



# LIBRARIES

UNIVERSITY OF WISCONSIN-MADISON

## The Wisconsin engineer. Vol. 1, No. 4 April 1897

Madison, Wisconsin: Wisconsin Engineering Journal Association,  
[s.d.]

<https://digital.library.wisc.edu/1711.dl/7P3DBZ6M5SIJV8I>

<http://rightsstatements.org/vocab/InC/1.0/>

The libraries provide public access to a wide range of material, including online exhibits, digitized collections, archival finding aids, our catalog, online articles, and a growing range of materials in many media.

When possible, we provide rights information in catalog records, finding aids, and other metadata that accompanies collections or items. However, it is always the user's obligation to evaluate copyright and rights issues in light of their own use.

*Prof. Meek*

# The Wisconsin Engineer.

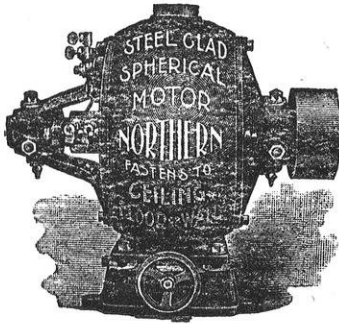


THE CYLINDRICAL COTTON BALE, MAGNUS SWENSON.	441
INTERNAL COMBUSTION ENGINES, C. W. HART and C. H. PARR.	452
COMPENSATION FOR PROFESSIONAL SERVICES, ALLAN D. CONOVER.	457
ONE OF MANY, CHARLES ISAAC KING.	465
NOTES ON THE USE AND TESTING OF HYDRAULIC CEMENTS, H. P. BOARDMAN.	471
AN OASIS, LEONARD S. SMITH.	479
EDITORIAL NOTES,	484
INDEX TO ENGINEERING LITERATURE,	485
ALUMNI NOTES,	496
LOCAL NEWS,	500
NEW PUBLICATIONS,	504
INDEX TO ADVERTISERS,	520

Published Quarterly by The University of Wisconsin Engineering Journal Association.  
Madison, Wisconsin.

DEMOCRAT PRINTING CO., MADISON.

# The Northern Electrical Mfg. Co.



MADISON, WIS.,

MANUFACTURERS OF

## MOTORS AND DYNAMOS.

SHOPS COMMODIOUS,  
MODERN and FULLY EQUIPPED  
FOR QUICK WORK.

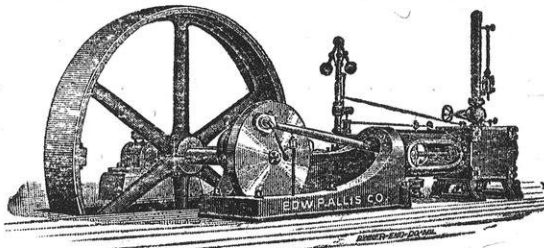
Tests and Estimates Made on Electrical Equipment  
of Shops and Factories.

**Motors Direct Connected to Machines a Specialty.**

The U. S. Government has adopted the Northern Dynamotors for use in New Library of Congress Building on account of novelty of design, superior construction, and high efficiency.

We make the only electric motor that will operate **inverted, suspended overhead to ceiling or bolted direct to side wall** as readily as if occupying **floor space.** Buy a Northern and Save all floor space.

## THE EDWARD P. ALLIS COMPANY, MILWAUKEE, WIS.



MANUFACTURERS OF

Blowing Engines, Hoisting Engines, Pumping Engines, Air Compressors,  
Special Engines for Electric Lighting, Street Railways and Rolling Mills,  
Ore Crushers, Crushing Rolls, Stamp Mills, Concentrators, General Mining,  
Milling and Smelting Machinery. \* \* \* \* \*

**Reynolds Patent Vertical Boilers, \* Reynolds Corliss Engines.**

NEW YORK: Room 1111, 26 Cortland St.

SAN FRANCISCO: 9 Fremont St.

MINNEAPOLIS: 416 Corn Exchange.

PITTSBURG: Room 702, German Nat. Bank Bldg.

CHICAGO: Room 509, Home Insurance Bldg.

SALT LAKE CITY: Desert Bank Bldg.

KANSAS CITY: Armour Bldg.

DENVER: 427, 17th St.

Please mention Wisconsin Engineer when you write.

# The Wisconsin Engineer.

PUBLISHED QUARTERLY BY THE STUDENTS OF

THE COLLEGE OF ENGINEERING, UNIVERSITY OF WISCONSIN.

---

---

Vol. 1.

Madison, Wis., April, 1897.

No. 4.

---

---

## BOARD OF EDITORS:

W. F. MACGREGOR, '97, *Editor-in-Chief*.

BUDD FRANKENFIELD, '95, E. E., *Graduate Editor*.

LLEWELLYN OWEN, '97, *Index Editor*.

A. E. BROENNIMAN, '97.

JOHN KREMERS, '98.

H. C. SCHNEIDER, '98.

W. G. SLOAN, '99.

T. A. GERLACH, '98.

H. J. PEELE, '99.

E. E. SANDS, '00.

P. F. BROWN, '97, *Business Manager*.

R. D. JENNE, '98, *Ass't Business Manager*.

---

---

PRICE PER YEAR, \$1.50.

SINGLE COPIES, 50 CTS.

[Entered in the Post Office at Madison, Wis., as matter of the second class.]

---

---

## THE CYLINDRICAL COTTON BALE.

By MAGNUS SWENSON, B. M. E. '80, M. S. '82.

When the first shipment of American Cotton, consisting of six bags, left the harbor of Charleston, S. C., about a century and a half ago, little did the shipper dream that he was the pioneer of an industry that was destined to reach the colossal proportions of the cotton industry of today. The United States now produces about 9,500,000 bales annually; fully three fourths the entire cotton crop of the world. Its annual value averages about three hundred and fifty million dollars, and it stands first on the list of our exports. There is probably no industry, however, that from a mechanical point of view has received so little attention as that of preparing the great southern staple for the market, and the crude, careless and wasteful methods employed with this extremely valuable product, almost surpass belief. The cotton as brought from the field consists of two thirds seed and one third lint. These are separated from each other by

the process of ginning. Cotton ginning is almost entirely confined to small gin houses scattered all through the cotton region. These houses are of the most primitive character. Much of the ginning is still done by mule power, and the gins in use are practically the same as the one invented by Whitney, about a century ago, and consist of a gang of 70 to 80 circular saws working between ribs, the teeth tearing the lint from the seed and drawing it down between the ribs which are placed close enough to keep the seed from passing through; and the lint is removed from the saws by a circular brush, which, revolving at a greater speed sweeps it off the teeth of the saws. The only merit the present gin possesses is its great capacity. The delicate cotton fibre is torn and nepped by this severe treatment, and the cotton crop is reduced in value many millions of dollars.

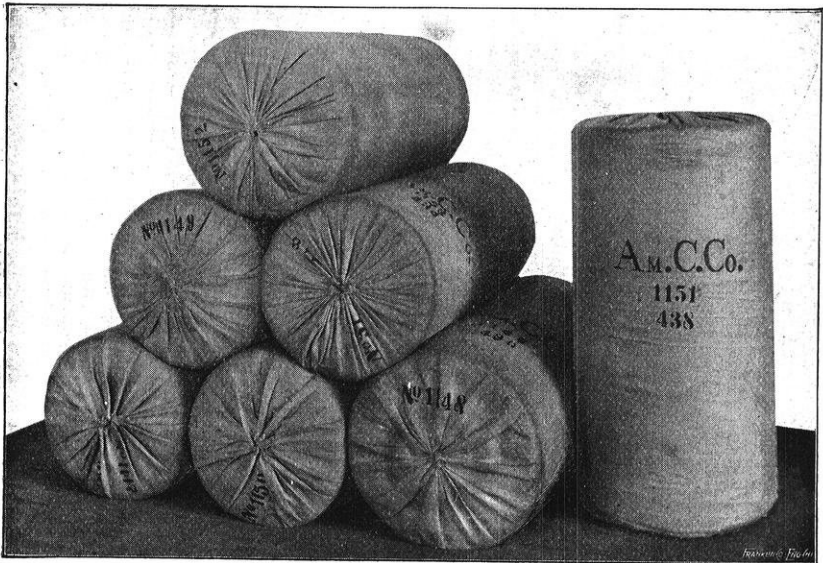
The roller gin obviates these difficulties, but the capacity is so small that its use is limited in this country to a comparatively small amount of high grade Sea Island Cotton.

The lint as it leaves the condenser of the gin is thrown into a gin press, which is simply a rectangular box where about 500 lbs. of cotton is pressed into a bale, weighing about 12 lbs. per cubic foot. This bale is covered with coarse jute and strapped with six or more steel bands, and is then shipped to a central compress where the bale is subjected to a pressure of fully 2400 tons and reduced to about half its former thickness, or to a density of 22 lbs. per cubic foot. The compressing occupies but a few seconds, and is more like a blow from a ponderous steam hammer. The air already compressed in the gin bale, in its explosive efforts to escape tears and greatly injures the fibre of the cotton, but by far the greater part of the air is compressed and retained in the bale, so that if the steel bands are cut the confined air causes the bale to greatly expand. This compressed air also causes the bale to assume a rounded form, making it impossible to pack it tightly, and necessitating the use of jack screws for pressing the bales into the holds of ships. The presence of the compressed air, however, has a much more serious result, causing the bale to be a veritable fire trap by

supporting combustion in the interior of the bale, where it is impossible to reach it. This is why cotton fires are so very destructive, almost always resulting in total loss.

Many attempts have been made to produce a new bale of cotton that would be free from the objections of the old, and the net result of these efforts has been the cylindrical bale.

This bale as now made is practically both fire and water proof. It dispenses with heavy bagging and steel ties. It weighs 35 lbs. or more per cubic foot, and owing to its regularity of size packs in less than half the space of the old bale.



CYLINDRICAL BALE.

It unwinds like a roll of carpet, and goes direct from the gin to the warehouse, or mill, instead of lying in the compress yards for weeks waiting its turn to be compressed, gathering dirt and moisture. Instead of 30 lbs. of bagging and ties the covering of the cylindrical bale consists of 5 pounds of cheap cotton duck or burlap.

This bale is formed by winding the bat of cotton on a steel spindle between two revolving iron rolls, which separate as the bale grows in diameter. This separation is resisted by a hy-

draulic cylinder so that any desired pressure can be brought to bear on the bat as it is wound on the bale. A wide endless belt passes over the two rolls and under the bale for the purpose of keeping the bat from sagging underneath the bale, and also to aid in putting on the covering.

Owing to the continuous pressing of this comparatively thin bat of cotton, the air is easily expelled, and the bale has no tendency to swell after it leaves the press so the covering need only be sufficient to keep the cotton clean. After the covering is put on, the steel spindle is extracted, and the same piece of cloth that covers the cylindrical surface is drawn over the ends, thus completely covering the bale. The time required for making a bale depends on the number of gins in use. At the plant in Waco, Texas, where there are eight gins, and where we made several thousand bales last season, we made a bale every six to eight minutes. The average pressure on the bale is less than ten tons, as compared with 2400 tons, at the compress. To operate the press requires 10 horse power, while a compress requires about 300 horse power. The comparatively slight pressure used tends greatly to save the cotton fibre from injury. Moreover, the method of forming the cotton into a continuous bat and pressing it in this form, straightens the fibre instead of crinkling the whole mass together as is done in the compress.

Attempts at making a cylindrical cotton bale were made over 50 years ago, but the early inventors confined their experiments to machines having three or more rolls. That patented by North, in 1848, will serve as a general type for all of this class of presses.

This press consists of three rolls. Two of these were placed side by side horizontally in fixed bearings, while the third roll was placed directly over these like a three roller cane mill. The upper roll, however, had a vertical motion so that as the bale increased in diameter this roll was forced upwards, the bale being formed between the three rolls. In order to have a space for the bat of cotton to enter, it was necessary to have a distance of several inches between the surface of the top and lower

rolls, thus leaving a large space between the rolls that had first to be filled up with cotton before it would begin to revolve and start the regular formation of the bale. The center of the bale being just a tangled mass of matted cotton, caused great injury to the fibre and it could be loosened only with the greatest difficulty. Moreover, this style of press necessarily begins the formation of the bale on a soft center which is not round but



BALE UNROLLING.

conforms in shape to that of the space between the rolls. Under such conditions it is impossible to form a hard bale, and the greater the pressure, the more out of round the bale becomes, and it will soon stop revolving or result in a comparatively soft bale.

During the past season several attempts were made to make bales in presses with three and four rolls all of which failed to



make a dense bale of cotton, and proved the correctness of the preceding conclusions.

The necessity for a hard core on which to start the formation of the bale, soon became evident, but it could not be used with a three roller press, owing to the large core required to fill the space between the rolls, and the extreme difficulty of extracting so large a core from the bale.

The first successful attempt to make a bale on a core was made by Graves and Anderson who used an endless belt which passed over two small rollers. A loop was formed in the belt directly under the center of the space between these two rolls, and a steel core fastened in the bottom of the loop in such a way that it would revolve readily by the friction of the belt. The two rolls were placed far enough apart to allow the bat of cotton to pass into the loop and around the core, and the bale would immediately begin to form, and the loop would enlarge to meet the growing size of the bale.

This press made dense bales and would no doubt have been a success if a belt could have been found strong enough to stand the strain for any length of time. All the pressure on the bale had to be transmitted by the tension on the belt, and even where this was made of heavy steel links it soon gave out.

The next advance was the two roller press of Bessonette which consisted of two rolls placed one above the other, the lower one fixed, the upper one in sliding bearings. A steel core was placed between the rolls, on which the bale was formed. Several thousand bales of cotton were made on these presses, and these, except for the hard centers proved quite satisfactory, but this defect was sufficiently serious to render the bales undesirable to the spinners. The hard centers were due to the fact that at the very beginning the pressure on the bale was always equal to the weight of the heavy upper roll and attachments, and direct steam pressure being used it was found very difficult to regulate the pressure on the bale. The sagging and folding of the bat in bales made by this press was also very objectionable.

The next advance was made in the press of the Walburn

Swenson Co., as exhibited at the Atlanta Exposition. This press was made horizontal instead of vertical, and the only pressure on the bale in the beginning was the resistance to sliding the movable roll horizontally. Moreover, the adoption of a hydraulic cylinder connected with a very large air chamber made the pressure very yielding, and easy to regulate automatically. The driving mechanism was also greatly simplified. There was, however, one difficulty caused by the bat of cotton stretching and sagging under the press. This was partially

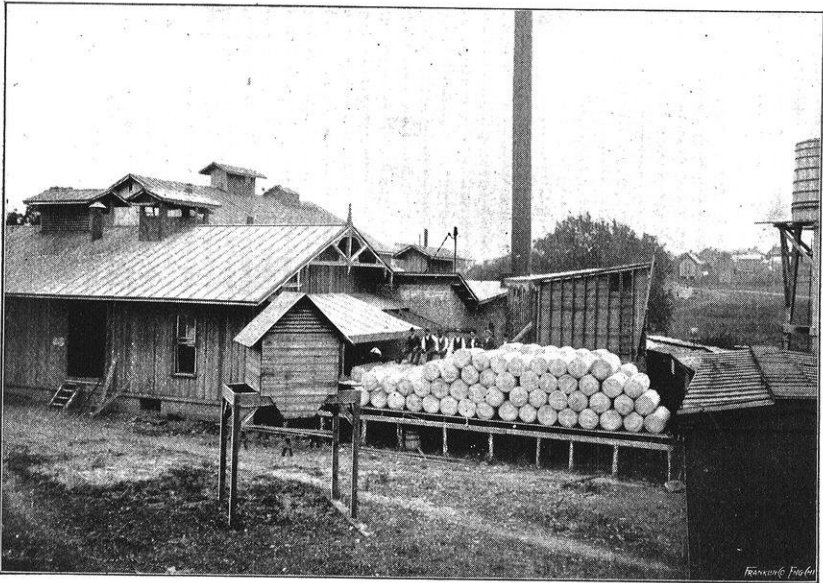


NEW AND OLD BALES.

overcome by the use of a smooth platen under the press which kept the bat from breaking, but it would cause the bat to fold over and give the bale a somewhat lumpy appearance. This difficulty was at last overcome by the use of a broad endless belt passing over the rolls and under the bale, but unlike the belt press before referred to, the pressure on the bale is still imparted by the rolls; the belt merely serving to keep the bale in shape, and keep the bat from sagging, and incidentally serves an excellent purpose in putting the covering on the bale. This press is also built double in such a way as to enable the ginning to go on continuously. The stopping of all the gins dur-

ing the covering and discharging of a bale from the press being a very great drawback to all former presses.

Several attempts at making dense bales without the use of rolls have been made, but they have never passed beyond the experimental stage. The latest of these employs a revolving steel casing into which the cotton is pressed by a contrivance like a post auger. The press being about the same as a flour or sugar packer. The cotton has first to be formed into a very small bat or rope in order to make it enter the small space in



AMERICAN COTTON CO.'S PLANT, WACO, TEXAS.

the side of the screw, and as cotton will not spread like sugar or flour the bale will of course, be dense in the center, and very loose on the outside. Moreover, it will be found impossible to push the bale down against the friction of the casing when making anything like a dense full sized bale. The very limited capacity, owing to the small feed and the expense of forming so small a bat of cotton makes success in this direction practically impossible.

The far reaching effects of this new system of baling can



EXPERIMENTAL STATION.

W. H. R. 1914

hardly be appreciated by any one not familiar with the cotton industry. As conducted at the present time a whole army of middle men and factors are supported at the expense of the producer. Before a bale of cotton is sold, it is first sampled by the prospective purchaser who cuts big gashes into the covering, bores into the bale, and pulls out a liberal sample. Other buyers do likewise, and raise in this way what is called the "City Crop." This crop is wholly independent of climatic conditions, and never fails. The enterprising city farmer neither sows nor reaps, still gathers a crop of 180,000 bales of cotton annually, worth about seven million dollars.



A CAR LOAD.

This sampling is justified by the fact that the guileless farmer has been known to allow rocks and other heavy foreign matter to get into the center of the bale. This "loading" is practically impossible in the cylindrical bale on account of the way in which it is made, and the ends of the bale which are easily examined show the quality of the cotton from the beginning to the end of the baling operation. Moreover, the cotton is carefully sampled as the bale is formed, and the bale guaranteed to come up to grade.

The bale can also be sampled just as well as the ordinary bale if desired and the claim to the contrary by many cotton buyers who are of course against its introduction is entirely without foundation.

In the matter of transportation, this system will work a tremendous saving. Cars can be loaded to their full capacity without difficulty; many shipments of from 65,000 to 68,000 lbs. were made in 40 foot box cars last season. Taking into consideration that these bales are shipped direct from the gin house to the warehouse or factory, conservative railroad men estimate that the crop can be handled with not over one-fifth the number of cars now needed. In foreign shipments this saving will also be very large, ships being able to load nearly double the amount of cotton possible under the present system. This is due both to greater density of the bales and their perfect uniformity in size.

The heavy jute bagging and steel ties which cost the farmers from 75c. to \$1.00 per bale are replaced by a cheap covering costing less than 20c. The compress and screwing charges of \$1.00 per bale are saved, and the cost of insurance greatly reduced. The insurance people have made a great many attempts to burn this bale. Large quantities of wood being piled around the bale and the whole saturated with coal oil; when the fire burnt out, the bale was rolled out practically uninjured, only the outer layers being scorched. This induced them to make the rate one half of that on the other bales, and no doubt it will be still lower. Taking into consideration the various economies and the much better condition of the cotton when put up in the cylindrical bale it is estimated that at least forty millions of dollars annually will be saved over the present method, and as the progressive methods of the nineteenth century have but just begun to invade this industry after nearly a century of stagnation, it is fair to presume that other improvements will be made, especially in the ginning of cotton, that will greatly enhance even this enormous saving.

## INTERNAL COMBUSTION ENGINES.

BY C. W. HART, B. S., '96, AND C. H. PARR, B. S., '96.

## III.

## IGNITION.

From the time of the earliest gas engine the subject of ignition has been one of considerable controversy, and the igniter is still the part that gives the most trouble in the modern gas and gasoline engines. Upon thorough investigation, however, it will often be shown that poor ignition is caused more by the improper working of some other part of the process than by a faulty action on the part of the igniter.

Electric ignition was early applied in the Senoir engine but later the flame method was the more popular one. The flame method could be readily applied to those engines in which the charge was not compressed, for the piston could be made to uncover a port at the proper time and suck in the flame from a burner just outside of the port. But when the charge in the cylinder was compressed to a pressure of several atmospheres this problem of communicating the flame to the charge became a very difficult matter. Upon opening a port from such a charge beside an external flame, the latter would be immediately extinguished by the sudden rush of gases, and it was evident that some means must be employed to maintain this constantly burning flame. This object was first attained by Burnett in his igniting cock. This was a hollow cock with a port on one side which could be turned so that this port opened to the air, or in another position was opposite a port connecting with the explosion chamber of the engine. Inside this cock was a small gas jet and just outside the cock and pointing into the opening when the cock was open to the air was another gas jet. In action, the cock was first turned to the open air when the jet inside would be lighted from the jet outside. Then the cock was revolved and its port closed first, inclosing the burning jet and a small quantity of air, and then opening to the cylinder, thus firing the charge. The inner jet was extinguished by the force of the explosion but was immediately relighted upon turning

the cock so as to communicate with the air and the external flame. This made a very sure method of ignition but could only be worked at rather slow speeds.

A little later Otto developed his slide valve in which was a small cavity filled with air and gas. This mixture was first ignited by passing before a continually burning flame in the valve cover, and then carried on till it reached a port opening into the cylinder of the engine. Clerk also used a valve constructed upon principles similar to the Otto valve, and until recently these were the most popular methods of ignition. They gave a pretty sure ignition for moderate speeds, but the valves themselves were difficult to keep in order. It was necessary to have small channels to open first between the cylinder and the cavity and thus slowly equalize the pressure in the two spaces or the flame would be extinguished upon opening the main port. It naturally required very accurate arrangement of the edges of the ports and channels to secure the proper working of the valve, and as these became encrusted with soot this accuracy was destroyed. Then, too, working under such great pressure and intense heat, the valve was very liable to injury from lack of proper lubrication, and required frequent cleaning and refitting.

These difficulties with the flame method led to a great deal of experiment upon ignition by incandescent metals. Clerk arranged a slide valve in which was a small port filled with a grating made of platinum plates. This valve was first moved out and the grating heated to incandescence by a jet of gas-flame. The valve was then run in till the grating covered a port leading from the cylinder to a small cavity in the valve cover. The compressed gases in the cylinder were ignited upon rushing through the hot grating, and their combustion kept up the temperature of the grating. This worked very well until from any cause the engine missed an explosion. Then the grating would become too cool to ignite the charge and the engine would stop.

Drake first used a thimble shaped piece of metal in a cavity in the back of the cylinder and heated it by a blow-pipe flame directed into the interior of the thimble. The ignition took place when the piston uncovered a port communicating with this cavity containing this hot piece of metal. These pieces of metal soon became brittle and weak from the intense heat. Atkinson finally



overcame this difficulty by using wrought iron tubes closed at one end and the other end opening into the cylinder. This tube with some modifications has been the method used most extensively in this country. In a great many of the engines the tube is left constantly open to the cylinder and the proportions so designed that the compression will force the fresh gases up the tube to the heated part and thus give ignition at the proper time. It is generally found, however, that in these engines the point of ignition varies a great deal and the explosion very often comes far from the beginning of the stroke. Some manufacturers have endeavored to overcome this difficulty by using a timing valve which gives communication between the cylinder and the tube only at the proper time for ignition. This does away with premature explosions, but does not prevent their being late at times, and it is found that the tubes give out more quickly than they do when they are in constant communication with the cylinder.

Under ordinary conditions the tubes will not last for more than thirty hours, and in order to secure the best running they should be renewed more often as the metal usually thickens up with the heat and chokes the tube before it finally gives out. The hot tube furnishes a fairly reliable method of ignition except as to time, but there is the constant trouble and expense of renewing the tubes and in some cases it is dangerous to have the external flame necessary to heat the tube. It is also evident that this method cannot be used in a portable engine or in one which is so situated as to be exposed to draughts of air.

Electric ignition has lately been developed so as to overcome a great many of the difficulties mentioned in connection with the other methods. As has been said before, electric ignition was used on one of the early Senoir engines but was abandoned for the flame method. All the earlier experimenters used the spark from the secondary of an induction coil, which was made to pass between two electrodes, generally of platinum, in the back part of the cylinder. Sometimes the electrodes were in the cylinder itself and the spark was made to pass only at the time of ignition. This did away with all timing valves, but it was found that occasionally the interrupter on the induction coil would not start immediately upon making connection in the primary circuit and this would cause

either late firing or missed explosions. To remedy this evil, some makers placed the electrodes in a small side cavity of the cylinder, which was placed in communication with it only at the proper time for ignition, and allowed the spark to play continuously between the electrodes. This necessitated the use of a timing valve and in all these early electrical methods the electrodes were found to be difficult to keep in order. The current being so high tension was difficult to insulate. The platinum points would become dirty or damp and the spark would not pass. These facts, together with the trouble and expense of keeping up batteries, were serious drawbacks to the use of electric ignition.

Within a few years it has been known that a spark sufficient for ignition, due to the induced counter electromotive force, can be obtained by breaking connection in a primary circuit in which is a simple coil of wire with an iron core. This has been applied with more or less success in various ways. The current, being low tension, is easily insulated.

Some makers place an insulated plug in the back end of the cylinder with a contact piece inside such that the piston will break the contact when it reaches the back end of its stroke. This furnishes a very simple and effective method of ignition, but gives a useless drain on the batteries unless there is some external arrangement for breaking the circuit part of the time. It also allows very little adjustment of the point of ignition. Other manufacturers cause the piston to make the contact by means of flexible contact pieces just before it reaches the back end of the stroke, and to break the contact just after the piston has started on its working stroke. This has not proved satisfactory since the explosion can never begin till after the piston has begun its working stroke, and this is too late to get the greatest amount of work from the charge. Since the piston is moving comparatively slowly at the time of breaking contact, it is sometimes hard to get a sufficiently powerful spark when starting the engine.

After trying various igniting devices with cells of the Edison-Lelande, Le Clanche, mercury-bicromate, storage and dry cells we conclude that for economy, reliability and ease of manipulation a simple cell such as are commonly on the market with elements of carbon and zinc of liberal dimensions, a salamoniac solution and some depolarizer is the best to use. To give satisfaction with

such cells the igniter must be positively moved so as to close the circuit for a certain definite length of time and break it quickly at a certain part of the cycle. Both the length of time which the circuit remains closed and the point of ignition should be capable of considerable adjustment. Adjustment should also be at hand to compensate for the slow eating away of the contact points. This brings all under control of the operator so that the length of contact may be made as short as will furnish current enough to ignite, while the point of ignition may be adjusted so as to give the most effective working of the engine. When the igniting device is properly made these results can be obtained just as surely in the portable or marine engine as in the stationary engine, and there is no external flame to produce danger of fire.

Not less than one dozen cells in series should be used. A spark coil consisting of about 1,000 turns of number sixteen wire wound on a soft iron core one inch in diameter must be placed in series with the batteries. With the contact points together not over .02 sec. and making not over 200 sparks per minute cells such as the Sampson or Hercules will not polarize to an extent that will interfere with their giving the necessary current for runs of 10 hours duration, and they will last under these conditions for 100 days of 10 hours each. The solution and zincs will then have to be renewed. An average current of 8 volts pressure and from .1 to .2 amperes according to the conditions of the mixtures to be exploded will be drawn from the batteries. The condition of the engine and the quality of the mixtures have much to do with the amount of current required. In a test made on a Sintz engine the current could not be reduced below .2 ampere without missing explosions, while in another test on an exactly similar engine the average was .116 ampere. The average current used in a test on an Otto type engine was only .063 ampere.

Our experience has shown that the platinum points for the contact pieces within the cylinder are unnecessary. Wrought iron points are just as reliable and require no more current, and with proper combustion of the gases do not become coated.

The employment of batteries for ignition interposes complications which bar the use of electric ignition in many places where from the standpoints of safety and convenience it would be most desirable. Even in their simplest form they are extremely liable

to accident, and if the attendant is unfamiliar with their action delays and losses are sure to result. There is another method of producing the current for ignition which we believe is destined to supersede the battery and which adds complications of a simpler nature only. This is the magneto generator. If properly constructed this machine would be as long lived as the engine and with proper mechanical connections would undoubtedly run at much less expense than batteries.

(To be continued.)

---

## COMPENSATION FOR PROFESSIONAL SERVICES.

BY ALLAN D. CONOVER, '74, C. E., '75.

*Professor of Civil Engineering, '79-'90.*

Not much previous to the present century, military engineering included the greater part of engineering developed as an applied science.

It was classed as a profession with that of arms and with other callings requiring a good degree of training and the use of intellectual faculties as well as control and direction of physical forces. By the "learned" professions were then, and until recently, distinctly understood the three professions of religion, law and medicine.

As "nothing is more certain than the essential identity among ancient nations of the professions,—religion, law and medicine,—which the progress of civilization has separated into three;" nothing is now more certain than that the development of a higher civilization has greatly enlarged the field for, and the list of, the professions.

No one acquainted with the character of the training now received by candidates, and essential to their success, in the professions of authorship, of higher teaching, of astronomy, of scientific investigation, of engineering in its various branches, and of architecture will question the propriety of including these on the same plane with those of religion, law and medicine as learned professions.

It is proper to recall that to the great body of the members of each of these professions, especially in our own country, their pro-

fession represents not simply the work to which they have devoted their lives, by the study and practice of which they expect to develop the best that is in them, and the field in which they hope to add something to the sum total of human knowledge, but represents as well their means of maintenance and hope of competence.

In most of these professions there has grown up a system quite generally and uniformly established for the compensation of their practitioners, but in none of the professions included under the broad title of engineering has there as yet been any system generally adopted, or any general principle recognized as the basis for such a system of compensation for those who practice the profession.

It is desirable both for the engineers themselves and their clients that some rational system should be adopted where now there is none, and that methods more rational and more equitable should be adopted and become generally recognized in all branches of engineering, and to that end it is proper to look for suggestions from the practice of other professions and particularly those in which the conditions approximate those in engineering.

In the profession of religion, or as more commonly distinguished, of theology, there is in theory, and to a large extent in practice, an element of personal consecration and of devotion to a life work for the benefit of others, which places the question of compensation in a position, at least apparently, less important. The system of employment and compensation is most generally that of continuous employment and salary, and the pecuniary rewards are generally on a lower basis than those in any other profession.

In the profession of medicine there is a well and generally understood system of charges for ordinary services, and in most places, where there is more than one physician, all practitioners agree on a regular schedule of charges deemed proper for ordinary and extraordinary services, the rates of this schedule being regarded as minimum rates. Every practitioner who by his special gifts has built up an unusually large practice with good clientage feels at liberty to increase his charges beyond the minimum schedule, gauging his increase by what he deems the market for his skill will allow. The demand for his services while fluctuating much from season to season still remains comparatively steady from year to year. A skillful and faithful physician whose address is such

as to inspire the confidence which he deserves, is reasonably sure of a practice, that will engross his entire time and energy, and leave him few vacations. He will, in general practice, have on the average a larger percentage of losses than in almost any other business or profession, and still (this western country over) he will earn and collect one of the best incomes of the place in which he lives.

In the profession of law there is in every locality a similar minimum charge for ordinary routine work. For a large share of his work, however, the average lawyer sets a value on his work not based on what he deems his time is worth, but on the much more speculative basis of what he esteems the value to his client of his knowledge, skill and wits, or as a railroad manager would say, "what the traffic will bear." Fees for services are often not only much larger than the minimum rates, but frequently so much larger as to leave the minimum rates for routine work merely a drop in the bucket of the total cost of legal services, especially in very important cases. Under this system shrewd and successful lawyers nearly everywhere secure good and even very large incomes. The demand for lawyers' services, while varying from season to season and year to year, still is as steady as the demand for staples is in most forms of commercial business, and fluctuates on the average with what is called the general business of the country.

In the profession of architecture, there has been for a long time among those who practice the art as a profession, a system of charges based upon the percentage principle, and a well recognized schedule of prices for different classes and portions of the work. In its application to existing conditions the system of charges by percentage has proved both equitable and advantageous to clients and to the profession; and while experience and changes of condition have from time to time caused modification in the amount of the percentage for different classes of work, and in its apportionment to the different parts of the work, and while there is a variety in the practice in the different countries and different parts of the country, the tendency is to the universal adoption of the percentage system, and to a greater uniformity of charges everywhere where there is any considerable demand for services of architects.

The fee charged by architects for the planning and supervision of most structures is five per cent. of the cost of the structure. For an especially simple class of work where the design involves engi-

neering rather than architectural design, and that of a simple sort, a lower percentage is the rule. Where work requires a high grade of artistic ability and much study of detail in proportion to the cost, such as for instance the designing of elaborate interior decoration and the superintendence of its execution, a higher percentage, frequently double that named, is charged. The percentage charge named is the architect's full charge for services in making preliminary studies, general drawings, detailed drawings and giving supervision to the work of construction, and pays for the responsibility on the architect's part to furnish complete and correct drawings for a safe structure and to see that it is properly built. The nature of his responsibility is determined by the common law and requires that he shall have and exercise knowledge and skill in his professional work, and use diligence in its execution.

In the profession of engineering, whether the department be the broad one of civil engineering or mechanical engineering or any of the specialties those titles fairly include, their development into callings "involving special mental and other attainments and special discipline" has been of comparatively recent date.

Moreover, the range of service covers such a wide variety as to have rendered its classification very difficult and the establishing of anything like a general principle for establishing a schedule of rates for services still more so. There has besides been less organization in these professions, until lately, and less effort to secure concerted action in matters of common interest.

In these professions compensation is variously based on continuous engagement, upon salary by the year or by the month for either definite or uncertain periods, on a stipulated sum for a particular piece of work, on a percentage of the cost of the work to be designed, or to be designed and supervised, on the same principle as compensation is arranged for on similar work in architecture, and finally on the per diem basis, in this latter case usually for very short term services.

In scarcely any of the various departments of engineering is there a well settled and generally followed plan by any one of these methods.

It will probably be the practice for all time that apprentices and assistants in all classes of engineering work will be paid by salary. It is also likely that to a great extent the larger corporations, com-

mercial and municipal, which require the service of engineers continuously will secure their continuous employment and entire time upon the salary basis in nearly all grades of service. In case where engineers prepare for and give expert testimony in trials at law and where they act in a semi-judicial capacity as referee, there seems not to be any better method than that of charging for services at the price per diem for the necessary time.

Besides these classes of engineering work there is at the present day a vast volume of professional engineering work carried on by men in what may be called independent practice. The majority of these have special skill in one or more branches of engineering. They examine into and make reports upon properties and schemes for improvement, and design and supervise works of public and private improvement, including often very much work for even those corporations who regularly employ engineers on salary for their ordinary routine work.

In scarcely any, if indeed any, of these specialties, including the entire field of engineering, is there any generally adopted system for making charges or schedule of rates, or indeed any general principle adopted as to method of making charges for professional service.

Instead of a uniform system there seems to be a uniformity of confusion.

In this wide range of professional work it is hardly possible, and indeed it is hardly desirable to establish anything like uniform rates for compensation, and it may be that it is neither possible nor desirable to establish a uniform system with varying rates, or to adopt a principle as the basis of the method of determining compensation. This latter at least seems, however, to be both possible and desirable and it is believed that the general adoption of such a principle will be one long step taken for securing a much more suitable and equitable schedule of rates for compensation.

The essential nature of the service required in connection with engineering work of almost every description above referred to seems upon analysis to be very closely the same.

There is scarcely a class of such work, perhaps, excepting the one of survey work of determining land boundaries with no other object in view that it does not involve these steps:

Preliminary investigation of essential facts and conditions.



Outlining and comparison of possible schemes as a basis for rational choice of the best scheme.

Planning and detailing of work to be done.

Administration of the execution.

These steps furnish an exact parallel to an outline of the operations in the vast majority of works of architecture. The natural suggestion then is that the principle upon which the method of compensation in that profession is based, namely the percentage principle, is possible of application to determining compensation for engineering works. We know that to some extent this is already done, though with no uniformity in any single branch, and to a much greater extent abroad than in our own country.

It is further suggested to inquire what would be the advantages in such work of the application of the percentage principle.

Let us suppose a case where the investigation, planning for and execution of the work of improvement will require a brief period of years.

On every account such a case would be one of the most favorable to the method of continuous and entire employment on salary and least favorable to the percentage method.

What are the advantages to the *client* of the percentage principle in determining the rate of compensation?

The engineer so employed makes with his client entire contract for services which renders him more clearly and definitely responsible to his client for the success of the work than if employed on salary.

During the progress of the work, and particularly as it nears its completion, there are generally considerable sums still due him for services which act as a powerful stimulus to his zeal, and in a considerable measure as a bond for the successful completion and working of the improvement he has planned. It is true that whatever the method provided for his compensation, his reputation depends upon the success of his work, but if his contract for services be made upon this basis both reputation and purse are directly at stake.

In addition to this his obligation to complete his entire contract prevents his accepting other engagements and retiring from this wholly to suit his own purposes as he might do if upon a salary.

Another advantage, and no small one, clearly obtains in a great

variety of works of improvement whose execution requires less time and money than the case supposed. In many cases the means involved do not warrant the employment of engineers of note upon the large salaries which their services command. In these cases the use of the percentage principle as a basis for their compensation allows the employment of the highest grade of talent on such a basis as to secure for the work its skilled control and direction from beginning to the end without excessive proportional expense, while under the salary method of compensation only second rate talent can be employed without excessive expense. Moreover, it leaves open to the younger and less experienced practitioners of the profession opportunity to take charge of the work of a simple character and not requiring so high a degree of talent nor so extended an experience.

What are the advantages to the engineer of the application of this principle of percentage to determine compensation?

His obligation to a thorough and skillful service to his client does not prevent his carrying on simultaneously other work if he keep within the limit of his powers. He may, in the case we have supposed, give his best effort and skill, exclusively if desirable, to the careful investigation and thorough planning and detailing of the work he is engaged to do, and the organization of the means for its execution. Then he may trust to his trained assistants the routine work of supervision while maintaining a general oversight and control of the execution of the work, and apply his own especial talent to the very limit, in the investigation of and planning for new work.

There can be little doubt that the dead drag of mere routine work of supervision of construction which would constitute the latter part of the engineer's work in the carrying out of almost all engineering work when engaged upon a salary, does not employ the best talents of the expert designing engineer, and might better be borne by men of lesser talent and experience whose training has been adequate for such work.

It is true also that the client in contracting for this entire service incurs a more definite obligation to the engineer to allow him to retain control of his work until its completion. He cannot discharge him without good cause and diminish his liability to pay the engineer his full percentage, and this obligation undoubtedly

has a tendency to secure the engineer more firmly in the control of the work of his design to successful completion, by rendering his employment less likely to be terminated from the whim or from a trifling quarrel or political complication.

The application of the percentage principle obviously then has some decided advantages to both parties interested in such work.

Its fair measure of success in its application to architectural work, has been supplemented by the moderate degree of successful application in almost every branch of engineering work, more particularly in other lands than our own.

It is a matter of observation that in England where perhaps more generally adopted than elsewhere, it has contributed something towards securing better compensation for successful engineers, and both by that means and otherwise to bettering their standing.

It is certainly true that there are difficulties in the way of even its gradual general adoption for a large range of engineering work. The most serious of these, however, are the difficulties of determining what are the fair rates for the various kinds of work, and for their different steps. It is true, however, that engineers now have in their possession data from which a fair compensation on the percentage basis can be determined quite readily for almost every class of engineering works.

If the fair value of services in any line of their professional work can be clearly established and become generally known, there can be little doubt of its rendering much easier the securing fair compensation for such services.

It is greatly to be hoped that some such action, or some concerted action towards establishing fair rates may soon be taken. If experience in other professions is any guide as to proper results, it would seem that the securing of general public knowledge of what are fair rates, is the longest step towards securing rates that are better than fair, and that co-operation is the proper "push."

ONE OF MANY.

By CHARLES ISAAC KING,  
*Professor of Mechanical Practice.*

Several years ago the writer was requested by the parties in interest to supervise the installation of a warming and ventilating system in a public building in the city of Blank.

The original structure, where the work was to be done, was erected about twenty-five years ago, and from time to time as the exigencies of the case demanded additions were made, until the building was nearly or quite three times its original size.

The warming was done by the well known hot air method, the furnaces being located in different parts of the basement with a chimney for each, thereby avoiding the long conducting pipes which are so fatal to this system.

During the evolution period a draught and ventilating shaft was needed at a place not originally contemplated, and as it would have been awkward to have had it pass up through any of the rooms, it was built outside, making a lean-to as it were.

The design provided for a flue four feet square inside, with eight inch walls, to be built of common brick, with a partition taking up about one-fourth of the area; this to be connected with the furnace, while the rest was used for ventilating some dry closets. The partition was properly bonded with the sides of the flue during erection and gave considerable strength, but there was no bond between the chimney and the side of the building.

The especial motives which governed in this design may not be stated, but the work was done as here outlined, and it made a fair showing for the cost involved, and I think rendered good service while doing the work originally planned for it.

The wall of the building next to which this flue was constructed had a bush hammered lime stone facing for ten feet from the ground, and brick from this up to the eaves.

A few years prior to the writer's acquaintance with the case an addition was made to the building on the side where this chimney was located, therefore bringing it inside one of the new rooms.

Still later another addition was made, which, being of consider-

able size and modern in its appointments, made a steam warming and ventilating system seem a necessary part of the equipment.

Plans and specifications for this apparatus were made by a contracting and engineering company of the city of Blank Blank, and it was by them decided to use this flue in connection with the boiler, which would furnish steam for power and heating.

It was specified that an opening should be cut in the side of the flue for a connection with the breaching, and that a sheet iron partition should extend from the corner of the small flue to the building, thereby taking up one-half of the whole chimney. The structure also was raised thirty feet, giving it a total height of about seventy-five feet.

Two years later it was decided to replace the furnaces in the old part of the building with modern appliances, and the same company was employed to make the plans and specifications.

This change made it necessary to purchase two additional boilers, and required a larger breaching connection to the flue. The sub-contractor in immediate charge of the work was instructed to remove all of the brick partition, and to extend the sheet iron, dividing the whole chimney into two parts.

It is fair to assume that the flue had not been carefully inspected at any time to determine its value for the additional work required, and therefore the conditions may not have been known to the people who made the plans. Be that as it may, the sub-contractor on his own responsibility refused to cut out the partition, as in his opinion it would weaken the whole structure to such a degree that it might collapse at any moment, but of this decision the principal contractor was not informed.

However, to receive the enlarged breaching, it was necessary to cut out the side of the flue for a distance equal to its full inside width, and as high as the breaching.

At Fig. 1 a section of the chimney just above this opening is shown, A representing the interior flue, B the ventilating portion, C the sheet iron, and D the opening for breaching.

The sheet iron partition was held in place by clips riveted to its edges, and these were nailed to the wall and partition.

It may at once be assumed that it would be nearly impossible without undue expense, to prevent leakage along both edges of the iron, the one lapping onto and the other abutting against ordi-

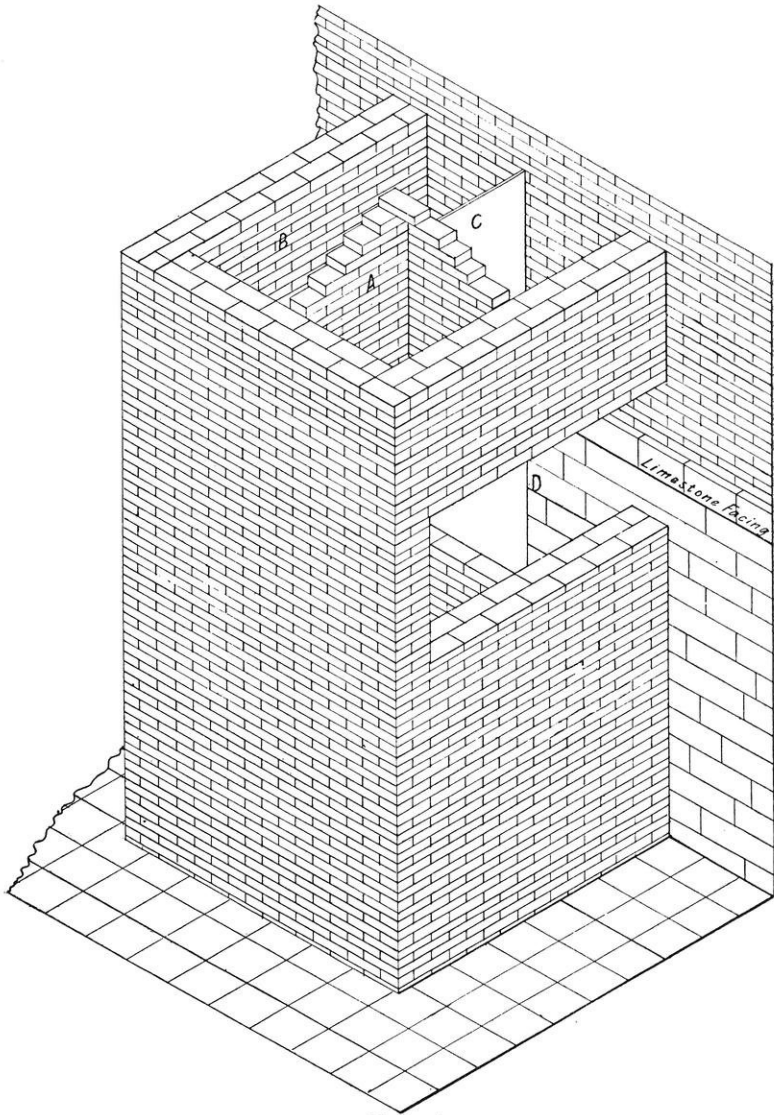
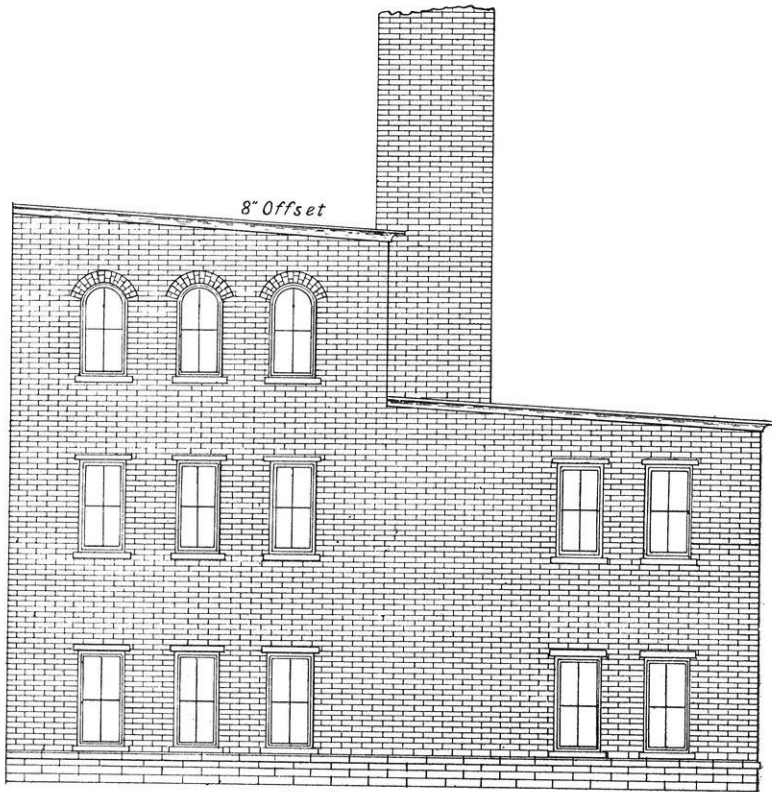


Fig. 1

nary brick work; and enough air did pass by along these edges to effectually prevent good combustion, the draught gauge showing less than one-eighth inch.

As the chimney had been in use during the two years previous to the second installation, with the one boiler, it was taken for granted that it was capable of rendering fair service under the new



*Fig. 2*

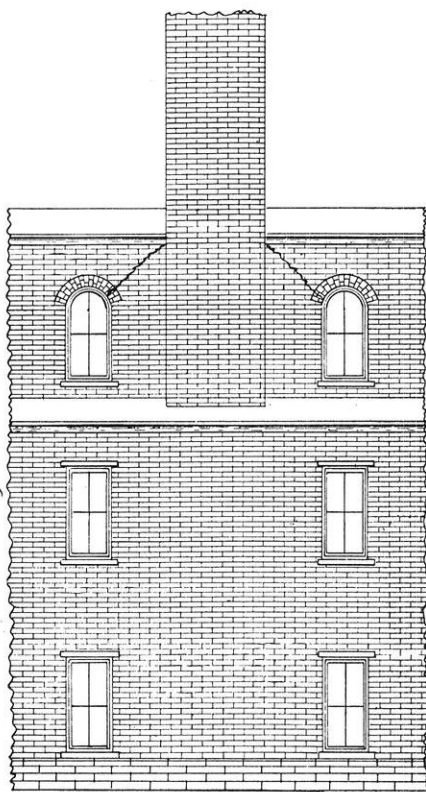
conditions; but in testing the system after completion, it was found difficult to maintain sufficient steam pressure to do the work as specified. This led to an investigation for cause which revealed the situation as narrated.

