is being worked, the air allowed to enter the aperture to be cooled and deprived of moisture by being passed over chloride of calcium or other absorbent of moisture.

Eighth. The material in mass or sheets is then, after the cloths are taken off and cut as required into various sizes, removed to the drying room. The air admitted to this room is first to pass over a series of bottles filled with sulphuric acid, quicklime and chloride of calcium. If the arrangement of the drying room does not allow the air to strike over the sulphuric acid, etc., I give the material or sheets a bath of phosphoric or sulphuric acid, wipe them off and then place them in the drying room. After remaining in it two or three days the material or sheets are then ready for final manufacture, either by turning, cutting or pressing, except that where silica is incorporated it can be only ground or pressed.

Ninth. Before the last pressing to attain the manufactured product or parts thereof commences, the material is to be softened. In cold and damp weather this is preferably to be accomplished by exposing it to hot air above 220° Fah., and in warm and dry weather by high steam. This hot air or high steam is let into an iron box in which the material, on shelves of perforated tin, has been placed. In about a half hour, according to the thickness of material, the supply of hot air or steam is cut off and the box opened, and one, with asbestos gloves or like coverings for the hands, takes out the material and puts it into moulds for final pressure into the desired shape or pattern. In cold weather the moulds may be suitably warmed. When removed from the moulds and after trimming the edges left by the outer lines of the moulds, the pieces so patterned are placed in the drying room to remain, in winter time, at least two days.

Tenth. Thereafter the polishing process commences, first in the use of tallow or castor oil for white, or of linseed or of cotton-seed oil for colored products and finishing with alcohol, or with shellac or copal dissolved in alcohol. For the darker shades a little color of the same tint may be added to the alcohol or its solutions. When a very fine and delicate polish is required, I put the shaped pieces in a bath of collodion thinned greatly with alcohol and ether, the latter in largest proportion, to which I add per gallon one-eighth of an ounce of castor oil or glycerine, or one-half that quantity of each. Let the pieces dry for at least two hours, and rub with chamois, very fine felt or material for like use.

Eleventh. When skimmed milk is not of easy access, the ordinary pot cheese made without, or the skimmed milk cheese with, rennet may be substituted and treated as above, except that the amount of caustic soda in the handling of the first is to be trebled and in that of the second quadrupled; or borax may be used in place of caustic soda. The amount of water for dissolving the cheese will be about four times its volume. Common salt is then to be added to this solution. It is not, however, to be cooled below 80° Fah. before the fat can be skimmed or drawn off.

Twelfth. When a thin sheet of the more delicately colored and costly material is designed for any structure, some of the less expensive incorporated with any of the above admixtures of silica with hydraulic cement, to give it solidity and strength, or pulp of any kind, where weight is objectionable, may be used as a backing to the thin sheet, and so applied before the final pressure in the mould or die.

Having fully described my invention, what I claim is:

1. The combination of skim milk with salt, caustic soda, terra-alba, hydrochloric, nitric and sulphuric acids with coloring matter, as above described and set forth.
2. The combination of skim milk with caustic soda, alum, glycerine, ammonia, chloride of barium and sulphuric acid with or without silica and coloring matter, as above described and set forth.
3. The combination of pot cheese with borax, hydrochloric, nitric and sulphuric acids, silicate of sodium, terra-alba and coloring matter, as above described and set forth.
4. The combination of skim milk cheese with caustic soda, alum, terra-alba, tannin and silica, as above described and set forth.

THE TELESCOPE.

By LEON LE PONTOIS.*

I DESIGNATE by this name an apparatus having for its object the transmission of pictures or views of moving or stationary objects at great distances, and as I use electricity for the purpose of obtaining this result, I call this apparatus a telectroscope.

First let me say that by the transmission of pictures to great distances I do not mean the graphic transmission of sketches or writing as done, for instance, by the very ingenious invention of Prof. Elisha Gray, namely, the telautograph.

I intend to describe to you to-night the general outline of an apparatus that I have conceived for the purpose of seeing over as great distances as we hear by the long distance telephone.

There is, to a certain extent, an analogy in the mode of propagation of light and sound, therefore it seems rational to transmit the light rays over as great distances as we transmit the sound waves, by converting at a transmitting apparatus the rays of light into proportional electric undulations and reconvertng at the receiving apparatus the electric undulations into rays of light of proportional intensity.

But the analogy between the telephone and the telectroscope is not so close as it seems to be. Sonorous vibrations affect our nerves of hearing by differences in the number of their vibrations per second, their loudness or their character. We can easily detect a certain sound among other separate sounds, and even give a name to their harmonious groupment (what the musicians call a chord), because each sound or its harmonies vibrates one of our nerves of hearing and only this one.

Vision is the sensation produced on the nerves dispersed all around the retina by the rhythmic motion called light.

