MAKING THE EYE OF SCIENCE.

BY C. H. CLAUDY.

Ask a man in the street what a lens is, he will probably answer: "A piece of glass." A lens is, indeed, usually a piece of glass, unless it is made of several pieces. So is a house several pieces of wood, a locomotive many pieces of steel, and a watch a collection of wheels and springs. But the house, the locomotive, or even the watch does not require more exquisite care than the making of a lens. The mechanical error in architectural work may be measured in fractions of a foot, in locomotives in fractions of fractions of an inch, in watches in fractions of a millimeter. In lenses it is measurable in microns, and a micron is *the thousandth part of the thousandth part* of a meter.

The lens for microscopes, the lens for telescopes, the lens for cameras, for spectroscopes, for 'scopes with all sorts of prefixes, each carries its own special standard, highest of all in microscopes, in cameras, and in telescopes. Telescopic lenses, with their large size and huge cost, are more or less familiar to the reading public, but comparatively little is known of the making of the eye of the magic tube which shows what the human eye cannot see, and the eye to that other equally magic tool of science, as well as plaything of us all, which limns, in a fraction of a second, a picture more perfect than the most expert artist could draw in a lifetime.

The first step in making any kind of lens is the procuring of the glass. Optical glasses of the newer kinds cannot be made anywhere and everywhere. Practically all of it is made in Jena, Germany. To the crown and flint glass of the earlier opticians, science has added a large number of new and different kinds which have in themselves, without curvature, many different properties, different refractive indices, and, extremely important, different dispersive abilities. A lens not only refracts or bends light rays in a certain degree, depending on both curvature of surface and composition of material, but it disperses color, separates the spectrum, or refracts different colors of light differently, in a manner dependent largely on its chemical constitution.

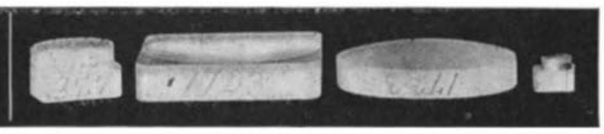
In making a microscope objective, or a telescopic lens, or the lenses for cameras, it is the great aim of the optician to eliminate color fringes about the images formed, because they interfere seriously with the accuracy of observations or the perfection of pictures.

The proper glass obtained and the curvatures determined, the next step is grinding. But it should be understood that neither the fine photographic lens, usually termed an "anastigmat," because free (over a certain area of image) from the aberration of astigmatism and its kindred ills, or the wonderfully tiny microscopic objectives, are made of one piece of glass. The mathematician who calculates the lens puts curve against curve, glass against glass, refraction against refraction, dispersion against dispersion, until one corrected element balances the under-corrections of another. It would be simple enough if the making of a lens were merely the simple grinding of one piece of glass on both sides. It is the grinding of many glasses to form one lens, and making them fit both conditions and each other, that taxes both the man and his methods. All lenses, both photographic and microscopic, are ground by hand. The glass is cemented to a tool called a "block," and pressed with an abrasive and water into a revolving metal shell of proper curvature. The shell revolves, and the block revolves, the grinder constantly changing the angle of the block, so that all parts of the glass are ground evenly. Necessarily, all such lenses are ground on the section of a sphere. They are ground three times — "rough," "second," and "fine" grindings they are called—before being polished with rouge and time and care until the last faint abrasive mark is taken out, and nothing but the high "black" polish of the perfect lens remains.

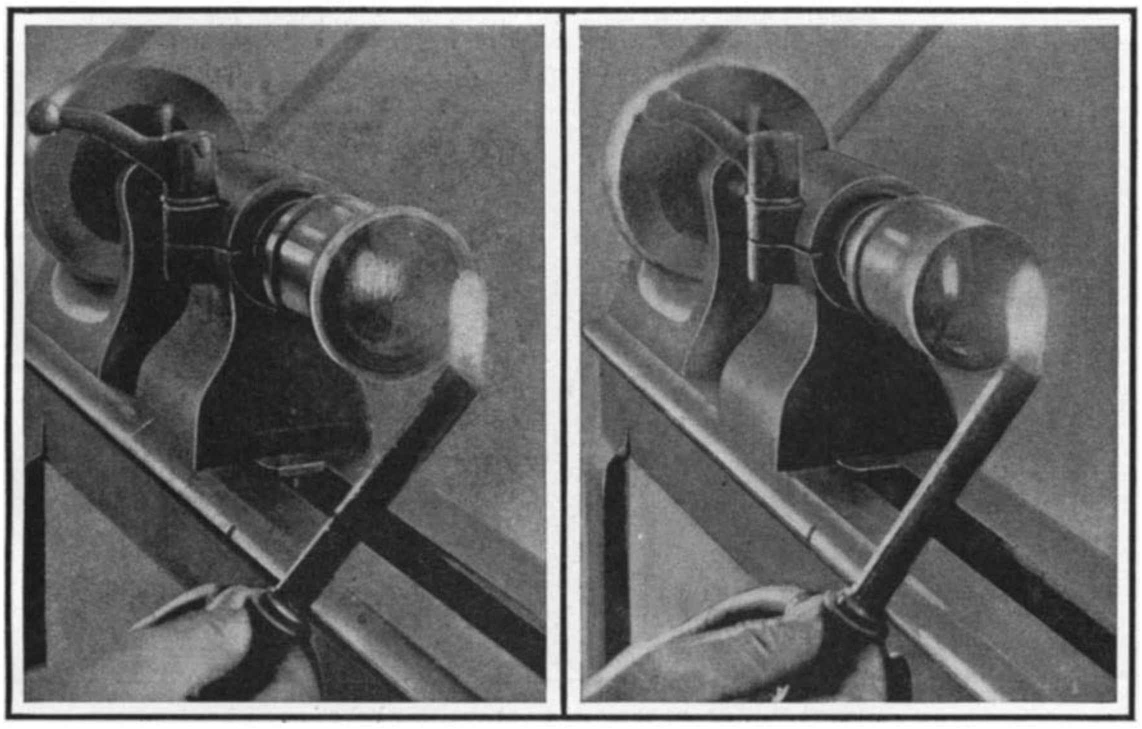
If the glass is to be a component of a fine photographic lens, it has now to undergo an ordeal. Two blocks of perfectly homogeneous optical glass have been formed to the shape of the lens element and curve to be tested. Every possible care has been taken in the making of these test glasses, and optical, refractive tests, far more delicate than any measuring engine test could possibly be, have shown them to be as absolutely perfect examples of the desired curvatures as science and art can make. So that if the element tested exactly and perfectly fits this test glass, it is, obviously,

(*Continued on page 431.*)

Elements of a one-twelfth inch microscopic objective (enlarged).

