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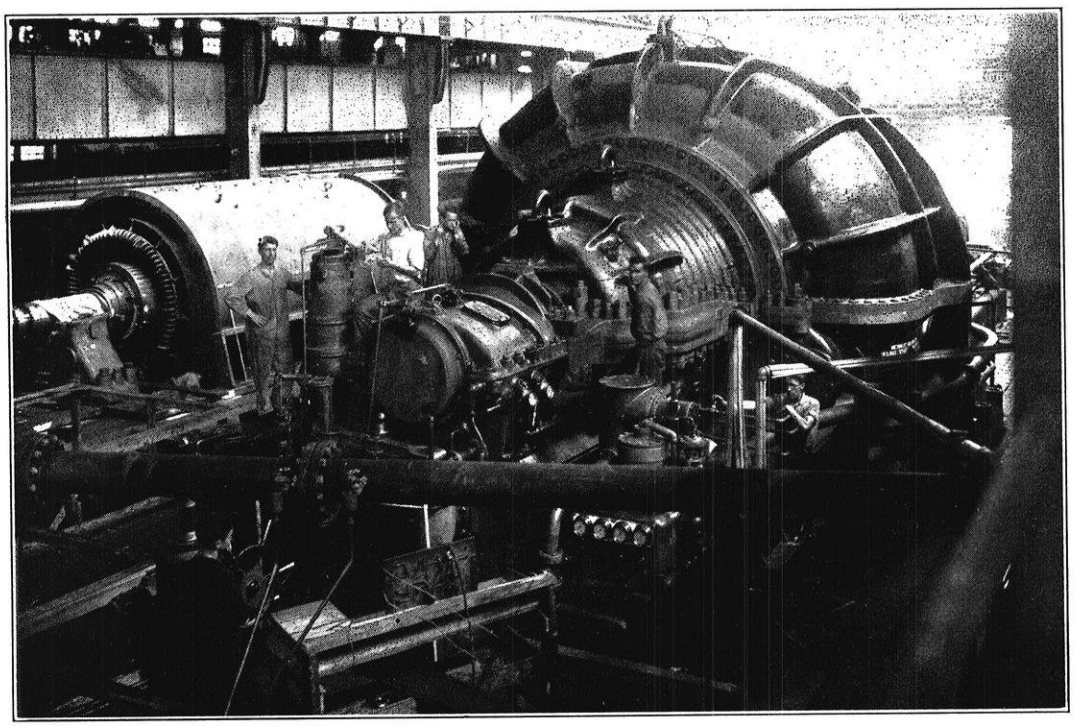

STEAM TURBINE UNDER TEST

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The Wisconsin Engineer

VOLUME 33, NO. 5 FEBRUARY, 1929

Municipal Administration

By Alden C. Fensel, c'23

Director of The Municipal Research Bureau of Cleveland

THE government of cities is frequently likened to a business corporation — the voters being the stockholders, the city council being the board of directors, and the mayor being the manager. Such a fancy has been taken to this simile that some three hundred and fifty cities are operating under charters which have a manager as the administrative authority of the city. The postulate of city management is centralization of authority — it is supposed to eliminate "passing of the buck" and thereby secure efficiency. The council is that centralized authority; the people elect the council and expect that council to give them a maximum of service at a minimum cost. The council selects a manager to run the city under its direction.

In a business corporation the normal function of the management is to produce and market commodities at a minimum cost and sell at a maximum price. The differential is a very tangible thing known as profit and satisfies stockholders in the form of dividends.

Excepting utilities, a municipality does not sell commodities — it gives service. This service is varied in character and is generally very intangible; the citizen normally does not know that he is getting a service until for some reason or other it fails to function. Further, even if the voter does appreciate the service, he does not know what it should cost, most of them not even knowing what it does cost. There is no measuring stick of service.

Mr. A. C. Fensel

The service rendered covers protection of welfare, health, life, and property, maintenance of cleanly conditions with respect to streets and air, sanitation, expedition of traffic, and usually the operation of one or more utilities. The rendering of the service requires the construction of hospitals, maintenance of staffs of visiting nurses, application of quarantine, operation of recreational facilities, provision of fire and police force, street cleaning, the curbing of fumes and smoke, collection and disposal of sewage — garbage — and refuse, opening — widening — paving — and lighting of streets, and the operation of power and water plants.

The administration of the service requires the operation of public buildings and structures and the employment and direction of personnel. Funds must be collected by taxes or licenses to finance construction and operation. The funds must be properly allocated to the various activities; control of expenditures by book-keeping and auditing must be maintained, and purchases must be made as cheaply as possible by proper purchasing control.

City Management. The city-manager plan is designed to remedy several faults of the mayor-council type of government. Short tenure of office, which is a protective measure against incapable incumbents, under the mayor plan, is not conductive to efficient administration. The mayor is elected to office from private life; he probably has never had any experience in pjublic affairs. The city then trains this man at the expense of the organization, fires him at the

end of two or four years, and then trains a new one. The cost of this turn-over in dollars and cents must be enormous.

One of the essential features of the city-manager form of government is that local residence is not required for holding office. Men can train themselves for municipal work because of the opportunities for permanent work and advancement. The plan gives rise to a new profession.

Type of Government. Managers have been drawn from all walks of life as there have been few opportunities for training. Many of the officials are adapting themselves to the work and are making good; others who are inherently incapable fall by the wayside.

The success of a city manager depends largely upon his qualifications for the work. As the city manager is to be responsible for the administration of the municipality it is apparent that he is primarily an executive. As an executive, he should be able to build up an organization which always tends toward the attainment of better economies and greater efficiencies in operation, always striving for a closer approach toward ideal conditions. In order to accomplish this, the executive must have a well defined conception of the duties of administration. The previous analysis of the service rendered by a city discloses an extreme diversity of functions.

Mr. Fensel attended the National Institute of Public Administration after being graduated; he then served as an engineer in the office of the City Engineer of Ashtabula and also as unofficial assistant to the manager. He was later appointed as the engineering staff member of the Municipal Research Bureau of Cleveland of which he is now director.

It is apparent that one individual cannot be a specialist in public welfare, safety, works, finance, and law; so these functions are usually departmentalized and a head created for each department who is responsible to the manager. In order to appoint and supervise the various department heads, the manager must have a fundamental knowledge of the functioning of each department. He must know the relative importance of each service rendered; so that he can intelligently allocate the funds, whose total amount is usually so limited that money is not available for the operation of any service to the fullest extent that is considered desirable. The manager should be able to work out problems with his department heads and make final decisions in matters of major importance.

Personal Qualities. The city manager is always in close contact with the people; he must meet all classes of citizens and receive their complaints and suggestions. He not only must keep harmony in his organization, but he must maintain concord between himself, the citizens, and his council. A consideration of this human element is a vital factor in the success of the administration. A manager is frequently subjected to unwarranted, malicious attacks which necessitate his being thick-skinned to prevent mental wear and tear. Therefore, in addition to technical qualifications a successful manager must have such personal qualities as to make compatible his relations with the public and his council. Before entering the field, a person contemplating city management should study himself to ascertain the natural inclination and adaptability for such service.

The Profession of Municipal Administration. Municipal administration is a relatively new technic in this country, although it has been developed for many years in Europe. While the city manager form of government gives expression to this art or profession, it is not the only means of obtaining economical and effective government; however, it probably is the biggest factor that has obtained in the betterment of government. Perhaps a limited number of technically trained men were available at the inception of the new era in administration, but very few were given managerships. We find engineers, lawyers, doctors, business men, and newspaper men occupying these positions with more or less success. Some of them had previous training in municipal work serving in various capacities as city engineers, treasurers, clerks and councilmen. Normally the length of service has not been long. The professional mortality of city managers has been the highest known in any profession. While this may be attributed to some extent to unqualified incumbents it is more probably due to petty policies and inability of citizens to appreciate good management. An instance of this is two cities twenty-five miles apart; one had a poor manager for many years and thought him satisfactory until his failure in financial administration was so positive as to force him to resign; the other had a man who can be rated as one of the best managers in the country — petty politics and an unappreciative public forced him to resign.

It is probably true that a manager cannot continue in a city over an extensive period, as many of his decisions and actions incur enmity of selfish individuals. The pyramidal effect finally forces the man out. A discouraging feature of the service is that a large number of managers are forced out under fire.

One of the talking points of the city manager form is the promotion of managers from smaller cities to larger ones — the English and German procedure. While this procedure should be effective in the training of managers and the obtaining of good management, it has not generally been put into effect in this country, and there are small indications of its adoption in the immediate future. Conversely, the forced resignation of many of our managters precludes them from a managership in another city.

Training for the Profession. The University of Michigan and the National Institute of Public Administration in New York City have, for considerable time, run training schools for city managers. The course of the Institute is now incorporated in the School of Citizenship and Public Affairs of the University of Syracuse. The curriculum

(Contnued on page 164)

Intercity Toll Cables

By H. R. HUNTLEY, e'21
Wisconsin Telephone Company, Milwaukee

IN situations where the long distance telephone traffic along a route has grown to the extent that it is difficult to place the necessary number of open wire or carrier telephone circuits on existing pole lines, the use of intercity toll cables is often considered. This is particularly true in those sections of the country where large open wire lines are frequently subject to storm damage. By the use of toll cables, a relatively large number of telephone circuits can be carried on one route and are so enclosed and protected as to be reasonably free from damage due to external causes. In a single toll cable, for instance, it is practicable to carry as many circuits as could be supported by 8 or 10 heavily loaded pole lines on an open wire basis. Where the growth in circuits is expected to be very rapid so that it is likely that a number of cables will be required within a reasonable time or local conditions make it advisable, underground conduit construction proves in.

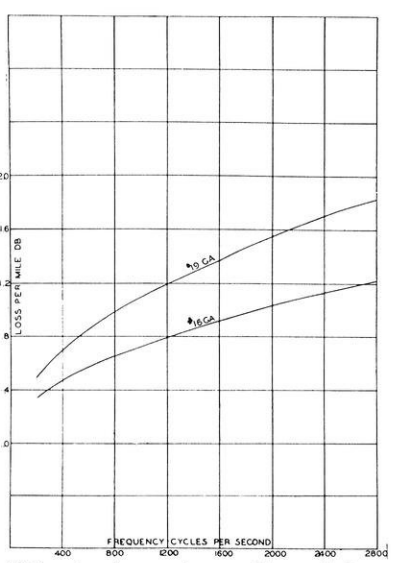


FIG. 1. Approximate Transmission Loss of 19 and 16 Gauge Non-loaded Cable Side Circuits.

When circuits are placed in toll cable, they, of course, employ conductors having very much smaller cross-section which are much nearer together than in open wires. Due to the small copper cross-section employed, the resistance of the circuits is relatively high. Likewise, due to the small spacing between conductors, the capacities between them are relatively great and the inductance per unit length of circuit is relatively small. In the general case, the inductance of a non-loaded cable circuit can be neglected at voice frequencies and the circuit can be considered electrically to consist only of series resistance and shunt capacity.

Due to the relatively high resistance of the conductors and the high mutual capacity between the conductors, the attenuation per unit length of non-loaded cable circuit is relatively high. In addition, the attenuation per unit length varies approximately as the square root of the frequency within the audio frequency range so that uniform efficiency over the audio frequency range is not provided unless some means of correction is employed. In Figure 1, the attenuation at various frequencies for typical 16 and 19 gauge non-loaded cable circuits is shown.

In the curves shown in Figure 1, the unit of attenuation employed is the "decibel" (abbreviated "db"). The decibel is defined as follows:

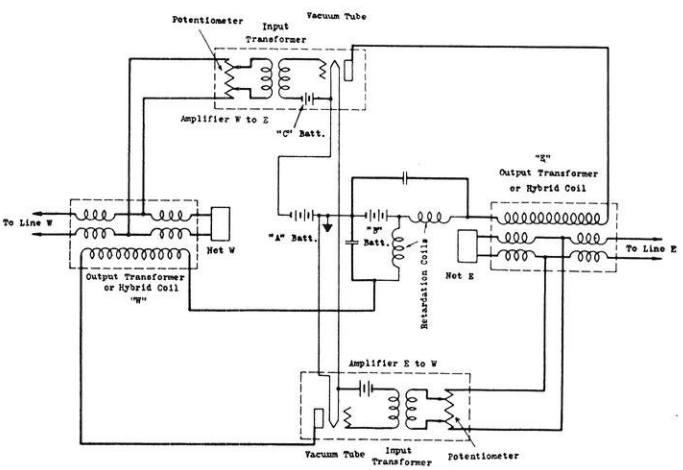


FIG. 2. Schematic Diagram of Two-way Telephone Repeater.

