The Demand for Electrical Engineers.

BY FREDERICK H. FORD.

In a recent issue of a technical paper, devoted to the interests of electricity, there appeared an article, copied from the New York Sun, in regard to the demand for educated engineers. The writer made the statement that, in his opinion, the field of electrical engineering offered more promise of wealth and fame than "law, the grocery business, writing, or knife grinding."

Although no editorial comment was made upon the article, its appearance in a technical paper would give added weight to the opinions of its writer in the mind of a young man making a choice of occupations.

A great mistake is being made in continually holding up the profession of the electrical engineer as one offering almost unlimited possibilities in the matter of salaries and demand for men. This mistake is most frequently made by persons who probably really know nothing whatever of the subject, and who are of the class who are continually making the statement that "electricity is in its infancy; and the laws which control its working are but little understood."

The aim of the present article is not to question the value of a technical education for the electrical engineer, but to give some facts in regard to the demand for young men with such an education.

At the present time there are probably not more than half a dozen entirely distinct companies in the country that would be able to furnish the entire electrical equipment for a plant for light or power of more than 500 horse power capacity. In these large works the design and planning of both plants and machinery is under the immediate charge of two or three electricians who have a thorough understanding of the practical requirements of their work, as well as the theories which govern it. The ideas which they furnish are carried out by the draughtsman in an almost purely automatic manner by the use of tables and slide rule. In the shop the work is carried on from working drawings, and no special knowledge of electricity is required. When the machines are tested for efficiency or other qualities, the work is done according to some scheme worked out by the chief electrician, and the results are worked out by means of formulæ selected by him to fit the case in hand. In many cases the persons making the test know nothing of the reasons for what they do. In the smaller factories the apparatus is often designed by some outside engineer. It is turned out from working drawings, and no attempt is made to test the machines in any way. Often there is no one in the factory who can, with justice, lay claim to the title of electrician.

In the central station for power and light we find the same conditions. The aim of the supply companies has been to turn out machines of the utmost simplicity of design and construction. To such a degree of perfection has this been carried that all parts of a machine liable to injury or wear are made interchangeable, and it only requires a fairly good mechanic to make what repairs are needed. The work of keeping the machinery running is a matter of such simplicity that almost any mechanic is thought equal to the task after a few months' experience.

The capital invested in the electrical industries of the country is largely in the form of stock companies. The larger companies have been gradually absorbing the smaller ones, and have united among themselves. This has lessened the demand for educated electricians, the executive departments of the companies uniting having been combined into one department. The closing of many large works owing to financial trouble or patent litigation has also thrown a large number of men having both experience and ability on the market, thus causing the supply of engineers to be in excess of the demand. The struggle for place caused by this state of affairs has forced down the wages to such an extent that the average engineer will not receive a better salary than the head bookkeeper of a large wholesale concern.

The statement that for the average young man the field of electrical engineering offers more promise of success than "law, authorship, the grocery business, or knife grinding," may be questioned.

He will be obliged to spend at least six years in preparation before he will be able to earn enough to barely pay his expenses, and during the greater part of this time he will be paying out money instead of earning it. The same time spent in preparation for either law or medicine would qualify him for beginning practice, while the time spent in business or journalism should find him in a good position. In the law or medicine he is working for himself, and he reaps the benefit of whatever success he may have. The young engineer will in most cases not have the capital needed to start in business for himself, and is forced to accept a subordinate position with some company.

Here he will get but a part of the profit coming from any success on his part, the greater share going to his employer, while he will suffer for his failures as much as if he were working for himself.

The young man choosing electrical engineering as a profession must do so with the understanding that he will have to work hard and long, and for wages which are not large in relation to the work done. For the young man who loves engineering enough to work for engineering, and not for wealth, there is as good a field in electrical work as in any branch of engineering. The idea that there are positions with large salaries attached waiting to be filled by him is a mistake. There are but few large salaried positions at best, and they are filled by men having large experience and influence with the capitalists back of the company.

The demand in electricity at the present time is not for educated electricians, but for educated capitalists; for men who will see that it is better to hire men who know why things should be done, and who will look after economy in the output, rather than to hire cheap men and waste the salary of a good man in inefficient methods of working.