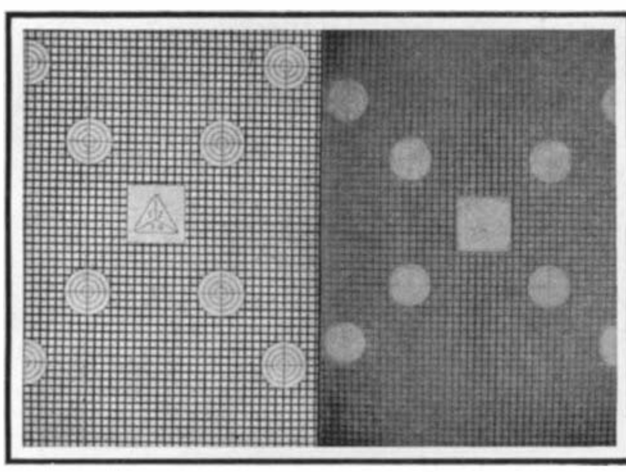


Glasses which are used for testing an anastigmat lens.

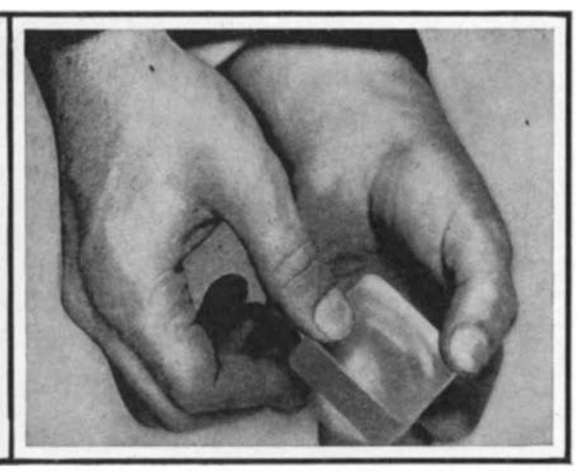


In the picture on the left the flame dances as the lens is revolved and is stationary in the picture to the right. Observe the untrimmed edges in one and the trimmed edges in the other picture.

How the elements of an anastigmat are centered.

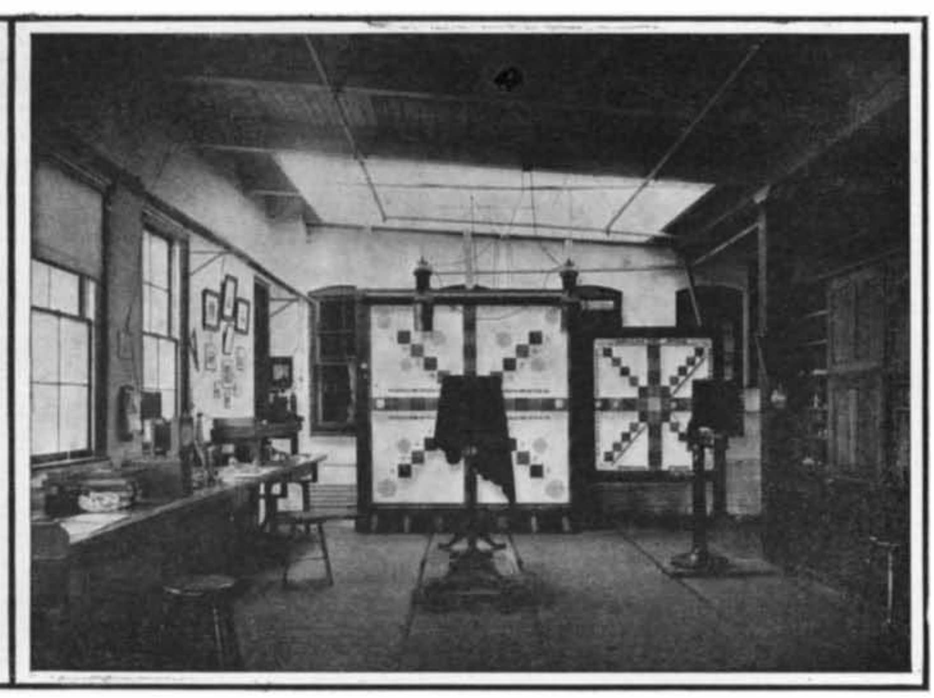


Photographs of a test chart made by a good and a poor photographic lens.



Using the test glass on an element of an anastigmat lens.

Grinding photographic lenses by hand.



Room for testing photographic objectives.

MAKING THE EYE OF SCIENCE.

different parts of a coil, since such formulas have proved a very poor reliance when applied to an actual case. Slight differences in quality of material and sizes, or in thickness of insulation may lead one astray in the rigid application of a formula. Mr. Collins has taken up each part of an induction coil by itself and has discussed its size, construction, and adaptation to the other parts in a most complete and satisfactory manner. The best proportions are given for a series of coils giving a spark of twelve inches and under. Higher than this it is not necessary to go, since one requiring more energy than can be converted by a coil giving a spark twelve inches long will use a transformer and not an induction coil. The different uses of a coil are also considered and such variations as are necessary to adapt a coil to Roentgen-ray or wireless telegraph work are given. Of course these differences are principally in the secondary winding, where will be found in separate columns the data for these two services. This is a very important advantage of this book over other books recently published upon this subject. One cannot but notice the care with which small details are worked out. The numerous cuts show every separate piece in fullness and completeness. The volume contains 160 illustrations, while a single illustration may contain as many as 21 cuts as does the one on page 101, illustrating the construction of an interrupter. The data furnished in the form of tables are quite as full. Of tables there are 122, containing the sizes and dimensions of every detail of every part of an induction coil, and also the prices of every kind of material to enter into it. It is difficult to see how any one with the slightest skill in the use of tools can fail to build a good coil under the guidance this book affords. We believe it will displace all other books upon this subject.

THE MANUAL OF STATISTICS. Stock Exchange Handbook. New York: The Manual of Statistics Company, 1909. 12mo.; 1194 pp. Price, $5.

