temperature, the shorter are the oscillations. Here are some of the figures: Selenium, 3·7, lead, 3·3, zinc, 3·5, silver, 3·8, copper, 3·4, gold, 3·4, iron, 3·3, platinum, 3·6. These numbers are evidently near enough together to warrant the statement that the law of constancy is here verified with conditions of exactness comparable to those which Dulong and Petit declared satisfactory in their researches on specific heats.

RECENT MECHANICAL INVENTIONS.

A machine for laying bands or stripes of color around broom handles, which does its work rapidly and neatly, has been patented by Mr. Solomon Lang, of Schenectady, N. Y. The machine is fitted to carry two handles and two sets of striping brushes, which act alternately, so that while one handle is being striped the other may be removed and replaced by another.

Messrs. A. H. Simms, of Nixburg, and J. L. Porter, of Rockport, Ala., have patented an improved rope measuring machine. It consists in the arrangement of a measuring wheel provided with an alarm device for indicating its revolutions, and in a semicircular receptacle for containing the rope to be measured.

Mr. John G. Meeker, of Danbury, Conn., has patented an improved machine for filling and hardening hat bodies and other fabrics. The invention consists in forming ribs of hempen rope upon the opposite working faces of the filling roll and apron of a machine for fitting and hardening hat bodies.

American Hardware in British Colonies.

The *Ironmonger* continues to lecture the English manufacturers for their apathy in not bestirring themselves to prevent the introduction of American manufactures into the British colonies.

There would appear to be much reason, says the editor, for fearing that English manufacturers are not even yet fully alive to the extent and nature of the competition they have to meet and fight. Through our own columns, for instance, attention has repeatedly been called to the subject, and we have been careful to give, from time to time, the latest and most authentic information obtainable. It has been shown more than once that our colonists in Australia, New Zealand, the Cape, and elsewhere are rapidly developing an amount of business in American hardware which was not even contemplated half a dozen years ago. They are well and attentively served by the manufacturers of the United States, and appear to be disposed to transfer to them many of their commissions. They tell us directly, or indirectly, that they are more thoroughly satisfied by their new providers than by our own traders, and we cannot blame them, therefore, if they continue to divert their favors into transatlantic channels. They would, and do, prefer to have English made goods of all kinds, but they find that the patterns, finish, and packing of the Americans are frequently so superior that they are literally compelled to cease doing business with us. In not a few instances they still send their indents to England, but they specify American goods, and decline to be put off with any others. They are, as our correspondent tells us, often charged nothing for packages, and have everything so carefully wrapped up or boxed, marked, and labeled, that they find far less trouble in retailing the goods than those sent to them from this country. We have before remarked that there is not the slightest reason why this state of things should continue. We are able to compete successfully with the whole of the outside world, either as regards quality, quantity, or price, and it ought not to be publicly stated that we do not do so. We have every advantage on our side, and it is nothing less than a notorious scandal if we neglect our opportunities any longer. As a nation we are compelled to manufacture, and inasmuch as we produce immensely in excess of our internal consuming powers we must continue to export the surplus. It is, therefore, not merely our interest, but an absolute necessity, that we should consult the tastes and requirements of our customers, and by the exercise of enterprise, tact, and progressive tendencies, keep ourselves in that foremost position we have so long held. The time for apathy, indifference, and adherence to obsolete patterns or practices has gone by, never to return. The recognition and full appreciation of these facts ought to be sufficient to put our manufacturers and merchants on their mettle to such an extent as to render the continuance and repetition of these complaints impossible and unnecessary.

Copper and Iron Lightning Conductors.

What should be the relative sectional areas of lightning rods in order that neither metal should be more liable to fusion by the passage of an electrical discharge through it than the other? Mr. R. S. Brough (whose recent death in India we regret to announce) has answered this question in the May number of the *Philosophical Magazine*. The relation usually given—viz., that an iron rod should have four times the sectional area of the copper rod—is based on the fact that copper conducts electricity six times as well as iron, while the melting point of iron is about 50 per cent higher than that of copper, and $\frac{6}{1 \cdot 5} = 4$. This simple treatment is incomplete, because it neglects the following important factors: (1) The influence of the rise of temperature in increasing the electrical resistance of the metal; (2) the difference between the specific heats of the copper and iron; and (3) the fact that the iron rod being made several times more massive than the copper rod, it will require a proportionally greater quantity of heat to increase its temperature. Taking these considerations into account, Mr. Brough finds that the sectional area of an iron rod should be to the sectional area of a copper rod in the ratio of 8 to 3. For the same efficiency iron rods are therefore cheaper than copper rods.

