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THE ENGINEER'S DAILY ROUTINE.

In our best regulated and most efficiently managed steam plants, the life of the engineer is one of a regular routine of duties, for while each day may not be exactly like its predecessor, still it is so nearly so as to be at times very monotonous. Notable exceptions are those days in which some accident happens of greater or less magnitude, causing him extra labor and exertion in both body and mind.

Where the plant is a medium sized one, and the engineer does his own firing, his first duty on entering the fireroom is to try the gauge cocks and admit water and steam to the water gauge glass. In doing this, care should be taken to avoid bringing the pressure onto the glass too suddenly, for the expansion caused by the heat may break it. It is a good plan to admit a little steam first and gradually warm it up by allowing the steam to escape through the drip for a few seconds, and then close, not forgetting to open both steam and water valves sufficiently to show a true water level.

Assuming that there are three gauges of water in the boilers, it will then be in order to open the blow-off valves and blow down two or three inches of it before opening the dampers. Some engineers claim that it will answer every purpose to blow down while the engine is running and the fires at a white heat. It is the opinion of the writer that the best results are obtained by blowing down in the morning before the water is agitated by the heat of the fire, as much of the sediment having settled to the bottom of the boilers during the night, a portion of it may be removed in this way before it hardens into scale. This opinion is based on the fact that having once taken charge of a boiler that had not been properly cared for, on opening the same the spaces between the tubes at the rear end were found to be completely filled with scale.

By using a boiler compound and blowing down regularly every morning before starting the fire this boiler was entirely cleaned in a few months. Others may have had success in blowing down during the day, but even if this is true there is one reason which, standing alone, should decide the matter in favor of the former plan, and that is because it is the safer way, for when an engineer opens a blow-off valve he never knows whether he will be able to close it when he wishes to or not, and a number of accidents have happened in this way, as even a small piece of scale lodged in the right place will cause the boiler to be emptied before it can be removed, and such being the case, is it not much better to have the fire banked than to have it burning briskly.

If the extra strain on the pipes caused by the water rushing through them at a great speed and turning abrupt corners, perhaps, in its passage, should cause a corroded piece to give out, filling the fireroom with steam and hot water, would it not be a source of satisfaction to the engineer to know that he had taken every precaution to prevent his boiler being ruined? It is true that if a stream of water is turned on the fire through the bursting or breaking of this pipe, or if a large volume of steam is forced into the furnace, the fire will be extinguished; but who can guarantee that the pipe will break in such a way as to cause this to be done?

Having attended to this and levelled the fires; while steam is being gotten up it is a good time to key up any boxes or bearings that may need it. An objection to doing this work at night is because if anything should prevent the engineer from reporting for duty the next day, and some one else should start the engine, not knowing what had been done, it is quite possible that a hot box would be the result, whereas it would have done no harm to let it run as it was for another day; and when the keying up is done in the morning, the engineer is more apt to remember the circumstances and govern himself accordingly. It is well to have glass sight feed oilers filled when starting up in the morning, and also at noon, for if this is done regularly, when the engine has been running half an hour, if the cups are feeding properly, it may be noted at a glance, from any part of the engine-room; but if the practice of filling them up only when they are empty is adopted, without regard to any regular time for it, then it becomes necessary to go to each one separately, in order to tell whether they are working or not.

The writer has seen a systematic engineer take out his watch when setting his sight feed lubricator, feeding cylinder oil in the usual way, and adjust it to feed a certain number of drops each minute. This is a good plan, but at the same time it appears as if the watch was unnecessary, as the engine was running at a slow speed, for every engineer is supposed to know how many revolutions his engine is making per minute, and if it is found to be eighty, and he wishes to feed four drops per minute, then one drop should ascend for each twenty revolutions; and if it is sixty, and four drops per minute are required, then it should be one for each fifteen revolutions. The places that must be oiled by hand should receive attention at regular intervals, and all bearings inspected systematically, that hot boxes may be avoided.

Engineers have different opinions concerning the proper time to wipe up an engine, for while some will wipe every place possible while the machine is in motion, others will not attempt it until after it is stopped, and still others clean up early the next morning.

Little can be said of the first plan spoken of, as the only advantage to be gained is a few minutes time, and this too at the expense of thorough work. Those engineers who adopt the second one usually condemn those who think that the third plan is a good one, as they claim that if it is done at night, it will be more apt to be well done, and on the other hand, those who prefer the third plan consider that the others run a risk in getting into the engine-room only in time to oil and start the engine, for if anything has been disarranged during the night, there is no time to remedy it, and start up as usual. As many good engineers favor the one that suits their case best, and care for their plants well, is plainly a matter of choice.

In regard to firing, only general directions can be given, as each man must be governed by existing conditions to a certain extent, but in the fire room as in the engine room, all should be done systematically.

It is generally considered that to secure the highest economy possible, the fuel should be supplied in small quantities and at regular intervals (with a constant load), that the fires should be cleaned at stated times each day, the water kept at a uniform height, except just before shutting down, as at that time the boilers should be filled up to the third gauge, to leave over night, and in short, everything done in a business-like manner.

Some time ago, while on a visit to a neighbouring city, we were shown a large plant where bituminous coal was used for fuel, and it was piled into the furnaces until the bridge wall was covered up, and a part of the time it was actually in contact with the shell of boiler. The dead plate was also utilized in an endeavor to enlarge the grate surface, and it was piled on here until it dropped out of the doorways. The furnace doors were then shut up, they being in contact with the coal for about one-half their height.

While some engineers favor what is ordinarily called a thick fire, still it is not probable that any of them will endorse this plan as being a good one. The water gauge glass should be blown out whenever the water becomes discoloured, or floating particles of dirt appear on the surface of it.

The boiler fronts may be wiped off with a piece of oily waste, after cleaning fires or removing ashes, and if this is done they will seldom need repainting.—By W. H. Wakeman, in *Manufacturers' Gazette.*

STEAM BOILER TESTS AS A MEANS OF DETERMINING THE CALORIFIC VALUE OF FUELS.*

BY D. W. ROBB, AMHERST, N.S.

It will be recognized by those who use large quantities of fuel, especially of bituminous coals, that they differ very greatly in value, even coals which are taken from adjoining areas give very different results, so that it is sometimes very puzzling to the consumer and difficult to decide upon the merits and proportionate values of the fuels within his reach. It is likewise difficult to determine when the greatest practicable amount of work is being obtained from the fuel, and consumers are frequently subjected to great loss from the want of this knowledge. There are three recognized methods of determining the calorific value of fuels, viz.: by chemical analysis, by the use of calorimeter, and by actual measurement of the water evaporated by a definite amount of fuel in a steam generator. By the first method, it is possible to ascertain the constituents of the fuel in their various proportions, and to determine the theoretical heat value when combined with a definite proportion of pure oxygen, and approximately to compute the amount of heat which would be converted into work when combined with ordinary air, and consumed under usual conditions. But this becomes a complicated problem, as will be seen when it is considered that the heat absorbed and wasted in heating the non-combustible constituents of both the air and the fuel must be taken into account, and that these wastes vary with the amount of superfluous air admitted through the grate, and with the proportion of non-combustible matter in the fuel, therefore, any estimate of the practical value of a fuel deduced from chemical analysis can only be approximate. In testing fuels by a calorimeter, a sample of the fuel mixed with chlorate of potassium is placed in an open mouthed copper vessel, which is submerged open mouth downward, like a diving bell, in a vessel containing a measured quantity of water, combustion of the fuel takes place and the heat produced is absorbed by the water, the total quantity of heat being determined by the rise in temperature of the water. This method has some advantages over an analysis and, if care is exercised in the selection of samples to be tested—or a large number of samples tested—is perhaps the best means of establishing a theoretical standard calorific value of a fuel, but the quantity tested is necessarily small and may not fairly represent the fuel; it also leaves out the heat absorbed by the non-combustible portions of the air and fuel, which is an important factor in the combustion of fuel, under ordinary conditions. The method by which the fuel is consumed under actual conditions and in large quantities, in evaporating water in a steam boiler, is generally regarded as a test of the efficiency of the generator, rather than as a test of the value of the fuel, but somewhat extended observation of the performance of various steam generators using similar grades of coal has convinced the writer that the steam boiler test, when properly conducted, is quite as valuable as a means of determining the calorific value of fuel, and of comparing various fuels as for finding the efficiency of the generator; in fact, the latter is the more uncertain of the two, because, unless a boiler is tested with a fuel of a known calorific value, it is impossible to arrive at its actual efficiency or to compare it fairly with any other form of generator. In testing the heat value of fuel in an ordinary steam boiler two elements of uncertainty are introduced, viz., loss through imperfect combustion of the fuel, and the escape of gases at a higher temperature than the atmos-

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* A paper read on Dec. 8th, 1890, before the Nova Scotia Institute of Science, Halifax, N.S.

phere, but as these losses, as well as the heat absorbed by the noncombustible portions, the air and fuel are unavoidable in the present state of science, they should be taken into account in making a practical test of fuel, and strict accuracy only requires that the loss be uniform and minimum in result. Practical experience teaches that almost perfect combustion may be attained in any of the common forms of steam generator by careful and regular stoking with a proper air supply; and, that the skill necessary to produce this result is possessed by many ordinary stokers, who have no knowledge of the laws which govern the combustion of fuels, will doubtless be admitted by many persons who have observed locomotive firemen or others, who are compelled to get a high rate of steam production. It is of course impossible to transfer all the heat produced in combustion to the water in a generator, because the gases cannot be reduced below the temperature of the water or steam within the generator, and a certain temperature above the atmosphere is necessary to produce draught in the chimney, but it is quite possible to so proportion the grate surface to the heating surface of the boiler that the gases will be reduced to a certain minimum temperature, and maintained at that temperature during a test. The temperature may be indicated by a pyrometer or high registering thermometer at the base of the chimney, and the rate of flow of the gases may be ascertained by the use of a draught gauge. Frequently an attempt is made to analyse the waste gases, this gives an uncertain result on account of the difficulty of getting representative samples of the gases, but from observation and examination of many tests the writer believes it unimportant, if the stoking and air regulation receive proper attention. The surface of the grate should be so proportioned to the heating, or heat absorbing surface of the generator that the gases will, when they reach the uptake, be reduced to say 400° Far.; the skilful firing and air regulation will produce practically perfect combustion, and uniform temperature. It is not of so much consequence either, as some people imagine, what kind of generator is used. The brick furnace is supposed to possess an advantage in maintaining the temperature necessary to perfect combustion, while contact with the cooler surface of a water lined furnace is supposed to prevent ignition of the volatile hydro-carbons coming from some fuels, producing carbonic oxide; but the writer is convinced that, by a proper regulation of the fire, so that the air will pass through and the gases pass over a bed of hot coals, or incandescent carbon, with frequent and even distribution of the fuel, as perfect combustion may be, and is, obtained in a water lined furnace as in a brick one. The water lined furnace avoids the radiation of heat and admission of air, both of which are an uncertain but certainly wasteful feature of the brick furnace. Steam boiler tests, although attended with some difficulty, are quite within the reach of ordinary consumers, and deserve to be better understood and used more than they are. In addition to their value as a method of determining the heating properties of fuel, they furnish the best possible means of ascertaining the condition and efficiency of the generator, and of checking, and if necessary correcting waste on the part of the stoker. It is desirable that such tests should be made frequently, because steam boilers are very liable to deteriorate and become wasteful, especially when set in brick, through the cracking of the brick walls, as well as by the coating of heating surfaces with scale or other deposits on the inner, and soot or ashes on the outer surfaces. It is quite practicable for steam users to have tests made by their engineers and ordinary assistants, but it is preferable to have an occasional test made by a professional engineer who has had experience in making such tests, as he will have gained special knowledge which will enable him to detect and locate imperfections in the generator more readily than those unaccustomed to such work. The writer would suggest to steam users the following practice: That one or more tests be made by an expert to determine the efficiency of the generator, and that he may direct any necessary repairs or corrections in the generator. After this has been done, and a standard of efficiency established, a good water meter should be inserted in the water supply pipe, so that a record of the water used may be continuously kept, and the stoker or engineer should keep a log and make daily reports of the coal consumed and the water evaporated. The meter readings will need correction, if absolute accuracy is desired, but for practical purposes this may not be necessary. It may seem like unnecessary labour and expense to weigh all the coal used, but a short trial will undoubtedly prove its value, as it will not only indicate, constantly, the condition of the generator, but to a certain extent, be a check upon the working of the engine and the amount of power used by the establishment, and it will furnish a constant incentive to the engineer, stoker, and those in charge of the steam machinery, to improve its working and reduce the amount of fuel consumption to its lowest limits. A general practice of this kind throughout the country would induce a rivalry in the saving of fuel, parallel to that found in marine practice, where it is claimed a horse power is produced by from one and a half to two pounds of fuel per hour, instead of four to ten pounds,—the last named quantity being not uncommon in ordinary steam plant, and would in course of a few years cause an enormous saving to the country, as well as to individual consumers. Rules governing the standard system of boiler trial, adopted by the American Society of Mechanical Engineers may be found in the transactions of that Society, vol. vi., 1884. The following simple instructions will enable any steam user to conduct a test of his boilers for the purpose of comparing the values of fuels, etc., after the efficiency of the generator has been established by a complete test by an expert, (observations of the quality of steam, strength of chimney draught and analysis of gases are omitted as they require special instruments and skilled manipulation).

INSTRUCTIONS FOR CONSUMERS' TEST.

A test to be of any value should be continued for not less than ten hours, and will require the constant attention of not less than four persons besides the regular attendants appointed as follows:—One or two men to weigh the coal, and one or two to attend to and weigh the water; one clerk to keep the log of the coal and water weighed, and one clerk to record the pressure of steam, temperature of feed water, temperature of chimney gases, and to keep a gross account of the coal and water as a check to the regular log.

These should be careful men, well posted as to their duties. Three good platform scales will be required, and two tanks, or clean tight casks, to weigh water in. Preparation should be made so that the water can all be delivered into the two tanks, which are placed upon two platform scales, and the water pumped alternately from the tanks to the boiler. A piece of hose attached to the suction pipe of the pump or injector will be convenient to transfer from one tank to the other. It will be advisable to procure from reliable instrument makers one or two accurate thermometers for the purpose of taking the temperature of the feed water and chimney gases. The temperature of the feed water should be taken by inserting a brass or copper cup in the feed pipe near its connection with the boiler. This cup may be filled with oil and the thermometer set in the oil. The temperature of the cold water before it enters the injector or feed water heater should also be taken. Great care should be exercised that all scales, steam gauges, etc., are correct, and that there are no leaks about the pumps, pipes or boiler, by which any water may escape without being evaporated. Steam leaks are not material except as misrepresenting the consumption of the engine. The temperature of escaping gases may be taken by inserting a brass or copper pipe, with closed end in the smoke connection where it leaves the boiler. This cup, which should reach the center of the escaping gases, may be filled with oil and a high registering thermometer placed in it. Previous to the hour for starting, say at 6.30 o'clock, steam should be up to the working pressure and the tubes and all surfaces and flues should be swept clean. The ash pit should be cleaned and the first charge of kindling and coal, or the fuel to be used, should be weighed, every man should be at his post, those who are to note the various readings provided with ruled forms for recording the gross, tare and net weights of fuel and water, and others for the pressure of steam, temperatures of feed water and escaping gases, which should be noted every quarter hour. At the hour for starting the height of the water in the boiler should be marked on the gauge glass, so that it may be brought to the same place at the close of the test, and the fire should be drawn quickly and replaced with the weighed kindlings and fuel, (wood kindlings are generally taken at $\frac{4}{10}$ the value of coal by weight). The working of the boiler may be conducted as usual in every way, the stoking should be done carefully, so that no waste may occur through dead spots or holes in the fire, or uneven distribution of fuel. If the fire is too thick, some of the gas will pass off unconsumed for want of sufficient air, and if the fire be too thin, too much air will be admitted. The draught or air supply should be regulated by the ash pit doors or registers, and an even fire and steady pressure of steam maintained throughout the test. If work is to be suspended at mid-day or any time, during the test, the drafts may be closed, the fire banked, and an attendant left in charge who will regulate the fire if necessary, so as to keep the pressure constant. At the close of the test the water should be brought to the same level in the boiler as at the beginning and the fire withdrawn and deadened quickly with water. The remaining coal should be weighed and deducted from the quantity charged to the boiler, and the ashes may also be weighed. The net weights of coal and water may then be summed up and the result of the test ascertained and recorded in the following manner :—

Test of boiler at
day of 18
Kind of boiler
Dimensions
No tubes
Size of fire-box
Grate surface sq. ft.
Heating surface do
Height of chimney
Size of chimney
Duration of test hours
Kind of fuel
Boiler pressure (by gauge) lbs.
Temperature of feed-water entering boiler degrees Fah.
Temperature of feed-water entering pump or injector degrees Fah.
Temperature of escaping gases degrees Fah.
Total fuel consumed lbs.
Percentage of moisture in fuel per cent.
Equivalent dry fuel lbs.
Total weight of ash lbs.
Equivalent combustible lbs.
Total water evaporated lbs.
Water evaporated per hour. lbs.
Water evaporated per pound of dry fuel lbs.
Water evaporated per pound of dry fuel from and at 212° lbs.
Water evaporated per pound of combustible from and at 212° lbs.
Horse power developed.

The above particulars are determined in the following manner :—The pressure of steam and temperature of feed-water and gases are taken from the average readings of the same.

The total quantities of fuel, ash and water are taken from the net summing of log, great care being taken that no error is made. The percentage of moisture in fuel is determined by drying a sample of the fuel for 24 hours and getting the difference between the wet and dry weights, which difference is multiplied by 100 and divided by the weight of sample before drying.

The equivalent dry fuel is found by multiplying the total quantity of fuel by the percentage of moisture and dividing by 100, which is deducted from the total quantity of fuel.

