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Prof. Mech.

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THE CYLINDRICAL COTTON BALE.

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

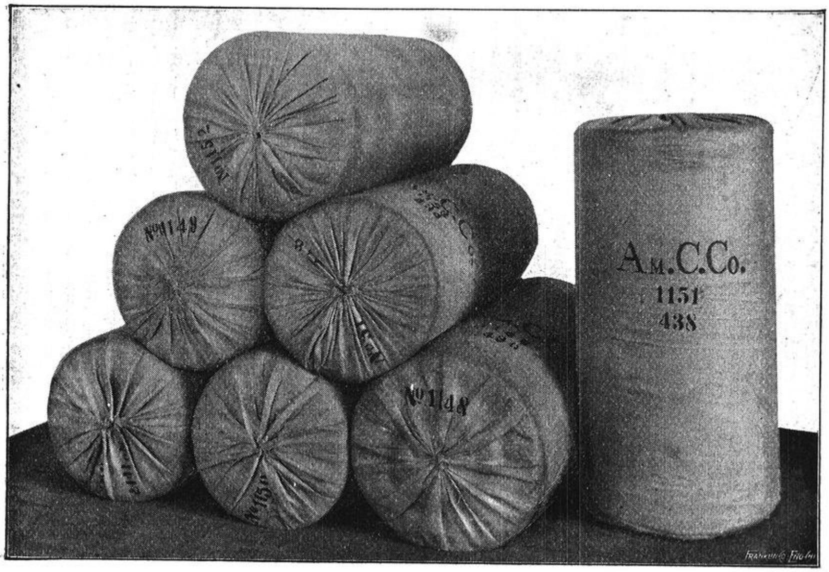
When the first shipment of American Cotton, consisting of six bags, left the harbor of Charleston, S. C., about a century and a half ago, little did the shipper dream that he was the pioneer of an industry that was destined to reach the colossal proportions of the cotton industry of today. The United 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 hydraulic 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.

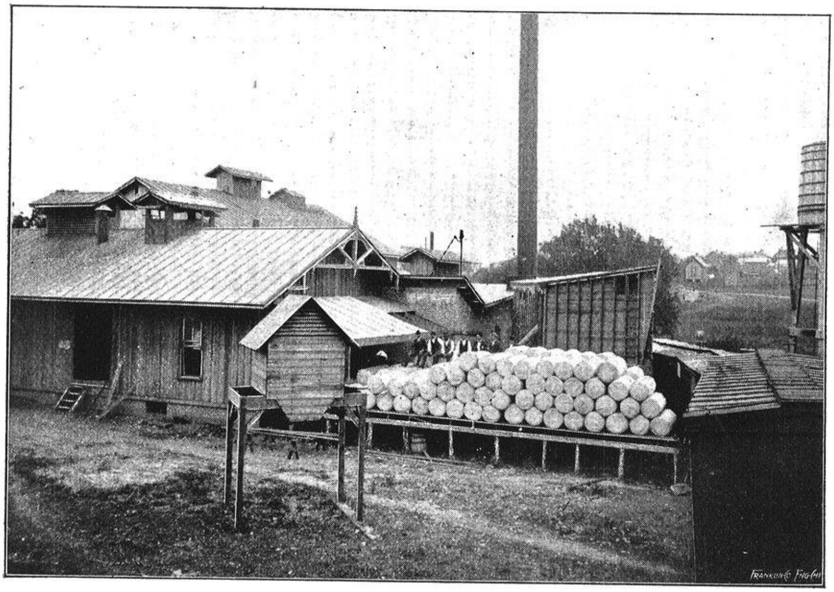
The next advance was made in the press of the Walburn

