THE BALL ELECTRIC LIGHT SYSTEM.

When it is shown that a machine performs its work with two-thirds the power required for driving other machines of the same class and the same nominal capacity, and when it is demonstrated that the machine does this without destructive wear or other ill effects, it becomes an interesting question as to how the superior results are obtained; and if the machine be constructed with almost entire disregard for accepted principles, the matter becomes still more interesting, and is naturally referred to experts for explanation; and when experts who are governed by accepted principles are obliged to say that "it is a good and efficient machine constructed on bad and inoperative principles," we have an anomaly which needs explanation.

This is about the scientific status of the Ball dynamo electric machine, which we illustrate. Its practical and commercial standing show in a remarkable way that accepted scientific principles are not always reliable as the basis of business operations, and that theory is sometimes unsupported in practice. The Ball dynamo was at first called an unipolar machine, which, according to the common understanding of the term, is incorrect. It was not, however, so named by its inventor; but wherever it has appeared in the literature of the subject, it is known as the Ball unipolar dynamo.

By referring to the engraving, it will be seen that the field magnet of this dynamo consists of four cylindrical bars of soft wrought iron, arranged in two pairs connected with yokes or end pieces, which also form the support of the armature shaft. To these bars are secured curved pole pieces, which partly encircle the armatures, one pole piece being attached to each pair. Upon the armature shaft are mounted two Gramme armatures, one arranged to revolve in proximity to the upper pole piece, the other being similarly arranged with reference to the lower pole piece. The pole pieces are diagonally opposite each other, there being but one for each armature. It will be noticed that the bars forming the field magnets are of unusually small diameter, and that the winding of the field magnet is apparently somewhat out of balance.

The two armatures, which are independent of each other, are each provided with a commutator. The positive brush of one commutator is connected with the outgoing conductor, and the negative brush of the other commutator is connected with the return conductor. The remaining brushes of the two commutators are connected to the terminals of the field circuit. The armature shaft has a central bearing, and upon one of its extremities outside of the yoke of the magnet is arranged a pulley, which is preferably of the same diameter as the armatures. A noticeable feature of this dynamo is that its armature is driven by a belt which is comparatively very narrow.

The commutators of this machine are substantially made of bars of pure copper, with intervening sheets of mica, the whole being clamped together by heavy bronze clamps, forming a practically solid cylinder, with an arm extending from each bar to the periphery of the armature, to receive the ends of the conductors forming the armature sections.

The armature ring, which is of the Gramme type, is supported by adjustable spiders, which permit of great accuracy in the adjustment of the ring, and also of perfect balancing, so that the dynamo runs steadily and without jarring. The armature rings are constructed according to a method which yields an armature which is almost as solid as if it were of homogeneous metal throughout. The winding is thoroughly soaked with insulating material, so that all of the covering of the wire is thoroughly saturated, and the insulation is baked on by heating the conductor by means of a current from a large dynamo. After the insulation becomes dry, the ring is provided with a protecting covering of tape, and is surrounded by bands of steel wire, for retaining the conductor of the armature against pressure due to centrifugal action.

These dynamos are made for both arc and incandescent lighting. There are five sizes, and of each size there are machines of four different windings, thereby virtually furnishing twenty different machines. The journal boxes of the armature shaft are made of fine, hard bronze, which shows no appreciable wear after years of use.

A complete Ball system includes, besides a dynamo, an arc lamp of novel construction and an incandescent lamp. The arc lamp is provided with a rack bar for holding the positive carbon, which is moved by gravity under control of a peculiar escapement, the escapement being let off or retained by an armature acted upon by series and shunt solenoids. No dash pots are required in the construction of this lamp, as there are no sudden movements, except that required to form the arc when the current is turned on. The light is white and uniform, and the lamp and dynamo are so arranged in relation to each other that a considerable variation of speed produces no effect in the light, and does not result in wasting the current in the production of heat in the armature. This feature is of great importance, as it permits of placing the dynamo in factories, and driving it by the power employed for running other machinery.