The equivalent combustible is found by deducting the total amount of ash from the total quantity of fuel.

The water evaporated per hour is the total quantity of water divided by the number of hours duration of test.

The water evaporated per pound of dry fuel is the total quantity of water divided by the total quantity of dry fuel.

The water evaporated per pound of fuel from and at 212° is found by multiplying the water evaporated per pound by the total heat, or heat units, or one pound of steam at the average pressure, less the total heat of one pound of feed water at the average temperature of feed water before entering the pump or injector, and dividing the product by 966, which is the total heat in units, of one pound of steam at 212°.

The horse power is determined by deducting the total heat units of one pound of feed water at the average temperature before entering the pump or injector, from the total heat units of one pound of steam at the average pressure, and multiplying the product by the quantity of water evaporated per hour and dividing by 1110·343 (which are the heat units required to raise one pound of water from 100° and evaporate it at 70 lbs. pressure), the quotient should be divided by 30, which will give the horse power according to the American standard. The following is an example of this method of finding the horse power :—

Total quantity of water evaporated=2,000 lbs.
Steam pressure (by gauge) 60 lbs.
Temperature of feed water before entering pump, 40°
Total heat of 1 lb. of steam at 60 lbs. pressure=1175·710 B. T. U.
Total heat of 1 lb. of feed water at 60 lbs. pressure 40° =8 B. T. U.
1175·710—8 × 2,000 ÷ 1110·343 + 216·33 ÷ 30 = 70 H. P.

Example of finding the equivalent evaporation from and at 212°

Water evaporated per lb. of fuel, 10 lbs.
Average pressure by gauge 60 lbs.
" temperature of feed water, 40°
Total heat of one lb. of steam at 60 lbs. pressure, 1175·710 heat units.
Total heat of one lb. of feed water at 40°, 8. heat units.
Example :
10. × 1175·710 –8. ÷ 966=12·08 lbs.

In comparing fuels as well as in comparing the efficiency of boilers, the quantity of water evaporated per pound of fuel from and at 212° should always be used. The actual quantity of water evaporated per pound of fuel will differ with variations of temperature of the feed-water entering the boiler, and also with the steam pressure or temperature at which the steam leaves the boiler, but the quantity evaporated per pound of fuel from and at 212° allows for these variations and gives a true comparison of the value of fuel if the efficiency of the generator is constant, or of the efficiency of the generator if the calorific value of the fuel is known. The temperature of saturated or dry steam always corresponds with the pressure, but if from any cause the steam be not dry, it will carry away less heat in proportion to weight, or, if the steam be superheated by contact of the products of combustion with the steam surface of the boiler, it will carry away more heat. In either case the result of the test will be vitiated unless the quality of the steam be ascertained and accounted for. This is usually done by means of a calorimeter, one of the best of which, known as the "Barrus Calorimeter," was designed by Mr. Geo. H. Barrus, of Boston. No attempt has been made to ascertain or account for the quality of steam in the simple test given, because it would complicate the work, it is intended that a professional test of the boiler should include this important item, and, if the boiler is found to be abnormal in this respect, the expert should either give directions for the removal of the cause, or provide a formula for the correction of the error due to wet or superheated steam in future tests.

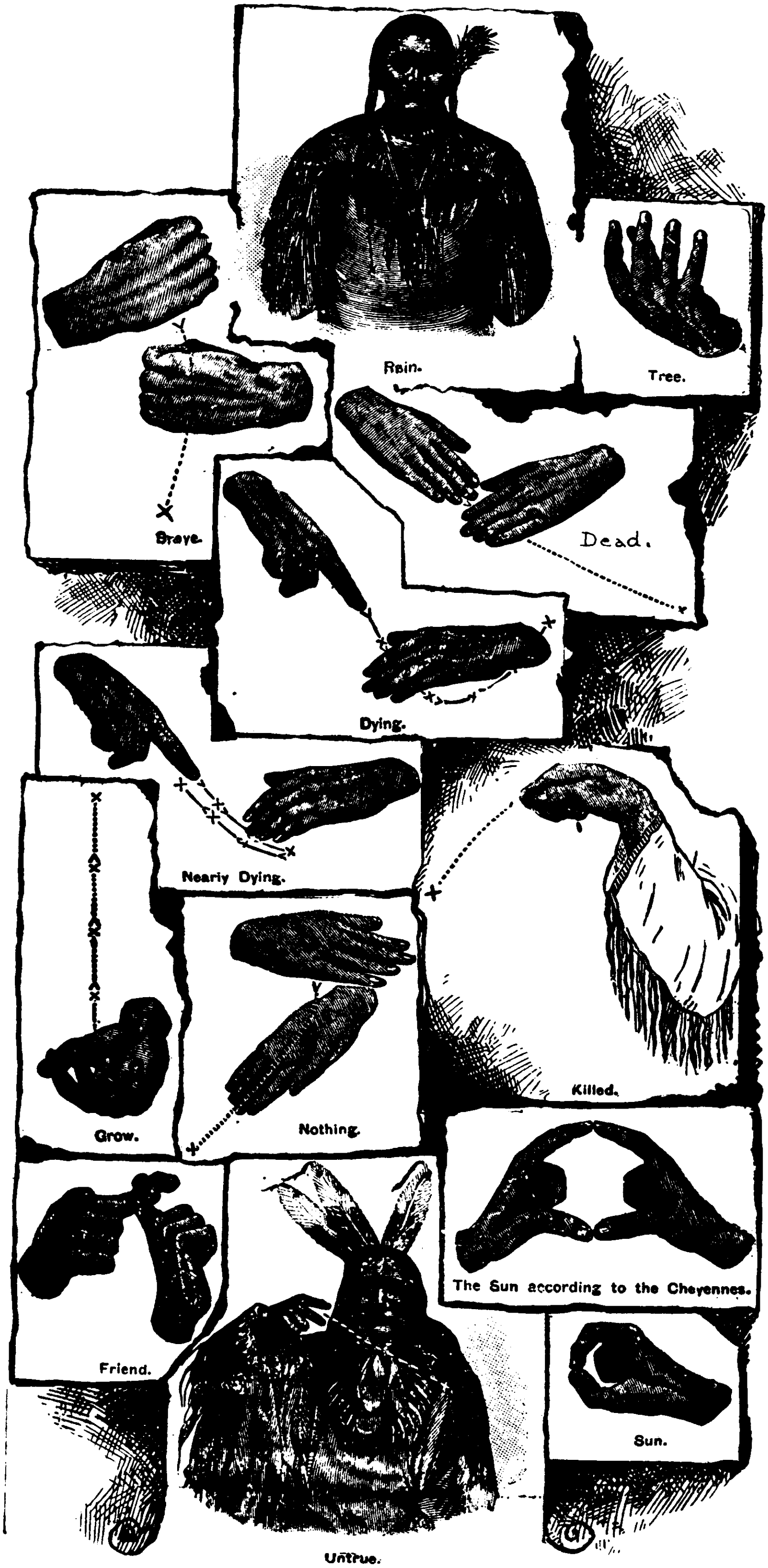
The following table will be found useful in ascertaining the equivalent rates of evaporation, horse-power etc. :—

STEAM TABLE.

Pressure of steam by gauge........	Temperature....................	Total heat of evaporation above 30° in heat units..................
40	286.9	1169.460
45	292.5	1171.176
50	297.8	1172.779
55	302.7	1174.286
60	307.4	1175.710
65	311.8	1177.060
70	316.	1178.343
75	320.	1179.569
80	323.9	1180.741
85	327.6	1181.866
90	331.1	1182.945
95	334.5	1183.986
100	337.8	1184.992
105	341.	1185.961
110	344.1	1186.899
115	347.1	1187.809
120	350.	1188.695
125	352.8	1189.555

FEED WATER.

Temperature of feed water........	Total heat above 32° in heat units.
32	0
40	8.06
50	18.1
60	28.1
70	38.1
80	48.1
90	58
100	68
110	78
120	88.1
130	98.1
140	108.2
150	118.3
160	128.4
170	138.5
180	148.5
190	158.6
200	168.7



Sign Language of the American Indians.

THE SIGN LANGUAGE OF THE AMERICAN INDIANS.

The language of signs is the only universal language, and it is the oldest language, says *The Illustrated Christian Weekly*, to which we are indebted for the accompanying engraving and article. It is by signs that the brutes converse. Monkeys talk with their hands and legs, and even insects talk with their antennæ. The child speaks at first by gesture, though the gesture language is discouraged, and the limbs are put aside for the tongue. But just as we have to converse with a little child by signs, so we have to talk to the insane, who often have no knowledge of words. And signs are still used by the sane. When we pray we use our clasped hands as a sign of appeal, or bow the head in sign of reverence or adoration; and when we welcome a friend we clasp hands in token of welcome. In fact, try as we will, we cannot yet dispense with the gesture language.

At Washington, on March 6, 1880, seven Ute Indians who were proficient in the sign language were introduced to seven deaf mutes, and conversed with them. The experiment was entirely successful. They told each other stories, and the stories were written down and examined, and found to agree in every particular.

The Indians are the best sign talkers in the world. The multiplicity of their dialects rendered some general means of communication inevitable among them, and though legend assigns the invention of the sign language of the plains to the Kaioways, we shall not be far wrong in assuming that it is much older than the division of the Indian race into its minor tribes. This language, to which we propose to devote some attention, is curiously complete. By it one Indian can converse with another from Alaska to Panama. It has its general signs, its conversational signs, and its tribal signs. Let us take the general signs first.

The blanket is often used for signaling. When the Omahas discover buffalo, the blanket is held out at length, with the hands as far apart as can be. When it is intended to camp, the blanket is raised aloft on a pole. When a signal is made to approach, the lower edge of the robe or blanket is waved inward to the legs. The signal of the discovery of enemies, game, or anything else is to ride round and round in a circle, passing and repassing each other if there is danger.

If at any time it becomes necessary to communicate with friends at a distance, smoke signals or dust signals are used, so many pillars at different intervals apart signifying certain warnings or encouragements. At night a most remarkable system of signaling by means of arrows of fire is in use. The arrows are wrapped with tow round their heads, the tow is dipped in some resinous matter and lighted, and the blazing messenger is then shot aloft, to be visible over a wide extent of country, and by many to be mistaken for a meteor.

But it is with the conversational signs that most interest lies. Over and over again furs have been sold, leases granted, and treaties made in the far West without a word being spoken between the parties. The Indian interpreters employed by the United States government are all proficient in this wonderful universal language; and, though it varies in different districts, yet its meaning is always unmistakable. Some of the gestures used are strangely eloquent.

Take bad, for instance. The general sign for this is to scatter the right-hand fingers outward, as if spurting away water from them. But among the Arapahoes the fingers of the right hand are half closed, the thumb is hooked over the fore and middle fingers, the hand is moved back upward a foot or so toward the object referred to, and then the fingers are scattered, so as to show that the object is only worth throwing away.

Brave is shown among the Shoshones by clenching the right fist, and placing it on the breast. But among the Sioux the two fists are pushed forward about a foot at the height of the breast, with the palms inward, the right being about two inches behind the left. Among the Comanches and Kaioways the sign is that given in the illustration.

Dead is shown by throwing the forefinger from the perpendicular into a horizontal position toward the earth, with the back downward, or else by crossing the arms on the chest and then letting them drop at the same time on the head. The Bannack sign is that we give, which is also in use among the Shoshones. For dying we give the sign common to the Apaches, Comanches, and Kaioways. For "nearly dying, but recovered," the Kaioways have a most significant gesture. The hand is moved slowly downward, and then upward again.

Grow has another eloquent sign, the hand being held as in the illustration, and moved upward in an interrupted manner. Much the same sort of sign is used for smoke, but in that the hand is thrown upward several times from the same place instead of continuing the whole motion upward.

For None, Nothing, or I Have None, a very expressive sign is used among the Sioux. The palm of the flat right hand is passed over the left from the wrist toward and off the tips of the fingers. With a little modification this sign is used among the Kaioways, Comanches and Apaches.

For Friend we give the Dakota sign. It is worthy of note that an Indian rarely shakes hands with Indians; that is a ceremony he reserves for his pale-face friend.

For Killed, the Cheyenne sign is given.

Rain is denoted by the Shoshones and Apaches by apparently dripping fingers.

We give the ordinary Sun and the Cheyenne Sun. Both mean the same, the completeness of the disk being shown in each case.

Tree is given according to the Dakotas, the right hand being held before the body, as shown, and pushed slightly upward, to give the idea of growth.

Untrue. The Arikara emblem of a falsehood is significant, the first and second fingers being moved in the direction of the dotted line.

The American Indians are the most stolid of races. We hear of them times and again sitting for hours without moving a muscle, and yet among them the language of pantomime flourishes at its fullest. It is much the same with them as it is with the Italians. As a nation of gesticulators, we should class the Italians far below the French, but owing to their peculiar divisions it has been found indispensable to have one general language, and to keep it at a fair average of cultivation. A most striking example of the perfection to which sign language can be brought forced itself into history in 1282. In that year the Sicilian Vespers rebellion was arranged throughout the island, and even the day and hour fixed, without a word being spoken or written. Every detail of the conspiracy was commanded by gesture.

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MISTAKES OF ARCHITECTS.

In the search for the beautiful, the demand for impressive facades, the taste for complicated ornament and a most singular appreciation of the odd, the grotesque, and the ugly, there is little attention paid to matters which seem self-evident and are of really vital importance. Windows are arranged to suit a symmetrical facade, whether they are just what are needed for the rooms or not, and even where it is possible, little attention is given to the direction of the sunlight in order that the living rooms may receive the full benefit of the natural warmth, nor are those rooms were it is not needed, or minor offices, relegated to the exposed side. The most important external feature, the door, is seldom adjusted to the climate.

Even in large office buildings, hotels and churches, where there should be ample space for every structural convenience, the door is frequently of cramped dimensions, instead of being preceded by a porch, which would be an integral part of the architecture, and which is absolutely essential in our long, cold, damp winters, is boarded up with "storm doors," that are not only hideous in design but an actual obstruction. With the rapid increase in the value of land which has taken place in all our large cities in late years, a wild fear lest any inch be wasted has resulted in a compactness of plan that is frequently painful. The housekeeper longs for the roomy closets and ample storerooms of the old buildings; the fine hall that once formed an imposing and appropriate entrance has given place to the narrow entry through which it is frequently impossible to carry the larger articles of furniture.

The same difficulty is experienced in the sharp, frequent turns which characterize so many stairways. Bedrooms are pushed into corners where they seldom have the benefit of pure, free air and the heat of the sun, for no other reason than that space is required for ample reception rooms and state apartments, which, though used comparatively seldom, are treated as the most important part of the house.—*The Telegram.*

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WHAT IS FIREPROOF?

This question is suggested by an article in The Clayworker on "Slow Burning Construction," in which the writer contends that a high commercial sense suggests the largest possible use of clay in any building structure. The commercial requirement of any structure is permanency. One need not look for fireproof construction. It is unnecessary to make the distinction between a building that is fireproof and one that is not fireproof. The expression "fireproof" does not make the impression on the public mind that it once did. The destruction by fire of fireproof buildings has weakened the effect of the expression. The commercial way to look at the fire hazard is in degree. One kind of a structure is more readily destroyed by fire than another. The one that resists longest, the one where the chance of burning is the least, will cost the least to insure. Theoretically a fireproof building would need no insurance. The stock might, but the building would not. The esteem in which fireproof buildings are held may be estimated when we call to mind the fact that no building is without insurance because there is no possibility of its being destroyed by fire.

Proceeding, the writer gives his definition of a fireproof building. A fireproof building is one which is not destructible by fire in itself nor from the combustion of material which it contains. Apply this definition to any structure, and where is the fireproof building? The detail of a building structure which it costs less to insure than some other detail is better, from a constructive stand point, in proportion as the rate of insurance is less. No one would insure a pile of bricks on a sidewalk which were waiting to go in a structure. Place those bricks in a wall, run iron beams into that wall, floor them with wood, fill the building full of dry goods, and we insure bricks and all. A granite monument may be defaced from the burning of the grass in the graveyard.

The high commercial sense, says the writer, is realizing all this. The best investment structures in America are being built of brick or some other clay product. There is no sentiment about this. It costs less to insure a clay product than any other building material, hence its use. Iron can only be used successfully in a building structure when surrounded with one of the clay products. The rate of insurance pronounces clay the best building material. There is no better certificate of character.

In a word, adds *The Brick and Tile Gazette*, the most truly fireproof material is that which has passed the fiery ordeal which is always so damaging to stone.

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BOILER TRIALS.

SOME ERRORS TO BE AVOIDED.

Many engineers and experts, in making boiler trials, measure the weight of fuel, the weight of water, and the other quantities, without paying the slightest attention to the relative accuracy with which these quantities should be determined. The object of this article is to show that such considerations may be of importance when a very accurate result is required.

As an illustration of the point we wish to make, says "*Locomotive*," let us take the following example: At a certain boiler trial the amount of coal actually burned was 2,354 pounds, and the amount of water evaporated was 20.640 pounds. These figures give us an evaporative efficiency of 8·77 pounds of water per pound of coal.

Now let us assume that an error of fifty pounds was made in weighing the water, so that the apparent amount of water evaporated was 20,690 pounds instead of 20,640 pounds, the actual amount. 20,690 ÷ 2,365 = 8 79, so that the apparent evaporative performance of the boiler is 8·79 pounds of water per pound of coal, instead of 8·77 pounds, which is the correct result. The difference introduced by an error of fifty pounds in weighing the water, it will be seen, is only ·02.

Now let us make a different supposition. Let us assume that the water was weighed correctly, but that an error of fifty pounds was made in weighing the coal, the apparent weight of coal being 2,304 pounds. Then 20,640 ÷ 2,304 = 8·96, so that the apparent evaporative performance of the boiler is 8·96 pounds of water per pound of coal, instead of the true result, 8·77 pounds. The difference in this case is quite appreciable, and the example shows that it makes quite a difference whether a given error is made in weighing the coal or in weighing the water.