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

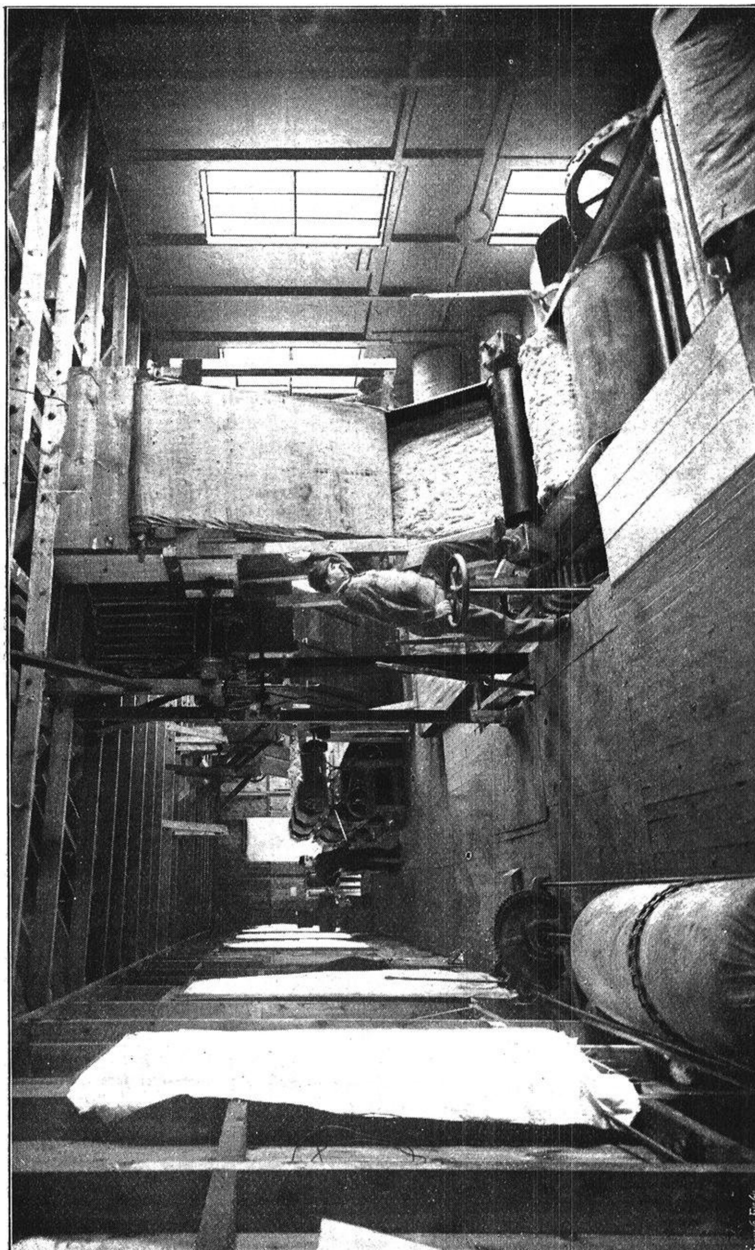
Several attempts at making dense bales without the use of rolls have been made, but they have never passed beyond the experimental stage. The latest of these employs a revolving steel casing into which the cotton is pressed by a contrivance like a post auger. The press being about the same as a flour 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.

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. PARK, 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 communicatng 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 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 cricuit 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 and 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 saitsfactory 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 certan 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 profession 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 approxmate 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 engineering 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, commercial 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 engineeer 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 considerable 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-

