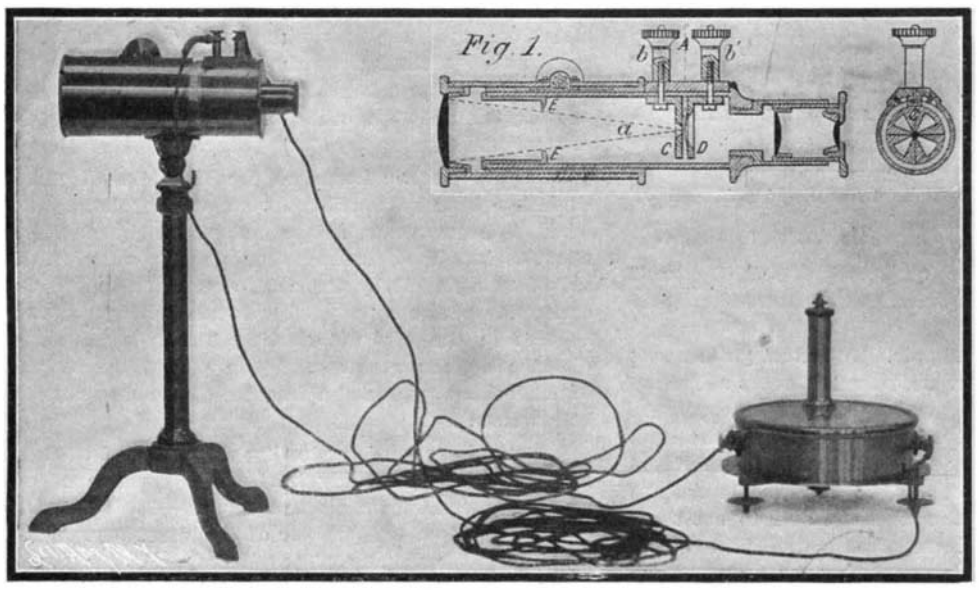
THE FÉRY PYROMETRIC TELESCOPE.

BY DR. ALFRED GRADENWITZ.

A pyrometer the range of which is practically unlimited, has recently been designed by Prof. Ch. Féry, of the Paris Ecole de Physique et de Chimie. The underlying principle on which the apparatus is constructed, is the law regarding the relation of the thermic radiation of heated bodies to their proper temperature as enunciated by Stefan as far back as 1880 and confirmed by the researches of Prof. Boltzmann and other physicists. The problem solved by Stefan seemed for a long time a rather complicated one, as the emissive power of solids is itself in most cases an unknown function of the temperature, which further complicates the relations observed. The problem, however, is simplified in a high degree when considering the so-called *black bodies*. The notion of "black bodies," as first introduced into science by Kirchhoff, is relative to a body emitting, when heated, any kind of radiation in normal proportions; carbon and a large number of black metallic oxides will show this behavior. The theoretical notion of the "black body" is however best realized in practice by a large sized furnace, possessing only a very narrow opening through which the radiations are allowed to pass. Any body heated, not in the open air but in a large closed furnace, will accurately show the normal radiation of black bodies quite independently of the nature of the walls of the furnace. Now as a similar heating process is mostly used in industrial practice, an instrument based on the behavior of black bodies would seem to be highly suitable for industrial purposes. This behavior of black bodies is indicated by Stefan's law as follows: The amount of heat radiated from a black body (or from the opening of a furnace) brought to a high temperature, is proportional to the fourth power of the absolute temperature of the black body (or the furnace).



THE FÉRY PYROMETRIC TELESCOPE.

The instrument designed by Féry on this principle is represented diagrammatically in Fig. 1. The cross wires of a telescope, the objective of which is made of fluorine (a substance highly transparent to any radiation and the presence of which does not alter to any appreciable degree the composition of the radiation), are replaced by a system of two narrow and extremely thin plates of iron and constantan* respectively soldered to one another at their points of intersection and fixed by their ends to two brass disks, *C* and *D*, from which the electric current is taken through the binding posts *b* and *b'*. This system obviously embodies a thermo-electric couple. The attachment is readily pointed at the hot body, while being independent of any lateral stray radiations; in fact, on the tube of the telescope being heated, the temperature of all the soldered seams of the thermic battery constituted by the two metallic plates will be increased by equal amounts without any disturbance in the readings being produced. In order to limit the length of the plates submitted to the thermic radiation, a cross-shaped screen has been added, allowing only the soldered seam to be exposed; finally a diaphragm, *E*, placed at a constant distance from the cross-wire plates, makes the readings independent of the distance at which the body is placed. The angle, *a*, of the cone of rays striking the soldered seam will accordingly be independent of the length to which the tube of the telescope has been drawn out.