Further observations also revealed an astonishing bit of construction work at the top of the wall against which the chimney had been built.

Evidently the builder realized the weakness of his structure in the absence of a bond to the wall, and to compensate for it as well

as he could, made an eight inch offset in his brick work, lapping it over that distance.

One need not wait for the result to know what it would be. Of course the chimney settled and a considerable load was concentrated at this point, but as it went down, it could not carry the wall with it, an equal amount, and therefore it was thrown out of plumb nearly three inches in thirty feet.



*Fig. 3*

This feature of the construction is shown in side elevation in Fig. 2.

On each side of the chimney there was an arched window, and the extent to which it affected the wall in coming to rest was shown in two well defined cracks leading upwards at angles of about forty-five degrees, as shown in Fig. 3.

The roof of the front part of the building was some distance above the top of the chimney, and prevented a free passage of air



currents from two points of the compass, and as the prevailing winds were from these points they gave no aid to the draught, which at certain times came near being in the wrong direction.

Let us briefly review the findings:

A chimney is built for use as a ventilating shaft with partition for connection to a hot air furnace. The foundation was too small, of insufficient depth and was laid against the building foundation.

The wall of the building formed one side of the flue, and the foundation was therefore eccentrically loaded. There was no batter to the structure and the walls were but eight inches thick.

The surface of the surrounding ground is level, with no drainage. The soil is clay.

The subsequent addition to the building left the chimney inside and its foundation was protected from the weather.

When the first steam system was installed, an opening was cut in the side of the chimney next to the building, sheet iron being used to enclose the space between it and the partition, and the breaching was connected to it.

The chimney was raised thirty feet and finished with corbeled courses heavy enough for a twelve inch wall.

When the second installation was made, the cut for breaching was extended across the full face of the wall, leaving but two sides to carry the load.

The ventilating shaft was still used for the original purpose.

The opening for breaching was made low enough for the gases to come in contact with the stone surface of the sub-structure, and calcining had set in when the examination was made.

What may be said of that state of affairs which makes it possible for the public business to be done in this way, the fault could not be put upon those temporarily in charge of the building as they knew nothing of the situation until it was developed by the test, and had they known it, would not have tolerated it.

The same contracting firm acted as engineers as well on both occasions, and at one time at least must have known something of these details and for some reason failed to report to the authorities.

But one explanation has been offered: Funds were not available for more material and labor than was furnished—surely not

a good one when it was shown that fuel to the value of at least \$500.00 each year was sacrificed to the insufficient draught and this in two years would have paid for a new chimney.

There was danger also of loss from fire, and any insurance company might well refuse such a risk could they have known of this situation.

What may be done in all public and private undertakings of any magnitude, which will render it impossible for such contingencies to supervene?

One answer to the question may be given: employ a thoroughly reliable and competent engineer who may stand between the parties in interest, but who will be loyal to the owner, and just to both.

If there is in this story a lesson for prospective engineers which will teach them, on all occasions when in charge of work, to take nothing for granted, to know that what has been done is right before pronouncing it so, the writer will feel grateful for the opportunity of telling it.

---

## NOTES ON THE USE AND TESTING OF HYDRAULIC CEMENTS.

(CONCLUDED.)

By H. P. BOARDMAN, B. S., '94.

### II.

#### BREAKING OF BRIQUETTES.

The breaking of briquettes is a detail to which less attention is liable to be paid than the making. But experience seems to show that it is a mistake to think that breaking machines always show the true strength of briquettes.

Two kinds of breaking machines have been used by the sanitary district, the Fairbanks and the Riehle. The Riehle, however, was not procured until 1896, so we will take up the Fairbanks first.

Until about May, 1895, one machine answered the purpose and then another becoming necessary, a second Fairbanks machine was procured. Soon after the arrival of the new machine the writer discovered a radical difference in the breaking of the two. When every alternate briquette of a set was broken on the old machine and the others on the new machine the difference in aver-

ages was always in favor of the old and amounted to 15 or 20 per cent. of the strength in most cases. On examination the difficulty was found to be in the clips. They were filed by the firm manufacturing the machine and thereafter gave results nearly equal to those from the clips of the old machine.

The object aimed at in the regulation Fairbanks clips is to have close contact between the clips and the briquette along the curved surface of the latter, from points about 1-8 inch above and below its center to the corners.

It being likely that a slight change of volume often, if not usually, takes place in the briquette, the perfect fit of the clips against the surfaces of the briquette may be considered as seldom present even though the clips correspond exactly to the shape of the molds. The fact is that good center breaks can seldom be obtained on the Fairbanks clips, especially in neat Portland briquettes where the strength is considerable.

Complex stresses due to the wedge action of the slightly diverging opposing surfaces often cause the briquette to break in several places within the clips. These breaks are often curved over so as to be normal, or nearly so, to the surfaces of the clips. The writer procured an extra pair of clips and filed them so that the bearing surfaces that came in contact with the briquette were of much smaller area. These filed clips gave better results both as to strength and nature of break than the regulation, and were used through the season of 1896. But they are far from perfect for breaks seldom occur in the center of the briquette.

Another modification of the Fairbanks clips, made by filing them so that the bearing surface is a spot about the size of a pea, has been recommended. It is being tried now but has not been shown to be an improvement, though probably will give better results after more filing to widen the opening and remove the bearing points a little farther from the center of the briquette.

Early in 1896 a Riehle breaking machine was purchased and both that and the older Fairbanks machine were used for the regular tests throughout the season. For some time rubber clips were used on the Riehle machine and they gave good results, except when they became nearly worn out, as they did in a short time, for there were a great many Portland briquettes to break. When worn and weak they were liable to give out at any time,

causing a bad break, so the brass cylinders of same shape and size as the rubbers were finally substituted for them. These seem to give the best results as to location of breaks that have been obtained, usually causing the break to be at or very near the smallest section.

#### COMPARISON OF MACHINES.

During the season of 1896 a comparison between the Riehle and Fairbanks machines was carried through the regular neat tests. Individual sets occasionally show considerable difference in favor of one machine or the other but in the long run these differences, which are usually small, nearly balance up. The advantage in the case of natural cement, breaking less than 250 pounds, averages about 3 or 4 per cent. in favor of the Fairbanks machine. For Portland cement breaking from 400 pounds up it is in favor of the Riehle, but not more than 1 or 2 per cent.

The writer thinks that this difference between the results with the natural and Portland cements may be because the superiority of the Riehle clips, or the inferiority of the Fairbanks clips, has a better chance to affect the result in the case of the greater stress. The automatic method of applying the load in the Fairbanks machine seems the better. The rate of applying the load is supposed to affect the result, and in the Fairbanks machine this is constant and adjusted to what is considered the best rate, 400 pounds per minute. In the Riehle machine, unless it is operated by mechanical power, the rate of applying the load is variable and the tendency is to hurry it. The generally accepted theory is that this rapid application of stress gives higher results. The writer is of the opinion that unless great care is taken throughout the whole operation of breaking briquettes, when the common machines are used, much greater variations will be caused than can fairly be attributed to the making.

#### INSTANCES OF ABNORMAL BEHAVIOR.

Early in the season of 1895 a large amount of natural cement was received, which was too fresh (probably underburned) containing too much free lime. This excess of free lime by slacking in the briquettes, caused bad swelling and checking and led to the rejection of many carloads, after which it was very noticeable that

for the remainder of the season the percentage of rejected carloads of this same cement was extremely low. Samples from this badly checked cement taken for retest were allowed to season about a month and mortar briquettes, 1 to 1 and 2 to 1, were made up of it. These tests howed up very well in long time, 3 months to a year.

A similar experience was had with another brand of natural cement, both in 1895 and 1896. In all of these cases except where the trouble was plainly due to excess of free lime, the cement manufacturers and their agents, professed utter ignorance of any possible cause for the sudden and marked falling off in the strength of their product. But notwithstanding this ignorance it was noticeable that soon after enough cement had been rejected to thoroughly impress upon the minds of those most deeply interested, that questionable cement would not pass, there always came a decided improvement and a return to former good quality.

The behavior of some of the natural cement tested this summer (1896) seemed peculiar. During the very hot weather the tests were nearly all high. Second sets of samples were procured from two carloads, each of Louisville and Utica. The regular tests of these were made in the very hot weather but the retests from second sets of samples were not made up until about three weeks later when the temperature was lower. The results of these tests are as shown in Table II.:

*Table II.*

Kind of cement.	Car.	Nature of test.	Date of mixing.	AVERAGE BREAKING STRENGTH AT AGES OF					
				7 Days.		28 Days.		3 Months.	
				Neat.	1 : 1	Neat.	1 : 1	Neat.	1 : 1
Louisville...	69621	Regular .....	Aug. 7..	239.3	.....	.....	.....	.....	.....
		Special Re-test...	Aug. 27..	180.0	82.4	226.0	189.2	301.9	319.6
	1307	Regular .....	Aug. 7..	230.0	.....	.....	.....	.....	.....
		Special Re-test...	Aug. 28..	145.6	60.3	221.4	127.8	288.2	294.5
Utica.....	50133	Regular .....	Aug. 7..	278.6	.....	.....	.....	.....	.....
		Special Re-test...	Aug. 29..	156.0	.....	261.2	.....	310.8	.....
	50876	Regular .....	Aug. 7..	272.4	.....	.....	.....	.....	.....
		Special Re-test...	Aug. 29..	.....	122.5	.....	242.8	.....	248.6

## TEST OF PORTLAND CEMENT.

The specifications of the sanitary district, relative to cement, call for the "best Portland and natural cements", "brand and quality subject to approval of chief engineer who shall from time to time cause such tests to be made as may seem to him proper." The tensile strength required is for natural 100 and for Portland 400 pounds per square inch, in 7 days neat test.

Much more thorough tests were made of Portland cement than of natural.

For tensile test of each carload 3 briquettes were made for 7 days neat test and 15 for 28 days, and when there was time 5 each for 3 months, 6 months and 12 months neat and 10 for 7 days and 5 each for 28 days, 3 months, 6 months and 12 months of either 2 to 1 or 3 to 1. Tests of the times of setting, initial and final, and the fineness were made of every carload and also tests for uniformity of volume.

As a rule the American Portland cements were found to be finer ground than the imported Portlands. The sand used in the 2 to 1 and 3 to 1 mortar tests was a commercial sand instead of "standard sand". It was clean, sharp, rather coarse, but varying in size from the finest up to what would just pass a sieve with 8 meshes per linear inch.

## SETTING TEST.

The pat used in making the setting test should be covered up in a moist place to protect it from warm air and drafts. In some cases it was found that a Portland cement which would require 5 or 6 hours for its initial set when thus protected, would set in 1 hour 30 minutes to 2 hours 30 minutes on a hot summer day if exposed to the drafts of the room. Drying cracks are often caused in the best cements by such exposure. The amount of water used in mixing the pat has a very marked effect on the time this test considerably wetter than the briquettes for tension test. of setting. In our tests it was thought best to mix the pats for

It being a difficult matter to accurately define or identify just the same consistency for all cements, especially where the test is made by different persons at different times, it was decided to use 30 per cent. of water for all Portland and 40 per cent. for all natural cements in the setting tests.

## TESTS FOR UNIFORMITY OF VOLUME.

Checks on the uniformity of volume were made by observing the behavior of pats placed in water and others in the air and also by the boiling test. After some experimenting and reading up on the subject an apparatus was evolved for boiling test which answers the purpose very well. A wash boiler was rigged up with a perforated iron shelf hung inside. This shelf conforms to the shape of the inside plan of the boiler, leaving about half an inch space all around and is suspended by two chains passing over small pulleys fastened in the ends of the boiler near the top. The boiler is heated over a two-burner gas stove. With the cover on, there is escape for the steam so it can not be held under pressure. Tests can be made in the steam by fastening the shelf, holding the pats for test, above the surface of the boiling water, or in boiling water by lowering the shelf and pats below the surface.

The test usually made was to expose the pats to the steam for about three hours and then lower them into the boiling water for about three hours 30 minutes.

It was found that if the temperature of the water was raised to boiling point before placing the pats on the perforated shelf and the pats were not set hard, surface checks and blisters very often formed on the pats in a short time, due to the rapid rise in temperature. But if the gas was not lighted under the boiler until the pats were placed inside, it would take 30 or 40 minutes for the water to boil and by that time the pats would be set hard, unless the cement was very bad, even though they were freshly mixed when placed in the boiler. The gradual rise to a high temperature serves to greatly accelerate the setting and yet has not been observed to cause failure of the pat in any case where pats of the same cement which had set hard before being subjected to the boiling test, remained perfectly sound through the test.

Some engineers object strongly to the use of the boiling test for cement and possibly there are some brands of cement that utterly fail in the boiling test and still give satisfaction in actual use. But in the writer's opinion the boiling test made in conjunction with other tests is a very useful one. As an instance of its use: a certain brand of American Portland cement which was used this season in work of the sanitary district tested well and gave satisfac-

tion in use early in the season. Later on this same brand of cement showed signs of irregularity in tests, some carloads being too quick setting and some being much lower in tensile strength than usual. All of this cement submitted for use on the drainage canal withstood the boiling test very well from the beginning of the season up to the last consignment of several carloads, all of which utterly failed in the boiling test, most of the pats in fact, swelling and finally totally disintegrating after two or three hours' exposure in the steam bath. These carloads were all right for fineness and rate of setting and two or three of them showed a sufficient tensile strength in seven days neat test to admit of acceptance, if that had been the sole criterion. But the wisdom of rejecting them as soon as the boiling tests were completed, without even waiting for 7 days neat tests, became evident later on, for very marked checking and swelling developed in the briquettes of the 28 days neat tests of every one of these carloads. This checking had not become apparent in any of the seven days briquettes. The 28 days 3 to 1 test of one of these cars averaged over 200 pounds. Half of each of the 5 briquettes was put through the regular steam and boiling test soon after breaking. The pieces all swelled badly and became so soft that they could be crushed between thumb and finger. The older pieces of these briquettes are laid away in a box to see what effect time and ordinary temperature will have on them.

#### IRREGULARITY IN PORTLAND CEMENTS.

The following Table III. gives an idea of the variability of Portland cement as delivered for use on public works. I. P. is an imported Portland and A. P. (1) and A. P. (2) are American Portlands, A. P. (2) being the same cement mentioned in connection with the boiling tests.

Lack of space will not permit the insertion of tests of each carload, but the breaking strengths given as the minimum and maximum for 7 and 28 days are in each case averages of the regular tests of a carload and the number of carloads tested from which these selections were made is given in the last column. The variation in time required for initial set is also given. The cement marked (C) is an imported Portland having a very good reputation, yet several carloads of it submitted for use on the drainage canal were absolutely too quick setting for ordinary work.



Table III.

	Pro- portion of mix- ture.	7 DAYS.		28 DAYS.		Setting test variation in time of "Initial Set."	No. of Cars Tested.
		Mini- mum.	Maxi- mum.	Mini- mum.	Maxi- mum.		
I. P....	Neat..	428	643	578	724	1 hr. 25 min. to 5 hrs. 50 min.	25
	2 to 1..	155	035	218	312		
	3 to 1..	121	159	142	145		
A. P.(1)	Neat..	490	691	541	793	1 hr. 25 min. to 5 hrs.	45
	2 to 1..	212	348	289	446		
	3 to 1..	135	246	209	316		
A. P.(1)	Neat..	372	580	454	689	5 min. to 4 hrs. 10 min.	30
	2 to 1..	*164	562	*98	346		
	3 to 1..	†55	219	†164	287		
(C) ....	.....	.....	.....	.....	.....	13 min. to 3 hrs. 45 min.	9

A sample of a certain brand of German Portland cement enjoying an almost undisputed reputation for excellence was brought to the writer for test and gave the following results neat: One day briquettes which were placed in water before acquiring final set, swelled and checked badly; seven days test averaged 282 pounds; 28 days test averaged 370 pounds. The dealer from whom this cement was obtained made tests agreeing closely with these and the best excuse he could give for such behavior was that upon inquiry he learned that that particular lot of cement had probably been damaged in transit or while stored in some warehouse.

Such instances of failure or great irregularity in some of the best brands of imported Portland cement lead the writer to think it is unsafe to accept any brand of cement unconditionally for important work.

Another reason for testing all Portland cement used in important work is that dealers are often tricky and if they have an idea cement is not to be tested they will often substitute an inferior article for the one contracted for, if necessary, even packing it into emptied barrels bearing the label of the better cement.

The use of hydraulic cement is increasing so rapidly both as to quantity and variety of applications that even during the past year of hard times many of the mills both of Portland and natural

cements had difficulty to fill their orders. Such a state of affairs is bound to place poor cement on the market along with good, for many of the mills will ship cement as fast as it is turned out, without taking time for tests or seasoning, merely for the sake of holding customers whom they are very likely to lose on account of their haste.

This is exactly what did happen in the case of the Portland cement which stood the tests of the sanitary district early this season but failed so utterly at the end.

This uncertainty is not restricted to the newest mills but is shared by all Portland cement mills that do not hold their cement until its good quality is proven by tests and analyses. Probably the majority of poor Portland cement is the result of either overburning or underburning, the operation of burning Portland cement being a very particular one.

Anything approaching absolute accuracy in cement tests may never be attained but this does not greatly impair the usefulness of such tests, since by taking reasonable care sufficient accuracy *can* be attained to warn us of radical change in quality of product and afford much other useful information.

---

## AN OASIS.

BY LEONARD S. SMITH, '90, C. E. '95.  
*Assistant Professor of Topographical Engineering.*

It is a mistake to suppose that the hard work and often severe privations, incidental to field operations in an unsettled country, are not sometimes relieved by an experience of lighter vein, as the following, taken from my diary, may serve to illustrate.

It was early in March, 1893, that our party of about thirty men set out eastward from the Colorado river to survey the international boundary line across the 200 miles of dreary waste called the Yuma Desert. No previous expedition with wagons had ever succeeded in crossing the fifty miles of sand dunes immediately east of the Colorado river, though the attempt had been repeatedly made. Natives most familiar with the desert region regaled us with tales\* of the horrible death by starvation of

---

\*During the trips, evidence of the truth of these tales was not wanting. At the first watering place forty-five miles from the Colorado I counted over forty graves.

water, which had overtaken the too venturesome prospector and prophesied our own failure. Under these circumstances it was not without some misgivings for the future that our party prepared to break camp and leave the muddy but hospitable shores of the Colorado river.

On account of the intense heat of summer, sometimes reaching 118 degrees in the shade, it had been planned to cross the desert in the winter time, but owing to a series of unfortunate delays the party did not get started till spring. The months of March, April, May and most of June were spent in surveying about 130 miles of the desert and every one had become heartily sick of seeing nothing but sun, sand and saurians, when it was announced that the next day we should camp on the banks of a real live running stream of water, the Sonoyta river. 'Tis true that this little creek seemed ashamed of its size and was glad to hide its tiny form under the protecting sands, after running but a few miles in the sunlight, but it was the first running water we had seen and the welcome it received was correspondingly cordial.

The point where we first crossed the river was called on the maps "Aqua Dulce" (Sweet Water). Enticed by the name and an abnormal desert thirst, some members of the party including myself essayed to drink from the river, not noticing the glistening crystals of salt on the banks. The result was a great disappointment and we were forced to delay drinking until the water had been mixed with a generous proportion of coffee. Farther up the valley the water is very much better, and here, where the underlying rocks first force the river to come to the surface, near the center of the Yuma desert is located the little cluster of adobe huts called Sonoyta, a veritable oasis.

Seemingly Robinson Crusoe on his solitary ocean island was not much more isolated from the world than were these primitive Mexican villagers in their little valley. The effect of this isolation upon the people was everywhere in evidence. I saw a rancher threshing his wheat by chasing a drove of about a score of young horses around in a small (but high) enclosure, while his assistant from the center of the stack threw down the grain beneath the horses' feet, to be trampled upon till threshed. What answered for plowing in this primitive community was universally done with a crooked stick. The family supply of flour was prepared either by hand

with mortar and pestle or with two mill stones turned by the slow but patient little donkey. What little work I saw in progress seemed to be done by the women, Papago Indians, or the donkeys. Unfortunately for the people, the soil near the river where water is abundant, is so productive that nature requires but little encouragement or assistance. For instance, ten heavy crops of alfalfa during the year are common. The year is one continual summer time.

As evidence of the universal laziness and improvidence of the people I may state that not infrequently grain was left standing in the field months after it had ripened, each morning just enough of grain being gathered with a sickle to suffice for that day's needs. Before breakfast it would be ground as described above and baked into tortias, the Mexican bread, a substance not unlike crackers with the thickness of window glass, and varying in diameter from a few inches to two feet, depending upon the skill of the cook. The latter person scorns such a modern convenience as the rolling-pin, but instead, with a dexterity hard to understand, rolls her tortias with her hands, giving the tortias meanwhile a peculiar circular motion. Wash tubs did not seem to be appreciated either. Instead the women repaired to the river bank on wash days. That their labors were thorough was proved by the fact that while the men were almost universally shabbily dressed (except their hats and spurs) their linen was quite as generally snowy white.

Until we reached Sonoyta we had seen no white people outside of our own party and four Mexican smugglers. As the latter refused to be interviewed but instead galloped by us with their carbines in their arms, they can be disregarded in the enumeration.

Reading matter was almost as scarce as visitors and talking matter even scarcer, for every one had told every one else his ideas, and the more talkative members of the party had even repeated their list several times. As a result, even were the ideas ever so bright and witty constant handling in such a dry climate had made them dry and uninteresting. It was quite usual at the table to hear a statement begun by one person and finished by another. Knowledge seemed to be owned in common. We were quite ready for something new by way of variety and this is the form it took:

We had been camped near Sonoyta but a few days when our head heliotroper gave out at supper time a cordial invitation from

Senior Don Carlos Cervantes to attend a Mexican country dance or "bailar." In order that the reader may appreciate the honor this conferred and the pleasure it promised, it need only be explained that Don Carlos was practically the ruler of the community, for in addition to being mayor and postmaster of the village he had managed, by a judicious use of credit at his saloons and his general store, to keep nearly every one in his debt. Of course he lived in a style becoming his great wealth and high station, and his adobe was famous both for its size and its hospitality.

Arrayed in our best canvas clothes the three engineers in camp set out together. Upon our arrival at the home of Don Carlos we found a large company had preceded us. The fact that only the upper crust of Sonoyta had been invited to meet the Americans, seemingly did not prevent all the other men, women and children of lesser note from gathering around the piazza to witness the unusual event. Only three of us were formally introduced to the ladies by Don Carlos, perhaps because we were supposed to serve as sample copies of the remainder of our party. The young ladies were all seated on benches around the piazza, accompanied by their mothers. Four sisters especially attracted my attention for the reason that all were dressed exactly alike in true Wisconsin colors. I interpreted their unanimous use of the cardinal as being an expression of their regard for the U. W. Mr. P. from Johns Hopkins took an altogether different view of the matter but failed to convince me that I was wrong. As a small recompense for their loyalty I gave the fair sisters my entire attention for the evening. Unfortunately the young ladies could not speak or understand a single word of English and my own command of Spanish was not much better. It improved, however, during the evening, and after this experience I borrowed a Spanish grammar and made such good use of it that the next time I happen in Sonoyta I shall be better prepared for such an emergency.

The poor success of the conversation was in striking contrast to the remainder of the program. Upon being invited to sing, the four cardinal dressed sisters and a brother responded by singing a very weird but characteristic Mexican song accompanied by a harp and guitar. The effect was irresistibly beautiful. It is difficult to analyze the peculiar charm of the Mexican songs, though they seem to respond to the free, open air life of the people. The songs

themselves are many of Indian origin, and even those distinctly Spanish have been greatly modified by their Indian environment. It is this peculiar expression that gives the Mexican songs their chief charm.

The singers responded to a hearty encore by singing their national hymn with great spirit and enthusiasm. They then invited the Americans to sing their national song. As would be expected this request precipitated an animated discussion among the Americans as to what our national song really was. Yankee Doodle, Hail Columbia, Nellie Was a Lady, The Star Spangled Banner, America, etc., were suggested, and each had its own supporters. Finally the majority agreed upon America and sang it with some spirit. Their efforts would doubtless have met with greater success, had not the several minorities continued in their desire to sing their own selection. Apparently a working majority in politics will not constitute a working, or at least a singing, majority in music. It is quite significant that the Americans were not invited to sing again.

Instead, as our head heliotroper had given the ladies glowing if not truthful descriptions of the wonderful American quadrille, the ladies suggested that this be made the next number on the program. The Americans were only too glad of a chance to redeem themselves. A prompter was chosen, the selection falling upon an old grey-haired man, whose life had been spent in Salt Lake City. Now the result of his calling showed clearly that either the species of quadrille current in that Mormon state differed from the quadrilles of Wisconsin, or else the old gentleman had allowed the liquid refreshments to usurp an undue amount of his attention. At any rate before the conclusion of the dance each one found it necessary to be his own prompter. This resulted in some confusion, the dark eyes of the senioretas showing both wonder and amusement, but it was evident that in their estimation the American quadrille was a great success.

I should have stated before that the dancing hall was the space beneath the large piazza, the supports of which each held a candle, shedding just enough light to render the scene a most picturesque one. The floor was natural soil, not entirely free from gravel and quite suited to our number ten hob-nailed shoes.

After several quadrilles, a waltz was announced. Its execution

proved quite as remarkable as the quadrille, but this time it was the Americans who were surprised. The cause of our amazement was the remarkably fast time with which the dance was executed. I regret that I am not able to state the exact average number of revolutions per second made by the Mexican dancers, but it would be difficult to overestimate it. Reversing seems to be unknown. How the natives can attain and continue such remarkable velocities in dancing, especially at such high temperatures, without sacrificing both grace and pleasure, is beyond my comprehension. Yet they do it. One could not but notice that every movement of the Mexican ladies was the very essence of grace and poetry. Every movement of the arm was made in some graceful curve, never in a straight line, and all agreed that such a melodious language either in speech or song had never been dreamed possible.

The dancing continued till a late hour when the Americans bade farewell to their fair companions, to begin anew on the morrow the fatiguing mountain climbing of their topographic work. It is safe to say, however, that the memory of this little oasis in that far-away Sonoyta valley will not soon be forgotten.

---

#### EDITORIAL NOTES.

##### *Not yet a Volume.*

The first volume of this publication will contain five numbers; there being but one number in the academic year, '95--'96, it was decided that it would be best to make volume one contain five numbers. Our readers will therefore do well to postpone binding their copies until number five is printed.

##### *The Need of an Engineering Building.*

The engineering department of the University of Wisconsin is one of the best in the United States and yet is without an engineering building. Her facilities are good, her courses are well developed and some of them more advanced than in any other American university, yet all three of the engineering departments are so crowded for room that an engineering building is an absolute and immediate necessity.

The steam and hydraulic laboratories are crowded into a room

# Wisconsin Engineer Index

## To Current Engineering Periodicals.

**Explanation:**—W. words, M. Jan., W. Jan. 4, or E. Jan. 6, at the end of the reference, indicates that a description or digest of the article may be found in the index of the Engineering Magazine of January, in The Electrical World digest of January 4, or in the Electrical Engineer digest for January 6th.

List of periodicals from which articles are indexed:

- Age of Steel, The. *w.* \$3. St. Louis.  
American Architect, The. *w.* \$6. Boston.  
American Electrician. *m.* \$1. New York.  
Am. Engineer and Railroad Jour. *m.* \$2. New York.  
Am. Chemical Journal. *b-m.* \$4. Baltimore.  
Am. Gas Light Journal. *m.* \$3. New York.  
American Geologist. *m.* \$3.50. Minneapolis.  
Am. Journal of Science. *m.* \$6. New Haven.  
American Machinist. *w.* \$3. New York.  
Am. Manufacturer and Iron World. *w.* \$4. Pittsburgh.  
American Miller. *m.* \$2. Chicago.  
American Shipbuilder. *w.* \$2. New York.  
Am. Soc. of Irrigation Engineers. *qr.* \$4. Denver.  
Annual Report of Illinois Society of Engineers and Surveyors. New York.  
Architect, The. *w.* 26s. London.  
Architectural Record. *qr.* \$1. New York.  
Architectural Review. *qr.* \$5. Boston.  
Architecture and Building. *w.* \$4. New York.  
Architektonische Rundschau. *m.* 18 marks. Stuttgart.  
Australian Mining Standard. *w.* 30s. Sidney.  
Baker's Railway Magazine. *m.* \$2. New York.  
Board of Trade Journal. *m.* 6s. London.  
Boston Journal of Commerce. *w.* \$3. Boston.  
Brick. *m.* \$1. Chicago.  
Brick Builder, The. *m.* \$2.50. Boston.  
British Architect, The. *w.* 23s. 8d. London.  
Builder, The. *w.* 26s. London.  
Bulletin Am. Iron and Steel Assn. *w.* \$4. Phila.  
Bulletin of Univ. of Wisconsin. Madison.  
California Architect. *m.* \$3. San Francisco.  
Canadian Architect. *m.* \$2. Toronto.  
Canadian Electrical News. *m.* \$1. Toronto.  
Canadian Engineer. *m.* \$1. Montreal.  
Canadian Mining Review. *m.* \$3. Ottawa.  
Cassier's Magazine. *m.* \$3. New York.  
Clay Records. *m.* \$1. Chicago.  
Colliery Engineer. *m.* \$2. Scranton.  
Colliery Guardian. *w.* 27s. 6d. London.  
Compressed Air. *m.* \$1. New York.  
Deutsche Bauzeitung. *b-w.* 15 marks. Berlin.  
Dingler's Polytechnisches Journal. *w.* 43.60 marks. Stuttgart.  
Domestic Engineering. *m.* \$2. Chicago.  
Electrical Age. *w.* \$3. New York.  
Electrical Engineer. *w.* 19s. 6d. London.  
Electrical Engineer. *w.* \$3. New York.  
Electrical Engineering. *m.* \$1. Chicago.  
Electrical Industries. *m.* \$1. Chicago.  
Electrical Journal. *s-m.* \$2. Chicago.  
Electrical Plant. *m.* 6s. London.  
Electrical Review. *w.* 21s. 8d. London.  
Electrical Review. *w.* \$3. New York.  
Electrical World. *w.* \$3. New York.  
Electrician (Electn.). *w.* 24s. London.  
Electricity, (Elec. Lond.). *w.* 7s. 6d. London.  
Electricity (Elec.). *w.* \$2.50. New York.  
Elektrochemische Rundschau. *t-m.* 9.50 marks. Frankfurt.  
Electrochemische Zeitschrift. *m.* 18.40 marks. Berlin.  
Electrotechniker. *b-w.* 12 marks. Vienna.  
Elektrotechnischer Anzeiger. *s-w.* 10 marks. Berlin.  
Elektrotechnische Zeitschrift. *w.* 25 marks. Berlin.  
Engineer, The (Eng.) *s-m.* \$2. New York.  
Engineer, The (Eng. Lond.). *w.* 36s. London.  
Engineer and Contractor. *w.* \$1. San Francisco.  
Engineer's Gazette. *m.* 8s. London.  
Engineering (Engng.). *w.* 36s. London.  
Engineering and Mining Jour. *w.* \$5. N. Y.  
Engineering Magazine. *m.* \$3. New York.  
Engineering-Mechanics. *m.* \$2. Phila.  
Engineering News. *w.* \$5. New York.  
Engineering Record. *w.* \$5. London.  
Engineering Review. *m.* 7s. London.  
Eng. Soc. of the School of Prac. Sci. Toronto.  
Eng. Soc. of Western Pennsylvania. *m.* \$7. Pittsburgh.  
Fire and Water. *w.* \$3. New York.  
Foundry, The. *m.* \$1. Detroit.  
Garden and Forest. *w.* \$4. New York.  
Gas Engineers' Magazine. *m.* 6s. 6d. Birmingham.  
Gas World, The. *w.* 13s. London.  
Glaser's Annalen für Gewerbe und Bauwesen. *m.* 20 marks. Berlin.  
Heating and Ventilation. *m.* \$1. New York.  
Ill. Carpenter and Builder. *w.* 8s. 8d. London.  
India Rubber World. *m.* \$3. New York.  
Indian and Eastern Engineer. *w.* 20 Rs. Calcutta.  
Indian Engineer. *w.* 18 Rs. Calcutta.  
Industries and Iron. *w.* £1. London.  
Inland Architect. *m.* \$5. Chicago.  
Inventive Age. *s-m.* \$1. Washington.  
Iron Age. *w.* \$4.50. New York.  
Iron and Coal Trade Review. *w.* 70s. 4d. London.  
Iron and Steel Trades Jour. *w.* 25s. London.  
Iron Industries Gazette. *m.* \$1.50. Buffalo.  
Iron Trade Review. *w.* \$3. Cleveland.  
Jour. Am. Soc. Naval Engineers. *qr.* \$5. Washington.  
Jour. Assn. Eng. Societies. *m.* \$3. St. Louis.  
Journal of Electricity, The. *m.* \$1. San Francisco.  
Jour. Franklin Institute. *m.* \$5. Phila.  
Journal of Gas Lighting. *w.* London.  
Journal of Inst. of Elect. Engineers. London.  
Jour. New England Waterw. Assn. *qr.* \$2. New York.  
London.  
Jour. of Royal Inst. of British Arch. *s-qr.* 6s. London.  
Journal of Society of Arts. *w.* London.  
Journal of the Western Society of Engineers. *b-m.* \$2. Chicago.  
Kansas University Quarterly. *qr.* \$2. Lawrence, Kan.  
La Nature. *w.* 24.50 francs. Paris.  
La Revue Technique. *b-m.* 28 francs. Paris.  
L'Eclairage Electrique. *w.* 60 fr. Paris.  
L'Electricien. *w.* 25 fr. Paris.  
L'Energie Electrique. Paris.  
L'Génie Civil. *w.* 45 francs. Paris.  
L'Industrie Electrique. *b-m.*  
L'Moniteur des Architectes. *m.* 33 francs. Paris.



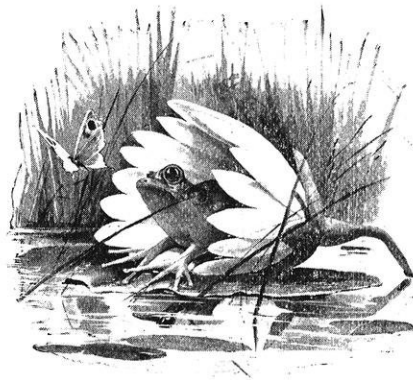
eighty by forty feet. This same room also contains apparatus for testing oils. The arrangement of engines and other machinery with regard to floor space is in this laboratory, is a marvel of ingenuity. Apparatus is needed to extend the usefulness and capacity of the hydraulic laboratory; the thermodynamic department requires the addition of more machinery in the line of refrigerating apparatus, gas engines and the like, but cannot get it because, were the machinery obtained, lack of floor space would prevent its installation.

The dynamo laboratory is also crowded, every square foot of the thirty-five by fifty foot room being occupied. This room would be larger but for an additional length of twenty-five feet which is at present devoted to the testing of constructive materials, the electrical department having sacrificed this for the accommodation of the much crowded mechanical laboratory. The room originally intended for the electrolysis laboratory is for a similar reason now occupied as a drafting room, this laboratory being crowded into a much smaller room. None of the departments have suitable places to keep their standard instruments and there are no small rooms to secure to advanced students the privacy which is necessary for the success of research work. It seems unnecessary to multiply further on this crowded condition of affairs, than to quote from the last biennial report of the Board of Regents. From President Adams' report we extract the following:

"The various scientific departments of the College of Letters and Science need the entire room afforded by Science Hall, and it is hoped that in the near future some provision may be made by which the large space now occupied by drawing rooms and lecture rooms for the College of Engineering, may be turned over to the exclusive use of the College of Letters and Science." \* \* \* \* \*

"An inspection of the quarters of the engineering students, however, will show that even at the present time the accommodations are inadequate for the proper development of the department. In discussing the needs of the College of Letters and Science, I made reference to the fact that the College of Engineering is obliged to occupy a very considerable part of Science Hall, much to the inconvenience of the College of Letters. *It is hardly too much to say that the most pressing of the material needs of the University at the present time is the erection of a new and adc-*

- L'Moniteur Industriel. *w.* 40 francs. Paris.  
 Locomotive Engineering. *m.* \$2. New York.  
 Machinery. *m.* \$1. New York.  
 Machinery (Mach. Lond.) *m.* 9s. London.  
 Manufacturer and Builder. *m.* \$1.50. New York.  
 Manufacturer's Record. *w.* \$4. Baltimore.  
 Marine Engineer. *m.* 7s. 6d. London.  
 Master Steam Fitter. *m.* \$1. Chicago.  
 Mechanical World. *w.* 8s. 8d. London.  
 Metal Worker. *w.* \$2. New York.  
 Mining and Sci. Press. *w.* \$3. San Francisco.  
 Mining Industry and Review. *w.* \$3. Denver.  
 Mining Journal, The. *w.* £1, 8s. London.  
 Mining World, The. *w.* 21s. London.  
 Monatschrift des Württ. Vereins für Baukunde.  
 3 marks. Stuttgart.  
 Municipal Engineering. *m.* \$2. Indianapolis.  
 National Builder. *m.* \$3. Chicago.  
 Nature. *w.* \$7. London.  
 New Science Review, The. *qr.* \$2. New York.  
 Oesterreichische Monatschrift für den Oeffentlich-  
 en Bandienst. *m.* 14 marks. Vienna.  
 Physical Review. *b-m.* \$3. New York.  
 Plumber and Decorator. *m.* 6s 6d. London.  
 Popular Science Monthly. *m.* \$5. New York.  
 Power. *m.* \$1. New York.  
 Practical Engineer. *w.* 10s. London.  
 Proceedings Engineers' Club. *qr.* \$2. Philadel-  
 phia.  
 Progressive Age. *s-m.* \$3. New York.  
 Railroad Car Journal, The. *m.* \$1. New York.  
 Railroad Gazette. *w.* \$4.00. New York.  
 Railway Age. *w.* \$1. Chicago.  
 Railway Master Mechanic. *m.* \$1. Chicago.  
 Railway Press, The. *m.* 7s. London.  
 Railway Review. *w.* \$1. Chicago.  
 Railway World. *m.* 5s. London.  
 Safety Valve. *m.* \$1. New York.  
 Sanitarian. *m.* \$4. Brooklyn.  
 Sanitary Plumber. *s-m.* \$2. New York.  
 Sanitary Record. *m.* 10s. London.  
 School of Mines Quarterly. \$2. New York.  
 Schweizerisches Bauwesen. *w.* 20 marks. Zurich.  
 Science. *w.* \$5. Lancaster, Pa.  
 Scientific American. *w.* \$3. New York.  
 Scientific Am. Supplement. *w.* \$5. New York.  
 Scientific Machinist. *s-m.* \$1.50. Cleveland.  
 Seaboard. *w.* \$2. New York.  
 Sibley Jour. of Engineering. *m.* \$2. Ithaca, N. Y.  
 Southern Architect. *m.* \$2. Atlanta.  
 Stahl und Eisen. *s-m.* 20 marks. Dusseldorf.  
 Stationary Engineer. *m.* \$1. Chicago.  
 Steamship. *m.* Leith, Scotland.  
 Stevens' Indicator. *qr.* \$1.50. Hoboken.  
 Stone. *m.* \$2. Chicago.  
 Street Railway Journal. *m.* \$4. New York.  
 Street Railway Review. *m.* \$2. Chicago.  
 Technology Quarterly. \$3. Boston.  
 Tradesman. *s-m.* \$2. Chattanooga, Tenn.  
 Trans. Am. Inst. Elect. Engineers. *m.* \$5. New York.  
 Trans. Am. Inst. Mining Engineers. New York.  
 Trans. Am. Soc. Civil Engineers. *m.* \$10. New  
 York.  
 Trans. Am. Soc. Mechanical Engineers. New York.  
 Transport. *w.* £1, 5s. London.  
 Western Electrician. *w.* \$3. Chicago.  
 Western Mining World. *m.* \$4. Butte, Mon.  
 Wiener Bauindustrie Zeitung. *w.* 22 marks. Vi-  
 enna.  
 Wisconsin Engineer. *qr.* \$1.50. Madison.  
 Yale Scientific Monthly, The. *m.* \$2.50. New  
 Haven.  
 Zeit chrift des Oesterreichischen Ingenieur und  
 Architekten Vereins. *w.* 53 marks. Vienna.  
 Zeitschrift des Vereines Deutscher Ingenieure. *w.*  
 32 marks. Berlin.  
 Zeitschrift für Beleuchtungswesen.  
 Zeitschrift für Electrochemie. *s-m.* 16 marks.  
 Halle.  
 Zeitschrift für Elektrotechnik. *s-m.* 16 marks.  
 Halle, a. S.  
 Zeitschrift für Instrumentenkunde. *m.* 20 marks.  
 Berlin.



*quate building for the college of Engineering.* This would enable the Regents to remove the drawing room and the mechanical laboratory from Science Hall, and bring together into a single building all the activities of this great and important division of the University."

Quoting from the report of the Board of Visitors in 1895: "Additional space is also much needed for the College of Mechanics and Engineering. The surveying instruments are now kept in the Janitor's room, an arrangement seriously interfering with their proper care and use. The basement room used as a laboratory is unsuited for the purpose, and no satisfactory hydraulic work can be done without additions to the apparatus which are impracticable in the present building and in another case it is necessary to use the same room for both a draughting room and a blow-pipe laboratory. It is also impracticable to make a collection of specimens, models, and other illustrative apparatus until a suitable room can be provided for such a collection. The new extension to the machine shop relieves the college only in the matter of draughting rooms, and that relief can only be temporary since that space is already needed for laboratories by the electrical department.

While we realize that the financial condition of the University renders the construction of such a building at present impossible, yet in view of these facts and of the continued growth of the college, it is extremely important for the good of the University that an adequate building be begun at the earliest practicable moment."

Again the Board of 1896 reports as follows:

"The present quarters in Science Hall are entirely inadequate for the best facilities for modern instruction. The necessity for increased facilities has been recognized and met by such institutions as Purdue, Illinois, Minnesota, Colorado, Nebraska and many others by the erection of suitable engineering buildings costing from \$20,000 to \$150,000. We feel, therefore, that in order to maintain and improve the present standard in this work it will be necessary to have an engineering building at the earliest possible date."

Ohio, Cornell, Michigan, California, Columbia and a number of the other universities have magnificent engineering buildings. While Wisconsin has advanced and maintained her reputation with

- A**BSORPTION of Electric Waves by a Terminal Bridge—Barton and Bryan, Proc Phys Soc, Lond, Feb—97.
- ACCIDENTS** in the United States in October, Train—R R Gaz, Nov 20—96. 4500 w.
- Accidents** in the United States in November, Train—R R Gaz, Dec 25—96. 2700 w.
- Accidents** in the United States in December, Train—R R Gaz, Jan 29—97. 2500 w. M Mar.
- ACCUMULATOR**—Zacharias. Elektrochem Zeit, Nov—96. W Jan 2.
- Accumulator**, Effect of Manganese Compound in the Lead—Knorre. Zeit f Elektrochem, Feb 20—97.
- Accumulator** of Faure and King—Elek Anz, Jan 21—97.
- Accumulator** of the Jefferson Physical Laboratory of Harvard University, The High-Tension—John Trowbridge. Elec Wld, Jan 2—97. 1300 w.
- Accumulator**, The Blot—Elec Eng, Lond, Jan 15—97. E Feb 10.
- Accumulator**, The Gulcher (III)—Elektrochem Zeit, Dec—96. 500 w.
- Accumulator Traction** at Ostende—L'Elec, Feb 27—97.
- Accumulator vs. Trolley Traction**—Elek Anz, Feb 14—97. W Mar 27.
- Accumulators**—Elektrotechn Zeit, Jan 21—97. W Feb 20.
- Accumulators**—Gruenwald. Elek Anz, Nov 22, 29—96. W Jan 2.
- Accumulators**, Air—Elek Anz, Feb 4—97. W Feb 20.
- Accumulators**, High Potential—Zehnder. Electn, Lond, Jan 22—97. W Feb 6.
- Accumulators** in Power Railway Houses, Application of—Schoop. Zeit f Elek, Feb 15—97. W Mar 13.
- Accumulators** in Telegraphy—Montpellier. L'Elec, Dec 26—97.
- Accumulators** with Gas Relief, Concerning—Jos. Zacharias. Elektrotechn Zeit, Nov—96. 3900 w. M Feb.
- Accumulators**—See Electric Railways.
- ACETYLENE**, Carbide of Calcium and—Eng, Lond, Jan 15—97. 3000 w.
- Acetylene Gas**—Eng, Lond, Dec 11—96. 1300 w.
- Acetylene** for Motors—The Use of—Jour Gas Lgt, Dec 15—96. 700 w.
- Acetylene**, Studies of the Explosive Properties of—Messrs. Berthelot and Violle. Pro Age, Dec 1—96. 2200 w.
- ADIRONDACK** of the People's Line, The Hudson River Steamer (III)—Sci Am, Dec 26—96. 1700 w.
- AFTERDAMP**—T. G. Davies. Col Eng, Dec—96. 2000 w.
- AIR** at the Shops of the Atchison, Topeka and Santa Fe (III)—R R Gaz, Jan 15—97. Serial Part I. 1500 w. M Mar.
- Air-Brake System**, Two Pipe (III)—Loc Engng, Feb—97. 1400 w.
- Air Compressor**, Belt Driven Automatic (III)—Am Mach, Jan 14—97. 300 w. M Mar.
- Air Compressor**, Electrically Driven—Ry Rev, Jan 23—97.
- Air Compressor** for Shop Service, The Best—Frank Richards. Am Mach, Dec 3—96. 1500 w. M Jan.
- Air-Lift**, Some Figures on the Cost of Pumping with the Pohlé—George R. Murray. Compressed Air, Jan—97. 2200 w. M Mar.
- Air Passing** Through a Register per Minute, Volume of—J. H. Kinealy. Met Work, Jan 20—97. 2400 w. M Mar.
- ATCHISON'S** Address Before the Royal Institute of British Architects—Jour Roy Brit Arch, Nov 5—96. 9500 w. M Jan.
- ALKALI** and Bleach by Chemical and Electrolytical Methods, On the Manufacture of—Bertram Blount. Electn, Lond, Dec 11—96. 5500 w.
- Alkalies** and Bleach—Kellner. Zeit f Elektrotechn, Feb 1—97.
- Alkalies** and Chlorine—Stoermer. Zeit f Elektrochem, Feb 20—97.
- Alkalies**, Future of—Carpenter. Elec Rev, Lond, Dec 11—96. W Jan 2.
- Alkaline Phosphate** and Caustic Alkali—Elec Rev, Lond, Mar 12—97. W Mar 27.
- ALLOYS** for Coinage, To Experiment with Different—Sci Am Sup, Jan 9—97. 600 w.
- Alloys** of Copper and Zinc, The—T. K. Rose. Nature, Dec 19—96. 1300 w.
- ALLOTROPIC** Theory, Evidence for the—Henry M. Howe. Eng & Min Jour, Dec 12—96. 800 w.
- ALTERNATING CURRENT** Electrolysis with Lead Electrodes, On the Formation of Lead Sulphate—Samuel Sheldon and Marcus B. Waterman. Phys Rev, Jan, Feb, 1897. 1200 w.
- Alternating Current Machinery**—Edwin G. Houston and A. E. Kennelly. Elec Wld, Jan 2—97. 1000 w.
- Alternating Current** Measuring Apparatus—Armagnat. L'Eclair Elec, Feb 13 and 20—97.
- Alternating Current** Problems, The Validity of the Use of Sine Curves in—W. G. Rhodes. Elec Rev, Lond, Dec 25—96. 1100 w.
- Alternating Current Traction Plant**—West Electn, Feb 20—97. W Feb 27.
- Alternating Current** Waves, Distortion of—Eisler and Reithoffer. Elektrotechn Zeit, Dec 10, 17—96. W Jan 2, 9.
- Alternating Current** Working, Principles of—Hay. Elec Eng, Lond, Dec 11—96. Jan 22—97.
- Alternating Currents**, Boosting with (III)—Alexander Russell. Electn, Lond, Nov 13—96. 1300 w. M Jan.
- Alternating Currents**, Conductor Resistance Met by—Dugald C. Jackson. Elec Wld, Jan 16—97. 1200 w. M Mar.
- Alternating Currents**, Through Unsymmetrical Self-Induction, On the Distortion of—H. Eisler and Dr. Max Reithoffer. Elektrotechn Zeit, Dec 10—96. E Jan 13.
- Alternating**, Direct Currents from—Albert G. Davis. W Jan 9—97. 700 w. M Mar.
- ALTERNATOR**—L'Elec, Jan 2—97.
- Alternator**—Guilbert. L'Eclair Elec, Jan 9—97.
- Alternator** (III)—Electn, Lond, Feb 12—97.
- Alternator**, Diphase—Guilbert. L'Ind Elec, Jan 10—97.
- Alternator** with Stationary Armature, A 640 Horse-Power Hutten-Leblanc (III)—F. Guilbert. Electn, Lond, Dec 11—96. 1300 w.
- ALTERNATORS**, Calculation of the Iron Losses in—Behn-Eschenberg. Elektrotechn Zeit, Jan 14—97. W Feb 6.
- Alternators**, Loss of Voltage in—Elektrotechn Zeit, Dec 10—96. W Jan 2.
- Alternators**, Parallel Operation of—Charles Proteus Steinmetz. Elec Wld, Jan 2—97. 1400 w.
- ALUMINUM** Amalgam—Biernacki. Elektrotechn Zeit, Feb 11—97. W Feb 27.
- Aluminum Conductors**—Burr. Elec Eng, Feb 3—97. W Feb 13.
- Aluminum**, Copper Plating—Elek Anz, Dec 10—96. W Jan 2.
- Aluminum**, Electrical Conductivity of—Richards and Thompson. Jour Fr Inst, Mar—97. W Mar 13.
- Aluminum Industry**—Leeds. Electn, Lond, Mar 5—97. W Mar 20.
- Aluminum** Manufacture in Europe—Alfred E. Hunt. Ir Age, Dec 10—96. 3000 w.
- Aluminum** Manufacture in Europe—Jour Fr Inst, Feb—97.

them all, a few more years of this crowding will lead first to stagnation, then retrogression, and we must keep to the front! Now that the legislature has continued the 1-5 mill tax for the support of the university indefinitely, there is no reason why the erection of an engineering building should not be begun immediately.