The thirty-first annual issue deals with railroad securities, industrial securities, government securities, stock exchange quotations, mining, grain, provisions, cotton, money, bank and trust companies. It is admirably printed and the maps are clear and numerous. The information conveyed is of exactly the nature which is of almost daily request in offices where financial matters are of any moment. It should be on the desk of every railway and bank official.

THE BANKING AND CURRENCY PROBLEM IN THE UNITED STATES. By Victor Morawetz. New York: North American Review Publishing Company. 12mo.

The author of this book, Mr. Victor Morawetz, is an authority on corporations and finance. His book is chiefly concerned with solving the problem of currency shortage, which seems to confront this country at recurring periods. He advances a plan for cooperation between the banks and the Treasury, which includes a note redemption fund to be elastic, regulating the uncovered volume of notes outstanding, and thus giving stability to financial institutions generally.

THE NEW BUILDING ESTIMATOR. A Practical Guide to Estimating the Cost of Labor and Material in Building Construction, from Excavation to Finish, with Various Practical Examples of Work presented in Detail, and with Labor Figured Chiefly in Hours and Quantities. A Handbook for Architects, Builders, Contractors, Appraisers, Engineers, Superintendents, and Draftsmen. By William Arthur, Box 482, Omaha, Neb. New York: Published by David Williams Company.

Probably no task requires nicer judgment on the part of the engineer or architect than the estimation of building costs. For this reason any book which will materially help him in solving the peculiar problems which are presented to him must be welcomed. Mr. Arthur in his previous edition has demonstrated the fact that he is certainly competent to guide the estimating engineer and architect. The new edition of his book brings the prices up to date and incorporates much new tabulated matter.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending

May 25, 1909,

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

SOME NEW AMERICAN AEROPLANES.

(*Concluded from page 421.*)

plane he has made use of eight of these propellers, and has arranged them in a line between the two planes, the idea being to give a propulsive effort throughout the entire width of the machine. It has also been proven that a number of small propellers will give a greater thrust per horse-power than one or two large ones. Mr. Kimball makes use of the same motor and wire-rope drive that he employed in his helicopter; but he has improved upon this drive by installing a friction clutch between the driving drum of the motor and the driven drum carrying the wire ropes. The clutch consists of a cast-iron floating ring, and also of a leather lining in these two drums. It allows a certain amount of slipping to occur at the start, so that the propellers are not strained and broken as before. It is also set so that it will slip with a 25 per cent overload. This improvement, according to the inventor, has made a rope drive for aeroplanes entirely practicable. The wire rope used is only ⅛ of an inch in diameter, and consists of six strands, each of which contains 19 wires. The rope has a tensile strength of 2,000 pounds, while the pull to which it is actually submitted is only 80 to 90 pounds. There are two endless cables, one for each set of four propellers. They are held under proper tension by a single idler for each one. The motor makes 1,900 revolutions per minute to 1,600 of the propeller, and the cable travels at the rate of 7,500 feet per minute, or about 86 miles an hour. The propellers have four blades each. They are 3 feet 10 inches in diameter, and have a pitch of 4 feet. The thrust obtained is about 175 pounds. The motor is a four-cylinder, two-cycle engine of an improved type, the cylinders being 4 x 4. It develops 50 horse-power at 2,000 R.P.M.

The main planes of the Kimball machine are 37 feet by 6½ feet, and they are spaced 4 feet 2 inches apart. They have a very slight curve of about 1 in 26, and their angle of incidence is about 5 deg. The rear edges project out 18 inches beyond the main plane and are rather flexible. The machine is provided with movable wing tips, 4 by 4 feet in size, on the ends of both planes. There is a double-surface horizontal rudder in front, 12 by 2½ feet in size, the planes of which are spaced 3 feet apart. This rudder is located 9¾ feet in front of the main planes. It is operated by a lever convenient to the right hand of the aviator, while another lever worked by the left hand operates the two sets of four vertical rudders each, placed on the rear of the movable wing tips. This lever also operates the front wheel, in order to steer when running on the ground.

The main features of the Kimball aeroplane are the use of multiple propellers and fitting of quadruple vertical rudders close to the main planes, near their extremities. If the inventor can run his propellers at a high enough speed to obtain from 300 to 400 pounds thrust, he will probably be able to get in the air; but at the present writing he has made only one attempt, which was unsuccessful in this respect.

MAKING THE EYE OF SCIENCE.

(*Continued from page 425.*)

of the proper shape and curvature.

But, you will want to know, how does the workman know when the glass to be tested fits the test glass? It is in this "how" that the exquisite fineness of the test resides, for the beautiful phenomena of Newton's rings comes into play here. Any extremely thin and attenuated film will show diffraction colors—soap bubbles are common examples. Every child knows that the bigger the bubble, the more beautiful the colors, and the grown-up knows that the bigger the bubble, the thinner the film. When the glass to be tested is laid in the test-glass hollow, there is a thin film of air left between

(*Continued on page 432.*)

them. If this thin film of air is of even thickness throughout, the lens will be filled with a glow of color which changes as pressure may be brought to bear on the lens, thus thinning the film of air. If this glow is but one color and with no colorless patches, it is evident that the lens fits the glass perfectly; if the color is in bands or rings, or if more than one color shows, it is equally evident that the lens does not fit over all its surface, and consequently is not accurately ground and polished. This is the most delicate test known to science for equality of surfaces, and, if properly done, is absolutely reliable.

Microscopic objectives are tested in other ways. A 1/12-inch objective possesses a front element so small as to be seen with difficulty. It is actually 1/7 millimeter in diameter. This is too minute to admit of using the color test. These tiny lenses are ground by workmen of whom there are hardly ten in the world—men who have spent their lives over the tiny lathes and shells which grind hemispheres of glass of such exceeding smallness as this. It is more by feeling and intuition than by examination with magnifiers that they know when such lenses are true and perfect to their shells, but it is the fine optical and visual test on a diatom of fine markings and infinitely small size, such as *Amphipleura pellucida* or *Pleurosigma angulatum*, which determines their degree of perfection.

When all the elements of a fine anastigmatic photographic lens are ground, they have then to be cemented together, if it is a cemented lens, and, most important of operations, trimmed so that the optical center and the mechanical center of the several individual elements coincide. While the clear Canada balsam cement is yet "green," the glasses are revolved on a lathe, and the workman observes in them a reflection of a light source—in the illustration, a burning gas-jet held in the hand. When the optical centers of the lenses do not correspond with the center of revolution or mechanical center, the reflected image dances. The cement is softened with heat and, by pushing on the edges of the revolving lenses, the operator makes them move against each other until the flame is reflected perfectly, and remains absolutely stationary while the lens revolves. When this condition is obtained the cement is allowed to harden, and the edges of the lenses are trimmed away with a diamond cutter.

