steam immediately raises the ram upon the water being allowed to escape.

The valve used for the rapid admission and escape of water becomes, therefore, rather an important feature and is shown in fig. 2. It consists of a cylindrical casing, having a hollow cylindrical valve or plunger, working endwise through hydraulic leathers; at each end of this valve or plunger very fine slits are sawn lengthwise through its sides or walls. The principle of the valve is the allowing of the admission and escape of water through the fine slits, by moving the valve endwise until the fine slits pass the hydraulic leather; the set of slits at one end of the valve being for the admission of water, and those at the other for the escape.

L is the casing bored through and fitted with hydraulic leathers shown in section. *M* is the inlet, *N* the outlet, and *O* a passage into the pipe *K*. The valve or plunger is fitted pretty freely into the casing, and is capable of being removed endwise. It is hollow, with a solid division in the center, the hollow forming a sort of cup on each side of the solid part, and through the side walls of these cups the fine slits are cut.

When it is desired to bring the press ram down, the valve is moved endwise to the left until the fine slits pass the hydraulic leather, and a passage is thereby opened from the inlet *M* through the slits, and water is admitted into the passage *O*, and then on to the pipe *K*, and the ram at once descends. When it is desired to raise the ram the valve is moved to the right, and water passes out through the other set of slots, and away by the outlet *N*, and the ram at once ascends by the action of the steam.

It should be observed that at the time the slits pass the leather the low pressure only is in operation, and at the moment of impact of the ram upon the work the valve is always in its neutral position, the position shown in the diagram, the plain body of the central portion of the valve, with a cup leather on each side, being all that is exposed to the great pressure.

The proper time for the additional water is when the pump plungers are receding from each other, and the valve should always be put in its neutral position before the ram face comes upon the work. This arrangement of valve is found to operate most successfully, and the change of position of the ram is effected as quickly as is necessary or desirable. The valve, being in perfect equilibrium, is most easily worked by a handle, brought to a convenient position for the operator to see the work in hand.

The ram may be raised or lowered for its entire range in very few seconds. It can be brought down to the greatest nicety a little lower down each stroke, enabling forgings to be made correct to dimensions, or in case of any sudden occurrence, when it is found undesirable for the impending pressure to take place, the stroke can instantly be averted by moving the valve to the right, although the face may even be in contact with the work. The ram, in fact, is perfectly under control, and almost as lively as the tup of a hammer. An accumulated power is obtained by two heavy fly-wheels on the crank-shaft of the pumps, the momentum of which imparts very great force at the moment of impact of the ram, at which time the cranks approach and turn their centers.

As a security against accident, and a precaution against this force becoming too great, a system of safety-valves has been devised (although not shown in the diagrams). It consists simply of a steam cylinder and piston, the piston-rod of which works into a small hydraulic cylinder that is in constant connection with pipe *K*. Steam is admitted into the steam cylinder at the opposite end to that of the piston-rod, and when the hydraulic pressure on the end of the piston-rod becomes sufficient, it forces the steam back into the boilers. Thus, if the steam piston is 60 in. in diameter, and the piston-rod 6 in. in diameter, and the pressure of steam 50 lbs. per circular inch, a hydraulic pressure on the end of the piston-rod of 5,000 lbs. per circular inch will be an equivalent, and a pressure exceeding that will force the steam back into the boilers, and relief for the water will thereby be obtained.

The press ram makes a stroke of 2½ in., and its diameter is 30 in., so that at a pressure of 3 tons per square inch (deducting the area of the shank) we have a power of 1,700 tons. But, of course, no pressure is developed until resistance takes place; hence no power is lost or consumed (except what is lost by friction) until the ram face comes into actual contact with the work, and then sufficient pressure only is developed and consumed to do the work. The press was fitted by W. & J. Galloway & Sons, of Manchester, and with the exception of the steam cylinder *F*, is constructed entirely of steel. The form and strength of all the parts have proved to be capable of sustaining the sudden and great strains to which they are subjected, and no springing or flinching takes place—the ram always descending to the same spot, whether it has to press 2 in. into an ingot, or has nothing to do. This has been found useful in rounding-up, for when the ram is once brought down to the right point to give the required diameter, the work has only to be regularly turned round. Of course all has to be dead tight, but there are no joints except cupped leather ones, and very few of those.