Each of the nerves can indistinctly vibrate for the different light radiations known as colors, and we have

an exact idea of them because they differ one from the other by the number of vibrations per second.

We see an object when it produces light by itself or reflects the radiations of another source of light, and we have a notion of its structure because from each point of its surface starts a ray of light affecting by its color and its relative intensity one of the nerves of the retina and only one.

Another object will affect this same nerve differently and will communicate to the cerebral matter a different impression, while on the contrary each of the nerves of hearing, similar to a resonator, always vibrates for the same sound and thus always transmits to the cerebral matter the same impression. This essential difference in the mechanism of vision and audi-

FIG. 1.

tion renders the realization of an apparatus to see at long distances more difficult than the realization in an apparatus to speak at long distance, because while we distinguish one object from another by differences in the number of vibrations and the relative position of its radiations, we differentiate one sound from another merely by the number of their vibrations per second.

However, a few attempts have been made in this fascinating field, and among them I must recall to your minds the telephoto of Prof. Bidwell. This apparatus for producing pictures or writing at a distance is an application of a property of selenium in combination with the chemical telegraph. In this telegraph a colored mark is made at a distance when current is transmitted, and *fac-simile* of the original may be produced by a series of dots and lines. A continuous current of greatly varied intensity would result in similar variations in intensity, and such a variable current is producible by changes in the resistance which may be produced by light acting upon selenium.

Mr. Shelford Bidwell made an apparatus for this

receives the line current at one terminal and that of an opposed local battery at the other, the line being also connected to the other pole of the battery and resistance so arranged that the local battery acts and makes a mark whenever a dark line is to be produced, and thus the traveling style produces either no action at all or colored lines varying in depth of tone in correspondence with the amount of light falling upon the selenium cell from the distant transmitting illuminated picture.

It is a well-known fact that the impressions made on the retina by the rays of light emitted or reflected by a body do not disappear instantaneously if an opaque body is suddenly placed between the eyes and the luminous body. This persistence of vision can be explained by the fact that, vision being caused by vibratory movements imparted to the optic nerves by the rays of light, on account of inertia these vibrations have a tendency to persist a short time after the cause that has originated them disappears.

On account of the same principle of inertia, the impressions do not take place on the retina as soon as the light rays strike it. It takes a certain time before the optical nerves vibrate synchronously with the rays of light. That is why we cannot see a body when it passes very rapidly before our eyes, and we have in optics the retardation of vision as we have in electricity the capacity and the self-induction. That is why we can see distinctly and continuously an object placed on the rear of a fly wheel turning very fast, though the spokes cover successively the different points of its surface, and it does not matter whether the object has a movement of its own or not, provided, of course, that the speed of this movement does not exceed a certain limit. Quite a number of optical instruments—rather toys—have been constructed on this principle: the taumatrope, the phenakistiscope, the kaleidoscope, so universally known that they do not need to be described.

The only difference existing between this last instrument and the Edison kinetograph lies in the fact that the pictures that in the phenakistiscope represent a different position of a body while moving are drawn by guess (so to speak), while in the Edison kinetograph they really represent a different phase of the movement, because each of them is a photograph taken in the one ninety-ninth part of a second, showing a different position occupied by a moving body. Forty of these pictures are taken in a second, and their rapid succession before the retina gives a perfect illusion of the motion.

The impression is striking, and one would vow that the picture is really moving. Consequently the kinetograph stores and reproduces the impression made on the retina by moving objects as the phonograph stores and reproduces the human voice.

I have spoken at some length about the persistence of vision because the telectroscope is partially based on this fact.

The transmitting apparatus is made of a dark box provided with lenses like a camera. At the focus, where the sensitive plate is ordinarily exposed to the action of light, is placed an open disk made of very thin and light material, mounted on a shaft. This disk is shown in part in Fig. 2. Pinholes, about $\frac{1}{100}$ of an inch in diameter, are perforated near the periphery on concentric arcs of circles, the difference between the radius of two successive arcs being $\frac{1}{100}$ inch, while the distance between two holes is equal to the width of

FIG. 2.—SEEING BY ELECTRICITY.

purpose. The transmitter is a dark box, one end containing a selenium cell forming part of the line circuit and facing a small hole at the other end; the box is mounted on an axis so as to move up and down, each upward motion corresponding to one rotation of the receiving cylinder, and so to one line on the drawing produced. The box also moves sideways at each stroke, to correspond to the distance of the lines apart. The face of the box corresponds to the screen of a magic lantern and the picture to be transmitted is thrown upon it continuously, so that the pin hole is, so to speak, an eye by which the selenium cell looks the picture over and receives impressions from each part successively as it traverses over the space filled by the picture. When a dark line is thrown on the hole the resistance increases, while a white portion reduces it. The transmitter is really a differential instrument. It

the image painted by the rays of light on the superior part of the disk.