PREVENTIVE FOR SLIPPING BELTS.

Mechanical engineers and users of machinery know only too well that all belts slip more or less, thereby occasioning a loss of both power and motion as well as the wearing of the belt. Several remedies have been suggested and tried such as the application of rosin and other adhesive substances to the belt or pulley, but none of them, so far as we are aware, with the exception of the device shown in the accompanying engraving, have proved of any practical value. In fact the application of adhesive substances is

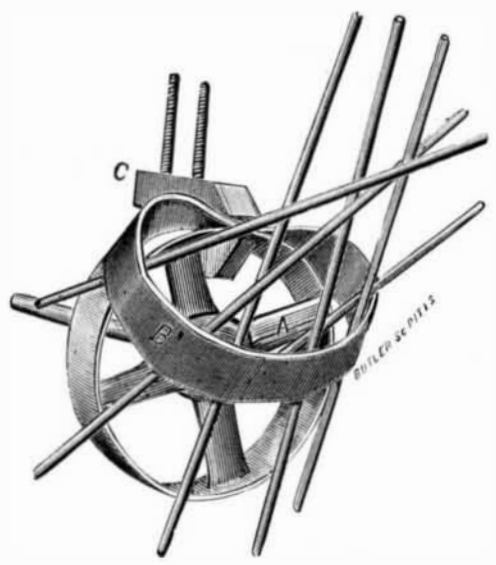

Fig. 1.—SUTTON'S PATENT PULLEY COVER.

productive of a direct loss of power, and injury to the belt. To secure the required amount of friction by tightening the belt brings greater pressure and consequent friction upon the journals and increases the strain and wear on the belt.

The pulley cover shown in the engravings is designed to obviate all of these difficulties and greatly increase the transmitting capacity of both belt and pulley. It is simply a flat endless band of elastic rubber and canvas, made about one inch to the foot shorter than the circumference of the pulley, with the inside face unvulcanized. It is stretched around the pulley and cemented fast.

The manner of applying the cover is shown in the engravings. After cleaning the pulley the cover is clamped to the upper part of the pulley by means of an ordinary hand screw, then a number of rods are inserted in the cover and placed against the rim of the pulley, as shown in Fig. 1. Three or more men, taking one rod in each hand, stretch the covering outward and place it on the pulley, as shown in Fig. 2; then all of the rods but one are removed, and the

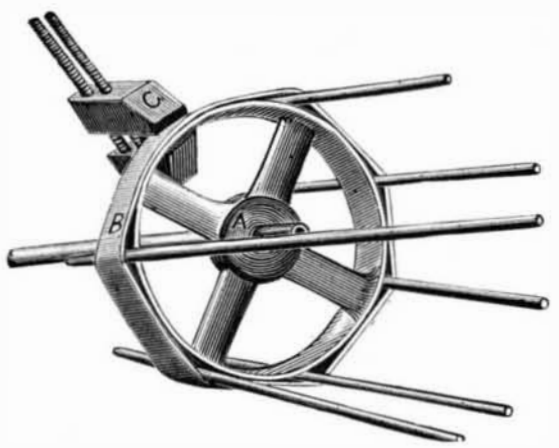

Fig. 2.—PULLEY COVER.

hand screw is taken off; cement is placed between the cover and the pulley as the remaining rod is rolled around the pulley under the cover. When all sides of the pulley have been cemented the rod is removed, and the cement is allowed to dry.

The manufacturers assert that this cover effects a great saving in power, and that a pulley having this cover applied has at least double the capacity of a plain pulley of the same dimensions.

Further particulars may be obtained from Joseph Woodward, room 11, 55 Liberty street, New York (P. O. box 3419).

The Nature of Plastic Substances.