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CONTRIBUTIONS TO PRACTICAL RAILROAD INFORMATION.[*]

CHEMISTRY APPLIED TO RAILROADS.
XXIII.—SOAP (*Continued*).

BY C. B. DUDLEY, CHEMIST, AND F. N. PEASE, ASSISTANT CHEMIST, OF THE PENNSYLVANIA RAILROAD.

(*Continued from page* 494.)

OUR specifications for soap have been revised twice or three times, and need another revision in one or two particulars, which we will mention a little later. The specifications at present in force are as follows:

PENNSYLVANIA RAILROAD COMPANY.

Motive Power Department.

SPECIFICATIONS FOR SOAP.

All soap will be bought by the pound. A shipment of toilet soap or common soap having been received, one cake or bar taken at random will be subjected to examination, and the shipment will be accepted or rejected on this sample cake or bar. The amount of soap to be paid for in a shipment of toilet and common soap will be determined by the amount of combined alkali or its equivalent in the shipment, and this will be determined by multiplying the amount of combined alkali in the sample cake or bar by the number of cakes or bars in the shipment, and dividing this product by the amount of combined alkali in a pound of soap as detailed below. The amount of detergent for cleaning paint and varnish in a shipment will be determined by the net weight of the material as received.

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[*] The above is one of a series of articles by Dr. C. B. Dudley, Chemist, and F. N. Pease, Assistant Chemist, of the Pennsylvania Railroad, who are in charge of the testing laboratory at Altoona.

The articles will contain information which cannot be found elsewhere. No. I, in the JOURNAL for December, 1889, is on the Work of the Chemist on a Railroad; No. II, in the January, 1890, number, is on Tallow, describing its impurities and adulterations, and their injurious effects on the machinery to which it is applied; No. III, in the February number, and No. IV, in the March number, are on Lard Oil; No. V, in the April number, and No. VI, in the May number, on Petroleum Products; No. VII, in the June number, on Lubricants and Burning Oils; No. VIII, in the July number, on the Method of Purchasing Oils; No. IX, also in the July number, on Hot Box and Lubricating Greases; No. X, in the August number, on Battery Materials; No. XI, in the September number, on Paints; No. XII, in the October number, on the Working Qualities of Paint; No. XIII, in the December, 1890, number, on the Drying of Paint; No. XIV, in the February number, on the Covering Power of Pigments; No. XV, in the April number, on How to Design a Paint; No. XVI, in the May number, on Paint Specifications; No. XVII, in the June number, on the same subject, and No. XVIII, also in June, on the Livering of Paint; No. XIX, in the July and August numbers, on How to Design a Paint; No. XX, in the September number, on Disinfectants; No. XXI, in the October number, on Mineral Wool, and No. XXII, in the same number, on Wood Preservative; No. XXIII, in the November number—continued above—on Soap.

These chapters will be followed by others on different kinds of railroad supplies. Managers, superintendents, purchasing agents and others will find these CONTRIBUTIONS TO PRACTICAL RAILROAD INFORMATION of special value in indicating the true character of the materials they must use and buy.

Toilet Soap.

The material desired under this specification is a neutral soda soap, as free as possible from water, mineral matter, carbonated alkali and uncombined caustic alkali. It may contain glycerine and sugar, or may be free from them, and may be either transparent or opaque. The cakes should weigh about 4 ounces each. The shape of cake preferred is oval, about 3⅜ inches by 2⅜ inches, with edges about ½ inch thick, and the thickness of cake in the center about 1⅛ inches. The color preferred is somewhat lighter than that of Brown Windsor. The perfume should have the characteristic odor of Lavender, and should not add over five (5) cents per pound to the cost of the soap. It is desired to have the cakes stamped on one side with the initials of the Road to which the soap is furnished, and each wrapped in soft paper. The manufacturer may put his stamp on the opposite side of the cake.

