LENSES.

[*Continued from first page.*]

classed according to the use to which they are applied. The flint glass for telescope objectives is more dense than that used for the achromatic lenses of photographic cameras.

The disks are cut to the required size, either by means of a diamond or by a revolving iron hoop supplied with sharp sand and water; they are then roughened into shape in the machine shown in one of the upper views in the large engraving on our front page. The hopper suspended from the ceiling contains sharp sand and water, which are allowed to flow out upon the form or tool on the upper end of the vertical spindle. This form, or tool as it is called, has the same curvature as the lens to be made. It is convex for a concave lens, and concave for a convex lens. A disk of glass held upon this tool, charged with wet sharp sand and water, soon assumes the desired curvature, and is ready for the next step, which consists in grinding the lens in another machine with three different grades of emery on as many different tools.

The emery ranges from No. 90 to No. 150, the last grade leaving a surface sufficiently fine to be at once polished with rouge. To the back of each disk of glass a hub is cemented with pitch. In the center of this hub there is a conical hole of sufficient depth and size to receive the point that projects from the lever by which the disk is held down upon the finishing tool. When small lenses are ground, an ordinary handle, having a steel point, is used, instead of the lever, as shown in the lower left hand view. When lenses are ground in this way the tool is much larger in diameter than the disk, and the latter is held eccentrically in relation to the axial line of the tool, so that as the tool revolves the disk is also made to revolve, thus continually changing the relation of the surfaces in contact, thereby insuring greater accuracy in the form of the lens.

Between the applications of the several grades of emery the disk is thoroughly washed, and great care is exercised to prevent any particles of the coarser emery from becoming mixed with the finer.

After the application of the finest grade of emery the glass disk and the tool are both thoroughly washed, and the face of the tool is covered with fine woolen cloth simi lar to broadcloth, which is made to adhere by a thin coating of melted pitch applied to the face of the tool before putting on the cloth. The tool thus prepared is wet by blowing on water from the mouth in a thin spray as represented in the engraving, and the workman applies to the cloth surface a ball of fine rouge, forming on the face of the cloth a thick paste of rouge and water. The lens, if large, is held upon the tool with the lever in the same manner as in grinding. If small, it is held by the steel-pointed handle. A gentle pressure is applied, and, should the tool become too dry before the required polish is secured, water is blown over it with the mouth, as before described. After having finished one side of the lens the other is proceeded with in precisely the same way. The treatment is the same for both convex and concave lenses. In grinding the best quality of telescopic objectives the operation is wholly performed by hand. This is done in the manner shown in the upper right hand figure of the engraving. The tool is supported by the post, and the disk is moved in a series of small circles, and at the same time turned as the operator moves slowly around the post. In the case of telescope lenses, the final finish is secured by a pitch surface formed on the tool, and traversed by grooves running across it in different directions.

Very small lenses are formed from pieces of glass cemented to the end of a stick. The roughing is done upon a common grindstone. The grinding is done in much the same way as already described; the polishing, however, is somewhat different; the tool being covered with a mixture of rouge and beeswax, the amount of rouge being sufficient to render the beeswax quite hard. The form is given to the wax surface by pressing the unpolished lens into it. A thin paste of rouge and water is applied to the tool occasionally.

Ordinary spectacle lenses are ground in quantities in the manner represented in the lower left hand view in the front page engraving. Here a great number of pieces of glass are cemented to a form with pitch, and the tool is moved over it by a short crank on the lower end of the vertical spindle. The workman dashes emery and water or rouge and water over the form; and the upper tool, in addition to receiving an oscillatory movement, is slowly rotated by the action of the crank in the socket at the back of the tool. Generally a series of forms are operated in a single bench and attended by one man. The steps in the operation of grinding spectacle lenses are about the same as when single lenses are ground. After they are ground and polished upon one side they are removed from the form and turned over, cemented to the form, and ground and polished upon the other side.

