be placed on their Newhaven-Dieppe service. The dimensions of this new vessel are as follows: Length, 280 feet; beam, 34 feet; draught, 22 feet; gross tonnage, 1,100 tons. It is stated that in general design she will be similar to the twin-screw steamer "Arundel" with reciprocating engines, built by Messrs. William Denny & Brothers in 1900 for the Brighton Company. With practically the same boilers as the "Arundel" it is anticipated that the new Brighton Company's turbine vessel will travel half a knot faster, and in addition will be free from all troubles caused by vibration.

The Lancashire and Yorkshire Railway Company in a recent invitation to shipbuilding firms throughout the kingdom for designs and tenders for a new steamer for their Irish Sea service stipulated for alternative designs as regards the means of propulsion, viz., for the ordinary twin-screw reciprocating and for steam turbine engines, the speed desired being 17 knots.

The invention and development of the marine steam turbine is a subject on which Great Britain may well pride herself, for though we have undoubtedly been left behind in various fields of latter-day activity and enterprise, in this particular sphere we took the lead and have maintained it ever since.

Until the new cross-channel turbine steamers have shown their speed and their coal consumption, it is not to be supposed that shipping companies and shipowners will take any very decided move with a view to adopting the turbine as a mode of ship propulsion in place of the ordinary engine of the reciprocating type.

There can be, however, little doubt that before many months have elapsed a turbine-driven Atlantic liner will be built, which will materially lessen the time at present taken by the swiftest steamers of the Hamburg-American and North German Lloyd lines.

Mr. Parsons claims that the principal advantages of steam turbine engines as compared with ordinary engines are as follows:

1. Complete absence of vibration from main engines.
2. Increased economy in steam and coal consumption.
3. Increased speed, owing to diminution of weight and smaller steam consumption.
4. Increased stability of vessel, owing to lower center of gravity of machinery.
5. Increased safety to engine-room staff, owing to absence of reciprocating parts.
6. Perfect balancing of engines, which permits of very light engine foundations and obviates stress on hull.
7. Reduced size of engine room.
8. Reduced weight of machinery.
9. Reduced cost of attendance on machinery.
10. Reduced consumption of oil and stores.
11. Reduced diameter of propellers, which gives increased immersion and obviates racing when rolling and pitching in a seaway.
12. Reduced diameter of propellers, giving increased facilities for navigating in shallow waters.

One might be tempted to inquire why, if these advantages were real, the number of turbine vessels under construction should not be greater than it is at present. The answer to this may be found in the innate and inveterate conservatism of the shipbuilder, who likes to see others experiment, and to delay action until he is perfectly assured that the pathway of success lies before him.

A PORTABLE OSCILLOGRAPH FOR ALTERNATING CURRENTS.

BY THE LONDON CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

A convenient and handy little apparatus for utilization in connection with alternating currents has been introduced by the Cambridge Scientific Instrument Company, Ltd., of Cambridge, England, which should be of incalculable value to manufacturers and engineers who utilize alternating currents. It is the Duddell portable oscillograph, an illustration of which we give herewith.

The increase in the use of alternating currents, especially two and three-phase currents for supplying motive power, and the use by central stations, distributing both on the direct and on the alternating current system, of high-tension alternating currents for the transmission of power over any considerable distance, has rendered a knowledge of the shape of the wave form of the alternating current of the utmost importance to electrical engineers. For instance, alternating-current motors which will work well and have a good efficiency on one wave form may have but a poor efficiency, or may even refuse to work at all, on another. The efficiency of transformers also depends to some extent on the wave form; yet many engineers who are prepared to pay large sums of money for a slight increase in the efficiency of their transformers or motors, do not realize the important effect their wave form has on this efficiency. Again, in the case of cables used for high-tension and extra-high-tension transmission, resonance effects often occur, causing the breakdown of cables and loss of money and prestige due to interruption of supply.