The telescope is, by means of a flexible wire of a known resistance, connected to a special galvanometer by the deflection of which the energy of the radiation is indicated. Experiment goes to show that the relative absorption of fluorine becomes constant from the temperature of 900 deg. C.; that is, the amount of heat absorbed then bears a constant ratio to the amount of heat transmitted. A telescope standardized at a temperature upward of 900 deg. C. will therefore allow of ascertaining immediately the unknown temperature corresponding to an observed radiation.

If, for instance, the deflection obtained on the transparent scale of the galvanometer be 75 mm. in case the furnace the telescope is pointed at is at a temperature of 1,000 deg., and 300 mm. be the deflection due to a body brought to a temperature x, then Stefan's law will give immediately

$$\frac{x^4}{(1000 + 273)^4} = \frac{300}{75};$$

whence $x = 2{,}547$ deg. absolute, or 2,274 deg. C.

As the temperature is proportional to the fourth root of the galvanometric deflection, even a rather large error as to the radiation will result in a much smaller relative error with respect to the temperature. In order to avoid any calculation, the temperature corresponding to the observed deflection may be derived from a curve. There are several diaphragms intended for different ranges of temperature, allowing temperatures included between 800 and 4,000 deg. C. to be readily determined, though the deflection corresponding to the latter temperature be 250 times greater than that observed at 800 deg.

For industrial purposes, the inventor has slightly modified his apparatus, using instead of fluorine lenses, a lens made of a special glass, the opening of which is large enough to insure easy readings on industrial galvanometers. Such pyrometers are standardized by comparison with a fluorine objective pyrometer.

* Constantan is a German alloy of copper and nickel containing 50 per cent of each.

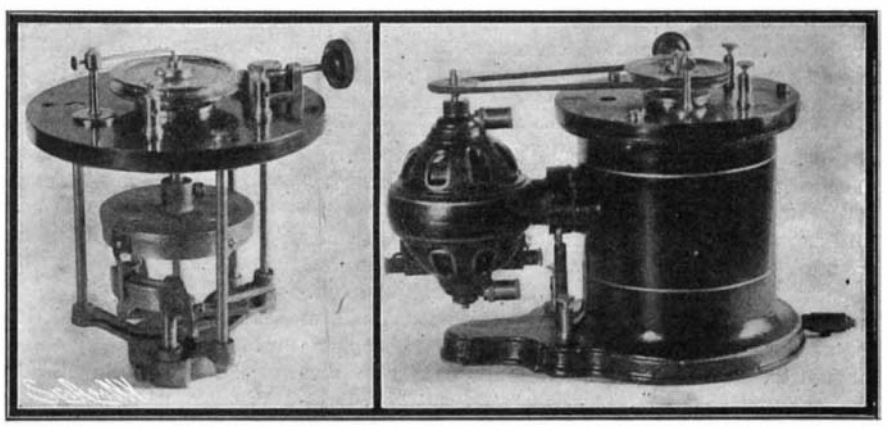
A NOVEL INTERRUPTER FOR INDUCTION COILS.

BY OUR BERLIN CORRESPONDENT.

Ever since induction coils have obtained their present importance in connection with Röntgen rays and wireless telegraphy, there has been a demand for a reliable interrupting device, which can be regulated to give any desired frequency and any desired duration of the current impulses.

This demand is greater in connection with Röntgen apparatus, as Röntgen bulbs have to be regulated during operation, to give most favorable results. On the other hand, such interrupters have to work with a low consumption of energy and the bulbs must be put to as low strains as possible.

