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SOME FEATURES OF ENGINE HOUSE DESIGN

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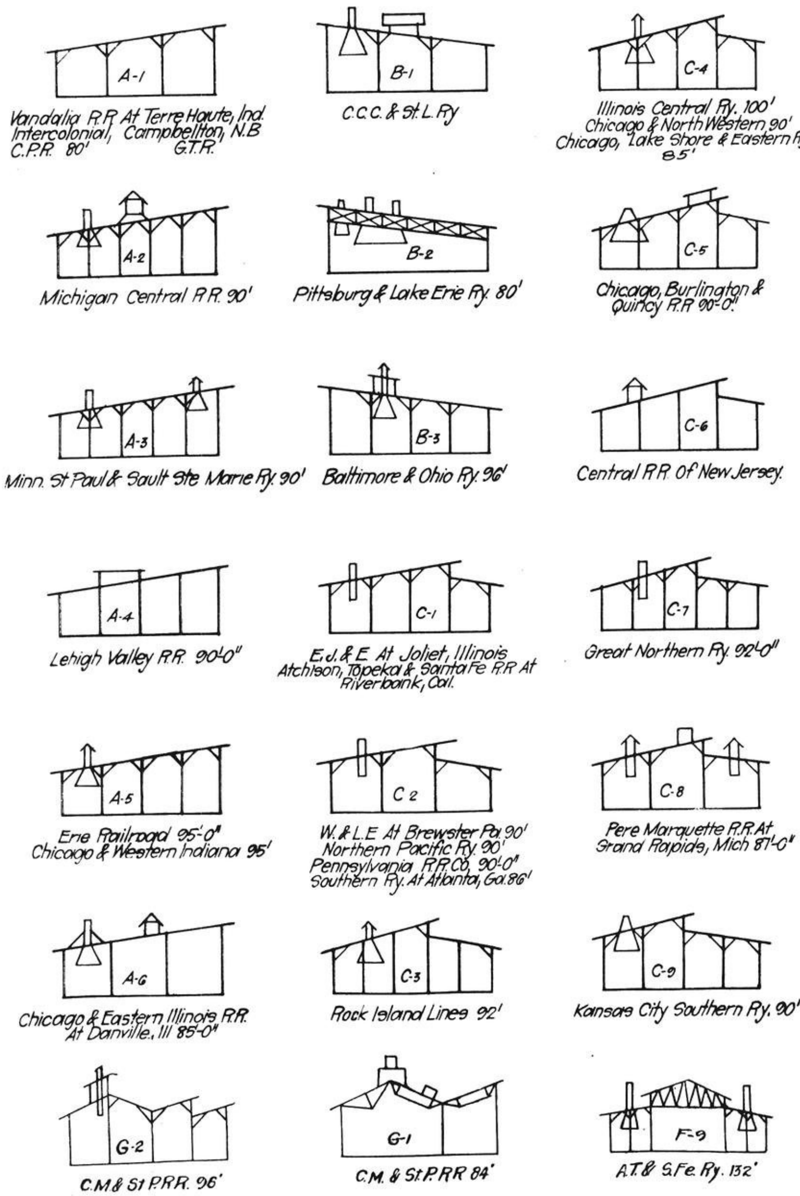
The early conception of the purpose of an engine house was that it was to shelter engines, but now this has come to be only of secondary importance and such structures are used more particularly for making light repairs, and for cleaning or washing out locomotives. It is advisable to protect engines when out of use but those in active service need not, as a rule, be housed except in the more northern climates, where proper care in the open, at times, would be difficult. Some railroads provide an engine house capacity for about twenty-five per cent. of the motive power actually in use.

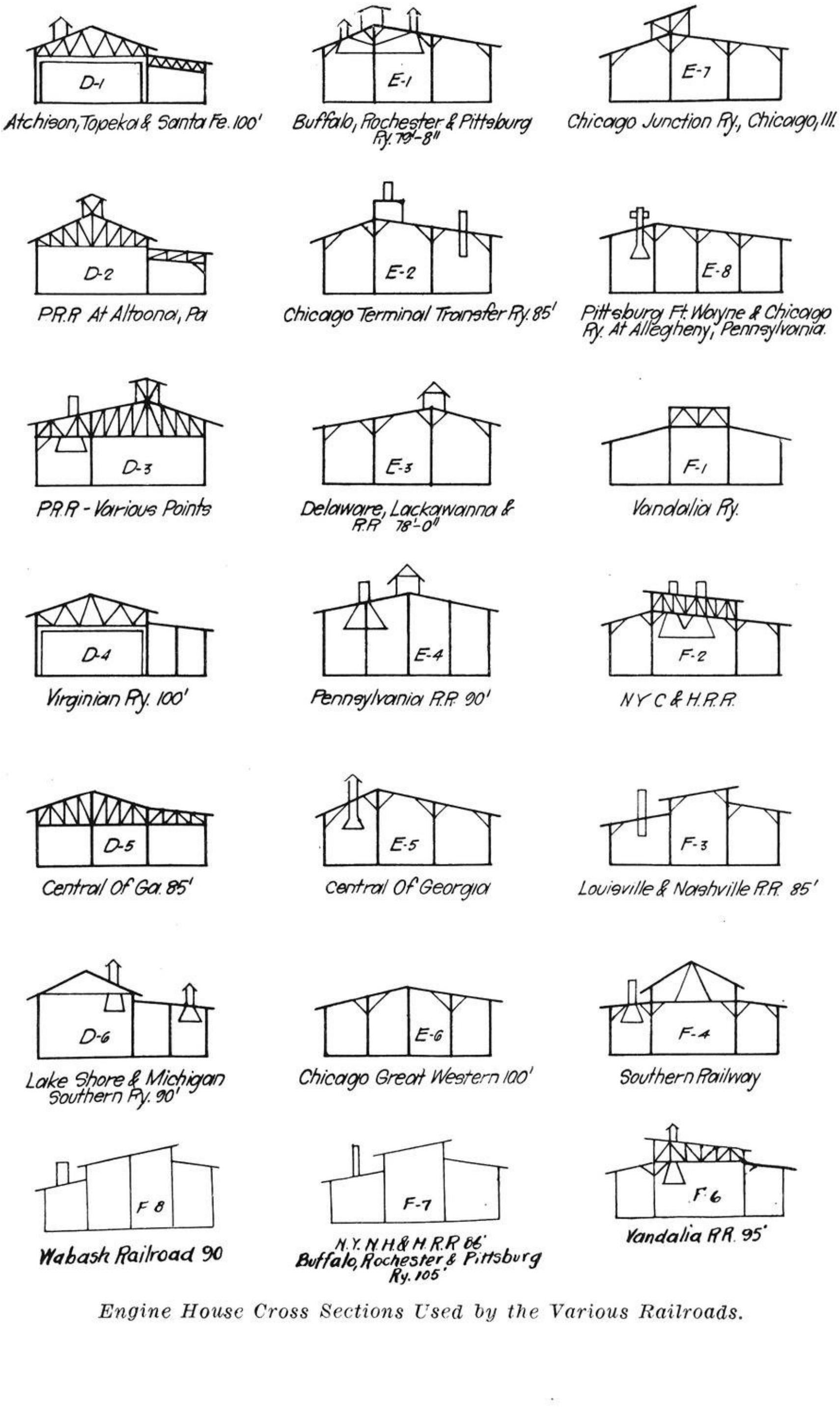
Engine houses are generally located at points where locomotives are changed or held in reserve, such as terminals, division points, or junctions. In connection with the engine house will usually be found a group of auxiliary structures which provide coal, water, sand, oil, and ash handling facilities.

There are two general types of engine houses, (1) the round or polygonal house served by a turntable, and (2) the square or rectangular house which is served either by a ladder track connection to each stall or by a transfer table. Practice has shown that the latter type of construction is used principally for the smaller structures while the round house is used almost universally for the larger designs. There are other forms of houses, some of which have been used quite extensively in other countries, but in America the round house has taken first place in the larger constructions.

