chronometer-maker, but the navigator rating his own chronometer is easily misled by them.

4. There is still a point to which I wish to make a brief reference; viz., the absolute accuracy of time-singals in general; for this question is one of great importance in rating chronometers. The best data that have yet been obtained for determining this question are the series of daily comparisons of time-signals of the Naval Observatory at Washington, the Cambridge (Mass.) Observatory, and the Allegheny (Penn.) Observatory; this having been done for some years by Mr. James Hamblett of the Gold and Stock Exchange of New York City, in order to regulate the standard clock which furnishes New York with accurate time. The comparisons frequently show differences of two and three seconds between the observatory standard clocks, and I believe instances are not wanting in which the amounts reached even five seconds.

Recognizing that these comparisons could not, perhaps, lay claim to the greatest accuracy attainable, an elaborate plan was matured some years ago by which the United States Signal Service should make a daily comparison of the time-signals of a dozen of our principal observatories, and thus find out with certainty the accuracy attainable by a single observatory, and to inquire into the desirability of the permanent organization of a sort of clearing-house system of time distribution, by means of which a very accurate time-signal could be distributed over the whole country, no matter what the weather might be. For various reasons this plan was not carried out, but its execution is still very much to be desired.

Taking into account the just mentioned facts, and others which might be given, I think that a careful inspection of the ships' chronometers and their rates should be made as frequently as may be found possible. The exact form of this inspection, which might be undertaken by the exchanges, and the best method of securing the greatest accuracy in rating ships' chronometers, cannot be discussed here.

Concerning the compasses on shipboard, I will only say, as has been frequently urged, that they should be examined and tested at every opportunity. The possible errors of the compass have been thoroughly studied, and those existing can be accurately determined; but the subject is too technical to be explained in a few words. FRANK WALDO.

Cincinnati, O., March, 1890.

Storage-Batteries.

MANY a person who has experimented with secondary batteries has become convinced, as I have, that the Planté form of battery was superior, especially as regards durability, to any of the various batteries in which the "active material" is applied in the form of paste. Realizing that this superiority was mainly due to the relation of the molecules of the active material with each other, and also their relation with those of the support part of the electrode, I was led to make experiments, the outcome of which was a storage-battery, which I have patented. For the sake of illustrating how the Planté form of battery is superior to the pasted forms, I will suppose that a piece of wood represents the support of the pasted plates, and that sawdust represents the oxide which is to be applied to the support part of the electrode in the form of a paste. The sawdust may be mixed with this, that, or the other liquid, and made to adhere to the wood, to a greater or more likely to a lesser extent. I immerse this wood electrode, if I may be allowed to call it such, in sulphuric acid: the sawdust will fall off in a comparatively short time, leaving the wood support to a more gradual destruction. If the surface of wood could be changed in some way so that it would resemble sawdust, and yet in such a way that the molecules of this changed surface preserve to a considerable extent their original relation with each other (that is to say, their original attraction for each other), and at the same time preserve their attraction for the molecules of the unaltered portion, we would then have a wood electrode (I apologize for the term) which would resemble the lead electrode of Planté. Almost invariably, when the pasted electrodes peel, they do so, not from the surface of the "active layer," but from the surface of the support metal. I have experimented with but one Planté battery, which, by the way, was the first storage-battery that I ever made. This battery was charged to its greatest possible capacity many times, and also discharged suddenly, but the active layer has not peeled from the non-oxidized portion of the lead plate. There has been at times a falling of fine particles of peroxide, but no peeling such as you get in pasted batteries.

The sooner storage electricians recognize that the greater the attraction of the molecules of a secondary electrode for each other, the more durable will the electrode be, the better for all concerned. Just as soon as storage electricians recognize the fact that the quality of a storage-battery is to be judged, not by the amount of peroxide the electrodes contain, but by the degree of attraction which exists between the molecules of the active layer, their experiments will be more fruitful, and the pasted plates of to-day will be no more. The problem is not how to store oxygen, but how to increase the affinity of each molecule of an oxide for its neighbor. Hoping that these remarks will set the readers of *Science* a-thinking, and that they may have some weight towards convincing them that all that is necessary in a good storage-cell is molecular affinity, I close my communication with great faith in the future of storage electricity.

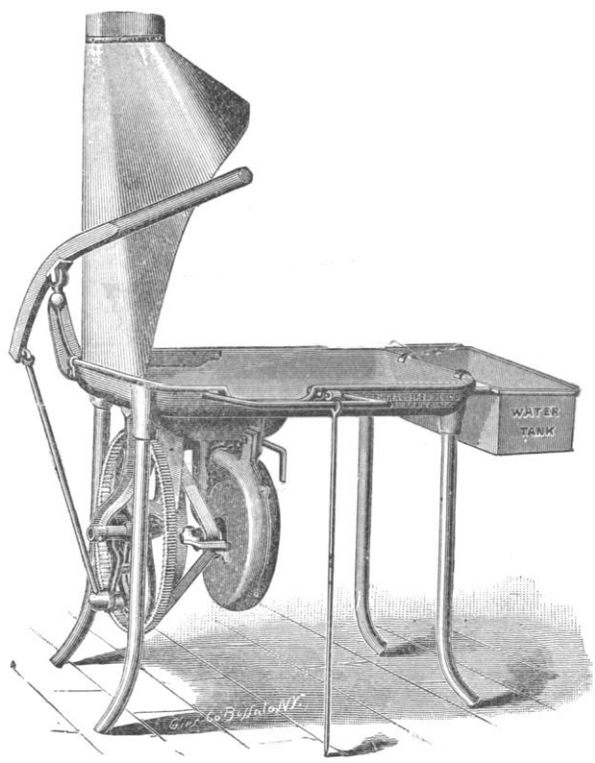
N. B. ALDRICH.