If the ratio of two powers (such as the powers at the beginning and end of a section of an infinitely long cable circuit) is $10^{.1}$, the attenuation is said to be 1 decibel. The power ratio for "n" decibles is, of course, $(10^{.1})^n$ or $10^{.1n}$.

In order to improve the characteristics of the cable circuits, loading is generally used. Loading consists essentially of adding inductance in series with the conductors. When inductance is added in the proper manner, the attenuation is reduced and, within limits, as described later, the attenuation becomes more nearly constant with frequency variation over a limited range than for the case of the non-loaded circuit. One method of applying loading is to enclose the conductor in a sheath or wrapping of magnetic material. This has been used both in telephone and telegraph deep sea cables. In land cables, however, the use of "lumped" loading in which the inductance is inserted by means of coils spaced at regular intervals is generally more economical and practicable and is very widely used.

At the present time the spacing between successive coils on toll cables is generally 6,000 feet. In one of the generally used types of loading, coils having an inductance of 172 millihenrys are used on the side circuits and coils having 63 millihenrys inductance are used on the phantom circuits. In another commonly used type of loading, coils having 44 millihenrys inductance are used on the side

circuits and coils having 25 millihenrys inductance are used on the phantom circuits. The lighter "weight" loading, that is, the type of loading employing 44 and 25 millihenry coils, is used to span the longer distances because of its better attenuation frequency characteristics and its higher velocity of propagation. In both types, coils wound on cores of compressed powdered permalloy are usually used.

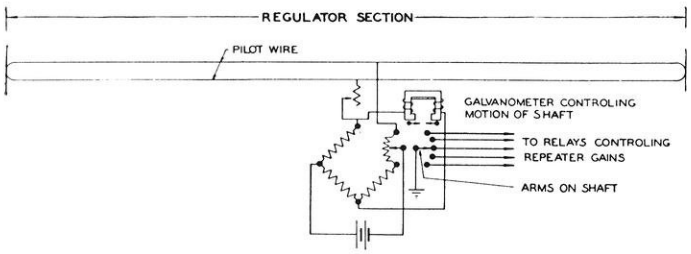


FIG. 3. Automatic Transmission Gain Regulator Circuit.

The electrical structure of a loaded circuit is very similar to that of a simple type of loss pass filter having considerable resistance in the series elements, that is, a filter which transmits more or less uniformly up to a given frequency (called the "cutoff" frequency) and suppresses frequencies above this frequency. For this reason, the loaded circuit transmits frequencies reasonably well which are well below the cutoff frequency but has a relatively high attenuation as the cutoff frequency is approached and practically suppresses frequencies above the cutoff frequency.

While the velocity of propagation in open wire circuits approaches that of light (approximately 186,000 miles per second) the velocity of propagation on loaded cable circuits is relatively low, varying between about 10,000 and 20,000 miles per second for the usual types of circuits. In the long circuits, the velocity of propagation is very important since it determines the length of time elapsing between the start of an electrical impulse on the circuit and the return to the sending point of any reflected waves from this impulse. The amount of reflection and the time interval elapsing must be kept relatively low in telephone work in order to avoid echoes. If strong echoes having a relatively long time delay are present, it becomes very disconcerting to talk on the circuit and the usefulness of the circuit is materially impaired. The magnitude of the delay may be determined roughly by considering a circuit having a velocity of 15,000 miles per second 1,500 miles long. In this case, the total time elapsing between the start of a wave and the return of the echo would be .2 of a second. In some of the very long circuits, it is necessary to employ "echo suppressors" which consist essentially of voice operated relays which short-circuit the path traversed by the echo current.

Even with the use of loading, it is impracticable to secure circuit losses low enough for use over long distances and it is necessary to amplify voice currents at various points. In order to do this, telephone repeaters are connected into the circuits generally at about every 50 miles. The telephone repeater consists essentially of vacuum tube amplifiers so arranged as to amplify the voice waves in both directions on the circuit.

Two general types of repeatered circuits are employed at the present time. One of these, the so-called two-wire circuit, employs one pair of conductors or a "phantom" circuit for each talking circuit and uses the so-called "22" type repeater. In Figure 2 is shown schematically the transmission circuit of a 22 type repeater. It will be noted that two amplifiers are used, one for amplifying in each direction so interconnected through the use of "hybrid" coils that if the impedances of the lines are balanced by the networks, no undesirable interaction between the amplifiers results. The path of the voice currents through such a repeater can be traced as follows:

> Assume that the voice currents are coming into the repeater from line "W". As they enter the "west" hybrid coil, half the energy goes into the "west-east" amplifier and is there amplified and the other half goes into the plate circuit of the "east-west" amplifier and is there dissipated as heat. The amplified output from the "west-east" amplifier enters the "east" hybrid coil and the energy divides, approximately one-half going into the line "east" and one-half going into the network "east". If the impedances of the line and network are equal at all frequencies amplified by the repeater, there will be no potential difference across the bridge points of the hybrid coil connected to the input of the "east-west" amplifier so that there is no tendency for circulation of currents between the amplifiers. Of course, if the impedance balances are imperfect, a certain amount of current will be fed into the opposite directional amplifier and undesirable interactions may result. In some cases, if the balances are relatively poor and relatively high gains are employed, continuous oscillation may result. The tone from this oscillation is sent out on both lines and is called "singing". Under these conditions, the circuit is useless for telephone purposes.

For very long circuits with repeaters approximately every 50 miles, it can readily be seen that there are numerous points at which balance must be maintained and in such cases the so-called four-wire circuit with four-wire repeaters may be employed.

It may be interesting to note the improvement in power efficiency of toll cable circuits obtained through the use of loading and repeaters. As an example, consider a relatively short cable circuit, such as one between Milwaukee and Madison. On a non-loaded basis and without telephone repeaters, the transmission loss at 1,000 cycles in a 19 gauge circuit 90 miles long is approximately 90 db. This corresponds to a power ratio of 10^9 which gives a power transmission efficiency of .0000001 percent. With loading employing 172 millihenry coils on 6,000 ft. spacing alone, the loss is reduced to about 30 db. corresponding to a power transmission efficiency of about .1 percent. With loading and repeaters, the loss of such a circuit can readily be reduced to 10 db. or less, which corresponds to a power ratio of $10^{1.0}$ or a power transmission efficiency of approximately 10%. Of course, the additional power is supplied by the repeaters.

In long cable circuits, the variation in loss with temperature may be relatively great due to the relatively high

resistance of the conductors and the change in resistance with temperature. As a general rule in aerial cables, the transmission loss (based on the loss of the circuit without repeaters) may be expected to vary as much as plus or minus 11% throughout a year. As an example how this variation may cause the efficiency to change, data are given below on a typical aerial circuit of moderate length:

Length of Circuit	250 miles
Grade of Circuit	19 gauge H*-172 loading
Average Loss without Repeaters	70 db.
Yearly Variation from Average	7.7 db.
Total Yearly Variation	15.4 db.
Total Yearly Variation in Power Received	35 to 1

*"H" indicates 6,000 foot spacing.

This variation is, of course, not dependent on whether or not repeaters are used or what actual working loss is used. It can readily be seen that without some means to compensate for the effects of temperature variation, the operation of a circuit such as this would be impracticable. In order to avoid large variations in the losses of circuits, the automatic regulation of the gains of one or more of the repeaters in the circuit is usually resorted to. Automatic regulation is accomplished by employing a Wheatstone bridge arrangement with a galvanometer arranged to control the gain of the repeater in the "regulated" circuits in accordance with the variation in resistance of a "pilot wire", which is a pair in the cable extending over

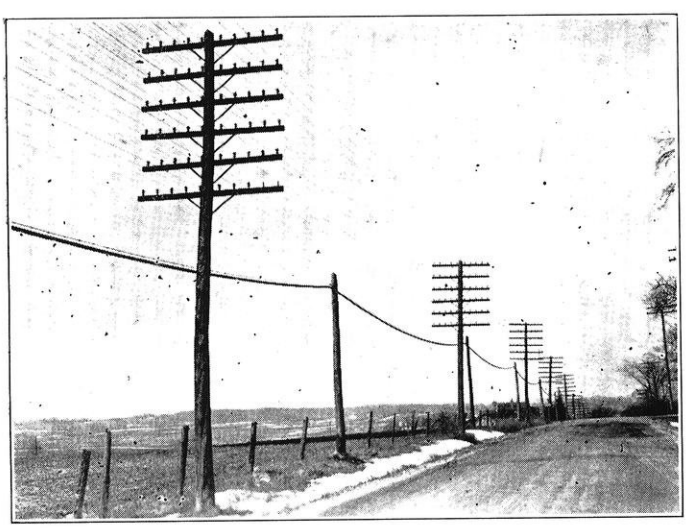


FIG. 4. A Portion of the Cable Together With One of the Open Wire Lines Which the Cable Replaces.

the section regulated by one repeater. Figure 3 shows schematically the essential parts of a pilot wire regulator.

When the circuits are in underground cable, the temperature variation is usually much less than for aerial cable and circuits can be operated over greater distances without automatic regulation and, for the long circuits, the sections regulated at one point may be longer than for aerial circuits.

In the construction of a toll cable, various types of circuits are included under one sheath. The types of circuits generally placed in a toll cable are listed below:

1. 16 gauge 2-wire circuits for H-44-25 loading
2. 16 gauge 2-wire circuits for H-172-63 loading
3. 19 gauge 2-wire circuits for H-172-63 loading
4. 19 gauge 4-wire circuits for H-44-25 loading
5. 16 gauge circuits for program supply

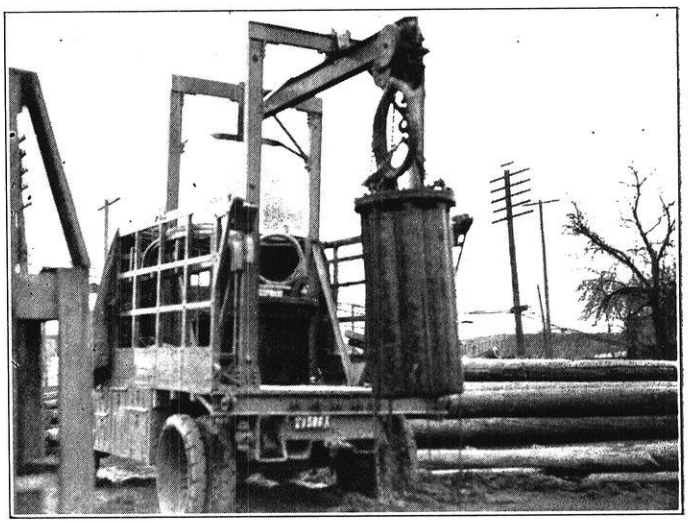


FIG. 5. One of the Cases Containing the Loading Pots Together With the Method Employed for Handling Them.

NOTE: In the above classifications, the spacing of the load coils is indicated by "H" equal to 6,000 feet. The first figure following the designation of spacing is the inductance added at each point in the side circuits and the second figure is the inductance added in the phantom circuits.

In general, all of the conductors, except those reserved for program supply use (such as remote control radio broadcasting) are "quadded", that is, are arranged for the use of phantoms. In a "quad" two wires are twisted together to make a "pair" and two such pairs are twisted together to make a "quad". The lengths of the twists in the pairs and in the quad are so adjusted as to minimize the crosstalk between pairs, between pairs and phantoms, and between the phantoms in different quads.

A certain amount of segregation between the various classes of circuits is obtained in the construction of the cable and the splicing of the various lengths together is so done that this segregation is maintained throughout the entire length of the cable. The most important segration is that necessary between the "east bound" and "west bound" sides of four-wire circuits.

In addition to maintaining the necessary segregation between the different groups throughout the cable, the splicing is so done that the accumulation of crosstalk between phantoms in different quads as the sections are joined is restricted and that, within the quads themselves, the crosstalk in different sections tends to neutralize. This is done by handling the splicing as follows:

1. At the so-called "random" splices, of which there are generally four per load section, the quads are so spliced that no two quads are next to each other in the successive cable sections being joined. This is ac-

(Continued on page 190)

New Turbine Generator Installed *at* Lakeside

By R. H. SOGARD, m'25
The Milwaukee Electric Railway and Light Company

GROWTH of the electrical system load in and around Milwaukee required the installation of additional generating capacity at Lakeside Station this year. The demand indicated that it would be necessary to install either two 30,000 kw. units, one in 1928 and one in 1929, or one 60,000 kw. unit in 1928. Economic considerations, both from the investment and coal consumption standpoints, showed the 60,000 kw. single cylinder machine to be the best.