Whatever the type of the house, the question of the cross section and the type of roof construction are of considerable im-



Engine House Cross Sections Used by the Various Railroads.



Engine House Cross Sections Used by the Various Railroads.

portance. The accompanying drawings are an attempt to collect and classify the various types of cross sections which have been used by the different railroads in this country. The different houses can be separated into seven distinct groups with reference to the type of roof construction.

Group "A" represents the simplest type of cross section, being a simple shed with a one-slope roof having the lowest side on the outer circle or that which is away from the turntable. The roof itself is supported on the interior by columns or posts varying in number depending on the length of span.

Group "B" is also a one-slope type but it is the reverse of "A," since the lowest part is at the inner circle wall or that which is nearest the turntable. No. 2 of "B" differs somewhat from the others in that no columns are used, but the whole span is supported by a truss which extends between the two outside walls.

The section designated as "C" is a simple construction of rafters, posts, and the necessary bracing, and consists, in a way, of two separate spans, usually with a main or wider part on the outer circle, and a narrow part on the inner circle with C—9 divided equally. The highest point of the roof nearest the turntable is lower than the highest point of the outer circle and thus forms what may be called a "clere" story.

Types marked "D" consist essentially of a main gable-roofed structure with a shed attachment placed on either the outer or the inner circle. In this case a heavier and more cumbersome roof structure seems to prevail, which might be made of steel or wood or a combination of the two. Such a structure is desirable in case the engine house contains a more or less complete shop equipment including an overhead crane, which could operate in the longer or main span.

The section noted as "E" has a plain gable roof with flat slopes, spans of equal or of different lengths, but no "clere" story.

The sections "F" have a central panel where an overhead crane might operate, the roof is of the simple rafter type as F—3 or made of a built up truss as F—1 or 2. On the outer and inner circles are two plain sections, so that the roof drains to both sides.

The type "G" as used by the Chicago, Milwaukee and St. Paul Railroad consists of a main gable roof structure to which is attached one or more one-slope roofs which drain toward the main structure. The purpose of such an arrangement is to provide inside drainage and thus allow no water to accumulate on the inner circle where it might form ice during freezing weather and interfere with the operation of the doors.

In engine house construction there are several factors which influence the choice of the type of structure to be used. These are: the number of engines to be cared for, the climate, future extensions, materials available for construction purposes, the possibility of electrification of all or a part of the line, the available property, and the existing structures at the particular point. In any case, simplicity is an important factor to be kept in mind. By a simple structure is meant one as shown in A—1 or possibly C—2, where the roof consists of wood girders and wood rafters with wood sheathing which may be covered by a built-up roofing either of tar and gravel or asphalt and asbestos composition. In a house which is ninety feet deep say, this distance can be divided into four or five bays by the use of wooden posts with the necessary bracing at the top. The posts are not an objection, but rather an advantage, as many of the tools and appliances which are used in locomotive repair work can be placed conveniently on them and be handier than if put in other places.

Type C—9 is mentioned because such a structure with the clere story adds greatly to the light and ventilation, it is no more difficult to construct and probably not more costly than section A—1.

With simplicity of construction comes decidedly less first cost and maintenance than with a complicated roof truss and a much more satisfactory building as regards light and ventilation. In any structure used for repair work it is coming to be considered necessary to have the place clean for the convenience of the workmen. Not only does proper lighting increase the efficiency of the repairmen, but it aids materially in keeping the place clean. A large part of the light in an engine house comes from the windows in the outer circle wall, and for this reason it is the usual custom to have the engine "head in" so that the working parts are nearest the greatest source of light. The windows in the outer wall extend from perhaps three or four feet above the floor line nearly to the roof, and between columns which are never set directly in front of the engine pit. The reason for the bays in the outer wall being set opposite the stall is to provide for runaway engines and to allow them to run on through the house without damaging the columns and destroying the roof supports, but damaging only the panel or that part taken up by the windows.

In order that more light shall come to the rear of the engine when in the stall, sash are put in the "clere" story as shown by C—1. Such sash are hinged at the bottom and can be operated, when used for ventilating purposes, by a device on the interior of the house. The glass can readily be cleaned from the lower roof.

In engine houses where swinging wooden doors are used, these may contain glass, usually in the upper part, which aids materially in lighting the rear of the engine. Such windows are often apt to be broken from material falling against them or from the swinging of the door in the wind. In such sections as represented by A transoms are sometimes used over the doors. Glass surface in such a place is soon coated with smoke and soot from the engines passing directly under them and therefore the transoms are not able to serve their purpose unless cleaned very often, which is a difficult and continuous task.

Skylights in the roof would no doubt supply a more direct light but, in engine houses, they are not much used because of breakage and continually being in a smoked or blackened condition.

The heating of engine houses, in some cases, is by means of hot air which is forced in by a fan and delivered through registers located in the engine pits. This continuous draft of new air, in connection with proper openings in the roof, aids ventilation materially.

Suppose an engine enters a house such as A—5. Until the stack of the locomotive is directly under the smoke stack there is apt to be a large amount of smoke and gas that comes out into the house and naturally rises to the highest point in the roof or to the peak of the slope. Unless proper vents are provided for rapid removal such smoke and gases are apt to contaminate the surrounding air and thus irritate the workmen. A great many houses are equipped with a louvre constructed at the highest point of the roof. This is very satisfactory for removing impure air, but in colder climates other means must sometimes be used. The "clere" story of section C not only aids in lighting the house properly but by means of louvres also provides for ventilation by allowing the smoke from an incoming engine to be removed rapidly.

The use of metal in the form of roof trusses, drain ports, sash operating devices, etc., is quite undesirable because of the destructive action of the gases that collect near the roof of an engine house. Recently the Algome Central built an engine house with metal roof trusses to which was applied a protective coating produced by an English company. If this kind of protection proves successful it will probably open the way to the greater use of metal in roundhouse construction, and this in turn will simplify several features of design.

Drainage of the roof is taken care of either on the inner or outer circle, but preferably on the latter. If provided on the inner circle some kind of eave trough is necessary with one or more down spouts. These are kept in working order in freezing weather in several cases by means of a connection to live steam. The steam removes any ice which forms so that no great amount accumulates which is apt to hinder proper roof drainage. The Chicago, Milwaukee and St. Paul Railway avoids the annoyance of the dripping water above the doors by sloping the shed roof toward the main building and then providing inside down spouts.

The engine house is strictly a utilitarian edifice and the present tendency in design is to secure the simplest and most inexpensive structure consistent with proper lighting and ventilation.

DROP FORGE COSTS

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The Drop Forge Industry is, comparatively speaking, a new one and its phenomenal growth in the last few years has been due mainly to the automobile. To give an idea of the extent in which forgings are used on automobiles, it might be stated that on the Ford Car there are over one hundred and fifty drop forgings used, varying in size from parts weighing a quarter of a pound and less to an axle weighing thirty pounds. Drop forgings, as they will be considered in this paper, are pieces forged hot into different shapes in special dies. This excludes the work done in open frame steam or board hammers, without the use of dies.

Accounting in the drop forge business in most plants has not kept pace with the mechanical progress of the art. At first there was a large margin of profit; anyone could buy a hammer, press and other necessary equipment, and proceed at once to make large profits. There was a natural rush to this lucrative field of industry with the usual results, namely, heavy price cutting and a scramble for the business.

To give the reader an idea of the difference in original prices and those of today, it can be stated that certain pieces are now sold for about one-fifth of what they brought seven years ago. There is, however, a bottom to everything and the result of this heterogenous cutting of prices has resulted in a good many concerns actually going into bankruptcy, and a good many more running along from year to year with either losses or no profits whatsoever. Had the various forge manufacturers employed a suitable accounting system for determining their costs, they would long ago have discovered the fact that certain articles were being sold for less than the cost required to produce them and heavy losses and some failures would have been forestalled.

There are three items entering into the cost of an article, viz.: Material, labor and overhead. The question of the margin of profit is something that each manufacturer must decide for himself and will not be here discussed.