When capital has been so educated, then and not until then will the relation between work done and pay received by the engineer compare favorably with that of the lawyer, the doctor, the writer and the merchant.—The Electrical World.

A Magnetized Governor.

The Electrical Engineer states that an engine and dynamo, direct coupled, were started and worked in a satisfactory manner. After a time, however, complaints were received of unsatisfactory regulation. From the character of these complaints it was concluded that there might be some defect in the governor, and the maker incurred the expense of sending a complete new governor, requesting that the old one should be returned. The new governor was placed, adjusted, and the plant started, and the report came back that the regulation was perfect. In the course of a week or ten days complaints were again made of unsatisfactory regulation. It then occurred to the engine builders that possibly the governor was affected by magnetism. They conferred with the makers of the dynamo, and were told that in their judgment such could not possibly be the case. The governor wheel, it should be stated, was on the far side of the engine. It has since been ascertained that a monkey wrench is held fast to the rim of the governor wheel when the engine is under full speed; the speed of the periphery of the wheel being about 5,400 feet per minute. When the engine is in service the magnetic attraction is sufficiently strong to pull a man standing at the front or crank end with a wrench held out within two feet into the engine. Any magnetic substance, such as iron or steel, if placed on the throttle valve wheel, is held firmly. The distance between the center of the dynamo and the eccentric is about 48 inches.

RECENTLY PATENTED INVENTIONS.

Engineering.

LOCOMOTIVE.—Melbern B. Bulla, Yuma, Arizona. In this engine the connecting side bars for the main and rear drive wheels, and the counterweights of the latter, are dispensed with, so that it is not liable to roll at a high speed or move on a hard pull, and will run smoothly at any speed. It is a compound engine, and has friction wheels between adjacent drivers below their centers, the arrangement being such that when live steam is admitted to the steam chest of the high pressure cylinder the friction wheels are moved into firm frictional contact with the faces of the front and rear drive wheels, and move out of such contact when the steam is shut off from the high pressure cylinders.

LOCOMOTIVE WATER ELEVATOR.—George P. Glenn, Jacksonville, Fla. This invention furnishes an apparatus for utilizing steam and compressed air, together or separately, to actuate pneumatic water elevators, providing also a coupling device to connect the pneumatic pipes, the apparatus consisting of a suitable valved steam or air pipe carried by the locomotive and tender, and an air pipe carried by the movable joint of the water supply pipe, and furnished with a coupling device for automatically forming a connection with the pipe carried by the tender. Where locomotives are not provided with pneumatic air pumps, steam alone may be used for raising the water.

ROTARY VALVE.—Brainerd W. Smith, Delphos, Ohio. This valve mechanism comprises two segmental valve seats in the steam chest, with ports leading to the cylinder ports, the cylindrical valves turning in the seats, each having a cavity to connect the interior of the steam chest with the corresponding cylinder port and the latter with the exhaust chamber. Lugs connected by a link project from the valves, a valve stem pivotally connecting with one of the valves, and the stem having a head adapted to engage with its top surface the under face of the steam chest cover, the head also having rearward extensions traveling on a rib forming part of the bridge for the valve body. The valve is quick acting, requires but little power to operate it, and without strain on the valve gear.

FLUE CLEANER.—Joseph Bott, Leadville, Col. This device comprises a scraper forming a piston, and adapted to be propelled forward by steam or other fluid under pressure, a revoluble drum driven by such pressure being connected with the scraper to return it in the flue. The casing has an open end adapted for engagement with the flue, and an exhaust opening, and the piston is preferably made of two disks between which is clamped a rubber or leather disk fitting snugly in the flue and adapted to yield on rough places in the flue.

Electrical.

ELECTRIC CABLEWAY.—Richard Lamb, New York City. This inventor has devised a mechanism to convey logs from the interior of a forest, move other heavy bodies or propel canal boats, etc. The invention consists in supporting a motor-carrying car on a cable, effecting tractional friction between the car and hauling cable, and combining with the propelling trolley a log-carrying trolley on the supporting cable and connected with the propelling trolley. The latter is provided with a counterweight or balance to maintain it in a practically vertical position, and also has a seat for the motorman.

Railway Appliances.