Under competitive bidding, the order for the turbine-generator was placed with the Westinghouse Company, and that for the condenser and extraction heaters with the Foster Wheeler Company. The equipment was ordered in December of last year, and was started on October 15. The unit was tested for heat consumption to check the guarantee, and went into commercial service on November first.

The turbine proper has two impulse wheels and twenty-two reaction wheels. It has four extraction points, and can heat its maximum condensate flow (660,000 lb/hr.) to 360 degr. fahr. It can also be operated with heating in only two stages, giving a feed temperature of 210 degr. to the open feed-water system of the station. The turbine has three steam valves. With one valve open, a steam flow of 340,000 lb/hr. results, with a non-extracting load of 37,250 kw. or an extracting load of 33,400 kw. With two valves open and a throttle flow of 476,000 lb/hr., a non-extracting output of 51,400 kw. and an extracting one of 45,600 kw. are obtained. The third valve is then opened to carry further increases in load up to full capacity. The turbine governor is of the impeller type, controlling the turbine speed by oil pressure.

The generator is a three-phase 60 cycle 1800 r.p.m. machine, operating at 13,800 volts and 85 per cent power factor. A 175 kw. 250 volt exciter is direct connected to the end of the generator shaft. A closed type surface air cooler serves the generator, the heat being absorbed by the turbine condensate.

The condenser is single-pass, with 55,000 sq. ft. of surface. The tubes are rolled into both tube-sheets, one of which is fixed and the other floating. Doing away with packed tubes is expected to eliminate circulating water leakage into the condensate. An integral air cooler is provided, and air removal is effected by two element steam jet air pumps.

The turbine condensate passes first through the steam jet air pumps, then through the generator air cooler, and then in succession through four extraction heaters. Between the second and third heaters, a boiler feed pump raises the water pressure to 375 pounds, so that it may be heated to 360 degrees. After leaving the last heater, the high pressure pumps raise it to 1450 pounds, for feeding into the 1300 lb. boiler.

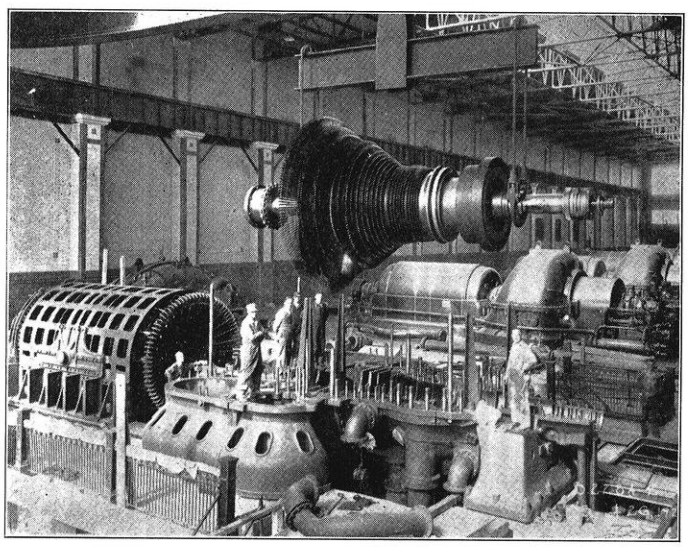


FIG. 1: Placing the Turbine Rotor of the New 60,000 K. W. Unit, Lakeside Power Plant, Milwaukee, Wisconsin.

This 60,000 kw. turbine will be tested by an actual weighed water test at full load. As far as is known, this new water weighing equipment is as large or larger than any similar apparatus installed in central stations. Two tanks of 100,000 lb. capacity each are set on Fairbanks beam registering scales. One tank will take the full load throttle flow of 660,000 lb/hr. for ten minutes. Provisions are made for one man operation of these huge weighing tanks. Contrasted with this, the previous weighing tanks were of 5000 lb. capacity each, and required at least three men for satisfactory operation.

Most central stations that run steam consumption tests on large turbines measure the condensate with some form of meter. The Lakeside equipment is thus distinctive in giving actual weighed results. One percent on the heat consumption of this machine would mean $6,900 per year in coal, which capitalized at 8% represents a sum of $86,300.

At this time also a second 1200 lb. 7700 kw. turbine is being installed. It will alternate in operation with the first 1200 lb. machine. Next summer when the second 1300 lb. boiler is installed, both 1300 lb. boilers will feed the new 1200 lb. 60,000 kw. turbine, and thus permit a large part of the station generation to be made by the economical high pressure section.

The Mechanical Delay-Network

By R. L. WEGEL*
Bell Telephone Laboratories, New York

SOMEWHAT reminiscent of the string telephones of our youth is an entertaining off-shoot of Bell Telephone Laboratories' research in acoustics, the recently developed mechanical delay-network. Essentially the device is a helical spring, hanging loosely between a transmitting and a receiving element. Wandering through the connecting wire coil, sound vibrations impressed at one end appear at the other some time later.

When recently shown by Mr. S. P. Grace, Assistant Vice President of the Laboratories, to the regional meeting of the American Institute of Electrical Engineers in Atlanta, the annual convention of Telephone Pioneers in Boston and the Cleveland Engineering Society, the delay-spring was incorporated in a demonstration apparatus. From a microphone transmitter Mr. Grace's voice proceeded to the spring, whose output, translated into electrical vibrations and amplified, was reproduced by a loud-speaker. The audience thus heard the same words twice: directly from Mr. Grace's mouth and one second later from the loud-speaker.

Due to the physical complexity of even their simplest forms, the theoretical explanation of this sort of apparatus is at best difficult. It is not always safe to make simplifying assumptions in discussing these problems; questions of speech transmission especially must be treated in considerable detail, for many of the most curious and important properties of mechanical structures vibrating at voice-frequencies result precisely from this complexity. Fortunately much assistance can be derived from the use of the familiar analogy between electrical and mechanical vibratory systems. Reference to the analogy, even if only qualitative, often makes it possible to predict from electrodynamic experience the nature of the effects which may be expected of the analogous mechanical apparatus.

Treating in this way, the famous problem of beads on a string illustrates well the aspects of vibrating systems which occasion their apparently strange behavior. And, simpler than that of the delay-spring, it is yet sufficiently similar to make possible some significant comparisons between them.

In the idealized form of this classical problem, first discussed by Lagrange and recently interpreted in terms of its electrical counterpart, the string is supposed to have negligible weight and the beads, arranged equidistantly in succession along it, to be infinitesimally small. The resulting model is a series of masses, concentrated at mathematical points, connected by pure weightless elasticity, and vibrating transversely to the direction of the string. Its electrical analogy is a low-pass wave filter, with series inductances

The Transmitter End of the Network. Spring is Shown at "A".

corresponding to the masses and shunt capacities to the segments of the connecting elastic string. More generally the mass-point could, of course, vibrate in three independent directions, the three mutually perpendicular coordinates of space, two of them transverse to the direction of the string and one along it. The corresponding analogy is three low-pass filters, through any of which impulses could be independently propagated.

When, however, beads are actually placed on a string, the ideal condition cannot ordinarily be realized sufficiently closely to permit its assumption in simplifying the study of voice transmission over the string. The beads must have length, breadth and thickness, the string must have appreciable weight, and the beads cannot be exactly centered on the string.

Introducing these complicating realities gradually, it is simplest to consider first beads on an ideal string: a weightless string, bearing beads possessed of dimensions and mounted off their centers of mass. It is apparent that a force applied through the elastic string to one of the beads at a point not on its centre of mass will tend not only to move the bead in the direction of the force but to rotate it as well. The beads may travel in circles or ellipses rather than in a straight line along the direction of the drive. Each bead must, therefore, be considered as an extended body, requiring six coordinates to specify its position or velocity at any particular time: the three co-

*Editor's Note: Mr. Wegel, a 1910 graduate of Ripon College, acted as assistant in Physics at the University of Wisconsin from 1910 to 1912. After a year as physicist with Thomas A. Edison, he joined Bell Telephone Laboratories in 1914, where he has made important contributions to the design and theory of electro-mechanical vibratory apparatus. This article is taken from the *Bell Telephone Quarterly*.

ordinates of its center of mass and the three angular rotations about its center of mass. A string has elasticity to twisting as well as to stretching, so that a disturbance of one bead, consisting of rotational as well as back-and-forth motions, will be transmitted in a modified form to the next bead.

Thus there are six ways in which disturbances may be propagated over the string, and, because they are interrelated through the inertia of the mass on account of its off-center mounting, these modes of disturbance are mass-coupled. The complete electrical analogy comprises six low-pass channels, inductively coupled to a degree dependent on the distance of the bead's mounting point from its center of mass. If the beads were mounted on their centers, the propagation characteristics of each channel would be independent of those of every other. Impulses started over one such channel would proceed without being augmented or diminished by contribution from or to other channels. Practically, however, the mass or "inductive" coupling causes the system to exhibit effects analogous to inductive interference by each channel with every other. This coupling, negligible when the frequency of the vibration to which the system is subjected is low, increases as the frequency becomes higher. Thus, whereas the visible waves of pendulum-frequency, with which classical investigators were concerned, advance intact along loaded strings, waves of voice-frequency are passed about from channel to channel and much modified. These six channels have, furthermore, different velocities of propagation. If account be now taken of the weight of the string, the six-channel inductively coupled low-pass structure becomes a six-channel inductively coupled multi-band-pass structure. If the elasticity of the string to bending is included in the consideration, the frequency-limits of the passed bands are shifted. Viewed finally in light of the inability to make beads all with exactly the same mass, and to mount them at exactly equal distances from one another and with their points of attachment at the same eccentricities from their centers of mass, each channel exhibits different propagation characteristics in different sections of the string.

In summary, then, the progressive embodiment of our theoretical bead-loaded string into a piece of equipment modifies one after another all its properties. Giving our beads dimensions, we invest them with the three rotatory degrees of freedom, multiplying the system's channels from three to six. Giving weight to our string, we add to the low-pass region of each channel an infinite number of higher pass-bands. Mounting our beads off-center, we couple the channels to one another. Permitting irregularities among the beads and their mounting, we give, to the properties of each channel, variation in differing sections like that of a non-uniform telephone line.

Obviously, complication such as this may readily give rise to quite singular phenomena. Methods of actuating the structure can no more be idealized than the structure itself; a real driving mechanism cannot onfine its motion rigidly to one dimension, its influence to one channel of the system. The attempt so to confine its action in practice, even when nearly successful, is considerably vitiated of advantage by the parasitic leakages sapping the driven channel through its couplings. When operated, therefore, the system receives initial impulses from the driver in all six channels, which these channels then feed back and forth to one another through their couplings and propagate at their different speeds and in their several ways. When the impulses reach the far end of the string, they have suffered extensive change.

The helical spring, different from the bead-loaded string in effect, is fundamentally similar in principle. It too is a six-channel structure. Its propagation characteristics, however, suit it especially for achieving large delays with compact apparatus.

The steadily increasing importance of mechanical vibrating systems is justifying persistent attention to the theory explaining their properties and to experiments with typical models. The delay-apparatus, interesting in itself, is yet more interesting as a sprig off the main limb of mechanical vibrators.

MUNICIPAL ADMINISTRATION

(Continued from page 158)

covers the major functions of government, and an apprentice course under a city manager is required for completion of the training. The training is splendid — the chance for getting a managership is negligible. So few of the graduates of these institutions have secured managerships that one must be an optimist indeed to anticipate even a village as a bailiwick. Municipalities do not seek apprentice managers and city managers generally do not have assistant managers; so after apprenticeships the graduate must usually seek other employment. The majority of them have landed in the research field — the training being excellent for this service.

Conclusion. The words above do not paint a roseate picture of the opportunities for an aspiring administrator. The desirability of a city to employ a trained administrator is not contended. That it is possible to adequately train managers has been proved. That the profession will in the future become more recognized is seemingly likely.

The obstacles in the present acceptance of training school graduates are provincial dislikes to a remunerative job going to a "foreigner", politicians objecting to a presumably uncontrollable manager, and inertia in accepting something that is different from past procedure.

Detriments to the continuity of employment of a trained administrator are incapability of the public to recognize and appreciate good management and the pyramidal effect of dissatisfaction from selfishly motivated persons.