At a recent meeting of the Philadelphia Academy of Natural Sciences, Dr. Koenig referred to a statement made by him some time ago when speaking of the composition of the so-called mountain soap of California, that the plastic components thereof are not crystallized substances. As this was contrary to the opinion held by certain authorities on such matters, he had been led to give the subject further consideration, and he was now prepared to sustain his original assertion, although it was at first based simply upon analogy. He believed that in the inorganic, as in the organic kingdom, no plastic substance is crystallized. The substances pholerite and necrite, which have indeed the same quantitative and qualitative composition as the plastic kaolinite, are indeed crystalline, but these are simply cases of polymerism. In the course of his investigations on the nature of clays he had studied the sediment thrown down by slightly turbid river water. If portions of this substance be again dissolved and the redeposit examined under microscope, it will be found to present the appearance of starch. The granules are transparent, and may be examined by polarized light, when it will be found that they are not at all crystallized. Further investigations of the subject are promised.

Emigration to the United States.

Probably from its comparative nearness, and the social and personal freedom it promises, as well as from the fact that so many of the working classes have "some friend or brother there," emigration to the Transatlantic Republic has always been much in excess of that to our own colonies, even to the adjacent Dominion. But for some years there has been a great commercial depression in the United States as in the United Kingdom, and during the past quinquennial period as much slackness in emigration as in everything else. The turn of the tide has, however, come at last, and it is doubtless a sign that a decided improvement has set in over the water. Both from the Clyde and Mersey, as well as from other less important havens, flocks of emigrants are leaving these shores. Nearly 11,000 persons left Liverpool to go into voluntary exile last month, of whom 8,931 were bound to the United States, 1,723 to British North America, and only 48 to Australia, 6,015 altogether over those of March, and 4,090 over the corresponding month of last year; while during the present May there is every prospect of numbers leaving several thousands in excess of the corresponding month for many years past. Of the April emigrants, 5,348 were English, 1,546 Irish, and only 58 Scotch. —*Iron.*

Phosphorescent Photographs.

To Mr. Woodbury's inventive ingenuity we owe this plan, which has been tested, and is a practical success. The method he employs is known as the "dusting-on" process. It consists in coating a plate with a preparation of dextrine, honey, and bichromate of ammonia, which, exposed under a negative, becomes hardened, where it is subjected to the action of light, through the transparent parts of the negative, remaining tacky where it is protected from the action of light by the denser parts of the negative. After exposure under a negative, the film, as it will be seen, is tacky in the lights of the picture, but hard and dry where light has acted on the shadows. The lights are therefore adhesive and tacky, retaining any fine powder which is dusted in or rubbed into the moist surface. At this point comes in the essential novelty. The powder to be used must be a phosphorescent substance. One of the best known and available is sulphide of calcium. A powder of this substance is applied to the image formed on the adhesive film, and sticks to it in due gradation of the tackiness, as regulated by the action of light which passed through the negative. An image of sulphide of calcium is thus formed, which, the powder being nearly white, is scarcely visible by daylight, but if the image be submitted for a time to sunlight, or bright daylight, or brilliant artificial light, and then taken into the dark, presents a luminous picture, somewhat startling, indeed, in the case of a portrait.

A variety of substances possess this phosphorescent quality: sulphides of barium, calcium, and strontium displaying it in the most marked degree; fluorspar, carbonate of lime, pearls, diamonds, phosphate of lime, arseniate of lime, and other substances, all showing in their degree this capacity of absorbing light and radiating it in the dark. The Bologna stone, consisting of sulphide of barium, displays this property in a marked degree. The old Italian cobbler to whom tradition assigns the discovery of the property of this stone, and its use to astonish his friends and neighbors, prepared it by heating red hot with charcoal a piece of sulphate of baryta, found plentifully in the neighborhood of Bologna. Sulphate of baryta made into a firm paste with gum, or with flour and water, and calcined, will produce the substance. It should be kept sealed in a stoppered bottle.

The phosphorescent property has been utilized in America for the production of luminous clock and watch faces, which readily show the hour in the dark. Professor Morton, in the SCIENTIFIC AMERICAN, points out the possibility of superseding gas or other incandescent substances as means of illumination by having the walls of a room treated with a phosphorescent substance, which might absorb sufficient light during the day to serve for illumination at night. Dr. Phipson points out that a whitewashed cottage exposed during the day to strong sunlight sometimes shines at night with a brilliant phosphorescent light; pure lime or a mixture of lime and nitrate of lime possessing the property in question. The substance used in preparing luminous clock faces is sulphide of calcium, sometimes known as Canton's phosphorus, Canton having prepared it by heating a mixture of three parts of calcined oyster shells with one part of sulphur to an intense heat for an hour. It may also be formed by heating.