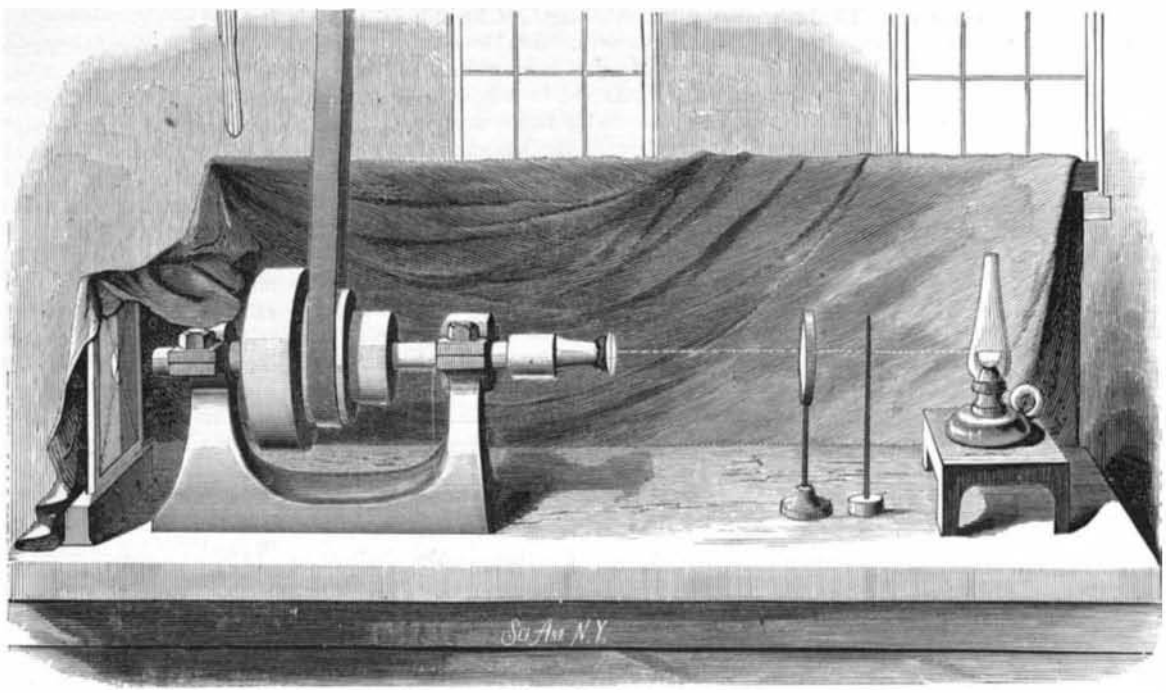
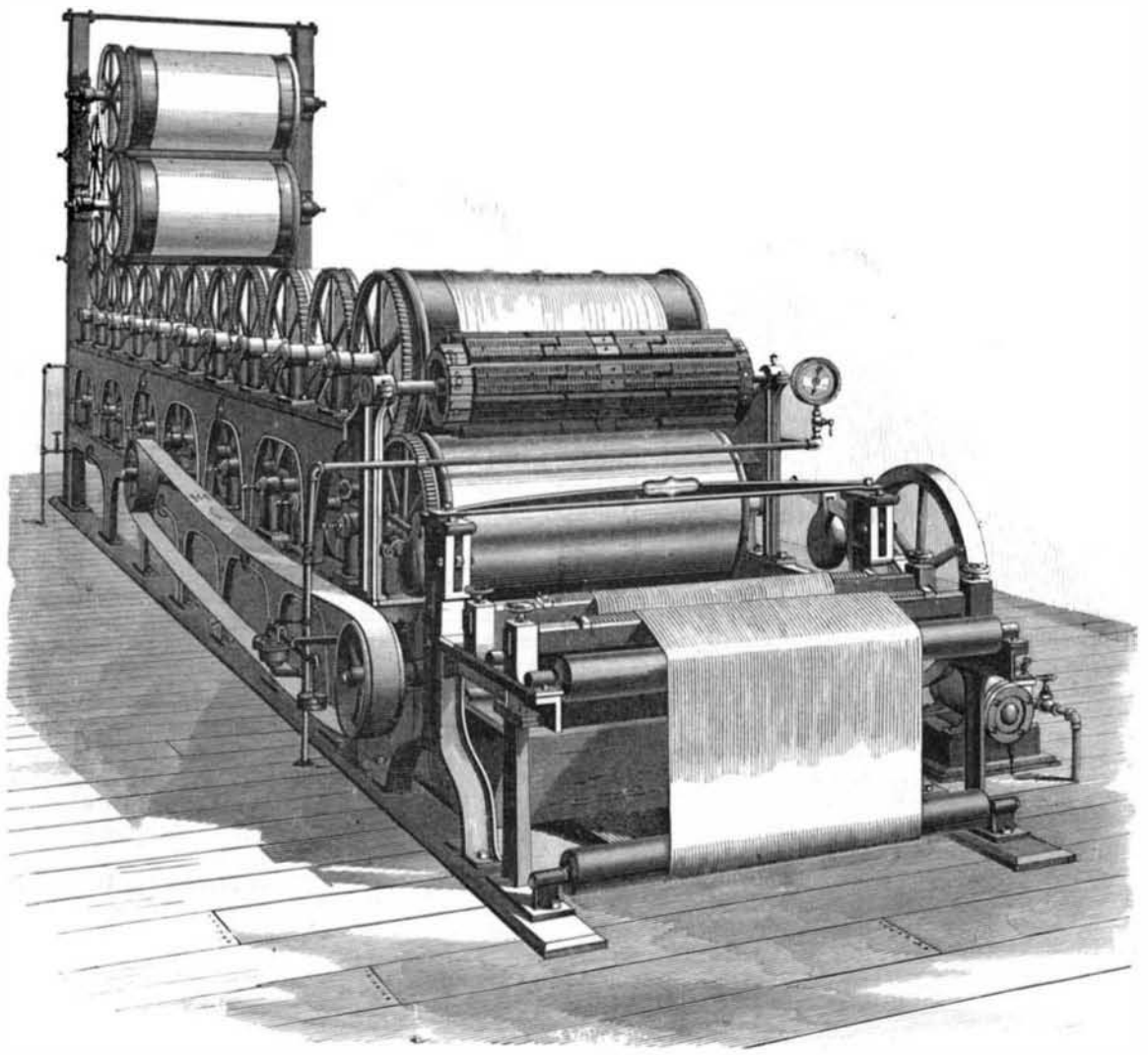