In determining the amount of soap in a shipment, 630 grains of combined alkali, reckoned as soda [Na_2O], will be regarded as a pound of soap. Also in the glycerine or transparent soaps the glycerine and sugar will be paid for, each five (5) grains of glycerine and each twenty (20) grains of sugar being received in place of and regarded as the equivalent of one (1) grain of combined alkali. Transparent soaps which contain less than 500 grains of combined alkali, reckoned as soda [Na_2O], or more than 1,000 grains of glycerine or more than 700 grains of sugar per pound, are not desired.

Toilet soap will not be accepted which shows on analysis more than one-fourth of one per cent. of mineral matter or more than one-fourth of one per cent. of carbonated alkali, reckoned as carbonate of soda [Na_2Co_3], or more than one-half of one per cent. of uncombined caustic alkali, reckoned as caustic soda [$NaOH$], or more than one per cent. of common salt; nor if a cylinder of the soap ⅞ inch in diameter, and one inch high, cut from the center of the cake, fails to sustain a weight of 15 pounds for five minutes without crushing or compressing more than $\frac{1}{16}$ inch. Also Toilet Soaps made so largely of cocoanut oil, palm oil, palm-nut oil, or other fat of characteristic smell that they leave their peculiar odor on the hands, will not be accepted.

Common Soap.

The material desired under this specification is a neutral soda soap as free as possible from mineral matter, carbonated alkali, common salt, and uncombined caustic alkali. It should be carefully cut in bars weighing about a pound each.

In determining the amount of soap in a shipment, 525 grains of combined alkali, reckoned as soda [Na_2O], will be regarded as a pound of soap. No allowance is made for glycerine or sugar in this grade of soap.

Common soap will not be accepted which shows on analysis more than one-fourth of one per cent. of mineral matter, more than one-fourth of one per cent. of carbonated alkali, reckoned as carbonate of soda [Na_2Co_3], more than one-half of one per cent. of uncombined caustic alkali, reckoned as caustic soda [$NaOH$], or more than one per cent. of common salt, nor if a cylinder ⅞ in. in diameter and one inch long cut from the center of the bar when received fails to sustain a weight of five (5) lbs. for five (5) minutes without crushing or compressing more than $\frac{1}{16}$ in.

Detergent for Cleaning Paint and Varnish.

The material desired under this specification is a mixture of powdered soap and tripoli or pulverized pumice-stone. The proportions of the two ingredients desired are 70 per cent. tripoli or pulverized pumice-stone, and 30 per cent. soap. The tripoli or pumice-stone should be very fine and free from hard particles. The soap should be as free as possible from water, carbonated alkali, uncombined caustic alkali and common salt, and should be finely ground.

This material will not be accepted if the proportion of tripoli or pumice is less than 65 per cent. or more than 75 per cent., nor if it shows on analysis more than 0.10 per cent. of carbonated alkali reckoned as carbonate of soda [Na_2Co_3], more than 0.20 per cent. of uncombined caustic alkali reckoned as caustic soda [$NaOH$], more than 0.30 per cent. of common salt, more than 5 per cent. of water, or if it contains any other substances than soap and tripoli or pumice, nor if the tripoli or pumice is so coarse or contains such hard particles that it scratches the varnish.

THEODORE N. ELY,
General Superintendent Motive Power.

Office of General Superintendent Motive Power, Altoona, Pa., January 3, 1888.