The Wodal mercury jet interrupter, which we illustrate herewith, fulfills these requirements in a very satisfactory way. The main casing carries at one side a small electric motor, which drives a shaft located centrally in the interrupter proper. This shaft comprises two sections coupled together but electrically insulated from each other by a disk of hard rubber. The upper member of the coupling consists of a circular metallic plate formed at its periphery with a flange which fits over the insulating disk. A number of contact fingers depend from this flange. Attached to the lower end of the shaft is a centrifugal device which operates in a quantity of mercury which fills the lower portion of the main casing. The mercury is thereby constrained to rise through a pipe to a perforated, curved casing whence it flows out in a broad jet in the path of the revolving contact fingers. Every time a finger encounters this jet, the electric circuit is completed to the induction coil. A shield which fits over the perforated face of the curved casing may be operated by means of a thumbscrew at the top of the interrupter to close any desired number of the perforations, thus permitting the width of the mercury to be adjusted. When the holes are all open, the contact fingers will encounter a broad ribbon jet, and a maximum duration of current impulses will be obtained; on the other hand, in the case of a single hole being opened, the impulses will be of short duration, and the current may



The Interrupter with Casing Removed. The Interrupter Complete.

A NOVEL INTERRUPTER FOR INDUCTION COILS.

Fig. 1.—Street Post.

Fig. 2.—Fire Alarm Switchboard.

A NEW ENGLISH TELEPHONIC FIRE ALARM.—[See next page.]

be wholly switched off by covering the last hole. The path followed by the current in the Wodal interrupter is as follows: The current is supplied to the motor through a variable resistance allowing regulation of the number of revolutions of the motor and, hence, the number of interruptions being readily altered. No special regulating resistance is necessary for the primary of the induction coil, even the most delicate regulation of the current supply being secured by means of the interrupter itself. The Wodal interrupter, like other interrupters, is inserted between the source of current and the primary of the induction coil, the current being conveyed to the mercury jet, and thence through the contact fingers and revolving shaft to the induction coil.

In order to insure more rapid interruptions with a minimum sparking, the reservoir is filled with a quantity of petroleum. As compared with electrolytic interrupters, the Wodal affords the advantage of being perfectly noiseless in operation, and of consuming very little current (about 1½ to 3 amperes). It can be used with any high-tension direct currents.

A NEW ENGLISH TELEPHONIC FIRE ALARM.

BY FRANK C. PERKINS.

A new English system of street fire alarms has recently been brought out by the General Electric Company, Limited, of London, which comprises street alarm and telephone posts located at various points in the city and an annunciator switchboard for the fire station, as shown in the accompanying illustrations, Figs. 1 and 2. As usual the functions of the post are to act as fire-alarm pulls to be operated by the public in the event of fire and to serve as street telephones for the use of the fire brigade in executing their duties, while they may also be employed if desired as police telephones.

The calls are received from the street posts by the annunciator switchboard, which indicates from which post the call is given. The function of the annunciator switchboard is also to discriminate between genuine and accidental calls, such as "grounds"; to allow the lines being tested; and, where required, to serve as a switch for connecting any street post with the police station, or with any official on the system.

The post is fitted with a locking pull to be operated by the public, a vibrating bell, which rings when the pull is operated and indicates that the call is passing through the station, while the stopping of the bell indicates that the call has been attended to. A replacement movement for the pull is provided, as well as the usual telephone receiver, water type microphone transmitter, and induction coil. There is also provided the usual automatic switch hook, call key, lightning arrester, and a two-microfarad condenser which is used in the line test.

The switchboard at the fire station noted in the illustration, Fig. 2, includes an annunciator drop and jack for each post, an 8-inch alarm bell, and an answering plug, also a control indicator, enabling a line which has been used to be kept under observation until the pull in the post is replaced. A control bell gives an audible signal when the pull in the post is replaced, and a discriminating buzzer is provided to allow of determination between real and accidental calls. In addition to the hand combination telephone and magneto generator for the purpose of testing the lines and when required to call any department, a perpetual calendar is provided, as well as an English timepiece, as noted at the top of the switchboard. The Tottenham Urban District Council has installed this system of electric fire alarms, as shown in the accompanying illustration, with thirty-five fire-alarm posts, each fitted with a telephone plug box. When the pull in the post is operated, the battery current passes through the indicator drop, closing the local alarm bell circuit, and the bell in the post at the same time rings.

The fireman attendant in the watchroom inserts his answering plug in the spring jack underneath the fallen shutter, and the discriminating buzzer at once emits a loud buzzing sound. If the alarm were caused by "ground" on the line, the buzzer would not operate, and the brigade would not be called out unnecessarily.

