Thermopile mounted in sealed bulb, and parabolic mirror

Complete receiver for infra-red rays, consisting of six-stage amplifier, potentiometer and tikker unit, thermopile, and head 'phones

Diminutive horn which produces direct audible signals

Putting Infra-Red Rays to Work

How the French Army and Navy Make Use of Heat Rays for Invisible Signalling

By George Gaulois

A SMALL searchlight provided with a shutter mechanism for breaking up the beam of light into the dots and dashes of the Morse code; a special screen for that searchlight which permits only the invisible infra-red rays to pass on; a parabolic mirror several miles away which gathers the infra-red rays from the transmitting searchlight and concentrates them on a special heat-operated detector; a collection of vacuum-tube amplifiers, potentiometers, interrupters and other equipment—all these things blended together in the proper way make a most remarkable system of infra-red ray or invisible light signalling developed by the French during the world war.

Infra-red and ultra-violet rays are commonly termed invisible light, because they are invisible to the human eye although visible to some of the living creatures. Light rays beyond the extreme red of the spectrum are invisible to the human eye because their wave length is greater than those to which the nerves of the human eye are sensitive; or, to state the same thing in another way, because their frequency is too weak to be detected by our organs of vision. So the infra-red rays, with which we are very much concerned in the description that follows, are to all intents and purposes invisible and inaudible and hence cannot be detected by the usual means.

The principal physical action produced by infra-red rays is to heat those objects on which they fall. For that reason they are often referred to as heat rays. These rays can be reflected, refracted, absorbed, polarized and diffracted. And it is precisely these properties that have been taken advantage of in developing the French system of invisible signalling with infra-red rays, under the guidance of J. Herbert-Stevens and A. Larigaldie of the French Army.

Small portable infra-red transmitter and receiver combined, with three-stage amplifier

The new system of invisible signalling has several advantages over other existing means, just as it has several disadvantages. In truth, in military commu-

nication it fills a need that has remained untouched despite the heliograph, radio telegraph and telephone, field telegraph, semaphore, wig-wag, and so on. The infra-red telegraph system requires no connecting wires between the two stations, hence it is ready for instant operation despite its extreme portability; and it is immune to the danger of interruption due to military action. It is a wireless system, so to speak. Most important of all, this system insures absolute secrecy, which cannot be claimed for any other existing method. In military use the infra-red telegraph messages cannot be intercepted by the enemy except by the merest chance, since it is necessary first to locate the invisible beam of light, and then employ suitable apparatus to translate the rays into intelligible signals. And even if the enemy did intercept the beam, the fact immediately becomes known to the operators, and the beam can be shifted to a predetermined point so as to baffle the eavesdropper.

The transmitting end of this system consists of a source of light which is rich in infra-red radiation. A parabolic reflector concentrates both the visible and the invisible rays into a thin pencil of light which is projected in the direction of the receiving station. However, before permitting the light rays to leave the projector, they are passed through a special screen or ray filter which absorbs all the visible rays and passes only the infra-red or invisible rays. This screen consists of black manganese-dioxide glass or a colored gelatine or cellophane.

As for the actual generation of the infra-red rays, the electric arc is preferred to all other forms of illuminants because of its great volume of light. Messrs. Herbert-Stevens and Larigaldie have made numerous

(Continued on page 260)

Cross-sectional view of the diminutive horn device

Wiring diagram for an infra-red receiving station complete with three-stage amplifier

Simple receiver in which there is no amplification

"SO, BOSS," YOUNG DOUGLAS COULD BE HEARD CALLING BEFORE DAYBREAK GOLD WINTER MORNINGS

W.L. DOUGLAS BEGAN THE DAY MILKING THE COW AND ENDED IT WITH CARRYING WOOD FOR THE FIRES

W.L. DOUGLAS BEGAN SHOES AT SEVEN YEARS OF AGE

W.L. DOUGLAS '99-00 SHOE

FOR MEN AND WOMEN

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The quality of W. L. Douglas product is guaranteed by more than 40 years experience in making fine shoes. The smart styles are the leaders in the fashion centers of America. They are made in a well-equipped factory at Brockton, Mass., by the highest paid, skilled shoemakers, under the direction and supervision of experienced men, all working with an honest determination to make the best shoes for the price that money can buy. The retail prices are the same everywhere. They cost no more in San Francisco than they do in New York.