CAR COUPLING.—Frank R. Bischoff, New Castle, and John C. Baird, Cheyenne, Wyoming. This is a knuckle coupler so made that by the movement of a single lever the locking device will be removed from the path of the knuckle and the latter will be swung to one side. The pivoted knuckle has a rear portion extending transversely beyond one side of the drawhead, and carries a latch or lock bar, with a device for elevating the latch and engaging the projecting portion of the knuckle to move it sidewise. The coupling has but few parts, all of which may be made very strong. By beveling an outer portion of the vertical wall of the drawhead recess the knuckle may be rocked to either side, and thus provide for coupling upon curves or for ample room between cars when rounding curves.

SWITCH AND SWITCH SHIFTER.—Robert E. Brackelsberg and Lewis Graff, Mankato, Minn. In switches for street railways this inventor has devised an improvement of simple and durable construction whereby the switch may be automatically shifted from an approaching car. The invention consists of a frame adapted to be lowered on the car, and a shifting block sliding transversely on the frame to engage and shift the switch mechanism.

LEVELING TRACKS.—Hiram H. Sponenburg, Wadsworth, Ill. This is an improvement upon the surfacing board set crosswise upon the rails and supported by loose blocks, to determine the proper adjustment in raising or lowering railroad tracks, and the invention provides for the employment of a target or measuring board supported by a slotted post or standard, a rail clamp to which the post is secured, and two sight boards or blocks adapted to be set upon a rail, and one of them clamped to it.

Mechanical.

CUTTING MACHINE.—Frank J. Richards, Needles, Cal. This is a machine more especially designed for use on boilers, to conveniently cut off stay bolts at any desired distance from the plate, and the machine has a revoluble spindle with a head in which cutters slide radially, while a longitudinally sliding sleeve engages the inclined backs of the cutters to fit the latter to the work. The sliding motion of the sleeve and the feeding of the cutters are readily regulated according to the work, and the cutting tools may be easily removed and replaced.

NAIL DRIVING IMPLEMENT.—Leonhardt Kornder, Uffenheim, Germany. This tool comprises an essentially cylindrical tube having at one end opposing longitudinal slots into which project pivoted spring-controlled grippers, there being an exterior handle end to each gripper, while a plunger slides in the tube. The implement facilitates the driving of nails in places difficult of access, and it may be elongated by additional screwed parts for driving nails at a little distance away.

GYRATORY ROCK CRUSHER.—Samuel C. McLanahan, Hollidaysburg, Pa. According to this invention a vertical shaft is suspended from a bearing at the top, and has below it a conical crushing hub operating in a crusher chamber, while at its lower end it is held in an eccentric bearing rotated by a beveled gear to give a gyratory motion to the lower end of the shaft and a corresponding motion of less degree to the conical hub in the crusher chamber. The invention provides improved means of suspending the haft, bracing and strengthening the crushing chamber at its upper edge, and closing the joints between the shaft and the stationary parts of the machine.

MACHINE FOR FORMING STOVEPIPE JOINTS.—Josiah E. Smiley, Smiley, Ohio. This machine comprises a frame with a fixed mandrel having a female die on its upper face, a vertically movable mandrel with male dies on its upper and lower faces, a bed plate having a female die on its upper face, plungers vertically movable over the mandrels having female die members, and lever mechanism for operating the plungers. The machine is especially designed to quickly and accurately form joint sections of a special character for which a patent has been applied for by the same inventor.

SOLDERING MACHINE.—Charles L. Olmstead, Big Timber, Montana. This is a simple machine by which solder may be economically applied to the seams of roofing tin or seams of tin employed to cover large surfaces. A suitable melting receptacle forms a portion of the machine, which is guided upon the seam, acid being applied to the seam in advance of the application of the solder, and a smoothing iron following the solder receptacle, insuring the solder being conveniently applied to and set upon the seam, the work being done very quickly and inexpensively.

MACHINE TO HEAD AND CRIMP CANS.—John W. Green, Portland, Oregon. This machine has a support to hold and clamp the can body temporarily in place, a revoluble carrier so holding the cover that its center will coincide with the center of rotation to turn the cover upon the open end of the can body, while a revoluble crimping disk is adapted to exteriorly press the cover flange on the can body and rotate both the body support and the cover carrier to firmly crimp the cover in place and seal the can body and its contents. The operation is continuously carried on as long as the main driving shaft is rotated, the operator placing a filled can body on the body support and a cover in the cover feed, and the sealed can being delivered in a chute at the side of the machine, the various mechanisms being timed to automatically carry out the entire work.