Fig. 2.—CENTERING LENSES.

For many purposes it makes little or no difference whether the axis of a lens corresponds with its geometrical center, but for telescopes, opera glasses, photographic cameras, and other instruments of accuracy, their optical and geometrical centers must correspond. The manner of testing lenses to ascertain if the optical center and the geometrical center coincide, is illustrated in Fig. 2. The lens is cemented to a chuck upon one end of a hollow lathe mandrel; near the opposite end there is a ground glass surface, and in front of the lens being tested there is another lens supported on a standard, beyond which there is a small vertical rod and a lamp. These different pieces are all in line with the axial line of the mandrel, and an image of the rod is cast upon the ground glass screen. If the image remains stationary while the lathe revolves, the optical center of the lens coincides with the center of rotation, but if the image moves, the optical center is out, and the lens must be centered while the cement which supports it is still warm and soft. This is easily done by holding the hands against the edge and sides of the lens as it revolves. When the lens is optically centered, if its periphery is out it must be ground down. This is readily done by placing under it a piece of sheet iron bent into semicircular shape, and forced upward against the edge of the lens by means of a screw passing through a board that supports it. The sheet iron is charged with sand or emery and water, and as the lathe revolves the lens rapidly assumes a circular form.

The matter of testing the different qualities of glass used in the manufacture of fine achromatic lenses has been omitted on account of the abstruseness of the subject and the amount of space required to properly treat it.

For many of the points given above we are indebted to Mr. Chas. F. Usner, a practical optician of this city, from whose factory, at 128 and 130 Fulton street, we have taken the majority of our sketches.



H. W. BUTTERWORTH & SONS' DRYING MACHINE.

DRYING MACHINES.

The lower engraving on this page represents one of Messrs. H. W. Butterworth & Sons' drying machines, such as are used for printworks, bleacheries, and for drying cotton warps and finishing tickings, osnaburgs, etc. This machine is arranged with twenty-four cylinders, supported by a framing, eighteen of them being on a horizontal and six on a vertical frame. The grouping of these cylinders in a horizontal, vertical, or other direction may be modified to suit special requirements; and where the floor space is contracted, the vertical arrangement is preferred.

The frames of the machine are made of cast iron, being quite heavy in their construction, with broad planed surfaces; and hollow passages are cast in them for the transmission of the steam used in heating the cylinders and the return of the condensation, thus dispensing with outside pipes and connections. The steam passes into each cylinder and leaves it again by means of branch passages cast on to the frames and connecting with journals in which the axes of the cylinders run. The stuffing boxes for the journals are packed from the front by an arrangement introduced by this firm in 1867, this packing, however, forming no part of the bearing. The advantages derived from this method consist in the easy access given to the packing, which also lasts longer than in the ordinary arrangement; in an allowance of greater freedom for expansion of the cylinders than can be attained in any other way, and in furnishing an abundant length of bearing for the axles. This firm formerly packed the stuffing

boxes on the inner side, but this rendered them much more difficult of access, and at the same time there was a greater tendency for them to blow out with the steam pressure. The length of bearing also obtainable for the axles was much less. In drying machines as usually constructed, the practice has been to introduce the steam to the cylinder by means of a steam pipe connecting from the exterior through the end of the journal by a countersunk joint. This arrangement did not allow of free expansion and contraction of the cylinder, and caused the end of the journal to press against the end of the steam pipe with more or less force, depending on the temperature to which it was raised, producing consequently more or less friction.