W. L. Douglas shoes are for sale by over 9000 shoe dealers besides our own stores. If your local dealer cannot supply you, take no other make. Order direct from the factory. Send for booklet telling how to order shoes by mail, postage free.

CAUTION.—Insist upon having W. L. Douglas shoes. The name and price is plainly stamped on the sole. If it has been changed or mutilated, BEWARE OF FRAUD.

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The Design and Construction of Induction Coils

By A. FREDERICK COLLINS

6 1/4 x 9 1/4 inches. Cloth. 272 pages. 159 illustrations. \$3.50; by mail, \$3.65

This work gives in minute details full practical directions for making eight different sizes of coils varying from a small one giving a 1/2-inch spark to a large one giving 12-inch sparks. The dimensions of each and every part are given and the descriptions are written in language easy comprehended.

SCIENTIFIC AMERICAN PUBLISHING CO., Woolworth Building, New York City

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The New Stromberg Carburetor meets both—to the fullest extent. On any car—under any condition—it increases production of power, of speed and of mileage.

It conserves fuel and fuel costs. Effects the greatest of economy through development of greatest fuel force, insuring a decided improvement in engine efficiency—an important increase in driving power and radical reduction in travel costs. Write for literature. State name, year and model of your machine.

Stromberg Motor Devices Co., Dept. 316, 64 E. 25th St., Chicago

New STROMBERG Does it! CARBURETOR

Wreck-Proof Safe for Ocean-Going Mail

(Continued from page 258)

it floats better in this form. The safes float on the bulkhead principal and the greatest care is taken in their manufacture to prevent any possible leakage of sea water. They are made without riveting and all joints are welded and hammered. In case of fire on board ship the safes are made to withstand a tremendous heat without melting or injury to the contents. They are really constructed of three different sheets of specially made steel, each built inside the other, giving the safes greater buoyancy and security.

When a shipwreck occurs and a safe with its precious contents is cast adrift on a stormy sea, it is by no means a helpless floating object. On the top or deck of each safe is a complete signal apparatus, which when the safe is thrown overboard and cast adrift from its cradle gets to work automatically one-half hour after the safe floats, showing a bright light every fourth minute for one minute just like a miniature light-house. But this is not all, as every ninth minute a signal horn sounds for one minute. These operations will keep up during three months, should the safe remain afloat that long without being found, while in addition to them for twelve hours after the safe leaves the ship a rocket is set off every hour.

After the postal authorities at a Dutch port have put the mail in a safe it is closed with two or more covers provided with special locks and keys. But the safety of the contents does not end here, as should the safe be cast afloat a device fastens the innermost cover so that it can only be opened by using a postal secret code. Finally every safe is provided with one separate compartment which automatically destroys all its contents should an unauthorized person attempt to open the safe. In other words the safe is as nearly a human guardian as it is possible to make an inanimate object.

So that the Dutch public may profit by the use of the floating safes special stamps have been issued by the Dutch Government. These stamps are now on sale at postoffices all over Holland, and one of them attached to a letter or package entitles it to be placed in the safe during the sea voyage.

The captain on board every ship carrying a mail safe is provided with keys to the safe and during the voyage should any of the passengers desire to place mails or valuables in the safe, they can do so by paying a small fee. All such parcels must also bear the special stamps to be purchased on board ship, and the address where the valuable are to be sent when the safe is found and opened in case of shipwreck.

How the Chinese Make Their Beautiful Enamel-work

(Continued from page 247)

takes fine strips of copper, each strip being about a sixteenth of an inch wide and about the thickness of stout paper. These he glues *edgewise* upon the black outlines of the pattern on the bronze vessel. The wire must follow the design with absolute accuracy, down to its finest detail, each curve being perfect, and each angle sharp. Infinite patience and skill are required, for it often takes months to execute an intricate design. The glue used to attach the wires to the vessel is prepared from the roots of orchids.

When the wirework is completed the whole pattern has been outlined in strips of fine copper, which form the cells, or *cloisons*, in which the pigments are afterwards placed. It is from the *cloisons* that the work takes its name—*cloisonné*-work.

Having got the wires attached, the next thing is to cover the whole surface with a kind of solder. To do this the enameller carefully brushes the vessel over with a mixture of silver filings, copper, and

borax. He places an iron ferrule around the top and bottom rims to prevent warping, encloses the whole in an iron wire cage and packs it around with charcoal. Then he fires it for about fifteen minutes, controlling the heat by the skillful use of a fan, which he holds in his hand. At the end of the firing the mixture on the outside has fused and the surface has been coated all over, perfectly, with the silver alloy.