Miscellaneous.

VULCANIZER.—Edmond H. Casgrain, Quebec, Canada. This is an improvement in hand vulcanizers for vulcanizing small articles, the pot having an outer cover and a cover plate within the pot top carrying a mould-carrying yoke. A vertical stem on the cover plate is encircled by a sleeve threaded to fit in the cover, there being a guide plug at the upper end of the stem through which a screw spindle extends downward through the stem and cover plate. The vulcanizer is strongly made, the cover and mould may be very quickly adjusted and hermetically sealed, and the mould compressed to any desired extent after it has been sufficiently heated.

DOOR CHECK.—Patrick McMahon, Whitestone, N. Y. This is a door guard and bolt designed as a substitute for a chain bolt and to afford a greater degree of safety, the construction being such that the bolt may be readily disengaged from the guard when the door is closed, although it cannot possibly be disconnected from the guard when the two have been attached and the door is opened. The device is simple, strong and inexpensive, and in connection with it may be employed a dead latch which cannot be forced open beyond a limited distance by any one outside the door.

INVALID BED OR COUCH.—Richard V. W. Wicks, Brooklyn, N. Y. According to this improvement, one lying on the bed or couch may, with but slight exertion, elevate or depress the head section, holding it fixed at any desired point between the horizontal and vertical. The mattress automatically adjusts itself to the position of the central portion of the body, and a support is automatically provided for the legs at the thighs and knees. A cool and simple head rest or pillow is also provided which is capable of adjustment laterally and vertically.

LAWN SPRINKLER.—Alexander Burt, Dunedin, New Zealand. This sprinkler will give a jet of a cyclonic character, or a single fine jet, as may be desired, and it may be used in the same manner as the plain nozzle of a hose, or be employed for spraying trees or shrubs with a chemical fluid or insecticide. It may be used either single or double and the water or other fluid may be cut off in a very simple and convenient manner.

PROPELLING GARDEN IMPLEMENTS, ETC.—Hampden Wilson, Crockett, Texas. This inventor provides an improved harness to be comfortably worn by a male or female to facilitate the propelling of garden implements or machines, whereby all the power employed will be most advantageously applied without unduly fatiguing, but will rather be beneficial to the operator, who will be impelled to continuously keep an upright position, favorable to lung expansion. The harness is so made as to suit people of different stature, leaving the hands of the operator free to guide the machine, which

may be a lawn mower, a wheelbarrow, a garden cultivator, a rake, etc.

WOODEN STOPPLES.—Randolph F. Radebaugh, Tacoma, Washington. This invention provides a simple, practical and inexpensive process of and apparatus for treating bottle stopples and bungs in a large way, to remove their resinous and gummy matters by means of a strong alkaline solution, they being then subjected to steam or hot water to remove the alkali, and treated with glycerine to soften and maintain their moist and flexible condition, being finally filled with paraffine or wax to render them impervious to liquids.

BURIAL CASKET HANDLE.—Lyman E. Woodard, Owosso, Mich. Novel hinge joints are provided by this inventor for connection with wooden caskets and wooden escutcheons that are ornamental bases for the arms of drop handles. The joints are adapted to receive the weight strain and transfer it to the clamped connections of the hinges with the walls of the casket, thus avoiding undue pressure on the escutcheons and affording strong and direct connections for the handles with the casket.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