### *The Federation of Graduate Clubs.*

Why is it that the Federation of Graduate Clubs does not recognize the engineers? There are any number graduate courses in engineering in the different universities represented in the federation, and yet their catalogue of graduate courses totally ignores the engineers. This omission is not an oversight; it is intentional, and should be resented by every engineering graduate. At Wisconsin, advanced students in engineering are welcome to membership in the graduate club, but the average engineering alumnus is too independent to join when he knows the way he is judged by the Federation. It is said that in the realm of thought, there is no aristocracy; but the statement seems questionable in this case. There is more evidence seen in daily life, of engineering intelligence than any other form of education. All our books, magazines, and newspapers must come from the printing press; the news, from the telegraph; our mails, from the locomotive; we are indebted to the engineer for every ride in a street car or elevator; the very streets upon which we walk were planned and made by engineers; and even the boards in our houses were made at the saw mill. The object of engineering science is the immediate benefit of man; the heart of the engineer throbs for humanity; and yet the Federation of Graduate Clubs, a body of intelligent men, does not consider him fit company.

Why not organize the engineering graduates in a separate body? Meetings could be held annually and immediately before or after an annual meeting of some one of the American engineering associations. Having it at this time would insure a large attendance at the outset, and the organization would undoubtedly be a success. We would be pleased to hear from our exchanges on this question.

- Aluminum Patent Decision—Eng & Min Jour, Feb 20, 27—97.
- AMAZONIA. Cable—Elec Rev, Lond, Jan 22—97.
- AMMONIA, Discussion of Mr. Ritson's Paper on Sulphate of—Jour of Gas Lgt, Dec 8—96. 2300 w.
- Ammonia, Notes on Sulphate of—T. N. Ritson. Jour Gas Lgt, Dec 1—96. 2309 w.
- Ammonia, Sulphate of—H. H. Cousins. Jour Gas Lgt, Jan 29—97. 1300 w.
- AMPHIBOLITE, the Coast Defense Monitor (L.)—Sci Am, Nov 21—96. 1300 w.
- ANACONDA Copper Mining Company, Montana—Eng & Min Jour, Dec 26—96.
- ANIMAL Electricity—Waller. Elec Rev, Lond, Jan 22—97. Elec Eng, Lond, Jan 22—97.
- APPARATUS, Standardized—Armagnet. L'Eclair Elec, Jan 30—97.
- APPRENTICESHIP in the Trades Concerned in the Production of Machinery, Status of—Am Mach, Dec 24—96. 24000 w.
- ARC for Lantern Projection, The Electric—E. P. Hopkins. Elec Eng, Dec 16—96. Serial Part 1. 1200 w.
- Arc Lamp—Elec Rev, Lond, Mar 12—97.
- Arc Lamp, How to Make a Constant Potential—Cecil P. Poole. Am Electn, Dec—96. 1700 w.
- Arc Lamp, The Development of the—J. Warner. Elec, Lond, Oct 30—96. Serial Part 1. 2309 w. M Jan.
- Arc Lamp Trimmers, Tower Wagen for (III)—West Elec, Nov 21—96. 610 w.
- Arc Lamps—West Electn, Mar 29—97.
- Arc Lamp, Faults in—Am Electn, Feb—97. Sci Mach, Mar 15—97.
- Arc Lamps on 110 Volt Circuit, Three—L'Ind Elec, Jan 25—97.
- Arc Lights, Enclosed—L'Ind Elec, Feb 25—97.
- Arc, Luminous Efficiency of the—Blandel. L'Eclair Elec, Feb 13—97.
- Arc, on the Effect of Pressure in the Surrounding Gas on the Temperature of the Crater of an Electric—W. E. Wilson and S. F. Fritz. Electn, Lond, Jan 8—97. 2230 w. M Mar.
- Arc, Temperature of—L'Eclair Elec, Feb 27—97. W Mar 27.
- Arcs, Whistling—Bain. West Elec, Mar 6—97. W Mar 13.
- ARCHITECT, An Ideal—Archibald Dunn. Arch, Lond, Nov 27—96. 2700 w. M Jan.
- ARCHITECTURE, Advancement of, with Some Remarks on the Study of Gothic—George Atchinson. Brit Arch, Jan 29—97. 4800 w. M Mar.
- Architecture, Animal Symbolism in Ecclesiastical—Andrew D. White. Pop Sci M, Dec—96. 3800 w. M Jan.
- Architecture, English, of 1896—Mr. Statham. Brit Arch, Jan 15—97. 1600 w. M Mar.
- Architecture in the University—S. H. Capper. Can Arch & Build, Nov—96. 6030 w. M Jan.
- Architecture, Notes on Cottage—Ralph Nevill. Jour Roy Inst of Brit Arch, Dec 31—96. 7000 w. M Mar.
- Architecture of Cities, Color in the—Halsey Ricardo. Builder, Dec 12—96. 1499 w.
- Architecture of Italy in the Dark Ages (III)—Builder, Nov 28—96. 4300 w. M Jan.
- Architecture, The Possibility of a New Style of—D. B. Dick. Can Arch, Jan—97. 8500 w. M Mar.
- ARCHITECTURAL Construction, The Stimulus of Competition in—Dankmar Adler. Eng Mag, Jan—97. 3300 w.
- Architectural Enrichment, A Plea for the Use of Natural Forms Revealed by the Microscope as Suggestions for—W. H. Seth Smith. Builder, Dec 26—96. 5000 w. M Feb.
- Architectural Studies; To Canterbury, Bath and Oxford (III)—T. Raffles Davison. Brit Arch, Dec 18—96. 4000 w.
- ARMATURE and Other Rotating Parts of Machinery—William Baxter. Am Mach, Jan 21—97. 900 w. M Mar.
- Armature Disks, Making (III)—Am Mach, Dec 3—96. 1400 w.
- Armature Reactions (III)—Alexander Rothert. Electn, Lond, Nov 6—96. 4500 w. M Jan.
- Armature Reaction and Magnetic Dispersion in Dynamos—Elektrotechn Zeit, Jan 21, 28—97.
- Armature Reaction in Alternators—Kando. L'Ind Elec, Feb 10—97.
- Armature Reaction in Unipolar Alternators—v. Kando. Elektrotechn Zeit, Dec 10—96. W Jan 2.
- Armature Windings of Unipolar Alternating Current Machines—K. v. Kando. Elektrotechn Zeit, Dec 10—96. E Jan 13. Feb 24—97. W Mar 6.
- Armatures, Dead Wire on—Anthony. Elec Eng, Feb 19—97. W Feb 27.
- Armatures, Practical Methods of Determining Faults on—Am Electn, Dec—96. W Jan 2.
- ARMOR Plate, The Cost of American—Eng News, Jan 14—97. 1500 w. M Mar.
- Armor Plates, Annealing Harveized—Dougherty. Cassier's Mag, Mar—97.
- Armor—See Fortifications.
- ARMORY, The Central, Cleveland, O.—Eng Rec, Dec 5—96. 1100 w. M Jan.
- ARMOUR Institute of Technology, Power Plant of—West Elec, Feb 27—97. E Mar 10.
- ASCENSION Pipes, Stopped—S. Carpenter. Jour Gas Lgt, Jan 12—97. 1700 w.
- ASHINGTON Colliery, Northumberland—Col Guard, Nov 20—96. 2700 w.
- ASPHALT Pavements, Specifications for Repair of—Munic Engng, Dec—96. 1200 w.
- ATMOSPHERE Electrically Measured—McTighe. Elec Rev, Feb 24—97.
- ATOMS and Molecules—Am Mach, Nov 12—96. 1809 w.
- AUSTRALIA, Exploration in West and South (II)—W. Cara Boyd. Aust Min Stand, Nov 26—96. Serial Part 1. 2400 w. M Mar.
- AUTOMOTORS, Electric—Fitzgerald. Elec Rev, Lond, Dec 11—96. W Jan 2.
- AVERY Island—See Mine.
- AXLE, The New Master Car Builder's—R R Gaz, Nov 13—96. Serial Part 1. 2000 w. M Jan.
- Axles, Comparative Abrasion Tests of—Ry Mas Meeh, Jan—97. 1000 w. M Mar.
- B**ALL Bearings, Formulae for—Am Mach, Dec 2—96. 1000 w. M Jan.
- BATTERIES, Liquid for—Elektrotechn Zeit, Dec 13—96. W Jan 2.
- BATTLESHIP, The New—Philip Hichborn. R R Gaz, Nov 19. 1600 w. M Jan.
- Battleships, The Latest American (II)—Philip Hichborn. Eng News, Dec 10—97. 1800 w.
- BAZIN Roller Ship—Oesterr Monatschr f d Coeffent Bauindust, Jan—97. 1600 w. M Mar.
- BEARINGS, Experiments with Aluminum Bronze Machinery—George D. Rice. Ir Age, Jan 21—97. 1200 w. M Mar.
- Bearings of the Marine Engine, The—John Dewrance. Engng, Jan 1—97. 1600 w. M Mar.
- Bearings, Tests of Novel Types of Ball (III)—Ir Age, Dec 10—96. 1000 w.
- BEDFORD Stone, Louisville Cement and Other Things, Notes on (II)—Jour West Soc Eng, Oct—96. 16500 w. M Jan.
- BELL Telephone Business in the West—West Electn, Jan 30—97.
- BELTING, Treatment of Leather—Elec Rev, Lond, Dec 4—96.
- BERLIN Exhibition—Elektrotechn Zeit, Dec 10—96.
- BERLINER Patent Situation, The—Elec Wld, Jan 30—97. 4700 w. M Mar.
- BESSEMER Process, Historical and Technical Sketch of the Origin of the (III)—Sir Henry Bessemer. Am Soc Mech Eng, Dec—96. 6000 w. M Jan.
- Bessemer Process, The—A. M. Shook. Tradesman, Jan 1—97. 2500 w.
- BETHLEHEM Plate Mills (III)—Ir Age, Jan 21—97. 1809 w.

*Patent Law.*

An examination of a few patent specifications will at once reveal to the reader their uniform indefiniteness. One man having a good invention will limit himself by applying it to a particular type of machine, another will be so broad in his statements that it is utterly impossible to make out what he is trying to describe, another gives a perfect description of his appliance and then limits himself unnecessarily in his claims; in fact it is an unusual thing to find a real good patent specification. Patent applications should be broad and yet definite and the fact that they are not so as a general rule, shows that something is lacking in the authors. The trouble is that our patent attorneys are not properly educated, they need scientific training. Our foremost law colleges should each have a chair in patent law, requiring for admission to the course a thorough scientific training. An engineering course is just the right kind of preparation, but almost any of the scientific courses would stand the patent lawyer in good stead. His field of work is a profitable one and the extra time required for preparation would be time well spent.

*Cotton Baling.*

It is difficult to conceive accurately of the gigantic proportions of the cotton industry. Any invention that will aid in the handling of such an enormous produce as cotton means a great saving to the world, and to the country producing three-fourths of the entire cotton crop, it is a godsend. The cylindrical press is such a machine, and is now a perfected reality. The public has contracted an enormous debt; Magnus Swenson, '80, is the creditor and there is no chance of his being repaid. The Wisconsin Engineer has been honored with a contribution from this great inventor, describing his new press. Mr. Swenson has been so extremely modest in presenting his subject that we feel that a short sketch of his career is necessary.

After leaving U. W. in '80, Mr. Swenson devoted the first few years of his professional life to the sugar industry, during which time he made a number of improvements. Perhaps the most notable of these are the comminutor for preparing sugar cane for diffusion, and the Swenson Multiple Effect Evaporator, a number of which are now in use, the combined capacity being over 6,000,000

- BICYCLE, The First (III)—Sci Am Sup, Nov 21—96. 600 w.
- Bicycle Tubing, The Manufacture of (III)—Ir Age, Jan 7—97. 4800 w.
- Bicycles, Changes of Speed for—E. Hospitalier. Sci Am, Jan 16—97. 1500 w. M Mar.
- BILBOA Railway (III)—Elektrotechn Zeit, Jan 21—97.
- BIRKENHEAD Electricity Works (III)—Elec Eng, Lond, Jan 15—97. 3500 w. M Mar.
- BISMUTH Refining—Zakorski. Elec Rev, Lond, Mar 5—97. W Mar 20.
- Bismuth, Resistivity of—Dewar and Fleming. Electn, Lond, Mar 12—97. W Mar 27.
- BLAST FURNACE Gases Upon Various Kinds of Ore. Action of—Am Mfr & Ir Wid, Jan 1—97. 2500 w.
- BLEACHING—Kellner. Zeit für Elek, Feb 15—97.
- Bleaching, The Use of Electrically Produced Chlorine of Lime in Cotton and Linen—Elektrochem Zeit, Nov—96. 1500 w. M Feb.
- BLENDE, Manufacture of Chlorine and Zinc from—Elec Rev, Lond, Dec 11—95. W Jan 2.
- BLOCK System, The—Elec Eng, Lond, Nov 13—96.
- BOAT, A New Submarine (II)—Mfrs Rec, Jan 8—97. 1000 w.
- Boats, Steel Canal—Lewis Nixon. Eng News, Nov 19—96. 2000 w. M Jan.
- BOILER Construction, Water-Tube (III)—Mech Wld, Jan 29—97. 1200 w. M Mar.
- Boiler Designing, Systematic—H. M. Morris. Mach, Jan—97. Serial Part 1. 2000 w.
- Boiler Efficiency, Capacity and Smokesiveness, with Low Grade Fuels—William H. Bryan. Jour of Assn of Engng Soc, Nov—96. 3500 w.
- Boiler, Evaporative Trials of an Almy Water Tube—George H. Barnes. Am Eng & R R Jour, Feb—97. 1500 w. M Mar.
- Boiler Explosion of the Centralia Colliery at Centralia, Pa. (III)—Power, Dec—97. 700 w.
- Boiler Grate, Efficiency of the—W. W. Christie. Am Soc Mech Eng, Dec—96. 1200 w. M Jan.
- Boiler Incrustation and Its Removal—Am Mfr & Ir Wid, Nov 13—96. 1800 w.
- Boiler Inspection, Government—Eng, Lond, Dec 18—96. 1500 w.
- Boiler Making—Henry J. Hartley. Bos Jour Com, Nov 28—96. 2500 w.
- Boiler Plant, Chicago Shops, C. R. I. & P. Railway (III)—Ry Rev, Feb 6—97. 800 w. M Mar.
- Boiler Progress—J. H. Barron. Dom Engng, Jan—97. 3000 w. M Mar.
- Boiler Room Labor, The Cost of—Eng News, Jan 28—97. 700 w. M Mar.
- Boilers, Ancient Pompeii—W. T. Bonne. Am Soc Mech Eng, Dec—96. 2200 w.
- Boiler Tests, Starting and Closing—Bos Jour Com, Nov 28—96. 1200 w.
- Boilers, Comparative Cost of English and American—Eng News, Dec 31—96. 1300 w.
- Boilers, Efficiency and Management of Steam—E. J. Duff. Col Guard, Jan 29—97. 4500 w. M Mar.
- Boilers, Internal Corrosion in Steam—Eng, Lond, Dec 4—96. 3500 w.
- Boilers, Marine—J. R. Fothergill. Jour Am Soc Nav Eng, Nov—96. 3800 w. M Jan.
- Boilers Over Other Types, Superiority of Water Tube—George Shaw. Am Mfr & Ir Wid, Jan 22—97. 3000 w. M Mar.
- Boilers, Water Tube (III)—Sci Am, Jan 30—97. 900 w. M Mar.
- Boilers, Water-Tube—G. L. Burton. Steamship, Jan—97. 3200 w. M Mar.
- BOLSTERS, Calculating the Strength of Body and Truck—Ry Mas Mech, Feb—97. 1000 w. M Mar.
- BOOSTING—See Alternating Currents.
- BOURGOGNE Canal, Electric Traction on the—Dupuy. L'Eclair Elec, Jan 30—97.
- BOWLING GREEN Storage Battery Station—Elec Eng, Mar 10—97. W Mar 20.
- BRAKE Be Reduced to a Minimum, In What Way Can the Rough Handling of Trains by the Air Trav Eng Assn Rept, Sept—96. 13500 w.
- Brake Cards U. P. R. R., Water (III)—Loc Engng, Dec—96. 400 w.
- Brake, Electric Pneumatic—L'Ind Elec, Dec 10—96. W Jan 2.
- Brake, The Bonta Electric Railway—Am Electn, Dec—96. W Jan 2.
- Brake, What Is a Water—T. A. Hedendahl. Loc Engng, Dec—96. 800 w.
- BRAZING, Bicycle—Hugh Dolnar. Am Mach, Nov 19—96. 2400 w.
- BRETT, Jacob—Elec Eng, Lond, Jan 15—97.
- BRICK Making in Australia—Frank W. N. King. Brick, Jan—97. 1100 w. M Mar.
- Brick Paving in Small Towns—A. W. Smith. Munic Engng, Feb—97. 1100 w.
- Brickwork and Masonry—Engng, Jan 1—97. 1600 w. M Mar.
- Brickwork Tests—William C. Street and Max Clarke (III)—Jour Inst of Brit Arch, Dec 17—96. 7000 w. M Mar.
- BRIDGE, A Novel French Highway—Eng News, Dec 10—96. 450 w.
- Onward Bates. Pur Soc of Civ Engs, 1896. 10000 w.
- Bridge at Rock Island, Ill, Double Deck Highway and Railway (III)—Eng News, Dec 17—96. 5000 w.
- Bridge, Burlington Channel Swing (III)—Can Eng, Dec—96. 1000 w.
- Bridge Competition, The St. Lawrence—Eng News, Jan 7—97. 4200 w.
- Bridge from Fort Washington to Kingsbridge, New York City, A Proposed—W. B. Parsons. Eng News, Feb 4—97. M Mar.
- Bridge in Berne, The Kornhaus (III)—H. V. Linden. Schweizerische Bauzeitung, Oct 17—96. Serial Part 1. 6300 w.
- Bridge in 150 Minutes, Replacing a Main Line Railway (III)—Eng, Lond, Nov 27—96. 1800 w. M Jan.
- Bridge Members, Stresses in—L. N. Hoskins. Trans of Wis Acad, Vol X. 4700 w. M Mar.
- Bridge, Nova Scotia, The Mira River—M. Murphy. Eng News, Dec 31—96. 400 w.
- Bridge of Forty Feet Span, Concrete Arch (III)—Sci Am Sup, Nov 14—96. 600 w.
- Bridge of the Exposition of 1900—La Revue Technique, Nov 10—96. 2500 w.
- Bridge of 200 Feet Span Over the Tegga River Near Demagiri, South Lushai Hills, Proposed Suspension (III)—H. C. Banerji. Ind Engng, Nov 14—96. 1200 w.
- Bridge on the Erie, A Novel Lift (III)—R R Gaz, Nov 27—96. 2500 w. M Jan.
- Bridge on the Erie Railroad, Counterweighted Lift (III)—Sci Am Sup, Nov 28—96. 600 w.
- Bridge Over the Inn Between Branau and Simbach, The Reconstruction of the—Leopold Petri. Oesterr Monat O B, Dec—96. 5000 w.
- Bridge Over the Otterthal, The Iron—E. Biedermann. Zeit f Bauwesen, No X—XII. 4900 w. M Jan.
- Bridge, Paris, The Rue de Tolbiac—Eng, Lond, Dec 25—96. 900 w.
- Bridge Practice—Engng, Nov 29—96. 1300 w. M Jan.
- Bridge Railway, The Terminals of the Brooklyn—Eng News, Jan 7—97. 2200 w.
- Bridge, The United States Rock Island—Eng Rec, Jan 30—97. Serial Part 1. 3000 w. M Mar.
- Bridge Transportation System Between New York and Brooklyn, The (III)—St Ry Jour, Feb—97. 4700 w. M Mar.
- Bridges, Large Span Railway—E. W. Young. Engng, Dec 11—96. 1500 w.
- Bridges, The Accuracy of the Ordinary Formulas for Swing—F. E. Turneaure. Eng News, Dec 3—96. 2300 w. M Jan.
- Bridges, The Mechanical Action and Resultant Effects of Motive Power at High Speeds on—Can Eng, Dec—96. 500 w.
- Bridge, The Operating Mechanism of the New Rock Island—Am Eng & R R Jour, Dec—96. 1300 w. M Jan.



gallons daily, the result being a great saving of fuel. He then turned his attention to the chemical industries and made a large number of improvements in the manufacture of such articles as glue, fertilizer, soap, glycerine, caustic soda, sugar of milk, potassium, ferro-cyanide, licorice, etc.

He next devoted nearly his entire time to the cotton industry and the result is so ably told in the present article that it would be useless to add more.

Mr. Swenson is at present occupied as secretary and manager of Walburn-Swenson Co., and is also manager of the manufacturing department of the American Cotton Co., a powerful corporation organized to push the introduction of his late invention.

### *The Cotton Gin.*

One of the greatest inventions the world has ever seen is the cotton gin. It is great, more on account of the economic effect resulting from its introduction than from a mechanical standpoint. There are a great many farming machines, wonderful to look at, that operate as though endowed with life, but they have been developed by a gradual process and improvement after improvement had to be added to the crude originals to make them the perfect mechanisms of today. Not so with the cotton gin, however. Born of the genius of Whitney, it stands today practically the same as in childhood. Though the economic achievements of the cotton gin have been great, it is not an economical machine, as pointed out by Mr. Swenson and it is hoped he will soon be able to give the world a gin that will make Whitney's a historical relic.

### *What They Say.*

The following unsolicited compliment is taken from the head of the editorial column of Engineering News:

"We noted some time ago the index to engineering literature which has been undertaken at the University of Wisconsin, but the undertaking is being pushed so conscientiously and promises to be of such value to engineers generally that we think it worth while to again call the attention of our readers to it. The index forms a part of the "Wisconsin Engineer," a quarterly magazine published by the engineering schools of the university. The number for January, 1897, contains over 30 solid pages of references to

- BRIQUETTES** from Waste Coal and Miners' Tar, The Velna Process for the Manufacture of—Am Mfr & Ir Wld, Nov 13—96. 1100 w. M Jan.
- BRIGHTON**, Charging for Current at—Wright. Elec Rev, Lond, Feb 5—97. W Feb 20.
- BRITISH** Columbia, Notes on Some of the Mining Districts of—W. H. Merritt. Eng & Min Jour, Jan 16—97. 1700 w.
- British Guiana**, Electric Lighting in—Vyle. Electn, Lond, Jan 29—97.
- BROOKLYN** Bridge Power Plant, New Electric (Ill)—Elec Wld, Jan 23—97. 4300 w. E Feb 10.
- Brooklyn** Bridge, Transportation over—St Ry Jour, Feb—97.
- Brooklyn**, Contract Trial of U. S. Armored Cruiser (Ill)—W. C. Herbert. Jour Am Soc Nav Eng, Nov—96. 6500 w.
- BRUSSELS**, Conduit System at—Pierard. L'Elec, Feb 6—97.
- Brussels** Exhibition—Elektrotechn Zeit, Feb 4—97.
- BUCKLING** for the Most Important Materials of Construction, The Laws of—Z Oesterr I u A V, Nov 27—96. 1500 w.
- BUDAPEST** Underground Electrical Railway—Montier. L'Eclair Elec, Feb 13—97.
- Budapest** Underground Electric Road—Eng News, Feb 18—97.
- Budapest**—See Pumping Station.
- BUILDING** Blocks, Ornamented—E. S. Durant. Brick, Jan—97. 1800 w. M Mar.
- Building** Construction, The Regulation of Tall—Eng Rec, Jan 2—97. 1200 w.
- Buildings**, Against High—Fire and Water, Dec 5—96. 1400 w. M Jan.
- Buildings** and Safe Elevations, High—Eng News, Nov 26—96. 2500 w. Dec 3—96. M Jan.
- Buildings**, High—Fire & Water, Dec 26—96. 1800 w.
- Buildings**, How to Make Safe High—Christopher Clarke. Fire & Water, Feb—97. 1200 w. M Mar.
- Buildings** of Calcutta, The "Standard" (Ill)—Ind & East Eng, Nov 14—96. 1300 w.
- Buildings**, Oxford Municipal—Brit Arch, Dec 18—96. 1800 w.
- Buildings**, The Architecture of Our Government (Ill)—William Martin Aiken. Eng Mag, Feb—97. 3100 w. M Mar.
- Buildings**, The Berlin Book of (Ill)—Builder, Dec 12—96. 2500 w.
- Buildings**, The Planning and Construction of High Office (Ill)—Wm. H. Birkinire. Arch & Build, Dec 5—96. 1500 w. M Jan.
- Buildings**, The Underpinning of Heavy (Ill)—Jules Breuchaud. Am Soc of Civ Engrs, Dec—96. 2700 w. M Feb.
- Buildings**, The Use of Practical Geometry in Designing (Ill)—W. R. Corson. Builder, Jan 16—97. 5000 w. M Mar.
- BUFFER** Blocks for Freight Equipment, Spring (Ill)—Rv Mas Mech, Feb—97. 900 w. M Mar.
- BUOY** in Boston Harbor, New Electric Bell (Ill)—Elec Eng, Dec 20—96. 1400 w.
- BURGLAR** Alarm for Safes—Kammeyer. Elec Rev, Mar 17—97. W Mar 20.
- BUSHES**, The Stripping of—Prac Eng, Nov 27—96. 900 w.
- BURMA**—See Gold.
- BUTT JOINT**, A Form of Quadruple Riveted (Ill)—Sta Eng, Feb—97. 3000 w. M Mar.
- BY-PRODUCTS** of Gas Works, The Nitrogenous—Eng, Lond, Jan 22—97. 2000 w. M Mar.
- CABLE** Making, Machinery for (Ill)—Ind Rub Wld, Jan 10—97. 700 w. Elec Rev, Lond, Mar 12—97.
- Cable** of 1864, The Persian Gulf—F. C. Webb. West Elec, Jan 2—97. Serial Part 1. 1800 w.
- Cable**, Rapid—Elec Rev, Lond, Jan 29—97. W Feb 13.
- Cable**, Rapid—Dearlove. Electn, Lond, Feb 26—97. W Mar 20.
- Cable**, Rapid—Rymer and Jones. Elec Rev, Lond, Mar 5—97. W Mar 20.
- Cable** Testing Carriages for the City Electricity Works in Munich—F. Uppenborn. Elektrotechn Zeit, Jan 21—97.
- Cable**, Thompson's Pacific—Sullivan. Electn, Lond, Feb 5—97. Elec Jour, Feb 15—97.
- Cable** to Hayti, The New—Elec Eng, Dec 16—96. 600 w.
- Cables**, Induction in Multiple Core—Dresing. Elec Rev, Lond, Jan 29—97.
- Cables**, Localizing Faults in Submarine Cables—Herbert E. Cann. Elec Rev, Lond, Dec 18—96. 1800 w.
- Cables**—See Insulated.
- CABLEGRAPHY**, Fifteen Years Advance in Submarine—George G. Ward. Elec Eng, Jan 6—97. 1300 w. M Mar.
- CABLING** of Edinburgh Tramways, The—Ry Wld, Jan—97. Serial Part 1. 2400 w. M Mar.
- CAGES** With Movable Floor, Falling Stop Arrangement for Winding (Ill)—Col Guard, Jan 1—97. 2000 w.
- CALCULATOR**—Lond Jour of El'ty, Oct—96.
- CANAL**, A Survey of the Great Lakes and Hudson River Ship—Eng News, Nov 19—96. 1800 w. M Jan.
- Canal**, An Old West Country—Eng, Lond, Dec 25—96. 1700 w.
- Canal** Barges, Electricity for Towing—Elec Rev, Lond, Feb 20—97.
- Canal**, Danube-Elbe—Oesterr Monatschr f d Oeffent Bau, Jan—97. 15000 w. M Mar.
- Canal**, The Chicago Drainage—Engng, Jan 1—97. Serial Part 1. 3400 w. M Mar.
- CAPITAL** Expenditure in Electric Supply Stations—Electn, Lond, Feb 26—97.
- CAPILLARY** Tubes, Viscous Flow in—R. M. Deely and C. E. Wolf. Eng, Lond, Jan 1—97. 2200 w. M Mar.
- CAR**, A Novel Design for a Combination Freight (Ill)—R R Car Jour, Dec—96. 800 w.
- Car** Axles, Abrasion and Etching Tests of Wrought Iron and Steel (Ill)—L. R. Pomeroy. R R Gaz, Dec 4—96. 1200 w. M Jan.
- Car**, Baltimore and Ohio 60,000-Pound Box (Ill)—Loc Engng, Dec—96. 700 w.
- Car** Doors, Weakness and Failures of Side and End Freight—Pro of South & So-West Ry Club, Nov 19—96. 6800 w.
- Car** Lighting in Austria, Electric—Ry Rev, Dec 15—96. 1400 w.
- Car** Lubrication—A. M. Knapp. R R Car Jour, Nov—96. 1500 w.
- Car** Tracks and Pavements—James Owen. Am Soc Civ Eng, Nov—96. 2500 w.
- Car** Trucks, Three New Metallic (Ill)—Ry Mas Mech, Dec—96. 1700 w.
- Car** Ventilation—R R Gaz, Dec 18—96. 1300 w.
- Car** Wheels, The New Heat Test for—R R Car Jour, Dec—96. 1800 w.
- Cars**, Box—R R Gaz, Jan 22—97. 2000 w.
- Cars** be Increased, Shall the Cubic Capacity of Ordinary Box—H. H. Perkins. Am Eng & R R Jour, Jan—97. 2000 w.
- Cars** for Narrow-Gauge Tramways (Ill)—Ry Wld, Nov—96. 400 w.
- Cars** for the St. Louis, Iron Mountain & Southern Railway, New 60-Foot Postal (Ill)—Eng News, Nov 26—96. 1700 w.
- Cars** in New York, Compressed-Air Surface—Safety V, Nov—96. 1200 w.
- Cars** on the Brooklyn Bridge, Motor (Ill)—Elec Eng, Dec 9—96. 1500 w.
- Cars**, Wide Vestibuled Passenger (Ill)—R R Gaz, Jan 1—97. 250 w.
- CARBON**, Contacts for (Ill)—L'Eclair Elec, Dec 5—96. W Jan 2.
- Carbon** Content on the Endurance of Steel, Effect of—H. K. Landis. Ir Tr Rev, Jan 7—97.
- Carbon** Determinations in Pig Iron (Ill)—Bertrand S. Summers. Jour Am Chem Soc, Dec—96. 900 w.
- Carbon** Electrode for Electrolysis—Lessing. Elektrochem Zeit, Jan—97. Electn, Lond, Feb 12—97. W Feb 13.
- Carbon** from the Non-Conducting to the Conducting State, Transition of—Brion. Electn, Lond, Dec 18—96. Feb 5—97.

articles, and the periodicals indexed include all the principal American and foreign engineering journals. The arrangement is an alphabetical one, and is not divided into departments, so that there is no opportunity for doubt as to the proper head under which to look for a subject. The price of the magazine is only \$1.50 per annum, which places it within the reach of any engineer who has use for an index to current engineering literature."

The editors of *Engineering News* know a good thing when they see it. We have been materially aided by this editorial and wish to express our thanks to this enterprising journal.

The April number of the *Journal of Electricity* devotes a page to comment on the editorial on collegiate tests in our January issue, and copies in full our argument defending Wisconsin's position on this subject. It will be remembered that the *Journal* criticized very severely, the practice of publishing the results of tests on commercial apparatus and withholding the names of the makers. After some comment, the *Journal* says: "Nevertheless, let our good friends of the University of Wisconsin be assured of the high esteem in which they are held, individually and as an institution, and, above all, let them not take umbrage at a well meant thought that hinges solely upon the point of view." We did not take this as aimed at Wisconsin in particular; but at an almost universal practice, and defended only Wisconsin's position in following it.

The *Journal of Electricity* is certainly very liberal minded in giving her readers both sides of the argument and we feel assured that the majority of them will decide in our favor.

---

#### ALUMNI NOTES.

'96.

R. Crowell is with the General Electric Company at Schenectady.

H. M. Tripp, E. C. Bebb and H. H. Ross took the recent examinations for civil service at Milwaukee.

F. M. Conlee, C. J. Carlson, A. L. Goddard and E. B. True are with the Northern Electric Company of this city

- Carbon in Incandescent Lamps, Deposit of—Popow. L'Eclair Elec, Jan 23-97. W Feb 6.
- Carbon in Iron—S. S. Knight. Foundry, Dec -96. 1400 w.
- Carbon-Zinc Alloys, Specific Resistance of—Haas. L'Eclair, Feb 13-97. W Mar 6.
- CARBORUNDUM at Niagara Falls, The Manufacture of—Francis A. Fitzgerald. Jour Fr Inst, Feb-97. 5500 w. M Mar.
- CARRIAGES, Recent Developments in Mechanical Road—W. Worby Beaumont. Jour Soc Arts, Nov 27-96. 11500 w. M Jan.
- CASTINGS, Defects in Cast Iron—Engng, Dec 25-96. 1500 w.
- Castings for Iron and Steel, Rustless—M. P. Wood. Am Soc Mech Eng, Dec-96. 3300 w.
- Castings in Cooling from the Fluid to the Solid State, Contraction and Deformation of—Francis Schumann. Am Soc Mech Eng, Dec-96. 3800 w.
- CATHODE and Roentgen Rays—Wilkins. Electn, Lond, Feb 12-97.
- Cathode Rays, A Residual Photo-Electric Effect of—J. Elster and H. Geitel. Electn, Lond, Dec 4-96. 2800 w. Elektrotechn Zeit, Feb 11-97. W Mar 6.
- Cathode Rays and Jaumann's Theory—Proc Lond Phys Soc, Feb-97.
- Cathode Rays by a Magnetic Field, An Experiment Showing the Deflection of (H)—J. A. Fleming. Electn, Lond, Jan 1-97. 700 w.
- Cathode Rays, Deflection of—Barr and Phillips. Electn, Lond, Feb 19-97. W Mar 6.
- Cathode Ray in an Electric or Magnetic Field—Garbasso. Proc Lond Phys Soc, Jan-97.
- Cathode Rays, New Kind—Goldstein. L'Eclair Elec, Feb 20-97.
- CELL, Cadmium Standard—Jaeger and Wachsmuth. Zeit f Elektrochem, Dec 5-96. W Jan 2. Jour Inst Elec Eng, Jan-97.
- Cell, Dr. Jacque's—Electn, Lond, Dec 11-96. 1100 w.
- Cell, Note on the Osmotic Theory of the Voltaic—H. M. Goodwin. Phys Rev, Nov, Dec-96. 1200 w. M Jan.
- Cell, Polarization and Internal Resistance of a Galvanic—B. E. Moore and H. V. Carpenter. Phys Rev, Jan, Feb-97. 2000 w. M Feb.
- Cell Without a Metal Electrode, A Carbon—C. J. Reed. Elec Wld, Nov 21-96. Elec Eng, Dec 2-96.
- Cells, Standard—Henry S. Carhart. Elec Wld, Nov 14-96. 3100 w.
- CEMENT, A New Test of the Rate of Setting—William S. MacHarg. Eng News, Jan 7-97. 1600 w.
- Cement and Concrete, Electrical Conductivity of—Sci Am, Feb 13-97.
- Cement, Forms of Clip and Briquet for Tensile Tests of—L. C. Sabin. Munic Engng, Dec-96. Serial Part 1. 1400 w. M Jan.
- Cement in France, The Manufacture of Slag—Eng News, Jan 7-97. 700 w.
- Cement Industry, Development of the American Portland—F. H. Lewis. Munic Engng, Dec-96. Serial Part 1. 1100 w. M Jan.
- Cement Laboratory of the City of Philadelphia, The (H)—Richard L. Humphrey. Pro Eng's Club, Phil, Nov-96. 9500 w. M Jan.
- Cement, Proposed Standard Specifications for Portland—William J. Donaldson. Eng News, Dec 10-97. 5000 w.
- Cement, Revision of the Methods of Making Tests of—Eng Rec, Jan 23-97. 800 w. M Mar.
- Cement Specifications of the South Australian Government, Standard—Eng News, Dec 17-97. 1600 w.
- Cement, The Effect of Admixtures of Kentish Ragstone, etc., upon Portland—D. B. Butler. Eng. Lond, Nov 6-96. 2800 w. M Jan.
- CENTRAL PLANTS, Warming Office Buildings and Residences from—Eng Rec, Jan 23-97. 1100 w. M Mar.
- CENTRAL STATION Costs—Elec Eng, Mar 3-97.
- Central Station Economics—Arthur V. Abbott and Franz J. Dommerque. Elec Engng, Feb -97. 41500 w. M Mar.
- Central Station, Improved Service—Am Electn, Feb-97. W Mar 6.
- Central Station Operation, Fifteen Years in—Samuel Insull. Elec Eng, Jan 6-97. 2300 w. M Mar.
- Central Station Statistics for France—L'Ind Elec, Jan 25-97.
- Central Stations Doomed? Are—Max Osterberg. Eng Mag, Dec-96. Elec Eng, Dec 2, 23-96. E Jan 6.
- Central Stations, Graphical Comparison Between Alternating vs. Direct Current—Fritz Goldenzweig. Elektrotechn Zeit, Dec 31-96. E Feb 3.
- Central Stations in London and Provinces, Capital, Outlay, Receipts and Expenditures of—Electn, Lond, Jan 29-97. W Feb 13.
- Central Stations vs. Isolated Plants—R. S. Hale. Eng Mag, Feb-97. 4800 w. W Feb 6.
- CHALFONT, Plant at—Elec Rev, Lond, Dec 18-96. W Jan 9.
- CHALONS-sur-Marne, Side Trolley—L'Energ Elec, Feb 1-97. W Feb 27.
- CHANNEL of the Delaware River, The Improvement of the (H)—Walter Atlee. Jour Fr Inst, Dec-96. 11000 w. M Jan.
- CHARCOAL for Foundry Purposes, The Manufacture of—L. S. Brown. Foundry, Dec-96. 2700 w.
- CHARGING for Electricity—Wilson. Elec Rev, Lond, Elec Eng, Lond, Mar 12-97. W Mar 27.
- CHEMISTRY—Eng, Lond, Jan 1-97. 2500 w. M Mar.
- Chemistry in the Boiler Room—William Thompson. Cap Elec News, Jan-97. Serial Part 1. 1400 w. M Mar.
- CHESTER, England, Plant at—Elec Eng, Lond, Dec 18-96. Elec Rev, Lond, Jan 29-97. W Jan 9.
- CHICAGO City Railway Power House—West Electn, Feb 20-97.
- Chicago, Conduit Road in—West Electn, Feb 20-97.
- Chicago Cycle Show, Electricity at the—Kimbarck. West Electn, Feb 6-97.
- Chicago Street Railway Company, South (H)—West Electn, Dec 26-96.
- Chicago—See Engineering.
- CHIMNEY, The Factory—Robert Kunstman. Brick, Dec-96. 3300 w.
- CHIPS, The Making of—Teemseh Swift. Am Mach, Feb 4-97. 1600 w. M Mar.
- CHLORINE—See Blende.
- CHURCH, Plans for a Greek Catholic, at Serpith—Oesterr Monatschr f d Oeffent Baudienst, Jan-97. 500 w. M Mar.
- Church, The Temple—Alfred J. Glasspool. Arch Lond, Dec 25-96. 1200 w.
- Churches and Suggestions They Offer for Modern Treatment, Structures Over the Eastern Ends of Some English (H)—Builder, Dec 5-97. 2600 w.
- Churches, Asymmetry in Medieval Italian—W. H. Goodvear. Arch Rec, Jan, Mar-97. Serial Part 1. 7000 w.
- CIRCUIT Breaker—L'Eclair Elec, Jan 9-97.
- Circuits, Calculation of—Perrine. Elec Engng, March-97. W Feb 27.
- CLARK Cell with the Helmholtz Electro-Dynamometer, Measurement of the—Kahle. Zeit f Elektrochem, Dec 5-96. W Jan 2.
- Clark Cells, Variation in the Electromotive Force of, with Temperature—Electn, Lond, Jan 1-97. 3800 w. M Mar.
- CLAYS, Mixing, Preparing and Burning—Brick, Jan-97. 3600 w. M Mar.
- COACH, A Copper Sheathed Passenger—R R Gaz, Jan 29-97. 900 w. M Mar.
- COAL as Steam Producer, Nova Scotia—F. H. Mason and W. G. Matheson. Col Guard, Dec 24-96. 2300 w.
- Coal at the Pit Bank, The Treatment of—Col Guard, Dec 11-96. 1200 w.

W. H. Williams is professor of Mechanical Engineering at the University of Montana.

G. H. Trautmann is editing on the Engineering Record.

'95.

G. H. Burgess is in the Chief Engineer's office of the Pennsylvania R. R. at Pittsburg.

J. T. Richards is with the Pencoyd Bridge Works.

'94.

H. P. Boardman is in the city engineer's office at Chicago.

E. M. Kurtz is with the Le Clede Power Company, St. Louis, Mo.

'93.

W. J. Richards is designer for the Gibbs Electric Co., Milwaukee.

J. G. Wray is assistant chief engineer of the Chicago Telephone Company.

J. H. Griffith is with the Massillon Bridge Company.

W. C. Burton recently had charge of the design and construction of the conduits and circuits of the great Buffalo-Niagara transmission in Buffalo.

'92.

J. H. Brace is with the engineering department of the Chicago West Park Commission.

'88.

W. A. Rogers is bridge engineer for the Chicago, Milwaukee & St. Paul, with headquarters at Chicago.

'87.

F. E. Bamford is second lieutenant, U. S. army, having risen from the ranks. He is stationed in North Carolina.

### *Deaths.*

'95.

Already three of '95's best men have left this world of struggle.

T. P. Schumann died March 16, 1896, after less than a year's service with the Westinghouse Company.

C. H. Kummel died about the same time.

J. H. Bucey met a terrible death by falling into a vat of cyanide while at work in a Colorado mine.

- Coal by the Luhrig Process. The Washing of Bituminous—J. V. Schaefer. *Am Soc Mech Eng*, Dec—96. 4200 w. M Jan.
- Coal by One of the Types of Electrical Mining Machines Now in Use? Is it Profitable to Mine Thin Seams of—*Am Mfr & Ir Wld*, Jan 1—97. 1200 w.
- Coal Dust and Colliery Explosions—Donald M. D. Stuart. *Jour Gas Lgt*, Dec 29—96. 1700 w.
- Coal Car, 65,000 Pounds Capacity, Double Drop Bottom (Ill)—*Loc Engng*, Feb—97. 1200 w.
- Coal Cutting by Machinery (Ill)—W. Blake-more. *Can Min Rev*, Dec—96. Serial Part 1. 3400 w.
- Coal Cutting Machinery—Cyrus Robinson. *Am Mfr & Ir Wld*, Jan 22—97. 1200 w. M Mar.
- Coal Cutting on Long-wall Faces, Electric—T. B. A. Clarke. *Col Guard*, Dec 4—96. 1700 w.
- Coal Field in Germany. The Westphalian—A. Kowatsch. *Eng & Min Jour*, Dec 19—96. 1160 w.
- Coal Field, The Heidelberg—Thos. B. Shipley. *Col Guard*, Nov 27—96. 1400 w.
- Coal Handling Machinery at the Yard of J. S. Story, Brooklyn, N. Y. (Ill)—*Am Eng & R R Jour*, Jan—97. 1600 w.
- Coal-Handling Machinery at Gladstone, Mich.—Karl J. C. Zineck. *Eng News*, Feb 4—97. 700 w.
- Coal in Mine Workings. Irruptions of—F. G. Meachem. *Col Guard*, Dec 11—96. 1800 w.
- Coal in Scotland, Working of—James Barrow-man. *Ir & Coal Trds Rev*, Jan 29—97. 3500 w.
- Coal in South Wales, The Regulation of the Output of—*Col Guard*, Dec 4—96. 2800 w.
- Coal Industry, A New Work in the—*Ir & Coal Trds Rev*, Nov 20—96. 4300 w.
- Coal Industry in 1896, The—*Ir & Coal Trds Rev*, Dec 24—96. Serial Part 1. 7600 w.
- Coal Industry of Germany in 1896, The—*Ir & Coal Tr Rev*, Jan 1—97. 1600 w. M Mar.
- Coal Interests of the South, The—J. J. Ormsbee. *Tradesman*, Jan 1—97. 4500 w.
- Coal Interests of the South, The—Jesse T. Hill. *Tradesman*, Jan 1—97. 1800 w.
- Coal Mine, A Saxon—E. R. Schoch. *Eng & Min Jour*, Dec 26—96. 900 w.
- Coal Mine, An Illinois Machine (Ill)—*Min Jour*, Jan 2—97. 3000 w.
- Coal Mine, the Virden Shaft, An Illinois "Solid-Shooting"—*Eng & Min Jour*, Dec 26—96. 1000 w.
- Coal Mining by Machinery—*Min Jour*, Nov 28—96. 1700 w. M Jan.
- Coal Mining, Economics of—*Ir & Coal Trds Rev*, Jan 29—97. 3200 w.
- Coal Mining Regions of Grundy County, Illinois, The Long-Wall (Ill)—*Eng & Min Jour*, Nov 21—96. 1500 w.
- Coal Mining, The Rise and Progress of—J. B. Simpson. *Col Guard*, Dec 4—96. 6000 w.
- Coal Trade in 1896—*Col Guard*, Jan 1—97. 8500 w.
- Coal, The Determination of the Calorific Power of—W. Noyes, M. Tuggart and W. Craver. *Pro Age*, Jan 15—97. 1200 w. M Mar.
- Coal, The Proximate Constituents of—*Jour of Gas Lgt*, Jan 5—97. 2500 w.
- Coal, Washing and Sizing—F. W. Hardwick. *Col Eng*, Nov—96. 5000 w. M Jan.
- Coal Washing Apparatus, The Baum (Ill)—*Col Guard*, Nov 6—96. 2500 w.
- COAST Defense, Application of Electric Light to—Boyd. *Electn*, Lond, Feb 5—97. *Elec Rev*, Lond, Feb 5—97. W Feb 20.
- COILS, Magnetic Fields of—W. H. Everett. *Elec Eng*, Lond, Jan 8—97. 2500 w.
- COKE Making and Southern Coals—John S. Kennedy. *Tradesman*, Jan 1—97. 2000 w.
- Coke, The Analysis of—George C. Davis. *Am Mfr & Ir Wld*, Dec 4—96. 1200 w. M Jan.
- COLLEGE at Colombo, St. Joseph's (Ill)—*Ind Engng*, Dec 5—96. 1500 w.
- COLLIERY, Chopwell—J. R. Gilchrist. *Col Guard*, Nov 27—96. 2000 w. M Jan.
- Colliery Working in the Pas-de-Calais—M. E. Duporeq. *Col Guard*, Nov 27—96. 1700 w.
- Collieries, The Engineering Equipment of—*Ir & Coal Trds Rev*, Jan 29—97. 1000 w.
- COLOGNE, Station at—*Elek Anz*, Dec 13—96.
- COLOMBIA—See Railroad.
- COLUMBS, The Strength of—J. B. W. Stokes. *Prac Eng*, Dec 18—96. 500 w.
- COMMERCE Commission, Tenth Annual Report of the Inter-State—*Ry Rev*, Dec 19—96. *R R Gaz*, Dec 25—96.
- Commerce Law, Amendments to the Inter-State—*R R Gaz*, Jan 1—97. 1800 w.
- COMMUTATOR, Truing a—Lynch. *Am Electn*, Dec—96. W Jan 2.
- Commutators, Care of—Poole. *Am Elec*, Dec—96. W Jan 2.
- COMPOUNDING, Neutral and Reverse—Charles M. Jones. *Eng*, Dec 19—96. 1200 w.
- COMPRESSED AIR—H. T. Hulst. *Yale Sci Mo*, Jan—97. 1600 w. M Mar.
- Compressed Air at a Blast Furnace, The Use of (Ill)—R. H. Sweetser. *Compressed Air*, Dec—97. 1000 w.
- Compressed Air, Economical Uses of—J. H. McConnell. *Loc Engng*, Jan—97. 1600 w.
- Compressed Air, Economy in—C. W. Shields. *Engng Mech*, Dec—96. 1800 w.
- Compressed Air for City and Suburban Traction—H. Haupt. *Jour Fr Inst*, Jan—97. Serial Part 1. 4500 w.
- Compressed Air for Hoisting Purposes—J. L. Klindworth. *Mach*, Jan—97. 1400 w.
- Compressed Air for Transmitting Power, Advantages of—J. W. Pearse. *Comp Air*, Jan—97. 1500 w.
- Compressed Air in Mines—*Col Guard*, Jan 22—97. 4500 w.
- Compressed Air in Railroad Shops—J. J. Flather. *R R Gaz*, Jan 22—97. 1800 w.
- Compressed Air in Railway Work—W. S. Aldrich. *Am Electn*, Dec—96. 2800 w. W Jan 2.
- Compressed Air in the Shops of the Union Pacific Railroad at Omaha (Ill)—H. N. Lathey. *R R Gaz*, Dec 4—96. 2600 w.
- Compressed Air, Its Generation, Transmission and Application with Special Reference to Its Use in Railroad Shops—C. W. Shields. *N Y R R Club*, Nov 19—96. 15500 w.
- Compressed Air on a Great Work, Use of—*Mfrs Rec*, Jan 15—97. 1500 w.
- Compressed Air on the Elevated Railroads of New York (Ill)—*Sci Am*, Jan 30—97. 1500 w.
- Compressed Air Plant, A Light-Ship—*Am Mach*, Dec 17—96. 1200 w.
- Compressed Air Recoil Cylinders for Heavy Mortars (Ill)—*Sci Am*, Jan 2—97. 600 w.
- Compressed Air, Some of the Uses of—*R R Gaz*, Jan 25—97. 6000 w.
- Compressed Air, Some of the Uses and Advantages of—J. H. McConnell. *Ry Rev*, Dec 19—96. 2300 w.
- Compressed Air, The Cost and Profit of—G. A. True and C. W. Shields. *Ry Mas Mech*, Dec—96. 2500 w.
- Compressed Air, the Rise of the Young Giant (Ill)—C. W. Shields. *Eng Mag*, Jan 4—97. 4200 w.
- Compressed Air—See Cars.
- COMPRESSION as a Factor in Good Running Engines—*Eng Rec*, Dec 26—96. 500 w.
- COMPUTERS, Some Special Forms of—F. A. Halsey. *Am Soc Mech Eng*, Dec—96. 1100 w.
- COMSTOCK, A Colorado Comparison Between Cripple Creek and the—*Min & Sci Pr*, Dec 19—96. 2000 w.
- Comstock—See Mines.
- CONCRETE Work in Detroit—F. A. Little. *St. Ry Rev*, Jan 15—97. 3000 w. M Mar.
- Concrete Wall on Clinton Ave, Brooklyn (Ill)—*Eng Rec*, Jan 9—97. 2800 w. M Mar.
- CONDENSER—Finn. *Tel Age*, Mar 1—97.
- Condensers for Short-Charge Periods, A Study of the Apparent Capacity of—Hubert V. Carpenter. *Phys Rev*, Nov, Dec—96. 1600 w.
- Condensers, Improved Method of Making—Tesla System. *Elec Rev*, Mar 3—97. W Mar 6.

