For glossy imitation ebonite:—

Resin solution . .	12,000 gms.	Zinc white . . .	2,000 gms.
Alcohol . . .	3,000 ,,	Carbon black . .	750 ,,
Magnesia . . .	1,200 ,,	Asbestos fibre, fine, short . . .	5,000 ,,
China clay . . .	2,500 ,,		

10. **Moulding and Pressing Imitation Ebonite Goods.**—Every article is made by compression in steel moulds, made up in three portions:—

1. The outer casing.
2. The matrix or mould proper.
3. The plunger.

The outer casing encloses the matrix, and must be designed with very thick walls. It is also designed, as far as practicable, to take as many different moulds as possible, so that the one casing will serve for all moulds of a similar type. The plunger serves to compress the mass, and should be an exact fit to the matrix.

The method of procedure is as follows:—

The powdered mass already described is accurately weighed out, filled into the mould, and compressed by means of the plunger under small hydraulic presses at a pressure varying from 75 to 300 atmospheres. The moulds are put into hot-air ovens for about ten minutes, then slightly cooled, and the matrix and plunger forced out of the jacket in the same way as they were put in, when the finished article drops out of the matrix. The manufacture can be carried through very rapidly, and an experienced hand can mould as many as 400 pieces of simple construction—*e.g.*, handles—per day.

The final process consists in buffing on emery-wheels and varnishing.

Imitation ebonite which is to have a good polish after coming from the press must, on the other hand, remain for about ten minutes under the press at 75 atmospheres pressure.

Naturally the material cannot be worked, drilled, or turned very well, since it breaks very easily, but where moulding is possible it constitutes a cheap electric insulating material, with a high resistance amounting to as much as 80,000 megohms, and can easily be applied to the insulation of metal parts of the most varied shapes.

APPENDIX I.

THE REGENERATION OR RECLAIMING OF RUBBER WASTE AS CARRIED OUT IN RUBBER GOODS FACTORIES.

Nearly all waste rubber is used over again in some form or other. The factories which have been established for the express purpose of reclaiming waste rubber have latterly advanced beyond the stage when old rubber shoes constituted the chief form of rubber waste worked up by them, although such old shoes are the basis of a very considerable proportion of the reclaimed rubber used in rubber factories. But, except in a few instances, the reclaiming of old rubber shoes is not, as a rule, carried out in the rubber factory, but in special factories. This statement holds good, also, for old bicycle tyres. The typical reclaimed rubber factories of Theilgaard in Copenhagen have been already so clearly described in the *Gummi-Zeitung*[1] that it is only necessary here to refer the reader acquainted with German to the articles in question.

The following short account is therefore concerned only with the reclaiming process as carried out in the rubber factory itself.

The fact that by no one of the reclaiming processes at present in use is it possible from vulcanised waste to reproduce *unvulcanised* (*de*vulcanised) rubber, must be assumed to be well known. The sole result of reclaiming processes as now applied is to render the rubber plastic again. If in any given instance the vulcanisation coefficient is reduced as a result of the reclaiming process, the reduction is only slight, and indicates that the rubber substance has undergone some decomposition. The only case in which this is not absolutely true is that of cut-sheet (or other cold-cured) waste, but the reduction is in this case due to the removal from combination with the rubber, not of sulphur, but of chlorine, a result which is achieved with comparative ease by heating the waste with solutions of the alkalis or alkaline earths.

[1] 1904, xix. pp. 87–93.

Practically the only really important operation in the whole process of working up rubber waste is the sorting of the waste. By carrying this out in a rational way the subsequent processes can be very much simplified.

Cut-sheet waste may be first of all referred to. This kind of waste is generally reclaimed by heating with alkali; the alkaline solution attacks the chlorine of the rubber, and to a still greater extent the white substitute. It is not possible to prevent the waste in question from becoming more or less dark in colour as the result of the heating and subsequent plasticising process (during which process the caustic liquor is, of course, washed out of the rubber), and as a rule, therefore, the uncoloured waste is not treated separately from the black; indeed in many factories the red waste is also included with these. As a result of such treatment with caustic soda, and subsequent heating in steam at a pressure of about 5 to 8 atmospheres in order to render it plastic, cut-sheet waste yields a product which can be more or less used in the place of raw rubber in a number of mixings. The vulcanisation coefficient of such a product is very low, and there is, therefore, room for a considerable degree of after-vulcanisation. This product, however, often smells very unpleasantly of the decomposition products of the white substitute. Its use in red goods which contain golden sulphide is not to be recommended.