The 1895 edition of the annual directory volume published by the Shoe and Leather Reporter has been issued. Great pains are taken to make this one of the most complete of any of the trade directories published, and it covers a very large field, including manufacturers of and dealers in boots and shoes, leather, findings, harness, hides, wool, furs, machinery, and about all the commodities pertaining to the shoe and leather industry in the United States and Canada, besides names of leading houses in the trade in other parts of the world. The volume has over 700 pages, and the first fifty pages are allotted to facts and statistics of special importance from a trade point of view.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(6453) D. R. asks: 1. Can the field magnets of the motor described in "Experimental Science" be made of cast iron and wound with No. 16 wire, the same as if made of Russian iron? A. Yes. 2. I have the armature of the motor completed, but find that it will not rest in any position; how may I fix it? A. Possibly you can balance it by lead. It may not be sufficiently out of balance to do any harm. 3. If the motor were used as a dynamo, how many volts and amperes would it develop, and if run as a motor how many volts are required to run it, battery power? A. It is not adapted for use as a dynamo. It runs with about 7 volts and 5 to 10 amperes. 4. What acid or acids are used in a copper plating bath to give the bright effect, using blue vitriol? A. Various baths are used; the practice is often adopted of removing the partly plated articles and scratch-brushing, and then replacing in the bath. No bright copper bath is given in the manuals.

(6454) R. L. H. asks: 1. Will you please tell me which of the following conditions determine the number of volts and which the number of amperes generated in dynamo: a. The weight of iron in the field magnet. b. The number of turns of wire on field magnet. c. The number of turns of wire on armature. d. Size of wire used. e. The speed at which the dynamo is run. A. A definite division cannot be made. In general a and d are ampereage dimensions, and the others are voltage dimensions; but all are interconnected. 2. Will old iron that is slightly rusty do as well for the field magnet of a small dynamo as new? A. Yes, except that the rust unless shellacked or removed invites and produces further corrosion of parts. 3. How can I convert the dynamo in SUPPLEMENT, No. 161, into a machine generating a large quantity but of low E. M. F.? What is the quantity and E. M. F. thus obtained? A. Wind with wire of larger diameter. We advise you not to attempt it. We have no data on the subject. 4. What kind of cotton thread is suitable for insulating magnet wire? A. Any kind will answer. 5. Why is shellac used on the coils of electrical apparatus? A. To protect from moisture. 6. Supposing two bars of iron, each one foot long and wrapped with the same number of turns of wire, the first being 1 inch thick and the second 2 inches, which would be the stronger magnet? A. Other things being equal, the thick one will be far the stronger.

(6455) C. R. S. writes: I have six Leclanche cells of battery for ringing door bells and lighting gas; they don't work any more. I broke one open, found what appeared to be gray iron and carbon chip. What is the material, and can I wash it and use it over again, or will soaking a few days in hot water and then drying them again do any good? A. You cannot. By pouring a strong solution of potassium permanganate into the porous cup without emptying it you may effect an improvement. The best plan is to get new cups. They are charged with manganese binoxide and carbon or graphite.

(6456) J. N. M. asks: 1. If soft annealed steel wire will work as the core of the armature of the motor described in No. 641. A. It is almost impossible to get iron wire here, as steel has taken its place in the manufacture of tube, plate, and wire work. 2. Will a laminated core of No. 16 sheet of the dimensions of the wire core answer as well as the wire? A. We answer both questions affirmatively—use the steel wire or the laminated sheet armature.

(6457) W. W. writes: I wish to put an eight or ten 16 candle power dynamo in a room 40 feet long; would it have any effect on watch movements in the same room, but at the opposite end, some 20 feet from dynamo? What size wire would it require for 100 light dynamo, 16 candle power each, to make a circuit of about five or six hundred yards? Also what horse power engine would it require to run the 100 light incandescent dynamo? A. Our best advice to you is not to put the dynamo in the same room with your watch movements. For one hundred 16 candle power 110 volt lamps use No. 5 wire for original leads, reducing in size as lamps are taken off it. Allow 10 horse power to run it.

(6458) B. F. asks: 1. In winding the secondary wire of an induction coil in sections how thick should the sections be? A. The thinner the better; half an inch is very good practice. 2. How thick should the rubber washers be to insulate the sections. The coil is to be 8 inches long, with ⅞ inch core. A. ⅛ to ⅙ inch. 3. Have you any publication of the SCIENTIFIC AMERICAN or SUPPLEMENT in which induction coils are described? I have SUPPLEMENT, Nos. 160 and 229. A. See our SUPPLEMENT, Nos. 74, 166, and SCIENTIFIC AMERICAN, Nos. 10 and 14, vol. 66. We have no special information as to the battery named.