The moral of this is, we suppose, that we should pay particular attention to the weighing of the coal. The scales should be very accurately balanced for the weight of the barrow, and the readings should be taken closely. The value of the kindlings, expressed in pounds of coal, should also be carefully ascertained. Furthermore, if we wish an accurate estimate of the evaporation per pound of combustible, we should be very careful about wetting down the fire after it is hauled; for the error introduced by the weight of the moisture in the ash produces as great an effect on the result as an equal error in weighing the coal.

The ideal way of carrying out a test is to make all the measurements in such a manner that the error committed in making any one of them shall have the same effect on the result as the error committed in making any other one. The principle is the same, to use an excellent but threadbare illustration, as in making a chain. Don't make one link any stronger than any other one, for if you do you are wasting labor. This can be achieved in evaporative tests by weighing the coal with eight or nine times the accuracy used in weighing the water, the ordinary evaporation per pound of coal being from eight to nine pounds. Of course, we do not mean that this should be done with any great degree of precision, but what we do mean is that the water should be weighed with ordinary care, and the coal with much greater care.

Another very necessary operation in testing evaporative efficiencies is the determination of the dryness of the steam generated. In the place of the steelyards for this work, a spring balance of some sort is often used. This should never be done unless the spring balance is of special construction, so as to weigh very accurately. The ordinary spring balance will not weigh closer than an ounce—or, at the outside, half an ounce. The total weight of steam admitted being sixteen ounces, half an ounce is one thirty-second of the whole amount, and an error of one thirty-second in the amount of steam admitted will produce approximately the same effect as an equal error in noting the rise in temperature of the water in the pail. For instance, let us suppose that a given sample of steam actually contains 3 per cent of moisture, but we have admitted 16½ ounces of steam when we think we have admitted only sixteen ounces. The error—half an ounce—is one thirty-second of the whole amount. The rise in temperature would have been 102° F., if we had really introduced only sixteen ounces; but the real rise in temperature will be only one thirty-second greater than this, since we have introduced one thirty-second more steam than we think we have. A thirty-second of 102° is 3°, which added to 102° gives 105°; and this is the actual rise in the temperature of the water in the pail. Thus we see that although the steam really contained 3 per cent of moisture, the error of half an ounce in the weight of the pail would make us conclude that it was absolutely dry. The moral of this is, that there is no use in measuring the rise in the temperature of the water to within 1 per cent, if we are going to commit an error of at least 3 per cent, and perhaps 6 per cent in weighing the water.

We may call attention here to another error that one is liable to in determining the dryness of steam by the ordinary method—an error that at first sight seems quite insignificant. When the steam is still entering the pail, and the steelyards are approaching equilibrium, the easiest way to secure an accurate balance is to leave the pail in position, with the steam pipe still dipping below the surface of the water, and close the valve just at the right instant. The final weighin gis thus preformed with the steam pipe submerged; while ordinarily the ten pounds of water originally put in are weighed without the steam pipe. For the sake of investigating the effect of this difference, let us assume that the pipe dips five inches below the surface of the water, and that the area of th cross section is half a square inch. When in position, therefore, is displaces 2½ cubic inches of water, and therefore increases the weight of the pail and contents by nearly an ounce and a half. It will be seen from this and from the previous calculation of the effect of an error of half an ounce, that it is a highly important matter to have the steam pipe dipping into the pail when the original ten pounds of water are weighed out. The most satisfactory way is to make a suitable mark on the pipe, and bring this mark to the level of the water in the pipe whenever a weighing is made.—*American Engineer.*

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USEFUL HINTS FOR STEAM USERS.

Gaskets of corrugated sheet copper last much longer than rubber, especially if they are to be broken often but are, of course, much more expensive. They will stand a higher steam pressure and temperature without being spoiled; in fact, are the only kind that can be used to advantage with superheated steam.

There are few better investments that can be made about a power plant than a well-constructed and accurate recording gauge. It will check and regulate incompetence on the part of the fireman, and, of course, be to a considerable extent a protector from danger by explosion.

It is absolutely essential that there shall be some method of seeing where the water is without going over to the boiler for that purpose. A properly constructed glass water gauge apparatus with Scotch glass, will, if properly proportioned and attached, show the same water-level in the tube as there is in the boiler. There should, of course, be provision for cleaning out the steam passages with a steel rod when they get wholly or partially filled up with scale or sediment; and it is well to have that with a safety attachment, so that in case of breakage of the glass the steam and water shall be shut off, so as to save the engineer from a scalding, and permit the insertion of a new glass.

Try cocks are very well to supplement the water gauge glass, and, in fact, I would rather have them alone than the glass alone. Whatever kind are used, they should be put at proper levels, so as to indicate when the water gets anywhere near the danger level.

There are in the market many different kinds of patent grates; some of them of no use whatever, others well worth the money asked for then. No grate should be put in which has not, at least, fifty per cent. of air space between the bars; and it is best not to try experiments. As a general thing let some one else do the experimenting. Put in grates which you know to be doing good service, and which those who used them recommend; remembering, of course, that the best recommendation is a second order, by a well-posted person who has no personal interest in the device, nor friendship for the inventor or salesman. Shaking grates have the merit of permitting the fire to be cleaned often and only a little at a time, instead of being coaled up in a great quantity, and raked out wholesale.

A separator or so-called steam dryer is at best but a remedy. If you find that you are stuck with a boiler that makes wet steam, or that the one which you have must be forced so as to give wet steam, it is well to try a dry pipe perforated with fine holes or saw kerfs and extending along the inside of the boiler in the steam room. If the dry pipe will not do, then try a separator. There are two or three in the market; other things being equal, buy the one best spoken of.

No matter how cheap your fuel is, have your boiler covered with a non-conducting covering. If it is in the open air or in an exposed place, the covering will save its cost many times over in fuel; and if it is in a close room it will not only save fuel but render the fireman's life more endurable. Consult the comfort of your men. If you don't care anything for their health and comfort they will care little for your safety and nothing for your cash. Of all the boiler coverings in the market those are the best, other things being equal, which contain most air. Plain, old-fashioned hair felt is good where the pressure is not high. Get one which is readily repairable in case it must be taken off in places. No matter what covering you use on boiler or pipes, be sure that it is white on the outside.—*Robert Grimshaw, in Power and Transmission.*

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ENGRAVING ON STEEL.

Here is another thing which many people do not know. There are hundreds of national banks in the United States, each of which issues bills bearing its name. An assortment of these bills will show frequent repetitions of the portraits of Lincoln, Grant, Stanton, and other prominent Americans. Take another bill and carefully compare the two impressions of the same head. Do you notice any difference? See that you have a strong light—daylight is best. Compare all the little dots and lines. Yes, they are identical. Well, the engraving of one of these portraits is a very expensive affair, and no matter how skilful the engraver he could not make a second plate which would be identical with the first.

This is the way in which the several heads happen to be exact counterparts: Many years ago Jacob Perkins discovered a way of so softening steel that it could be cut as easily as copper. After the work was done upon a soft steel plate he hardened it. Up to his time copper only had been used for engraving purposes so far as illustrative work was concerned.

After one of the fine heads (employing this method) is engraved upon the soft steel the plate is hardened to its utmost capacity. It is then put on the bed of a powerful transfer press, and over it is placed a roll of soft steel which is passed backward and forward under a pressure of twenty tons. This forces the soft steel into the lines of the hardened plate, and the result is a reverse in high relief on the roll of the engraved portrait where the lines were cut into the metal. The roll is hardened and the portrait is then capable of being transferred—that is, rolled into numberless soft steel plates.

So, you see, the exact similarity is easily accounted for, since it is obtained mechanically. The same means are resorted to with regard to the ornamental lathe work and other geometric figures—*Youth's Companion.*

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EMINENT PRINTERS.

THE ELZEVIRS.

Elzevir, Elsevier or Elzevier (for the orthography is variously given) is the name of a famous family of Dutch printers, who for nearly an entire century were celebrated for the beauty of their types, the number and elegance of their editions, the accuracy of their text, the excellence of their presswork, and the successful efforts they made to improve upon the work of their predecessors and contemporaries. They printed at Leyden, Amsterdam, the Hague, and Utrecht.

Louis Elzevir, the founder of the family, was born at Louvain in 1540, emigrated to Holland forty years later, and settled in Leyden, where he died on the 4th of February, in 1617. He held a subordinate position in the University of Leyden, and also engaged in selling books and in printing. It is said that he produced between 1583 and the date of his death no less than 150 works. He is credited with being the first printer who made a distinction in the use of the *u* and the *v* (though we think this rather apocryphal), and to have been the first to use the term "office" for printing-house. Louis Elzevir was the father of seven sons, five of whom became printers, as follows: Mattheus, who established himself at Leyden, where, upon his death, he was suceeded by his sons Abraham and Bonaventure, as partners; Louis (2d), who set up a printing office at the Hague in 1590, and died there in 1621; Gilles, who was in business first at the Hague and later in Leyden; Joost, who settled in Utrecht; and Bonaventure, the youngest, who was born in 1583, and died about 1652. In 1626 Bonaventure associated himself with Abraham, son of Mattheus, and together they issued the famous Elzevir classics, as well as those on history and politics, called by the French *Les Petites Republiques*, with which the family name is most intimately associated. Abraham died August 14, 1652.

Louis, grandson of the founder of the house, born in 1617 and died in 1670, established the Elzevir press at Amsterdam in 1638, and entered into partnership with his cousin Daniel. The latter carried on the business alone between 1664 and 1680, during which time he published 152 works. He was the last of the family who excelled in printing, though his widow and Pieter, grandson of Joost, carried on the business for some years.

The Elzevirs were inferior to the Aldii and the Stephenses in learning and critical abilities, and won their fame by the beauty and excellence of their paper and printing. The name Elzevir applied to a book has become a synonym for typographical beauty and correctness. The types made by the family were highly esteemed in England, and furnished the basis for the celebrated fonts of Caslon. Fonts are made and sold today cut in the styles of the types of the Elzevirs.—*Printers' Album.*

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PATENT LAW AND ITS DIFFICULTIES.

BY WH. H. WEIGHTMAN.

It seems to be a foregone conclusion that there are quite serious defects in our United States patent laws, and also in the administration of the same. The question of remedy and improvement, however, presents a serious problem, both to those who are moderately satisfied with the existing laws as well as to those who, having been scorched, think they are badly defective. If legislation be necessary, it must come, as does all progress, identified with the results of experience. Present patent laws do not guarantee the patent as it is allowed, nor do they at all provide for proportionate compensation as between the inventor and user. It may require hard study, close attention and marked genius to effect a new invention, but such requisites do not provide for or guarantee profit to the inventor, even though he be protected by a patent. The possession of such patent in most cases makes the inventor a target for the rest of the world, by the presentation of allowed claims which it is necessary for the public to keep clear of while effecting the object which the patent proves can be effected. The patent says: "This can be done, and this is the way our inventor does it;" the public observes: "This can be done, now can it be done some other way without interfering with the patent?"

Efforts have been made to pass a law providing for a more thorough examination, and that the patent, once insured, should guarantee protection for the whole seventeen years. The object of such provision would be to relieve the patents from the too extravagant expense of defending them. As turned now out, some upon their merits, but many in response to the request of a favoured solicitor, the average is over 450 per week, a considerable portion of which should not have been allowed at all. If the patent office were merely a court of record where, as with assignments, an inventor could have a defined exhibit of his invention recorded, the courts would then be the place for determining their validity. But as the law now stands, a "grant" is made after the usual—sometimes good and sometimes indifferent—search, to a patentee or inventor, his heirs or assigns, for the term of seventeen years, of the exclusive right to make, use and vend his invention or discovery throughout the whole United States and Territories. To define what is actually "granted" or conveyed by the Government, it is provided that a copy of the specifications and drawings shall be annexed to the "grant" and constitute a part thereof.

While such "grant" may be on the face of it a promise of protection in the making, using and vending of the invention, such protection really only gives the patentee the right to sue and be sued in the matter of court determination of the validity and financial standing of the patent. Hence, after all, the patent office is but a privileged hall of records to the extent of having the power of dictating what shall be officially recorded and who shall hold possession of such certificate of record. And when such certificate is issued, it only notifies those whom it may concern, that as far as department examination is able to determine, the party or parties named in the patent papers, are the original inventors, but these rights can only be secured and any infringement punished by recourse to the courts.

The doubt of the value of the examination of the records and the results thereof, as made by the department examiner is the feature of complaint, so many patents having been proved worthless after having passed through the department.

In a specification as outlined by an applicant, or his attorney, the patent office demands that the actual improvements shall be clearly defined, while the claims shall state precisely what the inventor considers new. If the claims as presented cover or include in themselves descriptions of mechanisms or results already reached by others, whether patented or not, right of ownership and originality must be shown or the claims withdrawn. The result of the examinationand contention between the examiner, as representing the government, and the applicant or his attorney, is that as a consequence of the special sharpness of the solicitor, or the lack of an infinite knowledge of the subjects pertinent to the application under dispute, there are a great number of patents allowed that could not under any possible legal ability be sustained as valid in a court of law. Or again, the examiner, as representing the government, and the commissioner of patents, may reject an application for a patent for stated causes, which, upon studied contention, could be reversed and a patent obtained. But owing to lack of ability or knowledge upon the subject in its broadest sense, or to the lack of the funds necessary to pay the costs of such contention by an appeal to a higher order of examiners, the application is allowed to lapse and no patent is issued where one should have been granted. If, however, the inventor is well up in the field of his invention, and he has money enough to pay a competent attorney to contest his application and pay the government fees as well, he may be able to prove his right to a patent, and obtain a return for the fees paid.—*American Engineer.*

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MAKE AN AGREEMENT.

It is a difficult matter to deal with that class of men who will neither give or receive a definite proposition looking toward compensation. If, on the one hand, you meet a man who says, "That will be all right; I guess we'll not have any trouble about that part of it," set it down that there will be trouble on just "that part of it." If, on the other hand, you find a man who is always declaring, "You'll not lose anything by this; I'll see that it's all right," you may be sure it will be all wrong in the end. When two men of this sort get together, and the services are of such nature that to determine their exact value at the time of their inception is impossible, the end will be a misunderstanding, mutual dissatisfaction, possibly an estrangement. Yet there is no case in which a probable value can not be got at. If you consider matters as a complete affair, estimating the value of results as you plan them to happen, you can never be a wrong. If one can not do that, he has no business to undertake to make contracts at all. It may be that there are times when a man may go into a business engagement without a definite idea of what his pay is to be, and there may be men who will always settle satisfactorily. But one is never safe to make engagements in such a lax way. False modesty always stands in the way of sensible business arrangements. But it has no place in business. As an old merchant said once to a writer: "We are friends, and I trust will always remain so. Perhaps it is against my interest to tell you so, but when you are making an agreement for the purchase and delivery of goods, don't think of your feelings toward each other at all. Buy of me as you would of a stranger; consider your needs and profits, and don't hesitate to buy where you can do best." It should be this way in making arrangements for employment. Treat the matter as business, pure and simple. You can't afford to do business without making proper arrangements for all points. These sensible suggestions from the *National Grocer* have more than a money value. "Business is business" seems sometimes like a heartless proverb, but it is a fact that no business is likely to prove so satisfactory as that which is done strictly on business principles. Here is where the great value of business education comes in. It impresses upon the mind at every stage of its course that "business is business."—*Scientific American.*

CHINESE WRITING AND PRINTING.

Paper was invented in the first or second century of the Christian era, and was made from fibers of the bamboo beaten into a pulp. That graceful plant—now so popular an element in our own ornamentation—is the classical emblem of literature in China, supplying from its inner layers the materials for the making of paper, and yielding up its tubular twigs to form shafts for hair brushes. Great varieties of papers are now made, many of them being of excellent quality, and of an exquisite fineness and transparency—like silk gauze. The pens used for writing were at one time made from fine tubes of bamboo, split at the points like our quill pens; but about three centuries before our era the hair pencil came into use, and is now universally employed throughout the land for all the uses to which a pen is put in our country. The writer holds the pencil perpendicularly as if he was going to prick the paper. An old traveler tells us that "The Chinese always write from top to bottom, and begin their first letter where ours ends; so that to read their books, the left page must first be sought for, which with them is the beginning. Their paper being very thin, and almost transparent, they are fain to double it, lest the letters do run one into another when they write on the back side; but these doubled leaves are so even that one can hardly preceive it." In printing a book, movable types were not employed until the missionaries initiated the change, indeed, it hardly seemed practicable to make types for an alphabet of some thirty or forty thousand of characters. An old fashioned Chinese book is an almost perfect facsimile of what the author himself wrote, or of the penmanship of the scribe who copied for him or wrote for him at his dictation. Written out on properly sized sheets of gauze-like paper we have described, the original manuscript is, sheet by sheet, firmly and evenly glued on to the blocks which are to be printed from, and when the white unwritten surface has been neatly cut away by a wood engraver, it is passed into the hands of the printer, and the rest is merely a matter of good ink and careful printing. Illustrations to the text generally involve no extra expense, unless they are of a character requiring unusual technical skill. The number of blocks required will be exactly as many pages as the printed book should contain, with the addition of title page, and while the risk of fire and expense of storage involve disadvantages, it must be admitted that there is no need to run the risk of printing a large issue till it is called for, and, of course, proof reading is not required. Imagine a modern political orator having to send the manuscript of his oration to be printed facsimile in the morning dailies! How carefully framed would each sentence be. How calmly the fire of partisan spirit would glow under the apprehension of a criticism of which there could be no verbal evasions. May this not be the secret of the strange and persisting survival of Chinese institutions?—*Conquests of the Cross.*

HAIRPINS, HISTORICALLY AND OTHERWISE.