*Marriages.*

It is sometimes said that engineers are devoid of sentiment. Without going back more than a year in events, let us see how true this is. F. I. Hartwell, '93, became lonesome soon after graduation and became engaged; he is now to be numbered among the dignified married men.

Fred Ford, '93, commenced an article for the Wisconsin Engineer and got as far along as fifthly, when Miss Harriet A. Armour of Milwaukee interrupted him with a winning smile. Mr. and Mrs. Ford live in Madison on the shores of Lake Monona.

F. M. Conlee, '96, caught the fever about this time and married Miss Reed, a Madison girl. They also live in Madison. L. E. Lemcn, '96, while apparently a very quiet fellow, did some desperate and successful scheming for the hand of Miss Florence Miller, '96. He is now settled down with his bride at Aurora, Ill. G. W. Wilder, '96, once an engineering student, did nearly the same thing. His wife is at present attending the university. J. W. Cosgrove (his wife probably calls him Dear) had a severe attack last January and married Miss Tessie Rice of Michigan. They are at present located in Chicago, Mr. Cosgrove being at the head of the instructional force at the Chicago School of Electricity. Not to be outdone by his old thesis partner, F. A. Vaughn, '95, returned to his first love, a Miss Lucile Phillips of Madison, and settled the dispute of their last falling out with a minister as umpire.

Yet some people will say that engineers are devoid of sentiment. While this may be so, in the manner of recording weddings, the above list seems to indicate that the engineer's coefficient of matrimony varies about as the square of his success in practice.

---

 LOCAL NOTES.
*Engineers' Joint Debate.*

A recent event worthy of note was the third annual joint debate between the engineering societies. The question was upon the municipal ownership of an electric lighting plant for the city of Madison. The affirmative was debated by P. F. Lueth, '98, H. J. Thorkelsen, '98, and M. H. Spindler, '98, of the Engineers' Association, while the negative was supported by T. G. Nee, '99.

- Condensers in Armatures of Non-Synchronous Motors—Guilbert. L'Eclair Elec, Jan 30—97. W Feb 20.
- CONDUCTIVITY by Continuous Current, Method of Measuring—Stroud and Henderson. Proc Phys Soc, Lond, Feb—97.
- Conductivity of Dilute Solutions of Salt—Joubin. L'Eclair Elec, Feb 13—97.
- CONDUCTION in Steam Boilers, Heat—Herbert G. Geer. Power, Feb—97. 1800 w. M Mar.
- CONDUCTORS for Discharges, Best Form of—Cardani. L'Elett, Dec—96. W Mar 20.
- Conductors, Properties of Intermediate—Kauffman. Zeit f Elektrochem, Dec 5—96. 1500 w. M Feb.
- CONDUIT, Armorite Interior (Ill)—West Elec, Dec 19—96. 2000 w.
- Conduit, Closed (Ill)—Electn, Lond, Dec 25—96. W Jan 9.
- Conduit—See Chicago. Brussels.
- CONGRESSIONAL Library, The Great Scaffolds of the (Ill)—Sci Am, Nov 14—96. 900 w. M Jan.
- CONNECTICUT Roads in 1896, Operating Expenses of—St Ry Rev, Feb 15—97.
- CONSTRUCTION, Some Valuable Opinions on Fire Proof—Brit Build, Jan—97. 3200 w. M Mar.
- CONTROLLERS, Theatre Lighting (Ill)—Elec Jour, Feb 15—97.
- COPPER and Other Metals from the Ores, Production of—Eng & Min Jour, Dec 19—96. W Jan 2.
- Copper Deposits—Zeit f Elektrochem, Dec 5—96. W Jan 2.
- Copper, Electrolytic Analysis of Commercial—Holland. Elek Anz, Feb 4—97.
- Copper, Improvements in the Electrolytic Refining of—Titus Ulke. Eng & Min Jour, Nov 14—96. 900 w.
- Copper Matte Blast-Furnace Charges, The Calculation of—H. Van Furman. Sch of Mines Quar, Nov—96. 3000 w. M Mar.
- Copper Mines of Nevada, The—Dan de Quille. Min & Sci Pr, Jan 23—97. 1800 w. M Mar.
- Copper Refineries, Present Method of Treating Slimes from the—Titus Ulke. Eng & Min Jour, Nov 28—96. 1700 w. M Jan.
- Copper Refining by Electricity—Min & Sci Pr, Dec 19—96. 1200 w.
- Copper-Silver-Gold Mountain, Tasmania, A—Aust Min Stand, Sept—96. 1000 w.
- Copper—See Alloys.
- CORE Oven, Down Draft (Ill)—W. L. Hayden Foundry, Dec—96. Serial Part 1. 1200 w.
- CORNER-STONE of a Structure, Origin of Ceremonies Connected with the Laying of the—Eng News, Jan 21—97. 1100 w. M Mar.
- CORPORATIONS, Honesty in the Management of—Eng News, Nov 12—96. 1800 w. M Jan.
- CORROSION Caused by Railway Return Currents—Dugald C. Jackson. Elec Wld, Dec 5—96. 800 w. M Jan.
- COUPLER Decision, A Review of the Recent—Dyer Williams. Ry Age, Jan 8—97. 1200 w. M Mar.
- Coupler Knuckles—Ry Rev, Dec 12—96. 2600 w.
- Couplers, Defects in M. C. B. W. (Ill)—J. Lorraine. Ry Rev, Feb 6—97. 1500 w. M Mar.
- Couplers, Experiments on the Lateral Movement of (Ill)—Ry Mas Mech, Jan—97. 900 w.
- CRANE, A Two Hundred Ford Gantry (Ill)—John W. Seaver. Am Soc Mech Eng, Dec—96. 2800 w. M Jan.
- CRIPPLE CREEK Mining District During 1896—Charles J. Moore. Min Ind & Rev, Dec 31—96. 2800 w. M Mar.
- Cripple Creek Practices, Some—Wascott. Min & Sci Pr, Jan 2—97. 1300 w.
- Cripple Creek—See Comstock.
- CROOKES Tube, Curious Motion in a—Peckham. Elec Eng, Dec 3—96. W Jan 2.
- Crookes Tubes, New—Drs. Oudin and Barthelmy. La Nature, Jan 9—97.
- CROYDON, Plant at—Electn, Lond, Dec 18—96.
- CRUCIBLE Fusions, Electricity for—Leeds. Electn, Lond, Jan 22—97. 2400 w. W Feb 6. M Mar.
- CULVERT for Bare Copper Mains (Ill)—Elec Rev, Lond; Electn, Lond; Elec Eng, Lond; Feb 19—97. W Mar 6.
- Cuiverts, Rail-Top (Ill)—Ry Rev, Dec 5—96. 900 w.
- CUPOLA Practice, Improvement of—James A. Beckett. Ir Tr Rev, Nov 26—96. 1800 w. M Jan.
- Cupola Practice, Possibilities of—Ir Tr Rev, Nov 19—96. 1300 w. M Jan.
- CUPRIC Oxide Element, The—P. Geibel. Elektrotechn Rundschau, Dec 1—96. 2000 w.
- CRUISERS with Rams—Engng, Dec 4—96. 1500 w.
- CURRENT, A Fragmentary Discussion of the So-called Electric—Ludwig Silberstein. Elektrochem Zeit, Dec—96. 4500 w.
- Currents, Idle—Elec Rev, Lond, Nov 20—96. 1300 w.
- Current, System of Charging for—Electn, Lond, Feb 12—97. W Feb 27.
- CYANIDE, Notes on the Estimation of Sulphides and Cyanates in Commercial—Messrs. Feldtmann and Bettel. Min Jour, Dec 5—96. Serial Part 1. 1000 w.
- Cyanide Process for the Treatment of Gold Ores, The—Joseph W. Richards. Jour Fr Inst, Feb—97. 4800 w. M Mar.
- Cyanide Process in South Africa—Butters. Eng & Min Jour, Mar 6—97.
- Cyanide Solutions, Solvent Power of Various—A. P. Crosse. Min Jour, Jan 23—97. 3400 w. M Mar.
- Cyanides for Electric Batteries and Accumulators—Platner. Elektrochem Zeit, Mar—97.
- Cyaniding, Some Problems in—Min Jour, Jan 23—97. 1500 w.
- CYCLE, Benzine Motor (Ill)—Sci Am, Dec 12—96. 1800 w.
- D**AM, The Clinton, Mass.—Fire and Water, Dec 12—96. 1300 w.
- Dams on the Great Kanawha River, West Virginia, Movable—Eng News, Dec 31—96. 1000 w.
- DAMME, A City of the Netherlands—J. Taveur Perry. Arch & Build, Jan 9—97. 1500 w. M Mar.
- DARK Light—Le Bon. Proc Lond Phys Soc, Dec—96. W Feb 6.
- DAVIS Coal and Coke Company, Central Electric Station of—T. W. Sprague. Eng & Min Jour, Jan 23—97. E Feb 10.
- DEBRIS, Responsibility for—Min & Sci Pr, Jan 9—97. 1100 w. M Mar.
- DERAILMENT of the Scottish Express at Preston, The—Zeitschr d Oestr Ing u Arch Vereines, Dec 18—96.
- DESILVERIZING Lead, Method for Electrolytically—D. Tommasi. L'Eclair Elec, Oct 17—96. Serial Part 1. 4200 w. M Jan.
- DIAGRAMS, Conventional—Tanner. Elec Eng, Feb 2—97.
- DIAMONDS, Artificial Production of—Moissan. Am Jour Sci, Mar—97.
- DIAPHHRAGM—Elek Anz, Jan 21—97. W Feb 13.
- Diaphragm of Telephones, Excursions of—Barus. Am Jour Sci, Mar—97. W Mar 6.
- DIATOMS, Some Observations on the Relation of Light to the Growth of—George C. Whipple. Jour New Eng Water Works, Sept—96. 5000 w. M Jan.
- DIELECTRIC Constants—Abegg. Electn, Lond, Jan 22—97.
- Dielectric Constant of Liquid Oxygen and Air—Fleming and Dewar. Electn, Lond, Dec 25—96. W Jan 9.
- Dielectric Constants of Solid Bodies, New Method of Determining—Starke. Zeit f Elek, Feb 5—97. W Mar 6.



R. A. Nommensen, '99, and John Barr, '99. Much interest was manifested in the debate and although there were attractions elsewhere that evening the senior law lecture room was well filled. The work of the debaters is highly commendable and manifested an immense amount of preparation. The jury, consisting of Profs. Bull, King and Whitney, decided unanimously in favor of the negative.

The debate showed clearly the excellent work done by these societies and that their members have gained a wider knowledge of current engineering practice and have improved in their ability to express themselves clearly and to the point. The existence of two societies has proved a benefit to both by creating a friendly rivalry and thus, besides making possible the annual joint debate, giving an impetus to the best methods of work. The weekly programs consist of papers, debates, reviews, and sometimes a lecture by a member of the faculty, and are undoubtedly more interesting and broadening than is the case with a society consisting only of members of one course.

#### *Science Club.*

The Science Club has had some interesting programs since our last number was printed. Following is a list of the papers read before that body:

January 18.

Mr. H. L. Russell—"Modern Methods of Milk Preservation."

Mr. Louis Kahlenberg—"The Toxic Action of Dissolved Salts and Their Electrolytic Dissociation."

February 22.

Mr. F. H. King—"Movements of Ground Waters."

Mr. C. R. Barnes—"The Mosses as an Evolutionary Failure."

March 11.

Dr. Wm. S. Miller—"Pulmonary Architecture."

April 20.

Mr. Edward Kremers—"The Periodic System."

- Dielectrics and Their Insulating Properties, Some—G. T. Hanchett. *Elec Wld*, Feb 6—97.
- Dielectrics, Capacity and Residual Charge of—Hopkinson and Wilson. *Electn*, Lond, Feb 5—97. *Elec Rev*, Lond, Feb 5—97.
- Dielectrics in the Magnetic Field—Duane. *L'Electr Elec*, Jan 30—97.
- Dielectrics, Viscosity of Polarized—*Elec Rev*, Lond, Jan 15—97. 1300 w. E Feb 10. M Mar.
- DIMENSIONS of Electric and Magnetic Quantities—Joubin. *L'Electr Elec*, Feb 20—97.
- DISCHARGE—Wesenhoeck. *Electn*, Lond, Feb 12—97.
- Discharge of Electric Railway Circuits—Mountain. *Am Electn*, Feb—97. W Mar 6.
- Discharges in Discontinuous Conductors—Vicentini. *Nuovo Cim*, Jan—97. *Electn*, Lond, Mar 5—97.
- Discharge—See Rays. Photographic. Conductors.
- DISTRIBUTION, Equalizer System of—Churchward. *Elec Eng*, Dec 23—96.
- Proc Lond Phys Soc*, Feb—97. W Mar 20.
- DISTURBANCES in Magnetometry—Du Bois.
- DOORS, Freight Car—R. R. C. Sanderson. *Engng*, Feb—97. 1800 w.
- DRAFT Apparatus, Beekman Automatic Forced—*Mas St Pitt*, Dec—96. 1800 w.
- DRAINAGE as Applied to Country Houses—W. J. Wells. *San Rec*, Jan 22—97. 1600 w.
- Drainage Construction, Improved Methods—E. C. Lynde. *Plumb & Dec*, Nov 2—96. 2000 w. M Jan.
- Drainage, Its Workmanship and Control—R. Thornton. *San Rec*, Jan 29—97. Serial Part 1. 1600 w. M Mar.
- Drainage of American Flat, The—Don De Quille. *Min & Sci Pr*, Jan 30—97. Serial Part 1. 1500 w.
- Drainage, Rural—*Dom Engng*, Jan—97. 4000 w.
- Drainage Works, Delhi—B. Parkes. *Ind Engng*, Dec 12—96. Serial Part 1. 1600 w. M Mar.
- DRAINING, Advantages of Main-Trap and Fresh-Air Inlet in House—J. J. Cullington. *San Plumb*, Jan 1—97. 2000 w.
- DRAINS, Construction of—E. C. Lynde. *San Plumb*, Dec 1—96. 1500 w.
- DRAWING, Instruction in Architectural (II)—William R. Ware. *Stone*, Dec—96. Serial Part 1. 2400 w.
- DREDGERS for the Colonies, Boat Channel—*Ind & East Eng*, Oct 17—96. 1000 w.
- DREDGING on the Rhine, Rock (III)—*Eng*, Lond, Jan 8—97. 2000 w. M Mar.
- DRESDEN, Electric Lighting on the Steamship—*Elec Eng*, Lond, Dec 11—96.
- DRILL, Hand Pressure Electric—*Elec Rev*, Jan 15—97. E Feb 10.
- Drills and Wood Runners (III)—John Randol. *Am Mach*, Jan 14—97. 2300 w. M Mar.
- DRILLING, Electric Rock (III)—A. T. Snell. *Electn*, Lond, Feb 26—97. W Mar 20.
- Drilling Machine, Portable Electrical (III)—*Sci Am*, Feb 12—97.
- DRIVES, Special—John Randol. *Am Mach*, Dec 31—96. 2300 w.
- DRIVING-Wheels, Larger—*R R Car Jour*, Jan—97. 1000 w.
- DUESSELDORF Station—*Elektrotechn Zeit*, Dec 10—96.
- Duesseldorf—See Electricity Works.
- DUST Figures—Archer. *Elec*, Feb 17—97. W Feb 27.
- DYNAMO Characteristics—Stine. *Am Electn*, Feb—97.
- Dynamo, Commutatorless Continuous Current—Poncin. *Elec Rev*, Lond, Feb 12—97. W Feb 27.
- Dynamo Construction—Seidener. *Zeit f Elektrotechn*, Mar 1—97.
- Dynamo Construction, Modern Type of—Schulz. *Elek Anz*, Jan 1, 10, 14, 17—97.
- Dynamo, Designing a Bipolar Drum—Kennedy. *Elec Rev*, Lond, Dec 11—96. W Jan 2.
- Dynamo, Determining the Efficiency of a—Bary. *L'Ind Elec*, Dec 10—96. W Jan 2.
- Dynamo for Three Wire System—Rothert. *Elektrotechn Zeit*, Jan 28—97.
- Dynamo for Three-Wire System—Ettinghausen. *Zeit f Elektrotech*, Feb 1—97. W Feb 20.
- Dynamo for Three-Wire Distribution, New—M. Alimet. *Elec Rev*, Lond, Jan 22—97.
- Dynamo, Note on the Relation Between the Speed and Efficiency of a Dynamo—A. G. Harstred. *Electn*, Lond, Jan 22—97.
- Dynamo-Telegraphy, Improvement in—F. P. Medina. *Elec*, Lond, Nov 13—96. Serial Part 1. 1500 w. M Jan.
- Dynamo, Three Wire—Kenny. *Elec Rev*, Lond, Feb 26—97. W Mar 20.
- Dynamos and Motors, Diseases of—J. C. Lincoln. *Sci Mach*, Feb 1—97.
- Dynamos, Calculation of—Arnold. *Elektrotechn Zeit*, Dec 17—96. W Jan 9.
- Dynamos, Calculation of—Gerault. *L'Ind Elec*, Feb 25—97. W Mar 27.
- Dynamos for Direct, Single and Multiphase Alternating Currents, Calculation of—E. Arnold. *Elektrotechn Zeit*, Nov 12—96.
- Dynamos, Relative Size, Weight and Price of—Wilson. *Elec Rev*, Lond, Mar 5—97. W Mar 27.
- Dynamos, Shunt Winding of—*Elec Rev*, Lond, Dec 18—96. W Jan 9.
- Dynamos, The Relation of Magnetic Flux to Output in—P. M. Heldt. *Elec Wld*, Dec 26—96. 1100 w.
- DYNAMOMETER, A Hydraulic (II)—Prof. James D. Hoffman. *R R Gaz*, Jan 22—97. 1500 w. M Mar.
- Dynamometer Car—*St Ry Rev*, Jan 15—97.
- E**ARTH as a Conductor—Bell. *Am Electn*, Feb—97. W Mar 6.
- Earth's Magnetism, Constants of the—Monreau. *L'Electr Elec*, Jan 23—97.
- EARTHQUAKES, Submarine—Milne. *Elec Rev*, Lond, Feb 19—97. W Mar 6.
- EDISON, Reminiscences of—Phillips. *Elec Rev*, Dec 23—96.
- EDUCATION, Technical and Mining—Regis Chauvenet. *Min Ind & Rev*, Dec 31—96. 2300 w. M Mar.
- EFFICIENCY for Steam Engine and Other Heat Motors, The Standard of—R. H. Thurston. *Jour Fr Inst*, Dec—96. Serial Part 1. 4000 w.
- Efficiency, Negative—F. A. Halsey. *Am Mech*, Nov 12—96. 1000 w.
- Efficiency, New Method for Determining Dynamo—J. L. Rontin. *L'Electr Elec*, Oct 24—96. 1200 w.
- EICHENDORF, 10,000 Volt Transmission Plant at—*Electn*, Lond, Feb 5—97.
- ELASTIC Limit or Yield Point?—P. Kreuzpointner. *Jr Age*, Jan 21—97. Serial Part 1. 2800 w. M Mar.
- ELECTRIC Arc and Surrounding Gas—W. E. Wilson and G. F. Fitzgerald. *Electn*, Lond, Jan 8—97. E Feb 3.
- Electric Clocks—*L'Elec*, Mar 6—97.
- Electric Current, On the Mode of Transferring Energy in the—Edwin J. Houston and A. E. Kennelly. *Elec Wld*, Dec 5—96. 1500 w. M Jan.
- Electric Discharge Through Electrolytes—Cardani. *Nouvo Cimento*, 4, p 200. W Mar 27.
- Electric Elevator Service, Automatic Starting and Stopping Devices for—*Elektrotechn Zeit*, Oct 15—96. 1000 w. M Jan.
- Electric Energy for Farming—*L'Energie Elec*, Mar 1—97. W Mar 27.
- Electric Furnace—Kuester and Dolezalek. *Zeit f Electrochemie*, Feb 5—97. W Mar 6.
- Electric Hanson—*Sci Am*, Mar 13—97.
- Electric Heating—*Elek Anz*, Jan 14—97.
- Electric Lamp for Lanterns, Hand Feed (III)—George M. Hopkins. *Sci Am*, Dec 26—96. 800 w.
- Electric Light and Power Co., Philadelphia, The New Station of the (II)—*Elec Eng*, Nov 25—96. 900 w.

## NEW PUBLICATIONS.

*New Engineering Journal.*

Engineering Journal is the title of a new semi-annual published by Stanford. The first number dated February, is a worthy attempt and we welcome the publication to the field and wish her success in the future.

---

Electro-Dynamic Machinery for Continuous Currents, by Edwin J. Houston, Ph. D., and A. E. Kennelly, Sc. D. The W. J. Johnston Co., price \$2.50.

The chief characteristic of this work is its delightful simplicity. With the exception of a few algebraic and trigonometric equations the computations are entirely arithmetical. The calculus is entirely avoided which makes the book suitable for a sophomore study in college. The authors are to be commended for their courage in adhering to the metric system throughout. If engineers ever hope to see the metric system prevalent, electrical engineers, above all others, should insist on using it, their entire science being founded on the c. g. s. system. The adoption of the notation of the Chicago Electrical Congress is also commendable.

Turning to the contents, the first chapter gives the general principles of dynamos. The use of the expression  $\frac{E^2}{r}$  for the *electrical capability* of dynamos illustrates in a striking way, how a dynamo may be wound for different voltages and yet have a constant output. The second chapter on the construction of dynamos is remarkable for its classification; but, while it may be a matter of taste, we think this chapter should be placed toward the end of the book. Chapter three, on magnetic flux, is good though there is perhaps more stress than necessary in a work of this kind laid on the mapping of lines of force. The next three chapters on magnetic circuits are excellent. The use of the formula  $\text{webers} = \frac{\text{gilberts}}{\text{oersteds}}$  in connection with a curve between magnetic reluctivity, or specific reluctance, and magnetising force, makes computation of magnetic circuits at once plain and easy. Chapters seven to fourteen inclusive take up in logical order the laws of electro-dynamic induction, the development of e. m. f. in an

- Electric Light and Railway Power Station of the Edison Electric Illuminating Co. of Paterson, N. J. (III)—Elec Eng, Dec 9—96. 4500 w.
- Electric Light Stations and Gas Engines—Elec Rev, Jan 27—97.
- Electric Light Stations, Pioneer—Elec Eng, Lond, Jan 1—97. 2500 w. M Mar.
- Electric Light System, The Hastings (III)—Electn, Lond, Nov 13—96. 3500 w.
- Electric Lighting at Brown's Hotel, London—Elec, Lond, Jan 15—97. E Feb 10.
- Electric Lighting at Darwin—E. M. Lacey. Elec Eng, Lond, Nov 20—96. 3500 w. M Jan.
- Electric Lighting at the People's Palace (III)—Elec, Lond, Oct 23—96. 2400 w.
- Electric Lighting by Gas Engine, Determination of the cost of—J. L. Christy. Stev In, Jan—97. E Feb 3. Elec Age, Feb 6—97.
- Electric Lighting in Cape Town—A. P. Trotter, Eng, Lond, Nov 20—96. 2500 w.
- Electric Lighting of Croydon (III)—Elec Rev, Lond, Nov 6—96. 2800 w.
- Electric Lighting of the Royal Poinciana Hotel at Palm Beach, Florida (III)—Elec Eng, Dec 30—96. 800 w.
- Electric Lighting of the Theatre of Earl's Court Exhibition, The (III)—Eng, Lond, Nov 6—96. 1600 w.
- Electric Lighting on the Avenue de l'Opera (III)—L'Eclairage Elec, Feb 6—97.
- Electric Lighting Statistics for Paris—Elektrotechn Zeit, Feb 11—97.
- Electric Plant for Country Residence, Typical—Maurice Barnett. Am Electn, Nov—96. 1600 w. M Jan.
- Electric Plant, Medical College—Am Electn, Dec—96. W Jan 2.
- Electric Plants in Small Towns—Eng Mag, Feb—97. W Feb 6.
- Electric Power in Shops—A. Hillairet. L'Eclair Elec, Oct 17, Nov 7—96. Serial Part 1. 2100 w.
- Electric Power in Workshops, Local Distribution of—E. K. Scott. Elec Eng, Lond, Jan 1—97.
- Electric Power on the B. & O., Some Results with—T. Fitzgerald. Elec Eng, Jan 6—97. 900 w. M Mar.
- Electric Power Plant, The Economics of—C. C. Longridge. Min Jour, Nov 21—96. 1300 w. M Jan.
- Electric Power, Use of—Bell. Eng Mag, Jan—97. W Jan 9.
- Electric Railroad Power Station, Test of an—F. W. Philsterer. Sib Jour of Engng, Dec—96. 2400 w.
- Electric Railroad, Test of Conduit—H. G. Ogden, Jr., and F. W. Heltkamp. Sib Jour of Engng, Dec—96. 1300 w.
- Electric Railway in Fairmount Park, Philadelphia, A Novel—St Ry Jour, Dec—96. 1500 w.
- Electric Railway of Varese, Italy, The (III)—St Ry Jour, Dec—96. 1500 w.
- Electric Railway Operations, Comparative Economy in—C. H. Davis. Eng Mag, Mar—97.
- Electric Railway Return, Notes on the—G. W. Knox. St Ry Rev, Dec 15—96. 5000 w.
- Electric Railway Power Stations in America and the Economic Results of Their Operation—L. D. Tandy. St Ry Jour, Jan—97. 1700 w.
- Electric Railway Statistics for Germany—Electn, Lond, Feb 21—97.
- Electric Railway, The Jungfrau Mountain (III)—Elec Eng, Nov 18—96. 1800 w.
- Electric Railways—Elec Eng, Lond, Feb 26 and Mar 6—97.
- Electric Resonance and Consonance—Feldman. Elektrotechn Zeit, Feb 18, 25—97. W Mar 6, 13.
- Electric Sad Irons in a Hospital for the Insane (III)—Elec Rev, Nov 25—96. 800 w.
- Electric Ship Lighting—Bernard. Cassier's Mag, Feb—97. W Mar 27.
- Electric Signs, Interchangeable (III)—Theodore Waters. Elec Eng, Dec 9—96. 1630 w. M Jan.
- Electric Subways, The Municipal Ownership of—Eng News, Jan 28—97. 1700 w. M Mar.
- Electric Supply at 230 Volts—A. H. Gibbings. Mech Wld, Mar 15—97. Pro Age, Mar 15—97.
- Electric Supply Stations, Capital Expenditures in—Electn, Lond, Feb 26—97. W Mar 20.
- Electric Traction, Application of Storage Battery to—Hewitt. Proc Eng Club of Phila, Jan. W Feb 13.
- Electric Traction Under Steam Railway Conditions—Dr. Chas. E. Emery. Trans Am Inst Elec Engrs, Oct—96. Nov—96.
- Electric Tramway, Clontarf (III)—Ry Wld, Nov—96. 900 w.
- Electric Travel, The Age of—George Ethelbert Walsh. Chau, Feb—97. M Mar.
- Electric Vehicles—Krieger System. Bul Soc d ut des Elec, Jan.
- Electric Waves—Drude. Electn, Lond, Jan 22—97.
- Electric Waves, Absorption of, by a Terminal Bridge—Barton and Bryan, Phil Mag, Jan—97.
- Electric Waves, Apparatus for Study of—Bose. Phil Mag, Jan—97.
- Electric Waves Through Tubes, Passage of—Rayleigh. Phil Mag, Feb—97.
- Electric Waves—See Absorption.
- ELECTRICAL Apparatus, Some New—Reginald A. Fessenden. Elec Wld, Dec 5—96. Serial Part 1. 3300 w.
- Electrical Development, Future—West Elec, Jan—97. 2000 w.
- Electrical Distribution, The Principles of—Francis B. Crocker. Elec Wld, Dec 19—96. Serial Part 1. 2000 w.
- Electrical Engineering in Canada—Can Elec News, Feb—97.
- Electrical Engineering in Germany, Progress of—West Electn, Jan 30—97.
- Electrical Energy from Gases, Production of—Andreas. Elec Rev, Lond, Mar 12—97.
- Electrical Energy, Fuel Energy into—Elihu Thomson. Elec Wld, Jan 2—97. 1500 w.
- Electrical Energy on a Small Scale, Making or Buying—Elec Rev, Lond, Dec 25—96. E Jan 13.
- Electrical Energy, The Direct Production of—Bertram Blount. Electn, Lond, Nov 20—96. 1300 w. M Jan.
- Electrical Firing in Fiery Mines—J. Van Lauer. Col Guard, Jan 22—97. 4000 w. M Mar.
- Electrical Inventions, Patents and—Henry C. Townsend. Elec Eng, Jan 6—97. 1600 w. M Mar.
- Electrical Machinery, A Few Points on the Care of—William Baxter, Jr. Power, Dec 10—96. Feb—97. Mar—97.
- Electrical Machinery, Repairs of—A. R. Harris. Am Mach, Jan 14, 28—97. 1400 w. M Mar.
- Electrical Machinery, The Mechanical Construction of—F. M. Weymouth. Elec Eng, Lond, Jan 1—97. 2200 w. M Mar.
- Electrical Measurements—W. A. Anthony. Elec Eng, Jan—97. 2000 w. M Mar.
- Electrical Plant During the Last Fifteen Years, Isolated—Gas Wld, Jan 2—97. 2000 w. M Mar.
- Electrical Phenomena, Mechanical Conception of—Heinke. Elektrotechn Zeit, Feb 4—97. W Feb 27.
- Electrical Progress as Evidenced by the Work Performed During the Past Year, Southern—F. M. Wilcox. Tradesman, Jan 1—97. 4500 w.
- Electrical Progress in 1896—Charles G. Armstrong. West Elec, Jan 9—97. 2300 w.
- Electrical Railway Operation, Economy in—Davis. Eng Mag, Mar—97. W Mar 13.
- Electrical Resonance, Practical Aspects of—Miller. West Electn, Mar 13—97. W Mar 20. E Mar 31.
- Electrical Subway Work, Progress of—William Weaver, Jr. Elec Wld, Jan 29—97. 1800 w. M Mar.
- Electrical Supply House, Past and Present—W. H. Kinlock. Elec Eng, Jan 6—97. 1200 w. M Mar.
- Electrical Traction on Steam Road in Belgium—Pierard. L'Elec, Feb 20—97. W Mar 13.
- Electrical Work in South America—Elec Rev, Lond, Dec 25—96. 900 w.

armature, the calculation of the windings of a gramme-ring dynamo and the construction of various types of armatures. The most striking thing here is the frequent use of the voltaic analogue to illustrate the principles of the magnetic circuit. After dealing with the friction, eddy current, and hysteresis losses in dynamos in three separate chapters, we come to an excellent exposition of the causes of sparking and of armature reaction. The heating of dynamos is next disposed of. In the chapter on regulation, the use of the Fröhlich equation for finding the complete magnetization curve of a dynamo from two observations is well brought out. Combined output of dynamos is next briefly considered, then follow four separate chapters on disc, armatures and single field coil generators, unipolar dynamos, electro-dynamic force, and motor torque respectively. There is a good chapter on regulation of motors and another on the starting and reversing of the same, meter-motors are then touched on briefly and the final subject treated is that of motor dynamos. Throughout the treatise there are numerous illustrative arithmetical examples; it is illustrated profusely with good cuts, and it is almost needless to add that the typographical appearance is neat.

---

Electricity and Magnetism, by Eric Gerard, translated by R. C. Duncan. The W. J. Johnson Co., price \$2.50.

This book is a translation of the fourth French edition; only those subjects such as storage batteries, transformers, etc., which have been so thoroughly treated in American books, having been omitted. This space, however, is replaced by chapters on special subjects by Steinmetz, Kennelly and Hutchinson. To read the book requires only the mathematical training received in a good engineering course, and this places within the grasp of the many who are not versed in the use of the most advanced mathematics, an opportunity of studying mathematically the phenomena of electricity and magnetism. The work is of special value to those interested in the physics of electricity.

The introduction deals with fundamental and derived units, the mapping of electrostatic lines of force, and of equipotential lines, and a few general theorems, of potential and attraction. The properties of magnets are taken up in a much more practical manner than one would expect of a mathematical treatise, and the chapter on hysteresis by Steinmetz is of necessity excellent, as any

- ELECTRICITY—Tesla. Elec Rev, Jan 27—97. W Feb 6.
- Electricity Against Compressed Air—Lewis Searing. Elec Eng, Nov 25—96. 2400 w. M Jan.
- Electricity, Age of—Tesla. Cas Mag, Mar—97.
- Electricity and Boiler Scale—West Electn. Mar 20—97.
- Electricity and Chemical Action. Mechanical Theory of—Hayercraft. Elec Rev, Lond, Jan 29—97.
- Electricity at the Chicago Cycle Show—Kimbach. West Electn, Feb 6—97.
- Electricity at the College of Physicians and Surgeons (Ill)—Am Electn, Dec—96. 1000 w.
- Electricity, Biographical History of—Am Electn, Feb—97.
- Electricity by Chemical Action, The Generation of—Ernst Andreas. Zeit f Electrochem, Nov 5—96. 1200 w. M Feb.
- Electricity Direct from Fuel—Weber. Elektrotechn Zeit, Feb 25—97. W Mar 13.
- Electricity for Suburban Railway Traffic—Wallace. Elec Eng, Mar 10—97. W Mar 20.
- Electricity from Coal—Willard E. Case. Elec Eng, Jan 6—97. 1700 w. M Mar.
- Electricity in Agriculture—Cassier's Mag, Feb—97.
- Electricity in Mines, Safe Use of—H. W. Ravenshaw. Col Eng, Jan—97. 4000 w. M Mar.
- Electricity in Relation to the Chemical and Metallurgical Industries—John B. C. Kershaw. Electn, Lond, Dec 25—96. Serial Part 1. 1000 w.
- Electricity in the Government Printing Office—West Electn, Jan 30—97. 4000 w. M Mar.
- Electricity in the Isle of Man—Gas Wld, Jan 2—97. 2000 w. M Mar.
- Electricity in the Mining Industry. Influence of (Ill)—Min Ind and Rev, Dec 31—96. 1500 w. M Mar.
- Electricity in the Weather Bureau (Ill)—Elec Wld, Dec 26—96. 1800 w.
- Electricity, Methods of Charging for (Ill)—Elec Rev, Lond, Nov 6—96. 2800 w. M Jan.
- Electricity, Motive Power for Generating—Jour of Gas Lgt, Jan 5—97. 2000 w. M Mar.
- Electricity on Cincinnati Southern Railway—Coles. Elec Rev, Mar 10—97.
- Electricity on Farms—Elec, Feb 3—97.
- Electricity on Seed, Effect of—Elec Rev, Mar 17. W Mar 20.
- Electricity on Steam Roads—Clark. St Ry Rev, Mar 15—97. W Mar 27.
- Electricity, Progress in the Adaptation of—M. J. H. Ir Tr Rev, Jan 21—97. 2000 w. M Mar.
- Electricity, Progress of—L'Eclair Elec, Jan 2. 9. 16—97.
- Electricity Supply at 230 Volts—Gibbins. Elec Rev, Lond, Feb 12—97. Elec, Feb 17—97. W Feb 27.
- Electricity Supply, Malta—Elec Eng, Lond, Dec 25—96. 2500 w.
- Electricity, Theft of—Elektrotechn Rundschau, Jan 15—97. 2000 w. M Mar.
- Electricity vs. Compressed Air—Lewis Searing. Min Ind and Rev, Dec 10—96. 2200 w.
- Electricity Works at Dusseldorf, Annual Report of the—Elektrotechn Zeit, Dec 10—96. E Jan 13.
- Electricity Works, Bury (Ill)—Elec Eng, Lond, Nov 6—96. 3000 w.
- Electricity Works, Chester (Ill)—Elec Eng, Lond, Dec 18—96. 5500 w.
- Electricity Works, Manchester Ship Canal (Ill)—Elec Rev, Lond, Nov 12—96. 1800 w.
- ELECTRO-CAPILLARY Experiment—Chassy. Jour de Phy, Jan—97. W Mar 20.
- ELECTRO-CHEMICAL Apparatus and Processes—Zeit f Elec, Jan 20—97. W Feb 13.
- Electro-Chemical Laboratory—West Electn, Mar 20—97.
- Electro-Chemical Industry, Progress in the—Dr. Hugo Ritter V. Perger. Zeitschr d Oesterr Ing u Arch Ver, Dec 11—96. Dec 18—96. Eng Mag, Feb—97.
- Electro-Chemical Theory—Bucherer. Elektrochem Zeit, Jan 2—97.
- ELECTRO-CHEMISTRY in 1895. Progress of—Elek Anz, Dec 10—96.
- Electro-Chemistry in 1896—Weyer. Elektrochem Zeit, Jan—97.
- ELECTRO-CULTURE, Narkewitsch—Iodko. L' Elec, Feb 6—97.
- ELECTRODES, Novelties in—Dr. H. Weyer. Elektrochem Zeit, Nov—96. 5000 w. Dec—96. 5000 w.
- ELECTRO-DYNAMICS, Foundations of—Wiechert. Proc Lond Phys Soc, Jan—97. W Feb 27.
- ELECTROLYSIS for the Preparation of Bleaching Compounds and Alkalies, On the Application of—Dr. Carl Kellner. Elek Echo, Jan 9—97.
- Electrolysis, New Carbon Terminals for—Elektrochem Zeit, Jan—97. 1000 w. M Mar.
- Electrolysis of Nitric Acid, Formation of Ammonia from the—Zeit f Physik u Chem, Mar—97.
- Electrolysis of Salts and Bases in Ammonia—Zeit f Electrochem, Dec 5—96.
- Electrolysis of Water—Sokolow. L'Eclair Elec, Dec 5—96. W Jan 2.
- Electrolysis, The Separation of Metals by means of Soluble Anodes—Elektrochem Zeit, Jan—97. 500 w. M Mar.
- ELECTROLYTES, Measurement of Resistance of—Wien. Proc Lond Phys Soc, Feb—97.
- ELECTROLYTIC Cell, Efficiency of an—Hurter. Electn, Lond, Jan 22—97.
- Electrolytic Chains, Thermic—William Duane. Zeit f Elektrochem, Oct 20—96. 1200 w.
- Electrolytic Conductivity, Measuring—Stroud and Henderson. Phil Mag, Jan—97.
- Electrolytic Decomposition of Fused Zinc Chloride—R. Lorenz. Elec Rev, Lond, Jan 15—97. E Feb 10.
- Electrolytic Preparation of Percarbonates—Elek Anz, Mar 4—97.
- Electrolytic Researches with Chlorine and Sulphur—Gross. Zeit f Electrochem, Feb 20—97.
- Electrolytic—See Resistance.
- ELECTROLYZERS for Laboratories—L' Elec, Jan 16—97.
- ELECTROMAGNETIC Formulas, Generalization of—Vaschy. L'Eclair Elec, Feb 12—97.
- Electromagnetism, Calculations in—Vaschy. L'Eclair Elec, Jan 8—97.
- ELECTROMETER for Low Potentials—Perot and Fabry. Electn, Lond, Feb 5—97. W Feb 20.
- Electrometer, Idiostatic—Barus. Phys Rev, Mar—97. W Mar 20.
- ELECTRO-MOTIVE FORCE from Voltage Curve, Graphical Method for Determining—Fleischman. Elektrotechn Zeit, Jan 21—97.
- Electro-Motive Force Produced in a Portion of a Gramme Ring Moving in a Constant Magnetic Field—Loppe. L'Eclair Elec, Oct 17—96. 800 w.
- Electro-Motive Force, Standards of—Armagnat. L'Eclair Elec, Dec 12—96.
- ELECTRO PHYSICS—DeHeen. Electn, Lond, Mar 12. W Mar—27.
- ELECTRO-THERAPEUTIC Terms—Electn, Lond, Feb 5—97.
- ELEVATION of the N. J., N. H. and H. R. R. at Boston Mass. (Ill)—Eng News, Jan 14—97. 2800 w. M Mar.
- ELEVATOR, Ducham's Pneumatic Grain (Ill)—Engng, Jan—97. 1000 w. M Mar.
- Elevator, Electric (Ill)—Sci Am, Jan 2—97.
- Elevator for Unloading Vessels, Travelling—Zeit d Oesterr Ing u Arch Vereines, Jan 1—97. 2000 w. M Mar.
- Elevator, Smith's Electro-Magnetic (Ill)—West Elec, Dec 19—96. 3700 w.
- Elevator Work, Some Problems in Electric (Ill)—H. Cochrane. Sib Jour of Engng, Dec—97. 5000 w.
- Elevators and Tall Buildings—Eng Rec, Feb 6—97. 900 w. M Mar.

one having read his papers on this subject before the American Institute of Electrical Engineers, would expect. The subjects of condensers, current electricity, properties of electrified bodies and thermo-electric couples are treated in a chapter on electricity. The subject of electro-magnetism is then covered. The chapter on units and dimensions by Cary T. Hutchinson, is touched upon briefly, yet with a thoroughness that makes it of practical value. The treatment of electro-magnetic induction is quite mathematical, but not at all difficult and covers the subject thoroughly from Lenz's Law to the principles of the rotary field. There is a short, sweet chapter on impedance by A. E. Kennelly, and the same may be said of this that was remarked of the contribution by Steinmetz. It may be remarked of the chapter on propagation of currents that it is exceedingly good, alternating currents, oscillatory discharges and Hertzian phenomena are the most prominent subjects in this chapter. In a final chapter on electrical measurements methods are given for the measurement of the magnetic permeability of metals and for electrical coefficients such as are most frequently needed in alternating current calculations.

---

The Materials of Construction, by J. B. Johnson, C. E. John Wiley & Sons, price \$6.00.

This is one of the most remarkable books we have seen. It is a complete treatise on all the materials of construction; it contains not only all the data of note made by private investigators the world over, but embodies the essence of the government reports of various countries on constructive materials. The book is the result of prodigious labor; in fact, it seems almost impossible that one man could collect, sift down, and concentrate all the available data of the world on this subject into a book of less than eight hundred pages.

The work is divided into four parts:

Part I is devoted to the mechanics of materials. First, there is a discussion of the nature of deformation and stresses, which is followed by separate chapters on materials under tensile stress, under compressive stress, under shearing stress, and under cross-bending stress. There are numerous typical curves and photographs of test specimens. In the chapter on cross-bending the various formulas for beams are developed. The latter part of Part I, treats of resilience of materials.