The Ball company claim that with their system it only requires three-quarters of one horse power for each full arc light of 2,000 nominal candle power, and that the dynamo requires but two-thirds of the power used in driving other dynamos. In the Ball dynamo, if one armature is disabled, the other armature will maintain nearly three-quarters of the full number of lights, thus rendering the dynamo equivalent to two ordinary dynamos.

This enterprising company has recently perfected a new dynamo and a new system for operating small subdivided arc lights of 800 nominal candle power each. These lights are produced on less than one-third of a horse power each, thus securing great economy, besides producing a light which overcomes the objections raised against arc lights of larger power, the light being diffused and the shadows being modified, so that the illumination, while very strong, partakes more of the nature of gaslight.

In Fig. 1 of the illustrations is shown the operation of winding the cores of the armatures. The core being the foundation of the armature requires careful manipulation, as a space between the convolutions of the wire would be an element of weakness. After the winding of the core it is carefully wrapped with tape, when the conductor is applied in sections. It is advantageous in the construction of the dynamo to provide as many sections of the conductor as possible. In the larger machines of this class there are as many as 360 divisions of the armature and commutator.

In Fig. 2 is illustrated the method of arranging the commutator bars with the mica insulation. Fig. 3 shows the Ball dynamo, which has already been described. In Fig. 5 is shown the operation of wrapping the armatures, connecting the commutator bars with the conductor, and applying the steel bands. In the foreground of this picture are shown two finished armatures, one showing the commutator end, the other exhibiting the spider upon which the ring is mounted. In the assembling shop (shown in Fig. 6) all the parts of the dynamo are brought together and adjusted one to another, and tested. Fig. 4 shows the lamp department, the construction being carried on in the farther part of the room, the lamps being adjusted and tested in the part represented in the foreground. In this view are also shown several lamps, both plain and ornamental.

The numerous testimonials which we have examined are unanimous in according to the Ball system great economy. They also express satisfaction in regard to the quality and steadiness of the light. In the list of Ball electric light plants which have been established, we notice many familiar names of large establishments scattered all over the United States and Canada, which are using these dynamos and lamps. In many cases the plant has been increased, thus showing due appreciation of the system.

Saccharine Prohibited in France.

The following is an abstract of the preamble of the bill now before the French chamber prohibiting the importation of saccharine into France: "The attention of the administration has been directed to a new coal tar product known as saccharine. This substance, which differs essentially in its elementary composition from vegetal sugars, possesses much greater sweetening power, a quality that was sure to lead to its being used as a substitute for sugar in many cases. We learned from our consular agencies abroad that factories were being established in certain countries for the purpose of bringing saccharine into competition with beet and cane sugar, not only in France, but also in other neighboring markets. The high cost of that substance seemed to constitute an insuperable obstacle to its general adoption, but lately the situation has changed. It can now be more cheaply produced, and already it is extensively used, mixed with glucose, in the preparation of jams, sirups, and liqueurs. It has, therefore, become an urgent necessity to provide a remedy for the evil, in the interests of the customs receipts and that of the health of the consumer; for it has been shown by the report of Drs. Brouardel, Pouchet, and Ogier, in the name of the consulting committee of hygiene, that saccharine, and the various preparations derived from it, are noxious to health, and ought to be prohibited. Wherefore the government has deemed it expedient to prohibit the importation of saccharine and saccharined substances."

Cement for Belts.

Wade's Fiber and Fabric made the above inquiry, and has published a number of replies. The following is as good an answer as we have noticed: I will tell, he says, what I use, but do not say it is the best, but gives good satisfaction in my case. When I put on a new belt I generally sew it with lacing, and run it for a few days to get the stretch out. Then some Saturday afternoon, when the machinery is stopped, I cut my belt and skive down so as to have about six inches lap of the same thickness, then I put on a thin coat of Le Page's prepared carriage glue, and put in two lacings lengthways, press with heavy weights, and let stand till Monday.

Peruvian Railways.