With regard to the above specifications, it will be noted we do not buy soap by the cake, but rather by the pound, and that although the manufacturers possibly many times claim to make each cake weigh a pound, we do not accept this as final. It will also be noted that we really have placed our valuation of the soap on the amount of combined alkali that it contains. This is in accordance with the explanation given in the early part of this article, that it is really the alkali combined with the fat that we want for detergent, not the free alkali or the carbonated alkali, but the alkali combined with the fat. One difficulty has arisen in regard to this method of buying soap—namely, the bill cannot be paid until the chemical analysis is made. A number of other plans were tried, but nothing has been found that was as successful as this, and all the annoyance that now results is that parties may have to wait three or four days longer for their money. This has not thus far in practice proved a serious difficulty. One point further. It will be noted that the analysis on which the shipment is paid for, and, indeed, the whole transaction, is based on a single cake of soap selected at random from the shipment. If this single cake happens to be larger than the average of the shipment, the manufacturer gets pay for a little more soap than the shipment really contains. If the single cake happens to be a little smaller than the average of the shipment, the manufacturer does not get pay for quite as much soap as the shipment contains. It is believed that these things will equalize themselves in the long run, and as the requirements of our specifications are moderately strict, we have only found a few parties who were willing to take the pains necessary to make as good a soap as we desire, and consequently their orders have been moderately continuous.

One peculiar concomitant of this method of buying and paying for soap has resulted. Of course the manufacturers are desirous of selling as much soap as possible. If, now, they receive an order for 100 lbs. of soap, and send 100 bars, each of which contains combined alkali—a little less than enough to make a pound of soap—they will not sell as much soap as the order calls for. On the other hand, if each bar contains a little more combined alkali than the equivalent of a pound of soap, the manufacturer is paid for a little more soap than the order calls for. In general, a bar that weighs exactly one pound as the manufacturer ships it, will rarely contain quite as much combined alkali as is the equivalent of a pound of soap according to specifications, owing to the fact that much of the soap is sold soon after it is made, and contains rather more water than a well-seasoned soap should contain. We accordingly find that almost all the manufacturers who supply us with soap are cutting all the bars a little heavy, both, as said above, to counterbalance the water, which is a varying constituent, and also because they know they get paid for all the soap there is in the shipment, even though it may exceed the amount ordered. A parallel to this is found in the oil trade. Originally a barrel of oil contained 42 gallons, but as oil is usually bought by the barrel, the size of the barrel has gradually crept up until now very few barrels contain less than 50 gallons. So with the soaps. We have seen many bars of soap, which nominally weighed a pound, which did not weigh over 11, 12, or 13 ounces. The bars in our shipments now almost universally weigh over a pound. A little reflection will convince every one that the only fair way to buy soap is by the actual value given, and that the method which we have adopted is not only fair to the consumer, but also to the manufacturer.

The peculiarities of the specifications for toilet soap are, perhaps, sufficiently evident without much comment. The glycerine and sugar mentioned, as will be observed, are measured in value in terms of combined alkali. The ratios used were based on the relative commercial prices of the articles involved. It is in the matter of sugar and glycerine that our soap specifications need revision, and we will explain this a little later, when we come to describe the chemical methods of determining the different constituents. We have had little difficulty in getting soaps that were within the limits for mineral matter, for caustic alkali, and for free carbonated alkali, and common salt given in the specifications. Many times manufacturers who do not know accurately what they are doing find that their soaps do not fill our requirements, but it is believed, after some six or eight years' experience, that the requirements are not excessively difficult. It will be observed that no limitation is placed on the manufacturers as to the kind of fat acid they shall use, except in the toilet soap, that those which leave a characteristic disagreeable odor on the hands shall be avoided. Otherwise than this the manufacturers can use any materials so long as they fill the requirements.

Upon this point it may be well to say that the physical test for hardness was devised as a simple means of controlling the kind of acids used. If the soap is made of all rosin, and shipped before it is dried out at all, it would not stand the physical test, and the same is true of a number of the other fats. In order to meet this difficulty, and at the same time not go into the question of specifying what kind of fats should be used, we devised the physical test, and it has served our purpose charmingly.