Motion is communicated from one cylinder to another by cast iron gearing, seen very distinctly in the engraving. The cylinders are carefully made, but no special balancing is required, such as is necessary in drying machines for paper making, the material to be dried in the present case being of much stronger texture.

In machines with wide cylinders, where more than one width of material is dried at the same time, the steam is so applied that each width is dried uniformly. A uniformity of temperature is maintained throughout the machine by allowing the steam to enter the top cylinder at one end, and the corresponding bottom cylinder at the other. The working pressure of the steam is usually from five to ten pounds per square inch, and it is controlled by an efficient regulator. The water of condensation is removed from the opposite end of the cylinder to that at which the steam enters, by means of Collins' patent trough, a device very extensively used in England, and quite effective in its operation, causing the water to pass out through the journal in a similar way to that by which the steam enters at the other end. The material to be dried, before entering around the cylinders, passes first through a "stretcher," made of brass, which prevents the edges from turning down, and smooths out all wrinkles, delivering it perfectly even and regular. The tension of the fabric is controlled by passing it between three rectangular bars, alternating above and below them, one after the other, and around a roller; or in another way by means of a strap and weight attached to the roller, from which it moves on to the drier.

ENGINEERING INVENTIONS.

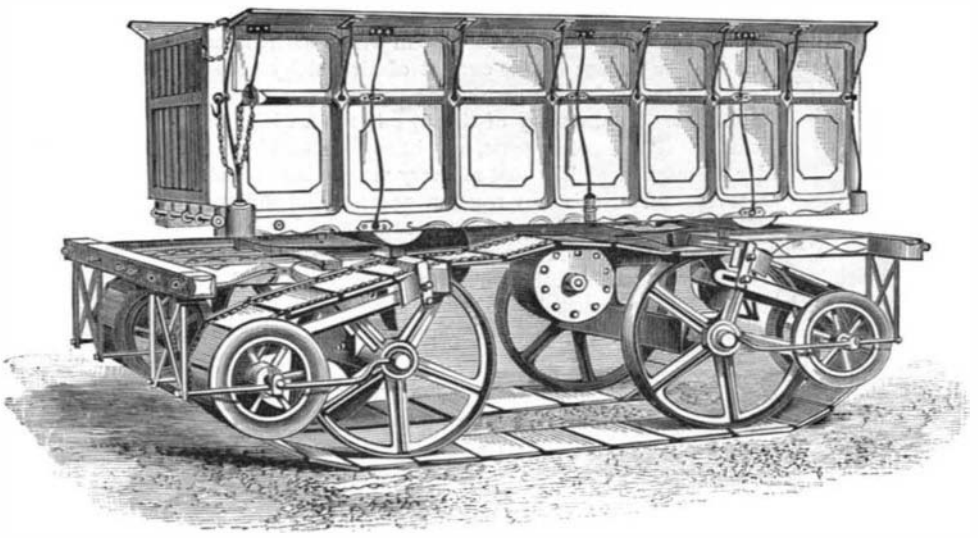
An improved aerial ship has been patented by Mr. Watson F. Quinby, of Wilmington, Del. The peculiar construction of this machine cannot be described without an engraving. The upward as well as the lateral movements are made by winged wheels of novel construction.

An improvement in permanent ways for tramways has been patented by Mr. Silas Nicholls, of St. Clement Danes, County of Middlesex, England. The object of this invention is to construct a tramway capable of resisting for a lengthened period the damaging effects of rain, frost, and snow, and in which the tram rails and the paving of the road on either side of them are kept firm and (so far as the durability of the road materials will admit) of uniform surface level. The invention enables the rails (when the road paving is fairly worn below their level) to be lowered until they are again flush with the surface of the road without taking up the whole of the paving between the rails.