Many of these breakdowns could easily be avoided by an examination of the wave forms, to find out under what conditions dangers to the insulation of the machines and cables occur, in order that these conditions may be avoided in the future. By the proper arrangement of the tests the examination of the wave forms will reveal the dangerous conditions, without, as is often the case, the only warning of a dangerous condition being the breakdown of valuable plant and cables. It is also very probable that the constants of some kinds of alternating-current meters, on the accuracy of which the revenue of the station may depend, are also influenced by the wave forms.

It is of paramount importance that station engineers, consulting engineers, and manufacturers of alternating-current plants should possess a small apparatus for reading quickly and accurately the wave forms for the above. These requirements are fulfilled by this small Duddell oscillograph, which enables an engineer to examine visually the wave forms of an alternating current without the necessity of making complicated connections or employing an arc lamp, synchronous motor, heavy electro-magnet, and other accessories used when a permanent record is required. In order to see the station wave form, it is only necessary to connect the oscillograph in place of a lamp by means of an adapter. The device comprises a small oscillograph set up in a case complete with lamp, rotating mirror, and all necessary resistances, etc., ready for use.

The small oscillograph, which is shown standing outside the case, from which it can be easily and quickly removed for separate use, consists of a single vibrating system mounted between the poles of a permanent magnet. The vibrating system is connected to the two small terminals shown on the base of the oscillograph, and these in their turn are connected through a suitable resistance by means of flexible wires to the terminals shown on the outside of the case.

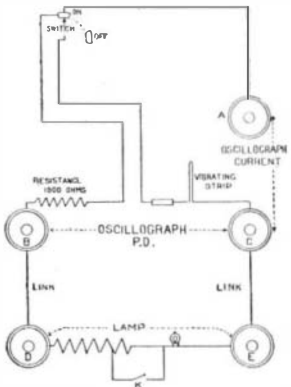
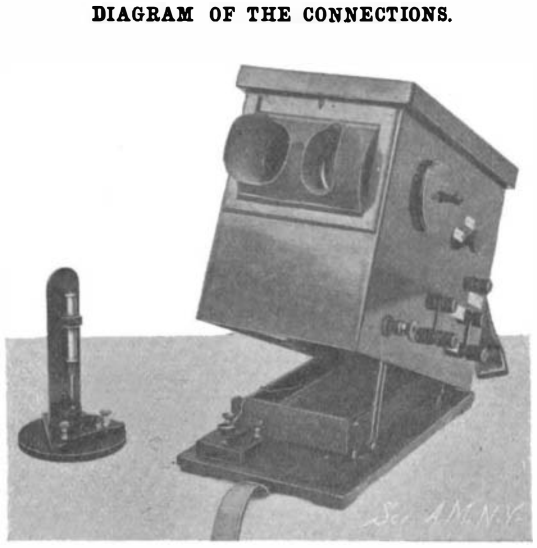


DIAGRAM OF THE CONNECTIONS.



PORTABLE OSCILLOGRAPH.

The smaller instrument can be used separately.

The vibrating system consists of a loop of phosphor-bronze strip under tension carrying a small mirror. A beam of light from an incandescent lamp is thrown on to this mirror, and thence is reflected on to a screen forming a bright spot. This spot vibrates horizontally, its deflection from the central position being at any instant proportional to the instantaneous value of the P. D. or current as the case may be. The movement of this spot is observed in a mirror, which is rotated by hand about an axis at right angles to that of the mirror attached to the strip. The handle by means of which the mirror is rotated is shown on the right-hand side of the instrument. The observer examines the wave forms seen in the rotating mirror through eye-holes. A rubber eyeshade prevents extraneous light from entering the instrument when in use. The shade is removable and packs inside the instrument when closed.

The following are the approximate data relative to the sensibility of the oscillograph:

Periodic time, 1-4,000 second as sent out with a tension of 1 ounce.

Sensibility, 200 mm. per ampere at the normal distance of 25 cm.

Normal working current, 0.05 to 0.10 ampere.

Resistance of strips without fuse and connections, about 4 ohms.