If, on inserting the answering plug, the discriminating buzzer does not operate, it indicates either that someone wishes to telephone, or that the line has become earthed and requires attention. The attendant can ascertain which by listening on the telephone and making the usual inquiries.

After calling out the brigade, the attendant withdraws the answering plug and inserts in its place a plug belonging to the control indicator. This stops the bell ringing in the post, and the control indicator pointer is deflected to the "on" position. The answering plug is now available to receive further calls.

When the post-handle is replaced, the control indicator returns to the "off" position, and the control bell rings continuously until the plug is withdrawn and placed in its normal position. The attendant now inserts his answering plug and listens on the telephone to ascertain if the person replacing the pull wishes to speak to him.

To test the lines from the station, the answering plug is inserted in each spring jack successively and the generator handle turned. If the line is in proper order the discriminating buzzer will be actuated, but if the line is discontinuous, it will remain silent.

At the post, if it is required to speak to the fire station it is only necessary to hold the receiver to the ear and press three or four times on the small push button for the purpose.

TESTING MACHINES AT THE BOSTON INSTITUTE OF TECHNOLOGY.

(*Continued from page 280.*)

ing machine in use at the Institute is of 100,000 pounds capacity, and will test specimens of material up to 26 feet span.

The machine is quite simple. Two steel girders rest at the center on a framework raised 4 inches above the floor. These girders support two movable carriages, which hold the jackscrews used for applying the load. At the center of the machine there are three levers used in weighing the load. Two of these levers are beneath the girders of the machine, and do not show in the cut. The main lever gives a multiplication of 10 to 1. It is of steel, about 6 feet long, and at the larger end it is 13 inches deep and 2¼ inches thick. The load is applied by raising the jacks at the ends of the specimen, and it is weighed through the pull exerted on the levers by the yoke attached to the center of the specimen. The steel girders forming the bed must carry, without undue fiber stress, the maximum load which the machine can exert.

The photograph shows a white pine beam which had been in service at least seventy-five years. The stick is 15 inches deep and 15⅞ inches wide. The span was 20 feet. In the test made on this beam in the testing machine, the load was applied at two points, 1 foot either side of the center. The manner of distributing the load is shown by the beams at the center of the machine. The deflection of the beam was measured in the following way: On either side of the beam a fine steel wire was stretched over pins driven into the beam directly above the supports and at the center of the depth. A ten-pound weight on the end of each wire kept the wire in tension. A micrometer was fastened to each side of the beam at center of the length and depth of the specimen. The faces of the micrometer screws were set parallel with the wires, the screws being perpendicular. To take a set of readings, the screws were turned down till contact was made with the wires.

In determining the torsional strength of substances, three machines are utilized by the students, being of 150,000 inch-pounds, 60,000 inch-pounds, and 6,000 inch-pounds capacity. The accompanying photograph is of the most powerful machine.

The specimens commonly tested in it are from 1½ inches to 2½ inches in diameter and of lengths varying from 3 to 12 feet. The power end of the machine is driven by a 4-inch belt running from a countershaft overhead. The gear is keyed to a 4½-inch diameter steel shaft, which turns once in about fifteen minutes. The holder is a massive piece of cast iron, reinforced by two bands of wrought iron three inches wide and one inch thick, shrunk on the outside. The grips are made of cast iron, faced with cast steel which is fluted on the outer surface. These grips are cams which tend to bite the specimens harder and harder as the twisting head turns to the right. The grips do not require a shouldered specimen. Steel bars 1½ inches in diameter, containing 1.10 per cent carbon, have been gripped without the least difficulty. A handwheel is attached to the driving shaft, so that any desired twisting movement may be held on the specimen. This is also used in adjusting the load accurately, when the angle of twist of the specimen is being noted.

The weighing end is held in a movable carriage which runs on I-beam tracks. A casting, with grips similar to those described above, is attached to a hollow frame made of boiler plate, which is hung from the carriage by an equal-arm lever and links, all turning on hardened steel V-shaped knife edges. From a knife edge at each end of this frame a link runs to a lever, one lever being near the top of the carriage and the other near the bottom. The free ends of these levers connect with the weighing beam shown running across the carriage. As the power end holder turns toward the right, the twisting movement, transmitted through the specimen, will tend to rotate the frame so as to cause the right-hand end to go down and the left-hand end to go up. This causes the free end of the weighing beam to lift, and poise weight must be moved to the right to bring this lever level again.