Mr. George W. Dixon, of Spring Lake, Mich., has patented an improvement in valves for steam pumps, the object of which is to simplify the construction of valves for direct acting steam pumps, and thereby reduce the first cost of such pumps and the expense of repairs. The improvement consists in a double seated slide valve, similar to the ordinary slide valve fitted within a case in the steam chest, in which the valve slides, the space at the ends forming steam chambers, into which the steam is admitted alternately to move the slide valve. The admission of steam to the chambers is effected by means of an auxiliary valve in the steam chest, which is operated by means of shifting levers that are acted upon by the piston head in the engine cylinder.

An improvement in railroad frogs has been patented by Mr. Michael McAleenan, of Peoria, Ill. This invention relates to the joint or intersection of the rails of railroad frogs. It is designed to strengthen the joint and prevent dislocation. The improvement consists in prolonging the web and base of one rail in the form of a tongue, that extends toward the point of the frog in the space between the head and base of the other rail.

An improvement in gates for railroad crossings has been patented by Mr. Thomas Meehan, of Brooklyn, E. D., N. Y., and Mr. Colin McLean, of Jamaica, N. Y. The invention consists in the combination of a vertical frame provided with the side posts, and the two trusses for supporting suspended railroad gates and their operating mechanism. Two sets of chains or ropes, and two sets of pulleys, two weights, and four pairs of bevel gear wheels, are employed in moving the gates and retaining them in the required position.



SELF-LAYING TRAMWAY.

Mr. Harrison Gillett, of Lake City, Minn., has patented an improvement in steam generators fitted for burning straw or hay. The object of the invention is to provide a regular and uniform feed of the material without requiring the fire-doors to be opened, to prevent ashes and sparks entering the boiler flues, and to effect the removal of ashes as fast as they accumulate. The inventor makes use of a cylindrical boiler fitted with an inner cylindrical fire space, smoke box, and return flues through the water space. The fire doors at the front are fitted with adjustable feed rollers driven by gearing and a feed table. At the rear of the fire box ash and spark arresters are fitted, and the smoke and ash box is fitted with a pipe from the boiler for wetting down the ashes, and with a spiral conveyer for delivering the ashes to the outside.

New Brake.

A novel form of railway brake has been invented by Mr. W. Wiseman, of the East Indian Government Railway Department. In the specification it is stated that sand is placed in a chamber fitted with valves, which when opened allow the sand to pass into a second chamber, in which revolve blades attached to the axle of the vehicle. The motion of these blades is arrested by the rush of sand impinging and clogging. The above suggests the idea that a small steam turbine or rotary engine might be attached to each car axle, and by letting on steam from the locomotive, turn the wheels backward, and so stop the train.

SELF-LAYING TRAMWAY.

The vehicle shown in the engraving is fitted with a continuous self-laying and self-adjusting tramway. It was among the novelties of a recent Royal Agricultural Show, being exhibited by Mr. W. C. Pellatt, of Red Lion street, Clerkenwell, England. As will be seen by the annexed engraving, the tramway is composed of plates of hard wood, faced and strengthened with metal, and attached to two parallel endless chains, which pass round revolving guides or drums at the ends of the vehicle, and both over and under the wheels. The chief points in which this arrangement differs from others of a similar character are the gain of a fixed rail without loss of power by friction, the endless chain of plates resting on the top of the van wheels, and being carried forward by them. In this way a free and noiseless action is secured. The under carriages, constructed on the bogie principle, lock simultaneously, thus causing the front and hind wheels to run in the same track, and also enabling the vehicle to turn a very sharp corner. The shafts, however, can be fixed at either end, so as to avoid the necessity for turning in narrow or inconvenient places.