Resistance of strips with fuse and connections, about 14 ohms.

A resistance wound on a slate frame is used in series with the incandescent lamp. A key is provided for cutting out some of this resistance, and thus increasing the brightness of the lamp when the wave form is actually under observation. The instrument is used at an angle as shown, allowing a free circulation of air round the lamp resistance. Terminals are provided in order that the lamp may be lit from a separate circuit from that under examination, if desired.

The instruments are generally made so that they may be connected directly to either a 100 to 110, or 200 to 220 volt circuit, but suitable resistances can be made to adapt the instrument to any particular voltage. For high voltages it is advisable to use a transformer.

Another very useful purpose which the oscillograph fulfills is that an engineer can tell at a glance whether a dynamo gives a true sine curve, or what effect a certain transformer, motor, or cable has on the wave form.

The accompanying diagram shows the general scheme of connections. To prepare the instrument for use, it is only necessary to open the case, slip out the brass plate on the front, and replace it by the one with an India-rubber eyeshade which is placed inside. The lid is then closed, and the instrument fixed at a convenient angle by means of a milled head on the right-hand side of the case. The instrument is then ready for use. If the spot is not in the middle of the scale, it can be brought to the center by slightly slackening the milled head underneath the base of the oscillograph and twisting the latter round. When the spot is in the right position, the milled head is screwed up tightly to keep the oscillograph in position.

The gaps in the vibrator must be kept filled with the special oil supplied with the instrument. This is introduced when required by means of a pipette into the oil cup which is placed at the back of the vibrator.

The instrument can be used to show either P. D. or current-wave forms of the circuit under examination. To investigate P. D. wave forms the terminals *B* and *C* are connected directly to the poles of say a 100 or 110-volt circuit. This can be done conveniently by putting the adapter supplied with the instrument into an ordinary lamp holder. The terminals *D* and *E* are connected to *B* and *C* respectively by means of the copper strips which are provided, so that the lamp is lighted from the same circuit. As will be seen from the diagram, there is a non-inductive resistance of 1,000 ohms permanently connected in series with the vibrating strip of the oscillograph, so that the current through it is about 0.1 ampere, which gives an amplitude of about 25 mm. on each side of zero. There is also a resistance of about 90 ohms in series with the Ediswan 'Miniature' 20-volt 5 c. p. lamp. The key *K* is arranged to short-circuit a portion of this resistance, thus increasing the brightness of the lamp when the curves are actually under examination.

For voltages up to three or four hundred, resistances can be used in series with the instrument. With higher voltages it is advisable that they should be transformed down by means of a small transformer having a closed iron circuit and small magnetic leakage. In this latter case it is advisable to disconnect the lamp terminals *D*, *E* from *B C* and to connect them to an independent 100-volt circuit and to earth one of the terminals *B*, *C*, as it is not safe to use the instrument if it is more than a few hundred volts above earth. Another method is to use a number of incandescent lamps in series as a potential divider, the instrument shunting one of the lamps, which must be connected to earth; it is not advisable to use this method for voltages above 2,000 or 3,000 volts.

To investigate current wave forms the terminals *A* and *C* are connected to the potential terminals of a suitable low-resistance shunt in the main circuit. This shunt should have a resistance so that at the maximum current there is a P. D. across it of about 1.4 volts. In this case the lamp must be lit separately from a 100-volt circuit. For both these investigations lamps having strong thick filaments should be used.

The investigation of form factors is easily accomplished by placing a divided scale for the spot of light to fall on, and finding what deflection d corresponds to a steady direct P. D. of 100 volts applied to the instrument; this is the calibration of the instrument, and will remain practically constant, and need only be repeated occasionally. If now the total amplitude D of the vibration of the spot be observed on the same scale for the wave form to be investigated whose R. M. S. voltage is V, then the form factor of the wave is evidently $50\ D/d\ V$ and this quantity is a very useful measure of the degree of danger to insulation of the wave form. The R. M. S. voltage V must be measured in all cases between the terminals *B*, *C* of the oscillograph at the same time as the observation of D is being made.