The material cost on a forging is usually easily determined. When a job is started in a hammer, a requisition for material is made out by the superintendent or his clerk for the stock required to complete the order on that particular piece. The steel is then given to the hammerman by the drop forge storekeeper as he may require it and a record kept of the disbursements. If a hammerman requires more stock than the requisition calls for, the superintendent's attention is immediately called to this fact and he can determine at once whether the amount of stock figured for the piece was not correct or whether the apparent shortage is due to an abnormal amount of scrap. Some plants have the original requisitions made out for an extra amount of steel in order to provide for this contingency, but this invites trouble and is particularly undesirable where the steel is Vanadium or some other expensive type. When the job is completed and the pieces have gone through inspection and have been checked as right, the actual material cost per forging can at once be determined.

The labor cost of a piece is obtained from the time-keeper's daily report. In practically all hammer shops the piece system of paying is used. A man is allowed so much per piece and at the same time is guaranteed a minimum day rate. The first day, when the dies are set up, the hammerman very often does not make enough pieces to give him his day rate, if figured on the piece price basis, so he is given his day rate which varies from three to six dollars per day, depending on the man, the character of the work, the plant, and the plant's location. If later he has trouble with the dies or with the hammer, he may again fail to make the required number of pieces, and when this trouble is something for which he is not responsible himself, he again makes his day rate. For this particular reason the actual cash paid the hammermen on each job must be carefully noted so that when the job is completed, the actual labor cost per piece can be determined which is usually a little higher than the piece price. Daily record sheets should be kept for each man working on a particular job, and when this is completed a labor summary sheet should be made up from the daily sheets and the total labor cost of the job thus found. In every case care should be taken to charge all work possible to the job directly instead of putting it into the general overhead. Some plants endeavor to charge trucking and inspecting to the individual job, but in most cases this is not feasible and only complicates the shop records with no immediate benefit.

The overhead cost to be charged to a piece is the most difficult to determine. It can be found and distributed in a good many different ways. One of the main points, however, is the securing of all the items that make up the overhead. In too many plants there is a tendency to consider certain outlays as extraordinary or as hard luck, and they are not charged to the plant overhead but to "Profit and Loss." This gives the management a wrong idea of what the overhead actually is and work is therefore taken at too low a figure. This results in the book figure profit for the year being entirely wiped out or at least badly cut into by the profit and loss account.

Under the head of Drop Forge Overhead, there are five main items:

(1) Non-productive labor in the forge plant.
(2) Non-productive material purchases.
(3) General overhead expenses.
(4) The die room.
(5) Depreciation.

In order to properly analyze the non-productive labor in a forge plant, it is desirable to cover with series of numbers the various non-productive activities. A table of such charge numbers is given below.

S—1 Repairs to Buildings and Grounds

This number covers repairs to buildings and grounds, and also cleaning up and grading.

S—2 Repairs to Equipment

This number covers repairs to the shop equipment, meaning non-producing units such as shop trucks, pulleys, line shafting, etc.

S—3 Repairs to Machinery

This number covers repairs to machinery such as presses, hammers, etc.

S—4 Repairs to Dies and Jigs

This number covers repairs to dies and jigs, but should in no case be used to cover the making of new or duplicate dies.

S—5 Repairs to Miscellaneous Tools

This number covers repairs to miscellaneous tools, such as chisels, hammers, tongs, etc.

S—6 Repair to Shop and Office Furniture and Fixtures

This number covers repairs to furniture, such as chairs and tables and also the making of rough shop fixtures such as cupboards.

S—7 Repairs to Patterns

This number covers repairs to patterns, but should not be used to cover the making of new patterns.

S—8 Experimental Work and Testing

This number covers experimental work and testing.

S—9 Power

This number covers the cost of power.

S—10 Foremen, Assistants and Die Setters

S—11 Shop Oilers

S—12 Trucking

S—13 Inspection

S—14 Stock Department

This number covers the labor used in handling rough stock.

S—15 Cutting, Handling and Loading Scrap

This number covers the labor used in cutting drop forge and sheet metal scrap.

S—16 Shipping and Receiving

S—17 Janitors and Sweepers

S—18 Hardening and Annealing

S—19 Perishable Tools

This number covers the cost of making small perishable tools such as reamers and drills.

S—20 Moving of Machinery

This number covers the necessary cost of moving machinery.

S—30 Extraordinary Expenses

This number covers unusual expenses which cannot be classified under the above charge numbers.

The time keeper carefully collects the time each day and at the end of the month or pay posts it from his daily reports, where it is kept under the workman's name, to the summary sheets where it is segregated according to the character of the work and the job. Under the character of the labor is understood asset labor, productive labor and non-productive labor. Non-productive labor is divided up as indicated and a monthly report made of the same. A table showing such a division for an actual plant is given below:

1	Repairs to buildings and grounds	$ 14.27
2	Repairs to equipment	143.34
3	Repairs to machinery	309.83
4	Repairs to dies and jigs	8.63
5	Repairs to miscellaneous tools	6.50
6	Repairs to furniture and fixtures	.14
7	Repairs to patterns	3.42
8	Experimental work and testing	1.96
9	Power	72.42
10	Foremen, assistants and die setters	125.10
11	Shop oilers	6.13
12	Trucking	53.47
13	Inspection	144.89
14	Stock	55.77
15	Cutting, handling and loading scrap	27.12
16	Shipping and receiving	36.00
17	Janitors and sweepers	67.66
18	Hardening and annealing	19.82
19	Perishable tools	.....
20	Moving machinery	.....
30	Extraordinary expenses	2.22
		$1,098.69

By keeping this record month by month and comparing the figures for the different months, a drop forge manager can very readily see which items are getting too high and can curtail accordingly.

The non-productive material purchases can be obtained either by classifying the original purchases or by means of a factory requisition system. The latter method is quite difficult and means considerable pricing with resultant clerical work. On the other hand, the classification of the actual purchase invoices as they are received and the charging of them to the current month is unfair to the particular month in which a large amount of non-productive material is purchased and not very much actually used. The overhead however must be determined for the year so that the total result obtained by the purchase invoice method is proper and also better than the shop requisition method where items are liable to be missed. The purchase invoice records must check with the monthly trial balance and they must always, therefore, be absolutely correct. It is very often desirable to classify the requisitions under different headings such as Tool Steel, Oil, Waste, etc. This classification should be made after a series of months rather than monthly, since many articles are purchased periodically.

Under General Overhead Expense we have first the items of Fuel, Fuel Oil, Electricity and Water. The other large items of General Overhead Expense are Executive, Office and Sales Expense. Under this heading it must also be remembered to include Interest and Discount, Taxes, Bad Accounts, Legal Expenses and all the expense of a general nature to which a drop forge plant is usually subject. Particular care should be taken to put these various miscellaneous items under the heading of General Overhead and not into the Profit and Loss Account. Any business is bound to have certain unexpected expenses of some nature and although they may be heavy in one particular month, the total result will be the same and in this case the overhead should be so figured that such contingencies are taken care of.

Below is a table showing non-productive material purchase items and expense items for a forge plant:

Non-productive material purchases	$ 667.00
Fuel, fuel oil used in heating	589.00
Power used for presses, grinders, etc	260.00
Gas used below boilers for steam	277.00
Water	60.00
Insurance and taxes	65.00
Office expenses	700.00
Interest, divident on preferred stock, discounts	453.00
	$3,071.00

The die room is a difficult matter to handle and every plant manager has his own idea of how this should be done. It all depends on the character of the business and the way prices are quoted. Most plants are now quoting a die cost entirely separate from the price of forgings and it really seems as if this were perhaps the best way to handle this difficult problem. The forgings are then obliged to stand on their own merits, as well as the dies. This tends to much more careful estimating than when the two are lumped together and the forging cost obliged to carry a part of the die charge. The die room should be considered as a separate plant and the material, labor and overhead figured the same as in the case of a forge plant proper. The productive labor of the die room is the work actually charged to dies. The material used is the material required for the dies and trimmers. The die room overhead is found and calculated exactly in the same manner as in the case of the forge plant proper. Figures for a die room are given below. The non-productive labor instead of being in detail as it was in the case of the forge plant is given in total.