- Elevators, The Latest Improvements in Electric (III)—Sci Am, Jan 2—97. 1100 w.
- ELEVATORS—See Buildings.
- ELLIPTICAL Arms, Diagram of Proportions of—S. E. Freeman. Am Mach, Dec 3—96. 500 w. M Jan.
- ENERGY of the Current—Gross. Elektrochem Zeit, Feb 1—97.
- Energy, Variations of—Vaschy. L'Eclair Elec, Feb 20—97.
- ENGINE Construction, Testing Steel for Marine—Eng, Nov 21—96. 1200 w.
- Engine Design, A Novel (III)—Am Mach, Jan 7—97. 1000 w.
- Engine Development, Steam—Bos Jour of Com, Feb 6—97. 1300 w. M Mar.
- Engine Room, Five Years' Apprenticeship in an—Age of St, Dec 5—96. 1800 w. M Jan.
- Engine Rooms, The Economy of the Modern—Eng Mag, Dec—96. 2800 w.
- Engine Tests—Lightning, Jan 14—97.
- Engine, The First Railway—Bos Jour Com, Nov 28—96. 1500 w.
- Engine, Triple Expansion Pumping (III)—Engng, Dec 18—96. Serial Part 1. 2500 w.
- Engine—See Bearings.
- Engines, Breakdowns of Stationary Steam—Col Guard, Nov 13—96. Serial Part 1. 4700 w. M Jan.
- Engines by Tons, Rating of—Trav Eng Assn Rept, Sept—96. 10000 w.
- Engines, On the Use of Steam—W. H. Hoffman. Safety V, Dec—96. 1600 w.
- Engines, Safety Apparatus for Winding (III)—Col Guard, Nov 20—96. 1200 w.
- Engines, Short Stroke Steam—J. S. Raworth. Engng, Jan 29—97. 3800 w. M Mar.
- Engines, The Balancing of Beam—Am Mach, Nov 19—96. 1500 w.
- Engines, Twisting Moments of Quadruple Expansion—H. J. Teiper. Eng, Dec 5—96. 1500 w. M Jan.
- ENGINEER of To-Day, The—Bos Jour of Com, Nov 14—96. 2800 w.
- Engineer, The Business Wisdom and Responsibility of the—W. F. Goodhue. Purdue Soc of Civ Eng, 1896. 1200 w.
- ENGINEERING, Civil—Eng, Lond, Jan 1—97. 3300 w. M Mar.
- Engineering Education, Electrical—Francis B. Crocker. Elec Eng, Jan 6—97. 3300 w. M Mar.
- Engineering, Electrical—Eng, Lond, Jan 1—97. 3000 w. M Mar.
- Engineering in Chicago, Recent City—Eng Rec, Nov 21—96. 700 w.
- Engineering Prospects in Japan, Civil—Engng, Jan 29—97. 1700 w. M Mar.
- Engineering, The Teaching of Railroad Mechanical—R. R. Gaz, Jan 8—97. 1400 w.
- EQUALIZING Connections for Compound Wound Dynamos in Multiple—Keller. Jour Fr Inst, Mar—97. W Mar 13.
- Equalizer System of Distribution, The Churchward (III)—A. Churchward. Elec Eng, Dec 23—96. 800 w.
- Equalizer, The—Am Electn, Jan—97. 1500 w. M Mar.
- ETHER and Light—Friedrich. Elek Anz, Jan 17—97.
- Ether Theories, On the Prospective Development of—Reginald A. Fessenden. Elec Wld, Jan 2—97. 1700 w.
- EXHIBITION—Electn, Lond, Mar 12—97.
- Exhibitions, German Achievements in—L. von Krockow. Am Arch, Jan 30—97. 2000 w. M Mar.
- EXPERIMENTS Bearing on the Causes of Explosions—J. Coquillion. Col Guard, Nov 6—96. 900 w. M Jan.
- EXPLOSION of a Kier at a Paper Mill, Bolton—Engng, Nov 20—96. 5000 w. M Jan.
- EXPLOSIVES in Belgian Collieries, The Use of—Victor Watteyne. Col Guard, Jan 29—97. 1800 w. M Mar.
- Explosives in Coal Mines—Col Guard, Dec 24—96. 2800 w.
- Explosives in Coal Mining—Min Jour, Jan 16—97. Serial Part 1. 2500 w.
- EXPOSITION of 1896, Notes on the Building Exhibits at the Berlin Technical—Oesterr Monat O B, Dec—96. 12000 w. M Feb.
- F**ACTORIES, The Commercial Organization of—Ir & Coal Trds Rev, Nov 27—96. 4000 w.
- FAN at the Saint-Eloy Colliery for Determining the Equivalent Orifice, Experiments with a Ser—M. de Lachapelle—Col Guard, Dec 11—96. 1200 w.
- Fan Capacity, Determination of—Heat and Vent, Jan 15—97. 1400 w. M Mar.
- Fans, Power for Centrifugal—Am Mach, Dec 31—96.
- FAULT Localizer, Direct Reading of—Raphael. Elec, Lond, Mar 12—97.
- FEED Heater System, A New—Karl Lundkvist. Engng, Jan 29—97. Serial Part 1. 2500 w. M Mar.
- FERRANTI Effect of Transformers—Grassi. L'Elect, Jan and Feb—97. W Mar 13.
- FERRY Boat, Speed Trials of a Screw Propelled—F. L. Du Rosque. Eng News, Nov 18—96. 1700 w.
- FILAMENTS in Paris, Incandescent Lamp—Elec Rev, Dec 23—96.
- Filaments—See Carbon.
- FILTER Gallery at Reading, Mass, Removal of Iron from Water from a—Eng News, Nov 26—96. 4700 w. M Jan.
- FILTERING Materials, Mechanical Analysis of—Allen Hazen. Eng Rec, Jan 23—97. 1800 w. M Mar.
- FILTRATION—S. A. Charles. Fire and Water, Nov 14—96. 2400 w.
- Filtration Plant at Lexington, Ky., Alum Feeder for (III)—Eng News, Jan 14—97. 700 w.
- Filtration, Sand—Allen Hazen. San, Nov—96. 6300 w. M Jan.
- FIRE Alarm Box, Requisites for a Perfect—Johnson. West Electr, Mar 20—97.
- Fire Mantel, The Incandescent—T. E. Pye. Jour Gas Lgt, Nov 3—96. 2800 w. M Jan.
- Firemen for Promotion and New Men for Employment, On Standard Form of Examination of—Trav Eng Assn Rept, Sept—96. 10000 w.
- Fireproof Constructions and Recent Tests (III)—A. L. A. Himmelwright. Eng Mag, Dec—96. 3900 w. M Jan.
- Fireproofing as a Specialty—Joseph K. Freitag. Purdue Soc of Civ Eng, 1896. 3000 w.
- Fireproofing Buildings—Fire and Water, Dec 19—96. 900 w.
- Fireproofing Material in Actual Tests, Some Experiences of Modern—Br Build, Nov—96. Serial Part 1. 1800 w. M Jan.
- Fireproofing Tests, Report of Progress of the Committee on (III)—Am Soc Mech Eng, Dec. 2000 w. M Jan.
- FLEISS Breathing Apparatus as a Life Saving Appliance—George H. Winstanley. Col Guard, Jan 15—97. 3000 w. M Mar.
- FLOOR Construction in New York City, Fireproof—Eng News, Feb 4—97. 5000 w. M Mar.
- Floor System, Construction Details and Testing of a Fireproof (III)—A. L. A. Himmelwright. Eng Rec, Jan 2—97. 2500 w.
- FLOORING, A New System of Fireproof—Arch and Build, Jan 9—97. 700 w. M Mar.
- Flooring, Test of the Bailey System of Fireproof—Eng News, Jan 7—97. 350 w.
- FLOW of Water Through Pipes, Familiar Methods for Calculating the—San Plumb, Jan 1—97. 2000 w.
- "Flow" in Rolling of Steel—William Cuthill. Col Guard, Jan 22—97. 2200 w. M Mar.
- FLUORESCENT Salt, New—Kolle. Elec Eng, Feb 10—97. W Feb 20.
- Fluorescent Screens, Power of—Nuovo Cimento, Jan—97.



Part II treats of the manufacture and of the various physical and mechanical properties of materials of construction. Cast iron, wrought iron and steel are each dealt with separately. A chapter on the minor metals treats of copper, tin, aluminum, and the various alloys. Lime, cement, concrete and mortar are next taken up. There is a chapter on the manufacture of vitrified paving brick by H. A. Wheeler, and then follows a long scientific discussion of timber.

Part III. deals with the methods of testing materials and the machines used for testing. The first chapter is a discussion of the general principles of mechanical tests. Then follow separate discussions of tension tests, compression tests, cross-bending tests, impact and hardness tests, shearing and torsion tests, and cold bending and drifting tests. The other chapters are on the testing of cements, of stone and brick, and of timber.

Part IV. covers nearly half the available space in the book and is a discussion of the mechanical properties of materials of construction, the conclusions being drawn from tests. The materials considered are each in turn taken up in the same order as in the preceding parts of the book, viz.: cast iron, wrought iron, and steel. Then the author treats of the fatigue of metals. This is followed by a chapter on copper-zinc-tin alloys, another on the mechanical properties of metals as affected by temperature and then follows a treatment of the strength of cements, cement-mortars and concretes. The results of tests on stone and brick are next discussed, likewise timber of tests. There is a chapter on the strength of iron and steel wire and wire rope. W. A. Layman has a chapter, the magnetic testing of iron and steel, and then follow the appendices, viz.:

Appendix A. A Biographical Sketch of the Life of Professor Johann Bauschinger.

Appendix B. Study of Iron and Steel by Micrographic Analysis, by Professor J. O. Arnold of Sheffield, England.

Appendix C. Comparative Analysis of the Resolutions of the Conventions of Munich, Dresden, Berlin and Vienna, and the Recommendations of the American Society of Mechanical Engineers, with the Conclusions Adopted by the French Commission in Reference to the Testing of Metals, by M. L. Baclé, translated by O. M. Carter and A. E. Gieseler.

- FLUXING Rocks of Alabama, Geologically Considered, The—Henry McColey. Eng and Min Jour, Jan 30—97. 1400 w. M Mar.
- FLY-WHEELS, Some Notes on—I. A. Taylor. Elec Engng, Nov—96. 1200 w.
- FORGINGS, Machinery Cycle (III)—Mach, Jan—97. Serial Part 1. 1400 w.
- Forgings, Steel (III)—H. F. J. Porter. Jour West Soc Eng, Dec—96. 8400 w. M Mar.
- FORMULAS—See Electromagnetic.
- FORT WILLIAM—Elec Rev, Lond, Mar 5—97.
- FORTIFICATIONS, Armor for—Sci Am, Dec 26—96. 1400 w.
- FOUCAULT Currents—Desombre. L'Eclair Elec, Feb 20—97. W Mar 20.
- FOUNDATION Piers, Repairing and Reinforcing (III)—Eng Rec, Dec 12—96. 1200 w.
- Foundations—W. A. Truesdell. Wis Eng, Oct—97. 4000 w.
- Foundations, Deep and Difficult Bridge and Building—George E. Thomas. Am Arch, Nov 28—96. 2000 w.
- Foundations for the Gillender Building in New York City, Pneumatic Caisson (III)—Eng News, Jan 7—97. 1500 w.
- Foundations, Testing Instrument for—Rudolph Mayer. Wiener Bauind Zeit, Oct 22—96. 1400 w. M Jan.
- Foundations, The Distribution of Pressure in—Rudolph Mayer. Zeitschr d Oesterr Ing u Arch Vereines, Jan 15—97. 3000 w. M Mar.
- FOUNDRY Costs—Ir Age, Dec 3—96. 3500 w.
- Foundry, Improvement in the—W. J. Kelp. Mach, Dec—96. 1200 w.
- Foundry Interests, The South's—E. H. Putnam. Tradesman, Jan 1—97. 4500 w.
- Foundry Practice, Niles Tool Works—Peter J. Connor. Mach, Feb—97. 600 w. M Mar.
- Foundries, Brass—Mach, Jan 7—97. Serial Part 1. 1500 w.
- FOUDROYANT—See Santa Fe.
- FOUNTAIN at the Budapest Exposition, Luminous (III)—Zeit f Beleucht, Dec 10—96.
- FRAMEWORKS, Notes on the Graphical Computations of (III)—Z Oesterr I u A V, Nov 20—96. 2000 w.
- FREIGHT Truck of Rolled Shapes (III)—R R Car Jour, Jan—97. 700 w.
- FREQUENCY Indicator—Meyer System. Elec Rev, Lond, Feb 19—97.
- FRESCOES of the Sistine Chapel, The—W. B. Richmond. Arch, Lond, Nov 27—96. 4000 w. M Jan.
- FRICTION Horse Power—C. H. Benjamin. Am Soc Mech Eng, Dec—96. 1500 w. M Jan.
- Friction Horse Power in Factories—Samuel Weber. Mach, Feb—97. 1300 w. M Mar.
- Frication of Water in Hot Water Heating Pipes—J. H. Kinealy. Heat & Vent, Nov 15—96. 700 w.
- FROG, Spring Rail, Union Pacific Railway (III)—Eng News, Feb 4—97. 500 w.
- FUEL, Burning Cheap—W. H. Wakeman. Safety V, Nov—96. 2500 w.
- Fuel Testing, Methods of—Arthur V. Abbott and Franz J. Dommerque. Elec Engng, Nov—96. 3400 w. M Jan.
- FURNACE, A New High Temperature—H. L. Gantt. Jour Fr Inst, Dec—96. 3500 w. M Jan.
- Furnace Construction and Management, Practical Notes on—Herbert Lang. Eng & Min Jour, Jan 23—97. 1800 w. M Mar.
- Furnace Construction, Progress in Blast—W. O. Amsler. Sib Jour Engng, Nov—96. 4000 w. M Jan.
- Furnace, Electric Distillation (III)—Zeit f Elektrochem, Jan—97. M Mar.
- Furnace for Reducing Iron, Electric—Elec Age, Dec 19—96. W Jan 2.
- Furnace, Heating—Dom Engng, Jan—97. 1200 w. M Mar.
- Furnace, Laboratory—L'E'ec, Jan 23—97.
- Furnace, The By-Products of the Blast—A. Humboldt Sexton. Phil Soc Glasgow. 4500 w.
- Furnaces, Wall Accretions of Lead Blast—M. W. Hes. Sch of Min Quart, Nov—96. 1800 w. M Mar.
- FUSE Block and Lightning Arrester Tests at Niagara Falls—Elec Rev, Dec 30—96. W Jan 9.
- Fuses, The Reasonable Method of Rating and Testing Safety—F. A. C. Perrine. Elec Wld, Jan 30—97. 1700 w. E Mar 10.
- GALVANOMETER, Astatic—Broca. Jour de Physique, Feb—97.
- Galvanometer, Balance (III)—Elektrotechn Zeit, Jan 28—97. W Feb 27.
- Galvanometer, D'Arsonval—Dujon. L'E'ec, Feb 13—97. W Mar 6.
- Galvanometer Needle, Motion of a Damped—Lendl. Rose Technic, Jan—97.
- Galvanometer—Waste Space Around the Needle of the Gray. Phil Mag, Jan—97.
- GALVESTON Harbor Works (III)—W. J. Sherman. Jour Assn Eng Soc, Dec—96. 3000 w.
- GARBAGE Disposal—H. C. Garneau. Yale Sci Mo, Jan—97. 1500 w.
- GARDEN Design—F. Inigo Thomas. Builder, Nov 28—96. 9500 w.
- Gardens, Botanic (III)—D. T. Macdougall. Pop Sci M, Dec—96. 4000 w.
- GAUGES, High Vacuum Pressure—Sutherland. Phil Mag, Feb—97. W Feb 20.
- GAS, A Survey of the Position of Water—Dr. Hugo Strache. Jour Gas Lgt, Jan 2—97. 1800 w. M Mar.
- Gas and Electricity, Facts Relating to—Seamon. Prog Age, Mar 1—97.
- Gas and Oil Engines—Thomas L. Wilkinson. Min Ind & Rev, Dec 31—96. 3300 w. M Mar.
- Gas Coal, Commercial Test of—T. Glover. Jour Gas Lgts, Nov 3—96. 3800 w. M Jan.
- Gas: Comparative Test of the Calorific Powers of Wilkinson Carburetted Water Gas and Lowe Carburetted Water Gas with the Junker Calorimeter—Pro Age, Nov 16—96. Serial Part 1. 2800 w. M Jan.
- Gases, Conductivity of Hot—Petinelli and Marroli. L'Elett, Oct—96.
- Gas Control from Meter and Burner—D. Macfie. Jour Gas Lgt, Jan 19—97. 5000 w.
- Gas, Conversion of Culm Into—N. W. Perry. Am Mfr & Ir Wld, Nov 20—96. 3300 w. M Jan.
- Gas Engine, Experiments on a—Jour Gas Lgt, Jan 5—97. 2500 w. M Mar.
- Gas Engines for Electrical Lighting—Prog Age, Mar 1—97.
- Gas for Domestic Lighting, The Use of—Vivian B. Lowes. Pro Age, Dec 1—96. 7300 w. M Jan.
- Gas Holder of the New York Mutual Gaslight Company, The New Four-Lift—W. A. Allen. Am Gas Lgt Jour, Dec 7—96. 1800 w. M Jan.
- Gas Manufacture and Appliances—Henry O'Connor. Gas Wld, Jan 2—97. Serial Part 1. 2400 w. M Mar.
- Gas Motor, Electrically Controlled (III)—Ir Tr Rev, Dec 16—96. 1600 w.
- Gas, Natural—J. M. Buckley. Pro Age, Nov 16—96. 1500 w. M Jan.
- Gas Plant, A New Loomis Fuel (III)—Ir Age, Nov 19—96. 1200 w.
- Gas Producers and the Mechanical Handling of Fuel for Same—C. L. Saunders. Jour of Assn of Engng Soc, Nov—96. 2200 w.
- Gas-stoves, Gas-fires and—W. Grafton. San Plumb, Dec 1—97. 1700 w.
- Gas Stoves, Trials of—A. von Ihering. Jour Gas Lgt, Nov 17—96. 2000 w. M Jan.
- Gas Supply—Jour Gas Lgt, Dec 26—96. 3500 w. M Mar.
- Gas Swoodies, Some Plain Words About City—Eng News, Dec 17—96. 2000 w.
- Gas, Testing Coal—Norton H. Humphreys. Jour Gas Lgt, Dec 29—96. 3800 w. M Mar.
- Gas, The Permanency of Illuminating—William Young. Gas Engng Mag, Dec 10—96. Serial Part 1. 2800 w.

## Appendix D. Specifications for Structural Steel.

As this work is intended as a reference book, there is an elaborate index at the end. The entire work is of such a high class or order that it will undoubtedly be a standard of reference for years to come.

---

Tables Showing Loss of Head Due to Friction of Water in Pipes, by Edmund B. Weston, C. E. D. Van Nostrand Co., N. Y.

A hand book containing tables of friction of water in pipes. These tables are the results of special investigation of the subject and collection of original material by the author. The data is taken from five hundred and twenty-six experiments made by twenty-six different investigators. This data is divided into three classes; that for smooth lead or brass pipe, that for new cast iron pipes and that for old cast iron pipes.

Table 1, for smooth pipe, is computed by the author's formula, and gives a range in size of pipe from one-half inch to three inches.

Table 2, for new cast iron pipe, is computed by Darcey's formula, which was verified by the author, and gives values for pipes from three to ninety inches diameter.

For the third class or old iron pipes, a formula could not be constructed, but the author gives in Table 2 a series of multipliers which can be used with the table for approximating the increase of loss of head due to friction, that will take place in five or more years' service.

The tables are very handily arranged, giving for any size of pipe the mean velocity, the required head to produce it, the discharge in gallons per minute and per twenty-four hours, the loss of head due to friction and also the loss of head due to orifice of influx.

Preceding each table is an explanation of the table and a number of examples completely worked out and explained, covering the entire scope of the table.

This little book has in it just what every hydraulic engineer needs and what he generally has to go through several bulky volumes to get otherwise.

- Gas, The Present Status of the Water Gas Question—Wiener Bauindustrie Zeitung, Jan 14—97. 2500 w.
- Gas Works, Regenerator Furnaces for Small—W. B. Randall, Gas Wld, Nov 14—96. 4800 w. M Jan.
- Gas—See By-Products. Rays.
- Gases of the Coal Mine, Some Dangerous—Min Jour, Jan 2—97. 1800 w. M Mar.
- Gases, Passage of Electricity Through—Baly. Electn, Lond, Jan 29—97. W Feb 13.
- Gases—See Blast Furnace.
- GEAR Teeth, Long—Horace L. Arnold. Am Mach, Jan 7—97. 2000 w.
- Gear Teeth, "Planed" Bevel—George B. Grant. Am Mach, Dec 3—96. 5500 w. M Jan.
- Gear, The Construction of an Accurate Large Spur—Am Mach, Dec 3—96. 1200 w.
- Gears, Lathe Cones and Back—R. E. Marks. Mach, Jan 1—97. Serial Part 1.
- Gears with Rotary Cutters, Experimental Investigation of the Cutting of Bevel—Forrest R Jones and Arthur L. Goddard, Am Soc Mech Eng, Dec—96. 2500 w. M Jan.
- GEARING, The Limited Velocity in Belt and Rope—George R. Bale. Prac Eng, Jan 29—97. 800 w. M Mar.
- GEM Fields of the World—George F. Kunz. Sci Am Sup, Jan 2—97. 2200 w.
- GENERATOR, A New Three Wire Machine (III)—Elektrotech Rundschau, Jan 1—97. 1000 w. M Mar.
- Generator, The Design of a 100 Kilowatt 500 Volt Power—H. J. Ryan and I. J. Macomber. Sib Jour Engng, Jan—97.
- Generators for Lighting Ever Constructed, Largest—Sci Mach, Dec 15—96. E Jan 6.
- Generators, High Frequency—Tesla System. Elec Eng, Mar 3—97. W Mar 13.
- GENEVA Exhibition (1906)—Guye. L'Eclair Elec, Dec 5, 12—96.
- GEOLOGY as Applied to Mining—James Stirling. Aust Min Stand, Sept—96. 3500 w.
- GILLESPIE Building, New York City, Plumbing in the—Eng Rec, Jan 16—97. 1400 w.
- GIPPSLAND, Victoria, The New Discoveries in—Aust Min Stand, Nov 5—96. 1300 w.
- GLASGOW, The Atmosphere of—Arch. Lond, Jan 8—97. 3000 w.
- GLASS—See Steel Construction.
- GOLD and Silver—Eng & Min Jour, Jan 2—97. 9500 w.
- Gold Bearing Vein at Victor, Colorado—Arthur Lakes. Col Eng, Dec—96. 1400 w.
- Gold Belt of Pitkin, Gunnison County, Colorado—J. R. Hollibaugh. Eng & Min Jour, Dec 12—96. 900 w.
- Gold Dredging—Eng & Min Jour, Mar 13—97. W Mar 20.
- Gold, Electrolysis of—Zeit f Elektrochem, Jan 20—97.
- Gold from Cyanide Solutions, Electrolytic Precipitation of—Stewart Croasdale. Eng & Min Jour, Dec 12—96. 750 w.
- Gold Field, New South Wales, Yowaka or Pambula (III)—J. E. Carne. Aust Min Stand, Nov 5—96. Serial Part I. 5500 w.
- Goldfield, The Ballarat—William Bradford. Aust Min Stand, Sept—96. 2800 w.
- Gold Fields of South Africa, The—George F. Becker. W Min Wld, Dec 5—96. 2000 w. M Jan.
- Gold Fields of the Houraki Peninsula, New Zealand, The—Joseph Campbell. Min Jour, Dec 12—96. Serial Part 1. 1100 w.
- Gold Fields, The Gippsland—Donald Clark. Aust Min Stand, Sept—96. 2800 w. M Jan.
- Gold in Australian Mines, The Loss of Flour—J. Cosmo Newberry. Aust Min Stand, Oct 15—96. 2200 w. M Jan.
- Gold in Chloride of Bromium, Dissolving—Gaze. L'Eclair Elec, Dec 12—96. W Jan 2.
- Gold in Gippsland, The Losses of Fine—Donald Clark. Aust Min Stand, Oct 29—96. 400 w.
- Gold in Refractory Ore Bodies, The Saving of (III)—Aust Min Stand, Sept—96. 900 w.
- Gold in Silesia—Glaser's Annalen, Jan 15—97. 4000 w.
- Gold, Metallurgy of Southern—William M. Bowron. Tradesman, Jan 1—97. 4000 w.
- Gold, Mexico and Its—C. C. Longridge. Min Jour, Dec 19—96. 1300 w.
- Gold Milling, Electricity in—H. M. Chance. Pro Eng Club Phila, Nov—96. 2500 w.
- Gold Mine in Australia, The Greatest—E. F. Morgan. Aust Min Stand, Sept—96. 4000 w. M Jan.
- Gold Mines, Electrical Energy in—L'Elec, Jan 30—97.
- Gold Mines of North Carolina, The—Maxwell J. Gorman. Eng News, Nov 19—96. 3300 w.
- Gold Mining in British Guiana—Min Jour, Nov 14—96. 2400 w. M Jan.
- Gold Mining in Burma, Notes on—A. H. Bromly. Min Jour, Jan 16—97. 1600 w. M Mar.
- Gold Occurrences, The West Australian—C. A. Huessler. Aust Min Stand, Nov 19—96. Serial Part 1. 1300 w.
- Gold, Oceanic—Henry Wurtz. Eng & Min Jour, Nov 21—96. 1800 w. M Jan.
- Gold of Otago, N. Z., The Alluvial—Aust Min Stand, Oct 8—96. 2300 w. M Jan.
- Gold Ores and Tailings, The Bromo-Cyanide Process of Treatment of—Aust Min Stand, Dec 3—96. 1400 w.
- Gold Ores at the Onro Preto Gold Mine, Brazil, Notes on the Treatment of Refractory Low-Grade—Eng & Min Jour, Jan 23—97. Serial Part 1. 3000 w. M Mar.
- Gold Ores of the Guanaco Mineral District, Desert of Atacama, Chili, Notes on the Treatment—G. M. Barber. Min Jour, Jan 23—97. Serial Part 1. 2300 w. M Mar.
- Gold Placers of Siberia, The—E. D. Levat. Eng & Min Jour, Jan 23—97. 1500 w. M Mar.
- Gold Production, Present and Future—Eng & Min Jour, Jan 9—97. 2000 w. M Mar.
- Gold Region, The San Juan—Arthur Lakes. Col Eng, Dec—96. 5400 w.
- Gold Region, Twin Lakes—J. J. Guentherodt. Col Eng, Dec—96. 1600 w.
- Gold Regions, Summit District—R. C. Hills. Col Eng, Nov—96. 1800 w. M Jan.
- Gold Stealing in the Siberian Placers—E. D. Levat. Eng & Min Jour, Feb 6—97. 700 w. M Mar.
- Gold; The Cyanide Process Patents Declared Void in the Transvaal—Sci Am, Nov 14—96. 2300 w. M Jan.
- Gold, The Ligation of Certain Alloys of—Edward Matthey. Can Min Jour, Nov—96. 1000 w. M Jan.
- Gold, The Solution and Precipitation of the Cyanide of—S. B. Christy. Trans Am Inst of Min Engs, Dec—96. 14000 w.
- GOVERNOR, Designing an Engine Shaft—Theodore P. Sheffer, Jr. Mach, Jan—97. Serial Part 1. 2000 w.
- Governor for Electrical Work, A New Steam Engine—C. Percy Taylor. Electn, Lond, Jan 15—97. 1000 w. M Mar.
- Governors, About Engine—Bos Jour Com, Nov 14—96. 1000 w.
- Governors, Steam Engine—Frank H. Ball. Am Soc Mech Eng, Dec—96. 4000 w. M Jan.
- GRADES, Mounting Heavy (III)—L'Ind Elec, Jan 25—97.
- GRATE for Burning Fine Anthracite Coal (III)—Am Eng & R R Jour, Dec—96. 500 w.
- Grate—See Boiler.
- GRANITE Country, The West of England (III)—Arthur Lee. Stone, Jan—97. Serial Part 1. 1200 w.
- Granite Quarries, Barre, Vermont—Stone, Nov—96. 3300 w. M Jan.
- GREAT MALVERN (III)—Builder, Jan 2—97. 2200 w. M Mar.
- GREYHOUND of the Future, The Atlantic—J. H. Biles. Safety V, Nov—96. 900 w.
- GROOVED Plates, The Strength of—C. E. Wolff. Prac Eng, Jan 29—97. 550 w. M Mar.
- GUN Magnet—King. Elec Rev, Feb 3—97.

## VIEWS IN BOILER HOUSE.

The University Boiler House is considered a model plant, being equipped with all modern appliances including a mechanical stoaker, fuel economizer and temperature regulator. The equipment is so well arranged and so complete, that, although the plant is about 1,200 horse-power, two men can handle it with ease. All of the University buildings, with the exception of those of the College of Agriculture, are heated from this plant. It also supplies the steam for the engines in the steam laboratory, those in the machine shops and dynamo laboratory and for the pumps at the pumping station. The steam is carried to the various buildings through covered pipes placed in underground tunnels. The condensed steam is all returned to the boilers.

The first of the two accompanying half-tones shows the conveyor for elevating the coal from the coal pit at one end of the building and conveying it to the hoppers. The coal pit holds about 1,000 tons, and the coal is dropped into it from the delivery wagons through holes. As shown in the cut there are seven hoppers, each of which holds from three to six tons, and supplies the fuel for one and some for two of the boilers.

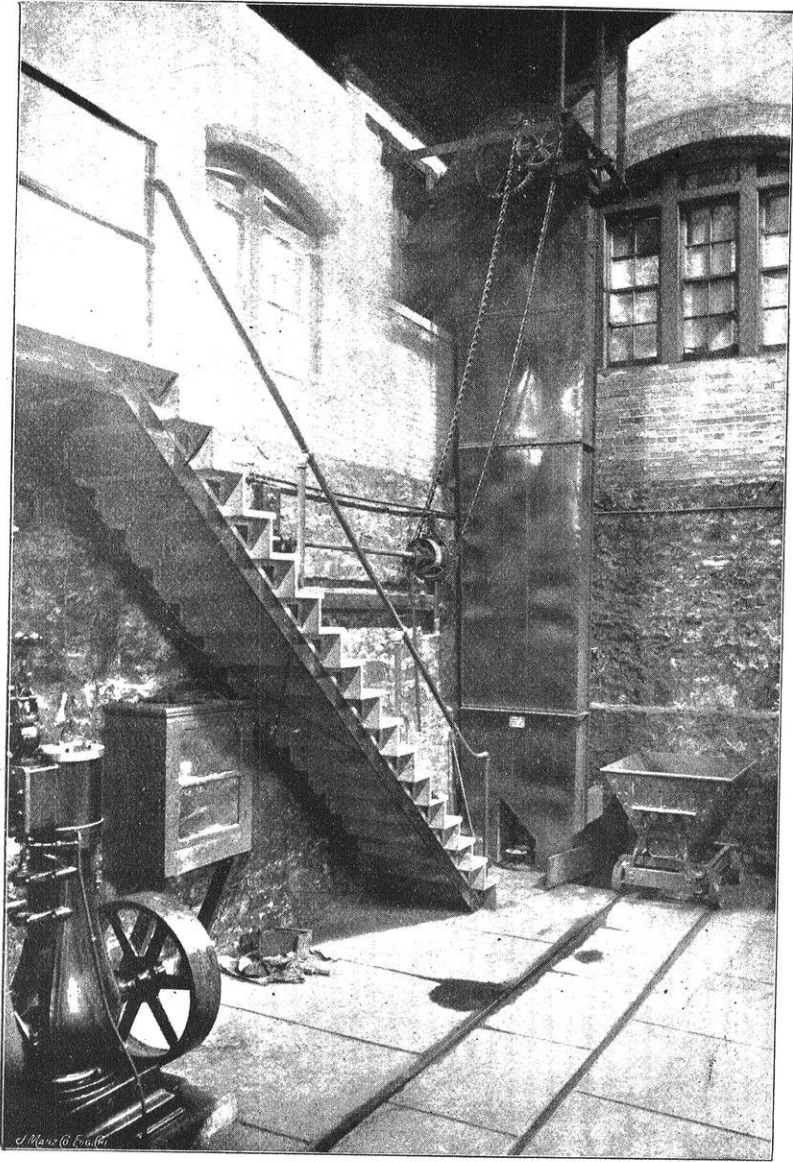
The second cut illustrates the ash car and the elevator for elevating the ashes into a wagon outside. The Nagle engine is also shown, which runs the conveyor and elevator. This engine is started at intervals during the day and the coal drops into the first hopper until it is full, the gate is then closed and the coal goes on to the next one and so on until all are filled. The coal conveyor and ash elevator were installed by the Link Belt Machinery Co., Chicago.

- Guns, Canet's Quick Firing Field—Engng, Dec 4—96. Serial Part 1. 1800 w.
- Guns, On Certain Physical Difficulties in the Construction of Large—W. Le Conte Stevens. Science, Nov 21—96. 2800 w. M Jan.
- GUPTA PERCHA in French Soudan—L'Elec, Dec 11—96.
- H**AEMOGLOBIN Carbon Cell—Case. Elec Eng, Mar 10—97. W Mar 20.
- HALL Effect and Thermo-Electricity in Bismuth and in Various Alloys—J. C. Beattie. Jour Phys & Chem, Jan—97.
- Hall Effect in Liquids—Rayard. Electn, Lond, Dec 11—96.
- HAMBURG, Technical Institution at (Ill)—Elek Anz, Jan 31—97.
- HAMMER, Notes on the—Herbert Aughtie. Prac Eng, Jan 15—97. 1300 w. M Mar.
- HANOVER Chapel—Paul Waterhouse. Jour Roy Inst of Brit Arch, Dec 31—96. 1800 w. M Mar.
- HARBOR and Trade, New York—Trans, Nov 12—96. 1600 w. M Jan.
- Harbors and Waterways—Eng, Lond, Jan 1—97. 2000 w. M Mar.
- Harbor of Constanza, The Corner-Stone Laying of the New—Friedrich Bönches. Zeitschr d Oesterr Ing u Arch Vereines, Nov 20—96. 2500 w.
- HARDENBERGH, Henry, Janeway, The Works of—Montgomery Schuyler. Arch Rec, Jan, Mar—97. 9300 w. M Mar.
- HAULAGE with Electric Transmission of Power, Mechanical (Ill)—M. Dickmann. Col Guard, Dec 18—96. 2000 w.
- Haulage—See Underground.
- Hauling Machinery, The Improvement in—Am Mfr & Ir Wld, Jan 8—97. 2600 w. M Mar.
- HEAT, Blue—Glaser's Annalen, Jan 15—97. 7500 w.
- Heat Transmission Through Metal Cylinders (Ill)—Lieut.-Col. English and Bryan Donkin. Engng, Dec 18—96. 3000 w.
- HEATERS, Economy of Car—West Electn, Dec 26—96. W Jan 9.
- HEATING and Cooking Utensils—L'Ind Elec, Feb 10—97.
- Heating and Lighting Plant, An Interesting Central (Ill)—Eng Rec, Feb 6—97. 1600 w. M Mar.
- Heating and Lighting with Mineral Oils—Dr. Stevenson Macadam. Arch, Lond, Dec 18—96. 1800 w.
- Heating and Ventilation—C. Weatherby. San Plumb, Nov 15—96. 2000 w.
- Heating and Ventilation of Public Buildings, Combined—J. D. Sutcliffe. Heat & Vent, Jan 15—97. 3400 w. M Mar.
- Heating and Ventilation of the Buffalo Real Estate Exchange (Ill)—Heat & Vent, Nov 15—96. 2500 w.
- Heating and Ventilation of the Central High School, Detroit, Michigan (Ill)—Eng Rec, Dec 19—97. 1800 w.
- Heating and Ventilation of the West Side Branch of the Y. M. C. A. (Ill)—F. R. Harris. Heat & Vent, Jan 15—97. 1500 w. M Mar.
- Heating and Ventilation of Topeka and Santa Fe Railway Hospital (Ill)—Heat & Ven, Dec 15—97. 900 w.
- Heating and Ventilation in the New Reichstag Building at Berlin (Ill)—Wiener Bauind Zeit, Oct 29—96. 1800 w.
- Heating in England, The High Pressure System of—Frederick Dye. Heat & Ven, Dec 15—97. 1800 w.
- Heating, Cost of Electric Car—Bost Jour Com, Mar 15—97. Sci Mach, Mar 15—97. E Mar 31.
- Heating of a Medford, Mass., School (Ill)—Eng Rec, Jan 2—97. 1200 w.
- Heating of a Prison Mess Hall and Hospital (Ill)—Eng Rec, Dec 5—96. 300 w.
- Heating—See Central Plants. Hot Water.
- HEFNER—Lamps, Influences of the Atmosphere Upon the—E. Boistel. Pro Age, Feb 1—97. 4000 w. M Mar.
- HELM Indicator—See Steering.
- HEMATITES of Alabama Geologically Considered, The—Henry McCalley. Eng & Min Jour, Jan 9—97. 2000 w. M Mar.
- HIDES and Leather in Europe—Cons Repts, Nov—96. 2550 w. M Jan.
- HITTOFF, Wilhelm—Zeit f Elektrochem, Oct 20—96. 1000 w.
- HIGHWAY Improvement in Vermont (Ill)—Munic Engng, Jan—97. 1800 w.
- HOEPFNER Process—See Copper.
- HOISTING Engines for the Anaconda Mine (Ill)—Sci Am, Jan 9—97. 700 w.
- HOLOPHANE Globes—Lewes. Elec, Dec 23—96. W Jan 2.
- HOOKHAN Meter—Electn, Lond, Jan 22—97.
- HOSPITAL Plant—Elec Eng, Feb 3—97.
- Hospital, The New Edinburgh Fever—Arch, Lond, Nov 20—96. 2000 w. M Jan.
- HOT WATER Circulation, Fundamental Principles of (Ill)—Jas. J. Lawler. San Plumb, Jan 15—97. 1000 w.
- Hot Water Heating Apparatus, Arrangement of Mains in—W. M. Mackay. Met Work, Jan 31—97. 2200 w. M Mar.
- Hot Water Plant, Near Philadelphia, A Recent (Ill)—Eng Rec, Jan 9—97. 600 w. M Mar.
- HOUSE in Vienna, Apartment—Oesterr Monatsschr f d Oeff Bau, Dec—96. 200 w.
- Houses in Paris, Corner (Ill)—P. Frantz Marcon. Arch Rec, Jan, Mar—97. 3300 w. M Mar.
- Houses, Model Apartment—Arch & Build, Jan 2—97. 900 w.
- HUNGARY—See Metal Mining.
- HURONIAN Series at Iron Mountain, Mich., etc., Traces of Organic Remains from the (Ill)—W. S. Gresley. Trans Am Inst of Min Engg, Dec—96. 3000 w.
- HYDRAULIC Laboratory, Worcester Polytechnic Institute (Ill)—Eng Rec, Nov 21—96.
- Hydraulic Mines, Amount of Loss to California Due to Closure of—Min & Sci Rev, Jan 16—97. 1300 w. M Mar.
- HYDROLYSIS of Ferric Chloride, On the—H. M. Goodwin. Tech Quar, Dec—96. 3700 w.
- HYPOCHLORITES and Chlorates, Production of—Oettel. Am Jour Sci, Feb—97. W Feb 6.
- HYSTERESIS, Magnetic—Ernest J. Berg. Am Electn, Dec—96. 1200 w. W Jan 2.
- I**FFLEY Church—Arch, Lond, Nov 20—96. 2400 w. M Jan.
- IGNITION of Coal Cargoes, The Spontaneous—Vivian B. Lewes. Pro Age, Jan 15—97. 6000 w. M Mar.
- ILLINOIS Legislature, Street Cars and the—West Elec, Feb 27—97. E Mar 10.
- ILLUMINANTS Employed in the Lighting of Mines, Photometric Value of Various—A. H. Stokes. Am Gas Lgt Jour, Jan 25—97. 3000 w. M Mar.
- ILLUMINATING Power as Exhibited in the Parliamentary Returns—Thomas Newbigging. Jour Gas Lgt, Dec 1—96. 1200 w. Dec 8—96. 2400 w.
- ILLUMINATION, Some Experience in Interior—Carter J. Page, Jr. Am Gas Lgt Jour, Nov 16—96. 6000 w.
- IMPORT Duties on Electrical Machinery and Lamps, Foreign—Elec Rev, Lond, Jan 22—97. Elec Eng, Lond, Jan 22—97.
- INCLINED Planes—Samuel Diescher. Ir Age, Dec 3—96. Serial Part 1. 3000 w. M Jan.
- Inclines, Crossing the Ends of Ropes in Self-Acting—M. Combalot. Col Guard, Jan 15—97. 5300 w. M Mar.
- INCANDESCENT Lamp Improvement—Clegg. Elec Eng, Jan 27—97. W Feb 6.
- Incandescent Lamp, The Carbon Circuit of an (Ill)—C. D. Marsh. Elec Wld, Nov 21—96. 900 w. M Jan.



- Incandescent Lamp Tests, Results of—H. Rigert. *Elektrotechn Zeit*, Dec 31—96.
- Incandescent Lamps, Measurement of Temperature of Filament in—P. Janet. *Elec Rev*, Lond, Dec 18—96. E Jan 6.
- Incandescent Lamps vs. Commercial Heaters—E. Y. Porter and C. D. Warner. *Elec Eng*, Jan 20—97. 1500 w. M Mar.
- INDEX in the Drafting Room, The Decimal—H. W. Alden. *Am Mach*, Feb 4—97. 2800 w. M Mar.
- INDIA Rubber and Gutta-Percha—Dooley. *Pop Sc Mo*, Mar—97.
- India Rubber Industry in Europe, The—Ind Rub Wld, Dec 10—96. 900 w. M Jan.
- India; Its Arts, Manufactures and Commerce—Sir Owen Tudor Burne. *Jour Soc Arts*, Nov 20—96. 6000 w. M Jan.
- India, The New P. and O. Steamship (III)—Eng, Lond, Dec 4—96. 4800 w.
- INDICATOR Diagrams from Locomotive Schemata—W. F. Goss. *Ry Rev*, Dec 19—96. Serial Part 1. 500 w.
- Indicator on the Western Railroad of France, An Automatic (III)—M. E. Brille. *Am Eng & R R Jour*, Jan—97. 2200 w.
- Indicator, The Steam Engine—*Am Electn*, Jan—97. 1700 w. M Mar.
- INDUCTANCE of Alternating Current Lines—*Am Electn*, Feb—97. W Mar 6.
- INDUCTION Balance, Interferential—Barus. *Am Jour Sci*, Feb—97. 1500 w. M Mar. W Feb 6.
- Induction Coil from Lighting Circuits, New Method of Operating—Norton and Lawrence. *Science*, Feb 26—97. W Mar 6.
- Induction Coil, How to Make an (III)—George T. Hanchett. *Am Electn*, Jan—97. 1500 w. M Mar.
- Induction Coils, An Action of—Meyer. *Elek Anz*, Feb 21—97. W Mar 27.
- Induction Coils, Automatic Interrupter for—Sayer and Willyoung. *West Electn*, Mar 20—97.
- Induction Coils, Insulation of—Thompson. *Am Electn*, Feb—97. W Mar 6.
- Induction in Multiple Core Cables—Preece. *Elec Rev*, Lond, Dec 11—96.
- Induction—See Cables.
- INJECTOR, Test of the Performance of a Locomotive—R R Gaz, Dec 11—96. 2500 w.
- INSTALLATION Testing—Y. Zingler. *Elec Rev*, Lond, Dec 11—96. Serial Part 1. 1600 w. M Feb 6.
- Installations, Electrical—F. J. Warden-Stevens. *Arch*, Lond, Nov 6—96. Serial Part 1. 2800 w.
- Installations—See Safety Rules.
- INSULATED Wires and Cables; Their Construction and Design; 1st Efficiency and Defects—J. Draper Bishop. *Elec Wld*, Nov 14—96. Serial Part 1. 3000 w. M Jan.
- INSULATION—W. M. Stine. *Elec Eng*, Nov 25—96. 1200 w.
- Insulation Measurements of Three Wire Circuits—Travailleur. *L'Eclair Elec*, Feb 6—97. W Feb 27.
- Insulation, Mysterious Breakdown of—Elihu Thomson. *Elec Eng*, Nov 11—96. 1100 w. M Jan.
- Insulation of Steam Pipes by Means of Zinc and Tinplate Jackets—Dr. Jsh. Russner. *Power*, Dec—96. 1100 w.
- Insulation Resistance of Street Railway Cables, Measurement of the—Uppenborn. *Elec Rev*, Lond, Dec 11—96. W Jan 2.
- Insulation Resistance, Voltmeter Measurement of—Hale. *Amer Electn*, Dec—96. W Jan 2.
- INSURANCE, Municipal—Pearson. *Elec Eng*, Lond, Jan 29—97. *Elec Rev*, Lond, Jan 29—97. *Electn*, Lond, Feb 5—97.
- INSTRUMENT Car of the Munich Station—Uppenborn. *Elektrotechn Zeit*, Jan 21—97. W Feb 20.
- INTERLOCKING System, The Taylor Electric (III)—*Ry Rev*, Jan 9—97. 1300 w. M Mar.
- INTERNAL Rays—Oudin and Korda. *Electn*, Lond, Feb 12—97.
- INTERRUPTER for Induction Coils, Automatic—Saven and Willyoung. *Jour Fr Inst*, Mar—97. W Mar 13—97.
- Interrupter, Thernic—L'Eclair Elec, Dec 19—96. W Jan 9.
- ION Groups in Analytical Chemistry, The Meaning of Arrhenius' Theory of—F. W. Kuster. *Zeit f Electrochem*, Dec 5—96. 2500 w.
- Ions, Theory of the Migration of—Hargreaves. *Elektrochem Zeit*, Dec—96. W Jan 2.
- IRON and Steel in China and Japan—*Ir Age*, Nov 19—96. 2000 w. M Jan.
- Iron as Related to Industrial Enterprises, The Cost of—George H. Hull. *Eng Mag*, Dec—96. 2000 w.
- Iron, Constitution and Properties of Cast—A. J. Rosgi. *Ir Age*, Dec 21—96. 3000 w.
- Iron Construction, Concerning the Computations for Beton—*Oesterr Monatschr f d Oeff Bau*, Dec—96. 3500 w.
- Iron for Transformer Cores—Clinker. *Electn*, Lond, Mar 5—97. W Mar 20.
- Iron, Freaks of Foundry—Dr. A. B. Harrison. *Am Mfr & Ir Wld*, Jan 8—97. 1800 w. M Mar.
- Iron in the Foundry, Physical Tests of Cast—J. E. Beckett. *Foundry*, Dec—96. 1800 w.
- Iron Industry of the Ural Mountains, The—J. Kowarsky. *Am Mfr & Ir Wld*, Nov 20—96. 1600 w.
- Iron Losses in Alternators of the So-Called Induction Type, Calculation of the—Dr. Behn-Eschenberg. *Elektrotechn Zeit*, Jan 14—97.
- Iron Losses in Toothed Armatures, Calculation of—Dr. Max Breslauer. *Elektrotechn Zeit*, Feb 11—97. E Mar 31. W Mar 6.
- Iron Markets in 1896, The Course of the—*Eng & Min Jour*, Jan 2—97. 8200 w.
- Iron Mines in 1896, Minnesota—Horace V. Winchell. *Ir Tr Rev*, Jan 7—97. 2000 w. M Mar.
- Iron Mines, Lake Superior—*Ir Tr Rev*, Jan 21—97. 1200 w.
- Iron Mines of the South and How They Are Being Developed, The (III)—Frank G. Carpenter. *Tradesman*, Jan 15—97. 3500 w.
- Iron Methods, Notes on Some Comparisons Between Southern and Nova Scotia—C. A. Meisner. *Can Min Rev*, Jan—97. 5500 w.
- Iron Mine, The Lease of the Mountain—*Ir Trd Rev*, Dec 24—96. 2500 w.
- Iron, New Method for Determining the Amount of Sulphur Contained in—Wilhelm Schulte. *Stahl und Eisen*, Nov 1—96. 300 w.
- Iron, The Influence of Heat Upon Cast—S. S. Knight. *Foundry*, Nov—96. 1600 w.
- Iron Trade in 1896, The Pittsburg—*Ir Age*, Jan 7—97. 7400 w.
- Iron Trade, 1896 in the—*Ir Tr Rev*, Dec 31—96. 1700 w.
- Iron Trade, The Pig—T. P. Wells. *Tradesman*, Jan 1—97. 1000 w.
- Iron Trade, The Southern—William B. Phillips. *Tradesman*, Jan 1—97. 10000 w.
- IRRIGATED West, The Ownership and Control of Water in the—*Eng News*, Dec 3, 17—96.
- IRRIGATION of Arid Lands, The—J. J. Miller. *Yale Sci M*, Nov—96. 2000 w. M Jan.
- Irrigation in Montana, Possibilities of—S. B. Robbins. *W Min Wld*, Nov 21—96. 2000 w. M Jan.
- Irrigation in Yakima County, Washington—A. B. Wyckoff. *Sci Am Sup*, Jan 16—97. 1500 w. M Mar.
- Irrigation, The Measurement of Water for—J. B. Pope. *Eng News*, Dec 3—96. 3500 w. M Jan.
- Irrigation Works of the Pecos Valley, The—Elwood Mead. *Purdue Soc of Civ Eng*, 1896. 1800 w.
- ITALIAN Electro-Technical Assn.—L'Elettr, Jan—97.