The number of the perforations is such that the total of their diameter is equal to the height of the image. The holes being thus dispersed on the surface of the disk, and the disk revolving, the perforations traverse the surface of the picture according to different concentric lines and the rays of light pass successively through the disk when the perforations are moving past them.

The conversion of the rays of light into electric currents of proportional intensity is effected by a special selenium cell of an extreme sensitiveness acting by the influence of the heated light.

There has been considerable debate as to whether the changes in the resistance of the selenium are due to the light or to the heat. In fact, I believe as the re

* Read before the Pittsburg Electric Club.—Electricity.

sult of my own experiments that in most of the cases the increase in the intensity of the current is due to the combined action of both.

Send a beam of light through a tube containing a solution absorbing the hot rays, alum for instance, before directing it upon the selenium, and let us suppose that the beam of light falling upon the selenium has exactly the same temperature as the selenium.

The resistance decreases in a certain value or seems to decrease—but how can we admit that in the conditions of the experience the light has modified the molecular structure of the selenium? In fact, the change of resistance is apparent, and the current flowing through the circuit has a greater intensity, not on account of a diminution in the resistance of the selenium, but because the undulatory movement called light has imparted an excess of speed to the undulatory movement called electricity.

I have demonstrated that in the mechanical theory of electricity the E. M. F. expresses the speed of the undulatory movement called current.

Consequently, the excess of speed imparted by the light to the vibrating atoms of the selenium will cause an increase in the E. M. F. of the battery and therefore in the current.

I am convinced that even if a galvanometer sensitive enough could be constructed, one could possibly detect the presence of a current merely due to the action of light falling upon the selenium.

If now the hot lights act directly upon the selenium, the variations in strength of the current are much greater, but the action of heat differs from the action of light.

While the light sets up, we might say, an additional E. M. F., heat causes really a diminution of resistance due to the fact that selenium being a crystalline body, the contact between its surface and the electrode on which it is deposited is far from being perfect, and is

tacle containing a cooling mixture; the cone is closed at its base by a lens facing the disk and directed at its focus where the selenium cell is exposed, and the rays of light pass through the perforations of the disk.

By this disposition the difference in the temperature of the heated light rays and the selenium is as great as possible, and consequently the variation of the current is a maximum.

The selenium cell is made of strips of tinsel foil separated by narrow strips of dry paper—the pile is held by a clamp and its face covered by a coating of selenium, which in turn is covered by a very thin coating of lampblack.

With the apparatus thus constructed, it can be easily understood that if the disk is caused to revolve, each of the rays of light forming the picture will successively set in the line currents of varying strength. These currents act at the receiving apparatus upon a microphonic relay acting on the telephone receiver, shown in Fig. 3, modified by the addition of a narrow chamber placed between the disk and a cover hermetically closing the telephone.

One of the chambers is full of oxygen, brought in by a pipe, and the other is full of hydrogen.

On the top of the covers is tubing properly adjusted and provided with regulating valves.

The two gases are brought under pressure near the surface of a cylinder of carbonate of calcium.

The variations in the strength of the current of the microphonic relay cause pulsation of the diaphragms. But those pulsations, even if they are of a molecular nature, impart to the molecules of the gas an excess of speed, causing proportional variations in the intensity of the oxyhydrogen light. Lens and a reflector concentrate the light on a ground glass or screen after having previously passed by one of the perforations of a disk absolutely similar to the disk placed in the transmitting apparatus.

FIG. 3.—SEEING BY ELECTRICITY.

rather a microphonic contact that can be modified by expansion or contraction.

It does not seem at first possible that such modifications can take place instantaneously, but we have learned by recent discoveries how great is the sensitivity of matter to the smallest variations in the streams of radiant energy. The changes of temperature are attended with great molecular changes, modifications of structure and properties, which occur with a rapidity comparable only to the speed of light.

The reason of this lies in the fact that each molecule of matter is the center of action of many forces, a center modified instantaneously by any change of relation among those forces.

As a consequence of this, a beam of obscure heat of variable intensity must modify the resistance of the selenium, and in fact it does so, but the action is more complete if the falling beam of heat is luminous, because the heated light penetrates more deeply through the selenium, whose molecules are probably more diathermanous for the luminous rays than for the obscure rays.

Consequently the variation that will occur in the resistance of the selenium cell, upon which falls a beam of heated light, will be greatly increased if the difference between the temperatures of the selenium and the rays of light is as great as possible.