The several lenses which compose a fine microscopic objective are not only centered and trimmed, but mounted, on one lathe and by one man, who also makes the mounting. This departure from the modern factory practice of "one man, one job," has been found necessary because no two lathes, be they ever so accurately made, revolve in exactly the same way, and if a lens be trimmed by one lathe and mounted in brass cells made on another lathe, the mechanical and optical centers will not align perfectly.

A 1/12-inch microscpoic objective is a collection of lens elements, the magnifying power of which is equivalent to a single lens of 1/12-inch focus or about 120 diameters. Its working distance, i. e., the distance the front element has to be from the object viewed, may be slightly greater or less than 1/12 inch. With an eyepiece of ½-inch focus, such a lens will give a magnification in the microscope of 2,400 diameters, or 5,760,000 times. In other words, if a diatom could be enlarged in wax as much bigger than the original as the image of it is greater than it is itself, by such an equipment as is described above, it would hold on its surface 5,760,000 diatoms.

It is obvious that any error in the making of such a lens is magnified equally with the object. If the lenses are in the least degree decentered, the amount of error is magnified according

(Concluded on page 433).

Chair seat, infant's portable high, F. L. Riddle 923,078
Check, baggage, etc., T. G. Portmore 922,948
Chilling machine, N. H. Hiller 922,898
Chuck, drill, G. Garretson 923,041
Chuck, rock drill, E. E. McKinney, Jr. 922,716
Churn, J. R. Holder 922,699
Churn, F. A. Miller 922,796
Cigarette, T. T. Hutchinson 922,481
Clock winding mechanism, E. E. Yaxley 922,550
Closure fitting, C. C. Puffer 922,508
Clothes rack, foldable, McIlvain & Key 922,803
Coal puncher or mining machine, electric, J. H. Thompson 922,736
Coin delivery machine, E. J. Brandt 923,013
Collar fastener, S. G. Eghan 922,682
Collar, horse, J. D. Whipple 922,988
Collecting and folding machine, H. M. Barber, reissue 12,958
Columns, base stand for porch, G. Royse 922,517
Combustion engine, O. Lietzenmayer 923,054
Concrete column, E. V. Johnson 922,910
Concrete mixer, M. J. Demorest 922,860
Concrete mold, W. H. Alexander 922,997
Conveyer and leer-charging device, J. McDermott 922,941
Coop or crate, folding, J. P. Mahoney 922,606
Core for hollow castings, J. K. Dimmick 922,678
Cotton picker, R. S. Wheeler 922,647
Counting machine, R. Buerk 922,663
Counting train, Sprague & Hookham 922,537
Cream ripener, J. T. Hanna 923,047
Cross tie, metallic, F. R. Slockett 922,968
Cuff fastener, J. H. H. Henderson 922,476
Cultivator shovel, W. J. Herscher 922,584
Curling iron, M. R. Prudhomme 922,949
Currency tray, W. A. Conway 922,751
Current motor, J. Messina 922,935
Curtain fixture, J. W. Kummer 923,050
Curve scriber, J. Gill 922,575
Cutting and conveying mechanism, S. M. Langston 922,918
Cutting off apparatus, Meeker & Carr 922,795
Cyanids and cyanamids, production of, Bosch & Mittasch 923,012
Cycles and other vehicles, power transmission mechanism for motor, G. W. Sherman 922,634
Damper regulator, T. E. McKenna 922,614
Dauber and polisher attachment for receptacles, H. J. Lyon 922,496
Decorticating fibrous plants, transportable apparatus for, E. A. J. Duchemin 922,865
Dental floss holder, T. A. Tubbs 922,824
Derrick, portable field, A. N. Hadley, reissue 12,960
Dies, making, J. M. Lynch 922,926
Dish or plate, A. Lust 922,495
Dish washer, C. Carstens 922,455
Display bin, F. F. Wear 922,738
Display box, F. G. Merritt 922,498
Display can, sheet metal, J. Xavier. 922,831, 922,832
Distillate burner, C. H. Schoff 922,522
Ditching and grading machines, deflector for, W. H. Morenus 923,064
Doffer, A. A. Vardell 922,545
Door lock, G. H. Day 922,675
Door operating appliance, F. Shoemaker 922,530
Door securing means, A. Cotton 922,460
Doors, guide bracket for edgewise movable, T. Mull 922,612
Drawing and spinning machines, wire board cleaner for, Nichols & Himes 922,806
Drawing table, H. Cole 922,565
Drill operating attachment, A. Belanger 922,558
Drum and cymbal playing apparatus, W. F. Ludwig 922,706
Drying mechanism, R. E. Valentine 923,092
Duplicating apparatus, stencil, A. B. Dick 922,862
Elastic materials, testing the tensile strength of, L. Schopper 922,524
Elastic webbing, S. Kops, reissue 12,962
Electric circuits, protective device for, A. C. Eastwood 922,464
Electric cut-out, T. E. Murray 922,801
Electric fixtures, attaching device for, L. A. Parrish 922,623
Electric furnace, Chaplet & Remond 923,018
Electric machine, dynamo, B. A. Behrend 922,839
Electric machine, dynamo, C. E. Lord 922,924
Electric machine, dynamo, W. D. Pomeroy 922,946
Electric switch, C. R. Beebe 922,746
Electric switch, Schweitzer & Herz 923,129
Electric terminal, G. C. Landis 922,917
Electrical circuit breaker, safety, W. F. Wocher, et al. 922,654
Electrical connector, G. E. Palmer 923,071
Electrode, battery, C. B. Schoenmehl 922,726
Electrode support, battery, C. B. Schoenmehl 922,727
Electrode support, battery, Schoenmehl & Krause 922,728, 922,729
Electrode support, battery, C. B. Schoenmehl 922,730
Electrolier bracket, I. Levinson 922,490
Elevator, J. P. O'Donnell 922,620
Elevator or mine cages, safety device for, G. S. Burgan 922,452
Elevator safety attachment, J. E. Barber 923,105
Elevator safety device, H. Martineau 922,607
Elevator systems, indicator for automatic, A. H. Buckelew 922,849
Ellipsograph, C. P. Brickey 922,560
Endoscope, R. H. Wappler 922,985
Engine ignition system, internal combustion, M. B. Crist 922,673
Engines, cut-out attachment for internal combustion, Sheibley & Moller 922,528
Engines, electric igniter for explosive, E. Westman 922,987
Envelop, H. F. Kruger 922,600
Envelop, A. E. Harker 922,891
Envelop fastener, N. L. Merrick 922,934
Expansion bolt, self-locking, Vernon & Morningstar 922,980
Explosive engine, R. Nessler 923,069
Explosive engine, compound, S. A. Reeve 922,509
Extensible bracket, C. B. Corbin 922,566
Eyeglass mounting, H. G. Roskind 923,080
Eyeglass nose grip, T. E. Carpenter 922,853
Fabric, L. Puryear 922,811
Fabrics, forming woven pile, J. K. Dalkranian 923,026
Fare register, L. Ehrlich 922,867, 922,868
Fastening inserting machine, Bates & Gamble 922,447
Faucet index, J. H. Glauber 922,576
Feed regulator, G. D. Scheiffler 922,725
Feeding water to flash boilers, automatic regulating means for, J. D. MacLachan. 922,790
Fertilizing material, making, J. W. Lowman 922,494
Fire alarm telegraph apparatus, F. W. Cole. 923,114
Fire apparatus, L. H. Overly 922,622
Fire extinguisher, chemical, G. W. Rankin 923,076
Firearms, especially for recoil loading firearms, magazine arrangement for, P. Manser 922,497
Firearms, rebounding hammer for, F. C. Chadwick 923,113
Firing and fuse-regulating mechanism, combined, Fritsch & Springer 922,877
Fish and animal catching hook, W. Gabrielson 922,879
Fish lure, C. M. Wilcox 923,095
Flange union, S. J. Davis 922,755
Flooring jack, J. W. Marsh 922,930
Flower stand, folding, F. C. Tedesco 923,089
Flue base, integral, E. P. Meredith 922,714
Flue scraper, W. Appenbrink 922,999
Flying apparatus, P. F. Degn 922,756
Flying machine, G. W. Thompson 922,972
Flying machine launching apparatus, J. Means .... 922,710 to 922,712
Flying machine launching device, J. Means. 922,713
Foot rest for chairs, swings, etc., W. & B. Zabel 922,994
Form, presser, J. M. Stein 922,734
Form, shoulder presser, J. M. Stein 922,735
Frangible protecting device, F. W. Cole 923,115
Fuel system, double tank, H. Lemp 922,604
Fume arrester, Rockliff & Booth 922,516
Fumigator, J. Hauck 922,582
Fuse adjusting device, R. H. Quisling 922,813
Game, G. H. Parker 922,717
Game board, D. W. Heydon 922,897
Garment rack, F. Wolf 922,991
Garment shoulder pressing device, J. M. Stein 922,733
Garment supporter clasp, R. A. Moore 922,799
Gas bags or the like, apparatus for ascertaining the buoyancy of, S. D. Wheeler. 922,648
Gas burner, F. & R. Park 922,502
Gas burner, E. L. White 922,989
Gas burner safety attachment, G. H. Jennings 922,770