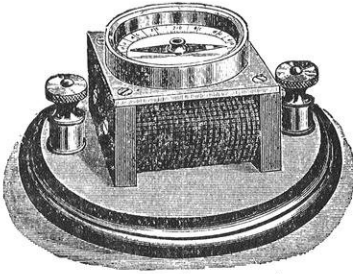


- J**ACKET on a Locomotive Engine, The Value of a Steam—Prof. T. H. Beare and Bryon Donkin. Eng. Lond, Nov 6—96. 2200 w.
- J**APAN, Industrial Revolution in—Mr. E. W. Curtis. Ind & East Eng, Oct 24—96. 2200 w. M Jan.
- J**apan: Its Openings and Opportunities—Mach. Lond, Nov 15—96. 2500 w. M Jan.
- J**apan, Modern: Industrial and Scientific—Eng. Lond, Nov 27—96. 3500 w. M Jan.
- J**ERSEY CITY Water Contract—Eng News, Feb 4—97. 900 w.
- J**ersey City Water Question—Eng Rec, Jan—97. 1100 w.
- J**OINT as a Conductor, The Cast Weld (III)—Harold P. Brown. Sc Ry Rev, Dec 15—96. 1400 w.
- J**oints, Large Bearing Surfaces for Rail—Ry Rev, Dec 12—96. 1400 w.
- J**oints, Cast-Welded Rail—William Baxter, Jr. R R Gaz, Dec 25—96. 2000 w.
- J**oints, Welded Rail—Sci Am, Jan 16—97. 1000 w.
- J**oints—See Riveted.
- J**OURNAL Box, The Korbuly Railway—Zeitsch d Oesterr Ing u Arch Ver, Nov 27—96. 1000 w.
- J**UNGFRAU Railway—Wauest and Thorman. Elek Anz, Jan 21, 28—97. W Feb 20.
- J**ungfrau Railroad—Elektrotechn Zeit, Feb 18—97.
- K**HERSON, The Machinery of the S. S. (III)—Engng, Dec 25—96. 2500 w.
- K**herson, The Russian Volunteer Steamship (III)—Engng, Dec 11—96. 2000 w.
- K**NICKERBOCKER Tunnel—See Mine.
- L**ACHINE Rapids Power Plant (III)—Eng News, Feb 18—97.
- L**AKES to the Ocean—R R Gaz, Feb 5—97. 1400 w. M Mar.
- L**ALIBELA, Monolithic Churches of (III)—Sci Am Sup, Jan 16—97. 1000 w.
- L**AMP Filaments Treated with Boric Acid—L'Elec, Feb 13—97. W Mar 6.
- L**amp, High Voltage—Electn. Lond, Mar 5—97. W Mar 20.
- L**amp Question, Incandescent—Bussmann. Elektrotechn Zeit, Jan 28—97. W Feb 27.
- L**amp Supply, The Problem of—Dr. O. Gusinde. Elektrotechn Zeit, Dec 24—96.
- L**amp, The First Safety—Wm. Clifford. Col Eng, Jan 8—97. M Mar.
- L**amp, The Hotter Standard—Pro Age, Jan 1—97. Serial Part 1. 2800 w.
- L**amp, The Past and Future of the Incandescent—Elec Eng, Jan 6—97. 1100 w. M Mar.
- L**amp, Ultra Incandescent—Electn. Lond, Dec 18—96. W Jan 9.
- L**amps, Free—Elec Rev, Lond, Dec 11, 18—96. W Jan 2.
- L**amps, Incandescent—Franklin S. Terry. Elec Eng, Jan 27—97. 2500 w. M Mar.
- L**amps, Shunts for Alternating Current Arc—Am Electn, Dec 20—96. W Jan 2.
- L**amps, Some Notes on the Use of High Voltage—G. L. Addenbrooke. Elec Eng, Lond, Jan 1—97. E Feb 3.
- L**ANDSCAPE Engineering in Connection with an Engineer's General Practice—W. K. Eldridge. Purdue Soc of Civ Engrs, 1896. 5500 w.
- L**ANTERNS—See Electric Lamp.
- L**ATHE, A 57-Inch (III)—Am Mach, Dec 10—96. 600 w.
- L**athe and Planer by Use of Solder, Accurate Work on (III)—A. H. Cleaves. Am Mach, Dec 31—96. 1000 w.
- L**AUSANNE, Railway at—Blondin. L'Eclair Elec, Dec 12—96.
- L**EAD and Other Minerals—Eng & Min Jour, Jan 2—97. 11800 w.
- L**ead Burning, The Process of—Dom Engng, Dec—96. 900 w.
- L**ead Cell—Moore. Phys Rev, Mar—97. Apr—97. W Mar 20.
- L**ead, Desilverization of—Tommasi. Zeit f Elektrotechn, Jan 20—97.
- L**EAKAGES from Mains and Services, Elusive—H. Tobey. Gas Engrs Mag, Dec 10—96. 2500 w.
- L**EHIGH Valley R. R., Annual Report of—R R Gaz, Jan 22—97. 1600 w.
- L**ENARD Rays—E. P. Thomson. Elec Rev, Mar 3—97. W Mar 6.
- L**EWIS Institute—Carman. Elec Eng, Feb 3—97.
- L**IABILITY Release Clause in Railroad Companies Ground Lease—W. L. Barnum. Ry Rev, Nov 21—96. 2800 w. M Jan.
- L**IGHT—Elliott. Elec Eng, Feb 3, 10—97. W Feb 13.
- L**ight by Gas and Electricity in Manchester, Some Notes on the Comparative Cost of Supplying—G. E. Stevenson. Jour of Gas Lgt, Dec 1—96. 6000 w.
- L**ight, Distribution and Diffusion of—E. L. Elliott. Elec Wld, Jan 23—97. Elec Eng, Feb 3—97.
- L**ight Plant in Melbourne, Australia, The City Council Electric (III)—Frank W. King. Elec Wld, Jan 2—97. 1600 w.
- L**ight Ships, Communication Between Coast and—Smith. Elec Rev, Lond, Feb 12—97.
- L**ight, Standards of—Boistel. Prog Age, Feb 1—97.
- L**IGHTING and Power Plants at Hearst Hacienda, Sunol, Cal., Isolated (III)—Am Electn, Nov—96. 700 w.
- L**ighting Appliances, Primitive (III)—Gas Wld, Jan 2—97. 1200 w.
- L**ighting, Architects and Electric—Arch, Lond, Jan 1—97. 2800 w. M Mar.
- L**ighting at Manchester, England, The Electric—Elec Rev, Lond, Dec 4—96. E Jan 6.
- L**ighting by Municipalities—F. B. Rae. Elec Jour, Jan 15—97. E Feb 3.
- L**ighting, Comparative Tests of Different Systems of—Joly. Eng News, Jan 28—97. W Feb 6.
- L**ighting Contract for St. Louis—Elec Jour, Jan 15—97.
- L**ighting, Decorative—E. J. Jenness. west Elec, Jan 9—97. 2300 w.
- L**ighting, Leyton Electric (III)—Eng, Lond, Nov 13—96. 1800 w.
- L**ighting, Lincoln Park—West Electn, Jan 2—97.
- L**ighting, National Electric System of Car (III)—R R Car Jour, Nov—96. 1200 w. M Jan.
- L**ighting of a Country Residence (III)—E. G. Bernard. Am Electn, Nov—96. 1000 w.
- L**ighting of Public Buildings—Handcock and Dykes. Elec Eng, Lond, Feb 19—97.
- L**ighting of the Avenue de L'Opera—L'Ind Elec, Dec 10—96.
- L**ighting of Theaters by the Federeau Diffusers, The (III)—G. Mercier. La Revue Technique, Nov 10—96. 1000 w.
- L**ighting or Private Contracts, Municipal—John MacVickar. Am Gas Lgt Jour, Dec 28—96.
- L**ighting, Oriental Electric—Lester Betts. Ind & East Eng, Dec 5—96. Serial Part 1. 1500 w.
- L**ighting Plant, Small—Elec Rev, Lond, Jan 22—97. W Feb 6.
- L**ighting Plants for the British Navy—Electn, Lond, Mar 5—97.
- L**ighting Plants, Two Interesting Small Electric (III)—C. G. Robbins. Power, Dec—96. 3500 w.
- L**ighting, Portable Electric Plant for Show (III)—West Elec, Dec 12—97. 1000 w.
- L**ighting, The Determination of the Cost of Electric—J. G. Christy and S. A. Hasbrouck. Am Gas Lgt Jour, Jan 25—97. 1000 w.
- L**ighting the Shop—Pratt. Mach, Feb—97. 1500 w. M Mar. Elec Rev, Lond, Mar 5—97. W Mar 20.
- L**IGHTNING Arrester—See Fuse Block.

## Index to Advertisers.

Allis Co., The E. P. ....	ii	Keuffel & Esser Co. ....	536
Battle Creek Steam Pump Co. ....	iii	Link Belt Machinery Co. ....	538
Besley, C. H. ....	iii	Lunkenheimer Co. ....	540
Boardman Engraving Co. ....	530	Madison Gas & Electric Co. ....	528
Brown & Sharpe Mfg. Co. ....	538	Nader, John. ....	532
Buff & Burger. ....	536	Northern Electric Co. ....	ii
College Book Store. ....	536	New York, Chicago & St. Louis R. R. Co. ....	526
Conover & Porter. ....	532	Peoples Electric Co. ....	534
Conradson, C. M. ....	532	Rochester Optical Co. ....	530
Crosby Steam Gage and Valve Co. ...	544	Schaffer & Budenberg. ....	544
Deane Steam Pump Co. ....	542	Tracy, Gibbs & Co. ....	532
Democrat Printing Co. ....	528	University Co-operative Association..	522
Eastman Kodak Co. ....	534	University of Wisconsin. ....	iii
Hunt & Co., Robt. W. ....	532	Warner, D. D. ....	524
Ide & Sons, A. L. ....	542	Wedderburn Co., Jno. ....	538
Johnson Electric Service Co. ....	542		

- Lightning—Deaths from—Turquan. L'Eclair Elec, Jan 23—97. W Feb 6.
- Lightning Flashes, Duration of—Kendrick. Rose Tech, Mar—97. W Mar 27.
- Lightning Rods, Concerning—Prof. A. Weller. Elektrotechn Rundschau, Nov 1—96. 200 w. M Feb.
- LIGHTSHIPS, Communication Between Coast and—Elec Rev, Lond, Dec 25—96. E Jan 13.
- LIME, Hydraulic Cement, Mortar and Concrete—Clifford Richardson. Br Build, Jan—97. Serial Part 1. 1800 w. M Mar.
- LIMONITES of Alabama Geologically Considered, The—Henry McCauley. Eng & Min Jour, Dec 19—96. 1500 w.
- LINCOLN Cathedral (III)—Arch, Lond, Jan 1—97. 2000 w. M Mar.
- LIQUID Cells, Theory of—Loven. Proc Lond Phys Soc, Feb—97.
- LIVERPOOL and City and South London Railways—Electn. Lond, Feb 5—97. W Feb 20.
- Liverpool Overhead Railway—Electn, Lond, Dec 25—96. Elec Rev, Lond, Jan 23—97.
- LOCOMOTION, Horseless Road (III)—Ind. Ir, Nov 13—96. 10500 w.
- Locomotive, A Balanced (III)—Sci Am, Nov 14—96. 1200 w.
- Locomotive, An Electric Switching—R R Gaz, Jan 8—97. 600 w.
- Locomotive Boilers and Tubes—Ed. Sauvage. Safety V, Nov—96. 1000 w. M Jan.
- Locomotive Building, Cast Steel in—R R Gaz, Dec 18—96. 4500 w.
- Locomotive Construction, Cast Steel in—J. E. Sague. Ry Rev, Dec 26—96. 2000 w.
- Locomotive Design, An Important Feature of—Ry Rev, Jan 16—97. 2000 w. M Mar.
- Locomotive for the B. R. & P. Ry., Twelve-Wheel Pusher (III)—Eng News, Jan 21—97. 300 w.
- Locomotive for the Illinois Central Railroad, Passenger (III)—Loc Engng, Jan—97. 1300 w.
- Locomotive for the Lake Shore & Mich. Southern, Ten-Wheel Passenger (III)—R R Gaz Jan 1—97. 700 w.
- Locomotive for the New South Wales Railways, Heavy Goods (III)—Engng, Nov 6—96. 1000 w.
- Locomotive, Hedley's "Puffing Billy"—Loc Engng, Jan—97. 1800 w.
- Locomotive Management, Economic—George H. Baker. Baker's Ry Mag, Nov—96. 2200 w.
- Locomotive, Mogul-Vandalia Line (III)—Ry Rev, Jan 9—97. 400 w.
- Locomotive Performances, Recent Developments in Rating—Eng News, Jan 7—97. 4500 w.
- Locomotive Repairing Works—Prac Eng, Nov 20—96. Serial Part 1. 4000 w. M Jan.
- Locomotive, The Construction of a Modern—William O. Weber. Tradesman, Feb 1—97. 3200 w.
- Locomotive, With the East Coast "F. ver" Charles-Rous Marten—Eng. Lond, Dec 18—96. 2500 w.
- Locomotives at High Speeds, The Slipping of—C. E. Wolff. Prac Eng, Dec 11—96. 1000 w.
- Locomotives by Enginemen, Treatment of—L. D. Westfall. Ry Mag, Jan—97. 1600 w.
- Locomotives, Class "O" Mexican Central Railroad, New Ten-Wheel (III)—R R Gaz, Dec 25—96. 1600 w.
- Locomotives, Compound Passenger—Ry Rev, Jan—97. 800 w. M Mar.
- Locomotives, Fast Express, for the N. Y. C. & H. R. R. (III)—Eng News, Jan 14—97. 800 w.
- Locomotives for the Jungfrau Railway—Elek Anz, Feb 4—97.
- Locomotives in England and America, Pioneer (III)—Alfred Mathews. M Feb—97. 4200 w. M Mar.
- Locomotives, Narrow Gauge and Mountain (III)—Eng. Lond, Nov 6—96. 2000 w.
- Locomotives, New Eight-Wheel Passenger, Illinois Central Railroad (III)—R R Gaz, Feb 5—97. 1400 w.
- Locomotives on American Railways, Results of the Working of Two-Cylinder Compound—John H. Cooper. Jour Fr Inst, Jan—97. 900 w.
- Locomotives, Rack Rail, Damascus Railway (III)—Eng. Lond, Jan 15—97. 400 w.
- Locomotives, Some Noteworthy Express (III)—George Frederich Bird. Eng, Lond, Jan 29—97. 8000 w.
- Locomotives, Some Types of Light Railway—Ry Wid, Dec—96. 1100 w.
- Locomotives, The Irish Railway and Its (III)—G. A. Sekon. Mech Wid, Dec 25—96. 1600 w.
- LODGING Houses for New York, Model (III)—Rev of Revs, Jan—97. 1500 w. M Feb.
- LONDON, New Railways for—Eng. Lond, Jan 22—97. 1800 w.
- LOOP, Electrical Equipment of the Union—Chicago (III)—W Elec, Jan 16—97. 1500 w. M Mar.
- LUBRICATION—George L. Fowler—Baker's Ry Mag, Nov—96. 4000 w.
- Lubricators, The Proper Operation of, Care and Instructions Concerning Light Feed—Trav Eng Assn Rept, Sept—96. 10000 w.
- M**ACADAM Road Construction, A Notable Departure in—Eng News, Dec 10—96. 1600 w.
- MACHINE Tools—La Revue Technique, Dec 25—96. 2500 w. M Mar.
- Machine Tools, American—Engng, Dec 18—96. 1600 w.
- Machine Tools at the Berlin Exposition, The Loewe (III)—Revue Technique, Nov 10—96. 3500 w.
- Machines, Some Forms of Screw-Swaging (III)—Ir Age, Nov 26—96. 900 w.
- MACHINERY Hall at the Swiss Exposition at Geneva, The—Eng News, Jan 21—97. 350 w. M Mar.
- Machinery at the Geneva Exposition—La Revue Technique, Nov 10—96. 6000 w.
- Machinery, The Secret of Cheap Production, Labor Saving—A. E. Outerbridge, Jr. Eng Mag, Jan—97. 3200 w.
- MAGNET Coils, The Heating of—Henry S. Carhart. Elec Wid, Jan 2—97. 3300 w.
- Magnet, On the Effects of Removing the Ends of a—Joseph F. Smith. West Elec, Dec 5—96. 600 w. M Jan.
- Magnet, The Great Gun—W. R. King. Elec Rev, Feb 3—97. 1600 w. M Mar.
- MAGNETIC Amalgams—Nagaoka. Proc Lond Phys Soc, Dec—96.
- Magnetic Bodies, Hard and Soft—Kohn. L'Eclair Elec, Jan 30—97.
- Magnetic Dip in Etruscan Times—Folgheraiter. Proc Lond Phys Soc, Jan—97.
- Magnetic Current, Experiment with—Braun. Elektrotechn Zeit, Feb 11—97. W Mar 6.
- Magnetic Elements at Sea, Determination of the—Guvou. Proc Lond Phys Soc, Jan—97.
- Magnetic Force Acting on Moving Electrified Spheres—Schuster. Phil Mag, Jan—97.
- Magnetic Hardness—Beek. Proc Lond Phys Soc, Dec—96.
- Magnetic Lock for Miner's Lamps—Eng and Min Mag, Mar 6—97.
- Magnetic Observations in Geological Mapping—Henry Lloyd Smyth. Trans Am Inst of Min Eng, Dec—96. 21400 w.
- Magnetic Separation of Non-Magnetic Materials—Raymond. Eng and Min Jour, Feb 20—97. W Feb 27.
- Magnetic Testing, Some Recent Developments in—Prof. Ewing. Electn. Lond, Nov 20—96. 1400 w. M Jour.
- Magnetic Viscosity—Martens. Electn, Lond, Jan 22—97. W Feb 6.
- MAGNETISM and Light—Zeeman. Elec Rev, Lond, Feb 19—97. W Mar 6.
- MAGNETIZATION and Stresses—Proc Lond Phys Soc, Dec—96.
- Magnetization by Oscillating Discharges, Energy Used in the—L'Eclair Elec, Jan 2—97.



Detector Galvanometer.

The Instruments

to use are

The "Western  
Electric Instruments."

PORTABLE  
TESTING SETS.  
REFLECTING  
GALVANOMETERS,  
TANGENT  
GALVANOMETERS,  
ASTATIC  
GALVANOMETERS,  
SHUNT BOXES,  
WHEATSTONE  
BRIDGES,  
STANDARD OHMS,  
GALVANOSCOPES,  
CONDENSERS,  
TEST BATTERIES,  
ALL STANDARD TELEGRAPH  
AND SIGNALLING INSTRUMENTS.

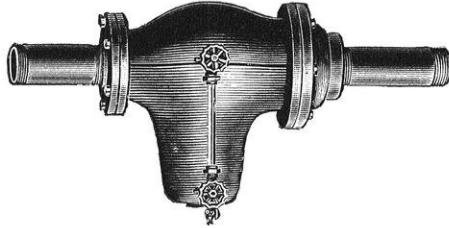
It is of importance that instruments should be accurate and to be accurate they must be good. In design, workmanship, and material we endeavor to give the best. Our instruments are in use throughout the entire world, and have been adopted as standards by some of the largest commercial enterprises. When the question of instruments is under consideration write for information.

**WESTERN ELECTRIC CO.,**  
**Chicago. New York.**

- MAIN and Surface Laying, Material and Tools for—E. H. Millard. *Prog Age*, Dec 1—96. 2500 w. M Jan.
- Mains, Bare Copper—J. H. Tonge. *Lightning*, Jan 7—97.
- Mains, Laying Water—J. H. Decker. *San Plumb*, Nov 5—96. 2000 w. M Jan.
- MALTA, Electricity Supply (III)—*Elec Rev*, Lond, Jan 12—97. 2400 w. M Mar.
- MANCHESTER, Electric Works—C. H. Worthington. *Prac Eng*, Jan 22—97. 3800 w. M Mar.
- MANGANESE in the Electric Furnace, The Preparation of—H. Moissan. *Elec*, Jan 20—97.
- Manganese Ores of Georgia, The—William M. Brewer. *Tradesman*, Jan 1—97. 2000 w.
- MANHATTAN, The Electrical Equipment of the Hotel (II)—*Elec Wld*, Jan 9—97. 2500 w. M Mar.
- MAN-HOLE Openings—*Bos Jour of Com*, Jan 23—97. 1500 w. M Mar.
- MANTEL.—See Fire.
- MANUFACTORIES, Valuation of—Oberlin Smith. *Am Mach*, Dec—96. 3300 w.
- MARBLE HILLS, The Vermont—Stone, Jan—97. 2000 w.
- MARINE Engineers' Qualifications—*Engng*, Nov 27—96.
- MASSACHUSETTS, Railway Power Distribution in Eastern—*St Ry Rev*, Feb 15—97. W Feb 27.
- MASONRY and Stone-Cutting, Practical (III)—E. W. Hind. *Ill Car and Build*, Dec 25—96. Serial Part 1. 1100 w. M Feb.
- MATTE and the Recovery of the Contained Precious Metals, Nickel and Copper in—Titus Ulke. *Eng & Min Jour*, Jan 30—97.
- Matte, Granulating—S. E. Brotherton. *Eng & Min Jour*, Jan 9—97. 400 w.
- MEASUREMENTS of Precision, Dr. Sheldon on Electrical—*Elec Eng*, Nov 11—96. 700 w. M Jan.
- MECHANICAL Conception of Electricity and Magnetism—Franklin. *Phy Rev*, Mar—97. Apr—97. W Mar 20.
- Mechanical Conceptions of Electrical Phenomena and Investigations on Alternating Current Resonance Effects—Dr. C. Heinke. *Elektrotechn Zeit*, Feb 4—97.
- Mechanical Plant, The—*Eng Rec*, Nov 28—96. 2300 w. M Jan.
- Mechanical Traction in Paris—*Bul Soc Int des Elec*, Jan—97.
- Mechanical World, The Hopeful Outlook in the—*Eng Mag*, Jan—97. 3800 w.
- MEDICAL College Electric Plant—*Am Elec*, Dec—96. W Jan 2.
- MERCURY Interrupter for Induction Coils—*Elec Rev*, Lond, Feb 26—97. W Mar 20.
- METAL, Expanded (III)—*Engng*, Nov 13—96. 800 w.
- Metal Mining in Hungary—*Am Mfr & Ir Wld*, Jan 29—97. 800 w.
- Metal Separation by Means of Hydrochloric Acid Gas—J. Bird Meyer. *Jour Am Chem Soc*, Dec—96. 4400 w.
- Metals by Means of Soluble Anodes, A New Method of Separating—R. Pauli. *Elektrochem Zeit*, Nov—96. 1000 w.
- Metals, The Precious—*Min Ind & Rev*, Dec 31—96. 3300 w. M Mar.
- Metals, Refining of—See Furnaces.
- METALLIFEROUS Mining in 1896—*Min Jour*, Jan 2—97. 3000 w. M Mar.
- METALLURGY, Electricity as Applied to—Prof. Threlfall. *Aust Min Stand*, Sept—96. 6500 w.
- METER, Alternating Current (III)—Hummel. *Elec Anz*, Jan 17—97.
- Meter, Calibration of a Worthington Water—John A. Laird. *Am Soc Mech Eng*, Dec—96. 500 w. M Jan.
- Meter, Hookham—*Electn*, Lond, Jan 22—97.
- Meter Testing—*Electn*, Lond, Feb 5—97.
- Meters (III)—*Armagnet*. *L'Eclair Elec*, Feb 6—97.
- Meter, Alternating Current Watt (II)—*Elektricitat*, Feb 13—97.
- Meters, Penny-in-the-Slot—Gibbins. *Lightning*, Dec 17—96. W Jan 9.
- Meters, Thermic Volt and Ampere—Dujon. *L'Eclair Elec*, Feb 6—97. W Feb 27.
- METRIC System in Electrical Industries, The—F. S. Hickok. *Electn*, Lond, Jan 9—97. Serial Part 1. 2000 w. M Mar.
- MICROPHONE in Germany—*Jour Telegraphique*, Jan 25—97.
- Microphone Patent before the U. S. Supreme Court, The Berliner—*Elec Eng*, Nov 18—96. 4000 w. M Jan.
- Microphone Resistance, Causes of Change of—Fessenden. *Am Electn*, Feb—97. W Mar 6.
- MICROPHONOGRAPH—Dussand System. *Elec Eng*, Mar 2—97. W Mar 20.
- MILEAGE Increased by Long Runs, Locomotive—*Ry Rec*, Jan 9—97. 2400 w.
- MINE and Knickerbocker Tunnel, Idaho Springs, The Crown Point—Arthur Lake. *Col Eng*, Nov—96. 2000 w. M Jan.
- Mine and the Joseph Jefferson Salt Deposit, Louisiana, The Avery Island (III)—*Eng & Min Jour*, Nov 14—96. 1700 w. M Jan.
- Mine Drainage (III)—Hans C. Behr. *Can Min Jour*, Nov—96. Serial Part 1. 3800 w. M Jan.
- Mine La Motte, Missouri, A Sketch of—*Eng & Min Jour*, Nov 21—96. 2000 w.
- Mines, Royal—*Col Guard*, Nov 20—96. 1000 w.
- Mines, Telluride, Colo., The Smuggler-Union—J. A. Potter. *Min Ind & Rev*, Nov 26—96. 2000 w.
- Mines, Timber and Wood Consumption in the Comstock—William Alvord. *Eng News*, Dec 31—96. 2800 w.
- MINERAL and Metal Production in 1896, United States—*Eng & Min Jour*, Jan 2—97. 4500 w.
- Mineral Deposits of Eastern California, The—Harold W. Fairbanks. *Min & Sei Pr*, Dec 12—96. 1700 w.
- Mineral Deposits, The Origin of Valuable—*Aust Min Stand*, Sept—96. Serial Part 1. 4500 w. M Jan.
- Mineral Fields of the West Coast of Tasmania, The—*Aust Min Stand*, Sept—96. 5000 w. M Jan.
- Mineral Industry of the South—William M. Brewer. *Tradesman*, Jan 1—97. *Eng & Min Jour*, Jan 2—97.
- Mineral Industry of the United Kingdom, The—C. Le Neve Foster. *Col Guard*, Dec 11—96. 1800 w.
- Mineral Industry, The—*Engng*, Jan 8—97. 1900 w.
- Mineral Resources of New Mexico, The—Thomas Tonge. *Min Jour*, Nov 14—96. 3000 w. M Jan.
- Mineral Resources of the State, The Relation of Geology to the Development of the—*Min & Sei Pr*, Nov 21—96. 4300 w. M Jan.
- Minerals, The Utilization of Rar—*La Revue Technique*, Dec 25—96. 1000 w. M Mar.
- MINING Activity, Prospective Resumption of—David T. Day. *Eng Mag*, Jan—97. 4200 w.
- Mining at Great Depths—Bennett H. Brough. *Jour Soc of Arts*, Dec 11—96. 11400 w.
- Mining "Boom," The Westralian—Nineteenth cent. Nov—96. 4000 w. M Jan.
- Mining Code, Outlines of the Mexican—C. C. Longridge. *Min Jour*, Dec 5—96. 1000 w.
- Mining Country, The Kootenai—*Ry Age*, Dec 18—96. 1800 w.
- Mining in Ontario, Recent Developments of—Dr. A. R. Coleman. *Can Eng*, Nov—96. 2000 w.
- Mining in the Leadville District—Franklin Ballou, Jr. *Yale Sei M*, Dec—96. 2400 w.
- Mining in Victoria—*Min Jour*, Nov 28—96. 2000 w.
- Mining Industry, The West Australian—C. C. Longridge. *Min Jour*, Nov—96. 1400 w. M Jan.
- Mining Installation—Sprague. *Elec Rev*, Mar 10—97.

# KING'S Exhaust and Water Separator.

REMOVES ALL  
OIL  
FROM  
EXHAUST.



REMOVES ALL  
WATER  
FROM  
LIVE STEAM.

Six of these separators are in use in the University of Wisconsin Buildings.

**Three Separations. No Back Pressure. Satisfaction Guaranteed.**

Send for circulars and prices to

**KING & WALKER CO., Mfrs.,**  
623 E. Main Street,  
Madison, Wis.

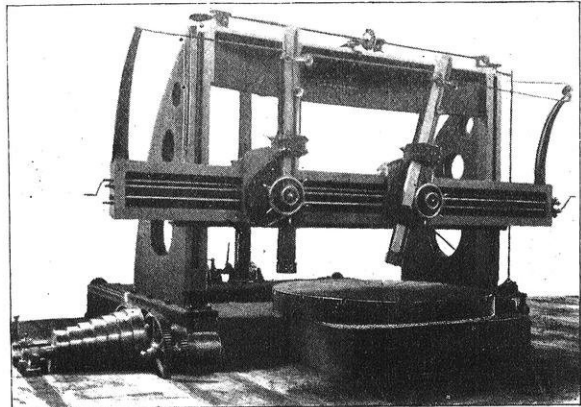
## LABOR SAVING MACHINERY.

Our Tools are designed  
with this end in view:



More than this, THEY  
ATTAIN IT! They  
don't stop at Good In-  
tentions. ❀ ❀ ❀

They MEET THE  
REQUIREMENTS ❀  
FOR WHICH THEY  
ARE DESIGNED. ❀



16 - 24 foot Boring and Trimming Mill.

Patterns for over 300 Different Types.

Write for Catalogue.

Your Correspondence Solicited.

THE NILES TOOL WORKS CO., Hamilton, O.

Branches: New York, Chicago, Pittsburgh, Philadelphia, Boston.

- Mining Law of Foreign Countries—Col Guard, Dec 24—96. 1600 w.
- Mining on the Witwatersrand Gold Fields, South African Rep., Some Economic Features in Connection with—Edgar P. Rathborn. Min. Jour, Nov 21—96. 2800 w. M Jan.
- Mining Pant—Eng News, Jan 21—97. Eng & Min Jour, Jan 2—97.
- Mining Power Plant, A Log Dam for a (III)—Eng & Min Jour, Nov 28—96. 1200 w. M Jan.
- Mining Purposes, The Use of Electrical Power for—Ir & Coal Trds Rev, Jan 15—97. 2200 w.
- Mining Rights in Germany and Austria-Hungary—Col Guard, Dec 4—96. 1100 w.
- Mining: Sinking and Lining a Shaft at a French Colliery (III)—Aime Gardon. Col Guard, Nov 6—96. 4800 w. M Jan.
- Mining Sketches (III)—Arthur Lakes. Col Eng, Jan—97. 1300 w. M Mar.
- Mining Stock Exchanges in 1896—Eng & Min Jour, Jan 2—97. 12500 w.
- Mining Waste Arnao Colliery, Filling Worked Seams with—Col Guard, Nov 20—96. 1500 w. M Jan.
- MIRRORS with Paraffine Lamp and Scale, Use of Small—Hoffert. Electn, Lond, Feb 19—97. W Mar 6.
- MISSISSIPPI, The Great Reservoir System of the Upper (III)—W. S. Harwood. Harper's Weekly, Jan 9—97. 4000 w.
- MIXTURES, Regulating Foundry—Thomas D. West. Ir Tr Rev, Jan 28—97. 1300 w. M Mar.
- MOTOR as Compensators in Alternating Current Distribution, Synchronous—Ernest J. Berg. Elec Wld, Nov 21—96. Serial Part 1. 2000 w. M Jan.
- Motor Car Competition, The Recent—Engng, Nov 6—96. 3300 w. M Jan.
- Motor Car in England in 1896, The—Eng, Lond, Dec 4—96. 2000 w.
- Motor Cars and the Advantages of High-Speed Oil Engines—Ind & Ir, Nov 13—96. 1400 w. M Jan.
- Motor Cars, Old-Time (III)—Ind & Ir, Nov 13—96. 1700 w.
- Motor Cars, Present Time (III)—Ind & Ir, Nov 13—96. 4000 w.
- Motor Cars under Various Potentials, Current Consumption—Chapman. St Ry Rev, Feb 15—97. W Feb 27.
- Motor Curves, Electric Railway—Am Electn, Dec—96.
- Motor, Practical Method of Differential Compounding a Shunt—for Constant Speed at All Loads—Reese and Hutchison. Am Electn, Jan—97. 600 w. M Mar.
- Motor, Wave—West Electn, Mar 13—97. W Mar 13.
- Motor—See Gas.
- Motors, A New Method of Speed Control for Electric—W. A. Anthony. Elec Eng, Dec 16—96. 800 w.
- Motors, Calculation of Electrical—Alfred E. Wiener. Elec Wld, Dec 5—96. 1500 w. M Jan.
- Motors, Compressed Air (III)—Carl Snyder. Harper's Weekly, Dec 5—96.
- Motors, Cost of Operating Electric—Elek Anz, Feb 11—97.
- Motors, Designs for Small—Poole. Am Electn, Feb—97.
- Motors, External Regulation of Alternating Current—Albert G. Davis. Elec Wld, Dec 12—96. 1700 w.
- Motors for Railway Work, Shunt—William Baxter, Jr. Elec Wld, Dec 12—96. 2500 w. Am Mach, Dec 17—96.
- Motors for Street Railways—Elek Rund, Jan 15—97.
- Motors, Graphic Calculation of Induction—Danielson. L'Eclair Elec, Feb 6—97.
- Motors, Pairing of Electric Railway—Am Electn, Feb—97. W Mar 6.
- Motors, Progress in Traction—Ziffer. Elek Anz, Dec 3—96.
- Motors, Theory of Constant Speed Direct Current—Joyce. Elec Rev, Lond, Mar 12—97. W Mar 27.
- Motors with Reduced Speeds, On Drehstrom—Hans Gorges. Elec Rev, Lond, Nov 27—96. 800 w. M Jan.
- MOMENT of Resistance, The—C. V. Kerr. Am Soc Mech Eng, Dec—96. 2200 w. M Jan.
- MONIER Arch—Prof. Josef Anton Spitzer. Zeitschr Oesterr Ing u Arch Vereines, Jan 7—97. 2500 w. M Mar.
- MONONGAHELA Navigation—See Navigation.
- MOSQUE of the Omeiyades Damascus, The Great (III)—R. Phene Spiers. Jour of Roy Inst of Brit Arch, Nov 19—96. Serial Part 1. 7500 w. M Feb.
- MOTHER Lode Power Plant—Eng & Min Jour, Mar 6—97.
- MOUNT NEBO Reservoir and Canal System, The (III)—Eng News, Dec 3—96. 3000 w.
- MUNICH, The Electric Plant at—Elektrotechn Zeit, Jan 7—97. 6000 w. M Mar.
- MUNICIPAL Control—See Tramways.
- Municipal Enterprises, Methods of Determining the Economic Productivity of—Am Jour Sci, Nov—96. 4500 w. M Jan.
- Municipal Plants—Elec Eng, Feb 17—97. Mar 3—97. W Feb 27. Mar 13.
- NAVAL Life, Electricity in—Elec Eng, Jan 27—97.
- Naval Practice in Ship Rivets and Riveting—J. H. Linnard. Eng News, Nov 26—96. 2400 w. M Jan.
- Naves of the World, The—Eng, Lond, Nov 13—96. 2000 w.
- NAVIGATION Co., The History of Monongahela—Eng News, Jan 7—97. 900 w.
- Navigation, Inland—Zeitschr d Oesterr Ing u Arch Vereines, Jan 15—97. 1500 w. M Mar.
- NEVADA, The Copper Mines of—Dan deQuille. Min & Sci Pr, Jan 23—97. 1800 w.
- NEW YORK Edison Co., Report of—Elec Eng, Feb 17—97.
- NIAGARA Falls, Local Distribution at—Elec Eng, Feb 10—97.
- Niagara Falls Power in Brooklyn (III)—Stephen L. Coles. Elec Rev, Nov 18—96. 3000 w.
- Niagara Power for the Buffalo Railway System (III)—St Ry Jour, Dec—96. 2800 w.
- Niagara Power Celebration, The Buffalo—Elec Eng, Jan 20—97. 5600 w. M Mar.
- Niagara, The Accomplished Utilization of—W. B. Rankine. Elec Eng, Jan 6—97. 2600 w. M Mar.
- NIAGARAGUA Canal—R R Gaz, Jan 22—97. 1500 w. M Mar.
- NICKLE and Copper in Matte and the Recovery of the Contained Precious Metals, The Separation of—Titus Ulke. Eng & Min Jour, Jan 30—97. 3300 w.
- NORFOLK Railway—St Ry Jour, Jan—97.
- OFFICES, The Proposed New Government—H. Heathcote Statham. Fortnightly Rev, Dec—96. 6000 w.
- OIL, The Shale Oil Industry in Scotland—La Revue Technique, Dec 25—96. 5000 w.
- Oils, Friction and Lubricating—C. A. Collett. Am Electn, Dec—96. 1300 w.
- Oils, Mineral—See, Heating and Lighting.
- ORE Deposition in Arizona, Facions in—A. F. Wuensch. Min Ind & Rev, Nov 19—96. 1200 w. M Jan.
- Ore Reduction in Colorado, Progress and Present Status of Methods of—H. Van F. Furman. Min Ind & Rev, Dec 31—96. 3300 w.
- Ore-Shoots of Cripple Creek, The—Edward Skewes. Trans Am Inst of Min Engrs, Dec—96. 8500 w.
- ORNAMENT, Interlaced, Celtic (III)—Arch, Lond, Jan 1—97. 1500 w. Mar.
- OSCILLATING Currents, Method of Determining Frequency of—Meyer. Elektrotechn Zeit, Jan 28—97. W Feb 20.





UNIVERSITY.....  
 CO-OPERATIVE  
 ASSOCIATION.

If You have a want,  
 Call and we will fill it.  
 A full line of Stationery,



Photographic Supplies,  
 Athletic Goods,  
 and Fountain Pens.

The only Firm in Madison carrying a Full Line of  
 Engineering Supplies.

Agents for EUGENE DIETZGEN & CO., and  
 KUEFFEL & ESSER.

**T. S. MORRIS, Mgr.**

*Please mention Wisconsin Engineer when you write.*

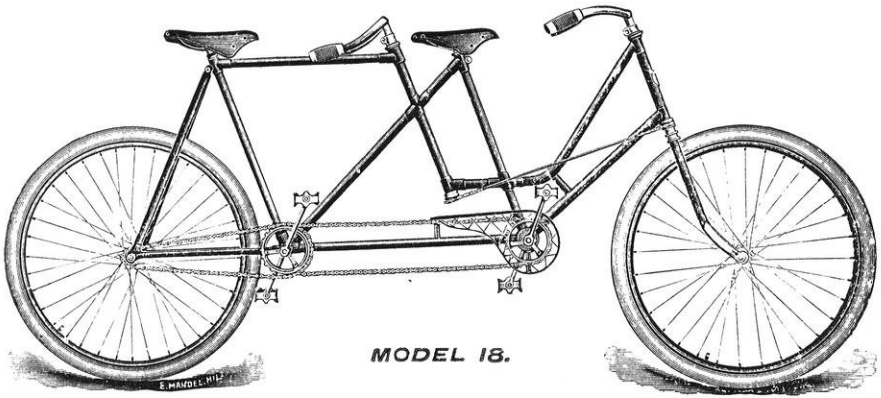
- OVERHEAD Construction for Suburban Lines—Macartney. *St Ry Jour*, Mar—97.
- Overhead Electric Railway in London—Electn, Lond, Feb 19—97.
- Overhead System—Brochet. *Electn*, Lond, Feb 26—97.
- OVENS, The Andre System of Gas Heated (Ill)—P. Chevillard. *Am Gas Lgt Jour*, Dec 14—96. 2000 w.
- OWOSSO Plant—*St Ry Jour*, Jan—97.
- OXYGEN in Gaseous Poisoning, The Use of (Ill)—*Pro Age*, Dec 15—96. 3500 w.
- OZONE, Industrial Production of—*Electn*, Lond, Feb 19—97. W Mar 6.
- Ozone, Production and Application of—Andreoli, *L'Elec*, Feb 13, 27—97. W Mar 6.
- P**ACIFIC Cable—Taylor. *Electn*, Lond, Jan. 22—97. W Feb 6.
- PAINTS for Railways—M. F. Lindsay. *Ry Rev*, Dec 5—96. 2800 w.
- PALACE for the Exposition of 1900, Revolving (Ill)—*Elec Wld*, Nov 28—96. 700 w.
- Palace of Justice at Budapest, The New (Ill)—*Arch Rundschau*, Nov 2, 1896. 500 w.
- PANAMA Canal, The New—*R R Gaz*, Jan 15—97. 1800 w. Mar.
- PARIS, Claret Vuillennier Tramway in (Ill)—*West Elec*, Mar 13—97.
- Paris Exposition of 1900—*West Electn*, Mar 6—97. *L'Ind Elec*, Feb 10—97.
- Paris, The Water Supply of—*Jour Gas Lgt*, Jan 12—97. Serial Part I. 2200 w.
- Paris—See Street Railway.
- PARK Making as a National Art—Mary Caroline Robbins. *Atlantic M*, Jan—97. 7000 w. M Mar.
- Parks and Park Roads—L. C. Alexander. *Jour W Soc Eng*, Oct—96. 6000 w. M Jan.
- PATERSON Power Station—Power, Feb—97.
- PAVING, German "Hit and Miss"—Robert Grimshaw. *Munic Engng*, Feb—97. 800 w. M Mar.
- PAWUCKET Power Plant (Ill)—*Elec Eng*, Dec 23—96. W Jan 2.
- PELATON—Clerici Process at De Lamar—*Min Ind & Rev*, Jan 28—97. 800 w. M Mar.
- PENITENTIARY for the Province of Posen in Wronke, The Central (Ill)—*Zeit f Bauw*, No X—XII. 2700 w. M Jan.
- PERMEABILITY of Liquid Oxygen and Liquid Air, On The Magnetic—J. A. Fleming and James Dewar. *Electn*, Lond, Dec 11—96. 1100 w.
- Peterborough Cathedral—*Arch*, Lond, Jan 15—97. 5700 w. M Mar.
- PHASE Differences, An Apparatus for Illustrating (Ill)—Louis Derr. *Tech Quar*, Dec—96. 800 w.
- PHONOPLEX, The Edison (Ill)—*R R Gaz*, Jan 1—97. 1200 w.
- PHOSPHATE Deposits in Maury County, Tennessee, The—J. B. Killebren. *Eng & Min Jour*, Nov 14—96. 1500 w. M Jan.
- Phosphate Deposits of Arkansas, The—John C. Branner. *Trans Am Inst of Min Eng*, Dec—96. 6300 w.
- PHOTO-Chronograph at the United States Artillery School at Fort Monroe, The New Polarizing (Ill)—A. C. Crehore and G. O. Squier. *Sci Am sup*, Jan 2—97. 9000 w.
- PHOTOGRAPHIC Action Inside of Discharge Tubes—Battelli. *Phil Mag*, Feb—97. W Feb 27.
- Photographic Action of X Rays—Vandevyver. *Jour de Phys*, Jan—97. W Mar 20.
- Photography to Surveying, The Application of—J. S. Dennis. *Eng News*, Nov 19—96. 1000 w. M Jan.
- PHOTOMETER, Universal (Ill)—Blondel and Broca. *L'Eclair Elec*, Jan 23—97. W Feb 6.
- Photometric Units—Blondel. *Zeit f Beleucht*, Nov 30—96.
- Photometric Units—Weber. *Elektrotechn Zeit*, Feb 18—97. W Mar 6.
- Photometry—Vielle. *Bul Soc Int des Elec*, Dec—96. W Feb 13.
- PHYLLXERA, Destruction of the—*L'Elec*, Jan 2—97.
- PHYSICAL Science, Advanced Studies in—Bose. *Electn*, Lond, Feb 19—97.
- PHYSICS, Latest Discoveries in—Lodge. *Electn*, Lond, Feb 26—97.
- PIER, Stone Filled Concrete—*Eng News*, Dec 17—96. 500 w.
- Piers, The Late Gales and the Brighton—*Eng*, Lond, Dec 18—96. 1500 w.
- Piers Upon Their Foundations, The Distribution of the Pressure of—Rudolph Mayer. *Z Oesterr In A. V.* Dec 11—96. 200 w.
- PIG IRON as a Possible Secondary Product of the Blast Furnace—B. H. Thwaite. *Ir & Coal Trds Rev*, Jan 29—97. 1500 w. M Mar.
- Pig-Iron Industry, Recollections of the Anthracite—E. Roberts. *Ir & Coal Trds Rev*, Nov 20—96. 2700 w.
- PILLARS OF VARIABLE Moduli of Elasticity, Concerning the relation of elasticity and resistance of—*Zeitschr d Oesterr Ing u Arch Ver*, Dec 25—96. 3000 w.
- PIPE Coverings, Experimental Determination of the efficiency of—F. G. Gasche. *Power*, Dec—96. 3000 w.
- Pipes and Service Piping, Service (Ill)—T. Littlehales. *Am Gas Lgt Jour*, Dec 7—96. 3800 w. M Jan.
- Pipes Stopped, Ascension—S. Carpenter. *Jour Gas Lgt*, Jan 12—97. 1700 w.
- Pipes, Making Cast Iron—Jesse Garrett. *Jour New Eng Water Works*, Sept—96. 12000 w. M Jan.
- PIPING for Electric Lighting Engines in Office Buildings, Good and Bad Steam—*Eng Rec*, Jan 2—97.
- Pit Bottoms, Laying Out—W. Steward. *Col Guard*, Nov 13—96. 3300 w. M Jan.
- Pits, The Covering Up—Cast—George H. Hollingworth. *Prac Eng*, Nov 13—96. 1600 w. M Jan.
- PLANING Jobs, Special—John Randol. *Am Mach*, Jan 28—97. 2000 w. M Mar.
- PLANTS, Combined Lighting and Traction—Spence. *Lighting*, Dec 17—96. W Jan 9.
- PLASTER WORK, Decorative—E. Prioleau Warren. *Builder*, Jan 23—97. 7800 w. M Mar.
- PLATE, The Cost of Armor—*Ir Age*, Jan 7—97. 4000 w.
- Plates, The "Kearsage" and "Kentucky"—*Ir Age*, Jan 7—97. 2800 w.
- PLAY GROUNDS, Municipal—*Gar & For*, Dec 16—96. 1100 w.
- PLOUGHS, Electric—*Elec Eng*, Lond, Dec 11—96. W Jan 2. *Elec Rev*, Lond, Dec 18—96.
- PLUMBING, An Example of High Class—*Met Work*, Jan 23—97. 2800 w. M Mar.
- Plumbing Apparatus, Proper Care of—*Plum & Dec*, Nov 2—96. 1100 w. M Jan.
- Plumbing, German (Ill)—Robert Grimshaw. *Dom Engng*, Nov—96.
- Plumbing, House (Ill)—Henry N. Ogden. *Dom Engng*, Dec—96. 2500 w.
- Plumbing Practice, Some Mistakes in Common—W. F. Taaffe. *San Plumb*, Jan 15—97. 1600 w. M Mar.
- Plumbing Regulations, New Haven—*Met Work*, June 23—97. 2800 w. M Mar.
- Plumbing Simplified (Ill)—Wm. Paul Gerhard. *Arch & Build*, Nov 14—96. 1800 w. M Jan.
- POLARIZATION, A New Method for Determining Capacity for—C. M. Gordon. *Zeit f Elektrochem*, Oct 20—96. 1200 w. M Feb.
- Polarization by Alternating Currents—Wien. *L'Eclair Elec*, Dec 5—96. W Jan 2.
- Polarization of the Electric Ray—Bose. *Elec Eng*, Lond, Feb 5—97. *Elec Rev*, Lond, Feb 5—97.
- POLARIZING Substances, Electric Conductivity of—Bose. *Electn*, Lond, Feb 12—97. W Feb 27.