In order to obtain this result I direct the light of a projector located on the top of the apparatus toward the object whose picture is to be transmitted to a distance, and I use preferably a source of light giving very hot rays—calcium light for instance; thus the temperature of the light rays reflected by the object and directed by the lenses on the surface of the selenium is higher, and therefore the effect is increased, but in some cases it is not possible to raise the temperature of the illuminating rays above a certain limit. To remedy this inconvenience I cool the selenium cell by placing it inside a conical cavity forming part of a recep-

Then, according to the position occupied by the perforation on the surface of the disk, the beam of light passing by this point makes a more or less luminous point some place on the depolished glass.

But as the two disks are revolved synchronously by the two pulsating current motors, whose pulsations are controlled and even created by the vibrations of a tuning fork, when the light of the receiver passes through a certain perforation of the receiving disk one of the rays of light emitted by the object passes by the same perforation of the transmitting disk. If the disk turn slowly, each ray of light emitted by the different points of the object placed in the field of the transmitting apparatus is converted into an electric current of proportional intensity, which current is reconverted at the receiving apparatus into a beam of light of proportional intensity, and if a sensitive plate were substituted for the ground glass, a picture would be taken of the object placed in view of the transmitter after a complete revolution of the disk. But if the disks are revolved at a rate of ten revolutions per second, each point of the depolished glass is more or less luminous or dark ten times a second, and on account of the persistence of vision the retina is not affected by the successive disappearance of the points, which taken together reproduce exactly the object placed in view of the transmitter.

It does not matter even if this object moves or not, because the image of the receiver is constantly modified by its movements.

IMPROVEMENTS IN TOOL HOLDERS AND CUTTING TOOLS.

MR. THOMAS BLEARS, of Fremas Street, Chorlton-on-Medlock, Manchester, has designed several improvements in turning tools and tool holders, which we illustrate in the accompanying drawings from

the *Engineer*. It will be seen that the turning or planing tool consists of a circular disk, the cutting edge being formed by means of a notch or recess in the circumference, and the disk is rotated on a pin or bolt passed through it at a position out of its center. The tool holder carries the cutting tool between two jaws, where it is held in position for its work by a thrust pin acting on a part of its circumference at one side of the center, and in the disk cutting tool three holes are arranged round the center to enable the tool to be completely rotated by the thrust pin in order to utilize the whole circumference for cutting. One main object in designing this improved tool and holder has been to afford greater facilities for the economical use of tool steel of all kinds, and it varies from other similar appliances in that by the method in which the cutting disk is supported between the jaws, it is carried eccentrically, and by means of the separate holes its position can be gradually varied so that the whole of the circumference of the cutter can be utilized—the position of the cutting edge being gradually brought forward as it is worn down by use and regrinding. Another advantage of these eccentric holes is that the cutter can be raised or lowered to suit the varying centers of different lathes, and this arrangement gives it practically a range of from 8 in. to 15 in., while another and equally important advantage gained by the eccentric position in which the cutter is supported is that it cannot possibly slip from its work, the tool being held rigidly in position below the point of suspension by the thrust pin, actuated by a forcing screw, which, as already indicated, also regulates the position of the cutter in relation to its work according to the lathe, or as it is ground for sharpening. The introduction of a thrust pin for holding the cutter in position also possesses the advantage that it dispenses altogether with any packing of the tool holder in the slide rest, all that is necessary being simply to bolt down the tool holder, and after regulating the cutter

BLEARS' CIRCULAR CUTTERS AND TOOL HOLDERS.

by means of the forcing screw, the only further operation required is the tightening of the bolt support between the jaws of the tool holder. This arrangement of holder also enables two separate tools to be used simultaneously, one roughing and the other finishing at the same operation, or in heavy work two roughing tools may be used at the same time, one, of course, taking the cut slightly in advance of the other. The illustrations show the tool holder with a square stem, but when used for chasing or screw-cutting purposes the stems of the holders are made round, so that they can be canted to suit the rake of the screw to be cut. The holders can also be made with straight stems as shown, or at any angle to meet the requirements of special work, but they are so arranged that the cutters in all cases remain straight, the jaws supporting them being placed at the angle required. On the face of each cutter a fine grinding line is circumscribed as a guide for the workman in grinding up the tool to prevent it being cut away below a certain point, and the tool can be kept in use until the whole of the surface outside this fine line has been completely ground away, leaving a small disk simply diminished in size by the amount of material which has been ground away.

Among other special features that the inventor claims for these new tools is that, in addition to the economical use of the expensive tool steels, no smithing or tempering of the tools is required, and that less grinding is necessary. Test tool holders and tools made on the above design have been worked for several months at one or two engineering shops in the district, and we are informed that they have given complete satisfaction for turning, planing and shaping purposes, and have fully carried out the special advantages which Mr. Blears claims for them. Our illustrations show a plain and sectional elevation of the tool holder and cutting tool, two sections of an angle tool holder and a group of the special cutters, which, of course, can be designed to meet all varying requirements of work.