Many glowing descriptions have been written by theorists of the opportunities in this particular field of service. In the face of an analysis of the prevailing opportunities, the picture is premature. The opportunity is potential; we may be near pinkness of the dawn, but the appearances are cold and grey.

Cosmopolitan Test

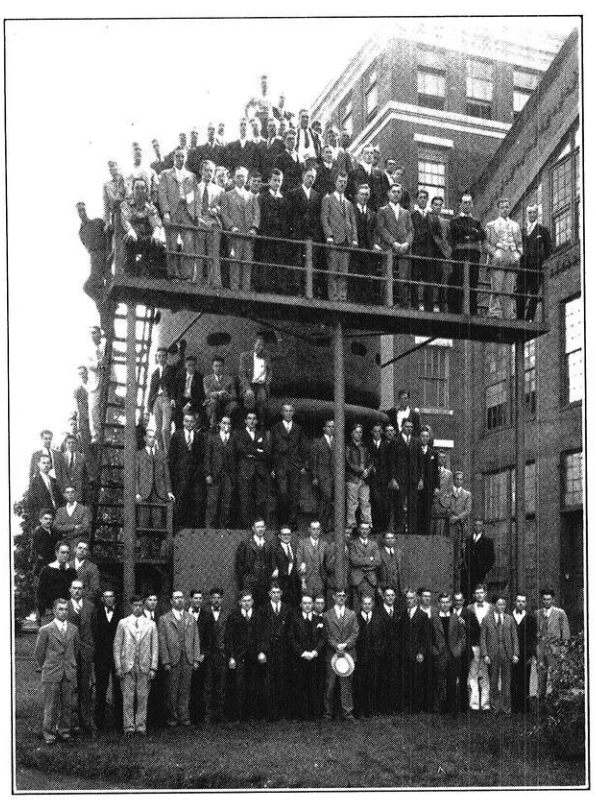
Seniors intending to seek employment with the various manufacturing companies will be interested in this representative account of the cosmopolitan character of the men they will meet on their first jobs

By R. DEWITT JORDAN, e'27
General Electric Company

PROBABLY no other manufacturing company in the world can boast of so truly a cosmopolitan gathering of technical college graduates as the Test men of the General Electric Company.

Every year, representatives from the Industrial Service Department travel nearly thirty-five thousand miles, visiting more than seventy-five colleges and universities in each of the forty-eight states on a quest for student engineers.

Last year, three hundred and eighty student engineers from one hundred and ten technical schools were enrolled in the Testing Department. In 1926 the number was slightly in excess of four hundred, and during the coming year it is expected that nearly three hundred and fifty newcomers will be received. This demand for technical graduates is annually renewed, for the student personnel is constantly changing as its members move forward into the engineering, manufacturing, or commercial departments. Records on file in the Industrial Service Department of this company accurately chronicle the march of this student army from year to year. A curve plotted to show the number of men hired each year would meander across the page like the profile of a mountain chain, rising and falling. Following the entrance of this country into the World War in 1917, such a curve would drop to an absolute minimum, and rising with the period of after-war prosperity, it would reach its highest peak in 1924 with an influx of six hundred students.



An All-states, All-schools, All-nations Group of Test Men.

From every state in the Union they come, and from nearly every civilized country in the world. As many as one hundred and eighteen technical schools and eighteen foreign countries have been represented at one time on the "greater campus." From far-off Australia, half-way around the world from Schenectady, from the scholarly centers of the Netherlands, and from the great universities in other parts of Europe, students come and are absorbed in that strenuously active life which is Test.

The photograph that appears on this page is of an "all-states, all-schools, all-nations" group of Test men posed on the forerunner of all large steam turbines, a 5000-kw. turbine built in 1902 for the Commonwealth Edison Company.

The historic old turbine which serves so admirably for a background in this photograph ushered in an era of larger and more powerful machines nearly twenty-six years ago. Early in the year 1902, the largest steam turbine in the world had a rating not in excess of 500 kw. When before the end of 1902 the 5000-kw. turbine shown in the photograph was built, a tremendous step was taken, for the rating of any previous machine was not more than one-tenth that of the new unit. It took courage to design and build such a machine, and it took courage and daring of an equal order to buy such a machine for commercial purposes.

This turbine was in customer-service seven years, and at the end of that time it was retired — not because it had worn out, but because it was to be replaced with a larger and more efficient machine.

Today turbines are built with ratings up to 40 times that of the 5000-kw. pioneer. A 208,000-kw. turbine in 1928 does not excite as much comment as a 5000-kw. turbine did in 1902 and no one knows the upper limits of this expanding industry.

Campus Notes

ENGINEERING PROFESSORS TO ATTEND WORLD CONGRESS

Four university men have been named to cooperate with the American committee of the World Engineering congress, of which President-elect Herbert Hoover is honorary chairman. The four who will endeavor to stimulate interest of local engineers in the Tokio convention of the organization next fall are Profs. G. L. Larson, D. W. Mead, E. F. Bean and J. T. Rood.

ALPHA TAU SIGMA ELECTS FOUR

Initiation of members into Alpha Tau Sigma, honorary engineering journalism fraternity, was held on Tuesday, Jan. 22, at which time the following four were admitted to membership: Robert V. Brown, m'29; Jack Lacher, ch'30; Sylvester K. Guth, e'30; and Rezin S. Plotz, c'30.

LIVE WIRE

"Hello son, what's the matter," said the electrical engineer to his small son who was showing signs of distress.

"Well, Daddy," said the boy, "you see I picked up a little bug and one end of it wasn't insulated."

NIGHTMARE OR WHAT HAVE YOU?

The big day was one. The wonderful gigantic bridge connecting two of the country's cities was being formally opened. At the height of the celebration, when thousands of people had thronged onto the bridge, the center span—with a crash to be heard for miles—fell into the river, a twisted mass of girders and human bodies.

The frenzied engineer standing at the river's bank, madly beat his chest with his slide rule and cried with great anguish:

"Ah me, ah me! Damn that decimal point; I knew it was in the wrong place!"

GRADS GO OUT OF STATE

Some statistics prepared by Dean Millar on last year's graduates show that two out of every three graduating mechanicals go outside of this state for their jobs while the remaining one of the three stays in Wisconsin. The graduating chemicals split up in the same proprotions. The civils reverse the order, however, two out of three remaining in the state and one of the three going outside. The electricals split up half-and-half.

This is the first time statistics of this sort have been prepared and it is not known whether the distribution is normal or abnormal. They at least show that in last June, Wisconsin presented a better field for civil engineers than for mechanicals or chemicals.

CASE GIVES TALK ON AVIATION

Clinton D. Case, m'29, who is a mechanical engineer of some flying ability entertained the members of A. S. M. E. at a meeting on Jan. 15. "Clint" has spent a major part of his vacations with the U. S. Navy and through this means has acquired a knowledge of flying that few of us have. His stories of incidents happening to himself and to others served to make this meeting of A. S. M. E. one of the most interesting of those held thus far this season.

The practice of securing members of the student body to entertain is a commendable one and when a meeting is thus planned, it becomes interesting because of the local color lent by a fellow student speaker.

AN OLD ONE

Emmy: "How do you suppose Noah could see during all the flood and darkness?"

Lab: "He probably had arc-lights aboard."

A. S. C. E. ELECTS OFFICERS

John Dahlman was elected president of A. S. C. E. at the regular meeting held Jan. 10, 1929. The other officers elected were Wesley Bliffert, Vice-President; S. Duncan Bailles, Secretary-Treasurer; and Alfred Wickesberg, Publicity Director.

A. S. C. E. has been very lively in sponsoring activities. The first of a series of inspection trips, conducted by A. S. C. E., was made to the Forest Products Laboratory. Other places that will be visited are the new Nine Springs sewage disposal plant, Madison Pumping Station, and the Burgess Battery Company.

A movie showing how the world's largest tunnel was driven was given in the auditorium on Jan. 22 and drew a large crowd.

These inspection trips and movies are open to all students.

OH WHAT COAL

A former shoe ad salesman now selling coal was giving his sales talk to a prospect: "There's no ash in this coal. Not a bit of sulphur or dirt. It's a wonderful coal."

"How many B. T. U.'s are there in it," asked the prospect.

"Not a damn one!"

ENGINEERING SOCIETY OF WISCONSIN MEETS FEB. 21 AND 22

The annual convention of the Engineering Society of Wisconsin will be held in the Engineering auditorium on February 21 and 22. The twenty-second falls on Washington's birthday this year, so the notice reads, and "Rube" Markwardt of the Forest Products Laboratory has agreed to furnish a cherry tree to be chopped down by anyone present who cannot tell a lie. The slogan is, "Bring your own hatchet."

The program is as follows:

Thursday A. M.

9:00 Registration
10:00 President's Address
10:20 Report of Secretary-Treasurer
10:30 "Future Possibilities of the Activated Sludge Process"—Robert Cramer
11:10 "Research Work in the Water Department of the City of Milwaukee" — C. S. Gruetzmacher, Research Engineer, City of Milwaukee
11:40 Reports of Standing Committees
12:15 Lunch at University Club

Thursday P. M.

"Recent Developments in Steam Engineering"—G. L. Larson
"Power Plant Metering and Automatic Combustion Control"—Representative of Bailey Meter Co.
"Long Distance Distribution of Gas"—Fred Hainer
"Electric Rates in Wisconsin and Ontario"—G. C. Neff
6:30 Dinner at University Club
8:00 Entertainment and talk fest in Rathskeller of New Union Building

Friday A. M.

Report of Nominating Committee and casting of ballots
"Steel Joists in Building Construction"—W. C. Muehlstein
"A Survey of George Washington"—G. C. Ward, U. of W. '29
"The Application of Least Squares in a Resurvey on a Nonmonumented Plat" — Ray S. Owen
"Financing Highway Construction in Wisconsin"—Walter Buetow
Reports of Standing Committees
12:15 Lunch at University Club

Friday P. M.

"Reforestation Policy of the Nekoosa-Edwards Paper Company and Results"—F. G. Kilp
"City Planning"—C. M. Osbourn
"Selection of Air-Ports"—Perry Fellow, City Engineer, Detroit, Michigan
Announcement of results of election. Installation of new officers
Reports of Standing Committees. Report of committee on Resolutions. Unfinished business. Adjournment of Regular Session

Friday Evening

6:30 Banquet
"George Washington, the Engineer"—Prof. F. L. Paxson
"The Boulder Canyon Project" —Words by D. W. Mead
Movies by W. J. Mead

A HARD PROBLEM

Metallurgy Prof.: "Which is the best, cast-iron or cast-steel?"

Allwise Soph.: "It depends on the particular quality desired; cast-iron is harder, but castile lathers quicker."

LET HER DROP

Wayne: "Hey, whatz all that noise out in the testing lab?"

John Henry: "Oh, that musta been Bob dropping a perpendicular."

AIRCRAFT MOTORS TO BE TESTED

Considerable curiosity has been invoked by the presence of the aircraft motors on the floor of the steam and gas laboratory. These motors have been procured from the U. S. Navy and are to be experimented on. One is a Union, six cylinder in line, and rated at 125 horsepower. It has never been run in the laboratory because the U. S. Navy forgot to include an oil pump with it when shipping it. Another one of the motors is a Liberty, twelve cylinders arranged in 60° V, and rated at 400 horsepower. The third is a Wright-Hispano make, eight cylinders arranged in 90° V, and rated at 250. Although the motors cannot be run at full load on the block, due to the small size of the dynamometer, various tests will be performed on them.

BAD BAD BOY

Johnny: "For two cents I'd knock your block off."

Bill: "Get away from me, you professional."

STANDARDS RISE IN ENGINEERING

Practical Application of Studies Brings Results Says Dean Turneaure

Practical application of college studies, which have advanced the standards of the school, and increased cooperation with outside professional and industrial organizations are the outstanding features of last year's research in the College of Engineering, according to a summary of the year's work by Dean F. E. Turneaure.

Added financial support from the legislature and from private sources has aided materially the work that the college is carrying on.

The report as given by the dean follows:

During the current year, the financial support will amount to about 23,000 from university funds, and about $18,000 from contributions of industries.

Many of the most important projects under way are being conducted in co-operation either with the industrial associations, or with national engineering societies. The largest projects of the former class are those in the metallurgical department under Prof. R. S. McCaffery.