Fall River, Mass., March 18.

INDUSTRIAL NOTES.

Buffalo Blacksmith's Forge.

FEW progressive blacksmiths or metal-workers who look into the matter fail to acknowledge the superiority of the modern portable forge over the bellows and stationary blast-forge. By



A NEW BLACKSMITH'S PORTABLE FORGE.

the use of an improved portable forge, heat is produced more quickly and with less labor and cost. The portable forge also takes less space, while, so far as durability and reliability are concerned, a comparison between the two is much to the disadvantage of the old style. The first cost of the brick forge is greater, and subsequent repairs and occasional movings make a considerable item of expense, while repairs are seldom required on an improved portable forge; and it may be moved from one part of the shop to another with little trouble.

In the accompanying engraving is shown the latest pattern of improved portable blacksmith forge, made by the Buffalo Forge Company. The distinguishing features of this forge are, easy lever and swivel movements; steady powerful blast for heavy work, and even, light blast for light work; no dead centre to overcome in starting; all of which are important factors in the successful working of a forge. The bearings, which are of hardened steel and of more than ordinary length, deserve comment also. By referring to the illustration, which shows the No. 0 size, it will be seen that the forge has a large fan-case. 14 inches in diameter, which affords a maximum blast with a minimum expenditure of power. A point of importance is that the blast continues some little time after a stroke is made, sufficient to allow the operator to work upon the iron quite a while before it ceases.

This forge is also arranged for belt attachment, for general use in large shops where power is used. When run by belt, a cut-off for the blast is provided, which permits of the fire being regulated to any required degree.

The A. B. C. Electric Motor.

ONE of the latest additions to the long list of small electric motors now in the market is shown in Fig. 1. It is made by the A. B. C. Motor Company of this city, and embodies some of the ideas of Mr. Brown of that company.

The A. B. C. motor is designed so as to obtain, with a small expenditure of current, a maximum amount of magnetism, and to produce a machine that will do its work at a high rate of efficiency over a wide range of power, and at a moderate and constant speed under all loads. The field-magnets are laminated, permitting the use of sheet iron, a form in which soft, pure iron can be obtained of uniform quality. The several laminated sections, as shown in Fig. 2, are bound together, not by means of bolts passing through them in the usual manner, but by an arrangement of rods fitting into the notches shown, which are formed by the die in the outer edges of the plates. By means of this construction any irregularity caused by inexactness in the separate punching of holes is rendered impossible. The field-magnet has but one coil, and consequently no yoke is necessary in its construction. The field-magnet is ample in cross-section, and as short as possible, the entire space between the limbs being filled by the coil and the armature. This form of construction gives a magnetic circuit of very low resistance.

The armature is thoroughly insulated, and can be removed very quickly if necessary. The brushes, being at the top, can

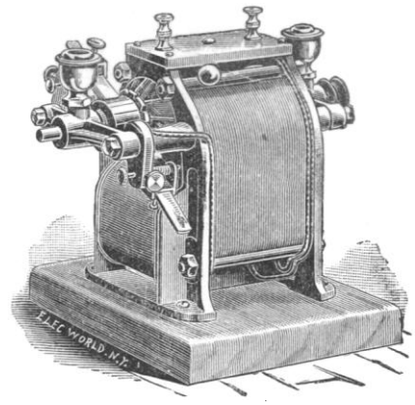


FIG. 1.

also be readily inspected; and, the armature being elevated, it is not necessary to place the motor on a special base when required for fan purposes. The mechanical construction of the

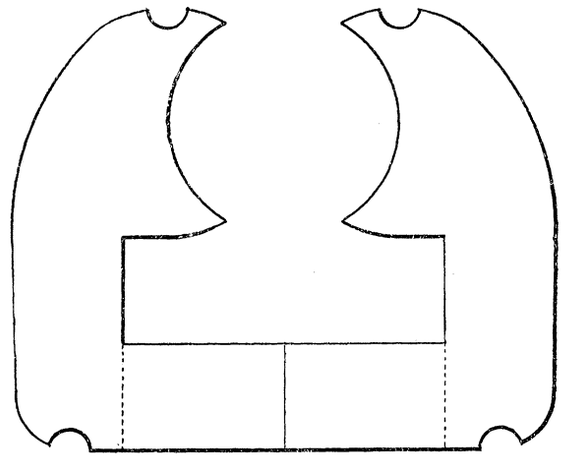


FIG. 2.

motor throughout has been carefully attended to, and all the details of the motor have been well worked out.