to the magnification of the object seen. It is essential, therefore, that the mounting be absolutely accurate, a condition satisfied by using the same lathe for both making the mount and trimming the lenses of the objective.

A photographic lens of high quality must pass tests of great difficulty and searching power. It is put in a camera and tried out on an accurate chart, and must "cover" a certain area of this chart at a certain distance, while rendering the image perfectly flat and without distortion. Uncorrected photographic lenses have a great many aberrations—curvature of the field, spherical aberration, coma, flare, astigmatism, curvilinear distortion, chromatic aberration; and a good photographic lens must be without these, or it fails to pass its tests. In the optical factory in which the illustrations for this article were made, every photographic lens is provided with a ticket, and on this chart the expert lens examiners put down a check mark against every fault or aberration of the lens under examination. A perfect lens, such as is marketed, shows on its chart nothing more damaging than the presence of a few minute air bubbles, impossible to avoid in the special optical glass which is used in the production of "anastigmats." These air bubbles, often giving great concern to purchasers who do not understand their harmlessness, do nothing more damaging than to decrease the light-passing capacity of the lens by a percentage equal to the percentage their area is to the area of the lens—a small fraction of one per cent.

In addition to testing out for optical aberrations, the tester hunts for striæ, streaks in the glass, for strains, for improper centering, for imperfections of cementing, for poor mounting, for defects in the glass not classified, as scratches and marred places, so that, when a lens has finally passed the inspector, it is a perfect specimen so far as human ingenuity can make it.

Microscopic objectives, on the work of any one of which may depend not only the success of scientific experiments and the obtaining of new knowledge in a hundred branches, but even human lives, are the subject of the most minute care in testing. An unskilled observer may find it difficult to distinguish between the image made by a poor and a good one-twelfth, but the scientist who uses it, and equally with him the trained man who examines it before its is put in stock, has no difficulty in finding out from the severe test objects whether it will properly "resolve" the fine markings on a diatom, whether it has "color fringes" or not, whether its field is flat or not.

Lens calculated, glass selected, shells and blocks carefully machined, glass ground once, twice, and again, lens elements tested, repolished or ground if necessary, centered, mounted, again tested, charted, and reinspected, the glass eyes of the microscope and the camera, twin eyes of science and the two most important tools in the laboratory, go from the factory all over the world to the laboratories where are made a large per cent of all the discoveries in science of all kinds, but particularly in the natural sciences and in all those departments of human knowledge which have to do with the body and with health and the cure of disease. And all the work done in these laboratories depends in the first instance on a little bit of glass, a mathematical formula, and the precision with which the glass can be made to fit the x^2n^2 of the master optician.

Testing Ancient Bronzes.