Study Steel Industry

This department is co-operating in a very important way with the iron and steel industries of Milwaukee and vicinity and those of the Fox River valley. Two lines of work are being actively prosecuted — studies relating to the grey iron foundry industry and the studies to the steel foundry industry. A very large group representing the former has been in active operation for the past two years, and a somewhat smaller group of the latter was organized about a year ago.

Meetings of both groups are held monthly in Milwaukee, under the general direction of a representative of the university. Discussions of various general problems are very actively conducted, and work in the laboratories related to the practical work in the foundries. These meetings are attended by from 75 to 100 of the men actively engaged in the industries. At the university is carried on the funda-

(Continued on page 184)

Alumni Notes

J. E. Brobst Heads Industrial Control Engineering Department of General Electric Company

Mr. J. E. Brobst, e'03, is manager of the Industrial Control Engineering Department of the General Electric Company at Schenectady, New York. "Jack" Brobst's Department is in no small way responsible for the tremendous strides which have been made in industrial control in the past five years.

Ever since his initial employment in the Testing Department of General Electric, Mr. Brobst has been actively engaged in new developments. He is one of the founders of the Edison Club of Schenectady, an organization which now has over a thousand members, three buildings on the grounds in Schenectady, and a separate country club. He is one of the officers of P. T. M., the alumni organization of all men who have taken the G. E. Test Course.

Brobst's ideas concerning the education of young engineers in the G. E. Organization have been adopted by all departments and by associated companies in foreign countries.

It is not surprising that we find J. E. Brobst managing the Department which engineers industrial control.

ELECTRICALS

Andreae, S. C., e'25, has changed his address from College of Engineering, University of Minn., to 3060 E. 5th St., Los Angeles, Calif.

Bittner, T. V., e'22, is power engineer for the Western United Gas & Electric Company, Elgin, Ill. His address is 76 S. Grove Ave.

Conley, B. L., e'18, M. S.'20, EE'26, has resigned his position as Chief Engineer of the Emerson Electric Manufacturing Company of St. Louis, Mo. On December 1, Mr. Conley began work with the Holtzer-Cabot Electric Company of Boston as Electrical Engineer. His present address is 11 Monroe Rd., Brighton Station, Boston, Mass.

Schmitt, Frederick E., e'99, is one of the Wisconsin men who is on the program arranged for the meeting of the American Society of Civil Engineers to be held in New York this month. Mr. Schmitt is now editor of the Engineering News-Record.

Wick, P. E., e'20, is president of the Central Electrical Sales Corporation of Milwaukee, distributors of electrical, automotive and radio supplies. **Louis Wick**, e'26, is the firm's representative in the Fox River Valley territory.

French, Newell E., e'23, has left the Wisconsin Rate Commission and is now with the Duquense Light Company, Pittsburg, doing cost allocation work and the design of gas and electric rates.

Guillemin, E. A., e'22, has recently been appointed Assistant Professor of Electrical Engineering at the Massachusetts Institute of Technology at Cambridge, Mass.

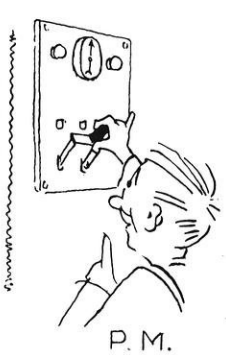
McDougal, Kenneth, e'28, is with the General Electric Company at Fort Wayne, Indiana, and is working in the electric refrigerator department. Mr. McDougal was a visitor in Madison during the Christmas holidays.

Rooks, Al., e'21, is employed in the engineering department of the Williamson Heater Company of Cincinnatti.

Rusch, Hugo L., e'23, severed his connections with the A. C. Neilsen Company and has joined the Johns-Manville Corporation in their headquarters division at 292 Madison Avenue, New York City, New York. Rusch was married on August 30, 1928, to Cynthia Katherine Van Tuyl. The couple are at home at Holbrook Hall, 472 Gramatan Avenue, Mt. Vernon, New York.

Bean, George H., e'24, is employed in the Department of Public Improvements of the city of Milwaukee. His work is largely concerned with street widening. Mr. Bean and his wife, formerly Mercedes Zander, LS'24, are living at 713 Newhall Street, Milwaukee, Wisconsin.

Coe, Simeon M., e'24, was married on December 29, 1928, to Miss Marion Fleming of Madison. The couple are living at 503 Gorham Street, Madison, Wisconsin. Mr. Coe is at present employed by the Wisconsin Light, Heat and Power Company. He comes to his present position from the Federal Radio Corporation for whom he was district manager in Wisconsin.



Fairweather, Burton A., e'28, is working on repeaters for long lines used in sending chain radio programs for rebroadcasting stations. With him in the Bell Telephone Laboratories are **Martin, Merlin L.**, e'28, and **Romnes, H. I.**, e'28.

Holmes, Hubert G., e'25, who is employed by the Consumers Power Company of Jackson, Michigan, is now living at 535 Wildwood Avenue, Jackson, Michigan.

Richmond, Lawerence P., e'23, has recently joined the radio department of the King Manufacturing Corporation at 254 Rano Street, Buffalo, New York.

Eaton, T. O., e'24, was married on Christmas day to Miss Esther Rogness of Minneapolis, Minnesota. The

wedding took place at Cleveland, Ohio, where Mr. Eaton is employed on the construction of the new Union Station.

Scheer, George H., e'28, after spending five weeks in the student training course with the Westinghouse Company, has become an engineer in the radio engineering department. He is rooming with **Galbraith, John**, e'28, who will soon go into application engineering in the central station field. Their address is 815 Franklin Avenue, Wilkinsburg, Pennsylvania.

Summers, E. R., e'26, formerly with the electrical engineering department of the University of Minnesota, is now testing electric refrigerators in the test course of the General Electric Company. Mr. Summers was editor of the "Wisconsin Engineer" when in school. His address is 12 Western Parkway, Schenectady, New York.

MECHANICALS

Edwards, Arthur W., m'25, has changed his business address to 307 Industries Building, Cincinnatti, Ohio.

Hagen, Berger A., m'21, is the proud father of a baby boy, Richard John, born October 11, 1928. Hagen's present address is 5830 West Lake, Chicago, Illinois.

Heise, Lorenz W., m'26, has changed his address from 2202 Fox Ave, Madison, Wisconsin, to 710 Prospect Ave., Milwaukee, Wis.

Kleinhammer, H. A., m'24, has moved from Oconomowoc, Wisconsin, to 30 North Seymour Street, Fond du Lac, Wis.

Langworthy, E. P., m'13, formerly plant manager for the American Radiator Co., is now Vice-president of Bearium Bearings, Inc., with offices at Boston, Mass. His address is now 258 State St., Rochester, N. Y., c/o Bearium Bearings, Inc.

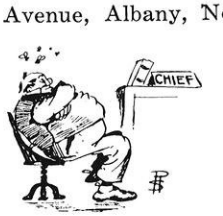
Leonard, John B., m'25, assistant chief engineer of the American Blower Co. of Detroit, was married to Miss Dorothy M. Davenport of New York on October 25.

Ligh, David R., m'28, who was formerly employed as an industrial engineer in the time study department of the Brown Instrument Company of Philadelphia, left that position in September. He is now with the Edison Storage Battery Company of Orand, N. J., as a Cost Survey Engineer in their Transportation Survey Division. He writes that he enjoys his work very much and that it consists in going to the leading concerns of the various industries and making transportation cost surveys somewhat similar to the well known Nielson Surveys. His permanent address is 612 Rockland Ave., New Dorp, Staten Island, N. Y.

Moore, Lewis E., m'00, CE'06, is engaged in engineering practice in Boston. His recent work includes the rebuilding of the Harvard Bridge and the design of the new Cottage Farm Bridge, both on the Charles River.

Thompson, David W., m'28, is now employed with the tractor works of the International Harvestor Company. His home address is 4712 Drexel Blvd., Hyde Park Station, Chicago, Illinois.

Verner, James, m'26, is now employed in active sales work in Albany, New York, office of the Aluminum Company of America. His present address is 83 Winthrop Avenue, Albany, New York.



Whittemore, Herbert L., m'03, was recently awarded the James Turner Moorehead medal for outstanding research work in oxyacetylene welding. Mr. Whittemore is now chief of the engineering mechanics division of the United States Bureau of Standards.

Mason, Warren A., m'24, is an engineer and draftsman for the National Enameling and Stamping Company, 907 St. Paul Avenue, Milwaukee, Wis. His resident address is 7020 Summit Ave., West Allis, Wis.

Richtman, W. M., m'25, former instructor in the Engineering School at the University of Wisconsin, is now employed by the Bayley Blower Company of Milwaukee. His position requires that he test the equipment, make up capacity tables and performance curves, and perform some research work. His present Milwaukee address is 765 Wentworth Avenue.

Shoemaker, William T., m'26, is now living at 219 Sansom St, Upper Darby, Pa.

CHEMICALS

Burgess Plant Develops New Process of Aluminum Manufacture

The Burgess Battery Company of Madison is building a small test plant to determine if a new method of aluminum extraction from low grade ores is possible on a larger than laboratory scale. The new method was developed by a Norwegian chemist, S. Svendson, and perfected with the help of Storey, O. W., ch'10, of the Burgess Laboratories. If it is found that this new method is practical on a large scale, it will undoubtedly materially decrease the price of aluminum. Mr. C. F. Burgess, e'95, EE'98, Hon D. SC. '26, is President of the Burgess Battery Company, which is making this contribution to modern manufacturing methods.

Fox, Gordon, e'08, electrical engineer with Freyn Engineering Company, Consulting Engineers, has written a book called Electric Drive Practice, published by McGraw-Hill Book Co., Inc.

The book is a complete discussion of modern, electrically driven commercial machinery covering the elements of load, the factors affecting the load motor size determination, the peculiar features and distinctive requirements of each machine, the functions they perform and the laws governing their action. This book was published January, 1929.

Herro, A. C., ch'28, who has been employed by the Wisconsin Public Service corporation at Green Bay, Wisconsin, has resigned to accept a position with the Carnation Milk Company of Oconomowoc, Wisconsin. His address is 404 West Wisconsin Avenue, Oconomowoc, Wis.

Mertes, John P., ch'19, has changed his address from 1203 Main St., Racine, Wis., to Mission, Texas.

CIVILS

Abendroth, George H., c'25, is at present estimating for the Dravo Contracting Company at their plant in Neville Island, Pennsylvania. In a recent letter to Professor Van Hagan, Mr. Abendroth enclosed a clipping from a Pittsburgh paper in which were printed some of the errors in definitions which were made by Wisconsin junior and senior engineering students. Mr. Abendroth's present address is 1630 Ridge Avenue, Coropolis, Pennsylvania.

Brandenburg, W. M., c'27, has been promoted to inspector with the Bell Telephone Company at Chicago. He is living at 454 Melrose Street, Chicago, Illinois.

Hollister, S. C., c'16, is a candidate for re-election to the office of Vice-president of the American Concrete Institute. Mr. Hollister is Vice-president of the W. W. Light Co., and National Freight and Delivery Company, of Philadelphia. His home is at 311 Elm Avenue, Swarthmore, Pa.

Jensen, Harold W., c'25, was recently promoted to the position of Assistant General Bridge Inspector, with the Chicago and Northwestern Ry. He is enjoying his work very much in spite of the trials and hardships in the life of a professional man who works under all conditions of temperature and weather.

Mr. Jensen is living at 9 South Chester Ave., Park Ridge, Illinois.

Engineering Review

STEAM GENERATED FROM HIGH VOLTAGE CURRENT

The Swedish Institute of Industrial and Engineering Research is carrying out experiments in generating steam from high-voltage electric current (50,000 to 80,000 volts). If successful, the great surplus energy of the waterfalls of Sweden could in this way be utilized to advantage. A tension higher than 30,000 volts cannot be used by the electric boilers in present use, but this method of generating steam will become remarkably cheap if the costly transformation from transformation-line voltage can be avoided. Industries which are very large consumers of steam, such as the pulp mills, would benefit by this arrangement.

A GIBRALTAR TUNNEL

Now that the eyes of Europe are turned toward Africa as the next field for commercial exploitation the idea of digging a tunnel under the Strait of Gibraltar comes to the front. The scheme appears more practicable than formerly in view of the success in construction of the Hudson River tunnel; the second Simplon tunnel, 12 miles long, and the Shandaken tunnel of the New York water supply, 18 miles long. A Spanish engineer, Ibanex de Ibero, has prepared a plan which he thinks could be carried out within five years at a cost of $70,000,000. He estimates that the traffic would by 1934 be enough to pay dividends on that sum.