The artisan now brushes the surface with an acid preparation made from apricots, and it is then ready for enamelling.

Working to the colored sketch, our Chinese workman, with a small iron trowel, packs the wire cells, or *cloisons*, with pigments in paste form, until each cell is filled with its appointed color. Then he fires the work again, in the same way as before, this time for about ten minutes. When the vase is taken from the charcoal fire the pigments have shrunk into the wire cells and have acquired wonderful brilliancy. But bubbles have appeared to mar the surface. The workman takes the vessel in his lap, and patiently breaks every tiny bubble with a small hammer and a sharp-pointed nail, and fills the holes with more color.

The coloring and firing process is repeated until the pigment, after firing, is level with the top of the wirework. It may have to be done as many as eight times on fine work, each time entailing the repairing process.

After the final firing the vessel is put on a lathe and polished, first with a file, then with sandstone, and finally with charcoal made from lime trees.

The finished vessel has a wonderfully brilliant surface upon which the wire pattern can be seen, clear and sharp, in the most beautiful tracery. The delicate coloring, which will last as long as the bronze itself, shows the touch of the real artist-craftsman.

The Japanese first invented the process upon metal, and the Chinese learned the art from them. However, the Chinese went one better; they found out how to do *cloisonné*-work on earthenware. And to this day they are the only people who know how. Nobody else knows how to attach the copper strips to the pottery so that they will stand firing.

Putting Infra-Red Rays to Work

(Continued from page 248)

experiments with carbon arcs in order to increase the infra-red radiations. Special incandescent lamps have been studied and experimented with in seeking suitable illuminants for the small portable sets used in field work. These lamps are of the nitrogen- or neon-filled type, in order to withstand a heavy current and give forth an intense white light. The filaments, of extra large diameter, are made in the form of a helix, so as to concentrate the rays. A current of 6 to 8 volts is employed with such lamps.

The parabolic mirrors employed in the infra-red signalling system are made of gilded bronze or silvered glass. The focal length of these reflectors is approximately half the diameter, if an arc is employed; but if an incandescent lamp is used the reflectors have an even more pronounced curve.

All the transmitting projectors are provided with quick-acting shutters which are used for chopping the rays so as to form the short and long flashes of the Morse code. Both the transmitter and the receiver are provided with a sighting tube which lies parallel to the rays of invisible light, and aids in aligning the stations for proper communication. Obviously, the two stations must always be within plain sight of each other, with no intervening obstructions.

Since the range of the transmitter is proportional to the diameter of the reflectors and the amount of light, all other things being equal, the French army has introduced various models and sizes of infra-red transmitters. The small portable transmitters, for work in the front

line and accordingly intended for very short distances only, say not over two-thirds of a mile, have a searchlight about 11 inches in diameter and operate with a 40- or 50-watt incandescent lamp. A storage battery supplies current for the incandescent lamp.

For greater distances, say one to two miles, the same projector is employed but with an arc lamp substituted for the incandescent lamp. For still longer distances, say from three to eight miles, the standard searchlights of the army and navy, measuring from 20 inches to 50 inches in diameter, are employed. The detector member is placed in front of the searchlight mirror for receiving purposes, so that the same searchlight is made to serve the dual function of transmitter and receiver.

The receiving station of the infra-red ray telegraph consists of a parabolic reflector, at the focal point of which is mounted a detector. In one system, known as the Charbonneau, the detection and reception of the infra-red ray signals is accomplished by visual means, while in the Herbert-Stevens and Larigaldie system the signals are detected by audible means.

In the visual or Charbonneau system of reception, a ribbon of paper coated with sulphur of zinc and giving forth a green phosphorescence is unrolled before a mirror. The light from a 10-volt lamp, specially filtered by means of a liquid color filter permitting only the luminous rays of high frequency to pass through, brilliantly illuminates that part of the ribbon on which it falls, and excites the phosphorescence. The infra-red waves, broken up into Morse signals at the transmitting end, are received by the mirror and concentrated on the paper ribbon, with the result that they become visible in the form of dark dots and dashes, since these rays tend to dim the phosphorescence. A special arrangement of the apparatus permits the visual means of detection to be employed even in broad daylight.