(6459) F. A. R. asks: By what preparation or means may I electrically insulate the surface of copper by a thin coating of some kind, like a varnish or oxide, so as to resist the passage of a current of about 15 amperes, and that will stand a heat of about 1000° C. without melting or being dissociated, or lessening its insulating quality materially? A. You must have the copper enameled. This will effect the object if the enamel is of high enough melting point. There will be trouble in getting such.

(6460) A. L. H. asks the reason for having and the action of the permanent magnet in alternating current bells, polarized bells. A. If the armature were not polarized, both ends would be equally attracted, whatever the direction of the current might be. By polarizing the armature so that both ends are of one polarity and the center is of opposite polarity each end is attracted by a pole respectively or is repelled thereby according to the direction of the current. This gives the rocking motion with an alternating current, which causes the ringing. See Poole's "Telephone Handbook," $1 by mail.

(6461) Bristletail or Silver Fish.—Mr. H. M. Webster, of Providence, R. I., inquires about a little creature called in that neighborhood the "slick," about ½ inch in length, which runs like "a streak." He finds them in different parts of his house, especially in the bath tub. He also inquires whether they originated from some hickory or white oak which has been stored in the cellar for some three years. He mentions also that his house is always warm and dry. The animal is undoubtedly one of the bristletails or silver fish, and, in all probability, Lepisma saccharina, which is very commonly found on book bindings and in clothing, though it also sometimes injures silks and other fabrics. This particular species is almost uniformly silvery gray in color. Lepisma domestica is a white, hairy species, spotted with black, and is more often found in dry places, and this may be the species your correspondent alludes to. Both these agile creatures have long setiform antennæ, six legs near the anterior portion of the body, and three long anal stylets. The use of pyrethrum powder, if fresh, will be the most effective means of repelling these insects. They have no particular connection with the wood stored in the cellar, and do no harm beyond that already mentioned.—Answered by Professor C. V. Riley.

(6462) C. S. asks: 1. Is rain water filtered through 4 inch brick wall (as in ordinary cistern construction) quite fit for drinking purposes? Is it as good as "hard" driven well water? Also, d scribe simple tests for hardness of water. A. Such rain water should be perfectly good, and probably safer than well water. Test for hardness with soap, seeing how much of a standard solution of soap in rain water has to be added to the sample to produce a lather. 2. Does typhoid fever always result from germs in drinking water, and can germs be filtered out or destroyed by distillation? A. Not necessarily; distillation would make the water safe. 3. Does electricity cure rheumatism, and if so, is it by dissolving crystallized uric acid, which accumulates at the seat of pain, and in this case what becomes of the acid? Will it not appear again elsewhere, and perhaps cause other more serious trouble? A. Any cure effected we would attribute to action on the nervous system. You take too much for granted in your statement of cause. 4. Is ordinary arc lamp carbon at all good for telephone purposes? A. Yes. 5. Could I carbonize hard coal (anthracite) by bringing it to a white heat in a closed vessel, and must it be packed in charcoal during process? A. It would have little effect on it. It should be protected from the air during the process. The charcoal is not necessary if this is done. 6. What determines the ampere hour capacity of storage batteries? A. Trial and experiment. 7. Have you SUPPLEMENTS on "Zinc Plating by the Dipping Process, on a Commercial Scale"? If not, can you furnish book on the subject, and what price? Also have you SUPPLEMENTS or book on "Simple Yet Efficient Alternating Motor Construction"? A. For articles on galvanizing, see SUPPLEMENT, Nos. 265, 833, 851, 911, 912, and 994. Articles on alternating current, motors, 601, 692, 717, 763 and 944.

(6463) T. F. C. asks: 1. Why does not a gravity battery polarize? A. Because the negative plate has no hydrogen set free on its surface. Copper is deposited there, and this is its own material. 2. What is the chemistry of bread making? A. The sugar of the mixture undergoes vinous fermentation, and the carbon dioxide set free makes the bread light. 3. What reactions take place in the explosion of gunpowder? A. They are very complicated. In general the carbon is oxidized to carbon dioxide and the sulphur to sulphur oxides at the expense of the oxygen of the potassium nitrate. 4. How is the weight of a lever eliminated? A. By making both sides of equal moment.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

March 19, 1895,

AND EACH BEARING THAT DATE.

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