The northern approach to the tunnel will not be of course Gibraltar, since that is British territory. Nor will it be located at Tarifa, although this is the nearest point to Africa, for the depth of the straits at this crossing is 3,300 feet. But from Vaqueros Bay, west of Tarifa, a tunnel could be constructed no more than 1,300 feet below sea level at any point, and by running to Tangier, an international port, would pass for 19 miles undersea with about 10 miles of approaches.

When, or if, the French construct their proposed railroad across the Sahara from Tangier to Dakar on the extreme western projection of Africa, the journey from Paris to Brazil may be reduced to three days by rail and four days or fewer by sea. —*Collier's*

COAL DUST ENGINES

The successful operation of the Pawlikowski powdered coal engine proves that Doctor Diesel's original patent on the internal combustion engine was sound, even though he was forced to turn to oil for satisfactory operation. That the two engines now using coal dust at Gorlitz, Germany, are beyond the experimental stage is attested by impartial American engineers who have seen the machines in action. The original unit was a single cylinder machine, 16.5″ by 25″, and rated at 80 HP. To this has been added a three cylinder unit of 180 HP. capacity.

In operation of the engine, coal is fed into a hopper which is heated by the exhaust gases to dry the coal. From the hopper this coal is fed to a grinder, where it is pulverized until 80 per cent of it will pass a 100 mesh screen. A blower then conveys the crushed coal to a separator above the cylinder head, where the coarser particles are returned to the grinder, and the finer particles are kept in suspension by the air currents until they are deposited in the feed hopper immediately above the cylinder head. From the hopper outlet the coal dust is conveyed to the fuel valve by a screw conveyor, and the engine is provided with a second conveyor to carry the excess fuel back to the hopper outlet, thus providing a constant stream of fuel over the inlet valve, and the speed of the conveyors is such that the fuel is kept well mixed with air.

The fuel valve is the most ingenious part of the whole layout. It consists of a double valve, with an outlet to the air provided for insuring no more than atmospheric pressure in the combustion chamber when the fuel is to be injected into an auxiliary chamber connecting with the clearance space of the engine. The action described, and the closing of the relief port to the atmosphere, followed by the injection of fuel to the auxiliary chamber, takes place during the suction stroke of the engine, and the entire fuel valve is closed when compression begins. Just before head end dead center on the compression stroke a fuel valve injects a minute quantity of fuel oil into the auxiliary chamber, and at the same time an air valve is opened and the mixture of coal and oil is injected into the cylinder proper by the air blast. The ignition of the oil insures the ignition of the coal charge.

The combustion proceeds as in the oil Diesel, and the piston moves on the power stroke. At approximately bottom dead center the hot gas ports to the coal drier are opened, and air from a scavenging pump is directed across the piston to clear it of ash. It has been found that this scouring is not needed, and that ash is kept off the piston through the use of more lubricating oil which is later reclaimed. On the exhaust stroke air is blown through a port higher in the cylinder to scour the ash off the piston and force it through the exhaust ports. From experiments with and without these jets it has been found that lubrication within the cylinder walls.

The success of this engine is due chiefly to the design of the fuel inlet valve and the use of a small charge of oil to insure ignition. In former designs the fuel caked about the inlet valve and refused to enter the cylin-

der, but this is eliminated by the constant flow of coal dust and air mixture. —*Power*

USES OF METALLIC CADMIUM

Metallic cadmium is now being put to many important uses, despite its relatively high price. It is used to make rustproof locks, hardware, automobile parts, and wire by electroplating the cadium on the articles and alloying it with the metal plated by heating for several hours. Silver is made more resistant to tarnish by alloying with a small proportion of Cadmium. Cadmium green alloys with gold and finds limited use in jewelry. Aluminum for aluminum powder is improved in color and luster and made more resistant to atmospheric corrosion in the use in paints and lacquers when cadium is added. Tungsten electric light filaments are being made with the aid of metallic cadmium. Alloys with copper used for wire-drawing have a higher tensile strength and annealing temperature, together with greater resistance to abrasion than unalloyed copper, while the electric conductivity is not reduced.

PROTECTING FRESHLY PAINTED TRAFFIC LINES FROM DAMAGE

A simple solution for the perplexing problem of how to prevent vehicles from driving over freshly painted traffic lines is described in California Highways and Public Works, the official organ of the California State Highway Commission. This scheme was developed in District 7 and has been very successful. Even with the use of fast-drying paint, it has been found that vehicles will run over the line and track it to other parts of the pavement. The placing of an occasional sign along the newly painted line helps, but it is not sufficient.

The California engineers prepared a number of simple signals, consisting of a piece of No. 8 iron wire bent into a loop, with a strand about 6 in. long at right angles to the plane of the loop. At the end of the 6 in. piece is a small kink or loop into which is tied a piece of bright red rag. The circle acts as a base, the rag as a signal. One man, who can easily carry 100 or more of these signals, walks behind the painting machine and places them at intervals of about 5 ft.

—*Engineering News-Record*

REMEDIAL WORKS AT NIAGARA FALLS TO BE CONSTRUCTED

Negotiations looking toward the execution of a treaty between the United States and Canada for the construction of remedial works in the rapids above the cataract at Niagara Falls are about to be completed. The proposed works have been approved by the Chief of Engineers, and nothing remains now to be done but the formal signing of the treaty.

An abstract of the report of a special international board to study conditions at Niagara Falls and recommend that changes should be made in the rapids can be found in the Engineering News Record of Feb. 23, 1923, on page 332. The report of this board was never given out in full by the State Department, but was made public in both Canada and Great Britain. The board recommended the construction of submerged weirs in the rapids and the enlargement of certain channels in order to distribute the flow of water over the Falls more uniformly and at the same time make more water available for diversion. The board estimated the work to cost $1,750,000. Apparently a lesser amount of work is contemplated in the proposed treaty, as its cost is estimated at about $1,300,000.

—*Engineering News-Record*

RADIO USED FOR EMERGENCY TRAFFIC CONTROL

Collapse of the Lincoln Highway bascule bridge over the Hackensack River in New Jersey Dec. 15, blocked without warning all traffic on one of the heaviest traveled roads in the United tate. The nearest alternative highway crossing, 1½ miles away, was not accessible from the bridge site except by a long detour. Unusual importance, therefore, was attached to quick distribution of the news of the bridge collapse so that prospective traffic from the northeastern section of New Jersey would use alternative routes to New York City and four stations in the Metropolitan District were broadcasting notices that the Lincoln Highway was closed within a few minutes after the disaster.

—*Engineering News-Record*

CHANGING COAL INTO LIQUID FUEL

After years of research, Dr. Frederick Bergius, of Heidelberg, Germany, has succeeded in liquefying coal. The necessity for liquefying coal due to the probable exhaustion of oil supplies was apparent to Europe as early as 1910, when Dr. Bergius commenced his experiments.

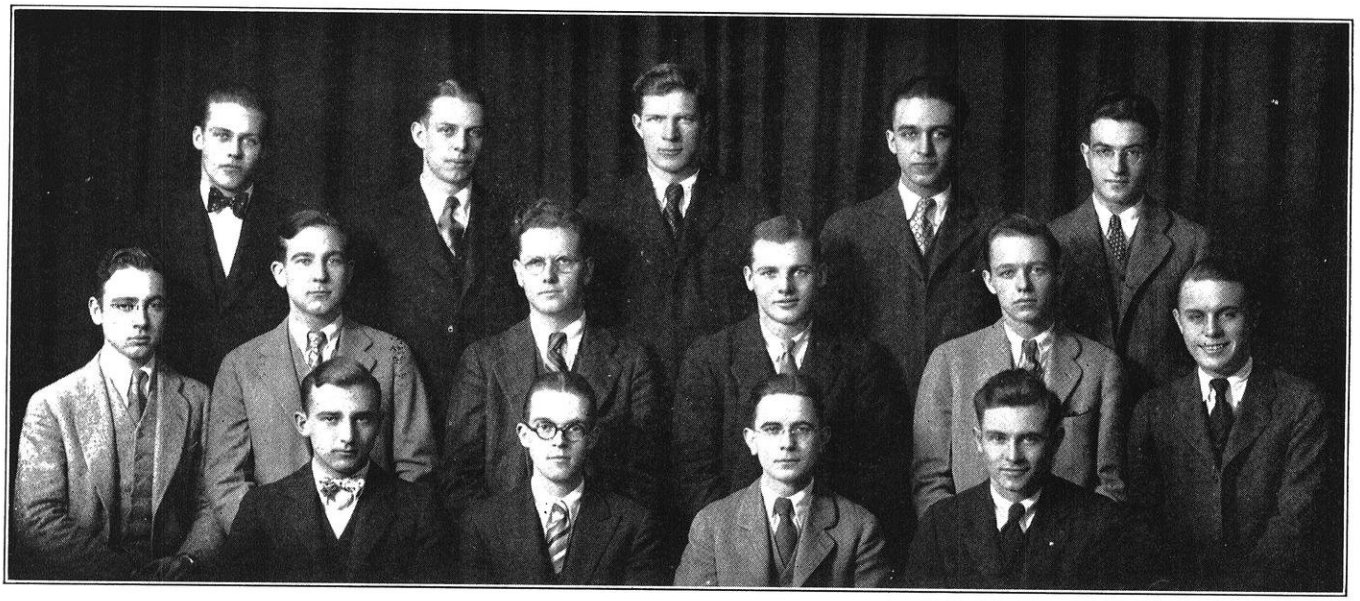
From 1910 to 1913 Dr. Bergius analyzed coal, and succeeded in making a coal-like substance from wood. With this reaction, the same amount of carbonic acid and water were always produced. It was deduced, by comparison with similar reactions, that it ought to be possible to change coal to hydro carbonates by the addition of hydrogen. At that time, hydrogen was being added to heavy oils, under high pressure and temperature, to make lighter oils. In the summer of 1913, hydrogen was added to coal under 1500 lbs. pressure at 700 degrees F., producing a mixture of gas and oils, and only fifteen per cent of insoluble residues. It was later found that the residues were taken up by stirring a mixture of coal dust with a small amount of tar oil while the reaction was in process. For industrial plants a pressure of about 2100 pounds per square inch and a temperature of 840 to 900 degrees F. are the best for most kinds of coal. The hydrogen necessary for the production of the liquid can be obtained by operating a coke-producing plant in conjunction with the main plant.

By the Berigus process of liquefying coal, two or three tons of coal are required to produc eone tone of oil. The cost of labor is low, because most of the work is done mechanically. As cheap coal dust may be used, it seems entirely probable that Europe may in the near future resort to this method of obtaining fuel oil.

—*Power Plant Engineering*

(Continued on page 174)

Editorials



TOP ROW: S. L. Johnston, E. A. Wegner, J. D. Horsfall, J. H. Kulp, Marvin Hersh.
MIDDLE ROW: R. S. Plotz, F. T. Matthias, G. C. Ward, W. P. Bliffert, S. K. Guth, H. E. Rex.
BOTTOM ROW: J. H. Lacher, R. V. Brown, W. H. Teare, R. J. Turton.

CHANGE OF STAFF This issue of the *Wisconsin Engineer* introduces the new staff headed by Franklin T. Matthias, c'30, editor, and Sylvester K. Guth, e'30, manager. In accordance with the custom established several years ago, the Board of Directors of the Wisconsin Engineering Journal Association elected the editor and business manager at the mid-year rather than in June. This practice, it has been found, gives the new staff a chance to become acquainted with their duties while under the eyes of the more experienced staff members, who have retired from active staff work.

The retiring men wish the new staff a successful year and trust that the future will see the magazine enjoying the student and alumni co-operation it had in the past. We wish to express our appreciation of the whole-hearted and loyal support given us by the faculty and the students of the College of Engineering, and hope that during the past year we have been able to fulfill our obligation to the College and the University.

PAY AS YOU GO HIGHWAYS Strong defense of the pay as you go plan of building highways as contrasted with the bonding system was made by Mr. T. J. Donaghey, former chief engineer of the Wisconsin highway commission before the highway research board recently. Wisconsin is one of the states which has constitutional prohibition of state bond issues for internal improvements and therefore cannot use the public credit for building roads.

The cost of the highways is placed on the motorist in the form of license fees and taxation of motor fuels. These means of building roads are popular because it is only fair that the users of the roads should pay for them.

The Wisconsin system has the following three advantages:

First, the pay as you go plan prevents waste through unnecessary and extravagant expenditures, which too often occur when large sums of money are made available by authorization of bonds for public improvements.