The audible method of detection is of two general kinds: First, the direct audible detector, which, while simplicity itself, does not permit of amplification and hence limits the range of the infra-red transmitter; secondly, a thermoelectric arrangement which, while quite complicated, permits of many stages of amplification and therefore the maximum range.

The direct audible detector calls for a diminutive horn connected by flexible rubber tubing to a pair of ear pieces. This diminutive horn, a cross-sectional view of which appears in the accompanying line drawings, is placed at the focal point of a parabolic mirror. The horn is provided with a window or disk of quartz, facing the mirror, while the interior is heavily coated with lamp black which, as is well known, absorbs visible and invisible rays in a most efficient manner. The operation of this detector is simply this: the infra-red rays pass through the window into the interior of the horn, where they are absorbed by the lamp black. The heat of the waves serves to heat the air confined in the horn and rubber tubing, with the result that said air expands and contracts according to the varying degree of heat. This expansion and contraction affects the ear drums. In this manner the infra-red signals are made audible and can be read by the operator. Obviously, such a detector does not readily lend itself to amplification of signals in its present form, although it has possibilities that may be worked out in the future. This detector works well for infra-red ray telephony—the telephone modification of the system—and short distances have been covered with it.

The second method worked out by Messrs. Herbert-Stevens and Larigaldie consists of an electric thermopile placed at the focal point of a parabolic reflector. The current produced by the thermopile,

as a result of the infra-red rays concentrated on it and producing heat, is broken up by a tikker or interrupter mechanism, similar to that employed in radio telegraphy for the reception of undamped waves, so as to produce a musical note of good audibility.

The thermopile in this instance presents numerous serious problems. It has to be extremely sensitive yet instantly and variably responsive; that is to say, it must have practically no electrical inertia. One of the most efficient thermopiles for this purpose consists of a metal plate 0.01 mm. thick which is sealed by autogenous fusion on the point of a crystal of great thermoelectric power. The thickness of the plate and the diameter of the point of contact are as small as possible, so as to give an arrangement of very small heat capacity. The best results have been obtained with platinum and a crystal of tellurium. A glass cell is used to contain the two elements and is provided with a fluorite window. The thermoelectric couple is connected to a valve amplifier in the manner shown in one of the accompanying line drawings, which is self-explanatory. A potentiometer is included in the circuit in order to eliminate any currents due to local conditions causing temperature variation of the junctions. The thermopile is mounted in a bulb very much after the fashion of an electric lamp, and the air is exhausted. In this manner the heat is conserved. A bayonet socket arrangement for the base of the thermopile lamp unit permits of removing and replacing a unit with little trouble.

The Heavens in March, 1920

(Continued from page 252)

above Orion in the west, and Canis Minor above Canis Major in the southwest.

The Planets

Mercury is an evening star till the 20th, and a morning star afterwards. He is best visible at the beginning of the month, when he sets at 7:15 P. M. Venus is still a morning star, rising about 5:10 A. M. in the middle of the month. Mars is approaching opposition, and rises at 10:30 P. M. on the 1st and 8:30 on the 31st.

Jupiter is in Cancer, and crosses the meridian about 9 P. M. in the middle of the month. Saturn is in Leo, and "souths" at 11 P. M. on the same date. Uranus is a morning star, too near the sun to be observable. Neptune is in Cancer, and observable in the evening.

The moon is full at 5 P. M. on the 4th, in her last quarter at 1 P. M. on the 12th, new at 6 A. M. on the 20th, and in her first quarter at 2 A. M. on the 27th. She is nearest the earth on the 24th, and farthest away on the 12th. During the month she passes near Neptune and Jupiter on the 2nd, Saturn on the 4th, Mars on the 8th, Venus and Uranus on the 18th, Mercury on the 20th, and Jupiter and Neptune once more on the 29th.

Jupiter and Neptune are in conjunction on the 29th, Neptune being 58 minutes of arc north of his great neighbor. This will afford an excellent chance for observers with small telescopes to identify the remotest of the planets.

Princeton University Observatory, Feb. 19, 1920.

What About the Old-Fashioned Winter?