What would the average woman do without a hairpin? She buttons her gloves with it. Likewise she buttons her shoes with it—buttonhooks get lost, or they are "up stairs" or down—one always has a hairpin, though. To be sure, a hairpin is rather cranky about buttoning shoes and gets twisted and the varnish comes off—but a hairpin is, after all, so handy; one always has one. A hairpin is also a good substitute for a hat pin. Almost anything can be mended with a hairpin, and there is no use having a new clasp put on one's little bag—a hairpin will twist up and make it just as safe. Of course after a hairpin is twisted it breaks easily, but one always has a hairpin, so it makes little difference if it does.

Latch keys are forever getting left home when one goes to the theater, but if anything will pick a lock a hairpin will, and one always has a hairpin.

A man thinks nothing so good for cleaning out his pipe as a straightened hairpin. It's really better than a broomstraw, and besides the broom may be away out in the kitchen, but one always has a hairpin.

There is nothing like a hairpin for chasing the dime or button small Dick dropped between the piano keys, and no broom can do the final cleaning of the parlor corners—a hairpin is the only thing. Then, too, it's so handy when the stationary washstand waste pipe gets stopped. A hairpin is the most convenient thing in the world for that sort of emergency and no delay, for of course one always has a hairpin. It is handy to turn over and hold an eyelid with while one hunts for a torturing cinder; and, though the cinder blow into the eye in the desert of Sahara, one always has a hairpin.

Then last, but not least, a hairpin is so convenient for doing up hair—but that is usually the time when one hasn't got a hairpin.—*Kate Field et al.*

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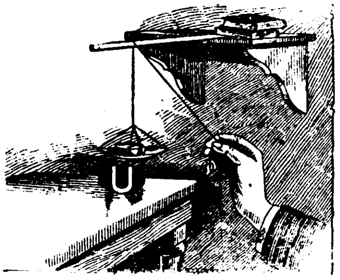
To Demagnetize a Watch.—A simple method, yet one that is said to be quite effectual for demagnetising watches, has been devised by Mr. P. D. Richards of West Medford, Mass., and is almost apparent from our illustration. A compound horseshoe magnet is placed conveniently with the poles up, and over a suitable support a thread is carried, having attached at one end a cardboard scale pan holding the watch. The thread is allowed to untwist itself as the watch is slowly removed from the magnetic field. An electro-magnet would answer the purpose as well, but the permanent horseshoe magnet is within reach of every one—*Electrical Review.*



Demagnetizing a Watch.

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MANAGEMENT OF FROZEN PIPES.

To find the water pipes leaking, frozen, or perhaps burst, is no rare occurrence during the winter in the modern much-plumbed houses. Nothing more thoroughly demoralizes the domestic machinery than such unlucky happenings. Floors are wet, ceilings leak, the water is shut off, and the whole household is at a standstill, waiting for that vexatious will o'-the-wisp, the plumber. Whenever the leak is visible, the housewife can cure the ill herself, at least temporarily. Shut off the water first, and then spread some white lead on a cloth, like a plaster. Tie this firmly over the leak, and the plaster will soon harden, for the water cannot work its way out or prevent the plaster's adhering. Unless the plumber will make thorough repairs when he does come, the hard plaster is more permanent than any puttied joint or weak solder. Let a pound of white lead stand a day or two until a skin has formed over it, and then cover it with water. It will be soft and ready for use at any time, and the housewife can "snap her fingers at the plumber's ways," to paraphase Sir Joseph Porter, as best suits a frosty morning. Strips of rubber cut from old rubber shoes and bound tightly over the leaks in hot-water pipes will close the holes and stop the dripping flood.

When the water freezes in the traps of the bathroom or the kitchen sink, a quart of common salt thrown into them will thaw them out more rapidly than hot water. A lighted lamp placed under a frozen water pipe is more rapid and convenient in its work than pouring on hot water. A lamp, the flame partly lowered, placed under an exposed bend or length of pipe which is liable to freeze is a simple preventive of trouble in bitter weather.—*Harper's Bazaar.*

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A modest plumber boy opened a $10,000 guaranteed burglar proof safe a few days ago, on a wager, in three minutes. They then turned him out, set a new combination and invited him to try it again. This time he got the big doors open in two minutes without defacing the lock. The county authorities up in Dakota, who own the safe, now refuse to pay for it, and the manufacturers have taken a dislike to the plumber boy.—*Stove and Hardware Reporter.*

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MY CLASS IN GEOMETRY.

A vivid recollection of my boyhood is the general disfavor with which my school-fellows used to open Euclid. It was in vain the teacher said that geometry underlies not only architecture and engineering, but navigation and astronomy. As we never had any illustration of this alleged underlying to make the fact stick in our minds, but were strictly kept to theorem and problem, Euclid remained for most of us the driest and dreariest lesson of the pay. This was not the case with me, for geometery happened to be my favorite study, and the easy triumph of leading the class in it was mine. As years of active life succeeded my school-days I could not help observing a good many examples of the truths set forth in the lines and figures I had conned as a boy; examples which, had they been presented at school, would certainly have somewhat diminished Euclid's unpopularity. In fullness of time it fell to my lot to be concerned in the instruction of three boys—one of fourteen, the second twelve, the third a few mouths younger. In thinking over how I might make attractive what had once been my best-enjoyed lessons, I took up my ink-stained Euclid—Playfair's edition. A glance at its pages dispossessed me of all notion of going systematically through the propositions—they took on at that moment a particularly rigid look, as if their connection with the world of fact and life was of the remotest. Why, I thought, not take a hint from the new mode of studying physics and chemistry? If a boy gets a better idea of a wheel and axle from a real wheel and axle than from a picture, or more clearly understands the chief characteristic of oxygen when he sees wood and iron burned in it than whed he only hears about its combustive energy, why not give him geometry embodied in a fact before stating it in abstract principle? Deciding to try what could be done in putting book and black-board last instead of first, I made a beginning. Taking the boys for a walk, I drew their attention to the shape of the lot on which their house stood. Its depth was nearly thrice its width, and a low fence surrounded it. As we went along the road a suburban one near Montreal, we noticed the shapes of other fenced lots and fields. Counting our paces and noting their number, we walked around two of the latter. This established the fact that both fields were square, and that while the area of one was an acre and a half, that of the other was ten. When we returned home the boys were asked to make drawings of the house-lot and of the two square fields, showing to a scale how they differed in size. This task accomplished, they drew a diagram of the house-lot as it would be if square instead of oblong. With a foot-rule passed around the diagram it was soon clear to them that, if the four sides of the lot were equal, some fencing could be saved. The next question was whether any other form of lot having straight sides could be inclosed with as little fence as a square. Rectangles, triangles, and polygons were drawn in considerable variety and number and their areas calculated, only to confirm a suspicion the boys had entertained from the first—that of lots of practicable form square ones need least fencing. In comparing their notes of the number of paces taken in walking around the two svuare fields, a fact of some interest came out. While the larger field contained nearly seven times as much land as the other, it only needed about two and a half times the length of fencing to surround it. Taking a drawing of the larger inclosure, I divided it into four equal parts by two lines drawn at right angles to each other. It only needed a moment for the boys to perceive how these lines of division, representing as they did so much new fencing, explained why the small field had proportionately to area so much longer a boundary than the large one.

A chess-board served as another illustration. Taking each of its sixty-four squares to represent a farm duly inclosed, it was easy to see how a farmer rich enough to buy the whole number, were he to combine them in one stretch of land, could dispense with an immense quantity of lumber or wire fencing. During a journey from Montreal to Quebec the boys had their attention directed to the disadvantageous way in which many of the farms had been divided into strips long and narrow. "Just like a row of chess squares run together," said one of the lads.

When a good many examples had impressed the lesson on their minds pretty thoroughly, I had them write under their drawings, taking care that the terms used were understood: "Like plane figures vary in boundary as their like linear dimensions; they dary in area as the *square* of their like linear dimentions." It proved, however, that while the boys knew this to be true of squares, they could not at first comprehend that it was equally true of other forms. They drew equilateral and other triangles and ascertained that they conformed to the rule, but I was taken aback a little when the eldest boy said, "It isn't so with circles, is it?" His doubt was duly removed, but the remark showed how easy it is to make words outrun ideas; how hard it is for a young mind to recognize new cases of a general law with which in other examples it is quite familiar.

One chilly evening the sitting-room in which my pupils and I sat was warmed by a grate-fire. Shaking out some small live coals, I bade the boys observe which of them turned black soonest. They were quick to see that the smallest did, but they were unable to tell why. They were reminded of the rule they had committed to paper, but to no purpose, until I broke a large glowing coal into a score of fragments which became black almost at once. Then one of them cried, "Why, smashing that coal gave it more surface!" This young fellow was studying the elements of astronomy at school, so I had him give us some account of how the planets differ from one another in size, how the moon compares with the earth in mass, and how vastly larger than any of its worlds is the sun. Explaining to him the theory of the solar system's fiery origin, I shall not soon forget his keen delight —in which the others presently shared—when it burst upon him that because the moon is much smaller than the earth it must be much colder; that, indeed, it is like a small cinder compared with a large one. It was easy to advance from this to understanding why Jupiter, with eleven times the diameter of the earth, still glows faintly in the sky; and then to note that the sun pours out its wealth of heat and light because the immensity of its bulk has, comparatively speaking, so little surface to radiate from.

To make the law concerned in all this definite and clear, I took eight blocks, each an inch cube, and had the boys tell me how much surface each had—six square inches. Building the eight blocks into one cube, they then counted the square inches of its surface — twenty-four; four times as many as that of each separate cube. With twenty-seven blocks built into a cube, they found that structure to have a surface of fifty-four square inches, nine times that of each component block. As the blocks underwent the building process, a portion of their surfaces came into contact, and thus hidden could not count in the outer surfaces of the large cubes. Observation and comparison brought the boys to the rule which told exactly what proportion of surface remained exposed. They wrote, "Like solids vary in surface as the *square*, and in contents as the *cube* of their like dimensions." They were glad to note that the first half of their new rule was nothing but their old one of the farms and fields over again.

As the law at which we had now arrived is one of the most important in geometry, I took pains to illustrate it in a variety of ways. Taking a long, narrow vial of clear glass, nearly filled with water and corked, I passed it around, requesting each of the boys to shake it smartly, hold it upright, and observe which of the bubbles came to the surface first. All three declared that the biggest did, but it was a little while before they could be made to discern why. They had to be reminded of the cinders and the building-blocks before they saw that a small bubble's comparatively large surface retarded its motion through the water. The next day we visited Montreal's wharves, and, pacing alongside several vessels, jotted down their length. In response to questions, the boys showed their mastery of the principle which decides that the larger a ship the less is its surface in proportion to tonnage. Going aboard an Allan liner, of five thousand tons burden, we descended to the engine-room; we next visited a steamer of somewhat less than one thousand tons, and inspected her engines — engines having proportionately to power much larger moving surfaces to be retarded by friction than those we had seen a few minutes before. On being reminded of their experiments with the vial, the boys were pleasantly surprised to find that the largest bubble and the ocean racer come first to their respective ports by virtue of their identical quality of bigness, by reason of the economies which dwell with size. As we walked homeward, the youngest of our party espied a street-vender with a supply of gaudy toy-balloons. One of them bought, I dare say the little fellow's mind was pretty confident that there was no Euclid in that plaything. It proved otherwise. That evening he calculated how much the lifting power of his balloon would gain on its surface were its dimensions increased one thousand or ten thousand fold—step by step approaching the conclusion that, if air-ships are ever to be manageable in the face of adverse winds, they must be made vastly larger than any balloons as yet put together.

Not far from home stood a large store, displaying a miscellaneous stock of groceries, fruits, dry goods, shoes, and so on. As we cast our eyes about its shelves, counters, and floor, we saw many kinds of packages—cans of fish, marmalade, and oil, glass jars of preserves and olives, boxes of rice and starch, large paper sacks of flour. Outside the door stood half a dozen empty barrels and packing-cases. It certainly seemed as if the cost of paper, glass, tin, and lumber for packages must be an important item in retailing. One after another the boys discovered that the store was giving them their old lesson in a new form. They saw that the larger a jar or box the less material it needed. On their return home they were gradually led up to finding that form as well as size is an element in economy. Just as farms square in shape need least fence, they found that a cubical package needs least material to make it, and that tins of cylindrical form require least metal when of equal breadth and height.

Our next lesson was one for lack of which not a few inventors and designers have wasted time and money. Taking the trio to Victoria Bridge, we asked its custodian the length of its central span. His reply was, three hundred and fifty-two feet. When I asked the boys how matters would be changed if the span were twice as large, they soon perceived that, while increased in strength by breadth and thickness, it would be heavier by added length as well. On our return we compared two boards differing in each of their three dimensions as one and two, serving to make manifest why it often happens that a design for a bridge or roof, admirable as a model, fails in the large dimensions of practical construction.

One day a roofer had to be called in to make needful repairs. We went with him to the roof, and found the gutter choked with mud. How had it got there? A glance at the roof, an iron one, showed it covered with dust which the next shower would add to the deposit in the gutter. Dust-particles are extremely small and fine, and did not this explain how the wind had been able to take hold of them and carry them far up into the air? Although the boys had considerably less pocket-money than they liked, they had still enough to enable them to observe that the smallest coins were most worn. When they came to think it over, they readily hit on the reason why.

Our next lessons were intended to bring out the relations which subsist between several of the principal forms of solids. Two series of models in wood were accordingly made. The first consisted of a cube having a base five inches square, and a wedge and pyramid of similar base and height. The second series comprised a cylinder, sphere, and cone, each five inches broad and high. Taking the first series, a moment's comparison of the sides of wedge and cube told that one contained half as much wood as the other; but that the pyramid contained a third as much as the cube was not evident. Weighing the pyramid and cube brought out their relation, but a more satisfactory demonstration was desirable, for what was to assure us that the two solids were of the same specific gravity? Taking a clear glass jar of an accurately cylindrical interior, measuring seven and a half inches in width by ten in height, it was half filled with water, and a foot-rule was vertically attached to its side. The models, which were neatly varnished, and therefore impervious to water, were then successively immersed and their displacement of the water noted. This proved that the pyramid had a third the contents of the cube, that the same proportion subsisted between the cone and cylinder, and that the sphere had twice the contents of the cone. Dividing the wedge by ten parallel lines an equal distance apart, I asked how the area of the smallest triangle so laid off, and that of the next smallest, compared with the area of the large triangle formed by the whole side of the wedge. "As the square of their sides," was the answer. Dipping the wedge below the surface of the water in the jar, edge downward, it was observed to displace water as the square of its depth of immersion. Reversing the process, the wedge became a simple means of extracting the square root. Dividing the vertical play of its displacement into sixteen parts drawn along the jar's side, we divided the wedge into four parts by equidistant parallel lines. Then, for example, if we sought the square root of nine, we immersed the wedge with its edge downward until it had displaced water to line nine on the jar's side. On the wedge the water stood at line three, the square root of nine. In a similar way the cone was observed to displace water as the cube of its depth of immersion, and therefore could be impressed into the service of extracting the cube root. For this purpose its total play of displacement in a jar of five and a half inches interior diameter was divided into twenty-seven parts, and the cone was marked off into three sections. To find the cube root of eight, we lowered the cone apex downward, until the water-level was brought to eight on the jar's side; at that moment the liquid encircled the cone at section two, denoting the cube root of eight. The pyramid immersed in the larger jar acted equally well as a cube-root extractor. Measuring both cone and pyramid at each of their sectional divisions, the boys were required to ascertain the rule governing their increase of sectional area, and arrived at the old familiar law of squares—a law true not only of all solids converging regularly to a point, but of all forces divergent or radiant from a center, simply because it is a law of space through which such forces exert themselves.

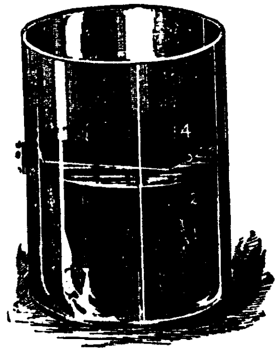

FIG. 1.

FIG. 2.

While I was glad to use examples and models to instruct my pupils, I wished them to grasp certain geometrical relations through exercise of imagination. They had long known that the area of a parallelogram is the product of its base and height; they were now required to conceive that any triangle has half the area of a parallelogram of equal height and base. It was easy then to show them the very old way of ascertaining the area of a circle, the method which conceives it to be made up of an indefinitely great number of triangles whose bases become the circle's circumference, and whose altitude is the circle's radius. Rolling the cylindrical model once around on a sheet of paper, its circuit was marked off; this was made the base-line of a parallelogram having a height equal to half the cylinder's breadth; half that area was clearly equal to the surface of the circle forming the cylinder's section. Another method of proving the relation between the area of a circle and its circumference was followed by the boys with fair promptness. I asked them to imagine a circular disk to be made up bythe contact of a great number of concentric rings. Supposing the disk to be a foot in diameter and each ring to be the millionth of a foot wide, I enquired, "How many rings would there be?" "Half as many, half a million." To the question, "What would be the size of the average ring's circumference?" "Half that of the whole circle," was the reply. They were thus brought to it that if a circle rolled around once is found to have 3.1416 lineal units for its circumference, its area must be ·7854, or one half of one half as much, expressed in superficial units of the same order.

A terrestrial globe was the text for our next lesson. Assuming its form to be spherical, shift its axis as we might, it was clear that its center remained at rest during rotation in all planes. A hint here as to why the calculations of the astronomer are less difficult than if the planets were of other than globular form, for each orb as affected by gravitation may be practically considered as condensed at its center. Turning from astronomy to navigation, we glanced at the principle of great circle-sailing. On the equator of our terrestrial globe we found the Gillolo Islands and Cape San Francisco. A ship's shortest course plainly lay along the equatorial line which joined them. When I asked which was the shortest route from San Francisco, California, to Figami Island, Japan, the boys concurred in the wrong answer, "Along the thirty-eighth parallel." Taking a brass semicircle equal in diameter to the globe's equator, and applying it so as to touch both places, the lads saw at once that the shortest route would take a ship somewhat toward the north for the first half of her voyage; that if two ports are to be joined by an arc, the largest circle of which that arc can form a part marks out the shortest track; and that this largest or great circle is practically no other than a new equator cutting the earth in a plain inclined to the geographical equator.