It will be observed that in the common soap the amount of combined alkali that is equivalent to a pound of soap is considerably less than toilet soap. This is due to the fact that in toilet soap there is much less water than in common soap. The ordinary common soap contains not far from one-third of its weight water, especially if the soap is fresh. Toilet soap generally does not contain more than 5.00 to 8.00 per cent. water. Due to this presence of water rendering the soap softer, the physical test is much less severe for toilet soap than for common soap. In the detergent for cleaning paint and varnish, the quality of the soap, so far as amount of free caustic and carbonated alkali are concerned, is the same as in the common soap, our idea being to limit the damage to the varnish, due to this constituent, as much as possible. We have had very little difficulty in getting this article in the market, although there is chance for some improvement in the manufacture. The material should be in the form of a powder, and as most of the shipments which we receive are a little lumpy, which we regard as objectionable, it is entirely possible that in the next issue of the specifications a proviso will be introduced to overcome this difficulty.

A circular giving directions for the use of detergent for *Cleaning Paint and Varnish* has been issued. The directions in this circular will undoubtedly be understood by what has preceded. The oil treatment recommended, following the use of the detergent, has been found to be quite valuable, so much so that a car properly cleaned with detergent, and gone over carefully with linseed-oil, looks almost as good as new, provided the varnish has not become cracked. The gloss is largely restored, and the inequalities of the surface are largely filled by this layer of oil. Of course if the varnished surface has become cracked nothing will restore this that we know of except revarnishing. The following in the circular:

PENNSYLVANIA RAILROAD COMPANY.

Motive Power Department.

DIRECTIONS FOR USING DETERGENT FOR CLEANING PAINT AND VARNISH.

The ordinary common soap used in cleaning paint and varnish has a very destructive action on the varnish, dissolving it rapidly; a car cleaned two or three times with strong soap suds must be revarnished and in some cases repainted. To diminish this destructive action of the alkali in the soap, is the object of the detergent for cleaning paint and varnish. This detergent is a mixture of tripoli or pulverized pumice-stone with powdered soap, and its cleansing power comes from the slight solvent action of the soap and the scouring action of the tripoli or pumice-stone. The varnish or paint is destroyed to a certain extent by the detergent, but the destructive action is very much less than with soap suds. This material should be used in accordance with the following:

Directions.

Go over the surface to be cleaned with a wet sponge, piece of waste or cloth, which has been dipped in the dry detergent. Use plenty of the material but not much water, and rub until the dirt is detached from the surfaces. Wash thoroughly with clean water, using sponge, hose, or soft washing brush. Allow the surface to become dry and then give it a light coat of raw linseed-oil, using a piece of waste or a cloth; what is known as rubbing oil may be used also for the purpose; care should be taken to leave only a very thin layer on the surface. The oil replaces much of the paint or varnish which has been removed by the detergent.

The oily waste or rags should be disposed of with great care, as they are quite liable to take fire from spontaneous combustion. They should never be left in the cars, thrown on the ground or floor, or put away with the cleaning utensils; when practicable they should be burned.

THEODORE N. ELY,
General Superintendent Motive Power.

Office of General Superintendent Motive Power, Altoona, Pa., March 16, 1888.

The chemistry required in our specifications presents some problems of considerable interest, and we have put a good deal of study on this subject, and are inclined to think that at least our method of determining caustic alkali in soaps is not in common use. Indeed, we may go a step farther, and say we do not know of any other method which will give the free caustic alkali in a soap except the one which we use. We determine in soaps the excess of caustic alkali, the carbonated alkali, the combined alkali, the mineral matter, the common salt, make physical test, and weigh the cake. The reasons for the weight of the cake, the physical test, and the method of making the physical test are sufficiently clear from the specifications.

The common salt is determined by decomposing a weighed sample of the soap with dilute sulphuric acid, sometimes with the addition of a little oil to dissolve the separated fat acid, in order to facilitate decomposition. After the decomposition is complete the beaker is chilled, and the fat acids become a cake. They are then removed and washed. If it is desired to be strictly accurate, a second melting of these fat acids with distilled water, so as to secure complete removal of every trace of common salt from the cake, is made use of. The solution containing the common salt is filtered and then neutralized with carbonate of soda, and then titrated with standard nitrate of silver solution, using neutral chromate of potash as the indicator.