Old objects of bronze and copper are usually covered with thick layers of oxide which make it impossible to recognize the true character of the metal or alloy. The removal of this highly valued patina is not generally allowable, and the metallic surface that may be exposed at sharp

(*Concluded on page 435.*)

Gas engine, E. J. Gulick	923,046
Gas extractor and mine ventilator, G. Laws	922,603
Gas machines, interlocking device for, L. H. Miller	923,063
Gas, manufacturing, W. H. Cone	922,857
Gasolene engine, H. J. Wegner	923,093
Gate, Z. T. Cox	922,461
Gate opener, F. A. Schuster	922,963
Gearing, G. Westinghouse	922,827
Gearing, reversible transmission, M. W. Kouns	922,599
Gearing, speed change, Garvin & McClellan	922,880
Glass drawing machine, L. A. Thornburg	922,973
Gluing textile fabrics, machine for, Schroder & Seldal	922,962
Golf ball, E. Kempshall	922,773
Governor, W. Fox	922,689
Grading attachment for vehicles, road, W. S. Livengood	922,493
Grain bin dump distributer, J. R. Pattinson	922,344
Grain mill signaling attachment, B. B. & J. W. Spratlin	922,821
Grain sprouting or germinating apparatus, A. W. Grunwaldt	922,888
Gramophone, L. T. Haile	923,119
Gripper attachment, J. R. Grove	922,762
Grubbing and root breaking machine, D. M. Gates	922,572
Gun, portable, O. Lauber	923,052
Gun, recoil, Lauber & Bominghaus	923,051
Hammer attachment, D. M. Eddy	922,568
Hanger. See Bedstead rail hanger.	
Harness suspending means, J. Howard	922,904
Harrow or cultivator, J. Courtenay	922,671
Harvester, potato, L. Kniffen	922,915
Harvesters, apparatus for straightening grain upon, D. H. Simmons	923,084
Hat brim curling machine, C. E. Sackett	922,959
Hay fork, A. A. Parish	923,072
Headlight, R. H. Welles	922,826
Heating device, Perelzveich & Rosenbusch	922,503
Heating device, orchard, R. Henry	922,478
Heating plant, room, B. Korting	922,783
Heating storage water, system of, J. L. Curran	923,025
Heddle making machine, C. B. Borgeson	923,011
Heel and protector therefor, boot, J. W. Baddock	922,555
Heel, shoe, M. Molitor	922,499
Hinge, D. W. Lenahan	922,605
Hinge, C. W. Ellerbe	923,037
Hinge, post, W. S. Emery	923,038
Hoisting and conveying apparatus, A. E. Norris	922,807
Hoisting apparatus, H. Aumund	922,554
Hoisting apparatus, W. F. Murray	922,937
Hoisting apparatus, C. Conklin	923,022
Hoop lug and connection, J. T. Hogan	922,767
Horn, cam operated, M. R. Hutchison	923,049
Horn or alarm, mechanically actuated diaphragm, M. R. Hutchison	923,122
Horse detacher, J. G. Miller	922,797
Horse detaching device, M. F. Sadler	922,518
Horseshoe, G. Marshall	923,060
Hose coupling, gas, C. Sautter	923,081
Hose pipe coupling end connection, Nelson & Brown	922,805
Hot-air engine, E. M. Fraser	922,875
Hub clutch gear, vehicle, B. Settergren	922,965
Igniter timing device, J. G. Heaslet	922,764
Indicator, H. D. Flegel	922,466
Inkstand, W. Rodiger	922,957
Insulating joint, A. F. Batchelder	922,556
Insulator, electric line, R. Henry	922,477
Insulator, third rail, L. M. Randolph	922,951
Internal combustion engine, C. D. McClintock	922,613
Internal combustion engine, T. D. Kelly	922,911
Ironing board, S. A. Barber	922,446
Ironing board, H. F. Knorr	922,487
Ironing board, G. F. & C. I. Wilson	923,097
Ironing table, folding, C. A. Detwiler	923,117
Irrigator having a constant temperature, E. de N. du Plantier	922,810
Jam dolly, A. Ricketts	922,514
Knob spindle compensator, W. S. Trask	923,091
Labeling machine, F. W. Wild, Jr.	923,096
Labeling machine, bottle, G. A. Thornbill	922,974
Labels to garments, etc., attaching, M. Mayer	922,608
Ladder, H. B. Fuller	922,878
Ladder, trussed, A. P. Boyer	922,847
Lamp, electric arc, L. O. Kozar	923,127
Lamp, gas, A. H. Humphrey	922,907
Lamp, mercury or other vapor electric, Kent & Lacell	923,124
Lantern, Koch & Mayforth	922,598
Latch, door, E. H. Todt	922,975
Latch, gate, B. H. Hannemann	922,889
Lathe, self-feeding scratch brush, J. H. Goss	922,761
Lemon squeezer, J. A. Bennett	922,449
Lens for building lights, F. Schwickart	922,964
Letter box, H. C. Giles	922,574
Level, H. A. Schatz	922,960
Lifting jack, A. M. Colt	922,856
Lightning arrester, E. E. F. Creighton	923,024
Liquid elevator, J. P. Buchanan	922,749
Liquid raising means, H. P. W. Esping	922,870
Liquids, apparatus for controlling the flow of, A. Priestman	922,629
Loading and unloading mechanism, G. Davis	923,028
Lock alarm, J. Newman	922,616
Loom, W. C. Perry	922,718
Loom thread parting mechanism, A. E. Rhoades	922,511
Looms, weft-feeler for automatic weft-replenishing, W. R. Stitt	922,539
Lumber handling apparatus, C. E. Cleveland	922,854
Magnetic separation, W. B. Moore	922,800
Mail bag delivery apparatus, G. A. Mains	922,707
Mail bag exchange apparatus, C. W. Burke, et al	922,665
Mail receiving and delivering apparatus, automatic, H. H. Hunter	922,701
Maize cars, utilization of, F. L. Stewart	922,822
Mangling roller, F. W. Lauterbach	922,488
Manhole frame and cover, combination, D. A. Harrington	922,892
Manure spreader, W. I. Wiedemeyer	922,830
Mashing machine, A. R. Keller	922,486
Match box, G. Gleasure	922,472
Match safe and cigar cutter, combined, D. C. Flanigan	922,570
Match safe and lighter, J. G. & A. L. Portteus	922,507
Measuring and indicating device, H. J. Marx	922,931
Mechanical movement, R. J. Forman	922,467
Mechanical movement, O. H. Slafter	922,532
Metal construction, W. P. Lawrence	922,919
Metallic linings, making seamless, Burr & Gibbs	922,851
Metronome, White & Hunter	923,094
Milk container, G. W. Maxwell	923,061
Milking machine, O. Mortensen	923,065
Mill. See Pulverizing or grinding mill.	
Mincing machine knife, A. Gomory	922,884
Miter box, W. H. Eastman	922,680
Mixtures, apparatus for obtaining intimate, E. Dor-Delattre	922,863
Mortar mixer, G. D. Scheiffler	922,724
Motor control system, H. F. Stratton	922,540
Motors, short circuiting device for electric, C. A. Schnur	922,521
Mower attachment, S. E. Staal	922,970
Muffler cut out mechanism, L. S. Chadwick	922,563
Music holder, R. W. Mills	922,610
Music roll container, L. Haas	922,695
Music sheet turner, Shaw & Yost	922,527
Music instrument, stringed, A. S. Leslie	922,921
Needle lubricating device, J. B. Hadaway	922,696
Needle and the like, holder for, F. W. Hawkes	922,893
Nozzle, G. L. Burden	922,664
Nozzle, H. B. Helm	922,895
Nuisance, device for preventing dog, A. H. Roberts	922,956
Nut and bolt, self-locking, M. Jacobs	922,482
Nut lock, S. Truston	922,543
Nut lock, L. T. Twyman	922,642
Nut lock, R. F. Ross	922,721
Nut lock, R. Scherer	923,082
Oil can, T. W. Alexander	922,996
Oil switch, H. L. Van Valkenburg	922,825
Ore pulverizer, Good & McCullough	922,577
Ore treating furnace, C. C. Medberry	922,609
Ore volatilizing, revolving, H. H. Hughes	922,906
Ores, treating nickel, A. G. Betts	923,005
Oven, camp, W. H. Hart, reissue	12,961
Packing box, G. Cerf	923,017
Packing for elastic fluid turbines, shaft, K. Ahlquist	922,551