By this time about a year had elapsed since our little class in geometry had been formed, and its progress was very satisfactory. The eldest boy was now studying Euclid at a high school and earning high marks for his proficiency. In the lessons I have described, and in others which followed them, all three lads showed their interest by being constantly on the lookout for new illustrations. Let an instance or two of this suffice. One day they walked to an immense sugar-refinery some distance off, paced around it, estimated its height, and brought me their calculations as to its storage capacity in comparison with that of a small warehouse near by; calculations showing how much outer wall and roof were saved in the vast proportions of the refinery. At home an extension of the house was heated in the winter by a small stove; at a neighboring station of the street railway there was a much larger stove of the same pattern. Counting efficiency to depend on surface, one of the boys asked me if it would not be better to have two small stoves instead of that large one. He was perfectly conversant with the reason why steam-fitters make their heating-coils of small pipes, and why their radiators abound in knobs and ridges.

It may be no more than the effect of bias due to an individual preference for the study, but, in the light of its influence on these three young minds, I can not help thinking that geometry affords a most happy means of developing powers of observation and reasoning. When the boys came to study plants, minerals, and insects they found their knowledge of Euclid gave them a new and vital thread whereon to string what they learned. This was even more decidedly the case when they came to study the various modes of motion and certain principles of engineering science. Mr. W. G. Spencer, the father of Herbert Spencer, in an invaluable little book * has shown how geometry can be taught so as to educe the noble faculty of invention. At the high school at Yonkers, New York, of which Mr. E. R. Shaw is principal, I have seen most original and beautiful solutions of Mr. Spencer's problems worked out by the pupils.—By George Iles, in *Popular Science Monthly.*

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PRACTICAL USE OF THE ELECTRIC MOTOR IN FACTORIES.

The value of the electric motor for the transmission of power is becoming more evident every year. Its development has been rapid. It is but a few years ago since it was regarded as a mere toy, which could never generate enough power to be of practical use. But with the perfection of the dynamo its use became apparent at once.

When, in a tall-factory building, the power is generated by a steam-engine on the ground-floor, and transmitted by belts to every part of the building, much power is lost by the slipping of these belts. And besides this loss, there is a large loss of space from running belts between the floors; and this loss is the larger, as it is impossible to run the belts vertically.

The reason of this is seen at once. Imagine a belt suspended vertically from one shaft to another; the whole weight would come on the top pulley, and the lower one, which was driving the upper, would slip around inside the belt, without turning it. Hence the belt must be run at an angle, at least about 60 degrees to the horizontal, in order to prevent excessive loss of power by slipping. All this waste of power and of room counts heavily in the maintenance of a factory, besides the constant attention and frequent repairs which the belts and shafting require.

With the system of electric transmission of power, the greater part of this particular expense is avoided. The engine on the ground-floor is connected directly with a large dynamo. The wires carrying the current go up into all departments of the factory, and wherever power is wanted, the wires are "tapped" and connected to a motor, which may be of one, two, three, ten, or any number of horse-power up to seventy-five! It is not a life-time since prominent electricians declared ten horse-power to be the limit of a motor.

By this system a great part of the shafting and belting in a factory is done away with, and in the case of a high factory it is often a great improvement on the old style. But we must not lose sight of the fact that in the transmission of force from the engine belt to the motor belt, fifty per cent. of power is lost. This, however, appears more important than it is. The great loss of power in a large system of belting cannot be exactly calculated, but experience shows that the electric transmission in the case of high factories is considerably more economical.

Another great advantage is that an increase in the power of the dynamo makes it possible to light the factory very economically with electric lamps—a very safe and convenient system of lighting.—By John D. Cochrane.

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* Inventional Geometry. D. Appleton & Co., New York.

ELECTRICAL

ELECTRO-MAGNETISM AND THE PRINCIPLE OF THE MAGNETO-ELECTRIC MACHINE.

Last month we considered the subject of magnetism and its laws. We will now take up that of electro-magnetism, and show how electricity may be converted into magnetism and magnetism into electricity.

A current of electricity passing through a coil of copper wire within which is placed a small bar of soft iron, makes a magnet of that bar, in all respects resembling a permanent steel magnet, except that the former loses its magnetism when the current is discontinued. Some of the strongest permanent steel magnets are, indeed, made in this way, but this is by inserting in the coil a piece of steel instead of soft iron.

In the case of the temporary magnet produced when soft iron and not steel is used, the North and South-seeking poles are determined by the direction in which the current passes around the coil. When this direction is contrary to that of the hands of a clock, looking along the bar from one end as if it were a telescope, the nearer end will be found to be a North-seeking pole. By turning the bar and looking at the other end, so that the current seems to pass in the direction taken by the hands of a clock, that end will be found a South-seeking pole.

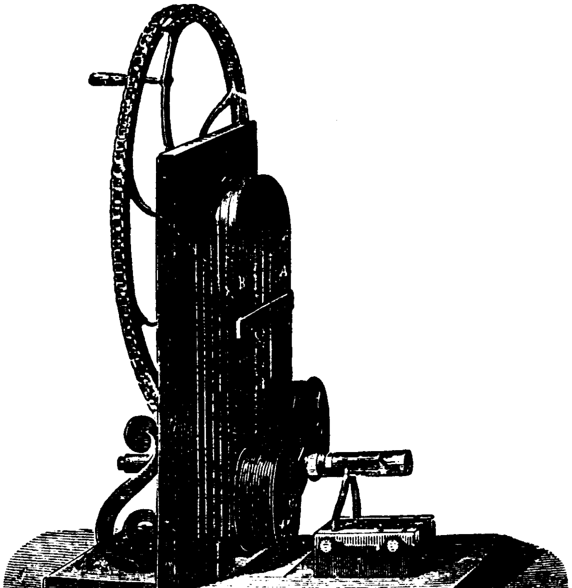

FIG. I.

It will be interesting to note just here that when the bar is magnetized by a strong current to saturation, the bar will lengthen by $\frac{1}{270,000}$ of its own length, while the instant the current flows a faint metallic click will be heard. This would substantiate the theory that the molecules of the bar are oblong in shape, every one being a magnet, and lying in all directions so as to neutralize one another. But when the bar is magnetized by the electric current or otherwise, the effect is to swing all the molecules around until they lie in the same plane, their north and south-seeking poles corresponding in their pointing. Hence, possibly, the sound produced, while the lengthening might be due to the swing of the oblong molecules into a direction parallel to the bar. If, then, currents of electricity can produce magnetism, why may not magnetism produce currents of electricity? Faraday, in 1831, showed that a magnet, when brought near a closed circuit, induces momentary currents in that circuit, so long as the magnet is kept moving. Let us see the direction taken by these currents. Suppose we have a coil of wire, fig. 1, in the middle of which a space is left in which a bar magnet may be inserted. If the two ends of the wire be connected to a galvanometer and one end of the bar magnet be suddenly lowered into the hollow space within the coil, a current will be found to flow while the magnet is being lowered, but when it comes to rest the current falls off, and there is then no deflection of the galvanometer needle. But when the magnet is withdrawn another current is established, but in an opposite direction to that of the first. These are induced currents, and depend for direction on which of the poles is inserted, and whether that pole is lowered into or drawn out of the hollow space in the wire. Let the N-seeking pole of a magnet be inserted and an induced current will be set up in the coil in a direction opposite to that taken by a current which would be necessary to make a north pole of that magnet, viewing the opposite end to that into which the magnet is lowered. Consequently the induced current, when the N-seeking pole is lowered, would travel around the coil of wire, the observer facing the opposite end to that in which the magnet is inserted, in the direction taken by the hands of a clock. Then when the magnet is drawn out the current set up will be in the opposite direction. Hence if a S-seeking pole is lowered and drawn out again, the first current induced will flow in the opposite direction to that of the hands of a clock, while the second induced current will flow clockwise.

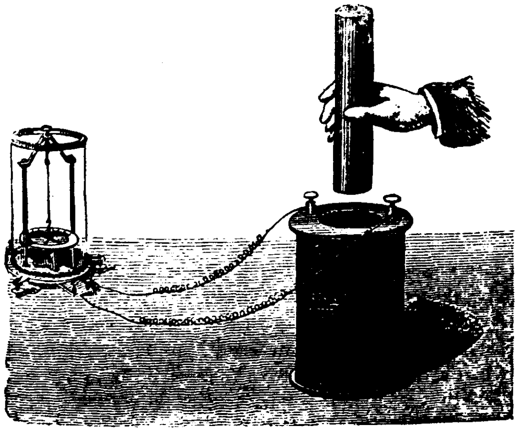

FIG. 2.

It will be further seen that precisely the same result would follow if, instead of lowering and raising a magnet in the coil of wire, a soft iron rod were permanently placed inside the coil, and a magnet brought near one end; for the magnet would induce magnetism in the soft iron bar, and thus induce a current in the coils.

Now let us, with the above facts in mind, look at the little magneto-electric machine so much used for medical purposes.

This machine was first constructed to be of practical use by Pixii in 1832, and improved by Clarke in 1834. It consists, fig. 2, of two coils of wire caused to rotate in front of a large permanent steel magnet, by means of multiplying gear at the back. Two ends of its wire are connected, one to the support in which the steel spindle between the coils turns, and from that to a binding post, the other to a plate on the spindle insulated from it, but in metallic connection with a brush, serving to convey the current to another binding post. Suppose the coils, fig. 3, are starting from a position between the two poles of the large magnet and are just moving to the left As the upper coil approaches the N-seeking pole of the large steel magnet, the iron core in the coil is converted by induction into a S-seeking pole, hence it is the same as thrusting a S-seeking pole into the coil, consequently an induced current is produced in that coil in a direction opposite to the hands of a clock. But as the figure represents the end of the coil into which the S-seeking pole would be thrust, it will have to be represented on the diagram in a similar direction. At the same time, however, when the upper coil approaches the N-seeking pole the lower coil approaches the S-seeking pole, hence the soft iron core in the coil is by induction converted into a N-seeking pole, a current is therefore produced in it in a direction similar to that of the hands of a clock, but as before represented on the diagram in an opposite direction. Now, as the wire in each coil is wound in an opposite direction, and as we have just seen the two induced currents set up in each coil are in opposite directions, then the combined effect of this is to momentarily combine the two currents into a continuous one flowing in a definite direction, which ceases when the coils become horizontal. In fact, this current is set up just for the instant when the coils come under the influence of the induced magnetism. But when the coils move away from the horizontal position to the vertical again in completing one-half a revolution, the two cores pass away from the magnetic poles, and hence it is the same as drawing a magnet out of the coils, consequently the current produced in the now lower coil will be the same as if a S-seeking pole were drawn out, that is, it will be in a clockwise direction. The current produced, then, in the now upper coil will be opposite to the direction of the hands of a clock. Therefore, just as before, the currents produced are combined into one, and form a momentary current produced in an opposite direction to that produced in the first quarter of the revolution.

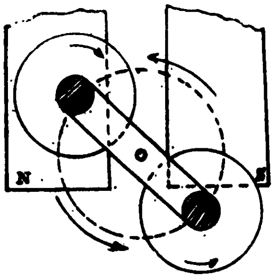

FIG. 3.

We have thus traced out the course of each coil during one-half a revolution. Let us now see what currents are set up in the other half of the revolution. We saw before that as the lower coil turns away from the N-seeking pole a current was generated in a direction similar to that of the hands of a clock, but the current produced, when the same coil approaches the S-seeking pole, is in the same direction ; hence there is no reversal of current as the coil passes between the two poles. For exactly the same reason no change of direction in the current will take place as the upper coil passes from the influence of the S-seeking pole to that of the N-seeking. Consequently, when these coils are revolving at a good rate of speed, there will be practically a continuous current as the coils pass from one magnetic pole to the other. It follows from this that the point at which the current is reversed is, when the coils lie in a horizontal position, directly across the two poles. This point is called the dead point.

This little machine produces an alternating current, or one that reverses itself at every half-revolution ; it is for this reason it is so valuable for medical purposes. Next month we shall see how this alternating current may be converted into a direct current by a very simple device known as a commutator.

The reader must have noticed an obvious difference by this time, between magnetism as produced by electricity and electricity as produced by magnetism ; for a continuous current passing through a coil of wire wound around a soft iron bar produces magnetism not for the instant, as is the case where magnetism produces electricity, but continuous as long as the current flows. But it may be asked, why does not a continuous current flow from a coil of wire when a bar magnet is inserted? Conservation of energy forbids this ; for what would there be to hinder us from taking a coil of wire and placing a strong permanent steel magnet in it, draw off an unlimited supply of electricity, and applying it to do work, so getting perpetual motion ? No ! it would be against all the natural laws that this should be so.

Next month we will talk about the dynamo-electric machine and its principle.—ED.

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SOME PRACTICAL SUGGESTIONS ON OVERHEAD CONSTRUCTION OF ELECTRIC RAILROADS.

In the construction of electric street railways, it is most essentially necessary that every detail shall be carried out in the most thorough and minute manner, and to all those parts, each of which has its own special function to perform, must the efficiency of the equipment as an aggregate be looked for. In discussing the best means of carrying out these details, the writer has classified the subject under the following heads :

RAILS.

All rails should be connected with railbonds of sufficient length to span the fish plate and allow a reasonable amount of slack so that the movements of the rail will not cause the bond to break. The rivet holes should be drilled at least two inches from either end of the fish-plate. On girder and T rail this hole should be drilled through the web of the rail, and on flat or tram rail through the flange, and countersunk so that the flange of the wheel will not reach the upset rivet. A rail bond 24 inches in length is usually sufficient for ordinary work. At frogs, switches, curves, or where short pieces of castings occur in the track, these pieces should be connected up in the same manner as the regular rail. It is also advisable to connect these small parts with a continuous wire to insure a good return circuit. At steam railway crossings the track should be connected in the same manner. On single track roads all rails should be cross-connected, in addition to regular bonding with a double headed bond, at every 60 alternate feet. No. 4 B & S. soft-drawn copper wire is preferable for all railbonds, this offering less resistance than iron wire. On double track roads the same manner of cross-connecting should be observed as on single track, and in addition a cross connection of all four rails should be made about every 300 feet. It is conceded by a number of authorities that a continuous ground wire is not necessary to get a good return circuit.

POLES.

Natural wood poles should be at least 30 feet long for straight line work, with a diameter at the top of not less than 7 inches. They should be of cedar, Norway pine, or chestnut, as straight as possible and free from knots. Octagonal wood poles should be 7 inches in diameter at the top and 12 inches at the bottom, with an untrimmed butt of 5½ feet, which should be tarred before placing pole into the ground. Where wooden poles are used in centre pole construction, an iron shield should be placed around them for a distance of 5 or 6 feet upward from the grade line to protect them from being marred by wagons striking them. Lattice iron or girder poles should be 4 inches in diameter at the top, 10 inches at the grade line, and 11¼ inches at the bottom, and at least 29 feet long. These, as well as all other iron poles, should be provided with a thorough insulated pole top. Corner poles should be heavier than side poles. If of wood, they should not be less than 8 inches in diameter at the top. Latticed corner poles should be 6 inches in diameter at the top, 13 inches at the grade line, and 14½ inches at the bottom. It is very important to have strong poles at curves and corners, and for that reason they should be extra long so as to allow of being placed 7 feet in the ground.

POLE SETTING.

For straight line work poles should be set 6 feet into the ground with a rake away from the track of at least 6 inches at the top. This rake will, of course, vary with the width of street, condition of soil, and weight of trolley wire. In setting iron poles a good cement concrete should be used. This concrete should be mixed with small stones and tamped well against the pole. The number of poles required for side construction is usually 88 to 90 per mile, making spans about 125 feet apart. This will necessarily vary with width of street and size of trolley wire.

INSULATORS AND FIXTURES.

Before setting wooden poles, a half-inch hole should be bored at a uniform distance from the top to allow for half-inch eye bolt or ratchet bolt. The use of a ratchet is advised, as it makes it very easy to adjust the trolley wire by simply letting out or drawing up on the ratchet. All insulating pins and brackets should be of best split oak or locust. At points where short turns in heavy feeder wires occur, an iron pin or wooden pin having a bolt through it should be used.

SPAN WIRES.

This wire should be ¼ or $\frac{5}{16}$ inch in diameter, of the best 7-wire steel strands. This is far better than solid iron wire, having much greater tensile strength, and being flexible. The pole ratchets to which these wires are attached should be placed on the poles at a uniform height from the track, which should be such as to hold the trolley wire at least 18 feet from the track, allowing 2 per cent. of its length for sag.

TROLLEY WIRE.

This wire should be put up in as long lengths as possible. The starting and ending points of this wire should be securely anchored to a strong double span of stranded steel wire, attached to extra heavy end poles. This span should be thoroughly insulated from the poles by means of a heavy strain insulator. The trolley wire should be drawn to moderate tension only, allowing about 18 inches sag to every 125 feet. In cold weather it may be drawn somewhat tighter. Great care should be taken in handling this wire, so as to avoid kinks or scratches.

Curves should be completed as they are reached by the trolley wire. The trolley wire insulators should be clamped on, not soldered, after the line is in place, and all curves are made.

CURVES.

