium, the former electro-negative to the latter in a voltaic couple. One of the principal difficulties found in the welding of aluminium is that it passes into a mushy or brittle state a few degrees under smelting point, and the solder freezes before flowing properly, it cools so rapidly. The best welding temperature for aluminium, it is claimed, lies just below the point where this pastiness occurs, and this metal has been welded at temperatures varying from 420 deg. C. (788 deg. Fahr.) to 600 deg. C. (1,102 deg. Fahr.), the latter being the temperature proposed by Wiszniewska and Strzelecki for welding aluminium in a non-oxidizing manner, this being accomplished by a heated plate, and in contact with a volatile compound with an affinity for aluminium, say flouride or nitrate of aluminium in a powder or solution. Mr. Cowper-Coles states that an oxy-hydrogen flame or gas with or without air blast can be used instead of the benzine lamp. The accompanying illustration, Fig. 3, shows the case or pipe of aluminium oxide, which supports the molten aluminium within. This view shows the outer shell of aluminium oxide, which has been pricked with a steel point, allowing some of the molten metal within to flow out. One of the beads of molten aluminium, which is incased in aluminium oxide, is shown in Fig. 4, the drop of metal having been allowed to fall on a metal plate. The broken aluminium oxide casing or shell may be noted by the dark portions. In a recent paper before the Faraday Society in London, on "Some Notes on the Welding of Aluminium," by Sherard Cowper-Cowles, he states that Dick in 1900 devised a machine for welding aluminium by the removal of the oxide mechanically, combined with pressure, while Heraeus, of Hanau in Germany, takes advantage of the fact that aluminium becomes plastic at a certain temperature, and can be kneaded into any shape. He further states that electric welding of aluminium has not been successful commercially, either by electric arc heating or by allowing the joint to be welded to form a resistance to the electric current. Aluminium welds have been made by Anderson by means of an electric arc drawn down by a magnet and a special tool and flux, while Schmidt uses a carbon-graphite or platinum stick through which he passes an electric current. By this process, the flow of current is such that the carbon stick acts as an anode with the metal to be welded as a cathode, the carbon stick being used somewhat as in soldering, it being moved over the portions to be welded, removing the oxide formed, the latter being reduced by the heat of the carbon.

On a test of several of a number of welds, made by the Cowper-Coles aluminium welding machine for tensile strength, the fractures occurred at quite a distance from the weld, showing that the metal was not deteriorated. One of the specimens having a diameter of 0.249 inch and an area of 0.0487 square inch was found to have a reduction of area at the fracture of 7.4 per cent, the extension on four inches being 8 per cent, while the break occurred on none of the twelve specimens tested at the welded portion. The specimen above mentioned had an elastic limit of 11,491 pounds per square inch (5.13 tons), while the maximum stress was found to be 20,249 pounds per square inch (9.04 tons). It is stated that in some cases very minute holes were found in the welds, but they were not large enough to affect the strength of the rod which was welded.

Another specimen having a diameter of 0.25 inch, with area of 0.0491 square inch, had a reduction of area at the fracture of 7.7 per cent, the extension on four inches being 9 per cent. The elastic limit was 12,320 pounds per square inch, or 5.5 tons, while the maximum stress was found to be 20,070 pounds per square inch, or 8.96 tons. One of the specimens had an extension of 14 per cent, with a reduction of area at the fracture of 7.7 per cent, the elastic limit in this case being 10,236 pounds per square inch, or 4.57 tons, and the maximum stress 19,152 pounds per square inch, or 8.55 tons per square inch.

Mr. Cowper-Coles states that the Jones process for making aluminium tubes consisted in simultaneously winding a flat strip of the metal in spiral convolutions, welding the abutting edges of the convolutions by the heat generated by the local passage, through the immediate parts to be joined, of a low-tension current of electricity, and pressing the heated edges toward each other with the necessary force.

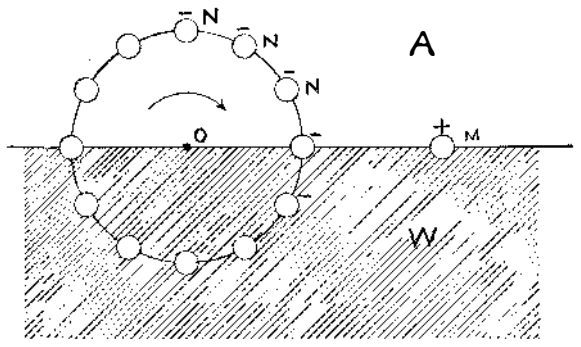
The subject of welding aluminium is a most interesting one, and is of considerable importance, on account of the extensive way in which this new metal is being used in the arts.

AN INTERESTING PARADOX.

BY DANIEL F. COMSTOCK.

Although the chimera of perpetual motion has retreated so far into the distance that scientific men consider themselves absolutely safe in assuming some fallacy in all propositions which involve the creation of energy, yet it sometimes happens that the various components of a system may be so arranged that this fallacy is by no means easy to detect. The common characteristic of such cases is thus rather a psychological than a physical one, for it is in the mind of the observer and not with Dame Nature that complication really exists.

The following is a paradox so apparently simple and yet so delusive that it possesses a peculiar interest:



AN INTERESTING PARADOX.