Two processes, dependent upon the fact that some oils, when brought into contact with finely-crushed ore in water, have the remarkable power of absorbing the particles of certain minerals to the exclusion of others, have been developed.

Engineering Notes.

In Belgium about 85 per cent of the navigable waterways are under the direct control of the state, which is also a large shareholder in the canals conceded to private companies.

Stamped sheet zinc is rapidly coming into use for metal ceilings in places where wood has heretofore been used. In some cases the material is even copper-plated and given a beautiful finish. Those who have had experience with other material will readily appreciate the advantage of using zinc.

Overhead electric trams on the Madeleine-Colombes line have been responsible for an extraordinary accident. The conductor, at the end of his journey, was about to turn the arm from front to rear when, in the act of swinging it by the cord, something caused the springs to act as a powerful catapult, lifting the man 18 feet in the air and hurling him a considerable distance on the roadway. When picked up he was found to have sustained a fracture of the shoulder and both wrists.

A method proposed for testing wood treated to resist fire consists in suddenly heating ½ gramme of the wood by means of an electric current—120 volts, 7 to 10 amperes—to a temperature of 700 to 800 deg. C., and measuring the volume of gas liberated in the course of two minutes. The wood is contained in a platinum wire basket, and the weight of ash and charcoal left can also be determined. A good sample should yield a smaller volume of gas and a larger weight of ash than an untreated sample.

The French Admiralty has quickly recognized the possibilities of the gasoline motor for the propulsion of small war vessels. A vessel intended for police purposes upon the rivers in the French Congo has been launched from Bangui, built under the supervision of the Admiralty, and fitted with two 30-horse-power gasoline engines. The boat is 97 feet 6 inches in length, and is armed with quick-firing guns. It is the largest gasoline-propelled boat that has yet been constructed in France and is purely an experimental vessel to demonstrate the capabilities of this type of engine for small craft of this type.

In Umea, Sweden, there has recently been installed a factory for the dry distillation of wood, by means of superheated steam, where, in addition to wood coal, wood tar and turpentine oil are recovered. According to the process invented by Mr. Elfström, the steam, superheated to some hundreds of degrees, is conveyed into a tightly-closed horizontal retort of a capacity of 15 cubic meters, filled with resinous wood, when the wood tar, mixed with condensing water, is deposited on the bottom of the latter, the volatile portions being removed with the steam generated by the moisture of the wood. On their way, they are once more highly superheated, and are allowed to exert their effect in a second similar retort. The water vapors, strongly saturated with turpentine oil, are eventually condensed, the turpentine oil being separated readily from the water, while the combustible wood gases are being used for heating the steam producer and the superheater. The wood-tar discharged from time to time from the retort is separated by an addition of common salt from the condenser water, the density of which is thus increased to such an extent as to cause the tar to accumulate on the top. The process is said not only to afford a large output of wood coal, but in addition, wood-tar and turpentine oils of far greater purity than in distillation plants with immediate retort firing, the process being much more uniform in the retorts and too high retort temperatures being avoided.

The Current Supplement.

The current SUPPLEMENT, No. 1503, contains an unusual variety of interesting scientific articles. Mr. Joseph Horner describes at length, in an excellent review, modern methods of steel casting. His article will be concluded in the next number of the SUPPLEMENT. Many illustrations accompany the text. H. W. Buck, electrical engineer of the Niagara Falls Power Company, outlines in an instructive way the method of utilizing Niagara power. Prof. Holden's splendid appreciation of Copernicus is concluded. It has been suggested (and the theory has received to some extent the support of experimental proof) that certain kinds of insects derive protection from the grotesqueness or hideousness of their appearance; Mr. Percy Collins convincingly proves the theory in an article entitled "Terrifying Masks and Warning Liveries." Numerous photographs of insects accompany his article and bear out his contentions. Just where King Solomon's Mines may have been situated no one knows. In an excellent article published in the current SUPPLEMENT, the location of this fabled land of wealth is given on the basis of modern explorations. Prof. Rutherford's painstaking discussion of the radio-activity and emanation of radium is concluded. Prof. Neesen contributes a valuable paper on "Protection from Lightning." The usual notes are likewise published.