The poles used at curves must be set so they will not give when the strain of the line is placed upon them. The curve brackets should be placed at equal intervals, and it is advisable to solder the clamp to the trolley wire, so as to avoid any possibility of sliding. They should be so placed that the trolley wire may be exactly in line with the trolley on the car. To accomplish this the curve bracket should be more or less inside of line vertically over the centre of track, the height of wire and radius of curve determining the position- The wire-holding curve brackets should be ¼ or $\frac{3}{16}$ inch 7-strand steel wire, same as regular span wire. They should be well secured to an extra strong strain insulator, which in turn should be fastened to pole ratchet. It is advisable to use an insulator where curve bracket wires come to a focus, as this insures additional insulation from the pole. This is particularly the case where an iron pole is used.

FEEDER WIRES.

Great care shoule be taken in running feeder wires so that they do not become chafed, rubbed or kinked. Where they are run through trees, every precaution should be taken that no limbs or twigs are allowed to lie against the wire, as the swaying of the trees from the wind will eventually destroy the insulation. Where large limbs come in direct line of the feeder, tree insulators should be used.

Feeding in connections to trolley wire should be made through an insulated 7-strand steel cable, this cable serving at the same time as a span wire. To this cable can be attached an uninsulated hanger which at the same time holds the trolley wire.

GUARD WIRES.

Wherever there is danger of crosses with telephone, telegraph or other foreign wires falling on the trolley wire, guard wire should be used. This can be a solid iron wire suspended from either solid or stranded span wire, and insulated from poles by porcelain insulators. By paying special attention to the above points it is thought that the construction will be rendered more simple, and certainly more reliable and durable, giving that constant efficiency and practical working which is the aim of every electric street railway man to carry out in its entirety.—*Electrical Engineer.*

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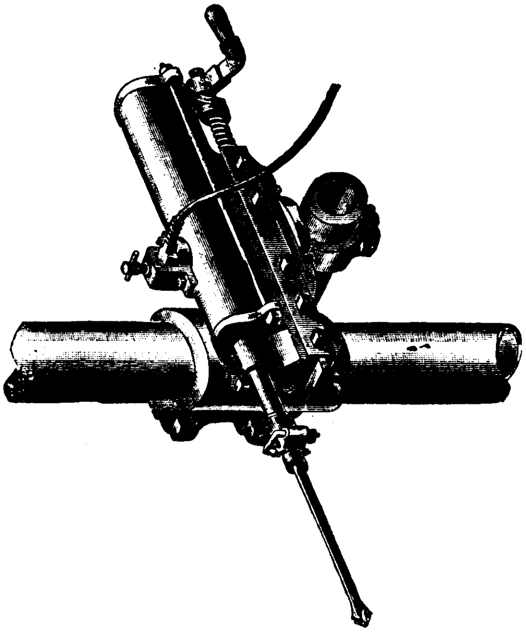
THE EDISON GENERAL ELECTRIC CO'S ELECTRIC PERCUSSION DRILL.

The one thing which has more than anything else prevented the all but universal application of electric motive power to mining operations, has been the lack of an efficient and practical electrical substitute for power drills operated by steam or compressed air.

The Edison General Electric Company, appreciating this fact, have obtained control of and are now manufacturing and exploiting a drill making use of the principles of the "Marvin system of percussion tools." This drill, a cut of which is here shown, consists simply of a reciprocating iron bar impelled backward and forward by the action of two solenoids which are alternately thrown into action by pulsating electric currents.

The alternate action of the two coils is accomplished without the aid of commutators, collectors or other moving parts on the drills which are involved in reciprocating motions in other machines, but is accomplished by the use of pulsating currents, positive impulses being delivered to one coil and alternately negative impulses to the other. Since there are no moving parts in the drill except the reciprocating bar or plunger, there is no wear except in the guides. The heaviest parts of the drill are the tripod weights which weigh about 100 pounds each, and the two solenoid coils which weigh 55 pounds each ; and the largest piece is the cylindrical casing, in which are enclosed the coils, which is 38 inches long by about 6 inches in diameter. The total weight of drill and tripod is about 400 pounds.



MARVIN ELECTRIC DRILL.

The drill makes about 600 strokes per minute of a maximum length of about 4 inches and will cut at the rate of two inches per minute in the hardest granite with a one and one-half inch bit, with a consumption of about 5 h. p.

One of the most remarkable features of this drill is that should the machine not be fed up to the rock properly, so that the bit fails to strike, the plunger immediately loses its stroke and its motion drops to a mere quivering action of about one inch travel. The plunger is automatically cushioned by the magnetic action of the coils and vibrates in space without striking anything at either end of the stroke. The machine cannot therefore injure itself while thus running free.

It may also be forced hard against the rock so that it cannot take its stroke, and left in this situation with the current on indefinitely without injury and with little waste of energy, as the power absorbed by the drill is automatically proportioned to the work it does. It is practically impossible to run the machine in such a way as to injure it.

The drills are run in parallel. The current, which is pulsating, is derived from a generator exactly similar to the standard Edison dynamo, except that it is supplied with pulsating current collectors, in addition to the regular commutator. The machine is thus self exciting and allows of continuous current apparatus being run on a separate circuit from it, at the same time that pulsating currents are delivered to the three wires leading to the drills.—*The Electrical Engineer.*

TRANSMITTING PICTURES ELECTRICALLY.

BY W. S. EATON.

Some few months ago in the electrical journals appeared a new method of sending pictures by telegraph. Briefly stated, the process was to divide the picture to be sent into squares, and each square was numbered to correspond with a paper similarly prepared and to be used at a distant point to draw upon, according to the direction sent from the transmitting station by the number communicated.

The example illustrated in the article alluded to, particularly impressed the writer with its very mechanical appearance. Every line was necessarily a straight one, and as the outline, only, of the picture could be thus communicated, it seemed to him that the idea, although an exceedingly good one, was altogether inadequate for practical purposes, to say nothing of its utter impracticability as applied to portraits.

When the Bell telephone was brought out as a commercial success it opened up a vast array of new possibilities. It was simple enough, too ; but it is singular, indeed, that these very simple things lie so long undiscovered.

I have apparently digressed from the subject and started to write on telephones, but this digression is more apparent than real, since the method of transmitting pictures electrically, which I shall venture to propose, is based upon principles inseparably connected with telephony.

In order to make clear my idea, I must be permitted, for another brief interval, to depart from electricity and take up the wonderful chemical changes brought about by the action of light in the art of photography.

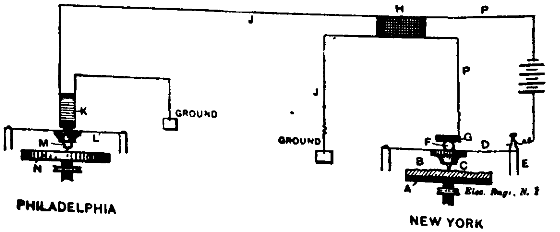
If we mix in proper proportion bichromate of potassium and gelatine we get a mixture that is highly sensitive to light. If now we coat a glass plate with collodion and then flow a moderately thick film of the bichromated gelatine thereon, and afterward expose this film to a strong light through a negative, the parts acted upon by the light become insoluble, and those parts protected from the light are easily soluble and capable of being washed out. After a suitable period this gelatine becomes so very hard that it is then possible to take an impression from it in soft metal. This is no discovery of mine ; it is an old and much used idea.

To return to the electrical portion again. To transmit pictures electrically between, say, New York and Philadelphia, we arrange two machines, one at each end of the line and both working synchronously. This, it will at once be evident, is imperative.

We will suppose that we are sending from New York to Philadelphia. A revolving table A has mounted upon it a bichromated gelatine film treated as described above. This film is shown in cross section at B. It will be noted that the surface is irregular, corresponding in its elevations to the lights and darks of the picture. It is, in fact, a perfect picture in intaglio.

A tracing point C, mounted under the diaphragm D, works, or rather rests, lightly on the surface of the film. The diaphragm is supported at E E, and is connected to one pole of a galvanic battery. F is a platinum contact and G a carbon button. P P are the primary wires leading to the induction coil H.

The action will now be easily understood. The table A is slowly revolved, and the diaphragm D, with its tracing point C, is fed slowly from the outer edge toward the centre. The elevations and depressions of the picture cause the diaphragm to vibrate, and a greater or less current passes through the primary circuit to the induction coil, varying, of course, with the amplitude of vibration of the diaphragm, and its corresponding pressure of the carbon button G.



Transmitting Pictures Electrically

The secondary wires J J are led one to ground and the other to the distant station to the electro-magnet K. The varying impulses from the secondary acting through the magnet K causes the diaphragam L to repeat every movement of the transmitting instrument D.

In the receiving instrument we replace the tracing point with a lead pencil or other marking device, and stretch upon the table N a sheet of paper. The movements of the tables A and N are rotary and synchronous. The transverse motions of the tracer C and the lead pencil M are at the same speed; consequently, with each electrical impulse, we obtain at the receiving station a line either dark or light, as the vibration of the transmitting diaphragm has been great or small, and finally we finish with a perfectly shaded picture, an exact reproduction in chiaroscuro of the original photograph.—*The Electrical Engineer.*

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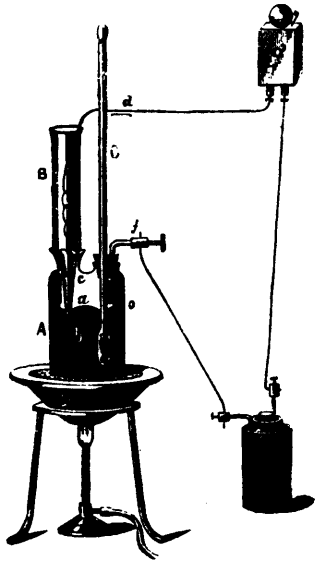
A NEW ELECTRICAL APPARATUS FOR DETERMINING MELTING POINTS.

The apparatus shown in the accompanying sketch is due to the ingenuity of A. C. Christomanos, who gives an elaborate description of it in the *Berichte der Deutschen Chemischen Gesellschaft.* He claims that by means of it a more correct determination of the melting point of substances may be ensured.

The essential features of this apparatus are as follows: The cylindrical vessel, A, which is 12 cm. in height and 6 cm. in diameter, is heated on a sand bath or in an air bath, and is provided with two apertures; a thermometer, C, and a platinum wire, *f*, pass through a cork fitting into one of the apertures, whilst the other, *c*, is conical and fluted, and serves for the reception of a drawn out test tube, B. The vessel, A, is filled with pure mercury to such a depth that the end, *b*, of the test tube is about 2 cm. below the surface, *a o*, of the metal.

The substance is introduced in a melted condition into the end, *b*, of the drawn out test tube, so that it forms a layer of from 0·5 to 1·5 cm. in length, and when it has completely solidified again the test tube is placed in position, and the space, *a c*, immediately above the substance filled with mercury, into which dips the platinum wire, *d*.



On applying heat, the mercury in A is uniformly heated throughout its whole mass, so that the thermometer and the substance are always at the same temperature; the moment the substance melts the two mercury columns come in contact, the circuit is completed, the bell, D, rings, and the temperature is noted.—*London Electrical Review.*

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ELECTRICAL HEATERS.

In the United States quite a large business is done in electrical heaters. At first sight this method appears an expensive way of heating, but on further consideration this is seen to be hardly the case. A fire sends most of its heat up the chimney—that is to say, it has a very much lower efficiency than a central station. In addition to this, it causes dirt in the house, and cannot be turned on or off just when wanted. It is not likely that we will use electric stoves instead of fire, but electric heaters are so very much more convenient that they will probably come into very general use. For instance, if a person is writing, his feet often get cold, and it is almost impossible to arrange a fire to keep them warm, especially during such weather as has been experienced lately. An electric heater, taking about twenty watts, and costing less than a farthing an hour, will do. To boil a kettle containing a couple of pints of cold water needs, theoretically, 125 watt hours, or a pennyworth of energy. If the kettle is coated with felt, and is heated from the inside quickly, this amount of energy should be nearly enough. In 1885 Mr. J. S. Sellon exhibited electrical foot-warmers at the Inventions Exhibition, and since then various engineers, such as Messrs. Ferranti, Madgen, Gay, and Hall, have been working in the same direction. For such purposes as keeping sleeping children warm at night, of course nothing can compete with electric heaters. In the United States it is said that instead of hot-water tins vessels containing fused acetate of soda are used. The latent heat of fusion is great, so they keep at one temperature a long time. Even they can hardly compete with electrical heating when once introduced.—*Industries.*

EXPLANATION OF ELECTRICAL WORDS, TERMS, AND PHRASES.

FROM HOUSTON'S DICTIONARY.

Alarms, Electric Burglar.—An electric device to automatically announce the opening of a door, window, closet, drawer, or safe, or the passage of a person through a hallway, or on a stairway.

Electric burglar alarm devices generally consist in mechanism for the operation of an automatic make-and-break bell on the closing of an electric circuit. The bell may either continue ringing only while the contact remains closed, or, may, by the throwing on of a local circuit or battery, continue ringing until stopped by some non-automatic device, such as a hand-switch.

The alarm-bell is stationed either in the house when occupied, or on the outside when the house is temporarily vacated, or may connect directly with the nearest police station.

Burglar-alarm apparatus is of a variety of forms. Generally, devices are provided by means of which, in case of house protection, an *annunciator* shows the exact part where an entrance has been attempted. Switches are provided for disconnecting all or parts of the house from the alarm when so desired, as well as to permit windows to be partly raised for purposes of ventilation without sounding the alarm. A clock is frequently connected with the alarm for the purpose of automatically disconnecting any portion of the house at or for certain intervals of time.

Alarms, Electric Burglar—Yale Lock Switch for.—An alarm whereby the opening of a door by an authorized party provided with the regular key will not sound an alarm, but any other opening will sound such alarm.

Alarms, Electric Fire or Temperature.—Instruments for automatically sounding an alarm on an increase of temperature beyond a certain predetermined point.

Fire-alarms are operated by *thermostats,* or by means of mercurial contacts, *i.e.,* a contact closed by the expansion of a column of mercury.

In systems of *fire-alarm telegraphs,* the alarm is automatically sounded in a central police station and in the district fire-engine house.

The action of mercurial contacts is dependent on the fact that, as the mercury expands by the action of the heat, it reaches a contact-point placed in the tube and thus completes the circuit through its own mass, which forms the other or movable contact. Sometimes both contacts are placed on opposite sides of a tube and are closed when the mercury reaches them.

Mercurial temperature or thermostat alarms are employed in hot-houses, incubators, tanks, and buildings, for the purpose of maintaining a uniform temperature.

Alarms, Electric Water or Liquid Level.—Devices for sounding an alarm electrically when a water surface varies materially from a given level.

An electric bell is placed in a circuit that is automatically closed or broken by the movement of contact-points operated by a change of liquid level.

Alarms, Telegraphic.—Alarm bells for calling the attention of an operator to a telegraphic instrument when the latter is of the non-acoustic or needle type.

In acoustic systems of telegraphy, the sounds themselves are gerneally sufficient for this purpose.

Alarms, Telephonic.—An alarm-bell for calling a correspondent to the telephone.

These alarms generally consist of magneto-electric bells.

Alcohol, Electrical Rectification of.—A process whereby the bad taste and odor of alcohol, due to the presence of aldehydes, are removed by the electrical conversion of the aldehydes into true alcohols through the addition of hydrogen atoms.

An electric current sent through the liquid, between zinc electrodes, liberates oxygen and hydrogen from the decomposition of the water. The hydrogen converts the aldehydes into alcohol, and deprives the products of their fusel oil, while the oxygen forms insoluble zinc oxide.

Alphabet, Telegraphic.—An arbitrary code consisting of dots and dashes, sounds, deflections of a magnetic needle, flashes of light, or movements of levers, following one another in a given predetermined order, to represent the letters of the alphabet and the numerals.

Alphabet, Morse's Telegraphic.—Various groupings of dots and dashes, or deflections of a magnetic needle to the right and left, that represent the letters of the alphabet or other signs.

In the Morse alphabet dots and dashes are employed in recording systems, and sounds of varying lengths, corresponding to the dots and dashes in the sounder system.

AMERICAN MORSE CODE.

ALPHABET.

a	. —	n	— .
b	— . . .	o	. .
c	. . .	p	. . . . .
d	— . .	q	. . — .
e	.	r	. . .
f	. — .	s	. . .
g	— — .	t	—
h	. . . .	u	. . —
i	. .	v	. . . —
j	— . — .	w	. — —
k	— . —	x	. — . .
l	——	y	. . . .
m	— —	z	. . . .

& . . . .

NUMERALS.

1	. — — .	6	. . . . . .
2	. . — . .	7	— — . .
3	. . . — .	8	— . . . .
4	. . . . —	9	— . . —
5	— — —	0	——

PUNCTUATION MARKS.

Period	. . — — . .	Interrogation	— . . — .
Comma	. — . —	Exclamation	— — — —

In the *needle telegraph*, the code is similar to that used in the Morse Alphabet.

Alloy.—A combination, or mixture, of two or more metallic substances.

Alloys in most cases appear to be true chemical compounds. In a few instances, however, they may form simple mixtures.

The composition of a few important alloys is here given :

Solder, plumbers' ; Tin 66 parts, Lead 34 parts.

Pewter, hard ; Tin 92 parts, Lead 8 parts.

Britannia metal ; Tin 100 parts, Antimony 8 parts, Copper 4 parts, Bismuth 1 part.
German silver ; Copper 50, Zinc 25, Nickel 25 parts.
Type metal ; Lead 80, Antimony 20 parts.
Brass, white ; Copper 65, Zinc 35 parts.
Brass, red ; Copper 90, Zinc 10 parts.
Speculum metal ; Copper 67, Tin 33 parts.
Bell metal ; Copper 78, Tin 22 parts.
Aluminium bronze ; Copper 90, Aluminium 10 parts.

Alternating Current.—An electric current that alternately flows in opposite directions.

Alternating Electric-Dynamo Machine.—A dynamo-electric machine that furnishes alternating currents.

