attempt to decrease the dissociation of the morphinate by ammonium chloride in *e* and thus permit its removal from the solution did not prove successful. The ammonium chloride apparently acts as so much free ammonia. The discrepancy in *e* between the weight of the residue and the morphine indicated by titration is due to ammonium chloride taken up by the solvent; to a moderate degree such disagreement is seen in all determinations.

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IMPROVED ELECTRIC FURNACE FOR LABORATORY USE.

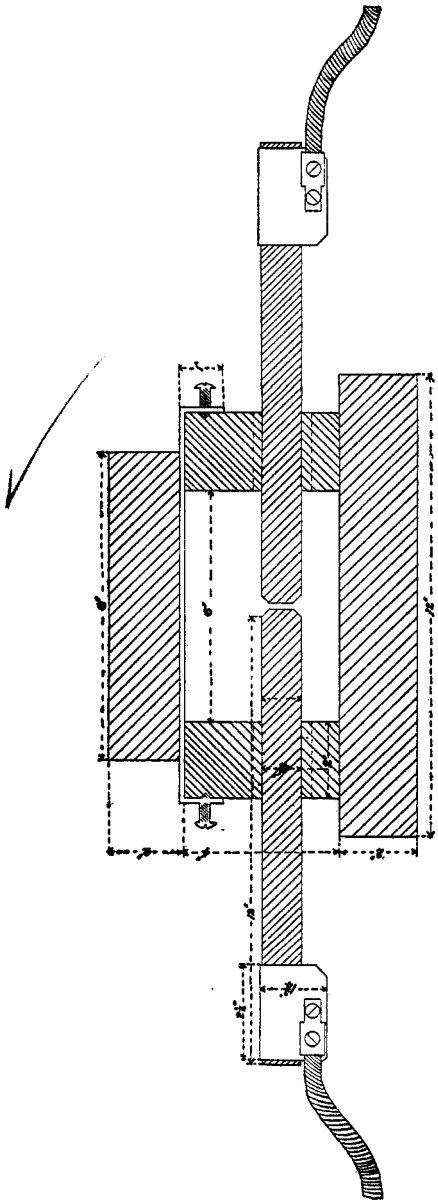
BY SAMUEL AUCHMUTY TUCKER AND HERBERT R. MOODY.

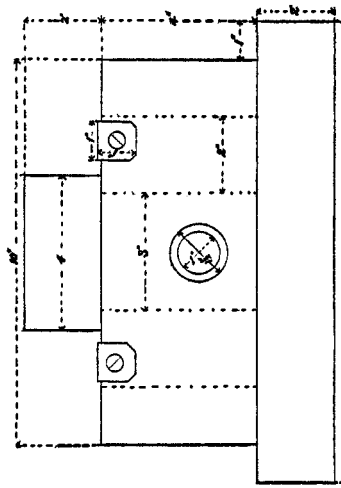
Received June 1, 1901.

ELECTRIC furnaces hitherto described have been found by the writers to possess certain disadvantages for experimental purposes. This led them to devise the form of furnace herein described which it is thought is a convenient piece of apparatus to build and will be found to be well adapted to a variety of work in the laboratory.

The Moissan type of furnace is now well known to every one, but it is troublesome in several ways. If built from chalk blocks in the rough, it takes both skill and time to cut them to the exact form required; it is then necessary to dry the blocks very thoroughly, otherwise they will crack in all directions and render the furnace useless immediately. A perfectly dry furnace supported by metallic bands will generally crack to some extent, and it is seldom possible to put the furnace in use a second time. The form of furnace described by one of us[1] which simply consists of a graphite crucible forming one pole, the other being a carbon rod supported vertically with an arrangement for raising and lowering it at will is useful for some purposes, but there is too much exposure to the air for many operations, and the material of which the crucible is composed is likely to introduce undesirable impurities during the fusion. The operator is exposed to very intense radiant heat which interferes considerably with its use for any lengthened period. The present form of furnace is after the Moissan type and is composed of carbon bricks 12 inches by 4 inches by 2 inches, luted together with Dixon stove paste. The sides of the furnace were of 6-inch brick, thus making