Non-productive labor S—1 to S—30	$ 549.00
Non-productive material	124.00
Power	43.00
Insurance and taxes	58.00
Office expense	620.00
Interest, dividend, discounts, etc	400.00
Total overhead	$1,794.00
Total productive labor	1,530.00
Die blocks and tool steel	500.00
Depreciation	100.00
Grand total die room expense	$3,924.00

The above figures show the total expense of running the die room for one month. From this figure we can subtract the actual cash received for dies from customers during the month and the difference will be the part of the die room expense that must be carried by the forge plant as an overhead amount. Most of the large drop forge companies have one or two large customers that are not charged for dies so that there is always a large portion of the die room expense not taken care of that must be charged to overhead. Assuming in the above case that $500 was received from customers for dies, we have a charge of $3,424 to be applied to the overhead of the forging plant.

The question of depreciation is a subject in itself and there are many different opinions as to the rate to be charged. We are not going into this matter, but will assume that in this case the depreciation charge is $400 a month. It should be borne in mind however, that there is a very great difference between a depreciation charge and a charge for depreciation and maintenance. The latter item in the case of a forge plant is very great, but in the system outlined herein, the maintenance is cared for by the non-productive labor charge as shown, so that the depreciation itself can be made correspondingly small.

Summarizing the items of overhead therefore we arrive at the following table:

1 Non-productive labor	$1,089.69
2–3 Non-productive material purchases and general overhead expense	3,071.00
4 Die room	3,424.00
5 Depreciation	400.00
Grand total overhead	$7,993.69
Productive labor	2,800.00
Overhead	284%

Assuming the productive labor to have been $2,800 the overhead for the month is 284 per cent. Having determined the overhead for the month, the cost of forgings can easily be determined by adding to the material and productive labor values for any particular piece, the proper percentage of the productive labor as an overhead item. In practice however, the overhead should be carefully checked up month after month and a yearly figure used, for the average will vary greatly depending on the amount of work in the plant, the character of the work, and other minor considerations.

There are several plants in operation where the overhead is applied somewhat differently. The blanket method of applying the overhead charges small jobs with too much overhead and the large ones with not enough. A large hammer represents a greater investment, occupies more space and its operating expense is greater than that of a small hammer, particularly if the latter is a board hammer. The fact that there will be more productive labor on the large hammer because of extra heaters will in a way take care of the difficulty but usually not sufficiently to equalize matters.

To handle this discrepancy an hour rate is determined for each hammer. A table of such hour rates is given below:

5,000 pound hammer	....	$8.00 per hour
2,500 " "	....	5.00 " "
1,800 " "	....	3.50 " "
1,200 " "	....	2.00 " "

Assume that a certain job is run in a 5,000-pound hammer for a day. The overhead to be charged to that job would then be $80. The material and labor are all found directly as previously shown. This method of handling the overhead is theroetically correct but care should be taken to see that at the end of a series of months, the total overhead earned by the hammers is equal to the actual overhead of the plant.

The method of obtaining the cost of 2,065 automobile spindles for a plant having 284 per cent. overhead is shown below:

	Total
Material cost	$538.56
Labor cost	64.21
Overhead cost (284%)	182.35
	$785.12
Good pieces made	2,056
Cost per hundred	38.20

The cost obtained by using the second method of applying the overhead assuming fifty hour of work in a 2,500-pound hammer would line up about as follows:

Material cost	$538.56
Labor cost	64.21
Overhead cost 40 hours @ $5.00	200.00
	$802.87
Good pieces made	2,056
Cost per hundred	39.00

In conclusion it should be stated that accuracy is essential to reliable costs in the drop forge business. Special precaution should be taken to cross check all important items so that no portion of material, labor or overhead is overlooked and omitted. The overhead should be found every month but should be carried as an accumulative total from the beginning of the fiscal year to its close. It is the final yearly total for overhead that determines the result of a year's operation and not the monthly figure for some particularly busy and prosperous month.

CONCRETE IDLER STANDS

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While employed as engineer on the installation of the permanent plant at the Isabella Mine, Palmer, Michigan, the author was requested by Superintendent Thomas J. Nicholas to prepare plans for three concrete idler stands. The plans, as drawn, were based on the circular, "Concrete Poles," published by the Universal Portland Cement Company.

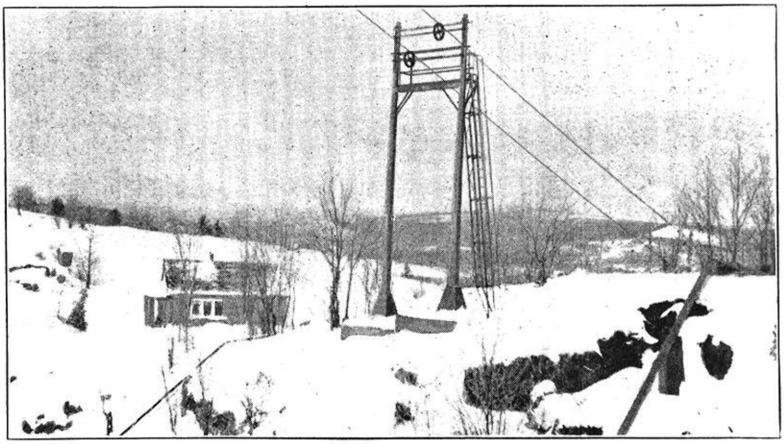


FIG 1.—*Stand No. 1.*

The first idler stand is placed on a solid rock bluff of Goodrich quartzite, eighty feet from the steel idler on the shaft house. The second is on an outcrop of the same rock standing up about five feet. The third is on a solid ledge five feet from the engine house.

Only the first and largest of the stands will be described in detail. The poles for this stand were given a greater span than necessary for carrying the two skip rope idlers, and by addition of a third pole, the stand will serve for both skip and cage hoists.

* Mr. Fred Gibbs, M. C. M. '14, assisted Mr. Hunner in the construction.

Computations were made on the run of the idler wheels at each stand, their rope and axle elevations, and the size of posts necessary. Three inches were allowed for play between the posts and the outer position of the hub of the idler, and this gave the distance between the centers of the posts and the co-ordinates of the centers. The general problem of construction will be easily seen from Fig. 4.

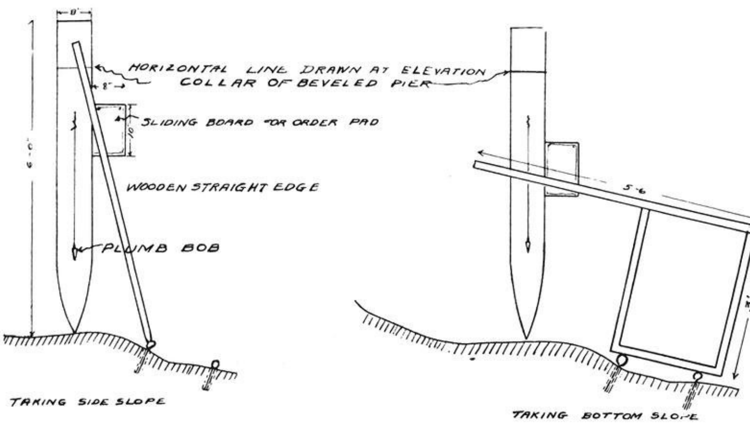


FIG. 2.—*Apparatus for Finding Angles.*

From the above mentioned centers, with a radius of one and five-tenths feet, eight holes in the rock for anchor bolts were spotted symmetrically. A second ring of holes with a three foot radius were lined up with the holes in the first ring, one set of four holes being in line with the pole centers. A jack hammer was used to put these holes down eight inches. Anchor bolts with eyes faced center were cemented into the holes. These were allowed to set before the reinforcing rods were put into place. The bolts were made of one and one-half inch iron with an eight inch shank and a one and one-half inch bend at the bottom. The eye was not welded and was made to pass a one inch square rod.