(Continued from page 253)

leap between 1917 and 1919, from the coldest of all winters to the third warmest—and back again to one that lies comfortably on the cold side of the median line. Consider the decade from 1905 to 1915, when the winters might be characterized as ruling warm throughout. And against this consider the period from 1885 to 1903, in which there was but one winter that got appreciably below the grand average. All this forces us to conclude that the distribution of cold and warm winters has not changed

Lather is Doubly Effective When Shavaid is Used

As a free trial will convince

Men the nation over have welcomed this new way to shave — this quicker, easier, pleasanter way. Shavaid, the new beard-softener, ends old, harsh treatments.

MEN who use Shavaid are finding that shaving isn't so difficult as it used to be. This new and scientific beard-softener makes your daily shaving a pleasure. For it softens the beard instantly, soothes the skin.

No longer is it necessary to use hot towels nor to rub the lather in. Shavaid does away with all before-shaving preparations. Now you merely rub on a thin coat of Shavaid — then apply your favorite lather. (Shavaid is not a soap and does not lather.)

Stop using hot towels

Hot water applications before shaving can now be avoided. Hot water makes the face tender and it brings the blood to the surface at the wrong time.

Shavaid keeps the skin firm and smooth, the pores clean. You can shave closer without the usual abrasions. The razor does not pull. There is no scraping. Shavaid accomplishes instantly what old-time methods were thought to do.

You do not have to spend a lot of time rubbing the lather in. You do not need to rub the beard harshly with brush or fingers. Shavaid works better if the lather is merely spread over the face.

A delightful sensation

The instant you apply Shavaid, note the cooling effect. Note that you can shave as closely as you like and there will be no drawn, burning sensation. Shavaid makes your face feel cool and comfortable.

The daily use of Shavaid keeps your skin smooth and firm, free from the tenderness and excessive dryness which are caused by hot water and rubbing in.

And best of all, when you use Shavaid, no after-shaving lotion is required. Shavaid is in itself a soothing emollient. Its use keeps the cuticle firm, smooth and in healthy condition.

Shavaid

Softens the beard instantly

—apply to dry face before the lather.

Saves time and trouble

—no hot water, no "rubbing in" of the lather.

Protects the face

—skin remains firm and smooth.

Removes the razor "pull"

—harsh ways age the skin prematurely.

Replaces after-lotions

—Shavaid is a cooling, soothing balm.

Prove all this

By mailing us the coupon below, we will send you at once a free trial tube of Shavaid. Thus you can find out for yourself the advantages of this easier, quicker, more comfortable way of shaving. You will join the thousands who would not do without it.

After you have proved to your own satisfaction that Shavaid is a real boon you can secure it from your druggist at 50c a tube. Or, if he cannot supply you, we will be pleased to fill your order direct.

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The Biggest Cheese

THE picture that goes with this story looks as though it might be intended to represent the travels of a tiny gas-tank. As a matter of fact, however, instead of being a case of the smallest in the world, this cylindrical affair is the largest thing of its sort ever made—the largest cheese, in fact. It was made to exhibit in connection with a recent dairy show at Chicago. It is 8 feet tall, 10½ feet in diameter, and 33 feet around its circumference. It was manufactured in Appleton, Wis., and when packed for shipment to Chicago the entire bundle weighed 20 tons; the cheese itself comprised 16 tons of this total. The milk to make this huge cheese was gathered from 1,800 farms, and it is estimated that 12,000 cows contributed to it.

Its combined size and weight made the transfer of the cheese to and from the cars quite a problem. Our picture shows it being unloaded in Chicago, with the aid of nine huskies, a power-operated windlass, rollers, block and tackle, and a specially constructed inclined stage. Some statistical genius has figured that the cloth to wrap the big cheese cost \$260; and worse yet, that at the rate of one cheese sandwich per day, the lucky purchaser of this dainty bit has enough cheese to last him till the year 4721.

The Traffic Tower

VARIOUS schemes have been put forward in several of the more congested cities for safeguarding the traffic officer from the traffic which he is supposed to control. In the latest of these, now being tried out in New York, the additional advantage is secured of giving the cop a position from which he can get a much more comprehensive survey of the traffic streams bearing down upon his corner than has been possible.

Our photograph shows what the proposed traffic tower looks like. It is of much more ambitious character than the usual means proposed for raising the policeman above the general level of the street, as will be seen at a glance. In fact, it is frankly modeled after the railroad signal tower in more respects than one.