[1] *American Electrician*, II, 408.





a working space of about 6 by 4 by 2 inches. This space could, of course, be increased or diminished at will according to the charge used. The whole was then clamped and held firmly together by iron cross bars provided with adjusting screws at each end, these bars being insulated from the body of the furnace by strips of asbestos. The end bricks were perforated with 1.5-inch holes containing a collar of asbestos or a small cylinder of clay, through which the electrodes of carbon passed (1 inch by 12 inches) into the furnace chamber. Connection was made with these electrodes by copper sleeves lined with copper gauze and tightened with set screws which at the same time carried copper lugs which held the flexible cables.

The tendency to overheat those portions of these electrodes outside of the furnace, and consequent wasting away, and also the tendency to melt the copper connections, was overcome by either one of two expedients; that is, by the use of the water-jacket or by heavily copper-plating the carbons. This latter did not furnish quite as perfect a protection, but it was somewhat less troublesome than the former, and was consequently the one most used.

The construction of this furnace gives it considerable durability; so much so is this the case, that only three sets of brick were used throughout the year in which almost a hundred runs were made. The greatest deterioration comes from the oxidation of the outer surface of the carbon bricks, and this could be largely avoided by a suitable covering of fire-bricks. Frequently ten or twelve runs could be made without dismantling the principal parts and the substitution of new asbestos collars serve to make everything ready for the next run.

In this type of furnace the desired current may be readily maintained throughout the entire fusion, and this is not easily done with a crucible furnace where variations are unknowingly introduced by the constantly changing distance between the poles. This form of furnace may be used with double arc on 110 volt circuit with considerable economy. For example, with a single arc furnace and with a polar separation of 18 mm. and enough resistance in circuit, the followiug reading was obtained: 125 amperes, 70 volts, and consequently 8,750 watts.

These should be compared with the following results obtained while using the double arc furnace. Here all the resistance was

cut out and then the instruments showed 175 amperes, and 90 volts. A few moments after this the reading was 125 amperes, and 100 volts or 12,500 watts.

The only difficulty in using this type is to prevent the extinction of the arcs, but that trouble is far from insurmountable. The dimensions given for the furnace are suitable for currents up to 300 amperes, at 70 volts. For work requiring more power than this it is necessary to increase the size throughout and use electrodes of 2-inch diameter.

If the luting has been carefully done the furnace will be sufficiently gas-tight to permit a fusion to be carried on in an atmosphere of any desired gas, the gas being introduced through an annular electrode. This furnace is adapted to almost all kinds of fusion processes, and has been used in the greatest variety of work.

[CONTRIBUTION FROM THE LABORATORY OF ANALYTICAL AND APPLIED CHEMISTRY, UNIVERSITY OF MICHIGAN.]

THE OXIDATION OF NITROGEN AS A SOURCE OF ERROR IN THE ESTIMATION OF HYDROGEN AND METHANE.

BY ALFRED H. WHITE.

Received June 10, 1901.

THE author had occasion some time ago to estimate accurately a small amount of methane mixed with a large amount of hydrogen. A sample mixed with air was exploded in a Hempel pipette with due precautions to insure accuracy, the measurements being made in the author's burette for exact gas analysis previously described in this Journal.[1] Though great care was taken in the work, the results were so discrepant as to be entirely useless for the purpose. The results of a series of five experiments follow, arranged in the order of explosive ratios.

TABLE I.—EXPLOSION OF HYDROGEN AND A SMALL AMOUNT OF METHANE.

		After explosion.				
Gas sample. cc.	Air. cc.	Contraction. cc.	CO_2. cc.	Hydrogen. Per cent.	Methane. Per cent.	Explosive ratio.
12.87	103.24	16.97	0.05	87.64	0.39	5.77
13.79	86.89	18.39	0.04	88.51	0.29	5.08
13.17	84.18	17.56	0.06	88.27	0.45	4.54
14.77	87.23	19.66	0.09	87.92	0.62	4.20
18.38	87.03	24.48	0.16	87.62	0.87	3.30

The increasing amounts of carbon dioxide can not be laid to

[1] This Journal, **22**, 343.