The mineral matter and the carbonated alkali are determined in one operation. A weighed amount, five grammes of the soap, is dissolved in alcohol. If we desire to be strictly accurate in our carbonate of soda determination, we use absolute alcohol, since carbonate of soda is slightly soluble even in 95-per cent. alcohol. For common purposes, however, ordinary 95-per cent. alcohol does very well. The soap dissolves readily, especially under the influence of heat. As soon as solution is complete, it is filtered through paper or in a Gooch crucible and washed with alcohol. The carbonate of soda and the mineral matter remain on the filter. When washing is complete, the carbonate of soda is dissolved from the filter by means of water, and is subsequently determined by the well-known methods of alkalimetry, using phenolphtaline for the indicator. The mineral matter remains on the filter, and is determined by ignition of the filter or drying with Gooch crucible, and weighing in the ordinary way.

If silicate of soda is a constituent of the soap, our experience indicates that quite a large portion of this will appear in the caustic alkali determination, which will now be described, and will render the amount of that constituent so high, that the soap would be rejected on account of caustic alkali. It also shows a tendency to break up in the alcohol solution used in determining the carbonate of soda and mineral matter, as above described, so that we are inclined to think we catch this element in one of these two places. If not, it would, of course, appear later in the determination of the combined alkali.

The excess of caustic alkali in soap is determined as follows: A standard solution of stearic acid in alcohol is prepared and its titer accurately determined. The solution that we use contains about seven and a half grammes of stearic acid to the liter of alcohol. The absolute amount is not essential, but the titer, in terms of the standard alkali, must, of course, be known. Five grammes of the soap to be tested are then placed in a small flask, and 100 cubic centimeters of the stearic acid solution added, and the vessel placed on the steam table or sand bath. Solution gradually takes place, the soap dissolving in the alcohol, and the caustic alkali, as fast as it appears, combining with the stearic acid in the solution. We also find that under the influence of the heat necessary to produce solution, the carbonate of soda in the soap, if there is any, is slowly dissolved, and if the amount is very small it may completely disappear. We are not quite sure whether this decomposition of the carbonate is due to the fact that we commonly use 95-per cent. alcohol in making the stearic acid solution, or whether the boiling stearic acid solution decomposes carbonate of soda. Whatever the explanation, the fact remains. When solution is complete the liquid is filtered through paper in the ordinary way, and any mineral matter, together with the carbonate of soda not decomposed, is left on the filter. The solution containing the soap and stearic acid is then titered with standard alkali, using phenolphtaline as indicator. The difference between the titer of the 100 cubic centimeters of the stearic acid solution which were started with and that obtained at the end of the operation represents the free caustic alkali together with a part of the carbonate of soda. The remaining part of the carbonate of soda on the filter is obtained in exactly the same way as above described—namely, by the well-known methods of alkalimetry, using phenolphtaline as the indicator. The sum of the caustic and carbonate of soda obtained by these two determinations represents the total of these two constituents present in the soap. The previous determination has, however, given us as accurately as possible the carbonate, and the sum above obtained diminished by the amount of carbonate shows the amount of free caustic alkali in the soap. We do not, of course, reduce the results obtained by the use of the standard solutions to percentages and then subtract the carbonate from the sum of the caustic and carbonate. The actual operation is done in cubic centimeters of the standard solutions. The final results are, of course, calculated to percentages. Duplicate results with this method are extremely close, and, as stated above, we do not know of any other method of getting at the amount of free caustic alkali in a soap better than the one which we use. Of course this problem has been studied a good deal. We have used this method now for some three or four years, and this is the first time that it has been published. It is obvious that there may be three conditions of the soap to be examined.

First, there may be an excess of free caustic alkali along with a neutral soap. It is quite probable that the common method—namely, of dissolving the soap in alcohol and titrating with any standard acid, using phenolphtaline as the indicator, would give the amount of free caustic alkali under this condition. Our own method is likewise, we think, equally reliable.

The second case would be when there is free caustic alkali and free fat—that is, the operation of saponification was not quite completed in the boiling. In this case the ordinary method of dissolving in alcohol fails entirely, since during the solution the free alkali combines with the free fat, and therefore does not appear as it should. In this case our own method gives likewise, we think, and accurately the free alkali, since the free alkali combines with the stearic acid rather than with the unsaponified fat.