The instrument is extremely portable, weighing only 11½ pounds, and measuring, when closed, 14 inches in length by 8 inches wide and 11 inches deep. The price is nominal, only $150 up to 220 volts.

GIGANTIC ORE-HANDLING MACHINERY.

BY W. FRANK M'CLURE.

The introduction this season of electricity as a power for operating Great Lake dock machinery at three of the most important lower lake ports, it is believed, will be a move of great importance to the future of ore-handling. It has been a query for some time as to when electricity would come into general use upon lake docks. It is now claimed that it will simplify the methods of operation, add to the speed, and reduce the cost of operating. The Pennsylvania Railroad Company in January decided to expend more than $100,000 in Cleveland and $27,000 at Ashtabula in the building of power houses and electric appliances upon its lake docks. The entire power system of the Pittsburg & Conneaut docks at the "Carnegie" port of Conneaut is to be replaced by electricity, all the machines to be furnished with power from a central station, with the possible exception of the "clamshell" automatic unloaders.

On the Pennsylvania docks at Ashtabula the work of installing the new electric system has been in progress for several months and will soon be completed. There are five large boilers at this plant. The electricity on these docks is also to be used for splendidly lighting even the most out-of-the-way corners. The plan is to place lights upon every machine. This, with the fact that the Vanderbilt docks at this port are also to be lighted by electricity, indicates that preparations are being made for a large amount of night work in handling ore this season, and that the ore traffic, which is constantly increasing in volume, will demand it.

Another important innovation in connection with the ore-handling industry consists in the constructing of new lake ore carriers with especial reference to the proper accommodation of the Hulett automatic unloaders. Also some forty vessels of the Steel Corporation's fleet are to be reconstructed with the same end in view, at an expense of more than $100,000.

The big steamer "James Gayley" was the first steamer to be built along the lines mentioned. She is named in honor of James Gayley, who is at the head of the ore department of the Carnegie Steel Company. Mr. Gayley has long taken a decided interest in the Hulett unloader, and was responsible for installing it at Conneaut. The accompanying photograph shows a battery of these machines at work in the "Gayley" during the first test, where the conditions within the hold of the vessel permitted of the machines' best work. Ninety-five per cent of the ore was taken out during this test without the assistance of shovelers.

Since that time another test was made in removing the cargo from the steamer "James Hoyt," which is also especially fitted for the "clamshells." This time ninety-eight per cent of the cargo was removed, and it was not thought worth while to put laborers to work in her to shovel out the rest. It was originally intended that the unloaders should make this record, but it had previously been found impossible, owing to the unfavorable construction of lake boats. By means of these machines working under the new conditions, a cargo of 5,500 tons has been removed in five hours. Officials of the United States Steel Corporation witnessed the latest notable test:

In building or rebuilding a lake vessel with a view to adapting it to the Hulett automatic unloaders, the principal operation is the enlarging of the hatches and the moving of the stanchions so as to give more play. On the steamer "Hoyt," for example, the hatches are not more than four feet apart. There are nineteen hatches in all, and the distance from center to center is twelve feet.

The introduction of the Hoover & Mason automatic unloaders at Ashtabula Harbor is an important feature of the present season. These machines have made some remarkable records at South Chicago, where they have been tested during the past two or three years at the docks of the Illinois Steel Company. During the past year the Hoover & Mason battery of ten machines working in a vessel at South Chicago established a record surpassing even the famous machines at Conneaut. By the unloading of 98 per cent of the "Hoyt's" cargo by the Hulett machines in four hours and fifty-four minutes, however, still another precedent was established.

The Hoover & Mason machines rest upon tracks on the docks, and move themselves upon these tracks. The grab bucket with which each machine is equipped has a capacity of more than five tons. It is possible for one of these buckets to make a trip a minute. The ore when lifted from a vessel is delivered either to cars or to the docks. With these machines ore can be taken out of a vessel at an expense of less than one cent a ton. Vice-President Brown and other high officials of the Vanderbilt railroad system witnessed a test of these unloaders at Ashtabula Harbor a few weeks ago. Machines of this style will likely be installed at Conneaut this season.