At a recent meeting of the Civil and Mechanical Engineers' Society, at the Westminster Palace Hotel, a paper was read on the "Oroya Railway, Peru," by Mr. W. Alfred Eckersley. The author, in commencing, chiefly alluded to recent Peruvian history, and the way in which during unnatural inflation money was borrowed in the most reckless manner for railways and other public works, which were only half executed when such a series of national reverses and disasters ensued as to almost paralyze the commerce and trade of the country. The natural resources of Peru, however, are so great that the author expressed the greatest confidence in the future prosperity of that country.

Proceeding to describe the railway, he stated that the line was now open to Chicla, a distance of 87 miles from Callao, but until completed to Oroya, a further distance of 50 miles, the object of the line and development of the rich mineral and productive districts of the interior would not be accomplished. The present terminus is over 12,000 ft. above sea level, and is gained by an uninterrupted series of ascending gradients, the steepest being 1 in 25. The sharpest curve allowed is 6 chains radius, but in several places single and double back shunts have been found necessary. The River Rimac and numerous gorges are crossed by viaducts of the American pin truss description, the spans varying from 91 ft. to 205 ft., and resting upon lofty, spidery-looking iron piers, sometimes over 250 ft. high, and the author seemed much impressed with the suitability of this description of iron work for such work, and considered it far superior to riveted structures. In making the surveys for the line, and also in constructing the viaducts, men and materials were slung along ropes across the lofty chasms, and much courage and energy must have been displayed, one of the largest of these grand examples of engineering skill having been erected in four months. The author tested the viaducts with heavy rolling and stationary loads, and found them to be very satisfactory, the deflection at center being generally less than 1 in 2,000, and the recovery perfect.

Insurance Restrictions on Oil Fuel.

The Hartford Insurance Company has laid down the following strict rules in regard to the use of crude petroleum as a fuel:

1. No storage of crude petroleum for fuel shall be allowed in any position where, in case of accident, it can flow toward the insured premises, or within less than 50 ft. if wholly under ground, or 100 ft. if wholly or in part above ground. This excludes all storage in boiler rooms, or adjacent to premises, or feeding from oil cars.

2. Delivering of oil to furnaces must be by suction or other process, whether by pump, vacuum, or any other appliance that will accomplish the end sought, the supply to be lower than the furnace, so that, when not being used, the flow shall be away from, and not toward, the premises. This prohibits the feeding of oil by gravity pressure or by other means from a storage supply higher than the premises.

Where the foregoing conditions are fully complied with, and storage tank, if wholly under ground, is 100 ft. or more from risk, or if wholly or in part above ground is 200 ft. and upward distant, permission to use oil for fuel will be granted without extra charge. If storage tanks are located less than 100 ft. and not less than 50 ft. of risk, wholly under ground, or from 100 ft. to 200 ft. if wholly or in part above ground, the extra charge will not be less than twenty-five cents.

To Precipitate Gold.

The gold from galvanic baths is easiest precipitated with the galvanic current upon a smooth copper plate. The gold which does not precipitate as a powder is then scraped off and purified, as well as that which precipitated as powder. Impure gold, which chiefly consists of gold, however, is dissolved in the indicated proportions in the *aqua regia*; it is then evaporated to one-half, diluted with water, filtered, and washed out with large quantities of water. This washing is continued until the escaping fluid is clear water, and no longer colored by sulphate of iron. Meanwhile a solution of handsome crystallized sulphate of iron has been prepared as follows: To 10 grammes (6 dwts. 10·32 grains) sulphate of iron, 100 grammes (3 oz. 4 dwts. 7·2 grains) water add 10 grammes muriatic acid. For precipitating the gold suffices the 4½-fold quantity of crystallized green copperas of the impure gold used. In order to precipitate the gold, pour its solution into the copperas solution. The gold will very quickly fall down in this diluted fluid. Decant the clear liquid, and first wash with water acidulated with muriatic acid, afterward simply pure water. Collect the gold in a porcelain dish, drain off the wash water as closely as possible, and let it dry in a moderately warm place.—*National Jewellers' Journal.*

BE very particular about disinfecting the kitchen sink. Washing soda, two tablespoonfuls to a gallon of boiling water, makes an excellent wash to pour hot into the sink at night after you have finished using it.