Alternating System of Distribution.—A system of electric distribution in which lamps, motors, or other electro-receptive devices are operated by means of alternating currents that are sent over the line, but which, before passing through said devices, are modified by apparatus called *converters* or *transformers.*

Alternatives, Voltaic.—A term used in medical electricity to indicate sudden reversals of polarity of the electrodes of a voltaic battery.

An alternating current from a voltaic battery, obtained by the use of a suitable commutator.

Sudden reversals of polarity produce more energetic effects of muscular contraction than do simple closures or completions of the circuit.

Since all electricity is one and the same thing or force, whatever its source, the necessity for the term voltaic alternative in place of alternating current is by no means clear. The only consideration that would appear to warrant its continued use is that the alternating currents obtained from the voltaic batteries generally employed in electro-therapeutics, by the action of a pole-changer, possess a much smaller electro-motive force than do faradic currents, which are also alternating.

Amalgam, Electric.—A substance with which the rubbers of the ordinary frictional electric machines are covered.

Electric amalgams are of various compositions. The following is excellent :

Melt together five parts of zinc and three of tin, and gradually pour the molten metal into nine parts of mercury. Shake the mixture until cold, and reduce to a powder in a warm mortar. Apply to the cushion by means of a thin layer of stiff grease.

Mosaic gold, or bisulphide of tin, and powdered graphite, both act as good electric amalgams.

An electric amalgam not only acts as a conductor to carry off the negative electricity, but being highly negative to the glass, produces a far higher electrification than would leather or chamois.

Amalgamation of Zinc Battery Plates.—Covering the surface of the zinc plate of a voltaic cell with a thin layer of amalgam in order to avoid *local action.*

Amber.—A resinous substance, generally of a transparent, yellow color.

Amber is interesting electrically as being believed to be the substance in which the properties of electric attractions and repulsions imparted by friction or rubbing were first noticed. This property was mentioned by the Greek, Thales of Miletus, 600 B.C., as well as by Theophrastus.

THE INSURANCE INSPECTOR ON HIS ROUNDS.

BY ALFRED E. BRADDELL.

Holding the position of electrical insurance inspector, I am naturally often asked to describe the kind of work found in my territory. In answering this question I have no hesitation in saying that cheap, which is only another name for bad, work predominates.

This is not wholly the fault of the contractor or constructing electrician, but partly of the general public, who ask that the work be put in in the best possible manner, and are then too reluctant to put their hands in their pockets and pay an adequate price. Nor can the public bear the whole blame, as they are in a great measure deplorably ignorant as to the nature of the electric current, and fancy that the installing of electric wires requires no more skill than the running of a wash line in one of their back yards.

It is certainly strange that the public, knowing, especially from the daily papers, what dangers may accrue from bad work, will persist in giving their contracts to so-called engineers (plumbers, gas fitters, etc.), instead of to men who have earned their names and reputation in the business, and can command their price.

Great trouble is found in small towns where the electric light company does no wiring but simply furnishes the current. This is the opportunity for the *electrical engineers* of that town. Naturally jealous of each other they cut their prices, even doing the work below cost in order to secure the job. As a result, the work is done in a careless manner, the conductors being undersized and out of proportion, secured with metal staples, and solder being an unknown quantity.

When making inspection of these places, the consumer, mistaking me for one of the company's employès, exclaims, in not a very pleasant tone of voice, interspersed with unmentionable adjectives, that he is obliged to light a match to find his lamps. Can this be wondered at ? How can the evil be remedied ? Such work is not only dangerous to property, but casts a blot on the electrical profession.

When speaking to an official of an electric light company about this kind of work I was told that the consumer put it in at his own risk. Is there not a good chance here of doing defective work by outsiders ? Why should a company hand over, as it seems to me, their legitimate business, and assume no responsibility ? I may ask here, if the insurance companies are to take the risk also and not ask any extra premium ?

If they have no faith in their electrician, let them pay one in whom they can place reliance.

Let them guarantee safety to their customers, and place their confidence in their electrician, and so build up a reputation for themselves and the electrical business.

The following are a few incidents met with in my rounds :

Being asked to inspect a certain isolated plant, a man was detailed to conduct me through the premises. Not being able to trace out the different circuits, I asked him to draw them on a piece of paper. This he could not do but said he would call the electrician. After waiting a few minutes I heard a voice asking if I wanted to see him. Turning round I beheld one of the colored fraternity. I asked if this was the electrician and got an answer in the affirmative. My first question was, "What is the potential of your machine (one of the Edison type) ? Answer : "500 volts." My next, "The "E. M. F. of lamps ?" Answer ? "Oh that's where you have got me, Boss." I examined one of the lamps and as well as I remember it was marked 110 volts. I then explained that lamps of that E. M. F. could not be run from a machine having the potential as he stated. His answer was that he "guessed" I was right.

Arc lamps were placed in multiple series on this circuit, a very primitive resistance being in series with the same. The latter was made as follows: Three porcelain insulators placed in the form of a triangle on a piece of board, a coil of German silver wire (of apparantly unknown resistance) resting on these, the ends being simply twisted around the copper conductors. The first of these inspected was broken in two, and another had become so greatly heated that the surrounding wood work of the building was considerably burned.

In another building an incandescent machine was being placed. The machine was set on a stone foundation, the bed plate being bolted directly to it without any insulating material whatever. On telling the man in charge that I did not consider it a very good method, and that I should prefer dry wood placed under the machine, he commenced an argument that stone was a better insulator than wood.

I was told a very good story of a man in charge of a plant I had occasion to visit, who directed one of his subordinates to give a machine a thorough cleaning. During this operation an ammeter which was in circuit was removed; when connecting up again this was reversed, thereby sending the needle in the opposite direction. When the man in charge observed this phenomenon he was greatly puzzled and could not understand why the "darned" instrument should be so erratic.

I will add but one more. On examing a joint in a building I found it wrapped with tin foil; on further examination I discovered that all the others were in the same condition. On meeting the individual who manufactured these, we held a somewhat lengthy and heated argument, on tinfoil versus solder, in which he claimed that the former afforded more carrying capacity for the current. I presume it is unnecessary to state the verdict.

The above are fair samples of some of the work as found, and the kind of men in charge. I do not wish it to be inferred that there is no good work being done; far from it, for where there is a reputable man in charge and no stint in price, work of a high character is the result. In many of the isolated plants there are practical mechanics having a good electrical knowledge in charge; but these are at a discount, the majority, as they have acknowledged to me, being "all right as long as the machines are."

As far as the central station for light or power is concerned, the day for placing delicate and expensive instruments and machinery under a "frame shanty" is disappearing, and good substantial brick or stone buildings are being erected. The construction, material, fittings, etc., for these is reaching a higher standard every day, and, calculating upon the present rate of building, it is only a question of a very short time when every city and town in the country will avail itself of one of the most powerful forces with which nature has endowed us.—*Electrical Engineer.*

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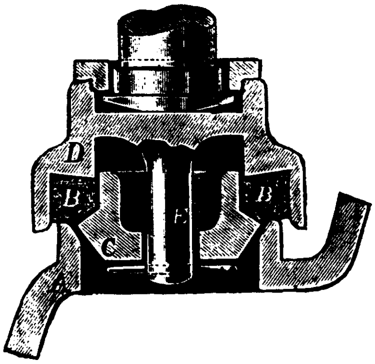
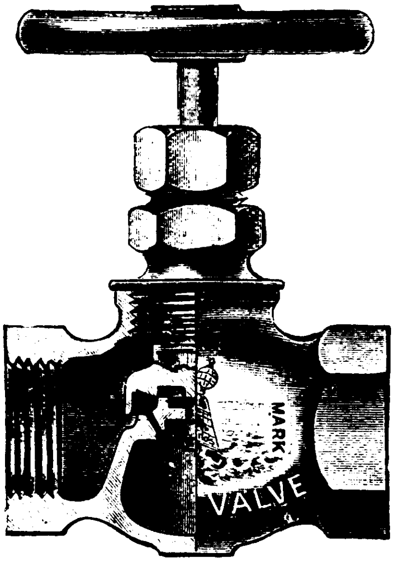
A NEW ASBESTOS-FACED VALVE.

The valve we illustrate will meet a long-felt want by supplying a flexible seating, which can be renewed if necessary in a few minutes by an ordinary workman at a cost of a few pence and for which no special tools are required. A represents the form of seat in this valve, which, in addition to the ordinary angled seat, has a round edge to the packing-ring B when the latter is brought into contact with it. D is a loose valve, actuated in the ordinary manner by a screwed spindle working in gland of the valve top, which, when first set down, brings the packing-ring B on to the seat A, and for ordinary pressures a perfectly tight and elastic joint is thus made; but by setting the loose valve D hard down, the sliding cone C comes into contact with the angle of seat A, and being free on the guide-stud E is forced into the chamber of the loose-valve D, and by compressing the packing-ring B prevents it becoming damaged.



ASBESTOS-FACED VALVE.

While the packing-ring B is thoroughly protected by the lower projection of the loose-valve D there is little tendency for D to become damaged by the passage of steam or water through the valve; but should it even become entirely washed out, a tight metal to-metal seating is the result, by A, C, and D being brought closely together.



ASBESTOS-FACED VALVE.

It is claimed that the valve, through its elastic seating, is not affected either by grit, dirt, expansion, contraction or uneven seating, which makes it alike suitable for the highest or lowest pressures of steam, hydraulic, or general water-valves by the insertion of packing rings made of the most suitable material to meet the various uses.

We have seen a 1½in. valve, made under this patent, which has been under test for three months at a steam-pressure of 100lb. per square inch and found to hold perfectly tight, after which it was put under hydraulic test, and by being lightly screwed down held a pressure of 2,240lb. per square inch.

The packing-ring used for these trials was made up specially in asbestos and is still in perfect order, and we are assured it has not been removed at any time during or since the above trials.—*The Builder.*

OPTICAL ILLUSIONS ADAPTED TO THE LANTERN.

BY GEORGE M. HOPKINS.

An interesting illusion produced by three coins—preferably silver dollars—consists in placing the pieces in a row and removing the center one from between the others at right angles to the line upon which they were all originally arranged until the distance between the moved coin and either of the others is adjudged to be equal to the combined diameters of the three coins, then measuring the distance. It is found almost without exception that the operator fails to move the coin far enough by its own diameter, or more. This simple experiment when shown in the lantern is much more effective than when viewed directly. To adapt it to lantern use, a spring slide holder like that shown in Fig. 1 is fitted to the lantern front, and beneath the springs are placed two plates of thin glass. Upon the inner glass near the upper part of its exposed surface are cemented two disks of paper five-sixteenths inch in diameter and separated a distance equal to the diameter of one of the disks. On the inner surface of the second glass plate is cemented a third disk like the other two. This is attached to the plate near its lower edge, and the plate is arranged so as to bring the three disks in line, as shown in Fig. 1.

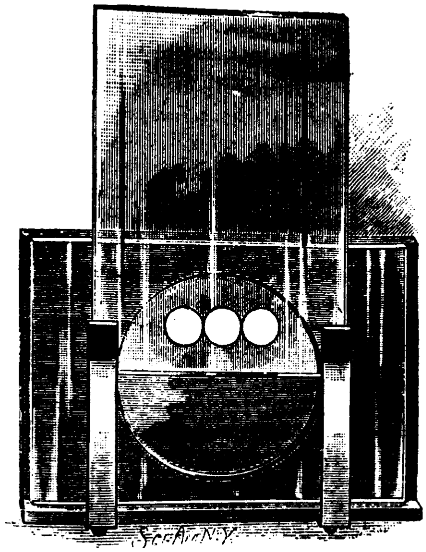


Fig. 1.—Optical Experiment with Three Disks.

By arranging the three disks in a row and projecting them on the screen and taking the distance across the three, at the screen, with a pair of large dividers, the experiment is made ready. Now the central disk is moved down in the lantern (as in Fig. 2), and of course the image moves upwardly on the screen. Let any spectator say when the distance between the moving disk and either of the others is equal to the distance taken by the dividers, then apply the dividers. It will be found that the best eye will be greatly deceived. It is not uncommon to find the best eye measurements wrong by a foot or more.

The probable explanation of this great error in eye measurement is that nearly every one has perhaps almost unconsciously the expectation of seeing the disks arranged on the apexes of an equilateral triangle, so that what he does see in reality is a distance exactly three times as great as is required to fulfil his expectations.

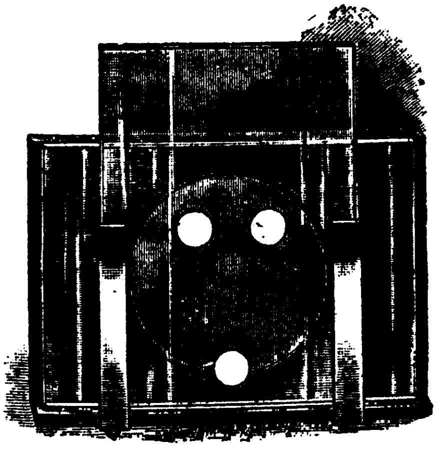


Fig. 2.—Central Disk Removed from the Others Three Times its Own Diameter.

In Fig. 3 is illustrated apparatus for exhibiting in a lantern Professor Thompson's curious illusion of the concentric rings. As is well known, it is necessary to give the rings a gyratory motion like that required in rinsing out a pail, to give the rings the appearance of turning. This is accomplished in the lantern by a movable holder which is suspended on a pendulum bar pivoted to the centre of the holder and to the support. The end of the holder which receives the slide is apertured and provided with two curved springs. The opposite end is furnished with a circular hole through which projects an eccentric mounted on a stud projecting from the support. By turning the eccentric by means of the attached handle, the slide is swung around in a circular path and the desired effect is produced on the screen.*

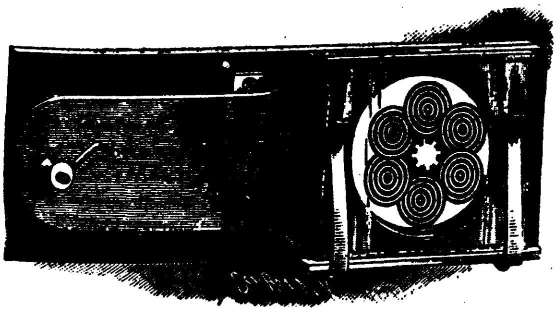


Fig. 3.—Professor Thompson's Optical Illusion Adapted to the Lantern.

The peculiar whirling effect is thought to be due partly to irradiation and partly to persistence of vision.

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* On page 133 of vol. 41, Scientific American, is given an explanation of the phenomena of these circles.

SOME PRACTICAL NOTES ON LUBRICATION.

BY F. J. KUHNE.

The laws regulating lubrication, the action which the varied articles used as lubricants have upon metals, and the chemical changes that are brought about by differences of temperature, have never received the consideration due to them. Of late years, however, they have been treated more seriously by owners of machinery.

Competition among manufacturers to-day demands that the utmost caution be taken to reduce the wear and tear on the machinery, to avoid loss of time, and, above all, to save fuel. In almost every case the correct use of proper oil will be found the precaution necessary.

A lubricant may apparently do good work and keep the part cool, but in reality the acid formed by the friction and heat of the journal is daily damaging the surface of the metal and will ultimately do great damage.

Consumers have for years been accustomed to rely upon the salesman, whose knowledge of the goods he sells is usually found to be very deficient. Nor can every engineer report on an oil to be relied upon,—many are really ignorant, while others are personally interested.

Some months ago I engaged as salesman an active and intelligent young engineer who professed to know something about oils and whose general idea about lubrication seemed sensible. Upon canvassing a part of the district alloted to him with good success, so far as he went, I received a letter from him saying, "I used to think I knew something about oil, but have come to the conclusion that my knowledge will not extend beyond the outside of a barrel." This is what nine-tenths of the engineers would come to if their knowledge were put to a practical test.

A good oil should be used as sparingly as the nature of the bearings will permit. The amount of resistance (friction) generated by the bearings depends upon the number of revolutions a minute a machine is capable of making and the amount of power necessary to run it.

In the use of oil, uniformity of distribution is as important as the regularity of supply. A dry spot on a bearing will at once cause heating, and, if allowed to continue, cutting will be the result.

There is no department in a factory more important than the engine room.

As the diminishing of friction will naturally result in gain of power, it is to the consumer's interest to learn by careful experiment the oils that are best adapted to run his plant, and to make the necessary tests of density, fire test, and viscosity. By so doing he can be certain to receive exactly what his machine requires, and run it at the lowest possible cost.

"Poor oils," says an eminent engine builder, "are a prolific source of injury, and often defeat the purpose for which a machine is intended."

If a machine is not properly lubricated it will bind, heat, and then cut, and the percentage of work added to the already overtaxed Corliss is sure to injure the engine, and certainly needs an extra dip now and then into the coal pile.

No oil has yet been made that can economically lubricate *all* the journals of a mill. An oil running a heavy Corliss engine would not do to run a spindle or a fast-revolving dynamo. The former runs slowly and has great pressure and strain on its journals, and consequently requires an oil which will not spread too quickly, but with low gravity and high viscosity. The latter needs a pure mineral oil, viscous and quick spreading, to enable it to enter into the closest parts of the bearing as rapidly as the speed at which it revolves necessitates.

In making an oil for a specific purpose the speed, power, pressure upon the journals, mode of application, and temperature in which it has to run should be known. This informamation in hand, an oil can be made to suit.

Some years ago I visited a mill and, by special request, made an oil specially to lubricate an iron fan, running 1,000 revolutions inside a wool dryer where the temperature was constantly kept at 280° Fahrenheit. This fan had been the source of great trouble on account of the pressure upon the journal and the high rate of speed while constantly subjected to such an intense heat. In addition to this it was necessary to keep the machine running for two or three weeks at a time, without a stop. At the end of a three weeks' test the bearings were found to be comparatively cool, perfectly clean and bright, while the quantity of oil consumed was one-third less than that of any that had yet been tried.