The interiors of several lake vessels also have recently been equipped especially for this style of machine. By means of a scraper system the portion of the cargo which could not otherwise be reached by the grab bucket is brought within its reach. Among the vessels thus already equipped are the steamer "Victory" and the schooner "Constitution."

The tendency now seems to be to place the grab styles of buckets on all ore-handling machinery. A two-ton grab bucket, for example, is being placed on the King machines at Ashtabula in place of the former style of buckets used on conveyors. Also Samuel and George Swedenborg, of Ashtabula, have invented a new-style grab bucket which has been tested on the portable machines here, and the test has proven highly satisfactory. This new bucket spreads 7½ feet, and will lift 2½ tons. It will dig as well upon the side of a pile as on the level. An advantage is also claimed for this bucket in its being round, thus avoiding corners, in which ore often becomes packed.

To accommodate the vast new machinery which is being installed this season, and to handle the greatly increased marine traffic which must be handled this year, the railroad companies owning so many docks at the various lake ports, also have extensive projects under way for the construction of new channels, the building of new docks and the installing of coal-handling machinery. Trains carrying ore south to the furnaces return to the lakes with coal. An increase in ore traffic is accompanied by a marked increase in coal shipments.

Typical of the railroad improvements to be made, it may be said that the Pennsylvania Company is planning to spend a million dollars on land west of the entrance to Ashtabula Harbor, which has long been known as the "greatest ore-receiving port in the world." Eventually a mile of this territory along the lake will likely be utilized. This work will not all be done this year, of course. Already, however, additional channel room is being excavated and the expenditure of $50,000 for a car-dumping machine has been authorized. The additional railroad yards and the channels and machines are to be used for coal traffic. With the coal traffic entirely removed to the lake front, much additional room for ore on the present extensive docks up the river will be gained.

The Current Supplement.

The excellent article published elsewhere in this issue on the disastrous Paris-Madrid race is to be read in connection with another article on the same subject published in the current SUPPLEMENT, No. 1433, and narrating various incidents which could not in these columns be recorded for want of space. Also of automobile interest are articles on an automobile Pullman car for time table distribution, on devices suggested by the jarring of automobiles, and on the density of petrol for petrol motors to attain the greatest horse power and the most efficient working. The English correspondent of the SCIENTIFIC AMERICAN reviews the work of the British Fire Prevention Committee. Recent experiments of M. Moissan are reviewed. William J. Hammer discusses phosphorescent and fluorescent substances. A short description of Jupiter and his red spot should be read with interest. Henry S. Spackman has prepared a most instructive technological article which bears the title 'Manufacture of Cement from Marl and Clay." Sir Oliver Lodge's excellent treatise on electrons is continued. How a storage battery cell can be made at home is set forth in a simple way by Walter Jones. Electrochemists will read with interest the article on the electrolytic manufacture of caustic soda and hypochlorites.

A new composition whereby steel can be more easily welded than formerly was tried recently at the Jefferson Iron Works, Ohio. The process employed consists in welding steel, and especially scrap steel, by putting scrap steel, layer upon layer, in any preferred shape or size, superposing on each layer some of the composition, and heating the entire mass, then subjecting it to mechanical pressure, whereby a homogeneous union of the separate parts is produced, forming practically a single, integral mass, possessing, it is claimed, all the practical qualities and characteristics of the steel billets produced by casting, or by other known methods. A billet was made from scrap steel and put through the furnace and rolls. It came out a perfect piece of sheet steel with smooth edges. This sheet was cut into smaller pieces, from which perfect nails were made. Washers were also made from this piece, and proved satisfactory. The cost of manufacturing the composition, including the making of the billet of scraps, per ton is from 25 to 50 cents, including labor, and therefore not only economical by saving time, but also saving the vast amount of scrap steel. A. S. H.