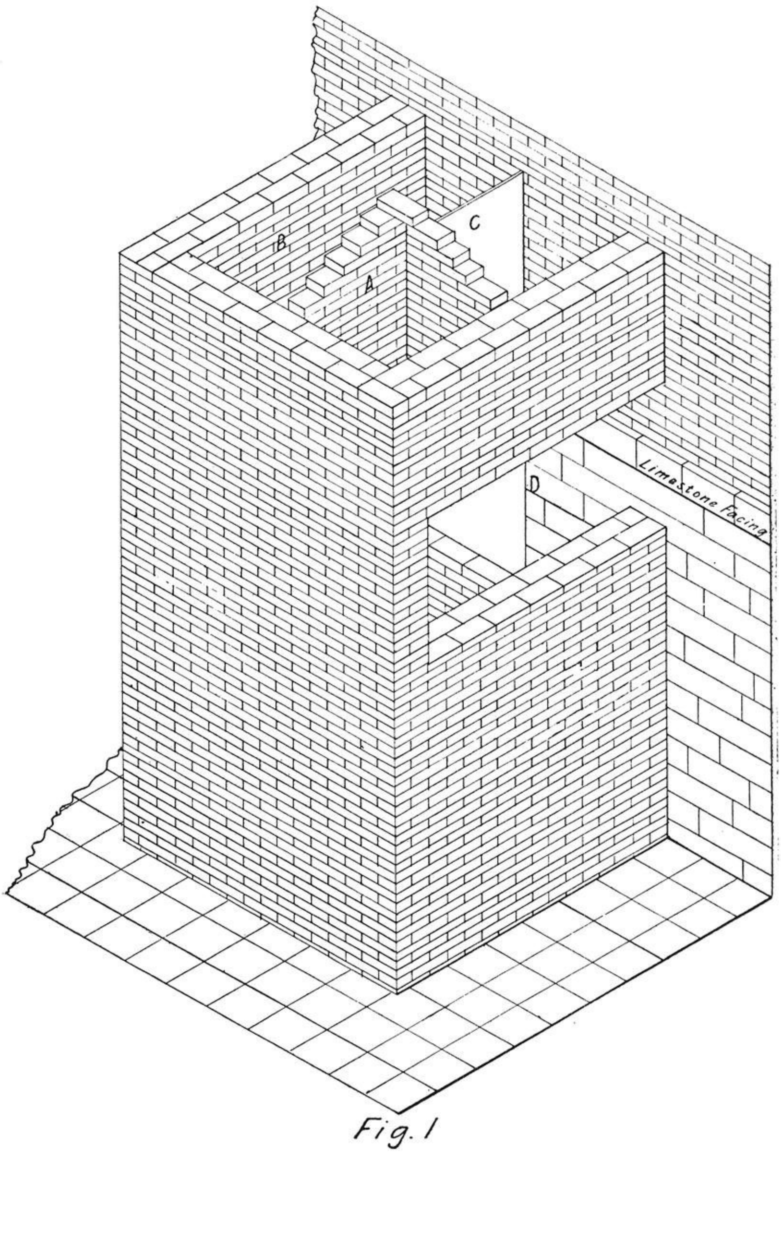


Fig. 1

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

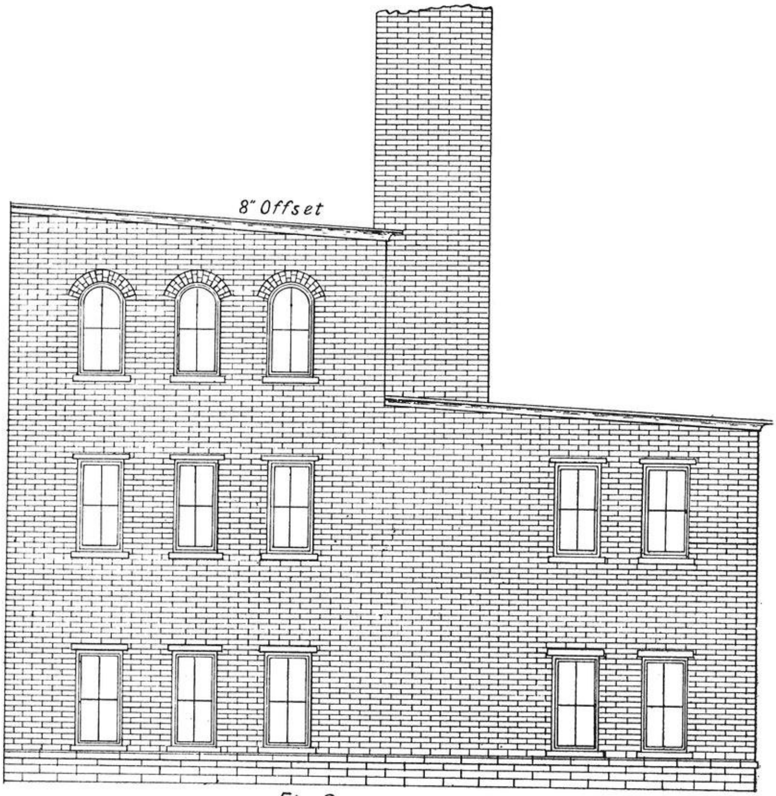


Fig. 2

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.

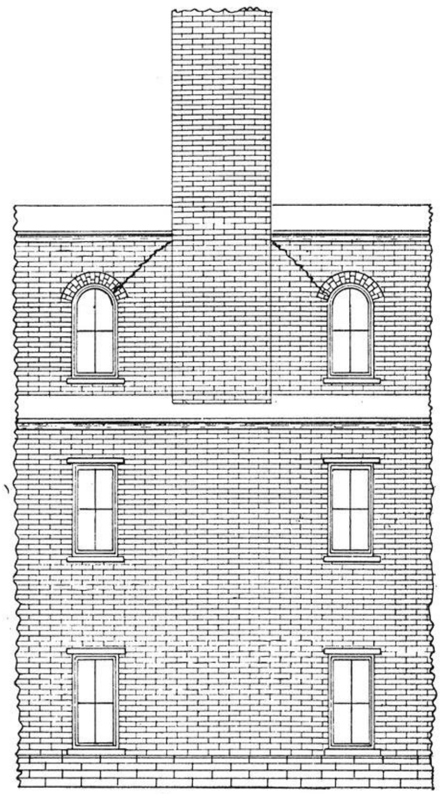


Fig. 3

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 averages 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 briqutte.