**W**arner **C**ycles 



~ ~ **NONE BETTER** ~ ~



**W**E manufacture a full line of strictly high grade Bicycles and Tandems. A Catalogue for the asking. ❁ ❁ ❁ ❁ ❁

**D. D. Warner Co.,     •     •     •     Madison, Wis.**

*Please mention Wisconsin Engineer when you write.*

- POLES for Line Wires—Elektrotechn Zeit, Jan 14—97. W Feb 6.
- Poles, Telegraph and Telephone—Petersen. Elec Rev, Lond, Feb 5—97.
- POOLING Bill, The—Ry Rev, Feb 6—97. 3400 w. M Mar.
- POTENTIAL Difference Between Metals and Electrolytes—Wiedeburg. Zeit f Elek, Feb 5—97.
- POWER combined, Remarks on Sail and Steam—H. C. Vogt. Steamship, Nov—96. 1500 w. M Jan.
- Power, Electric Motive—W. H. Weston. Baker's Ry Mag, Nov—96. 2000 w.
- Power for Suburban Traction, The Substitution of Electricity for Steam as a Motive—John Findley Wallace. Am Soc of Civ Engrs, Dec—96. 15500 w. M Feb.
- Power House of the New London Conn., Street Railway Co., New (III)—Elec Eng, Jan 27—97. 2000 w. M Mar.
- Power in Workshops, The Local Distribution of—Ernest Kilburn Scott. Elec Eng, Lond, Jan 1—97. Serial Part I. 2500 w. M Mar.
- Power, On Cheap Steam—J. S. Raworth. Elec Eng, Lond, Nov 13—96. 3800 w. M Jan.
- Power Plant at Armour Institute—West Elec, Feb 27—97. W Mar 6.
- Power Plant of Chicago City Railway (III)—St Ry Jour, Mar 97.
- Power Plant of the Pawtucket Electric Co. The Bridge Mill (III)—Elec Eng, Dec 23—96. 3000 w.
- Power Plant of the Washington Mill Co. The New (III)—Eng News, Nov 26—96. 2000 w. M Jan.
- Power Plant, Selections of a —Wagner. Rose Technic, Jan—97.
- Power Plants in Department Stores—Power, Mar—97.
- Power Station Records—Moors. St Ry Jour, Mar—97.
- Power Station Test—Tech Quart, Dec—96.
- Power Stations, Operations of—Tandy. St Ry Jour, Jan—97.
- Power, The New Marine—Sea, Dec 17—96. 1500 w.
- Power, The Wonderful Expansion in the use of Electric (III)—Louis Bell. Eng Mag, Jan—97. 3700 w.
- Power Transmission, Hydraulic—Gustave Kaufmann. Ir Age, Nov 12—96. 3000 w. M Jan.
- Power, Watt and the Measurement of—Preece. Electn, Lond, Feb 12—97. Elec Rev, Lond, Feb 12—97.
- "POWERFUL," The Trials of the—Eng, Lond, Dec 4—96. 3600 w.
- PREPARATION of Metallic Hydroxides—Am Jour Sci, Mar—97. W Mar 6.
- "PRINCE GEORGE," Her Majesty's Battleship (III)—Eng, Lond, Dec 18—96. 18000 w.
- PROBLEM of the City, The—Clinton Rogers Woodruff. Am Mag Civ, Nov—96. 3500 w. M Jan.
- PRODUCTION in Engineering Workshops, Economical—Mach, Lond, Dec 15—96. Serial Part 1. 1700 w.
- PROJECTORS—Perry. Electn, Lond, Feb 19—97. W Mar 6.
- PROSPECTORS, A Few Points for—Dan De Quille. Min & Sci Pr, Nov 28—96. 2200 w.
- PROTECTION of High Tension Lines from Atmospheric Electricity—Chavannes. West Elec, Mar 6—97.
- PROVIDENCE, The New Railway Terminals at (III)—Eng News, Jan 28—97. 3600 w.
- PULLEY Made Entirely of Wrought Steel, A Belt (III)—Eng News, Feb 4—97. 500 w. M Mar—97.
- Pulleys, So That the Same Open Belt Shall Fit Each and Every Pair, A Geometrical Solution of the Problem of Finding the Radii of Different (III)—W. J. Varley. Elec Rev, Lond, Dec 4—96. 700 w.
- PUMP Balancing—W. H. Booth. Am Mach, Nov 12—96. 1800 w.
- Pumps, Electric—L'Ind Elec, Jan 25—97.
- Pumping Engines, Brighton Water Works (III)—Eng, Lond, Jan 22—97. 900 w. M Mar.
- Pumping Oil by Electricity—Am Mfr & Ir Wid, Feb 26—97. E Mar 10.
- Pumping Plant of the Sewerage System of Budapest—Zeit d Ver Deutscher Ing, Jan 2—97. 3000 w. M Mar.
- Pumping Station of the Vienna Water Works at Breitensee, The—Wiener Bauindustrie-Zeitung, Jan 14—96. 2000 w. M Mar.
- PYROMETER in the Down Corner, The Value of—Edward A. Uehling. Am Mfr & Ir Wid, Jan 22—97. 2500 w. M Mar.
- Pyrometer, The Le Chatelier—Zeit d Oesterr Ing u Arch Vereines, Jan 1—97. 3000 w. M Mar.
- QUARRYMEN, Geology for (III)—Charles Richard Van Hise. Stone, Dec—96. 3600 w.
- QUARTZ Fibres—C. Vernon Boys. Electn, Lond, Dec 11—96. Serial Part I. 3300 w. W Jan 2.
- RACING in Marine Engines, Prevention of—Harlan. Elec Rev, Lond, Feb 20—97. W Mar 20.
- RADIATION—Dorman. Elec Eng, Lond, Jan 22—97. Elec, Mar 3—97.
- Radiation, Methods of Proportioning Direct—R. C. Carpenter. Met Work, Jan 30—97. 2500 w. M Mar.
- RADIOGRAPH—Elec Rev, Mar 3—97.
- Radiograph Showing Arterial Circulation—Elec Rev, Jan 27—97.
- RADIOSCOPE for Diagnosing Diseases of the Thorax, Application of the—L'Ind Elec, Jan 25—97.
- RAMS—See Cruisers.
- RAIL Joints, Large Bearing Surfaces for—Ry Rev, Dec 12. 1400 w.
- Rail Sections and Weights Again—R R Gaz, Jan 15—97. 1000 w. M Mar.
- Rail Transportation of Live Stock in Uruguay—Humphrey Chamberlain. Ry Rev, Dec 26—96. 1800 w.
- Rail, The Electrically Welded Continuous—Richard Eyre. St Ry Jour, Dec—96. 3300 w. M Jan.
- Rail, The Problem of the Continuous—Ward Raymond. St Ry Jour, Feb—97. 3300 w. M Mar.
- Rails and Tires, Micro-Mechanical Examination of Old Steel—J. E. Stead. Ind & Ir, Jan 15—97. Serial Part I. 1400 w. M Mar.
- Rails, Change in the Form and Position of—Zeit f Bauwesen, X—XII, 10500 w.
- Rails, Continuous—Electn, Lond, Dec 18—96. 2000 w. W Jan 9.
- Rails, Metamorphoses of the Basic Steel Process and the Methods of Testing Steel (III)—Prof. L. Tetmaier. Schweiz Bauzeitung, Nov 7. 14. 21, 28, and Dec 12—96. 15000 w.
- Rails on Street Pavements, The Influence of—Edward P. North. Am Soc Civ Eng, Nov—96. 2200 w. M Jan.
- Rails, Sandberg—A. L. Ugglä. Engng, Jan 29—97. 1000 w.
- RAILROAD Building and Manganese Mining in Colombia (III)—Eduardo J. Chibas. Eng Mag, Dec—96. 3000 w.
- Railroad Building in 1896—R R Gaz, Jan 1—97. 2700 w.
- Railroad Commissioner, Report of the Massachusetts State Board of—Eng News, Jan 28—97. 4000 w. M Mar.
- Railroad Earnings, November's Poor—Bradstreet's, Dec 12—96. 700 w.
- Railroad Engine, The First—Bos Jour Com, Nov 28—96. 1500 w.

## Unexcelled DINING CAR SERVICE.



**Rates** via the Nickel Plate Road between same points for like classes of tickets are lower than via other lines. ❀ ❀

All information as to routes and fares, including sleeping car reservations, furnished by your nearest ticket agent, or by addressing ❀ ❀ ❀

**H. THORNE,**

City Passenger and Ticket Agent.

**J. Y. CALAHAN,**

General Agent.

**111 ADAMS STREET, CHICAGO.**

**B. F. HORNER, G. P. A., Cleveland, Ohio.**

*Please mention Wisconsin Engineer when you write.*

- Railroad Engineering, Theory of Compound Curves in—Arnold Emch. Kansas Univ Qr, Oct—96. 1400 w.
- Railroad Map, Some Changes in the—J. C. Ransom. Tradesman, Jan 1—97. 4500 w.
- Railroad Move, A Wise—Mfrs Rec, Dec 11—96. 800 w.
- Railroad Report, Little's Baltimore and Ohio—Bradstreet's, Dec 12—96. 1100 w.
- Railroad Signals—Elec Eng, Lond, Feb 19—97.
- Railroad Testing Laboratory (III)—William O. Webber. Mach, Jan—97. 1200 w.
- Railroad, The First London—W. B. Paley. R R Gaz, Dec 18—96. 1200 w.
- Railroad Transport, American Lessons in Cheap—Ir & Coal Trds Rev, Nov 13—96. 900 w. M Jan.
- Railroads, A Study in the Designing and Construction of Elevated—J. A. L. Waddell. Pro Am Soc of Civ Engrs, Jan—97. 12500 w. M Mar.
- Railroads of India—R R Gaz, Jan 8—97. 1200 w.
- Railroads, The Present and Future of American—Thomas F. Woodcock. Eng Mag, Jan—97. 4800 w.
- RAILWAY at Bristol, New Harbor—Trans, Nov 27—96. 1000 w.
- Railway at Eaton Hall, A Light—Prac Eng, Nov 13—96. 1000 w. M Jan.
- Railway Circuits, Injurious Effects of—Van Vloten. L'Elec, Jan 30—97.
- Railway, Columbia and Maryland—Huff. St Ry Rev, Mar 15—97.
- Railway, Delagva Bay, Preforia—Ind Engng, Oct 10—96. 500 w.
- Railway Earnings, Gross and Net—Bradstreet's, Nov 21—96. 1000 w.
- Railway Exhibition, The Barsi Light (III)—Ry Wld, Nov—96. 1800 w.
- Railway Facilities, Continental—Engng, Jan 8—97. 2000 w. M Mar.
- Railway Improvements, The Baltimore & Ohio—Ry Age, Dec 18—96. 1000 w.
- Railway, Lancashire, Derbyshire and East Coast (III)—Eng, Lond, Nov 27—96. 1300 w.
- Railway, Light—Elec Rev, Lond, Dec 11—96.
- Railway Lines, Some Practical Suggestions for the Operation of Long—S. H. Short. Elec Eng, Jan 6—97. 1400 w. M Mar.
- Railway of Ceylon, Great Northern—Ind & East Eng, Dec 5—96. 1400 w.
- Railway, Operation of the Arlberg—Alfred Berg. Zeitschr d Oesterr Ing u Arch Verelines, Dec 18—96. 1200 w.
- Railway Plant, A Model Electric (III)—Sci Am Sup, Nov 14—96. 1400 w.
- Railway Power Distribution in Eastern Massachusetts—St Ry Rev, Feb 15—97. W Feb 27.
- Railway Power-House Transformed, A (III)—West Elec, Nov 14—96. 600 w.
- Railway, Reports on the Modified Routes for the New York Rapid Transit (III)—Eng News, Nov 12—96. 5000 w. M Jan.
- Railway Schemes in Parliament—Engng, Nov 27—96. Serial Part 1. 3000 w.
- Railway Schools—Ry Rev, Dec 12—96. 1600 w.
- Railway Signals—Hollins. Jour Inst Elec Eng, Mar—97.
- Railway Statistics, European—Cas Mag, Jan—97.
- Railway Statistics for 1895, British—Eng News, Dec 17—96. 1000 w.
- Railway Statistics in the United Kingdom—Electn, Lond, Jan 22—97. W Feb 6.
- Railway System of Paris, The Street—M. Lava-lard. St Ry Jour, Jan—97. Serial Part 1. 900 w.
- Railway System of the Island of Java, The—A. Suethlage. Ry Rev, Dec 26—96. 700 w.
- Railway System, The Richmond Tractor Co.'s (III)—Elec Eng, Dec 30—96. 1200 w.
- Railway, The Budapest Subway—J. Kollman. Electn, Lond, Nov 6—96. 1000 w. M Jan.
- Railway, The Central London—C. H. Grinling. R R Gaz, Nov 20—96. 2800 w. M Jan.
- Railway, The Eaton Light (III)—Ry Wld, Dec—96. 1000 w.
- Railway, The Englewood and Chicago Storage Battery (III)—Elec Eng, Dec 2—96. 1700 w.
- Railway, The Great Siberian—Eng, Lond, Nov 6—96. 1800 w.
- Railway, The Hamilton Radial Electric—F. C. Armstrong. Can Eng, Dec—96. 1200 w.
- Railway, The System of the Washington, Alexandria and Mt. Vernon (II)—St Ry Jour, Jan—97. 2800 w.
- Railway, The Trans-Siberian—Eng News, Nov 19—96. M Jan.
- Railway Through the Sea, A (III)—Elec Rev, Lond, Nov 24—96. 1400 w. M Jan.
- Railway to the Derbyshire Coalfields, The New—Trans, Nov 20—96. 4800 w.
- Railway Traffic, Sunday—L. S. Coffin. Ry Rev, Jan 2—97. 1000 w.
- Railway, Under-Tunnelling the District—Arch, Lond, Nov 13—96. 1500 w. M Jan.
- Railway Works, The Northeastern (III)—Eng, Lond, Dec 18—96. 9300 w.
- Railways and Ropes, Inclined Plane—Samuel Diescher. St Ry Jour, Feb—97. 5500 w. M Mar.
- Railways and Tramways of the United Kingdom, The Electric—Electn, Lond, Jan 22—97.
- Railways in the United Kingdom, Electric—St Ry Jour, Jan—97.
- Railways in War: Their Construction, Working Defense, Military—J. A. Ferrier. Ind Engng, Nov 28—96. Serial Part 1. 1800 w.
- Railways, Japanese—C. A. W. Pownall. Ry Age, Dec 11—96. 3700 w.
- Railways, Russian (III)—W. J. McCarroll. Loc Engng, Feb—97. 3000 w. M Mar.
- Railways, Some British Impressions of American Street—Alexander McCallum. St Ry Jour, Jan—97. 2500 w.
- RAY Apparatus, X—Willyoung and Sayen. Elec Eng, Feb 3—97. Elec Rev, Feb 3—97. W Feb 13. Elec Eng, Jan 27—97. W Feb 6.
- Ray Burns, Prevention of X—Elec Eng, Feb 10—97.
- Ray, Dr. Fleming's Lecture on the X—Elec Rev, Jan 27—97.
- Ray Experiments, X—Salomons. Electn, Lond, Jan 22—97. W Feb 6.
- Ray Exposures, Time of X (III)—E. G. Will-young. Elec Rev, Mar 3—97.
- Ray Fluorescence, X—Radignet. Electn, Lond, Feb 5—97.
- Ray Investigations, Formation of Penumbra in X—Sagnac. Electn, Lond, Jan 29—97.
- Ray Literature, Recent Contributions to, X—Electn, Lond, Jan 29—97.
- Ray Myths, X—S. P. Thompson. Electn, Lond, Dec 11—96.
- Ray or Static Discharge, X—Frei. Elec Eng, Feb 3—97. W Feb 13.
- Ray Tubes, Improvements in, X—Osterberg. Elec Eng, Feb 10—97. W Feb 20.
- Rays, Discharge—Hoffmann. Electn, Lond, Feb 12—97. W Feb 27.
- Rays Harmless When Generated with Static Machines, X—Frei. Elec Eng, Dec 23—96.
- Rays, Internal—Oudin and Corda. Electn, Lond, Feb 5—97. W Feb 20.
- Rays, New Kind Black—Elec Anz, Feb 18—97.
- Rays on Hair, Effect of X—Kolle. Elec Eng, Mar 10—97.
- Rays, Physics of X—Houston and Kennelly. Elec Jour, Feb 15—97.
- Rays, Physiological Effects of X—Hawks. Elec Rev, Feb 10—97. W Feb 20.
- Rays, Transparency of Gas to the X—Benoist. L'Electr Elec, Jan 30—97. W Feb 27.
- Rays, Velocity of X—Lussana and Cinelli. Electn, Lond, Dec 11—96.
- Rays, X—Turner. Electn, Lond, Feb 12—97. W Feb 27.
- Rays, X—Van Aubel. Electn, Lond, Dec 11—96.
- Rays, X—W. D. Hering. Pop Sci Mo, Mar—97. W Mar 20.
- REACTIONS in Carbon Cells—Liebenow and Strasser. Zeit f Electrochemie, Feb 20—97. W Mar 13.

Auxiliary Publishers.

Book Publishers.

Job Printers.

Blank Book Manufacturers.

Stereotypers.

**Democrat Printing Company,**

114-124 South Carroll Street,

Madison, Wisconsin.

**If Everybody****Knew** **The Convenience,****The Comfort,****The Safety,****The Pleasure,**

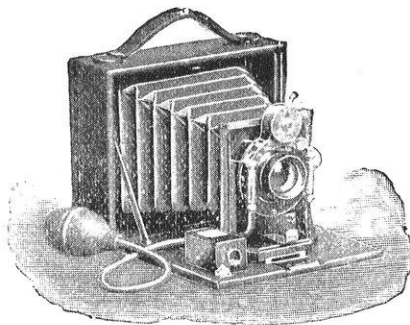
Afforded by a GAS  
STOVE, no home  
would be without one.

**TRY IT.****Madison Gas and Electric Co.,***Please mention Wisconsin Engineer when you write.*

- REAMER, Chattering—Frank Richards. *Am Mach*, Jan 28—97. 1200 w. M Mar.
- RECEIVERSHIP and Foreclosures in 1896—*Ry Age*, Jan 1—97. 800 w.
- REFRIGERATING Plant and Its Costs, Method of Determining the Work Done Daily by a—Francis H. Boyer. *Am Soc Mech Eng*, Dec—96. 1100 w. M Jan.
- Refrigerating Plant of the Slaughter-House in Cologne. Action of—R. Schlottler. *Zeit des Ver Deutscher Ingen*, Oct 10—96. 3500 w. M Jan.
- Refrigeration—Alfred Siebert. *Jour Assn of Engng Soes*, Dec—96. 3000 w. M Mar.
- Refrigeration, Compressed Air—Frank Richards. *Am Mach*, Jan 21—97. 1200 w. M Mar.
- REFUSE Destructor at Leyton (Ill)—*Engng*, Nov 27—96. 1300 w.
- Refuse Destructors and Electric Lighting—F. H. Medhurst. *Elec Rev*, Lond, Dec 11—96.
- REGULATOR for Series Motors—L'Eclair *Elec*, Dec 5—96.
- Regulators, Alternating Current—*Am Electn*, Dec—96. W Jan 2.
- REPAIR Shop Hints—C. B. Fairchild. *St Ry Jour*, Feb—97. 2400 w. M Mar.
- RESERVOIR System of the Mississippi—See Mississippi.
- Reservoirs—*Oesterr Monatschr f Oeffent Baudienst*, Jan—97. 6000 w.
- RESISTANCE. A Method for Measuring—H. Reinhorn. *Am Electn*, Dec—96. 900 w. W Jan 2.
- Resistance, Measurement of Electrolytic—Kohlrausch. *L'Eclair Elec*, Dec 5—96.
- Resistance of the Electric Arc, On the—Julius Frith and Charles Rodgers. *Electn*, Lond, Nov 13—96. 5000 w. M Jan.
- RESONANCE Effects—See Mechanical. Electrical.
- Resonance, Researches with—Heinke. *Elektrotechn Zeit*, Feb 4—97. W Feb 27.
- RETURN, Some Further Notes on Electric Railway—H. S. Newton. *St Ry Rev*, Jan 15—97. 1200 w. M Mar.
- RHEOSTAT—*Elektrotechn Zeit*, Feb 4—97. W Feb 20.
- RICHMOND Railway System—*Elec Eng*, Dec 30—96. *St Ry Jour*, Jan—97.
- RISE in Voltage on Three-Wire Circuits—*Elek Anz*, Feb 21—97. W Mar 27.
- RIVER-Pollution in England—Fire & Water, Jan 23—97. 1300 w. M Mar.
- RIVETED Joints, Tests of—*Jour Am Soc Nav Eng*, Nov—96. 2200 w. M Jan.
- Rivets—See Naval Practice.
- ROAD-Making, Rocks Suitable for—U. S. Shaler. *Stone*, Nov—96. 700 w.
- ROENTGEN Phenomena; Theory and Practice—Elmer G. Willyoung. *Pro Eng Club Phil*, Nov—96. 5500 w.
- Roentgen Radiation, Experiments with—Threlfall and Pollock. *Proc Lond Phys Soc*, Jan—97.
- Roentgen Ray Apparatus—*Elec Rev*, Lond, Nov 20—96. 2300 w. *Jour Fr Inst*, Mar—97.
- Roentgen Ray Apparatus; The Current Interrupter—W. M. Stine. *Elec Eng*, Nov 11—96. 1200 w.
- Roentgen Ray, Evolution of the—*Cornu. Elec Eng*, Mar 3—97.
- Roentgen Ray Lamp, New—*Elec Rev*, Lond, Feb 19—97. W Mar 6.
- Roentgen Ray Observations—Peckham. *Elec Eng*, Feb 24—97. W Mar 6.
- Roentgen Ray on a Jet of Steam, Action of—Richardz. *Phil Mag*, Jan—97.
- Roentgen Ray on Paraffine in Respect to Electric Conductance, Effect of—Lord Kelvin, Drs. Beattie and Smolan. *Elec Rev*, Lond, Jan 15—97.
- Roentgen Ray, Time of Exposure—Willyoung. *Elec Rev*, Mar 3—97.
- Roentgen Ray Tubes, Improvement in—Berlinger. *Elektrotechn Zeit*, Feb 11—97. W Mar 6.
- Roentgen Rays—*Proc Lond Phys Soc*, Dec—96. W Feb 6.
- Roentgen Rays—Sella and Majorana. *L'Eclair Elec*, Jan 2—97.
- Roentgen Rays, Action of, on Vision—Kolle. *Elec Eng*, Mar 3—97.
- Roentgen Rays and Water Vapor—Richardz. *Proc Lond Phys Soc*, Feb—97.
- Roentgen Rays, Curious Skin Burns from—Reid. *Elec Eng*, Lond, Feb 19—97. W Mar 6.
- Roentgen Rays, Discharge by—Perrin. *L'Eclair Elec*, Dec 5—96.
- Roentgen Rays, Electric Discharges and Their Conversion into—Puluj. *Zeit f Elek*, Jan 1—97. W Feb 13.
- Roentgen Rays, Electrification of Air by—Kelvin, Beattie, Smolan. *Science*, Jan 22—97. *Nature*, Dec 31—96. M Mar.
- Roentgen Rays in Chemistry—Hemptonne. *Zeit f Elektrochemie*, Feb 5—97.
- Roentgen Rays, Medicinal Properties of—William G. Caffrey. *Elec Wld*, Jan 9—97. 1000 w. M Mar.
- Roentgen Rays, New Physical Phenomena—*Elec Wld*, Dec 5—96. 1200 w. M Jan.
- Roentgen Streams, Tesla on the (Ill)—*Elec Rev*, Dec 2—96. 4000 w. M Jan.
- Roentgen Tube, Physiological Effects of the—W. M. Stine. *Elec Wld*, Dec 19—97. 900 w.
- ROLLING Mills, American (Ill)—Samuel T. Wellman. *Ir & St Trds Jour*, Nov 28—96. *Serial Part 1*. 2200 w. M Jan.
- Rolling Mills, Four American—Samuel T. Wellman. *Ir Age*, Dec 10—96. 4000 w.
- ROME, Pavements, Confined Rivers and Water Supply of Ancient—F. W. Blackford. *Jour Assn Eng Soc*, Dec—96. 4000 w.
- ROOF Coverings: Slates—Thos. Stirling, Jr. *Brit Arch*, Nov 13—96. 3800 w. M Jan.
- Roof Coverings: Tiles—F. Walker. *Brit Arch*, Nov 13—96. 2000 w. M Jan.
- Roof for the Chicago Coliseum, The Steel Arch (Ill)—*Eng News*, Nov 12—96. 1800 w.
- Roofs, Trussed (Ill)—F. E. Kidder. *Arch & Build*, Dec 12—96. *Serial Part 1*. 2500 w. M Feb.
- ROOFING, Copper, Lead and Zinc as Materials for—G. Ewart. *Arch*, Lond, Nov 13—97. 3000 w. M Jan.
- ROPE Driving Practice, European—P. M. E. Power. *Feb—97*. 1900 w. M Mar.
- Ropes and Rope Driving—G. H. Kenyon. *Mech Wld*, Nov 20—96. *Serial Part 1*. 1800 w. M Jan.
- ROTARY Converters—Berg. *Am Electn*, Feb. W Mar 6.
- Rotary Engine—*Sci Am*, Jan 30—97.
- ROTATION in a Constant Electric Field—Quincke. *Proc Lond Phys Soc*, Feb—97. *Elektrotechn Zeit*, Feb 11—97. *Wied Ann*, p 417.
- RUBBER Goods, The Demand for—M. F. Sesselberg. *Ind Rub Wld*, Dec 10—96. 1200 w. M Jan.
- RUDDER Steering Machine—*Elektrotechn Zeit*, Feb 4—97.
- RUSSIA, Electrical Industry in—Rosstin. *Zeit f Beleucht*, Jan 30—97.
- RUST in Iron and Steel Structures, The Prevention of—*Sci Am*, Dec 26—96. 1100 w.
- ST. HELEN'S Electricity Works (Ill)—*Elec Eng*, Lond, Jan 15—97. 3300 w. M Mar. E Feb 10.
- ST. LOUIS Lighting Contract—*Elec Jour*, Jan 15—97.
- St. Louis Tornado, Wind Pressure in the (Ill)—Julius Baier. *Proc Am Soc Civ Eng*, Jan—97. 21500 w. M Mar.
- SAFE-breaking by Electricity—Rodman. *Elec Eng*, Feb 24—97. W Mar 13.
- SAFES, Electricity for Opening—*Elec Engng*, Jan—97. W Feb 6.
- SAFETY Rules for High Tension Installations—*Elektrotechn Zeit*, Dec 10—96. E Jan 13.
- Safety Stop Attachment for Power-House Engines (Ill)—*Am Mach*, Dec 17—96. 450 w.



# TO ENGINEERS



THE

## Dory Dremo

SIZE OF 4 X 5  
5 X 7 1/8.

Will be found valuable in making reports of the progress of work on a contract. A photograph conveys a more definite idea than the longest written description. ❀❀

Furnished with our New Victor Lens and Shutter.

PRICE \$24.00.

Send Your Address for  
Illustrated Catalogue. ❀

ROCHESTER OPTICAL CO., Rochester, N. Y.

BOARDMAN  
ENGRAVING CO.

ILLUSTRATORS.

106-108 GRAND AVE., MILWAUKEE, WIS.

*Please mention Wisconsin Engineer when you write.*

- Safety Valves (III)—*La Revue Technique*, Jan 10—97. 3000 w. M Mar.
- SAILINGS, Ocean—III Car & Build, Nov 27—96. 1000 w.
- SAND, The Misuse of—H. S. Cooper. *St Ry Rev*, Dec 15—96. 1800 w.
- Sandstones, Minnesota—N. H. Winchell. *Stone*, Dec—96. 2800 w.
- SANGREI Hall, Philadelphia (III)—*Eng Rec*, Jan 9—97. 800 w. M Mar.
- SANITARY Engineering, Progress in—Andrew Noble. *San*, Dec—96. 5000 w.
- Sanitary Plumbing—Albert E. Hyde. *Dom Eng*, Nov—96. 1800 w. M Jan.
- SANITATION Has Done for Life, What—Prof. Brewer. *Safety V*, Nov—96. 1000 w.
- Sanitation of Vessels—*Zeit d Ver Deutscher Ing*, Jan 2, 9, 16—97. 2500 w. M Mar.
- SAN MIGUEL County, Resources of—T. F. Van Wagenen. *Min Ind & Rev*, Dec 31—96. 1800 w.
- SANTA FE, The Fondroyant and the (III)—*Sci Am Supp*, Dec 19—96. 1200 w.
- SCAVENGING with Special Reference to Rural Districts—George Mackay. *San Rec*, Nov 6—96. 3500 w.
- SCHOOL House in Zurich, New Secondary (III)—*Schw Bauz*, Dec 12—96. 800 w.
- SCIENCE, Practice with—Mr. Henry McLaren. *Engng*, Nov 27—96. 6900 w. M Jan.
- SCREWS and Screw-Making—L. A. Murray. *Sib Jour Engng*, Nov—96. 3000 w.
- SEA, Unification of Time at—*Trans*, Dec 25—96. 2500 w.
- SEARCH Lights—*Elec Eng*, Feb 24—97.
- SECHOMMETER as Used in the Electrical Engineering Laboratory, The—W. H. Freedman. *Sch of Mines Quar*, Nov—96. 1800 w.
- Secohmmeter in Measuring Co-efficients of Self-induction—Colard. *L'Eclair Elec*, Feb 20—97. W Mar 20.
- SELF-INDUCTION Standards—Wien. *L'Eclair Elec*, Feb 6—97. W Feb 27.
- SELENIUM—Majorana. *Proc Lond Phys Soc*, Dec—96.
- SENEGAL—Niger Railway—*La Revue Technique*, Jan 10—97. 5000 w. M Mar.
- SEPARATING Metals by Means of Soluble Anode—Pauli. *Elektrochem Zeit*, Jan—97.
- SEPARATOR, The Steam—*Bos Jour of Com*, Feb 6—97. 1200 w. M Mar.
- SEWAGE and Waters, Methods for the Quantitative Determination of Bacteria in—G. W. Fuller and W. R. Copeland. *Eng Rec*, Dec 26—96. 4000 w.
- Sewage by Chemicals in Perfect Solution, The Treatment of—Herbert Henry Law. *San Plumb*, Dec 1—96. 1000 w.
- Sewage by Filtration, The Purification of—Henry Law. *San Rec*, Nov 20—96. 1800 w. M Jan.
- Sewage Disposal by Chemical Precipitation at Hamilton, Ont.—*Eng News*, Jan 28—97. 900 w.
- Sewage Disposal Scheme, Manchester—*Eng*, Lond, Dec 4—96. 2000 w.
- Sewage Disposal Works, Hamilton (III)—*Can Eng*, Jan—97. 1500 w. M Mar.
- Sewage Irrigation in Europe and America—H. Alfred Roehling. *San Rec*, Dec 4—96. Serial Part 1. 1800 w.
- Sewage Lift, Some Applications of an English (III)—*Eng Rec*, Feb 6—97. 800 w.
- Sewage of Paris, Progress Made in the Purification of the—J. F. Flagg. *Eng Rec*, Dec 5—96. 5000 w. M Jan.
- Sewage, The Ultimate Purification of—George Thudichum. *San Rec*, Dec 18—96. Serial Part 1.
- Sewage Treatment, An Experiment in—*San Rec*, Dec 11—96. 1100 w.
- SEWER Gas and Its Disposal—Paul Plimton. *San Plumb*, Feb 1—97. 1100 w.
- Sewer Gas; Its Danger to Health—Dr. Joseph Priestly. *San Rec*, Jan 8—97. 1800 w.
- SHAFTING Tables—Hans Birkholz. *Power*, Feb—97. 1000 w. M Mar.
- SHAFTS, Crank—George P. Starkweather. *Jour Fr Inst*, Feb—97. 1500 w. M Mar.
- Shafts, A New Formula and Diagram for Combined Stresses in—A. L. Hopkins. *Am Mach*, Dec 31—96. 2000 w.
- Shaft for Winding, Adaptation of an Air—M. Prospect Vanhassel. *Col Guard*, Nov 27—96. 4300 w. M Jan.
- Shafts, On Crank—John H. Macalpine. *Jour Am Soc Nav Eng*, Nov—96. Serial Part 1. 16000 w. M Jan.
- Shaft Sinking at the Royal Brown Coal Pit Near Loderburg, Germany—*Col Guard*, Nov 17—96. 1200 w. M Jan.
- Shafts Subject to Bending and Twisting, A Diagram for Determining Diameters of Solid Round—Henry Hess. *Am Mach*, Dec 10—96. 1000 w.
- SHALES of New South Wales, The Bituminous (III)—*Aust Min Stand*, Oct 1—96. 2000 w. M Jan.
- SHIPBUILDING (III)—G. C. Mackrow. *III Car & Build*, Nov 27—96. 4200 w.
- Shipbuilding and Marine Engineering in 1896—*Engng*, Jan 1—97. Serial Part 1. 5500 w. M Mar.
- Shipbuilding on the Clyde—Francis S. North. *Yale Sci M*, Nov—96. 1800 w.
- Shipbuilding, Progress and Promise in American (III)—Lewis Nixon. *Eng Mag*, Jan—97. 4200 w.
- Shipbuilding, Recent Advances in—*Ir & Coal Trds Rev*, Jan 29—97. 1700 w. M Mar.
- SHIPS, Resistance of—J. R. Oldham. *Am Ship*, Feb 4—97. Serial Part 1. 1100 w.
- Ships, The Computation of the Resistance of—Prof. Th. Maryniak. *Zeitschr d Oesterr Ing u Arch Vereines*, Dec 4—96. 1200 w.
- Ships, The Stability of—James Reid. *Eng*, Lond, Nov 20—96. 2400 w. M Jan.
- SHIP Management, Six Examples of Successful—Henry Roland. *Am Mach*, Nov 12—96. 2600 w. M Jan. *Eng Mag*, Feb—97.
- Shops, Piece Work in Repair—C. F. Nebelacker. *St. Ry Jour Dec*—96. 3000 w. M Jan.
- SHUNTS for Alternating Arc Lamps—*Am Electn*, Dec—96. W Jan 2.
- SHRUBBERIES, The Planting of—*Gar & For*, Jan 6—97. 1200 w.
- SIDEWALK, Movable—*La Revue Technique*, Jan 10—97. 2000 w.
- SIEMENS and Halske Electric Company of America (III)—*Elec Wld*, Nov 14—96. Serial Part 1. 1600 w.
- SIGNALLING, Boulton's System of Railway—*Prac Eng*, Dec 4—96. 5000 w.
- Signalling, Block—Boulton. *Elec Rev*, Lond, Jan 29—97.
- Signalling, A Semaphore for Permissive Block (III)—*R R Gaz*, Dec 11—96. 900 w.
- Signalling Arrangements at Liverpool Street Station (III)—*Engng*, Dec 4—96. 7000 w.
- Signalling Railway Block—Pigg. *Elec Eng*, Lond, Dec 11—96.
- Signalling, Recent Practice in Railroad (III)—G. W. Blodgett. *Jour Assn Engng Soc*, Dec—96. 6000 w.
- Signalling System at Toronto, Grand Trunk—*Can Eng*, Dec—96. 700 w.
- Signalling System of the Broadway and Seventh Avenue Railroad (III)—*Sci Am*, Jan 2—97. 900 w.
- SIGNALS, Railway—Hollins. *Elec Eng*, Lond, Jan 29—97. *Elec Rev*, Lond, Feb 5—97. *Electn*, Lond, Feb 12—97.
- Signals—See Switch.
- SILICATES, Formation of—Mayencon. *Elek Anz*, Dec 3—96. W Jan 2.
- SILVER Lead Mines of New South Wales (III)—*Aust Min Stand*, Sept—96. 2500 w.
- Silver Mines at Joachimstahl, Bohemia—R. Helmhaecker. *Eng & Min Jour*, Dec 5—96. 3000 w.
- Silver—See Gold.
- SIMPLEX Conduit System—*Elec Eng*, Lond. *Elec Rev*, Mar 12—97. W Mar 27.

JOHN NADER, ❁ ❁ ❁ ❁  
**Architect and  
 Civil Engineer.**

Plans, etc., for all kinds of public and private  
 buildings.

14 East Mifflin Street,  
 Madison, Wis.

Al'an D. Conover.

Lew F. Porter.

Conover & Porter,  
**ARCHITECTS.**

Plan and Superintend construction of Heavy  
 Buildings, Bridges and Roofs. Special atten-  
 tion to Educational Buildings, and to  
 designing Heating and Ventilating  
 Plants.

Rooms 23-27, Brown Block,  
 Madison, Wis.

**C. M. CONRADSON, M. E.,**  
 Consulting Engineer.

Machine Tools,  
 Electrical Transmissions.  
 Electric Motors.

Madison, - Wis.

**The Robert W. Hunt & Co.,**

◦ ◦ ◦ ◦

**Bureau of Inspection,  
 Tests and Consultation.**

NO. 80 BROADWAY, NEW YORK.  
 1137 THE ROOKERY, CHICAGO.  
 PARK BUILDING, PITTSBURGH

INSPECTION OF..

❁ Steel Rails, Splice Bars,  
 Railroad Cars, Wheels,  
 Axles, Etc. ❁ ❁ ❁ ❁

**CHEMICAL LABORATORY.**

Analysis of Ores, Iron, Steel, Oils, Water, Etc.

**PHYSICAL LABORATORY.**

Test of Metals, Drop and Pulling Test of  
 Couplers, Draw Bars, etc.

❁ Efficiency Tests of Boilers, ❁  
 Engines and Locomotives. ❁

**VAN VELZER &  
 SLICHTER'S**

University Algebra, 732 p. \$2.00  
 School Algebra, - 1.00  
 Four Place Logarithmic Table .30

**VAN VELZER &  
 SHUTT'S**

Plane and Solid  
 Suggestive Geometry \$1.25  
 Plane Suggestive Geometry .75  
 Solid Suggestive Geometry .75

**TRACY, GIBBS & CO.,**  
 Publishers.  
 Madison, Wis.

- SINE Curves—See Alternating Current.
- SIPHONS, Automatic Air Relief Device for—Rudolph Muller, *Oesterr Monatschr f d Oeff Bau*, Dec—96. 6000 w.
- SKY-SCRAPERS, Dangers of the—Arch & Build, Dec 12—96. 1600 w.
- SLAG, The Manufacture and Use of Thomas—F. E. Thompson, *Ir Age*, Jan 7—97. 4200 w.
- SLEEPERS, Steel—Eng, Lond, Dec 25—96. 2200 w.
- SLIDE Rule as an Aid to Railroad Field Work, The—George Duncan Snyder, *R R Gaz*, Jan 22—97. Serial Part 1. 2200 w. M Mar.
- Slide-Valves for Locomotives, Balanced—Eng, Lond, Jan 22—97. 1100 w.
- SNOWPLOWS, Hydraulic Attachment for Raising Rotary (III)—*Ry Rev*, Nov 21—96. 700 w.
- SPARKS in Magnetic Field, Electric—Mastricchi, *Proc Lond Phys Soc*, Dec—96. W Feb 13.
- Sparks, Zig-zag Forms of Long—Mouckman, *Electn*, Lond, Jan 29—97. W Feb 13.
- SPECIFIC Heat of the Metals, The—F. A. Waterman, *Phys Rev*, Nov, Dec—96. 5500 w.
- SPECIFICATIONS—Builder, Jan 2—97. 2000 w. M Mar.
- SPECTRUM of Reflection, Study in the—Dr. W. H. Birchmore, *Elec Eng*, Nov 11—96. 1300 w. M Jan.
- SPEED Control for Electric Motors—Blood, *Elec Eng*, Feb 3—97.
- Speed, High vs. Low—*Elec Rev*, Lond, Mar 5—97. W Mar 20.
- Speed Indicator, Electrical (III)—*Am Mach*, Dec 10—96. 600 w.
- Speedway, New York City, The Harlem River (III)—*Sci Am*, Feb 6—97. Serial Part 1. 3000 w. M Mar.
- STABLES, Ventilating and Warming—Heat & Ven, Dec 15—97. 1800 w.
- STACKS, A Story of—Robert Kuntzman, *St Ry Rev*, Jan 15—97. Serial Part 1. 2500 w. M Mar.
- STAMP Mill Practices, Certain—James P. Abbott, *Min & Sci Pr*, Jan 2—97. 1400 w.
- Stamp with Amalgamation, The Use of the Tremain Steam—Edwin A. Sperry, *Trans Am Inst of Min Eng*, Dec—96. 2400 w.
- STAMPINGS, Cycle (III)—Hugh Dolnar, *Am Mach*, Dec 17—96. 2800 w.
- STANDARD for Rating Railway Apparatus, On the Adoption of a Universal—William Baxter, Jr., *Elec Wld*, Nov 21—96. 2200 w.
- Standards into Use, How to Bring the M. C. B.—*R R Gaz*, Dec 18—96. 1700 w.
- STAND-PIPE Incident at Atlantic City, N. J., An Overlooked—*Eng News*, Nov 12—96. 1400 w. M Jan.
- STATIC Charge on the Surface Tension of Water, Effect of—*Phys Rev*, Mar—97. Apr—97. W Mar 20.
- STATISTICS of Theoretical and Applied Structures—O. F. Semsch, *Am Arch*, Dec 5—96. 2000 w. M Jan.
- STATION at Boston, The New Union—*R R Gaz*, Jan 1—97. Serial Part 1. 2400 w.
- Station of the Canadian Pacific Railway at Montreal, New Terminal—*Eng News*, Dec 31—96. 500 w.
- Stations on Tramways, Fixed Stopping—C. Challenger, *Ry Wld*, Dec—96. 1700 w.
- STATUARY, The Founding of (III)—Horace G. Belcher, *Foundry*, Dec—96. 3400 w.
- STEAM and the Steam Engine, Some Common Fallacies with Regard to—*Ind & Ir*, Nov 27—96. 1500 w. M Jan.
- Steam, Cooking by (III)—*La Revue Technique*, Jan 10—97. 2500 w. M Mar.
- Steam Economics—W. H. Booth, *Mach*, Dec—96. 1800 w.
- Steam Engineering of Today and Tomorrow—R. H. Thurston, *Elec Eng*, Jan 6—97. 2800 w.
- Steam Heating Plants, Defective—W. H. Wake-man, *Mach*, Feb—97. 1500 w. M Mar.
- Steam in a 500 Indicated Horse Power Sulzer Compound Engine, Experiments with Superheated and Saturated—B. Donkin, *Eng, Lond*, Dec 11—96. 1600 w.
- Steam Making Capacity of Firebox and Tube Surface, Relative (III)—*R R Gaz*, Dec 4—96. 2700 w. M Jan.
- Steam-Making from Shovel to Stop-Valve, Practical Theory of—Winthrop Thayer, *Lords Mag*, Lond, Nov—96. 2300 w. M Jan.
- Steam, Methods of Determining the Dryness of Saturated—Osborn Reynolds, *Prac Eng*, Nov 13—96. 500 w. M Jan.
- Steam Plant, Boston Public Library—A. J. Guernsey, *Safety V*, Jan—97. 2200 w. M Mar.
- Steam Plants, Management of—M. W. Danielson, *Age of St*, Dec 19—96. 1400 w.
- Steam Pressure, The Promise and Potency of High—R. H. Thurston, *Ind & Ir*, Jan 8—97. Serial Part 1. 3000 w. M Mar.
- Steamship Passages—III *Car & Build*, Nov 27—96. 2000 w.
- Steam, Superheated—W. E. Burgess, *Elec Engng*, Nov—96. Serial Part 1. M Jan. 3000 w.
- Steam, The Potential of—Howard Pentland, *Mech Wld*, Dec 11—96. Serial Part 1. 1700 w.
- STEEL and Coal Industries in 1895, The Swedish Iron—*Eng, Lond*, Dec 25—96. 1400 w.
- Steel Castings, Moulding and Gating—George O. Vair, *Am Mach*, Jan 14—97. 1000 w. M Mar.
- Steel Construction and of Plate Glass on the Development of Modern Style, The Influence of—D. Adler, *Arch & Build*, Nov 21, 28—96. M Jan.
- Steel, Fluid Compression of—K. Landis, *Am Mfr & Ir Wld*, Nov 20—96. 1800 w. M Jan.
- Steel in America and the Relations of the Engineer to It, The Progress in the Manufacture of Iron and—John Fritz, *Am Eng & R R Jour*, Jan—97. 2500 w.
- Steel in Metallurgy, Mechanics and Armor Nickel—H. W. Raymond, *Eng Mag*, Feb—97.
- Steel Making in Japan, Experiments in—*Engng*, Jan 8—97. 1800 w. M Mar.
- Steel-Making Process, The Bertrand-Thiel—Percy C. Gilchrist, *Iron & Coal Trds Rev*, Dec 18—96. 2300 w.
- Steel Making, Twelve Months' Progress in Open Hearth—Bernard Dawson, *Ir & Coal Trds Rev*, Jan 29—97. 2600 w.
- Steel, Nickel—H. K. Landis, *Sci Am*, Jan 9—97. 1800 w.
- Steel Plates, American and English Methods of Manufacturing (III)—Jeremiah Head, *Ir Age*, Dec 24—96. 8000 w.
- Steel, Residual Stresses in—H. K. Landis, *Am Mfr & Ir Wld*, Dec 25—96. 1500 w.
- Steel Skeleton Construction—*Col Guard*, Dec 24—96. 1300 w.
- Steel, Some Open Questions Concerning Structural (III)—*Pro of Eng Club of Phila*, Jan—97. 15000 w. M Mar.
- Steel Specifications, First Principles of—H. K. Landis, *Am Mfr & Ir Wld*, Jan 1—97. 1400 w.
- Steel, The Testing of Iron and—*R R Gaz*, Dec 25—96. 1900 w.
- Steel Trades in 1896, The Iron and—*Ir & Coal Trds Rev*, Dec 24—96. 3000 w.
- Steel—See Flow, Engine Construction.
- STEERING Telegraph, Fiske's Helm Indicator and (III)—*Engng*, Dec 4—97. 1400 w.
- STEINAMANGER with 12,000 Volts Direct Current, Installation at—*Elek Anz*, Feb 21—97. E Mar 31.
- STONE Produced in 1894 and 1895, Value of Different Kinds of—William C. Day, *Stone*, Dec—96. Serial Part 1. 1100 w.
- STOKING, The Advantages of Mechanical—A. E. Outerbridge, Jr., *M Feb*—97. 3500 w. M Mar.
- STORAGE Battery and Engineering Practice—Appelton, *Elec Eng*, Mar 17—97.



# ELECTRICAL SUPPLIES

We Test Them, We Buy Them--Then we Sell Them.

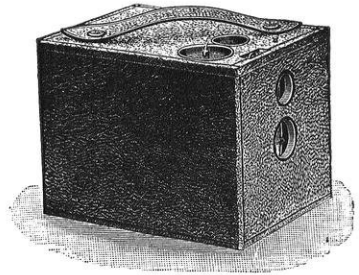
We know they are good before we offer them to you.  
You take no risk in sending your order to us.

## Everything Electrical for the

Central Lighting Station.	Central Telephone Station.	Railway Power House and Line.	Isolated Plants and Private Lines.	Laboratory, School, Fire and Police Alarm.
---------------------------------	----------------------------------	-------------------------------------	--	--

**PEOPLE'S ELECTRIC COMPANY,**  
THE SUPPLY HOUSE OF THE NORTHWEST,  
MADISON. - - - - WIS.

## PHOTOGRAPHIC SIMPLICITY...



It's a simple thing to take pictures with our Cartridge system cameras—that's why the Pocket Kodak is known as the photographic success of the decade. In the hands of the absolute novice, it produces a larger percentage of perfect pictures than any camera, big or little, has ever produced before.

**THE 1896 BULLET** reproduces the Pocket Kodak features in a camera of large size and greater capabilities, yet retains the Pocket Kodak simplicity. It uses either Film cartridges or glass plates, has a fixed focus achromatic lens of great depth, is carefully made in every detail, is covered with fine grain leather and beautifully finished. In short, is up to our high standard of excellence—the standard that made the Kodak famous.

**IMPROVED ROTARY SHUTTER,  
SET OF THREE STOPS,**

**SQUARE FINDER,  
SOCKET FOR TRIPOD SCREW.**

When used with film has a capacity of 18 exposures 3½ x 3½ inches and can be  
**RELOADED IN DAYLIGHT.**

Price, Improved No. 2 Bullet, for pictures 3½ x 3½ inches . . . . .	\$10.00
Improved No. 4 Bullet, for pictures 4 x 5 inches . . . . .	15.00

BOOKLET FREE.

**EASTMAN KODAK CO., Rochester, N. Y.**

Please mention Wisconsin Engineer when you write.