The rock surface was very irregular and the reinforcing rods needed considerable bending to pass through their anchor bolts. For finding the angles of bending the outfit in Fig. 2 was used. The board was one by eight inches and six feet high, pointed at the base. A plumb bob was hung on a center line for finding the vertical. A horizontal line was drawn across the board at the height of the collar of the bevelled pier (see Fig. 1), and on this line were marked the distances from the post center to the corner and side reinforcing rods. An eight by ten inch board holding order sheets was slid up and down on the edge of the larger board. The length to be included on the bend was taken from the point on the horizontal line on the board corresponding to the side or corner rods to the anchor bolt eye. A straight edged board laid between these points gave the slope, which was struck off on the order blank and the length marked upon it. A short vertical line was drawn from the top of this line and the total length of the reinforcing rod in the pole above the base recorded upon it. To get the angle at the foot the rectangular straight edge was placed on the top of the eye bolt loops and a line struck intersecting the first line. Enough length was recorded on this line to allow the rod to pass from the inner bolt through the outer to the edge of the footing. This data gave the blacksmith accurate measurements of the angles to put into the rods and the exact length of each portion of the rod. The rods were welded full length and were placed in position as soon as the scaffold was complete.

Reinforcement

All rods were of ribbed steel and were one inch square, with the exception of those on the corners, which were seven-eighths inch square. The rods were tied at the collar of the bevelled piers by number twelve galvanized wire to an iron hoop seven inches square and made from one-eight inch by one inch stock. They were tied to similar squares at three other places above: the first at the top of the poles, the second at the top of the east and west center rods, and the third nine feet below the latter.

Starting from the top of the bevelled pier all rods were bound horizontally with number twelve galvanized wire, the intervals being gradually reduced from twenty inches at the bottom to ten inches at the top of the pole. The wire was wound around each rod once and thence carried to the adjoining one until the circuit was made. At variable intervals the rods were bound by cross wiring in order to keep bends and kinks from protruding too far.

Four one-fourth inch square iron rods were used as reinforcement in the eight by eight inch horizontal brace. The rods were held apart at three points by hoops four inches square made of one-eighth inch by one inch strap. Eight inches back from the ends, the four horizontal rods were bent down and bound with number twelve wire to the vertical rods in the posts.

Forms

The base forms were made from two inch hemlock, the pier and pole forms of one inch hemlock. The pole forms were made in three sections, with twelve feet in the bottom, ten feet in the middle, and eight and one-half feet in the top sections. The side of each form consisted of one board braced every two feet

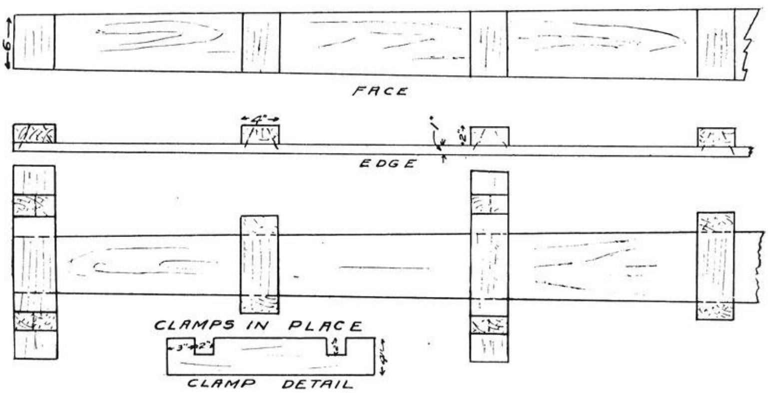


Fig. 3.—*Detail of Side of Form.*

by a piece of two by four nailed on as shown in the drawing, Fig. 3.

Three sides were nailed together on the ground and then this part was placed around the rods and the fourth side nailed on. The form was then lined in with a transit and spragged securely. Clamps to keep the forms from warping were constructed to fit over every other set of braces. The clamps were cut as shown in Fig. 3 and were held together by the notches, two of the pieces being placed with the notches up and two with notches down, inter-locking the first two pieces. Wedges were seldom necessary to bring them to a tight fit.

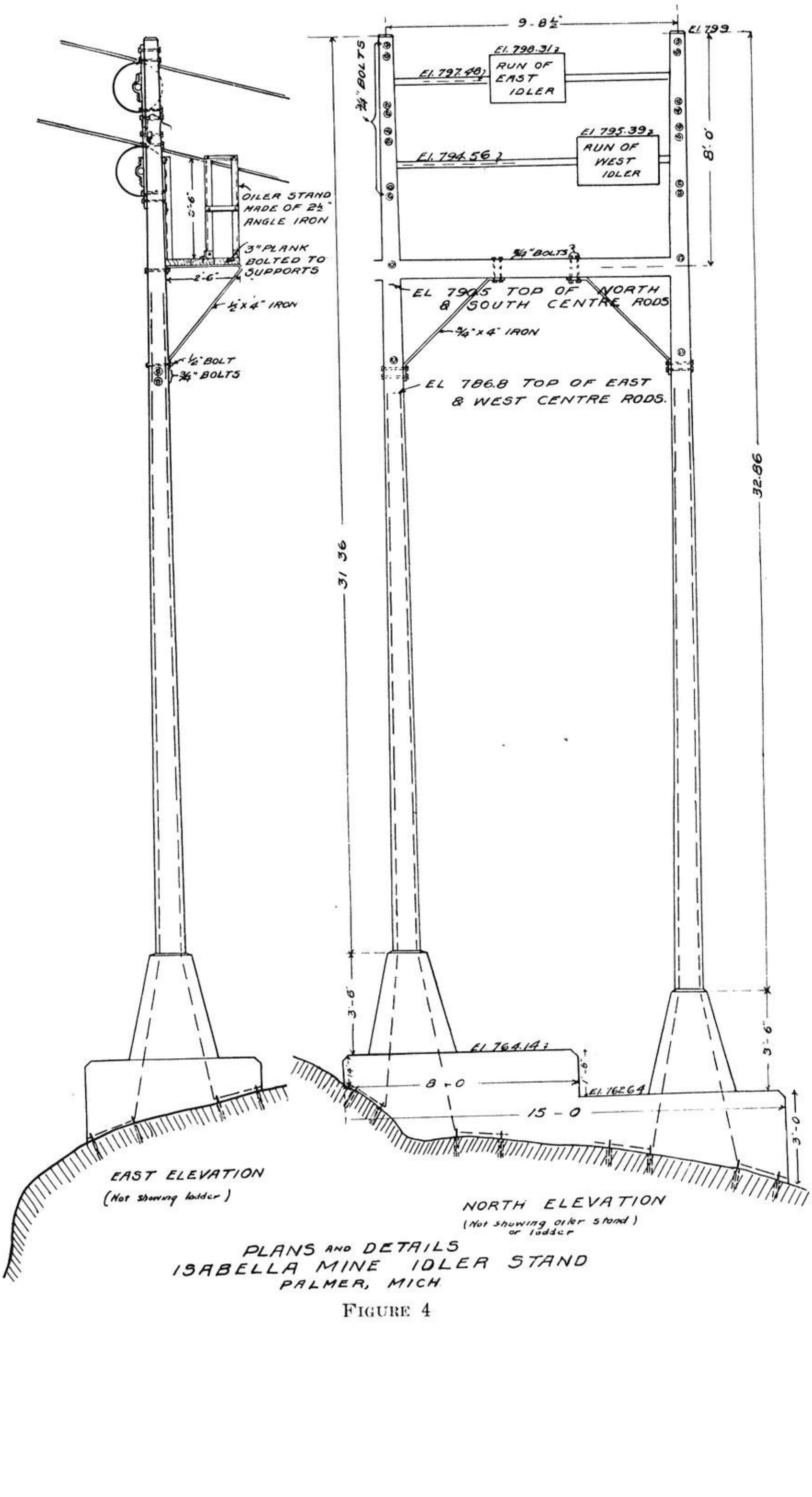

9-8½"
El. 799
El. 798.31½
RUN OF EAST IDLER
El. 797.48½
¾" BOLTS
El. 795.39½
RUN OF WEST IDLER
El. 794.56½
8'0"
OILER STAND MADE OF 2½" ANGLE IRON
5'6"
3" PLANK BOLTED TO SUPPORTS
2'6"
½"x4" IRON
½" BOLT
¾" BOLTS
¾" BOLTS
EL 790.5 TOP OF NORTH & SOUTH CENTRE RODS
¾"x4" IRON
EL 786.8 TOP OF EAST & WEST CENTRE RODS.
31.36
32.86
3'6"
3'6"
El. 764.14½
14"
8-0
1'6"
El. 762.64
15-0
3'0"
EAST ELEVATION
(Not showing ladder)
NORTH ELEVATION
(Not showing oiler stand or ladder)
PLANS AND DETAILS
ISABELLA MINE IDLER STAND
PALMER, MICH.