Floating waste is either uncoloured (grey), red, or black, for a good white which floats cannot be produced on account of the high specific gravity of the white pigments [or, rather, on account of the large proportions of such pigments required to mask the natural colour of the vulcanised rubber]. Floating waste is, therefore, sorted into "grey," "red," and "black." The sorted waste is generally heated with oil after being finely ground on roller mills with three rolls (fig. 100), which are also in part fluted. By this means a highly plastic mass of great stickiness is produced, which imparts to mixings in which it is employed a very great power of absorbing mineral compounds. Red floating waste should be specially examined to see that it contains no cold-cured waste, so that the golden sulphide may not change colour on reclaiming. To reclaim red floating bottle-washers it is only necessary to heat them under suitable conditions. Heating with oil is generally conducted in jacketed heaters, and the waste is kept well agitated during the process. Bottle-washers, on the other hand, are heated in the ordinary vulcanising heaters in steam at a pressure of 11 to 12 atmospheres. The heated bottle-washer waste must, of course, be

afterwards dried in the vacuum drier before being run out into sheet. That floating bottle-washers can be plasticised without the addition of any oil is due to the fact that the so-called "Parafactis," which is used in considerable proportions in bottle-ring mixings, usually contains about 45 per cent. of acetone-soluble oily and waxy constituents. With between 30 and 45 per cent. of this substitute in the mixing there is, therefore, present in the waste between 14 and 20 per cent. of oils and wax, which is ample to plasticise it, for the amount of rubber present is only between 48 and 63 per cent.

In non-floating waste a distinction is made between that which

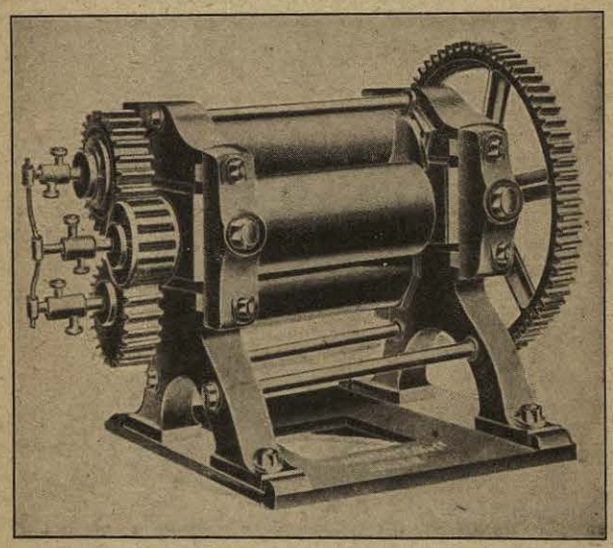

Fig. 100.

contains fabric and that which does not. Both kinds of waste, again, are sorted according to colour. Drab waste, and frequently also red, generally contains considerable quantities of free sulphur. For this reason this kind of waste is often desulphurised before it is heated with oil, by grinding it into fine crumb and then boiling it up with a solution of caustic soda or of sodium sulphite. The waste is then thoroughly washed and heated with about 20 per cent. of its weight of rosin oil, castor oil, or palm oil, occasionally also with paraffin wax. In a few factories this heating process is carried out under vulcanising presses, but most works probably employ for the purpose the jacketed heater with agitator.

The treatment of waste containing fabric insertions formerly gave rise to all kinds of difficulties in removing the insertion. Only

in the case of dark waste could acids be used to destroy the fibrous material. The acid treatment, too, was accompanied by a number of drawbacks, such as evolution of sulphuretted hydrogen, decomposition of whiting and other fillers, with formation of gypsum, etc., so that an important step forward was taken when other methods of destroying the fabric were introduced. One is now enabled by the use of these methods to reclaim both white and red waste containing insertion.

It is usual to free the plasticised waste, either on the refining roller mill or on a tube machine provided with a fine sieve, from all coarse particles that may still be present.

The possibility of reclaiming certain kinds of black waste, either without any addition, or by adding very small quantities of oil, etc., depends upon the presence in such waste of quite considerable quantities of pitch. In rubber shoes the resinous and oily substances of the varnish are present in addition to the pitch. Proofed, uncured canvas waste is sometimes ground up into fibre and then added to the mixing direct, or else the unvulcanised rubber is recovered in an extraction apparatus, with the object of using it again for solution.