- Storage Battery Compartments, Lining for—*Elec Eng*, Jan 6—97. 1000 w. M Mar.
- Storage Battery for Telephony—Gardanier. *Teleg Age*, Feb 16—97. W Feb 27.
- Storage Battery Station. Bowling Green—*Elec Eng*, Mar 10—97. W Mar 20.
- Storage Battery, The Electric—R. H. Klander. *Pro Eng Club Phila*, Nov—96. 10000 w. M Jan.
- Storage Battery to Electric Traction, Application of the—Hewitt. *Proc Eng Club Phila*, Jan—97. W Feb 13.
- Storage Battery—See Railway.
- Storage Batteries in Railway Work, The Use of—William Baxter, Jr. *W Jan* 9—97. Serial 1st Part. 2800 w. M Mar.
- STREET Architecture—H. H. Statham. *Arch*, Lond, Dec 11—96. 6000 w.
- Street Cleaning to Good Paving, Relations of—George E. Waring, Jr. *Eng Mag*, Feb—97. 2200 w. M Mar.
- Street Improvements, Methods of Paying for—C. C. Brown. *Munic Engng*, Feb—97. 2000 w.
- Street Rail and Its Relation to Pavements, The Modern—J. W. Howard. *Munic Engng*, Feb—97. 2000 w.
- Street Railway System of Geneva, Switzerland (III)—*St Ry Jour*, Feb—97. 800 w. M Mar.
- Street Railway System of Paris—Lavalard. *St Ry Jour*, Jan—97.
- Street Railways, British Impressions of American—*St Ry Jour*, Jan—97.
- Street Railways of Syracuse (III)—*St Ry Jour*, Mar—97.
- Street Traction in France—*Sci Am Sup*, Feb 6—97. 1300 w. M Mar.
- STRIKE, The Leadville—*Min Ind & Rev*, Nov 26—96. 1300 w.
- Strikes and Lock-Outs of 1895, The—Mr. Burnett. *Col Guard*, Nov 20—96. 1500 w.
- SUBMARINE Earthquakes—Milne. *Elec Rev*, Lond, Feb 19—97. W Mar 6.
- Submarine Telegraphy—Mance. *Ind Rub Wld*, Mar 10—97.
- Submarine Telegraphy, Sixty Years of—Ayerton. *Electn*, Lond, Feb 19—97. W Mar 6.
- Submarine—See Boat.
- SUCTION Pipes to the Handling of Grain at Millwall Docks, England, The Application of (III)—*Eng News*, Nov 19—96. 2400 w. M Jan.
- SUBSIDIES, Foreign Shipping—*Engng*, Nov 13—96. 1200 w.
- SUBWAY and Cable Traction, The Glasgow (III)—*Engng*, Nov 6—96. Serial Part 1. 4000 w. M Jan.
- Subway, Progress of the Boston (III)—*Eng News*, Feb 4—97. 2800 w. M Mar.
- Subway System of Baltimore, The—*Eng News*, Jan 28—97. 1200 w. M Mar.
- Subway, The Glasgow District—*Eng*, Lond, Dec 4—96. *Ry Wld*, Jan—97.
- Subway Work, Progress of Electrical—Wm. Maver, Jr. *Elec Wld*, Jan 30—97.
- Subways in Brooklyn, Electric—*St Ry Jour*, Jan—97.
- SUGAR Juices, Electrical Purification of—*Electn*, Lond, Feb 19—97.
- Sugar, Purification of—*Zeit f Elek*, Jan 20—97.
- SULPHITE Ores, Treatment of Broken Hill—F. J. Greenaway. *Aust Min Stand*, Sept—96. 1700 w.
- SULPHUR in Cast Iron, The Determination of—Francis C. Phillips. *Jour Am Chem Soc*, Dec—96. 2200 w.
- Sulphur in Iron—S. S. Knight. *Foundry*, Jan—97. 1200 w.
- Sulphur in Metallurgical Products, Estimation of—L. Compredon. *Col Guard*, Nov 20—96. Serial Part 1. 2100 w. M Jan.
- Sulphur from Brimstone Ore, The Extraction of—Edward F. White. *Eng & Min Jour*, Dec 5—96. 1000 w. M Jan.
- SUPERHEATING—Michael Longridge. *Eng Gaz*, Nov—96. 2500 w.
- SUPPLY and Demand, The Modern Version of the Law of—R. H. Thurston. *Science*, Dec 4—96. 800 w.
- SURFACE Contact System—*L'Eclair Elec*, Feb 27—97. *West Electn*, Mar 13—97.
- SURVEYING Mineral Lands and Gold and Silver Mines, General Practice in (III)—August Mathez. *Col Eng*, Nov—96. Serial Part 1. 2300 w. M Jan.
- SURVEYS, Topographical—J. L. Van Ornum. *Bul of Univ of Wis*, Vol I, No 10. 10700 w. M Mar.
- SUSPENSION, On a Delicate Method of—Frank A. Laws. *Elec Wld*, Jan 16—97. 700 w. M Mar.
- SWITCH and Signal System, The Thomas Pneumatic (III)—*Loc Engng*, Jan—97. 1400 w.
- Switch for Central Station Calls, Automatic—J. H. West. *Elektrotech Zeit*, Nov 26—96. E Jan 6.
- Switches for Electric Railways, Stationary—*Zeit f Elektrotech*, Jan 15—97. 3000 w. M Mar.
- SWITCHBOARD, Alternating-Current—Andrews. *Elec Eng*, Lond, Jan 29—97. W Feb 20.
- Switchboards, Maximum Capacity of Telephone—Pierard. *L'Eclair*, Jan 23—97. W Feb 20.
- SWITCHING Locomotives—Mullin. *Cassiers Mag*, Feb—97.
- SWITZERLAND, Installations in—Blondin. *L'Eclair Elec*, Dec 19—96.
- "SWORDFISH" and "Spitfire," The Engines of H. M. S. S.—*Engng*, Jan 15—97. 1600 w. M Mar.
- SYNCHRONOUS Motor for Determining the Frequency—Molar. *Phys Rev*, Mar—97. W Mar 20.
- SYPHON at Newton, Mass., Worcester Street (III)—H. D. Woods. *Eng Rec*, Jan 2—97. 800 w.
- Syphon Recorder—Kelvin System. *L'Eclair Elec*, Jan 16—97.
- TAPS, "Limit" (III)—Horace Arnold. *Am Mach*, Nov 26—96. 2500 w. M Jan.
- TARIFF Changes and Customs Regulations—*Bd of Tr Jour*, Nov—96. 7000 w. M Jan.
- TECHNICAL Methods, Germanisms and Americanisms in—*Deutsche Zeit f Elektrotechnik*, Oct 15—96. 1400 w.
- TELEGRAPH-Cable Companies, Proposed Consolidation of the Commercial Cable and Postal—*West Elec*, Dec 12—97. 1000 w.
- Telegraph Line from Bisbee to San Bernardino, Arizona, Military—W. A. Glassford. *Elec Eng*, Dec 30—96. 2000 w.
- Telegraph Lines, Length of—*Elec Tech*, Jan 31—97.
- Telegraph, Marconis' New—*McClures Mag*, Mar—97.
- Telegraph Printing—*Zeit f Elek*, Jan 15—97.
- Telegraph Statistics—*Elec Eng*, Lond, Dec 11—96. W Jan 2.
- Telegraph System of Brazilian Government—*Elec Rev*, Lond, Feb 26—97.
- Telegraph-Telephone, The Müller-Wilke Duplex—*Deutsche Zeit f Elektrotechn*, Jan—97. 2500 w. M Mar.
- Telegraphing Without Wires—H. J. W. Dam. *McClure's Mag*, Mar—97.
- Telegraphs, International—*Electn*, Lond, Jan 15—97. 3000 w. M Mar.
- Telegraphs, Postal (III)—*Elec*, Lond, Dec 4—96. 1100 w.
- Telegraphs with the Chitral Relief Force in 1895, Field—Dempster. *Jour Inst Elec Eng*, Jan—97.
- TELEGRAPHY and Telephony, Cailho's System of Simultaneous (III)—*Elec Eng*, Dec 2—96. 800 w.
- Telegraphy, Auxiliary (III)—Dr. I. Kitsee. *Jour Fr Inst*, Jan—97. 1800 w.
- Telegraphy, Fifteen Years of—William Maver, Jr. *Elec Eng*, Jan 6—97. 3000 w. M Mar.
- Telegraphy, Progress in American—F. W. Jones. *Elec Wld*, Jan 2—97. 2500 w.
- Telegraphy, Submarine—*Electn*, Lond, Jan 15—97. Serial Part 1. 7500 w. M Mar.

## PARAGON DRAWING INSTRUMENTS.

Superior to all others in CONSTRUCTION, FINISH, MATERIAL, DURABILITY,  
and everything else which goes to make up QUALITY.

Each Instrument Stamped "PARAGON."

They are the **American Pattern** of instruments, made of rolled German Silver (no hardened castings) and hand-forged English steel.

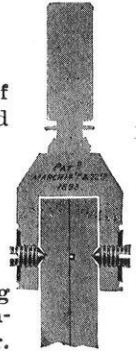
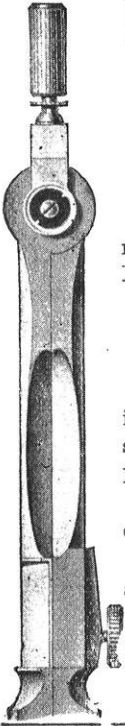
### Esser's Patent Pivot Joint

is far superior to the old-style pivot joint. No projecting screws to break off, no exposed threads to collect dirt, no impinging of the end of one screw against the thread of another.

We warrant our Paragon Instruments to last a life-time under proper care and to permanently retain their perfect action.

We make and carry the most complete assortment of **Drawing Materials and Surveying Instruments** in America.

Chicago Branch: **KEUFFEL & ESSER CO.,**  
111 Madison Street. **NEW YORK.**



## BUFF & BERGER,

✻ ✻ IMPROVED ✻ ✻

## ENGINEERING AND SURVEYING INSTRUMENTS.

No. 8 Providence Court, Boston, Mass.

They aim to secure in their Instruments: *Accuracy of division; Simplicity in manipulation; Lightness combined with strength; Achromatic telescope, with high power; Steadiness of Adjustments under varying temperatures; stiffness to avoid any tremor, even in a strong wind, and thorough workmanship in every part.*

Their instruments are in general use by the U. S. Government Engineers, Geologists, and Surveyors, and the range of instruments, as made by them for River, Harbor, City, Bridge, Tunnel, Railroad and Mining Engineering, as well as those made for Triangular or Topographical Work and Land Surveying, etc., is larger than that of any other firm in the country.

Illustrated Manual and Catalogue sent on application.

Watch the

# College Book Store

For Bargains in Books this Fall.

*Please mention Wisconsin Engineer when you write.*

- Telegraphy, Submarine—From *La Nature*, *Sci Am Sup*, Jan 9—97. 1400 w.
- TELEPHONE—L'Eclair Elec, Jan 9—97. W Feb 6.
- Telephone Cable, Submarine—Beylinski. L'Eclair Elec, Jan 2, 9—97. W Feb 6.
- Telephone Cable, Submarine—Mance. *Electn*, Lond; *Elec Rev*, Lond; *Elec Eng*, Lond; Jan 22—97.
- Telephone Charges—*Elektrotechn Zeit*, Feb 11—97. W Feb 27.
- Telephone Charges, The Basis of—Fred DeLand. *Elec Engng*, Dec—96. 900 w.
- Telephone Companies—*Elec Engng*, Mar—97.
- Telephone Competition—DeLand. *Elec Engng*, Jan—97.
- Telephone Conduits and Subways—Dr. V. Wietlisbach. *Elec Engng*, Nov—96. 7000 w.
- Telephone Election Returns, Casual Notes on the Use of—George Heli Guy. *Elec Eng*, Nov 25—96. 1400 w.
- Telephone Exchange at Larchmont, New Southern Bell (Ill)—*Elec Eng*, Jan 13—97. 500 w. M Mar.
- Telephone Eyes, Through—*Elec Rev*, Dec 16—96. 1300 w.
- Telephone, Inventor of the—L'Elec, Feb 20—97.
- Telephone Line, Trunk—*Elec Rev*, Lond, Dec 11—96.
- Telephone Lines, Disturbances in—Muench and Pierard. L'Eclair Elec, Feb 20—97.
- Telephone, Party Line—*Elec Eng*, Jan 27—97.
- Telephone Patent, Watson—*Elec Jour*, Mar 1—97.
- Telephone Plant, Modern—De Land. *Elec Engng*, Mar—97.
- Telephone Practice in America—Miller. *Am Electn*, Feb—97. W Mar 6.
- Telephone Rates in Germany Feasible? Is the Reduction of—*Elektrotechn Zeit*, Feb 11—97. E Mar 21.
- Telephone Receiver, The—Miller. *Am Electn*, Dec—96. W Jan 2.
- Telephone Relays—*Elec Rev*, Lond, Dec 11—96.
- Telephone Repeaters and Relays and Operating Systems—Thos. D. Lockwood. *Elec Wld*, Nov 14. Serial Part 1. 5500 w. M Jan.
- Telephone Service Without a Calling Battery at Subscriber's End—Ritter. *Elektrotechn Zeit*, Feb 18—97. W Mar 6.
- Telephone Situation, The—Jones. *Elec Rev*, Feb 17—97, Feb 24—97. W Mar 6.
- Telephone Situation, The Interests of the Public in the—F. W. Dunbar. *Elec Wld*, Jan 2—97. 2300 w.
- Telephone Statistics for the Year 1894, European—Franz J. Dommerque. *Elec Engng*, Dec—96. 350 w.
- Telephone System, Domestic—Pierard. L'Elec, Feb 27—97.
- Telephone Systems, Recent Improvements in Party Line—*Elec Eng*, Jan 27—97. 1000 w. M Mar.
- Telephone System, The Richmond (Ill)—W Jan 16—97. 2300 w. M Mar.
- Telephone Toll Lines—De Land. *Elec Engng*, Mar—97.
- Telephone, The Present Development of the Long-Distance—J. H. West. *Elektrotechn Zeit*, Feb 4—97. E Mar 31.
- Telephone Trunk Line System of Great Britain, The—Garvey. *Elec Eng*, Lond, Nov 13—96. Serial Part 1. 2500 w. *Jour Inst Elec Eng*, Jan—97.
- Telephone Trunk Lines—Pierard. *Elec Rev*, Lond, Feb 12—97. W Feb 27.
- Telephone Wire, The Use of a Midair, with Kites—Wm. A. Eddy. *Elec Eng*, June 6—97. 1200 w. M Mar.
- Telephone Wires in Indianapolis, Underground (Ill)—*Elec Eng*, Nov 11—96. 700 w.
- Telephones, Automatic Call for—L'Eclair Elec, Jan 23—97.
- TELEPHONING and Telegraphy with a Kite Wire—William A. Eddy. *Elec Rev*, Dec 30—96. 550 w.
- Telephoning in Germany—*Engng*, Jan 22—97. E Feb 24.
- TELEPHONY—Weitlisbach. *Elec Engng*, Jan —97. 3000 w. M Mar.
- Telephony, Development of—West. *Elektrotechn Zeit*, Feb 4—97. W Feb 27. Fe. —97. W Mar 6.
- Telephony in Stockholm—West *Electn*, Mar 6—97.
- TEMPERATURE Research, Low—*Elektrotechn Zeit*, Jan 28—97. W Feb 20.
- Temperature, The Measurement of—G. M. Clark. *Electn*, Lond, Dec 4—96. Serial Part 1. 3000 w.
- TERMINAL Station at Boston, The New Southern—*Eng News*, Jan 14—97. 3000 w.
- TERRACOTTA (Ill)—William F. Jelke. *Yale Sci M*, Dec—96. 1900 w.
- "TERRIBLE," H. M. S.—*Eng*, Lond, Jan 15—97. 3200 w. M Mar.
- TESLA Apparatus—Svilokossitch. L'Elec, Jan 2—97.
- Tesla on Electricity—*Elec Rev*, Jan 27—97. 6000 w.
- TEST Bar and Standard Systems for Comparative Tests, Utility of the—*Ir Tr Rev*, Dec 10—96. 2000 w.
- Test, see Power Station.
- TESTING Laboratory, The C. B. & O. (Ill)—*Ry Mas Mech*, Feb—97. 2000 w. M Mar.
- Testing of Iron and Steel, Standardizing the—P. Kreuzpointner. *Eng Mag*, Feb—97.
- Testing Set—*Electn*, Lond, Jan 29—97.
- TEXAS, Secretary Herbert's Report on the—*Sci Am*, Dec 26—96. 1500 w.
- THAMES, Deepening the—*Arch*, Lond, Nov 6—96. 1200 w. M Jan.
- THERMO-ELECTRIC Currents in Molten Metals—*Proc Lond Phys Soc*, Jan—97. W Feb 27.
- Thermo-Electric Properties of Liquid Metals—Burnie. *Electn*, Lond, Mar 5—97. W Mar 20.
- THREE-PHASE Traction at Lugano—L'Elec, Jan 9. *Elec Anz*, Jan 3—97. W Feb 13.
- Three-Phase Transmission Lines, Saving of Copper in—*Am Electn*, Feb—97. V, Mar 6.
- THREE-WIRE—See Dynamo. Insulation.
- TICKETS, Interchangeable Mileage—*Ry Rev*, Dec 5—96. 1400 w.
- TIDES, Power from the (Ill)—*Can Eng*, Dec—96. 1700 w.
- TIME—see Sea.
- TIN Mine in the Southern Hemisphere, The Greatest (Ill)—*Aust Min Stand*, Sept—96. 3500 w. M Jan.
- TINPLATE Industry and American Competition, The—*Ir & Coal Tr Rev*, Nov 13—96. 1500 w.
- Tinplate Trade in 1896—*Ir & Coal Tr Rev*, Jan 1—97. 1500 w.
- TOLEDO Street Railway System—*St Ry Jour*, Jan—97.
- TONNAGE Rating—*R R Gaz*, Dec 18—96. 4500 w.
- TOOLS, Some American Machine (Ill)—Henry Reband. *Eng*, Lond, Jan 15—97. 2000 w. M Mar.
- Tools, Some Shop (Ill)—*R R Car Jour*, Dec—96. 2000 w.
- TORONTO School of Practical Science (Ill)—*Can Elec News*, Jan—97.
- TORPEDO Boat, Destroyers "Furor" and "Terror" (Ill)—*Engng*, Jan—97.
- Torpedo Craft of the United States Navy, The New (Ill)—R. G. Skerrett. *Harper's Weekly*, Dec 26—96. 1200 w.
- TOWER of the World at the Exposition of 1900, The (Ill)—*La Revue Technique*, Nov 10—96. 2500 w.
- TOWN Halls of Europe, The Ancient—Dr. Rowand Anderson. *Buider*, Dec 19—96. 3500 w.
- TRACK and Track Joints; Construction Maintenance and Bonding—M. K. Bowen. *Electn*, Lond, Dec 18—96. 4500 w.
- Track Elevation in Jersey City—*R R Gaz*, Jan 29—97. 1100 w.

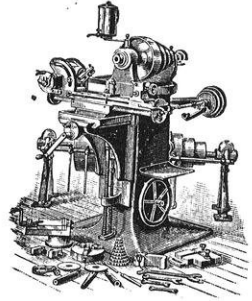


## Brown & Sharpe Manufacturing Co., PROVIDENCE, R. I.

OUR MACHINES AND TOOLS.—Milling Machines, Grinding Machines, Gear Cutting Machines, Cutters, Gears, Gauges, Micrometer Calipers, Etc., in design and workmanship embody the experience of sixty years, and are selected by leading technical schools and manufacturing establishments throughout the world.

They deserve to be carefully studied by those who wish to become familiar with or to employ superior appliances for educational or experimental purposes, or for manufacturing duplicate articles and interchangeable work.

Visitors are welcome at our Works, and Catalogue (sixty machines and 300 varieties of small tools.) is mailed on application



## LINK-BELT MACHINERY CO.,

ENGINEERS, FOUNDERS, MACHINISTS,  
CHICAGO, U. S. A.



Link Belting, Sprocket Wheels, Malleable Iron Buckets,  
Saw Mill Machinery, Elevators,  
Conveyors, Etc.

NOTE.—The Coal and Ashes Handling Machinery in Power House of University of Wisconsin was designed and installed by us.

## HOFFMANN & BILLINGS MFG. CO.,

MANUFACTURERS OF

Brass and Iron Work for Water,  
Steam and Gas, "Byers" full weight  
Wrot Iron Pipe. Engineers' Supplies.

AGENTS KNOWLES STEAM PUMPS.

96 to 100 Second Street, - - Milwaukee, Wis.

### Wanted—An Idea

Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write JOHN WEDDERBURN & CO., Patent Attorneys, Washington, D. C., for their \$1,800 prize offer and list of two hundred inventions wanted.

### Wanted—An Idea

Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write JOHN WEDDERBURN & CO., Patent Attorneys, Washington, D. C., for their \$1,800 prize offer and list of two hundred inventions wanted.

*Please mention Wisconsin Engineer when you write.*

- Track Elevation in Park Avenue, New York, New York Central (III)—R R Gaz, Jan 8—97. 1700 w.
- Track Maintenance, The Effect of High Speed on—P. H. Dudley. R R Gaz, Dec 25—96. 860 w.
- Track Sanding Device for Terminal Stations—La Revue Technique, Dec 25—96. 2500 w. M Mar.
- Traction Diagram—Tomlinson. Elec Rev, Lond, Dec 30—96. W Jan 9.
- TRACTION Current, Protection of Telegraph Wires Against—Elektrotechn Zeit, Feb 18—97.
- Traction Diagram—Tomlinson. Elec. Rev, Lond, Dec 11—96.
- Traction, Electric—Edward Barrington. Jour W Soc of Eng, Dec—96. 27800 w. M Mar.
- Traction in America, Electric and Cable—Ry Wld, Dec—96. 4000 w.
- Traction in Europe, Mechanical—Ziffer. St. Ry Jour, Jan—97.
- Traction in New York City, Competitive Systems of—Sci Am, Jan 16—97. 900 w. M Mar.
- Traction in Paris, Mechanical—Hillairet. L'Eclair Elec, Dec 12—96.
- Traction in the United States, in 1896, Electric—Elec, Lond, Dec 18—96. 2500 w.
- Traction in New York Street Railways, Compressed Air and Electric—Eng News, Jan 14—97. 600 w. M Mar.
- Traction Plant, Alternating Current—West Electn, Feb 20—97. W Feb 27.
- Traction, Review of Electric—Marchena. Electn, Lond, Dec 11—96. W Jan 2.
- Traction System, The Claret-Vuilleumier Electric—Elec Rev, Jan 20—97. 1600 w. M Mar.
- Traction, The Underground Trolley and the Third Rail in—Sci Am, Dec 19—96. 1600 w.
- Traction Under Steam Railway Conditions, Electric—John C. Henry. Elec Eng, June 6—97. 1000 w. M Mar.
- TRAFFIC Field in 1896, The—R R Gaz, Jan 8—97. 1700 w.
- TRAIN, an Innovation on the South Eastern (III)—Ry World, Jan—97. 2000 w.
- Train Lighting on the Southeastern Railway, Electric—Elec Eng, Lond, Dec 4—96.
- Train Lighting—Kriz. Elek Zeit, Mar 4—97.
- Train Service in France in 1896, Passenger—P. Mawry. R R Gaz, Jan 1—97. 700 w.
- Train Yard at Dresden-Friedrich-Stadt, The Great—Zeitschr d Oesterr Ing u Arch Vereines, Dec 25—96. 1000 w.
- Trains in Continental Europe, East—J. Pearson Pattinson. R R Gaz, Dec 11—96. 500 w.
- TRAMWAY at Chalons-sur-Maine, Electric—La Revue Technique, Jan 10—97. 600 w. M Mar.
- Tramway, Douglas Southern Electric (III)—Ry Wld, Jan—97. 2800 w. M Mar.
- Tramway Systems, Comparative Utility of Mechanical—Ry Wld, Dec—96. 1000 w.
- Tramway—See Paris.
- Tramways and Their Working in England, Details of—Elec Eng, Lond, Jan 22—97. E Feb 24.
- Tramways for Bradford, Electric—A. H. Gibbings. Elec Rev, Lond, Dec 1—96.
- Tramways, Gas—A. Lavezzari. Pro Age, Jan 15—97. 2000 w. M Mar.
- Tramways, German Electric—Electn, Lond, Feb 26—97. E Mar 31.
- Tramways in Paris, Electric—La Revue Technique, Dec 25—96. 3500 w. M Mar.
- Tramways in the German Empire, Some Electric (III)—Oesterr Monatschr f d Oeffent Bau-dienst, Jan—97. 12000 w. M Mar.
- Tramways, Municipal Control of—J. P. Wilmshurst. Lightening, Jan 7—97. E Feb 3.
- TRANSFORMER, Arc Lamp—Elec Rev, Lond, Jan 29—97. W Feb 13.
- Transformer, A Two-Phase Rotary—Electn, Lond, Jan—97.
- Transformer, Rotary—Saturin Hanappe. L'Eclair Elec, Oct 17—96. 1400 w.
- Transformers, Improvements in Continuous Currents (III)—Electn, Lond, Jan 8—97. 1000 w. M Mar.
- Transformers, Protective Devices for—H. C. Wirt. Elec Wld, Jan 23—97. Elec Rev, Jan 27—97. Serial Part 1, 1800 w. Elec Eng, Jan 23—97. M Mar. E Feb 24.
- Transformers—See Ferranti Effect.
- TRANSIT in New York, Rapid—R R Gaz, Nov 13—96. 3500 w. M Jan.
- Transit Plan for City Streets, Proposed Rapid (III)—Eng News, Dec 24—96. W Jan 9.
- TRANSPORTATION Topics, Current—Emory R. Johnson. An Am Acad, Jan—97. 4800 w.
- TRANSMISSION Line Calculation of a Three-Phase—Am Electn, Dec—96. W Jan 2.
- Transmission, Long Distance—Charles P. Steinmetz. Elec Eng, Jan 6—97. 900 w. M Mar.
- Transmission of Energy in Spain, Electrical—Electn, Lond, Dec 18—96. E Jan 6.
- Transmission of Power, The Economics of Electrical—W. Dixon. Ir & Coal Trds Rev, Jan 22—97. Serial Part 1. 2200 w. M Mar.
- Transmission of Power by Electricity, What has been accomplished in the Long Distance—Am Mach, Jan 7—97. 2000 w.
- Transmission, Old Hydraulic Canal Plant at Niagara Falls Transformed for Electrical (III)—Orrin E. Dunlap. West Elec, Dec 5—96. 2000 w.
- Transmission, Hydro-Electric System of Power—L'Elec, Dec 12—96. W Jan 2.
- Transmission Plant, 12000 Volt Continuous Current—Elek Anz, Feb 21—97. W Mar 27.
- Transmission, Recent Advances in Power—John McGhie. Elec Eng, Jan 13—97. 900 w. M Mar.
- Transmission Up to Date, Niagara Power (II)—F. C. Perkins. Elec Wld, Nov 21—96. Serial Part 1. 1200 w.
- TRANSMITTERS, Telephone—Wietlisbach. Elec Eng, Mar—97.
- TRANSMITTING Power in Mines, English Practice in—Eng Mag, Dec—96. 3700 w. M Jan.
- TROLLEY Contest, New Phases of the Connecticut Steam—Clarence Deming. R R Gaz, Jan 1—97. 2500 w.
- Trolley Contest in Connecticut, The Steam—R Gaz, Nov 20—96. 1500 w.
- Trolley in India, The (III)—George H. Guy. Elec Eng, Jan—97. 1300 w. M Mar.
- Trolley Wire Attachment for a Lift Bridge—St Ry Rev, Jan 15—97. W Feb 6.
- TRUCK, The Brill "Perfect" Passenger (III)—Ry Rev, Feb 6—97. 1200 w.
- TUBES, On an Improved Method for Preserving the Proper Vacuum in—Dr. A. Berliner. Elektrotechn Zeit, Feb 11—97.
- Tubes, The Manufacture of Iron and Steel—Edward C. R. Marks. Prac Eng, Nov 20—96. Serial Part 1. 2000 w. M Jan.
- TUBING, Aluminum Bronze Seamless—Leonard Waldo. Eng News, Dec 24—96. 1000 w.
- TUNNEL, A Brooklyn and New York Rapid—Eng News, Jan 14—97. 1400 w. M Mar.
- Tunnel in Philadelphia, The Philadelphia and Reading Railroad Subway and (III)—Walter Atlee. R R Gaz, Dec 18—96. 1400 w.
- Tunnels in Colorado, Some Important Mining—Thomas Tonge. Eng Mag, Feb—96. 3900 w. M Mar.
- Tunnel, Under the Spree near Treptow, The—Sci Am Sup, Jan —97. 900 w. M Mar.
- TURBINES and Their Regulators Exhibited at Geneva (III)—Franz Prasil. Schweizerisches Bauzeitung, Nov 14, 21, 28 and Dec 5, 12, 19, 26, 1896. 16000 w.
- TURBO-GENERATOR, Test of the 200 k w—Hunter. Electn, Lond, Feb 19—97. W Mar 6.
- TURRET Deck Steamers (III)—Sci Am Sup, Dec 12—96. 500 w.
- Turret of the Battleship Massachusetts Under Fire—Sci Am, Dec 12—96. 1500 w.
- TWIN SCREW Steamer Pennsylvania (III)—Am Ships, Nov 12—96. 1100 w.



Comprise the following goods which are of the very highest quality, strictly first-class and fully warranted.

Regrinding Globes,	Angle, Cross and Check
Swing Check Valves,	Valves,
Pop Safety Valves,	Automatic Injectors,
Handy Gate Valves,	Chime Whistles,
Automatic Water Gauges,	Steam Cocks,
Nenious, Sight Feed Lubricators,	
Glass Oil Pumps,	Glass Oil Cups,
Grease Cups,	Rod Cups,
Loose Pulley Oilers,	Plain Brass Oil Cups,
	Boiler Oil Injectors, Etc.

### The Most Comprehensive Line Made.

All goods rigidly tested and carefully inspected. None as good as Lunkenheimer's, if you want the best. In stock and supplied by dealers in Engineers', Factory and Mill Supplies everywhere. None genuine unless "Lunkenheimer" is cast or stamped on every article.

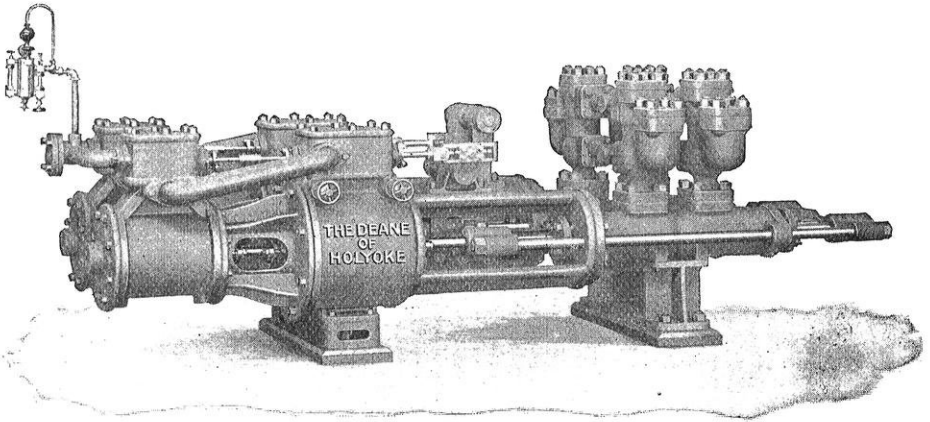
Complete Catalogue Free for the Asking.

**THE LUNKENHEIMER COMPANY,**  
CINCINNATI, OHIO, U. S. A.  
**SOLE MANUFACTURERS.**

BRANCHES: 108 Havemeyer Bldg., New York; No. 35 Great Dover St., London, S. E.

- UNDERGROUND** Conductor with Closed Slot—Zeit f Electrotech, Jan 15—97. 3000 w. M Mar.
- Underground Haulage** at Cannock and Rugerley Collieries—Robert S. Williamson. Col. Guard, Nov 27—96. 2500 w. M Jan.
- UNIPOLAR** Machine—Anthony. Elec Eng, Jan 27—97.
- URANIUM**, Fluorescence of—Spies. Proc Lond Phys Soc, Feb—97.
- VACUUM** by Electrostatic Discharge, The Determination of the Quality of a—C. D. Marsh. Elec Wld, Nov 28—96. 1400 w. M Jan.
- Vacuum Tube Lighting**—Edson. West Elec, Mar 6—97. W Mar 13.
- VALVES** of the Brown Engine, Setting the (III)—Thomas Hawley. Safety V, Dec—97. 2500 w.
- VEHICLES**, Electric—L'Enger Elec, Jan 16—97. W Feb 13. Elec Rev, Lond, Feb 5—97.
- Vehicles, Motor**—Elec Jour, Feb 1—97.
- Vehicles, Self-Propelling**—A. R. Sennett. Ind & Ir, Nov 13—96. 1200 w.
- VENT**, The Arch Enemy and How to Control It—L. C. Jewett. Foundry, Dec—96. 1200 w.
- VENTILATION** Practically Considered—Met Work, Dec 12—96. 3800 w.
- Ventilation**, Ship and Stokehold (III)—Steamship, Nov—96. 500 w. M Jan.
- Ventilating Fan?** What Is an Efficient Type of—William Clifford. Am Mfr & Ir Wld, Jan 22—97. 1100 w. M Mar.
- VERSAILLES** Electric Railway (III)—L'Enger Elec—Nov 16—96.
- VESSELS**, Electric Propulsion of—Hellmann. L'Eclair Elec, Jan 30—97.
- Vessels, Triple Screw**—Carl Busley. Eng, Nov 21—96. 1000 w.
- Vessels**—See Sanitation.
- VIADUCT** at Sydney, N. S. W., Proposed Subaqueous (III)—Eng News, Jan 21—97. 1500 w. M Mar.
- VIBRATIONS**, Apparatus for Eliminating the Effects of—L'Eclair Elec, Jan 30—97. L'Eclair, Jan 20—97.
- VIENNA** Electric Railway—Electn, Lond, Feb 5—97.
- VILAS** of Rome, The (III)—Marcus T. Reynolds. Arch Rec, Jan-Mar—97. 9500 w. M Mar.
- VISCOSITY** of Mercury Vapor, The—A. A. Noyes, and H. M. Goodwin. Phys Rev, Nov-Dec—96. 2200 w. M Jan.
- VOCAL** Register by Electricity, The Development of the Higher—W. H. King. Electn, Lond, Jan 20—97. Serial Part 1. 2000 w.
- VOLTAGES** from Discharge of Points—Wesendonck. Weld Ann, 60, p 209. W Mar 27.
- VOLTAIC ARC**—West Electn, Mar 20—97. W Mar 27.
- Voltaic Batteries** Are Thermo-Electric—Asher. Elec Rev, Feb 24—97. W Mar 6.
- VOLTS** vs Ohms—H. Ward Leonard. Elec, Nov 25—96. 2800 w.
- WAGNER**, Manufacturing Company (III)—Elec Eng, Feb 17—97.
- WALDORF** Hotel, Electric Lighting of the New—Elec Rev, Jan 13—97. 600 w. M Mar.
- WALHALLA** of Ratisbon (III)—Sci Am, Jan 23—97. 600 w. M Mar.
- WALKS**, Specifications for Cement—Br Build, Dec—96. 800 w.
- WAREHOUSE**, Grain Storage—Paul Kortz. Z Oesterr I u A V. Nov 27, 1896. 10000 w. Dec 4—96. 10000 w. M Feb.
- WARMING** of Buildings by Hot Water, The—Ernest King. Prac Eng, Dec 25—96. Serial Part 1. 1000 w.
- WASHINGTON**, Alexandria and Mt Vernon Railway, The System of the—St Ry Jour, Jan—97.
- WATCHES**, Observations on Magnetized (III)—William F. Lewis. Jour Fr Inst, Jan—97. 1500 w.
- WATER** Development by Tunneling at Ontario, Cal.—James T. Taylor. Eng News, Dec 24—96. 800 w.
- Water** from a Surface Water Supply. How to Secure Pure—John C. Haskell. Jour New Eng Water Works Assn, Dec—96. 9500 w.
- Water Hammer**—Bos Jour Com, Nov 21—96. 1200 w.
- Water Mains**, Machine for Tapping (III)—Am Mach, Dec 17—96. 700 w.
- Water**, On an Improvement in the Sedgwick-Rafter Method for Microscopical Examination of Drinking (III)—Daniel D. Jackson. Tech Quar, Dec—96. 1200 w.
- Water Power** Scheme, Large—Eng News, Feb 25—97. W Mar 6.
- Water Power** Station at Worcester—Electn, Lond, Mar 5—97. W Mar 20.
- Water Scoop** of the Pennsylvania Railroad, The New (III)—R R Gaz, Jan 8—97. 700 w.
- Water Supply**, A Hydraulic Ram Plant for a Public (III)—Eng News, Dec 31—96. 1500 w.
- Water Supply** and Sewerage as Effected by the Lower Vegetable Organisms—Clarence O. Arey. Fire & Water, Jan 9—97. Serial Part 1. 1500 w.
- Water Supply** for a Town, Utilizing a Spring as a Source of—Lewis E. Hawes. Jour New Eng Water Works, Dec—96. 6300 w.
- Water Supply**, New York's—Fire & Water, Nov 14—96. 1200 w.
- Water Supply** Project, Chittagong—E. G. Foy. Ind Engng, Nov 14—96. Serial Part 1. 1100 w.
- Water Supply** of Paris, The—Jour Gas Lgt, Jan 12—97. Serial Part 1. 2200 w.
- Water Supply** of Philadelphia, The—Pro Eng's Club of Phil, Nov—96. 5500 w. M Jan.
- Water Supply** of Small Towns and Rural Districts, The—Percy Griffith. Jour Gas Lgt, Jan 26—97. 2000 w. M Mar.
- Water Supply** of the Mutual Life Insurance Building in New York City (III)—Eng Rec, Dec 12—96. 1700 w.
- Water Supplies** by Sanitary Authorities, The Control and Supervision of Public—C. Porter. San, Nov—96. 2500 w. M Jan.
- Water Supplies** for Domestic Use in Rural Districts in Ireland, The Value of Rain—Patrick Letters. San Rec, Dec 18—96. 1300 w.
- Water**, The Purification of—Frank J. Thornbury. Chau, Feb—97.
- Water**, The Use and Misuse of—R. E. W. Berrington. Plumb & Dec, Dec 1—96. 2000 w.
- Water Under Pressure** for Transmitting Power, The Use of—M. Martin. Col Guard, Jan 8—97. 1300 w. M Mar.
- Water Wheels**, The Efficiency of—F. M. F. Cazin. Elec Wld, Jan 9—97. 1300 w. M Mar.
- Water Works**, Experience with the Sedgwick-Rafter Method at the Biological Laboratory of the Boston—George O. Whipple. Tech Quar, Dec—97. 1500 w.
- Water Works** in American Cities, Ownership and Capacity of—Munic Engng, Feb—97. 700 w. M Mar.
- Water Works**, Meerut (III)—Ind Engng, Oct 24, 31—96.
- Water Works** of Cambridge, Mass (III)—L. M. Hastings. Jour New Eng Water Works Assn, Dec—96. 4500 w.
- Water Works** of the City of St. Louis, Mo., Recent Specifications for Pumping Engines for the—F. W. Dean. Jour New Eng Water Works, Dec—96. 10000 w.
- Water Works** Question in Omaha, The—Howard Mansfield. Eng Rec, Feb 6—97. 1600 w. M Mar.
- Water Works** System in American Cities, Capacity of—Munic Engng, Jan—97. Serial Part 1. 600 w.

# The Deane of Holyoke Pumping Machinery



## DEANE COMPOUND DUPLEX HYDRAULIC PUMP

Suitable for any Pressure from 500 to 5,000 Pounds.

Manufactured **THE DEANE STEAM PUMP COMPANY,**  
...by...

Chicago Warerooms, 201 Van Buren St.

HOLYOKE, MASS.

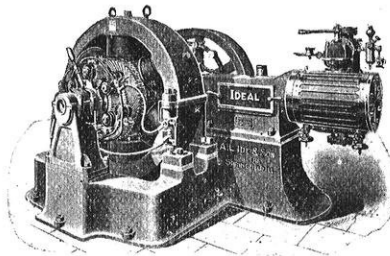
**I D E A L**

## The Self-Oiling Engine.

Direct  
Belted,  
Direct  
Connected

To all  
Types of  
Generators.

**A. L. IDE  
& SONS,**  
Springfield  
Illinois.



Send for Catalogue,  
large half-tone pic-  
ture and souvenir  
playing cards. e e e

## The Johnson System of TEMPERATURE REGULATION



e e e Is now used in all modern buildings, both  
public and private. It prevents the waste of  
heat and consequently is a fuel saver. e e e

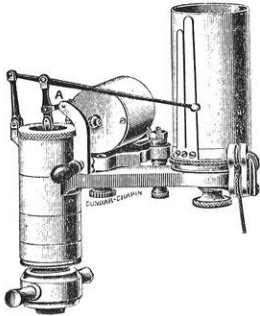
## Johnson Electric Service Co.

Boston, Pittsburgh, Detroit, Milwaukee, Minneapolis.

Please mention Wisconsin Engineer when you write.

- Water Works, Test of the Canandaigua City—E. Hensen and C. M. Riker. *Sib Jour of Engng*, Dec—96. 1000 w.
- Water Works, The Danube Tunnel of the Budapest—Josef Schustber. *Deutsche Bauzeitung*, Oct 24—96. 3000 w.
- Water Works, the Financial Management of—Freeman C. Coffin. *Jour New Eng Water-Works*, Sept—96. M Jan.
- Water—See Flow. Irrigable West.
- WATT and the Measurement of Power—W. H. Preece. *Elec Rev*, Lond, Feb 12—97. E Mar 10.
- WELDING, Electric—S. F. Walker. *Elec Eng*, Lond, Jan 8—97. 3200 w.
- WELSBACH Mantels, Electric Preparation of—L'Eclair Elec, Dec 10—96. *Electn*, Lond, Feb 12—97. W Feb 24.
- WHEELS, Cast-Iron and Steel-Tired—R. C. P. Sanderson. *Eng*, Lond, Nov 20—96. 2000 w. M Jan.
- Wheel Flange, The Discussion of the Proper Shape of—C. F. Ueberlacker. *St Ry Jour*, Feb—97. 2000 w. M Mar.
- Wheels, Machine Moulded—Joseph Horner. *Engng*, Jan 15—97. *Serial 1st Part*. 4700 w. M Mar.
- Wheels, Paper Friction (III)—W. F. M. Goss. *Am Soc Mech Eng*, Dec—96. 1800 w. M Jan.
- Wheel, The Development of the Modern Electric Railway Car—P. H. Griffin. *St Ry Jour*, Jan—97. 1700 w.
- Wheel Treads and Flanges, The Irregular Wear of—H S. Cooper. *St Ry Jour*, Feb—97. *Serial Part I*. 4500 w. M Mar.
- Wheel Tread and Flange, The Standard—R R Car Jour, Nov—96 2300 w. M Jan.
- WINDING Engines, The Use of Expansion in—M. Berne. *Col Guard*, Dec 4—96. 3500 w.
- WIRE and Cable Manufacture, The Improvement—Henry A. Reed. *Elec Eng*, Jan 6—97. 1700 w. M Mar.
- Wire, The Manufacture of—Frederick A. C. Perrine. *Elec Engng*, Dec—96. 7500 w.
- Wires and Cables, Covering Machines for—V. B. Ind Rub Wld, Feb 10—97. 1100 w. M Mar.
- Wires—See Insulated.
- WIRING—Bonfante. *L'Eclair Elec*, Feb 13—97. W Mar 30.
- Wiring Accessories—Hundhausen. *Elektrotechn Zeit*, Jan 21—97.
- Wiring, Alternating Current—Hanchett. *Am Electn*, Feb—97. W Mar 6.
- Wiring, Electric—Thomas W. Flood. *Am Arch*, Dec 12—96. 2000 w.
- Wiring, Free—Elec, Lond, Jan 1—97. 1800 w. M Mar.
- Wiring, Interior—Am Electn, Dec—96.
- Wiring Table, Theory of the—Grier. *West Electn*, Jan 2—97. 1600 w.
- WORCESTER—See Water Power.
- WORK of the Reichsanstalt—Eng, Lond, Feb 26—97. W Mar 27.
- WORKSHOPS, Electric Power in—Scott. *Elec Eng*, Lond, Feb 5—97.
- WORM-GEARING, Electrical Tests of the Efficiency—Am Mach, Jan 21—97. 1800 w. M Mar. W Feb 6.
- WYOMING Mining Interests—W. C. Knight. *Min Ind & Rev*, Dec 31—96. M M
- YARDS, Chesapeake and Ohio Improvements (II)—A. E. Coulter. *Ry Age*, Dec 4—96. 5000 w.
- Yards, Terminal—H. G. Hetzler. *Jour West Soc Eng*, Oct—96. 4800 w. M Jan.
- ZINC Electrolytic—Dieffenbach. *Zeit f Elektrotechn*, Dec 5—96. W Jan 2.
- Zinc Plates, Corrosion of—Mylius and Funk. *Zeit f Electrochem*, Dec 5—96. W Jan 21.
- Zinc—See Alloys. Blende.
- ZINCIFEROUS Ores—Aust Min Stand, Oct 29—96. 900 w.
- ZUMMAN'S Discovery, Notes on—Lodge. *Electn*, Lond, Mar 12—97.

## CROSBY STEAM GAGE AND VALVE CO.



Sole proprietors and manufacturers of Crosby Pop Safety Valves and Water Relief Valves, Crosby improved Steam Gages and Recording Gages, Crosby Steam Engine Indicators, Patent Gage Testing Apparatus, Bosworth Feed-Water Regulator, Crosby Spring-Seat Valves with renewable seats, both globe and angle, guaranteed not to leak at highest pressures. Manufacturers and dealers in Engine, Boiler and Mill Supplies.

OFFICE AND WORKS: BOSTON, MASS.

STORES:—Boston, New York, Chicago, and London, Eng.

## Schaeffer & Budenberg.

WORKS:  
Brooklyn, N. Y.

SALES OFFICES:  
66 John Street, New York.  
22 West Lake Street, Chicago, Ill.

MANUFACTURERS  
OF THE...

IMPROVED "THOMPSON" INDICATOR

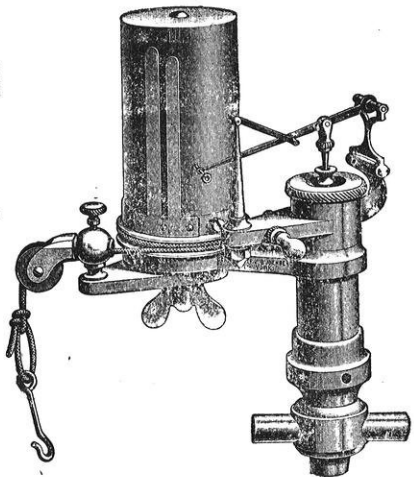
..AND..

"LYNE" INDICATOR

For Steam and Ammonia.

Prof. R. C. Carpenter's Calorimeters

For determining the percentage of moisture in steam, also of Tachometers, (Indicating and Recording), Revolution Counters, Pyrometers, Pressure and Vacuum Gauges for all purposes, Etc., Etc. ❀ ❀ ❀ ❀ ❀ ❀ ❀



*Please mention Wisconsin Engineer when you write.*

# University of Wisconsin.



## College of Mechanics and Engineering.



Offers Three Systematic Courses——



**CIVIL ENGINEERING,  
MECHANICAL ENGINEERING,  
ELECTRICAL ENGINEERING.**



It Also Affords——



Facilities for extensive experimental research and special training in Geology, Mineralogy, Physics, Astronomy, Commercial Assaying, Electrometallurgy, Chemistry, Electrochemistry, Machine Design, Testing of Materials; and in Steam, Hydraulic, Sanitary, Structural, Railway, Municipal and Geodetic Engineering.



The Library Facilities——

Are very complete, all the important Technical Journals and Society Proceedings in the world being kept on file and always accessible.



For further information send for Engineering Circular or University Catalogue.

Address,  
C. K. ADAMS, President,  
Madison, Wis.

*Please mention Wisconsin Engineer when you write.*



HYDRAULIC PRESSURE PUMP

SMALL BOILER FEEDER

LARGE BOILER FEEDER

**MARSH STEAM PUMPS**

STANDARD FOR ALL DUTIES

MANUFACTURED BY THE **BATTLE CREEK STEAM PUMP CO.**  
BATTLE CREEK MICH.

AIR COMPRESSOR

FOR DEEP WELLS

17,000 SOLD IN EIGHT YEARS

PATENT SELF GOVERNING STEAM VALVE  
PATENT EASY SEATING WATER VALVES  
NO OUTSIDE VALVE GEAR

MAXIMUM OF STRENGTH SIMPLICITY AND SERVICE

COMPOUND

LARGE TANK

WRITE FOR CATALOGUE

NEW YORK, 26 Cortland St.

CHICAGO, 32-34 W. Randolph St.

BOSTON, 41 Federal St.

ST. LOUIS, 718-724 St. Charles St.

NEW ORLEANS, 215 Magazine St.

SAN FRANCISCO, 31 Main St.

WHEELING, City Bank Building.

PITTSBURG, 14 Market St.

KANSAS CITY, 408-412 West 5th St.

OMAHA, 1014-1016 Douglas St.

DALLAS, Elm & Jackson Sts.

**GARDNER DIE STOCK**

FULL THREAD AT ONE END  
FULL THREAD AT OTHER END

ALL THE PARTS SUBJECT TO WEAR ARE CASE HARDENED

THE GUIDES ARE OF HARDENED STEEL

SIZE IRON & STEEL  
WITH 1/8" GAP

SIZE CAN BE CUT THE SAME DIE

**CHARLES H. BESLY & CO.**  
METAL WORKERS FINE TOOLS & SUPPLIES  
10 & 12 N. CANAL ST. CHICAGO, ILL. U.S.A.

LATHES FILES

CH. BESLY & CO.  
10 & 12 N. CANAL ST.  
CHICAGO, ILL., U.S.A.

**HELMET OIL**

CHUCKS VISES

PERFECTION OIL BOX FINE TOOLS

PLIERS CALIPERS

TRADE MARK REGISTERED