This is only one of many special cases that I can call to mind.

The numerous tests that have been made by learned men at various times within the last twenty five years tends to show that mineral lubricants, or compounds of mineral and animal, are the safest and produce better results than any others made.

I will here cite the opinions of a number of authorities on the subject :—

Professor Thurston remarks : "Vegetable and animal oils are compounds of glycerine with fatty acids. When they become old, decomposition takes place, acid is set free, and the oils become rancid. Rancid oil will attack and injure machinery. Mineral oil does not absorb oxygen, whether alone or in contact with cotton waste, and cannot, therefore, take fire spontaneously,—animal and vegetable oils do. Mineral lubricating oils are used on all kinds of machinery ; they are the safest and cheapest lubricants and are generally superior to animal and vegetable oils and greases."

According to experiments by Galletry and Coleman it was found that "Mineral lubricating oils diffused through textile cotton do not take fire even at a temperature at which Colga oil ignites, and that fatty lubricants to which twenty to fifty per cent. of mineral oil was added were thereby prevented from igniting."

Spon says : "A mineral oil flashing below 300 degrees is unsafe. The best oil is that which has the greatest adhesion to metallic surfaces and the least cohesion in its own particles ; in this respect, *fine* mineral oils stand first. No oil is admissible which has been purified by means of mineral acids. Mixed oil, if properly compounded, possesses the special advantages of both classes."

The blending of mineral and animal oils does not merely consist in shaking them together, as is supposed by many, but, as they are of different gravity, the globules of each must be broken and run into each other by agitation and heat, so that the oil will become one body. If this is not done the animal oil will become separated, and standing in a heated room the bad qualities will come out, and later, when used, the oil cannot do its work and at once the quality is condemned.

I had a case where a large mill owner was using oil said to be one part sperm and three parts paraffine of heavy gravity. The price was lower than I knew it could be made for. Upon analyzing a sample drawn from the barrel I found it contained sixty per cent. of sperm and forty per cent. paraffine, showing that the oil was separating. The sperm oil being lighter was coming to the top. Such oils cannot give satisfactory results.

If you have any stipulated formula, have it made up for you by parties who understand the business, and who have the facilities and appliances for doing it properly.

Mr Allen's experiments have shown that gumming is due to the action of free acid upon the metal bearing of machinery. The corrosion of bearings by oils has not received the attention it deserves, as the wear and tear of the metals and thickening of the oil have been attributed to other causes. Liquid oils corrode metals very evenly, so that the effect is not readily observed. Mineral oils contain no acid, unless they have been carelessly refined. Mr. I. J. Redwood says that "Mineral lubricating oil has the least action on metals: none on iron or brass. Tallow oil has most action on iron; castor, olive, and lard oils have most action on brass. Rapeseed has most action on copper."

Greases used as lubricants, although seemingly more economical than oil, are not so when the greater loss by friction is considered. Before grease can begin to work, sufficient heat must be generated to melt it. In doing this the power lost will more than counterbalance what is saved on the cost of the grease. It takes about thirty-three per cent. more fuel to melt it by the heat produced from friction than would be required were it to be melted over a fire. Professor Woodbury says, "In starting machinery, before sufficient heat had been generated to melt grease, twenty times the amount of fuel is required as would be needed to melt it over a fire; even when the melting point has been reached the friction is thirty three per cent. greater than when the machinery is lubricated with a suitable proportion of mineral oil."—*Electric Railway Engineer.*

INDUSTRIAL SCHOOLS.

Numerous associations have been organized from time to time by mechanics and operatives; and this proves that those who are termed working men are capable of combining together for the attainment of some special object. The ends sought may be legitimate or not, the advantages held up to view may be real or not; sanitary reform and social progress may or may not be advanced by the success of certain measures sought and obtained by any body of men who desire a change in affairs that directly concern themselves; but this fact is established, that mechanics and tradesmen can organize, have an interchange of ideas, discuss and argue their points *pro* or *con*, draw up resolutions, frame constitutions and by-laws, and enforce measures, all tending to the establishment and strength of their association, and the promulgation of their ideas and principles.

Keeping this fact in mind, we turn to examine the institutions and associations of the present day that have for their especial object the social and mental improvement of mechanics. At the outset we state, that taking into consideration the vast extent and resources of this country, the enormous population, the great wealth, the rapid progress, the enterprising spirit of the people, the democratic form of government, the means of education, the general intelligence of the people, the constant influx of foreigners, the facilities for appropriating all that is grand, great, and useful in art and science,—with such a country, with such a people, with such facilities and advantages, we should naturally suppose that institutions for industrial education would be among the most prominent in the land. But are they? Setting aside the public institutions of a sanitary and reformatory character, and public schools, which are instituted in a greater or less number throughout the various States, we find a host of political, religious, social, scientific, literary, musical, medical, mercantile, and charitable societies, firmly established, well organized, well supported, and enriched with endowments.

But where are our grand industrial schools?—institutions where, at trifling cost, the mechanic can educate himself in the theoretical as well as the practical part of his business; where the engineer can learn the nature of steam and metals, as well as the principles of good workmanship; where the dyer can learn the properties of chemicals; where, in short, mechanics, drawing, mathematics, hydraulics, chemistry, navigation, and other sciences, are taught in a plain, illustrative, comprehensive manner by practical experts competent to interest and teach men of ordinary intelligence. We can almost count the number on our fingers; and some of these are Mechanics' Institutes only in name, and do not meet the demands and requirements of the industrial classes. State prisons, and State reformatory institutions for the unfortunate and vicious should be balanced by institutions for industrial education and the mental improvement of the industrial classes. The working men are an immense power in this and all other civilized countries; they are bone and sinew of their greatness and prosperity; but as yet their influence and power are only partially developed. Great, grand and glorious discoveries are yet to be made by educated workmen; and it is possible that institutions can be founded and supported by them, and them alone.—*The American Engineer.*

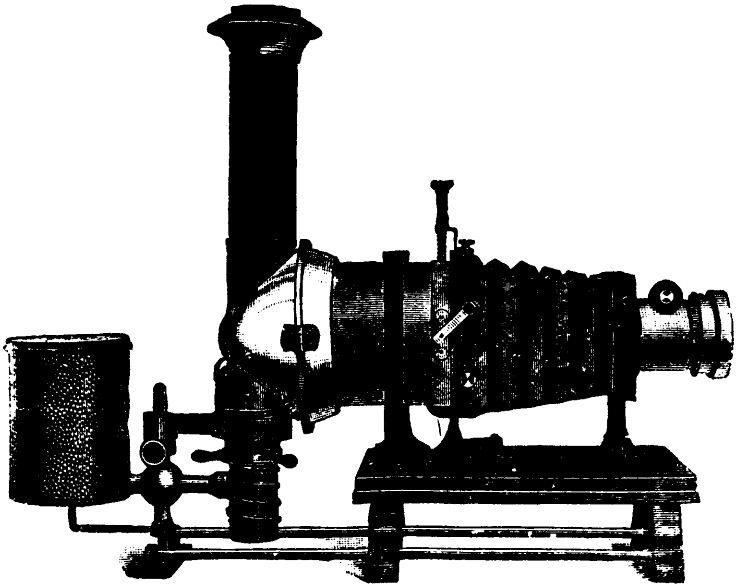
HOW CAMPHOR IS MADE.

Camphor is made in Japan in this way: After a tree is felled to the earth it is cut into chips, which are laid in a tub over a large iron pot partly filled with water and placed over a slow fire. Through holes in the bottom of the tub steam slowly rises, and heating the chips, generates oil of camphor. Of course the tub with the chips has a close fitting cover. From this cover a tube or pipe leads to a succession of other tubes, with bamboo connections, and the last of these tubes is divided into two compartments, one above the other, the dividing floor being perforated with small holes to allow the water and oil to pass to the lower compartment. This lower compartment is supplied with a layer of straw, which catches and holds the camphor crystals that are being deposited as the liquid passes to the cooling process. The camphor is next separated from the straw, packed in wooden tubs and is ready for the market. The oil is used by the natives for illuminating and other purposes.

IMPROVED OIL LIGHT LANTERN.

The optical lantern as a means of instruction and amusement, and as an advertising medium, is becoming more and more popular as the lantern is improved in quality and rendered more manageable. One of the objects sought by makers and users of lanterns is an inexpensive, safe and efficient means of illumination; something always ready and capable of being used anywhere.

The lantern shown in the annexed engraving seems to have these qualities, besides being optically and mechanically complete. It is not presented as the equal of the electric or oxyhydrogen lantern, but great superiority is claimed for the oil light used in this lantern. The manufacturers have named it the Parabolon Oil Light Lantern, on account of the peculiar construction of the lamp, which permits of the use of a



NEW OIL LIGHT LANTERN.

highly polished parabolic reflector, thus greatly increasing the effectiveness of the illuminating flame.

This lantern has a pair of 4½ inch condensers, and an achromatic objective of fine quality mounted in brass rack and pinion tube, with milled head for focusing. The objective tube is mounted on a cast metal stand, the foot of which has milled edges to run in machine-grooved tracks for extra focusing. At the back of the objective stand is fastened the small end of a bellows hood, having its large end fastened to another movable stand, in connection with which is a lever-actuating movement to extend the bellows evenly back, and, if necessary, close against the front condenser, thus preventing the escape of light.

In this lantern the oxyhydrogen jet may be used if desirable. The slide holder is arranged for the introduction of slides or negatives of any size, vertically or horizontally.

* * *

LONG SPLICE FOR ROPES.

The illustrations show how to make a long splice by a method somewhat different from the regular way. It is especially valuable for uniting ropes used in power plants. The union can be made so neatly as to be indiscernible.

The ends to be united are first unlaid for at least as many turns as there are threads in each strand. The ends are then "crotched," as shown in Fig. 1. The process of making a regular long splice is started. Strand *a* is unlaid and strand *a′* laid in its place. In regular practice this would be done without any reduction or tampering, which regular method is shown in Fig. 2 in process of execution. Then, when at a sufficient distance, *a′* and *a′* would be allowed to meet. Half of each would be cut off, and the other half would be knotted and stuck away beneath the strands.

In the method now to be described, a systematic tapering takes place. The place where the strands are to unite having been settled upon, half as many turns of both strands as there are threads in a strand, counting backward from the place where the two strands are to meet or unite, are unlaid. The rope shown in the drawings is supposed to have six threads in a strand, or to be "eighteen thread stuff." Hence each of a given pair of strands, say *a* and *a′*, is unlaid three times, counting backward from the place of meeting, and at that point a single thread is cut and removed. They are laid up each one more turn, and a second thread is removed ; one more turn brings them together, when a third thread is cut out of each, leaving each of half the original thickness. Here they are knotted or twisted, as shown in Fig. 4, a right-handed knot being used. This knotting and consequent doubling of the reduced strands, it will be seen, maintains the original thickness of the strand, each strand at this point being three threads in thickness. The ends of the loose strands are again wrapped around the laid-up tapered strand until the next turn is reached, when an additional thread is cut out, leaving two. This reduced portion is twisted around the laid strand, which, at this point, is four threads in thickness, until the next turn is reached. There another thread is cut out, and the single thread left is wound around the laid strand, here five threads in thickness, and is finally cut off.

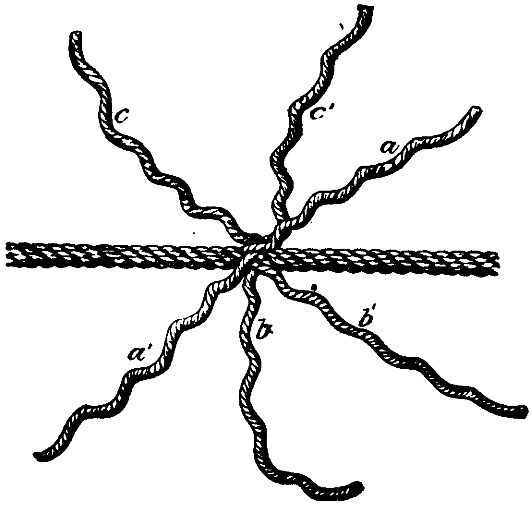


FIG. I.

It will be observed that this leaves the strands in all places of the exact original thickness of six threads.

In ropes in which the number of threads are uneven, one strand is unlaid one turn further back and is reduced one thread more than the other at the first knot, and the same principle is carried out, the twisted or united strands always being kept of uniform thickness.

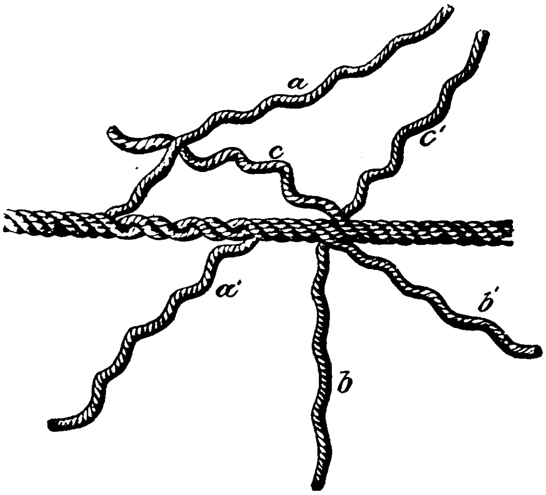


FIG. 2.

In Fig. 3, the reduction of the strands thread by thread is shown. It is better practice not to reduce them all at once, but to do it turn by turn as fast as they are laid up, as described above. The reduction after knotting is best accomplished in the same way, although the operation can be carried out as shown in Fig. 3 and Fig. 4. The threads too should be cut off so as to lie underneath the strand, and so be hidden, if a very neat job is wanted.

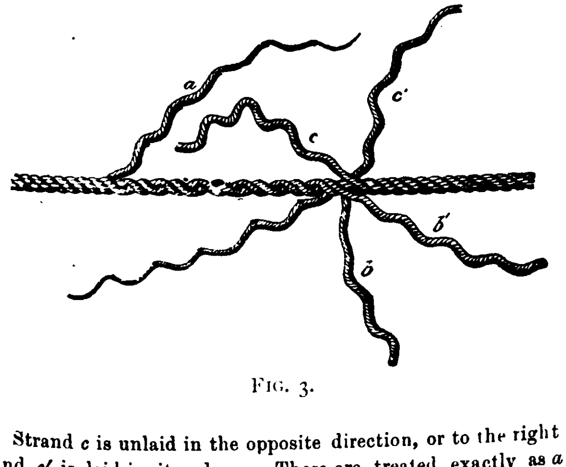


FIG. 3.

Strand *c* is unlaid in the opposite direction, or to the right and *c′* is laid in its place. These are treated exactly as *a* and *a′* were.

Strands *b* and *b′* are each unlaid for half as many turns as there are threads in each, in the present case for three turns, and reduced one thread, laid up one turn each and reduced by another thread, laid up a second turn and reduced by a third thread, and are knotted and twisted as described, the loose strands being reduced one thread for each turn given in the finishing twisting.

This splice has been used with great success by Mr. W. A. Wood, of New York. He has employed it on rope driving bands of rawhide, as well as on manilla rope, and it has given the greatest satisfaction. The splice being of uniform thickness, the band runs better and the spliced portion lasts as long as any other part.—*Scientific American.*

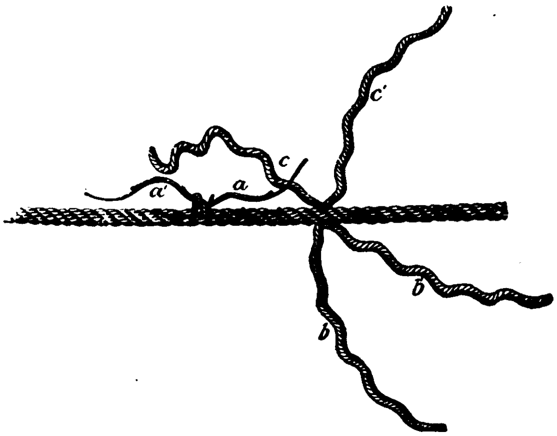


FIG. 4.

WHERE OIL STONES COME FROM.

Washita oil stone rock is crystallized silica. The crystals are very small, and are formed in clusters with point ends interlaced, leaving numerous cavities. These minute crystals are hexagonal in shape, with sharp points, and can be seen under a microscope when magnified about 100 times. They are harder than steel, and that is why whetstones cut from this rock will wear away and sharpen steel tools. Washita whetstones are called oil stones, because oil must be used to fill the cavities and float away the steel particles that are cut off the tools.

The peculiar geological formation from which these rocks are taken is not known to exist outside the State of Arkansas, where it occurs in many of the mountains of Saline, Hot Springs, Garland and Montgomery counties. These strata are in a vertical position varying from nearly perpendicular to nearly horizontal, and have been considerably broken by upheaval or folding of the earth crust.—*Ex.*

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"I believe in advertising persistently," observed J. O. Glenn, secretary of the Quincy (Ill.) Metal Wheel Co. "I would just as much expect to raise a big crop of wheat by planting one seed as to look for big returns from one advertisement. It stands to reason that if one advertisement pays, twenty will pay just that much better. If a firm can clear $50 off an $100 advertisement it would be foolish indeed not to expect more from a larger investment. Observation has taught me that there is too much spasmodic advertising done. It is like the farmer who plows his corn just when he feels in the humor. He don't very often feel that way, and often when he does it is at a time when it will do the least good. System is an essential cause to successful results in all things, and advertising is no exception. There are seasons for certain lines, of course, but there is never a period when it does not pay to keep interest alive in a manufactured product, even though it is not in demand at that juncture. Persistency in advertising an article must create confidence in it."

MACMILLAN & CO'S.

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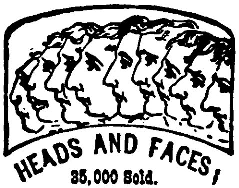

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