FIGURE 4

Construction

As soon as the anchor bolts had become firm, a staging was erected to the proposed height of the idler. The base of the staging was about eight feet by sixteen feet and the sides were carried up plumb.

The reinforcing rods were placed in position and were bound only at the collar of the bevelled pier. After the base forms were finished the rock footing was washed clean and the rods spragged into position, a transit being used to line up the bottom ring. The base was then poured, short lengths of rail, pieces of old cable and wire being used for reinforcement. The forms for the bevelled piers were immediately centered and filled and tamped thoroughly, pails being used to fill from the top. The mixing was all done by machine. The proportions used in the base and the bevelled forms were three sand, two small stones, one cement.

The wiring of the rods was completed while the base was setting for two days. The lower section of the pole forms was then centered, spragged and filled. The rods cleared inside of the forms about one and one-fourth inch and it was necessary in tamping to watch them closely in order to keep them centered. The proportions used were three sand, two pebbles (maximum size, three-fourths inch), one cement. The mixture was hoisted to the top of the forms in pails and was poured in and then tamped with long rods.

The middle section was added after the bottom section had set a few days. The upper forms were spragged to the lower sections of the opposite pole already placed and filled. The top forms were handled in the same manner as the other forms.

The holes for the bolts were made by inserting one inch iron pipe in the form just the length of the inside dimensions of the form. One end of the pipe was held in place by nails extending through from the outside, and other end was held by a wooden plug in the hole through which the pipe was inserted. The brace form was set into the sides of the top forms and filled at the same time.

The forms were left on for several days, and after they were removed the whole stand was allowed to set for two weeks before the trimmings were put on. The large idler stand was guyed at the top of the poles by four one-fourth inch wires, but this precaution seems to have been unnecessary. It was found when the first guy wire was attached that one could easily sway the stand three or four inches. After five months use they show no signs of craks and get stiffer as the cement nears its setting limit. The two shorter stands could not be swayed at all by hand.

Costs

Total labor costs (ladder included)		$356.15
Supplies:		
2,936 lb. reinforcing steel, 1 in., 7/8 in., 3/4 in., 1/2 in.		46.98
5/16 in. galvanized steel wire, 3 strand		4.00
95 sacks of cement		31.58
Sand (cost of hauling)		27.00
Total iron and steel (ladder included) (reinforcing not included)		22.95
Total costs		$511.82
Total labor	$356.15	
Total supplies	155.67	

Wood used in the forms was not included in the costs, since it had previously been charged to another job. Its cost at $22.50 per thousand would have been about $28. The work was nearly all done by unskilled labor and for this reason the smaller stands were built at a lower comparative cost than the larger, due to the experience gained.

Mr. Gibbs took charge of the engineering work at the time that the concreting was started on No. 1 stand. He furnished most of the data and the photographs, for which the author is greatly indebted. Permission to publish the costs was obtained through the kindness of Mr. O. B. Warren, general manager. The author wishes to thank Superintendent Nicholas for his kindly advice and interest in the planning. Credit is due to him for having been the first to use concrete construction in this particular work.

NICKEL STEEL

G. W. Armstrong
Instructor in Chemical Engineering

The nickel steels are the most important and the most widely used of the alloy steels. Those in common use seldom contain more than five per cent, nickel and five-tenths per cent. carbon. Their greatest use is in structural steel, rails, castings, and automobile steels, where their superior qualities more than compensate for their greater cost. In addition to greater strength, these steels are freer from segregation, less apt to corrode, have a lower melting point, thus facilitating casting, and are harder than ordinary straight carbon steels.

The strength of nickel steels depends on both the nickel and carbon content. Below are the results of comparative tests on nickel and straight carbon steels, each grain refined and hardened at the best hardening temperatures, and tempered to various degrees.

Straight Carbon Steel C .30

Drawing Temp.	Time Held	T. S.	E. L.	Extension	Contraction
Undrawn		112,000	88,000	16%	51%
204° C	half hour	108,500	74,400	21%	62%
316° C	one hour	108,500	76,700	21.6%	64.4%
427° C	one hour	108,000	70,500	17%	64%
538° C	half hour	91,600	58,100	28.1%	65%
649° C	half hour	84,300	49,000	31%	69.9%

Nickel Steel Ni. 3.50% C.%.

Drawing Temp.	Time Held	T. S.	E. L.	Extension	Contraction
Undrawn		Breaks Short			
204° C	one hour	250,000	218,000	7.7%	22.7%
316° C	one hour	216,000	190,800	11.7%	43.2%
427° C	one hour	148,400	137,500	16.1%	50.4%
538° C	half hour	121,500	100,000	21.2%	58.7%
649° C	half hour	102,000	60,000	27%	66.4%

It will be noticed that the nickel steel has a higher elastic limit with only a slight decrease in ductility as indicated by the extension. It is this increase in elastic limit which is the chief reason for the increased resistance of nickel steels to alternate stresses under which all steels will ultimately break down.

The heat treatment of nickel steel is very similar to that of straight carbon steel, except that the critical range, above which

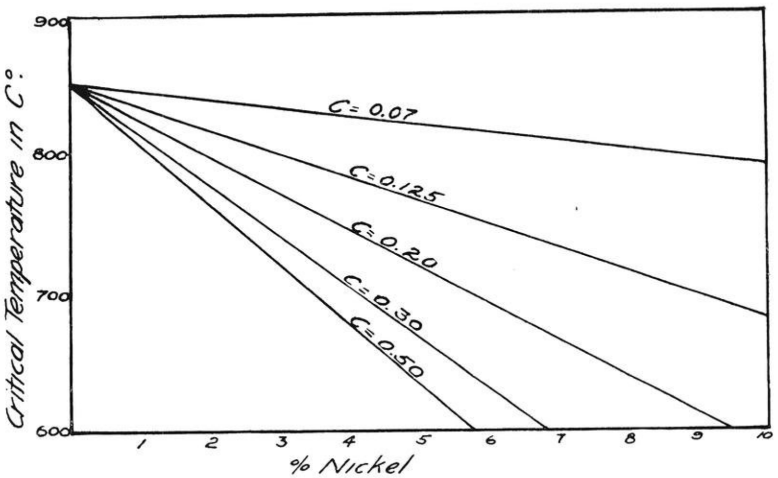


FIGURE 1

all steels must be heated to harden or anneal, is lower. Fig. 1 shows the effect of both nickel and carbon on the upper limit of