points and edges is too small to afford the desired indications. Two German investigators, having found that pure copper and bronzes containing various proportions of tin give characteristic streaks when rubbed on a touchstone, have devised a method of determining approximately the composition of any bronze object by comparing its streak with those made by a series of bronze bars of known composition. In practice, four such bars are found sufficient. The four bars are rubbed on the touchstone (Lydian slate or polished biscuit ware) and by the side of the four marks a fifth is made with a point or edge of the object under investigation. Pure copper gives a pure red streak, but a tinge of yellow is added by as little as 1 per cent of tin.

Chemical analyses of prehistoric bronze show percentages of tin ranging from 1.5 to 30, but very few specimens contain less than 6 or more than 12 per cent of tin. Silver, lead, antimony, arsenic, bismuth, nickel, and cobalt occur only in traces, and the proportion of iron is also very small in most cases. It is a remarkable fact that nearly all prehistoric bronzes are very nearly or quite free from zinc, of which many modern bronzes contain as much as 10 per cent.—Umschau.

America's Heavy Fire Loss.

At the forty-third annual meeting of the National Board of Fire Underwriters, held in New York city May 13th, President J. Montgomery Hare made an address, in which he stated that a comparison with statistics of losses in foreign countries shows that the loss per capita in the United States is from 10 to 30 times greater than in the principal European cities. For the last five years, he said, the annual fire loss in this country has averaged $269,200,412, the total for the period being $1,346,022,059, or about three-quarters of a million for each day of the five years. In this period the figures were largely increased by the San Francisco conflagration, but even taking the two years since then the losses have kept well above the $200,000,000 mark.

Without counting losses from forest fires, the destruction of property in 1907 by fire totaled $250,084,709, and in 1908, $217,885,850. The figures for this year give no promise of improvement, President Hare said, having reached a total of nearly $53,000,000 for the first three months.

According to dispatches from Atlanta, nothing which has been suggested for the benefit of the South since the war has aroused such unanimous enthusiasm as the proposed highway from New York to Atlanta. Whereas the suggestion originated with automobile users, it is obvious that any scheme for the promotion of good roads through country districts remote from railroads must directly benefit agricultural and other large communities largely dependent upon highways for transportation. Three alternative routes have been suggested, all of which follow the same course from New York to Philadelphia. Two routes thence to Washington are identical, whence one lies through Rapidan, Charlottesville, Lynchburg, Danville, Greensboro, and Salisbury, where it joins the third route and reaches Atlanta *via* Charlotte, Blackburg, Spartansburg, Hartwell, and Winder; while the other goes through Richmond, Petersburg, Raleigh, Columbia, S. C., and Royton to Winder. The third route leaves Philadelphia westward to Harrisburg, thence down the Cumberland and Shenandoah valleys to Harper's Ferry and Lexington, crossing the mountains to Martinsburg and Salisbury and continuing as above. The New York Herald and Atlanta Journal have offered prizes for the best sections of road in the various districts, and an endurance test for automobiles is projected, with the object of comparing the results on different routes, the ultimate decision as to the highway route being dependent upon the local road conditions achieved by local authorities.