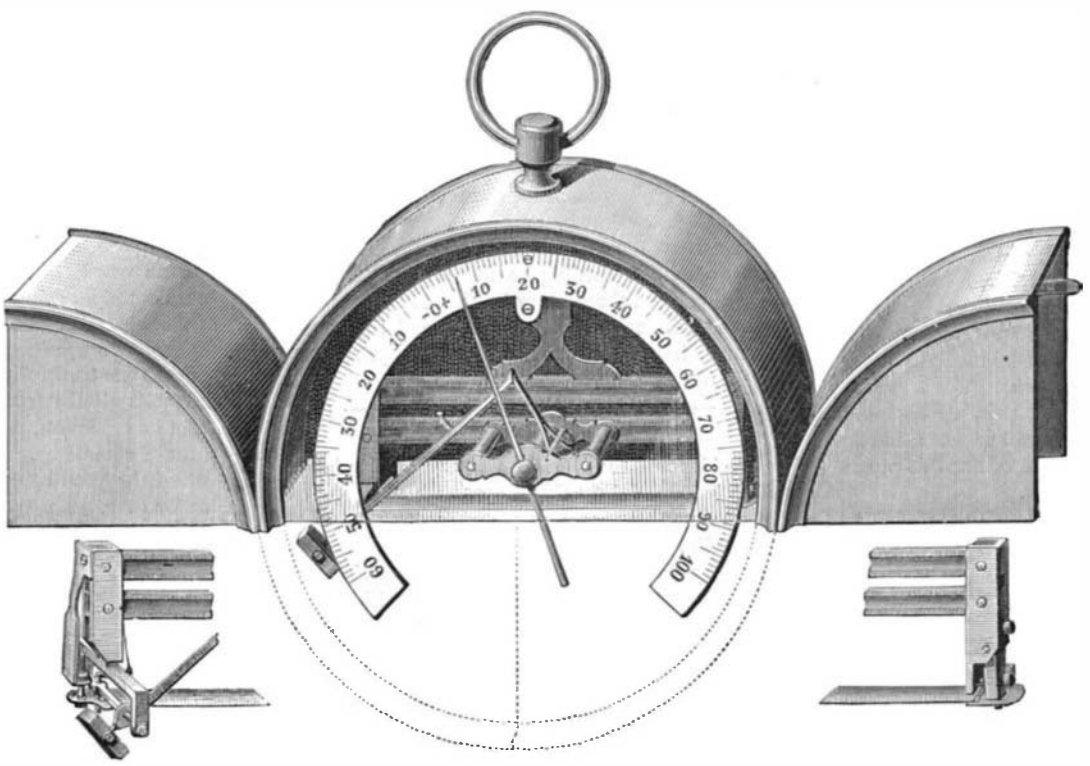
The body of the vehicle projects over the wheels, thus giving an increased capacity of over thirty per cent. A light four-wheeled van, fitted with this apparatus, and loaded up to 1 ton weight, may easily be drawn by one man; and over very heavy or plowed land, the gain is proportionately greater. In this latter case the plates of the endless chains are constructed of a sufficient width to well cover furrows or ruts.

The first two vehicles that were constructed under this patent were a farm wagon capable of carrying from seven to eight tons, and a vehicle for goods or passengers, suitable for high speed.

A NEW METALLIC THERMOMETER.

M. Tremischini's object in the construction of this thermometer, in which the expansion of one metal alone gives the measure of atmospheric temperatures, was to do away with the two inconveniences inherent to the nature of glass —its radiating and absorbing power. It was these inconveniences that the illustrious Tyndall had in view when he remarked that a glass thermometer suspended in the air does not give the temperature of the latter.

But in selecting a metal as an indicator of temperature, the inventor has not been unmindful of the fruitless experiments of those who have preceded him in this field. So, in this new thermometer, there is no system of coupling together two or more strips of unequally expansible metals, no curves especially, of any nature whatever. The metallic strip is made of very hard laminated copper, slightly platinized to prevent oxidation; or it may be of silver. Its thickness is only one hundredth and a half of a millimeter, so that it may possess the highest degree of sensitiveness. The dial of the instrument, on which the temperatures are marked by means of an index needle, rests on a frame which is deserving of a special description.



A NEW METALLIC THERMOMETER.

This frame is composed of two parallel metallic bars, one of steel and the other of copper, connected at their ends by metallic cross pieces. They are represented at the right and left of the accompanying figure. The upper horizontal cross piece, being fixed solidly to the two bars, maintains them at a constant right angle with it; while the lower cross piece, being fastened by two carefully adjusted pins, allows the two other angles of the quadrilateral to become modified under the influence of the unequal elongation of the bars. Taken as a whole, then, the frame forms a rectangular trapezium, one of whose sides (the lower one) may assume different inclinations. This movable side is prolonged beyond the trapezium, and to this prolongation, at a point previously determined by calculation, is fixed the sensitive strip of metal. As for the opposite side of the frame, it ends in a forked appendage, the two branches of which contain an M shaped mortise, and in this rests a movable blade. It is to one of the surfaces of the latter that is attached the other extremity of the sensitive strip. As a result of this arrangement the two points of the frame, to which are fixed on the one hand the oscillating blade and on the other the sensitive strip, are