Second, the pay as you go plan as compared with serial bonds retired from one to twenty years from sale in, say, twenty equal installments will provide forty-seven percent more miles of road with the same amount of money at like cost per mile.

Third, it is not a sound business policy to sell bonds for pavements that cannot be expected to serve traffic well beyond the end of the bonding period without resurfacing.

RESEARCH AND ENGINEERING "We can never be satisfied that what we have achieved is sufficient," said Charles M. Schwab recently. If there is any lesson to be derived from this spirit, it is that in order to establish permanent institutions we must be prepared for a change.

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ENGINEERING REVIEW

(Continued from page 171)

STORAGE BATTERY TRUCKS AND TRACTORS

The new Chicago Union Station has a very efficient system of handling mail and baggage. Between every set of two tracks there is a concrete platform which is on a level with the doors of the baggage cars; this platform runs to the basement where the mail terminal is located, and thus eliminates the use of elevators and saves much time. Passengers use a larger platform on the other side of the train; that is, the baggage and passenger platforms are placed between the tracks alternately.

Electric tractors and trailers are used to convey the mail and baggage from the basement to the cars. The fleet consists of twenty tractors and eight trucks. There are four hundred and fifty mail trailers and one hundred and fifty highway trailers for baggage. The trucks operate continuously except when the drivers change every eight hours, when the batteries are removed for charging and the motor commutator and controls are inspected. It takes but a few minutes to complete this change, however. The batteries are charged from an enormous unit of the most advanced type consisting of the equipment necessary to charge twenty truck batteries, and at the same time, batteries in railroad passenger cars which are standing in the station.

The entire fleet is fitted with Alemite lubrication. One truck is taken out of service each day and all moving parts are inspected before greasing; it takes a month to service all of the equipment. The men in charge firmly believe that if they wait too long they will have considerably more to repair.

—*Industrial Engineer*

CAST-IRON HOUSES FOR ENGLAND

Cast-iron Houses are one of the most recent novelties devised in England in the effort, which has now been going on for a number of years, to meet the problem of modern housing for workers, at rentals which are low.

The cast-iron house has a concrete foundation, timber floors, steel frame, cast-iron outer plates, an inner shell of fibre board four and a half inches insides the cast-iron, an outside finish of cement and pebble dash, a tile roof, and brick chimney. After the foundation is constructed, it is said that the rest of the house can be 'turned out' in two weeks and that the only men needed for the job are two laborers, one 'fixer' and two tilers. A cast-iron house of six rooms and bath is reputed to cost about 2,600.

ABRASIVES FINISH LARGE PROPELLERS

In the making of ship propellers, which are generally manganese bronze casting, considerable labor is involved in finishing the driving sides of the blades. If they are rough, unnecessary power is expanded to overcome the resistance set up by friction. For the large transatlantic liners, the propellers are first machine planed accurately to pitch on the driving surfaces, at which time the over-all finish is also completed. Part of this finish is brought

about by the use of pneumatic chipping hammers, followed by hand filing. The final finish is then obtained with abrasive cloth of various grades.

While these operations involve a considerable expense of labor and abrasive material, they are economical in the long run, as propellers finished in this manner can be depended upon to deliver as near maximum power as possible.

—*Iron Trade Review*

ELECTRIC POWER PLANTS SAVE COAL

Electricity, which has been used as a substitute for coal in so many ways, has, singularly enough, led to a substantial saving of that fuel. Since 1919, improvements in the generation of electricity have resulted in the saving of 75,000,000 tons of coal. Figures compiled by the United States Geological Survey show, that during the last six years, the consumption of coal and its equivalent in other fuels in central generating stations increased about 15 per cent, while the energy generated in these stations increased by over 80 per cent.

This saving is attributed to a variety of causes—actual progress that has brought the consumption to a pound of coal per kilowatt-hour in the most up-to-date plants, the elimination of inefficient equipment, the growth of interconnections, and similar factors. And it is claimed that the saving is not alone in what the industry has not taken from the national coal pile during the past six years, but in the price of coal, for competitive buying on the old scale would inevitably have marked up the general level of coal prices.

In one year the power plants that are to be classed as public utilities generate and distribute more electricity than do all the light and power companies of all the other countries in the world combined.

—*Power Plant Engineering*

ELECTRICITY AND THE HUMAN BODY

If electricity can have performed so many remarkable services in lightening labor, if it can have raised the standard of living throughout the world, must we continue to say that it is impotent in repairing bodies and in keeping them in repair?

Not for long, certainly. Electrotherapeutics has passed the stage of charlatanism and magic and has settled down to sober and honest progress. The alluring but entirely fictitious powers of "electronic reactions" and all their breed have been exploded and electricity has at last taken an active hand. Chemistry, once the only reliance of medicine, has a new and powerful ally whose purpose, like that of its colleague, is sound investigation and reproducible results. Ultra-violet light from electrical sources, far more powerful than sunlight and yet more controllable, has already gained a substantial reputation in medicine. It is conceded to be a cure for rickets, a powerful assistant in the treatment of tuberculosis and a bactericidal agent of great value in surface infections. It is also receiving much attention as an active force in the production of

the still mysterious vitamins in foods. X-rays, thanks to the intensive developmental work done by science, are now under effectual control and with each new advance in the art of their production they are finding new applications in the war against disease and disability. At first their value lay principally in their great assistance in medical diagnosis, but they are now the basis of a complete new therapy, having well established uses in the treatment of certain kinds of cancer and kindred ailments.

These two—ultra-violet light and X-rays—are already firmly established. But there are other electrical phenomena that may soon serve the doctor in his fight for men's bodies. High-frequency currents, whose curative power has been in dispute for years, are now suggested in medical circles as a possible means of aiding natural convalescence by producing artificial fevers. And recently has come the announcement of the cathode-ray tube, which can produce many hundred times more radiation than is given off by the radium in the world and, unlike that rare metal, is under perfect control. Neither doctor nor scientist can say at present what the cathode ray may do for medicine, but it is quite possible that great benefits may come from it.

These are a few of the contributions and the promises which electricity, turning from the remodeling of industry, has made to man himself. Research in its unending perseverance, supported by an open public mind, may turn these promises to realities, and it may reasonably be hoped that pain and suffering will steadily decrease throughout the world.

—*Electrical World*

HARK TO THE BLESSINGS OF SMOKE!

There seems to be much agitation these days in American cities in favor of smoke abatement, but I believe that we should consider this matter without emotion. We should see the facts on the other side of the question. If we are able to consider the subject impartially and for the good of our cities, I feel sure that this movement will cease at once.

First of all, smoke means prosperity. Every chimney that pours forth these rich, luscious black clouds of smoke is an advertisement of the prosperity of our factories and institutions. No matter how modest a plume of smoke waves heavenward, we know that the humble home beneath it has a full coal bin and is able to use it generously and unintelligently.

Little do our cities realize the far-reaching prosperity which this production of smoke causes. Consider not only the doctors who are general practitioners but the eye, ear, nose and throat doctors. It is painful to think of what would become of them if there were no more smoke. They would probably starve. No more throats to be sprayed, cut and operated upon; no more noses to be explored and excavated. No, let us offer our throats a willing sacrifice to our prosperity and stand by our doctors.

Then our hospitals would also suffer seriously if there

were no more smoke. They themselves produce clouds of it. Colds, bronchitis and pneumonia, all due to smoke, furnish hundreds of patients for these institutions.

Again, think of the predicament of our cleaning industries if smoke were really abated. Our clothes and household furnishings might last a lifetime, as they did in the good old days. Our laundries are now bountifully and generously covering our cities with the choicest soot crystals of modern times. Under smoke abatement these industries could hardly survive.

What would we women do without our beauty parlors? Our manicuring, massaging, oiling, scrubbing, soaking and shampooing processes are developing upon us a rich brown color and complexion. These lovely shades of brown not only give us character but conversation. Abate smoke and you abate the beauty parlors. We women must stand together on this matter of beauty parlors.

Then there are th epaper cleaners and house painters who every year clean our walls and paint our houses. What would they do if there were smoke abatement? We must drop this agitation at once.

Above all, consider the moral effect upon the housewife. Now she is always scrubbing and cleaning. She is kept out of mischief. He husband knows where she is. Take away her soot and give her any more leisure and the American home will disappear.

Soot has also educational advantages. Children with colds and illnesses arising from soot are forced to stay at home from school. This makes some children very happy. At school there are smaller classes, more teaching and more thorough work. The teacher is less nervous in having fewer children. Her own colds give her frequent vacations and her absences afford employment for substitutes.

We all appreciate the wonderful night air of our smoky cities. Small particles of carbon intensify the restful darkness. The night air, like molasses, envelops our evening gayety, calms our exuberant spirits and smothers us quickly in our nightly slumbers to blissful unconsciousness.

oot has also its architectural advantages. The blackness of our buildings gives age and dignity to our cities. The falling soot is converting them rapidly to the semblance of some ancient or medieval settlements. Thus do we acquire the appearance of age and culture without the pangs of history.

When I consider this mass of evidence in favor of smoke I become weak, and words fail me. Can we have any doubts now upon the merits of the smoke abatement question?

NEW TYPE OF FLOOD FORECAST

A service never before undertaken by the Weather Bureau was carried on in connection with the great floods of 1927 in the lower Mississippi Valley. This was the prediction of the rate at which the water would travel over the overflowed lands adjacent to the river. Information obtained from records of previous floods indicated that a flood moving across country behind the levees re-

quires about three times as long to reach a given place as is required for a flood in the river proper. Following the natural contour of the country, the overland flood travels about 13 miles a day, or, in a straight line, only 7 or 8 miles a day.

In order to make forecass of the movement of the flood water down the Tensas and Atchafalaya Basins a contour map was necessary. There was no such may in existence, and therefore the official in charge of the Weather Bureau office at New Orleans, after securing elevations and profiles from the railroad lines, constructed a map which answered the purposes for the time being. Then it became possible to issue specific warnings for each locality where overflow was threatened. These warnings covered not only the specific dates when flood waters might be expected to reach threatened localities, but also gave the estimated depth of the water that might be expected. They carried advices as to whether or not specific localities should be evacuated and when, and indicated points from which evacuation was not necessary, thereby saving much property, expense, discomfort and suffering. The conditions that occurred largely verified the forecasts both in respect to time of occurrence of overflow and the depth.

—*Engineering and Contracting*

NEW TYPE OF LIGHTS FOR MUSCATINE, IOWA

A new type of ornamental novalux lighting unit is used in a new street lighting system recently put into service in Muscatine, Iowa. This unit, designed by the General Electric Company and bearing the designation Form 26, has a new design ornamental support outside of the globe, and the casing is combined with straps and supports that slip over the top of a concrete standard. The extensions below the base can easily be slipped over the concrete standard and are of ornamental design. Earlier types of General Electric casing were flat across the base and were arranged for mounting directly on top of the post, no part of the casing fitting over the side of the post. A total of 184 units was installed, each equipped with a 155,000-lumen lamp. Units are spaced 130 feet apart on each side of the street in staggered formation.

Roads and Streets

HIGHWAY DAMAGE IN THE FLOOD DISTRICT

The American Road Builders' Association has called attention to the fact that most of the roads damaged by the Mississippi flood were unimproved highways, while the improved highways withstood the water without serious damage.

"Roads without improvement," says the association, "were in many cases virtually wiped out, causing an expensive delay in traffic and curtailing the movement of necessary food and shelter supplies. Bridges were completely destroyed in sections where the foundations were not constructed to withstand the swift moving waters." The total damage to highways and bridges is set at $3,949,900 by the survey which has now been practically completed.

The Association urges the immediate construction of an adequate highway system designed to withstand the maximum flood waters, in those sections subject to overflow. "The existence of these roads will facilitate the salvage of personal property, protect human life and permit speedy reconstruction of damaged areas."

Public Works

NEW USE FOR CHROMIUM PLATE

An application of chromium plating of large importance and industrial significance has recently been put into operation in California. At some of the large oil refineries, steel stills of varying dimensions are used for cracking operations in producing gasoline and other products. Some of these stills are produced by the A. O. Smith Corp., Milwaukee, and are in themselves unusual products. They are understood to vary from 3 to 6 feet in diameter, and some of them as long as 22 feet, and to be made of steel plate 3 inches thick, welded electrically. In the distilling operations, they must stand very hight temperatures and high pressures. After they have been used for some time the thickness of the still gradually lessens, forming corrosion until a point is reached where, for obvious reasons, the pressure must be reduced and consequently the output of gasoline and other products lessened. It is understood that this occurs when the stills reach a thickness of 1½ inches.