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 th boiler. The gradual rise to a high temperature serevs 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 satisfaction 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.

	Proportion of mixture.	7 Days.		28 Days.		Setting test variation in time of "Initial Set."	No. of Cars Tested.
		Minimum.	Maximum.	Minimum.	Maximum.		
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 seniorettas 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 faraway 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. *b-m.* 9.50 marks. Frankfurt.
Electrochemische Zeitschrift. *m.* 18.40 marks. Berlin.
Electrotechniker. *b-w.* 12 marks. Vienna.
Elektrotechnicker Anzeiger. *s-w.* 10 marks. Berlin.
Electrotechnische 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. New York.
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.
Glasers 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.* 20s. 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.
Journ. of Inst. of Elect. Engineers. London.
Jour. New England Waterw. Assn. *qr.* $2. New 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.

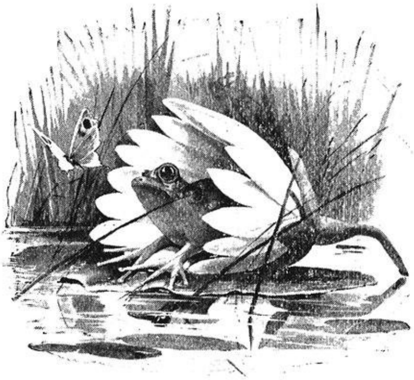
eighty by forty feet. This same room also contains apparatus for testing oils. The arrangement of engines and other machinery with regard to floor space is in this laboratory, is a marvel of ingenuity. Apparatus is needed to extend the usefulness and capacity of the hydraulic laboratory; the thermodynamic 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 sacrficed this for the accommodation of the much crowded mechanical laboratory. The room origiginally 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 ade-*

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.
Monatsschrift 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 Monatsschrift für den Oeffentlichen Baudienst. *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. Philadelphia.
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*. $4. Chicago.
Railway Master Mechanic. *m*. $1. Chicago.
Railway Press, The. *m*. 7s. London.
Railway Review. *w*. $4. 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.
Schweitzerisches 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. Vienna.
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

ABSORPTION 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 (Ill)—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.

Accumulaters, 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. 3000 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 (Ill)—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 (Ill)—R R Gaz, Jan 15—97. Serial Part 1. 1500 w. M Mar.

Air-Brake System, Two Pipe (Ill)—Loc Engng, Feb—97. 1400 w.

Air Compressor, Belt Driven Automatic (Ill)—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 Pohle—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 30—97. 2400 w. M Mar.

AITCHISON'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 Electrochem, 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 10—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 (Ill)—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 (Ill)—Electn, Lond, Feb 12—97.

Alternator, Diphase—Guilbert. L'Ind Elec, Jan 10—97.

Alternator with Stationary Armature, A 640 Horse-Power Huten-Leblanc (Ill)—F. Guilbert. Electn, Lond, Dec 11—96. 1300 w.

ALTERNATORS, Calculation of the Iron Losses in—Behn-Eschenberg. Electrotechn 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 engieering 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.

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

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 econmic 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 engineerng schools of the university. The number for January, 1897, contains over 30 solid pages of references to

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 Jounral 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'Elec, 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 (Ill)—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 Voltic—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. 1100 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 (Ill)—Richard L. Humphrey. Pro Engs' 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. 1000 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, Improvised Service—Am Electn, Feb—97. W Mar 6.
Central Station Operation, Fifteen Years in—Samuel Insull. Elec Eng, Jan 6—97. 2200 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. Electrotechn 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 (Ill)—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. Can 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—Kimbark. West Electn, Feb 6—97.
Chicago Street Railway Company, South (Ill)—West Electn, Dec 26—96.
Chicago—See Engineering.
CHIMNEY, The Factory—Robert Kunstman. Brick, Dec—96. 3300 w.
CHIPS, The Making of—Tecumseh Swift. Am Mach, Feb 4—97. 1600 w. M Mar.
CHLORINE—See Blende.
CHURCH, Plans for a Greek Catholic, at Sereth—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 (Ill)—Builder, Dec 5—97. 2000 w.
Churches, Asymmetry in Medieval Italian—W. H. Goodyear. 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. 3000 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.

C. 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.

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. Lemon, '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. Thorkelson, '98, and M. H. Spindler, '98, of the Engineers' Association, while the negative was supported by T. G. Nee, '99,

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."