Skirt marker, Wells & Meek 922,740
Skirt marker, J. D'Elia 923,029
Slack adjuster, automatic, C. O. Anderson. 922,552
Sleeve, splicing, H. Frankel 922,690
Slicing machine, bread, G. A. Kinder 923,125
Sliding gate, W. W. Wasden 922,548
Slip coupling, E. J. Gulick 923,043
Smoke consuming furnace, P. J. Flanagan .. 922,871
Snap hook, W. Gronke 922,473
Soap holder, liquid, H. W. Burgner 922,453
Socket fastener, E. L. Miller 922,936
Soy or sauce substitute, manufacturing, K. Okazaki 923,070
Speculum, C. H. Borden 922,845
Speed adjuster, L. R. Culver 922,674
Speed controller, W. J. Seitz 922,525
Spindle, J. N. Kelsea 922,912
Spoke, T. H. Walbridge 922,737
Spring wheel, E. B. Anderson 922,658
Spring winding tool, A. Worcester 922,656
Sprinkler system, automatic, J. P. Casey .. 922,456
Stadia reading apparatus, E. J. Young 922,833
Stalk cutter, raspberry and similar, M. B. Sherman 922,529
Station indicator, H. C. Wallace 922,984
Steam generator, H. Ritchie 922,817
Steam generator and heater, F. L. Dutcher. 923,034
Stencil machine, G. Remnsnider 922,815
Stoves, lamps, etc., attachment for gas, W. A. Caldwell, Jr. 922,666
Strain resisting mechanism, G. H. Forsyth. 923,040
Strainer for lubricating systems, C. H. Worsey 922,657
Stream motor, R. Wilson 922,652
Stream motor, P. J. Hansen 922,890
Street cleaning machine, F. B. Dickason ... 922,677
Suit case attachment, T. Cosgrove 922,567
Sulfocyanids, manufacture of, K. M. Chance 922,564
Surgical device, C. E. Eckrode 923,118
Swing attachment, M. R. Grant 922,886
Switch. See Electric switch.
Tabulating mechanism, S. J. Quincy 922,812
Tag or check, A. S. Rheaume 922,510
Talking machine stand and horn, combined, H. C. Miller, reissue 12,963
Tank heater and feed cooker, J. S. Christensen 922,457
Tank indicator, liquid fuel, S. H. Peckham 923,073
Target trap, S. A. Huntley 922,588
Teazling cloth, etc., device for, S. Grimson 922,887
Telegraph, printing, I. Kitsee 922,781
Telegraph transmitter, T. J. Dunn 923,033
Telegraphy, T. B. Dixon 922,462
Telephone system, A. H. Dyson 923,035
Telescope for indicating ships' oscillations, sighting, H. C. Mustin 922,938
Telescope, hinged double, E. Donitz 922,679
Theatrical effects, means for producing, A. F. Salle 922,722
Thermoplastic keratin composition, B. B. Goldsmith 922,692
Threshing machine feeder, J. H. Schlenter .. 922,520
Threshing machine separator, R. McLaughlin 922,615
Ticket, railway, R. A. Smith 922,818
Ties, means for securing splice bars to, M. F. Bonzano 923,007
Time recorder, A. P. Schmucker 922,633
Tire cover, spare, H. Cohen 922,669
Tire, pneumatic, F. Reddaway 922,631
Tire protector, E. J. Weidner 922,739
Tire tool, J. A. Swinehart 922,541
Tire, vehicle, A. M. MacFarland 923,059
Tire, wheel, A. R. Bangs 923,104
Tool, hand, A. G. Lamb 922,602
Toy, L. W. King 922,775
Toy spinner, W. Bohn 922,842
Toy vehicle, H. T. Kingsbury 922,914
Toy, wheeled, J. B. Spencer 922,639
Trace fastener, B. F. Woodhouse 922,992
Train or vehicle, electric, J. L. Creveling .. 922,752
Transportation system, elevated, A. E. Brock 922,662
Trowel, J. W. Denton 922,676
Truck, car, C. S. Shallenberger 922,966, 922,967
Truck, railway, A. M. Clark 922,750
Tube forming machine, L. C. Smith 922,536
Turbine, elastic fluid, Hanzlik & Hellmer .. 922,581
Turbines, nozzle for elastic fluid, J. G. Callan 922,562
Turn table, H. M. Verplanck 922,643
Type bar, justified, F. H. Richards 922,632
Type ribbon handling device, E. C. Magnus 922,927
Typewriting and calculating machine, combined, H. D. Bolton 922,559
Typewriting machine, G. C. Carhart 923,016
Typewriting machine, O. Woodward 923,099
Typewriting machine, E. E. Barney 923,106
Typewriting machine, F. W. Hillard. 923,120, 923,121
Typewriting machines, decimal spacing mechanism for, Laganke & Smith 922,601
Typewriting machines, variable carriage feed for, J. A. Smith 922,534
Umbrella, folding, A. Loukota 922,925
Valve, C. F. Fernald 922,686
Valve, W. C. Westaway 922,986
Valve, automatic shut off, A. T. Gries 922,578
Valve, gate, A. P. Smith 922,636
Valve lock, L. Toback 923,090
Vamp trimming machine, J. B. Hadaway ... 922,697
Varnish gum and producing same, J. J. Kessler 922,596
Vehicle brake operating mechanism, motor, P. Krause 922,916
Vehicle exhaust dissipating apparatus, motor, G. E. Whitney 922,741
Vehicle for hospital and other purposes, W. F. Bernstein 922,841
Vehicle front or platform gear, J. Erret .. 922,869
Vehicle spring, L. C. Burnet 922,454
Vehicle spring, E. L. Barton 923,107
Vehicle steering and turning device, J. M. Eadie 922,757
Vehicle wheel, E. S. Kintz 922,597
Vehicles, device for automatically stopping, S. H. Cluxton 923,020
Velocipede, R. V. Jones 922,484
Veneering drying apparatus, G. M. Walker .. 922,983
Vessel hull construction, E. S. Hough 922,907
Vibrating screen or separator, Bell & Sturtevant 923,108
Vise, bench, P. F. Wray 923,098
Voltage controller, multiple, E. W. Stull ... 922,823
Voting machine, B. F. Eilerman, et al. ... 922,683
Wagon brace, dump, P. H. Soentgen 922,969
Wagon jack, G. W. Harris 922,474
Wagon seat, A. A. Vik 922,546
Washer. See Dish washer.
Washer or button feeding attachment for setting machines, E. B. Stimpson 922,640
Washing machine, A. Hofmann 922,900
Washing machine, G. R. Adams 923,101
Watch, A. Pfister 922,809
Water closet seat, W. S. Emery 923,039
Water glass, White & Hof 922,829
Watering device, stock, G. E. Odell 922,943
Watering tank, stock, A. N. Eaton 922,681
Wax extracting apparatus, Smith & Waterhouse 922,637
Weather strip, C. B. Ford 922,873
Welding, electric, M. Lachman 923,128
Welding of aluminium, flux for the autogenous, M. U. Schoop 922,523
Wheel, G. M. Badger 923,001
Winding and cleaning silk and other fibers, apparatus for, E. Dubini 923,032
Winding machine guide motion, quill, E. E. Bradley 922,848
Window fastening device, L. H. Vogel 922,644
Window lock, J. E. Hissong 922,899
Window pane fastener, J. B. La Venture ... 922,785
Wire bed bottom, woven, G. Boehm 923,006
Wire drawing, plate stand for, P. Vanderauwera 922,979
Wire gripper, J. H. Reece 922,814
Woven fabric, T. Taylor 922,641
Wrench, Bean & Baldwin 923,103

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

Canadian Patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., 361 Broadway, New York.

SEALED PROPOSALS.

SEALED PROPOSALS will be received at the office of the Light-House Engineer, Tompkinsville, N. Y., until 1 o'clock P. M., June 28, 1909, and then opened, for furnishing materials and labor of all kinds necessary for the construction and delivery of a light-house at Staten Island Rear Range Light-Station, Ambrose Channel, New York, in accordance with specifications, copies of which, with blank proposals and other information, may be had upon application to the Light-House Engineer, Tompkinsville, N. Y.