Referring to the figure, *W* is water and *A* is air. A wheel made of insulating material is constructed to turn about an axis, *O*. The wheel has metal balls, *N*, placed around the periphery, and these are charged negatively, while the fixed metal ball, *M*, is charged positively. Each ball has a thin layer of insulating material surrounding it, in order that the electricity may not leak into the water.

The fixed charge, *M*, will now attract all of the movable charges which are above the surface, but will have practically no effect upon those below the surface. This follows immediately from the fact that the dielectric constant of water is nearly eighty times that of air. In other words, air transmits electrostatic force with eighty times the readiness of water. Hence the astonishing conclusion that the wheel will continuously rotate in the direction indicated by the arrow.

The discovery of the fallacy, which is more or less hidden, is left to the insight of the reader.

The Pollok Prize.

Owing to the unsatisfactory results obtained at the two competitions which have been held for the Pollok prize, it was decided that an investigation should be made for the purpose of securing the opinion and advice of the various maritime associations, boards of trade, and chambers of commerce in the leading cities of the world, as to the best means of accomplishing the end in view.

The International Association of Paris undertook this mission, and, after an extensive investigation, submitted a report some few months ago, in which it was recommended that the Pollok prize be transformed into a permanent endowment fund, the interest to be awarded periodically to the inventor or inventors of the best methods or devices for preventing collisions and loss of life at sea. The founders of the Pollok prize decided to accept the recommendations made, and to place the endowment fund in charge of the International Maritime Association, 3 Rue des Mathurins, Paris. The rules and regulations governing future competitions will be published shortly.

Engineering Notes.

Despite severe competition from American and German locomotive builders, the contract for fifteen powerful compound express locomotives, required by the Chilian railways, has been secured by the North British Locomotive Company, of Glasgow.

The British consul at Trieste, in a recent dispatch, reports that a large establishment for the manufacture of Portland cement will be erected near Albona, in Istria. The output is destined entirely for exportation. It is said that immense quantities of stone adapted for the manufacture of cement exist in the neighborhood, as well as a coal mine. All are situated close to the port of Rabaz.

At a meeting of the Royal Statistical Society held recently, Mr. Edgar J. Harper read a paper on "Statistics of London Traffic." Mr. Harper showed that there were about 600 miles of railway in greater London, of which 222 miles were in the county itself. It would seem that South London was better equipped with railway facilities than North, especially in proportion to population. The number of stations per square mile was almost the same on both sides of the river, but on the north side each station had to serve a population 10 per cent greater on the average than on the south side. The length of railway per square mile in the south was nearly 30 per cent more than in the north, while the population per mile was 45 per cent less. As many long-distance trains arrived from the south as the north, although the local trains were 20 per cent less.

We are accustomed to think and speak of the enormous and steady progress made in modern industrial machinery. While in general this may be true, in the office building it is only true of the details. We are beginning to put into effect improvements suggested years ago, and have made real progress in the direction of carrying out our plans more quickly, and all things considered, more cheaply; but our plans have not changed substantially, and the limiting conditions are the same. We are still aiming to make our buildings attractive, easy to rearrange to suit tenants, well lighted, with convenient internal communication, polite and efficient service, quick elevators, and as accessible as possible to elevated and underground stations. We supply them with every necessity and many luxuries, and do all in our power to get the maximum return for the money invested. The writer considers it certain that for at least a generation there will be an imperative demand for office buildings, and that the present type will be practically unchanged in its broad outlines. The improvement made during the past ten years may be briefly stated. There has been a very slight increase in net elevator speeds obtained mainly by improved signaling devices. Automatic heat regulation is practically unchanged, but it is a little generally used. Gas has practically been entirely replaced by electricity. The finish of the buildings is a little more luxurious and the exterior a little more expensive. The average height of a building is increased. To-day the highest practicable speed for a way elevator is 450 feet per minute, and for an express 600 feet to 700 feet per minute, depending on the distance traveled. We may, therefore, safely say that the future will see but little improvement, except in details.—Architectural Record.

Cornelius Voet, of Haarlem, Netherlands, has invented a novel coal-saving apparatus which seems promising. The company for the management of the State's Railways in the Kingdom of the Netherlands tested the apparatus at the Central Electric Works in Utrecht during 11½ successive hours, during which trial a saving of 18.2 per cent was found. The Steam Navigation Service of the Royal Dutch Navy, Section Amsterdam, applied the apparatus to the boiler of a dispatch boat. The inspector declares that the apparatus upon trial gave excellent saving results, and upon further use proved quite satisfactory. On a German steamer of the firm Fried. Krupp at Essen, on twelve voyages from Rotterdam-Bilbao and Santander and back to Rotterdam, the following results were obtained: Without apparatus, 13.13 tons of coal used per 24 hours; with apparatus, 12.01 tons of coal used per 24 hours. The apparatus supplies the furnaces of boilers with the air necessary for combustion and to apparatus therefor. In the ordinary way such supply of air is obtained either by artificial draft or by a blower or blast device. In the case of artificial draft the air is drawn by the chimney through the grate and the fire-tubes, while in cases where blast is used the air is forced through the grate at a pressure in excess of that of the surrounding air. This excess pressure is produced in all known cases by means of a blower or blast device. Mr. Voet's invention relates to an arrangement whereby such excess pressure is produced by the outer air itself, the air being received and pressed by the pressure of the outside air or current into air-collecting heads communicating through pipes with the space under the grate, into which the air rushes with the excess pressure thus acquired.