It must, of course, be admitted that the regeneration of rubber on the works itself is always less satisfactory as regards the product turned out than the recovered rubber produced by factories which make reclaiming a special business. For one thing, the price of old rubber is very much inflated by an extensive demand on the part of a large number of works, much more so than if the whole were being purchased by just a few large reclaiming works; and it is further obvious that the sorting and blending of the waste can be done to a much greater nicety when dealing with the large quantities used in a reclaiming works, than when, as in the case of a rubber factory reclaiming waste for its own use, one has to deal only with comparatively small quantities of material. Moreover, the cost of reclaiming is naturally higher in a rubber works than it is in a special factory. For these reasons the practice of reclaiming in rubber factories is gradually being given up.

[A process which seems likely to prove of considerable value in a number of cases, is that described under Gare's English patent No. 12,454, 1906. In this process the two following well-known facts find practical application, viz. (1) that when heated in contact with air, vulcanised waste is decomposed; (2) that when heated out of contact with air such waste is softened. According to the process the waste rubber is finely ground, and is then highly compressed

in moulds in order to drive out all air from between the fragments of waste. The mould, still under pressure, is then heated at about 205° C. for a length of time depending on the size of the mould, and is then allowed to cool before being opened. Under this treatment the waste amalgamates and forms an extremely dense mass, possessing good properties, and taking the shape of the mould accurately. Such articles as buffers, cab tyres, etc., are those to which the process is best adapted.]

APPENDIX II.

SPECIFIC GRAVITY.

SPECIFIC gravity plays a considerable part in the rubber trade, not so much in estimating the quality of a given sample of rubber, as in ascertaining whether, for example, two samples of rubber from different sources will yield the same length per lb. of gas tubing, etc., of a given size, or, in the case of such goods as are bought by weight and sold again by size or by the article, the same number of articles. The dealer in rubber goods knows far too much nowadays to regard specific gravity as a criterion of quality.

Specific gravity is a relative number; it shows how many times heavier or lighter a given article is than the volume of water at 4° C. which it displaces. Hence the article in question should, strictly speaking, be weighed at a temperature of 15° C. and the result calculated, by the aid of factors, to water at 4° C. It is not usual to employ so accurate a method of specific gravity determination in the rubber trade. The article in question is simply weighed in distilled water at 15° C., and the value found is subtracted from the weight of the article in air. The latter value is then divided by the difference between the two weights, and it is customary to call this quotient the specific gravity; it serves generally as a basis for the calculations of seller and buyer. Articles which float in water must either be weighed in some liquid which is lighter than water, or be attached to a glass sinker and then weighed in water. If the unknown quotient be called x, the weight of rubber y, the loss in weight of rubber + glass when immersed in water z, and the loss in weight of the glass alone in water u, the specific gravity can be readily calculated from the following formula:

$$x = \frac{y}{z-u}.$$

For practical methods of carrying out the determination, reference may be had to the very useful little book by Marzoll, *Anleitung zur Gewichtberechnung technischer Gummiwaren, sowie zur Ermittelung der specifischen Zahlen*, Dresden, 1904.

The method of determining the specific gravity of rubber goods by weighing in air and in water is so simple, and capable of being carried out so quickly, that there would appear to be no object in attempting to simplify it still further, whether by having a number of standard solutions ready made up to definite specific gravities, so that the pieces of rubber may be dropped into each in turn until in one of them it is found to just float (a method which is not so simple in practice, on account of the great difficulty of keeping the standard solutions accurate, and the necessity for cleansing and drying the sample after immersion in one solution before it is put into the next), or by adopting Minikes' modification of the floating method. This consists in dropping the sample of rubber into a test-tube graduated on two opposite sides and containing a solution of zinc chloride (of sp. gr. 2·000), diluting the solution until the rubber just floats in it, and then reading off the specific gravity from the graduations. The particular rubber article being examined is often too large to be put into the Minikes test-tube, and must not be cut.

Since, therefore, all determinations of specific gravity can be carried out on a good Mohr-Westphal balance, a Reimann's sinker is provided with the balance, so that where necessary the weighings can be carried out in media other than water, and the specific gravity determined by means of the sinker-thermometer which has 5 c.c. displacement. A good method of dealing with floating rubber goods is to weigh them in alcohol or in similar liquids of specific gravity less than 1·000.