These towers are being tried out at two of New York's most desperately crowded corners—Fifth Avenue and 42nd Street, where the usual volume of traffic that will be found at the intersection of leading cross-town and up-and-down thoroughfares is vastly increased by the Fifth Avenue busses, by the proximity of the Grand Central Terminal, and by the fact that this district is at once one of hotels, of offices, and of great retail shops; and Fifth Avenue at 57th Street, the neck of the bottle for all the traffic that passes through Central Park, up and down town on Fifth Avenue, over the Queensboro Bridge, and anywhere in New York via the motor busses, nearly all of which pass this corner or, worse yet, turn there. While of course no such elaborate system is contemplated as that of the railroad signal tower, with its interlocking block signals and the numerous sidings which are ordinarily controlled from the nearest block tower, the general scheme is to be one of signal lamps, as in the case of the railroad.

The signal tower should solve all the problems of the traffic officer save one. The mere cutting off of traffic on one of two intersecting streets, to allow traffic to pass through the other, will be much more effectively cared for this way than by an officer who is half concealed amid a maze of vehicles. But the real problem of the traffic cop is the sorting out of the vehicles that want to go straight ahead from those that desire to make the turn. Those turning to the right create no problem, unless there are two or more parallel lanes of traffic in each direction and they try to turn out of one of the inner lanes and cut across the outer ones. But when it becomes necessary to take the long turn to the left on the intersecting street, the

A 16-ton cheese being unloaded from the car on which it was shipped

The latest style in traffic towers, as now being tried in New York

driver involved *must* cross the line of vehicles moving in the opposite direction along the street out of which he is turning. The officer on the pavement can hold up individual cars affected by this incident long enough to allow the turning car to thread its way through the maze; the officer in a high tower has not this advantage. Whether all the other excellent features of the tower will be sufficient to overcome this will appear after trial. An effort is to be made to overcome or at least to minimize the difficulties of the traffic signalman under this head by providing him with a third light in each direction, in addition to the two which would be employed for "Stop" and "Go." This third signal, presumably, will cut off the traffic along the two intersecting lines which must be crossed by the car making the long turn, while leaving open the lines out of which and into which he is turning. With proper cooperation on the part of the drivers, it would seem that this might work well; at any rate, it is decidedly worth a trial if there is any chance that it would make the traffic tower practicable.

Restoring Mexico's Railroads

SHORTLY after the beginning of the revolution against Huerta, in 1913, and for a long time subsequent thereto, the destruction of railroad tracks, bridges, stations, etc., became common practice in Mexico in order to hamper the movements of opposing forces. Some novel devices were employed in carrying out this destructive work, as set forth in these columns at that time. Tracks were destroyed and rebuilt over and over again, as the roads were captured and recaptured by different factions, and if destruction was rapid, so was restoration. The Mexican railroad men showed themselves experts at this sort of work, and it was a constant matter of surprise to the foreign correspondents with the Constitutionalist Army (of whom the writer was one), to see how quickly traffic was restored upon lines which had been so thoroughly ruined that nothing but some bent and twisted rails and the right-of-way were left.

The work of reconstruction proceeded as rapidly as the different portions of the country were pacified by the present authorities, and now every road in the Republic is in operation with the exception of a few unimportant branch lines, while new lines have been built in several localities, bridges reconstructed, stations erected, and all this from the net earnings of the roads themselves, without calling for a dollar of outside money.

The latest lines to be restored were in the State of Morelos, so long dominated by Zapata but entirely pacified during the past year by General Gonzales. The accompanying photographs illustrate the manner in which a good-sized bridge that had been blown up by the Zapatistas on the line from Puebla to Cuatla, was restored to its former position, repaired and put in good order for traffic, and all by the use of simple appliances. As will be seen the abutment upon or against which one of the spans rested was partially dynamited and the end of the structure dropped into the ravine beneath. It is a testimony to the good character of the masonry of this abutment that no more of it was injured than is shown. As will be noted, a gallows frame of heavy timber was erected on the abutment from which the span had been dislodged, and from this a steel cable was led to a pulley attached securely to the end of the fallen span. The cable led back to a derrick car anchored to the track at the opposite end of the bridge and passed over another pulley on the end of the derrick boom. From this it was taken to the pilot of a powerful engine and attached thereto. When everything was "all set," signals were given and the locomotive slowly and steadily raised the span to its original position on the face of the abutment. The men who planned and carried out this feat are justly proud of their accomplishment.—By G. F. Weeks.

Three phases of the engineering work of restoring a Mexican railroad bridge dynamited by rebels