The third case would be where there is a deficiency of alkali that is not enough to saponify all the fat. If the excess of fat is unsaponified material, our method would show nothing. If, as happens in many cases, the excess of fat is free fat acid, we always get this by our method.

We have studied soaps and have used analytical methods for the sake of protecting the interests committed to our charge, and accordingly we have not put much study on the material from the soapmakers' standpoint. We have never tried to develop a method which under all circumstances would tell whether there was an excess of fat. This is a problem for the soapmakers rather than for ourselves, since the excess of fat causes us no injury.

The method used in determining the combined alkali depends something on what the previous tests have shown. If there is mineral matter, especially carbonate of lime, or other substances which under the influence of heat would either be alkaline or combined with the soda, we take the sample from which we have removed the mineral matter and carbonate of soda as previously described, and evaporate and burn until all the organic matter is gone. In case no mineral matter is present, five grammes of the soap is put in a platinum dish and the organic matter burned. At the last we usually add a little pulverized chlorate of potash, to assist in removing the last traces of carbonaceous matter, and also to oxidize any sulphides which may be present, and which are formed by the deoxidation of a trace of sulphate which may exist as impurity in the soap. It is obvious that in the first case all the alkali that was in the soap originally as combined alkali and caustic alkali is now in the platinum dish. In the second case all the combined, caustic, and carbonated alkali that was in the soap are now in the platinum dish. These are dissolved in water and determined by the well-known methods of alkalimetry. A deduction for the caustic in the first case, and for the caustic and carbonate in the second case shows the combined alkali. The whole operation of making all the determinations requisite for examining a soap need not take over one-half a day, and a good deal of the time, as would naturally be supposed, would be taken up in obtaining the solutions. Of course in a well-regulated laboratory other work is done while the solution is going on.

In addition to the above determinations it will be noted that we state that the sugar and glycerine in these kinds of soap will be paid for, and this, of course, involves a determination of these constituents. It is in regard to these two that our specifications, we think, need revision, since we find by actual experience that we have not yet been able to get a satisfactory method for the determination of the sugar and glycerine. We have experimented a good deal with the Benedikt-Zsigmondy method for the determination of glycerine, by converting the glycerine into oxalic acid, but have not always succeeded in getting satisfactory results with it. As soon as we obtain a satisfactory method for the determination of glycerine, it is probable we will revise our specifications, and require a small percentage of glycerine as an essential constituent of all our toilet soaps. Of course the sugar is previously separated from the glycerine, and is subjected to a separate determination. At present we are not encouraging the purchase of glycerine soaps, for the reason that we do not feel satisfied with our method of determining this constituent.

In the next article we will try to treat the subject of Steel for Springs quite at length.

(TO BE CONTINUED.)

ROLLING FLUID METAL.

In a paper read recently before the Iron and Steel Institute, Sir Henry Bessemer described his early attempts to roll sheets of steel from molten metal, the partial success which he had attained, and the apparatus which he had then patented. After this historical prelude, he continued as follows:

Having thus freely criticised my first imperfect form of apparatus, I will proceed to explain in what manner I now propose to remedy these defects. These suggested improvements will be readily understood by reference to figs. 1, 2 and 3, annexed; and here I beg to observe that I have not gone into the many details necessary for the construction of rolling mills of this description, but have merely given such an illustration of the general scope of my proposals as will enable them to be understood.

The rolls *L* and *M* consist of two hollow drums through which a tubular steel axis *N N* passes, and conveys a plentiful supply of water for keeping the rolls cool.

The brasses which support the roll *M* are fixed, while those which support the roll *L* are movable in a suitable slide, and are pressed on by a small hydraulic ram *X*, which is in free and uninterrupted communication with an accumulator, so that at any time should the feed of metal be in excess, the roll *L* will move back and prevent any undue strain in the machinery, the only result being a slightly increased thickness at that part of the sheet of metal, a defect which, as it extends parallel across the