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 characteristc 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 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

5—Wis. Eng.

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 hyteresis 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 theromes, 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

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 Lenzs' Law to the principles of the rotary field. There is a short, sweet chapter on impedence 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 tensil 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.

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.

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 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 cost 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.

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.

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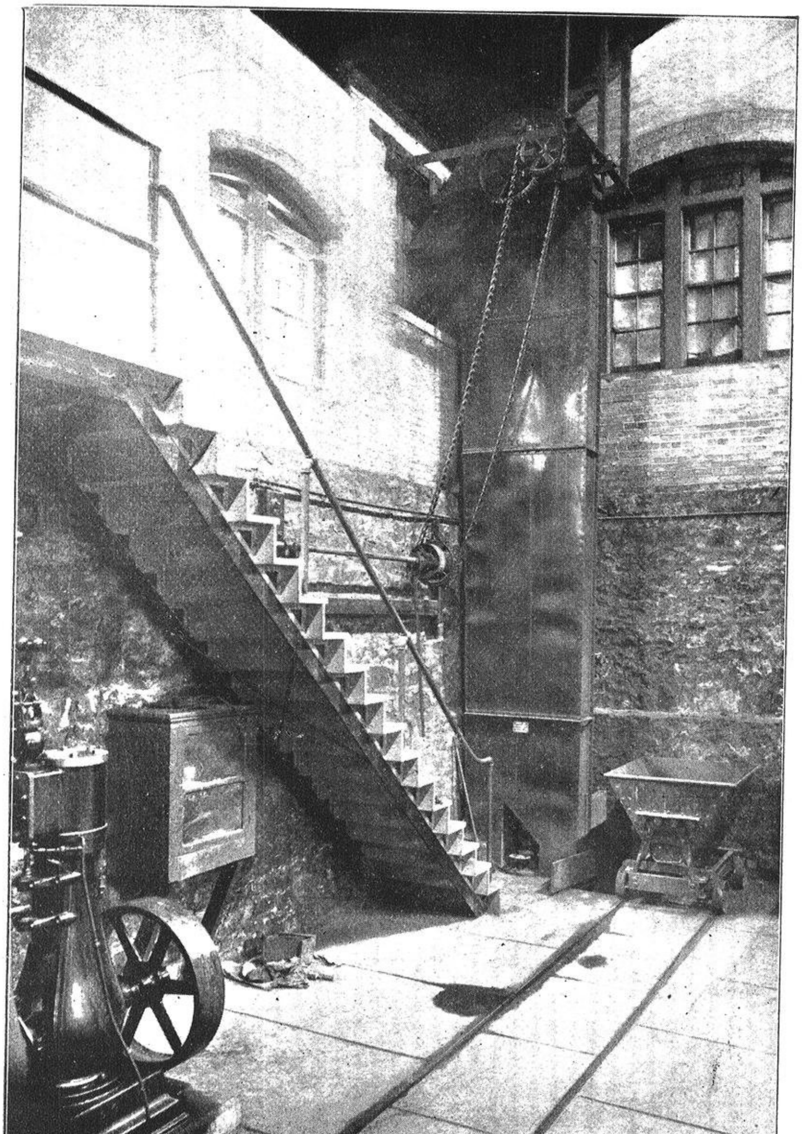
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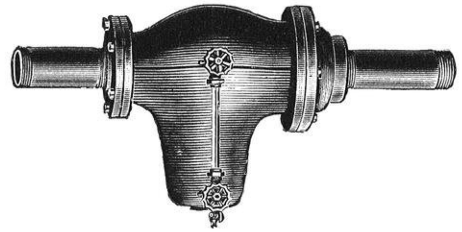

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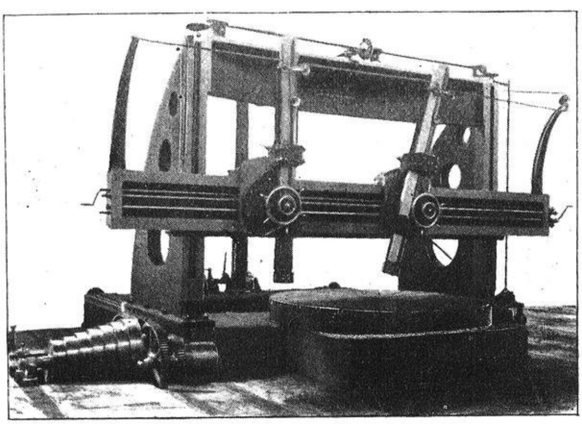

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