It is at this stage of the proceedings that chromium

plating has stepped in. A number of stills, which has been reduced in thickness to about 1½ inches, have been successfully plated inside with chromium and their life has been decidedly increased. The plating is accomplished by partly filling the still with the electrolyte, then introducing electrodes and revolving the still during the plating. Experience thus far has demonstrated that the cost of chromium plating is more than offset by the increased life of the still and the fact that the pressure does not have to be lessened, and therefore, the product of the still is not diminished.

The understanding is that it will be possible in the near future to make the original stills of a thickness less than 3 inches, which wlil be chromium plated and used in that condition at once. This is expected to result in a less expensive still with a considerable longer life. It is also stated that the carbon deposits from the cracking operations are more easily detached from the cromium plated steel than from the ordinary steel surface.

Those who are interested in this new development emphasized that the field is a wide one and are making plans to apply chromium plating on a large scale.

—*The Iron Age*

SPHAGNUM MOSS EFFECTIVE INSULATING MATERIAL

Sphagnum moss, as most of us can recall, was widely utilized during the World War as a dressing for wounds. Now we learn that it is an excellent insulating material in housebuilding, and in that capacity is gaining favor in Sweden, especially in the construction of suburban homes.

It has been found that the ancient Scandinavians recognized the value of sphagnum as an insulating and a calking material, as they employed it for that purpose in their castles, forts, churches, and other structures. With this in mind, an enterprising company has turned its attention to the vast sphagnum bogs of Sweden, with the result that the moss from those erstwhile more or less unprofitable lands is today being put to commercial use in the form of an insulating matting. The matting consists of layers of the moss fibers stitched between two sheets of kraft paper. It is said that building experts have endorsed the newmaterial, which is particularly desirable in connection with timber structures because it contains a large percentage of tannic acid, a wood preservative.

—*Compressed Air*

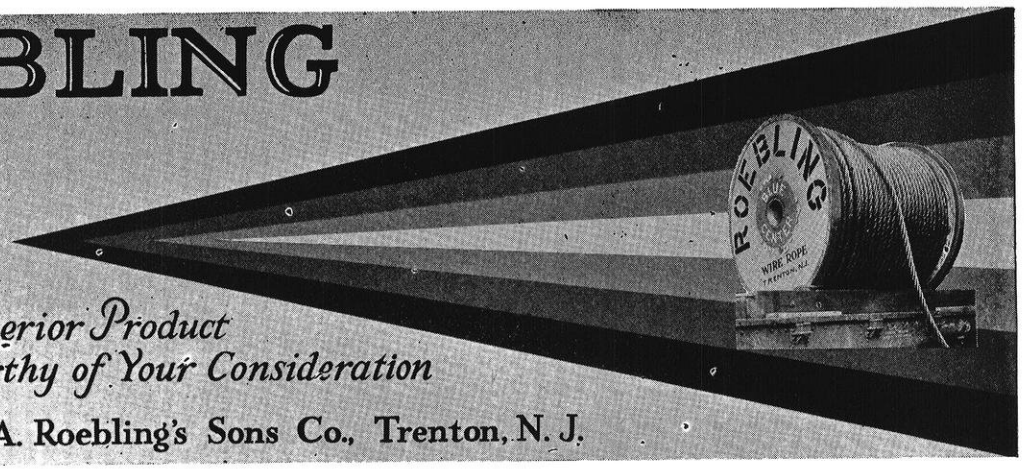
FOREST AND RUN-OFF OF WATER

As shedding light on the current discussion of forests as a factor in flood control, the Forest Service, United States Department of Agriculture, points to recent observations by Swiss scientists during a violent rainstorm on two small watersheds in the Canton of Berne, Switzerland.

The two watersheds are similar in altitude, exposure, slope and character of soil, but one of them is entirely wooded, while the other is only 35 per cent wooded. Practically the same amount of rainfall fell on each during

(Continued on page 186)

Please mention The Wisconsin Engineer when you write



CAMPUS NOTES

(Continued from page 167)

mental laboratory research related to these industries.

Investigate Slag

Another important project in this department, which is now in its third year, is the investigation of blast furnace slag. This is supported largely by the Engineering foundation, contributions from this source amounting to 6,000 or $7,000 per year.

In the Materials Testing laboratory, several projects are constantly under investigation. At the present time, the laboratory is co-operating with the American Society of Civil Engineers and the American Society of Testing Materials on subjects important to the profession: namely, strength of steel columns and properties of ordinary structural steel.

Test Concrete

The laboratory has done a very large amount of work on cements and concrete, being engaged, at the present time, in tests to determine the effect of freezing and thawing on concrete of various densities, the permeability of concrete, strength of cast iron under repeated loads, and tests of electric-welded joints.

In the testing of cast iron above mentioned, loads are applied and removed hundreds of thousands of times in a comparatively few days. The strength of cast iron, like other metals, depends, within certain limits, upon the number of repetitions of the stress.

Work on Radio

In the electrical engineering department, important work has been done on radio problems. Some of this is very highly mathematical in nature, and can only be understood by experts in the subject.

The department of steam and gas engineering is co-operating with the American Society of Heating and Ventilating Engineers on studies in the ventilation of buildings. At the present time, the particular subject under experimentation is the infiltration of air through walls and around windows. The Society contributes half the funds for this work.

Began 25 Years Ago

The chemical engineering department has been very productive of research results for many years, beginning some 25 years ago with the rather remarkable work of Prof. C. F. Burgess on the qualities of pure iron, supported by a grant from the Carnegie institution.

A great deal of productive research has been carried on continuously since this department was organized, in fields of electro-plating, corrosion, properties of many kinds of alloys, and subjects relating to the manufacture and utilization of gas.

The remarkable development of new materials used in construction, especially various alloys, is perhaps the most outstanding accomplishment in the field of engineering materials which has taken place in a great many years, and this laboratory has taken its fair share in this wonderful development.

ENGINEERING REVIEW

(Continued from page 182)

the storm. The maximum flow of water from the partly forested watershed was 15.4 cubic feet a second for each 100 acres and the crest occurred half an hour after the beginning of the rain. On the completely forested watershed the maximum flow was only 8.5 cubic feet a second and the crest did not occur until five hours after the storm began. The total run-off per square mile for 13 hours after the storm began was 702,000 cubic feet on the partly forested slope and 432,000 cubic feet on the completely forested area. By comparison with the normal flow of water, it was found that on the partly forested watershed 21 per cent of the storm water ran off, while the completely forested area only 10 per cent ran off.

In Switzerland the Government has long realized the necessity of forests to protect the steep slopes of the country's numerous mountains from soil washing and erosion and to regulate the flow of streams, and protection forests are a definite part of the Swiss forestry program.

—*Water Works*

THE MECHANICAL LOCOMOTIVE STOKER

After many years of experimentation and development work, the firing of locomotives by mechanical means is now a successful accomplishment, and practically all the new locomotives built today that come within what is considered the mechanical stoker requirements, are equipped with a machine for stoking the locomotive known as the Locomotive Stoker. The prime purpose of the locomotive stoker is not what might at first be assumed—to promote fuel economy, but rather to increase the capacity of the locomotive or to make larger locomotives possible. This results in increased earnings for the railroad and permits the building of the immense locomotives constructed today, which are admittedly beyond the capacity of a man to fire by hand—just as in the large steam or electric power plants no one would attempt to fire the boilers by the use of a single fireman, so in the larger locomotives they use the mechanical stoker, which is designed along widely different lines from the power plant mechanical stoker.

While in stationary power plants the coal is burned evenly and rather slowly, with a uniform load on the boiler, very different conditions prevail on locomotives. A locomotive stoker must be so designed that it can handle different types of fuel and be controlled by the fireman to take care of the varying loads and speeds of the train. The locomotive stoker consists of the following parts: Driving engine, conveying system, elevating system, and distributing system. The driving engine consists of a steam cylinder and piston which drives through a rack the vertical elevators and horizontal conveying screws. The conveying system consists of a worm which breaks the lumps to the proper size and brings them from the tender to the engine. The conveyor is controlled by varying the speed of the driving engine. The coal is delivered from the conveying screws to the vertical elevators which consist of similar screws driven by the same engine. The coal

is then distributed to the grates by jets of steam which direct the coal to different parts of the grate, thus insuring even distribution. The distribution is under complete control, as the speed of the driving engine and the steam pressure on the jets are under the fireman's observation and control. The fireman can also reverse the stoker so as to remove any foreign matter which may fall into the conveyor.

The exhausted steam from the driving engine is used to dampen the coal, thus giving higher efficiency.

ENGINEERS SEEK ACCURATE GAUGE AS PROTECTION TO LIFE AND PROPERTY

Because the safety of human life often depends upon the accuracy of the pressure gauge on a steam boiler or other pressure equipment which can explode, the American Engineers' Standards Committee has been asked by the American Society of Mechanical Engineers to approve the establishment of national standards for pressure gauges. The standards might provide, for example, for such construction that the gauge could not indicate a zero pressure when there is actually sufficient pressure to constitute a grave hazard if a workman should open a boiler or tank—a cause of loss of life in the past. Standardization of vacuum gauges is also requested.

Grant of the request by the Standards Committee will be followed by the formation of a committee of technical experts to undertake the work of gauge standardization. Besides decreasing the accident hazard, it will benefit the manufacturers and purchasers of gauges by replacing the great number of sizes and types now being manufactured by a comparatively small number of standard sizes and types based upon the findings of the committee of technical experts.

The U. S. Navy Department has done much important work in establishing gauge standards for the use of the Navy, and several private concerns, such as the Firestone Tire & Rubber Co., the General Electric Co., and the Pennsylvania Railroad Co., have established specifications for their own use. It is expected that these and other specifications will be studied and co-ordinated in a national way.

The standardization of pressure and vacuum gauges may incuude, in addition to specifications for accuracy and temperature of calibration such items as rating of capacity; arrangement of graduations, numerals, indicator hand, and certain features of the interior mechanism, and the position of the stop pins. Establishment of standards for test equipment and standard methods for testing gauges have also been recommended to the American Engineering Standards Committee.

—*Engineering World*

EDITORIALS

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Education and enlightenment make it necessary. Research and engineering make it possible.

Industry, today, is improving by organization and co-

operation among its members. The greatest work that is being done for the improvement of industry is in the laboratories of the research worker and the engineer. The most active of our modern industries are those which are founded on recent scientific research, and those which organize these researches on a large scale.

INTERCITY TOLL CABLES

(Continued from page 161)

complished by numbering the quads shown in Figure 7 and splicing them together in a predetermined manner.

2. At the so-called "test" splices, of which there are generally three per load section, the quads are so spliced that the "capacity unbalances" (which, in toll cables, contribute greatly to the crosstalk) of the quads spliced together tend to neutralize. "Capacity unbalance" can be roughly defined as the net unbalance in the capacities between the wires of different pairs or between side and phantom circuits which tends to cause electric induction between them. At test splices the capacity unbalances are measured on all of the quads in a segregated group in both directions and the splicing is done so as to secure the bset neutralization practicable.

The toll cable from Milwaukee to Madison is more or less typical of intercity toll cables. At Milwaukee, certain of the circuits connect to circuits in the toll cables between Milwaukee and Chicago so that an all-cable route between Chicago and Madison is available. Three repeater stations are employed with this cable; one at each end, that is, at Milwaukee and Madison, and one approximately at the center, at Watertown. Figures 4 and 5 show various phases of the construction work on this cable. Figure 4 shows a portion of the cable together with one of the open wire lines which the cable replaces. In addition to this open wire line, there is another line between Milwaukee and Madison which is largely replaced by the cable. The wire line shown in the figure has since been dismantled. Figure 5 shows one of the cases containing the loading pots together with the method employed for handling them. The case shown contains loading coils for 45 quads, i. e., 90 side circuit and 45 phantom circuit coils.

The telephone art is developing very rapidly and the descriptions of the methods and practices in this article pertain, of course, only to present conditions. On account of this development, it is obviously impracticable to attempt to predict what practices will be followed in the future.

WHEN LAWYERS FORGET THEIR POSE

Two lawyers in court were engaged in a heated quarrel. Hotter and hotter it waxed. "You're the biggest ass in this room!" cried one.

"Order! Order!" shouted the judge, "you forget that I am here."

A COLLEGIATE SON?

"Father, what makes the world go round?"

"Son, I've told you many times to stay out of the basement."

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