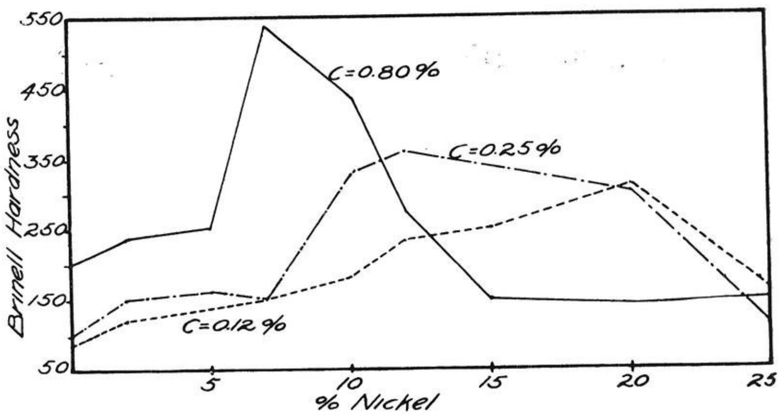


FIGURE 2

the critical range. Each curve represents a definite carbon content, and points on the curve represent the critical temperature for varying nickel content. If it were desired to harden a steel with three-tenths carbon and three and five-tenths nickel, the diagram shows that the steel must be heated above 740 degrees Centigrade. It is good practice to heat about 25 degrees Centi-

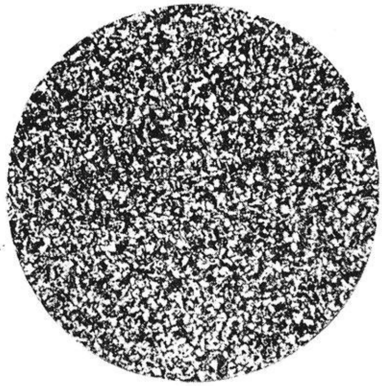


FIG. 3.—*Straight Carbon Steel Before Treating. C. 30% 72 dia.*

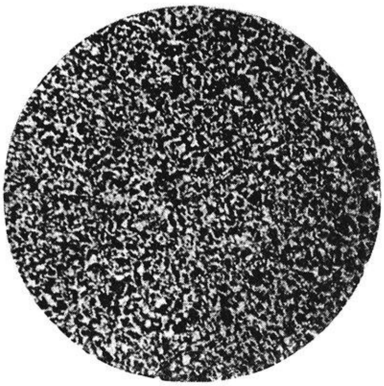
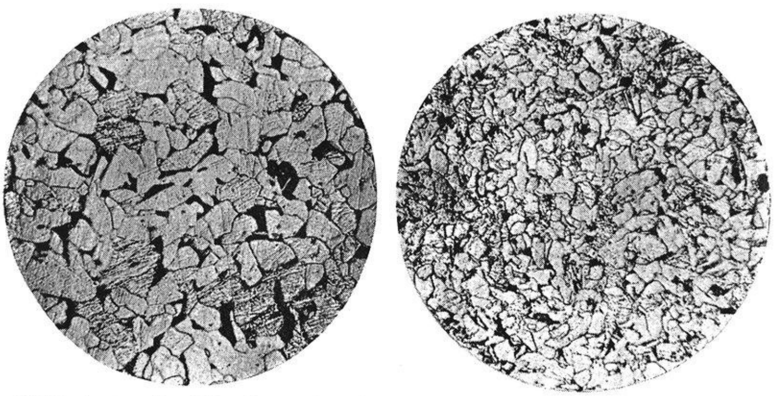


FIG. 4.—*Nickel Steel Before Treating. No. 3.50% C. 30% 72 dia.*

grade above the critical range to allow for any errors in the determination of the critical range and temperature measurement during heating, as well as the cooling which takes place while the



FIGS. 5 AND 6.—*The Same Straight Carbon and Nickel Steels After Heating to 1,200° for One-half Hour and Slowly Cooling. 72 dia.*

piece is being transferred from the furnace to the quenching medium. This would make the correct hardening temperature of this steel about 765 degrees Centigrade.

The hardness of a steel depends on the rate at which it is cooled through the critical range down to atmospheric temperature, and also on the location of the critical range. If the latter is at a low temperature the steel is so rigid that the changes which cause the steel to become soft can only take place with difficulty. This explains the fact that nickel steels are harder than straight carbon steels. Fig. 2 is a diagram showing the effect of nickel on the hardness of forged steels with .12 carbon, .25 carbon, .80 carbon.

Another beneficial effect of nickel steel is to decrease the rate at which the grain size increases. This is one of the reasons for the superior physical properties of nickel steels. Figs. 3 and 4 show straight carbon and three and five-tenths nickel steels, respectively, each containing about three-tenths carbon and having practically the same grain size. Figs. 5 and 6 show these steels heated to 1,200 degrees Centigrade, for one-half hour, and cooled in the furnace. It is very evident that in the straight carbon steel, Fig. 5, the grain size as indicated by the polygonal structure is much larger than in the nickel steel, Fig. 6. This property makes nickel steels well suited for case hardening since the soft core does not become coarse grained under the high temperature to which it is subjected for a long time.

WHY SOME ELECTRIC MOTORS FAIL.

EDWIN A. KAUMHEIMER.

Every designer of electric machinery allows a liberal margin for the fool factor which enters into every machine that is likely to be used by inexpert mechanics, but it seems as though it were impossible to make this factor anywhere nearly large enough in the case of electric motors. Here are two typical cases that came under the observation of the author during the past summer.

The first was the case of a ten horse-power, three-phase induction motor which furnished the power for a stonecrusher and conveyer. The repairmen who had been called to remedy a breakdown in the motor reported to the foreman of the shop that they could not find the ——d thing in the place which had been indicated. "Oh, there's a little dirt on top of it; if that's what you mean," they were told. The little dirt proved to be a single thickness of tar paper and two full wagonloads of crushed rock, a liberal quantity of which was also discovered in the motor. The motor had been running ten hours a day for two months and had not been oiled in that time. It was also discovered that the foreman had short-circuited the starting compensator "because it was too much trouble to use the thingumabob" and was starting the motor directly across the line. Blown fuses had been replaced with heavy copper wire. The company had previously threatened to sue the makers for delivery of a machine defective in material and workmanship!

The other case was that of a direct-current motor which the purchaser had connected up himself. The results surpassed the fondest expectations of the amateur electrician. The motor, which was a 110 volt series machine of three horse-power, was connected to 220 volt lighting circuit. The belt was placed on the pulley but the motor was not fastened down. When the current was turned on, the motor gave a complaining rumble and then commenced to give a first-class imitation of a flying machine. The belt became tangled about the pulley and the motor soared upward till it tore the lead wires, the resulting arc causing a small fire. The power for this man's little basement shop is now furnished by a water-motor. "Electricity is too risky."

Perhaps I am wrong in calling these cases typical. It is true that they are rather extreme examples of abuse, but the tendency which they illustrate is also extremely common.

A SUGGESTED RE-ARRANGEMENT AND CENTRALIZATION OF THE RAILWAY FACILITIES OF MADISON, WISCONSIN

Thesis by W. P. Bloecher, c '14 *and* H. C. Henze, c '14
Reviewed by L. F. Van Hagan, *Assistant Professor of Railway Engineering*

When Mr. Good Citizen, after remaining at his desk until the last possible minute, dashes into the station of the A. B. & C. railway only to be informed that the 5:15 train, which he had intended to take, leaves from the X. Y. & Z. station, a mile or so away; or when he lingers about the X. Y. & Z. station until midnight and then learns, after calling up his home, that wifey's college chum has arrived "on the A. B. & C. this time, for a change you know," he is inclined to wonder why such things must be, why it wouldn't be a good plan to provide a common meeting place for trains and passengers.

Whenever a city is so fortunately situated as to be served by more than one railway line, there is more or less temptation, for those interested in transportation matters and in the city, to devise some arrangement by which the passenger traffic of the various lines may be centered in a single station. This desire to consolidate railway facilities is in line with the tendency that is apparent in the business world, where firms that are in the same kind of business to segregate. In those cities that are large enough to have a considerable number of firms engaged in each of the important lines of business, this tendency is plainly evident. The commission merchants cluster in commission row; the typewriter firms center in another district; the law firms favor one office building, the doctors another, and so on through many businesses and professions. Such segregation offers convenience, if nothing more, both to the business firms and to the people dealing with them. Likewise, the centralization of railway passenger facilities presents many alluring possibilities in the way of convenience. The traveler who must change from one road to another, is saved the anxiety and annoyance attendant upon the transfer of himself and his baggage from one station to another several blocks away. Such considerations, small as they may seem, affect the regard in which a city is held by non-residents. The resident also benefits directly by being saved the annoyance and embarrassments arising from confusion and mistakes in regard to trains and stations. From the standpoint of the railways there is the saving effected in having but one station instead of several, to staff and maintain.