Correspondence.

Troublesome Gas Engine Gaskets.

To the Editor of the SCIENTIFIC AMERICAN:

The article about troublesome gaskets by A. E. Potter in the issue of SCIENTIFIC AMERICAN of May 16, is well pointed toward a very general defect in seventy-five per cent of the gas and gasoline engines that have come under my observation.

Leaving out the question of unevenness of packing surfaces as clearly a case of poor workmanship, there are two points of construction which, if better understood and applied, will overcome this annoying defect in most cases.

First, wherever possible inclose or confine the gasket to withstand the pressure of the gases against its edge.

This is readily effected in a cylinder head, for instance, by a projecting rim on the edge of the head which fits over the end of cylinder, or in a flange by recessing the seat, etc. A good practice is to make the confining recess in depth only twice the thickness of the gasket. This is a hint to inexperienced engineers not to add more thicknesses should repacking become necessary.

The second point is to groove the packing surfaces both for confined and unconfined gaskets. Many engine makers apparently vie with one another to produce the smoothest packing surfaces.

Because of unequal expansion of the parts of an engine, the inelastic asbestos will seldom be as tight when engine is cold as when hot. When pressure is exerted against the edge of a gasket, the part of the gasket filling the grooves acts against the sides of the grooves as a check, preventing the egress of gas between the slightly separated surfaces. This illustrates the necessity for grooves in the confined gasket.

The grooves help largely to prevent the blowing out of unconfined gaskets. Grooves for small surfaces need not be more than 3/32 inch wide and 1/32 inch deep. On circular surfaces they are made preferably concentric rather than spiral, the former not permitting the escape of gas if the gasket is not forced so as to completely fill the grooves. Many troublesome joints can be much benefited by grooving when it is impossible or inconvenient to confine the gasket. The grooves can be cut by a chisel or machined.

Ossining, N. Y., May 18. R. T. KIPP.

A Jointed Snake.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to your issue of May 16, I do not believe all that your Missouri correspondent says about the jointed snake; neither do I believe you when you say there is no animal known to science as a jointed snake. Neither need you believe the following incident that came under my observation—not as a small boy, but a grown-up man:

Riding along a country road, I saw a snake about thirty inches long and one inch in diameter. Alighting, I struck it with a piece of fence-rail. The blow fell about eighteen inches from the head, and just back of the abdomen. To my surprise, the snake broke in two; the blow was not sufficient to cut it in two. The forward part wriggled and made a little progress forward, before another blow killed it. Noticing a peculiar formation at the break, I pressed with a piece of timber on the tail end, and found it would disjoint in sections of about two and one-half inches. One end of the joints consisted of four short prongs, resembling the root of a human tooth freshly drawn, and the other end had sockets to correspond with the four prongs. Both ends were raw, and a little blood was noticeable. A brother was with me at the time, and readily remembers the incident, and I can give you ample reference as to my veracity. R. P. GETTYS.

Knoxville, Tenn., May 25, 1903.

A Mechanical Method of Measuring Surfaces.

To the Editor of the SCIENTIFIC AMERICAN:

I believe I have invented a process by which the area of any surface, no matter how irregular it may be in shape, can (provided it is not too large) be ascertained by a simple mechanical means, and with absolute accuracy.

I studied it out for the purpose of finding the number of square inches there is in boot and shoe uppers, so that a system could be arranged for giving the correct number of feet of upper leather to cutters, to cut uppers according to the sizes and widths the orders call for, and no useless waste be made.

My method is as follows:

First cut the patterns in heavy paper, exactly to model shape. Next cut, exactly, square inches and fractions in *the same kind and weight of paper.*

Next, using a pair of carefully and delicately adjusted balance scales, place the patterns on one side, and weigh with the paper square inches, used as weights.

No matter what shape the patterns are, when the square inches balance them, it shows the exact number of square inches are equal on both ends of the scales.

Philadelphia, May 16, 1903. C. B. HATFIELD.