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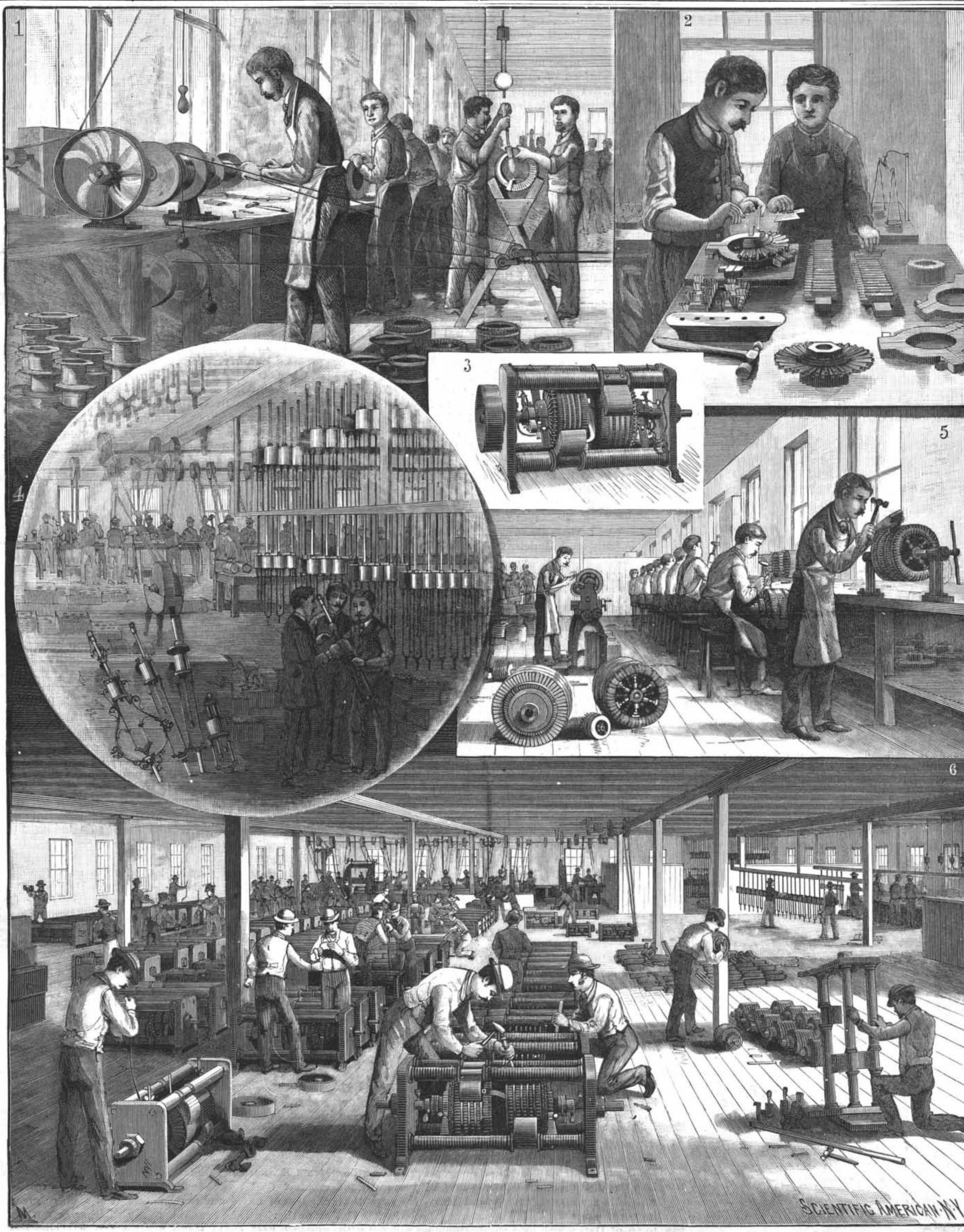

1. Winding armatures. 2. Assembling the commutator. 3. The Ball dynamo. 4. Lamp department. 5. Finishing the armatures. 6. The erecting floor.

WORKS OF THE BALL ELECTRIC LIGHT COMPANY, NEW YORK.—[See page 85.]