The present study was undertaken to ascertain whether it were possible to arrange such consolidated facilities for the passenger traffic of Madison.

The Present Situation

Madison is served by three railways, the Chicago and Northwestern, the Chicago, Milwaukee and St. Paul, and the Illinois Central, which provide nine separate railway lines into the city with four passenger and three freight stations.

The passenger station of the Northwestern Railway is new, commodious and well appointed as regards both convenience for passengers and track facilities. The location of the station is excellent, since it is but a short distance from the business center of the city and is located upon the longest and most important street railway route. The only serious objection to the station that the authors mention is the Blount street grade crossing, just north of the station platforms, as a result of which the longer trains must be cut in two if they stand in the yard more than five minutes.

The Chicago, Milwaukee and St. Paul Railway, known locally as the St. Paul, maintains two passenger stations. The main station is known as the West Madison station. The other, known as the East Madison station, is located near the Northwestern station and about a mile from the main station. The authors find the following defects in the stations and their locations:

1. The two stations involve an apparently unnecessary duplication of expense for maintenance and operation.

2. The West Madison station, while ample so far as the building is concerned, has an inconvenient track arrangement and inadequate platform facilities.

3. The West Madison station cannot be reached conveniently from the University district which furnishes a large proportion of the passenger business of the city.

4. It is the practice for the St. Paul trains to make the run from the West to the East Madison station and back in order to pick up those passengers who find it inconvenient to go to West Madison.

5. The larger portion of the company's passenger business is done at East Madison. The station is inadequate both in size and in appointment for the large amount of business handled there.

6. The two stations, located within a mile of each other and both poorly named, are confusing and inconvenient to the unknowing traveler, who frequently alights at the wrong station.

The Illinois Central station is more than ample in size for the business handled. The building, however, is an old one and is poorly appointed. It is located near the West Madison station of the St. Paul and, like the latter, cannot be reached conveniently from the University quarter of the city.

It will be noted from the preceding, that the passenger stations are arranged in two groups located about a mile apart, one group at East Madison, comprising the Chicago and Northwestern station and the East Madison station of the Chicago, Milwaukee and St. Paul Railway, the other group at West Madison, comprising the West Madison station of the St. Paul road and the Illinois Central station. Between these two groups mail, express, baggage and about one hundred and fifty passengers are transported daily by team and street car. The bulk of the passenger business is handled at East Madison which has the better street car facilities and is therefore more accessible.

A Union Station

The authors discuss the advisability of a scheme for a union station designed to accommodate all of the railways. Since none of the existing stations is large enough to handle the maximum business that a union station would be called upon to handle, a new station would be necessary with consequent abandonment of the several old stations. The authors conclude that such a scheme is impracticable, since the Northwestern is well provided for as it is and would receive little or no benefit from a union station. The economic waste involved in abandoning the present Northwestern station is believed to be unjustifiable under present conditions. The plan finally proposed by the authors, provides for a joint station to accommodate the Chicago, Milwaukee and St. Paul Railway and the Illinois Central Railroad.

Location of Proposed Joint Station

It is evident, from what has gone before, that West Madison is not a convenient location for a station. A study of possible changes in the routing of the street railway for the purpose of making West Madison more accessible offers little encouragement along that line.

The "Triangle" at the foot of Hamilton street, was suggested as a possible site in a thesis written some years ago. This site also is inaccessible. Street car facilities would always be poor and the streets leadng to the site are narrow and have bad grades.

Between the Triangle and East Madison the topography of the city is unfavorable. Nevertheless the foot of Monona avenue has been suggested as a site and some study was given to this location. At present no street railway is anywhere near this site. An attempt was made to arrange tracks and routing so as to provide satisfactory street car service for a station at that point but the attempt did not produce satisfactory results and the site was abandoned chiefly on that account.

The location finally chosen by the authors was the site of the present East Madison station of the St. Paul Railway. The company already owns most of the land necessary for the station. The authors recommend the purchase of a narrow strip of additional land, but state that although this strip of land is necessary for the most satisfactory arrangement of tracks, the purchase may be avoided by making a slightly different arrangement than the one recommended.

Capacity of the Proposed Station

The authors decided to provide for the probable traffic of 1940. A study of the growth of the city since 1850 indicates a probable population of 47,000 in 1940, or an increase of sixty per cent. over the present population. It was thought proper to assume that the passenger traffic will increase directly in proportion to the population of the city, so that the proposed station should be designed to handle sixty per cent. more business than is now handled by the existing stations.

Proposed Track Arrangement

The authors assume that the increase in business will not result in an increased peak load for the station, but that it will result partly in more trains scattered throughout the day and partly in increased length of trains. At present four trains is the largest number that would occupy the station at one time. These trains are made up as follows:

Lengths of Simultaneous Trains

No. of Train	Direction	Max. No. of Cars	Length of Cars	Total Length
33	Milwaukee to Prairie du Chien via Watertown	8	580′	660′
8	Prairie du Chien to Milwaukee via Watertown	8	580′	660′
142	Madison to Janesville via Milton Junction	4	290′	370′
516	Portage to Madison	4	290′	370′
	Totals	24	1,740′	2,060′

An increase of fifty per cent. in the train length would indicate that the total length of station platform should be, approximately, $1,740 \times 1.5 = 2,610$ feet. Accordingly, provision has been made for one 800-foot and two 880-foot platform tracks, or a total of 2,600 feet.

The general track arrangement, as proposed by the authors, is shown in Fig. 1. Local conditions make it impossible to have all three tracks open; so track one is made a stub track open toward the south, since most of the traffic is in that direction. There is an advantage in having this track so arranged, i. e., the reduction of the number of tracks to be crossed by passengers leaving trains.

The method of using the tracks during the peak load is as follows:

Track 1—Train from Prairie du Chien to Milwaukee
Track 2—Train to Janesville
Train to Portage
Track 3—Train from Milwaukee to Prairie du Chien

The Station Building

In the absence of reliable figures as to the number of passengers now handled at the stations of the St. Paul and the Illinois Central, the amount of floor space necessary in the proposed joint station was determined by a method of comparisons. The following table shows the areas of the four existing stations, together with that of the proposed station.

Areas Provided by Station Buildings (Square Feet)

Rooms	I.C. R.R.	C.M.& St.P.Ry. East	C.M.& St.P.Ry. West	Total I.C.R.R. and C.M.& St.P.Ry.	C.& N.W. Ry.	Proposed Station
General waiting rooms			2,400	2,400	4,640	4,380
Men's rooms...	750	624	270	1,644	777	863*
Women's rooms	750	624	600	1,974	700	768*
Total waiting room				6,018	6,117	6,011
Ticket office...	264	144	270	678	594	625
Baggage rooms	324	180	720	1,224	1,980	2,610
Express		180	720	900	1,980	1,085
Lunch and dining rooms...			1,000	1,000	3,025	1,840
Kitchens			450	450	1,072	630
Totals				10,270	14,768	12,801

* Includes men's toilet and women's toilet.

A suggested arrangement for the station building is shown in Fig. 1. This may be open to criticism in some respects; but it is offered as a possible solution of a somewhat difficult problem. One of the important considerations that has had some influence upon the arrangement of the building is the probable elimination before many years of the adjacent grade crossing. The new building should be so arranged that such elimination will not decrease either its appearance or its usefulness.

Grade Crossings

A proposal involving radical changes in the physical plant of the railways within the city limits, should take into consideration the correlated problem of the elimination of street crossings

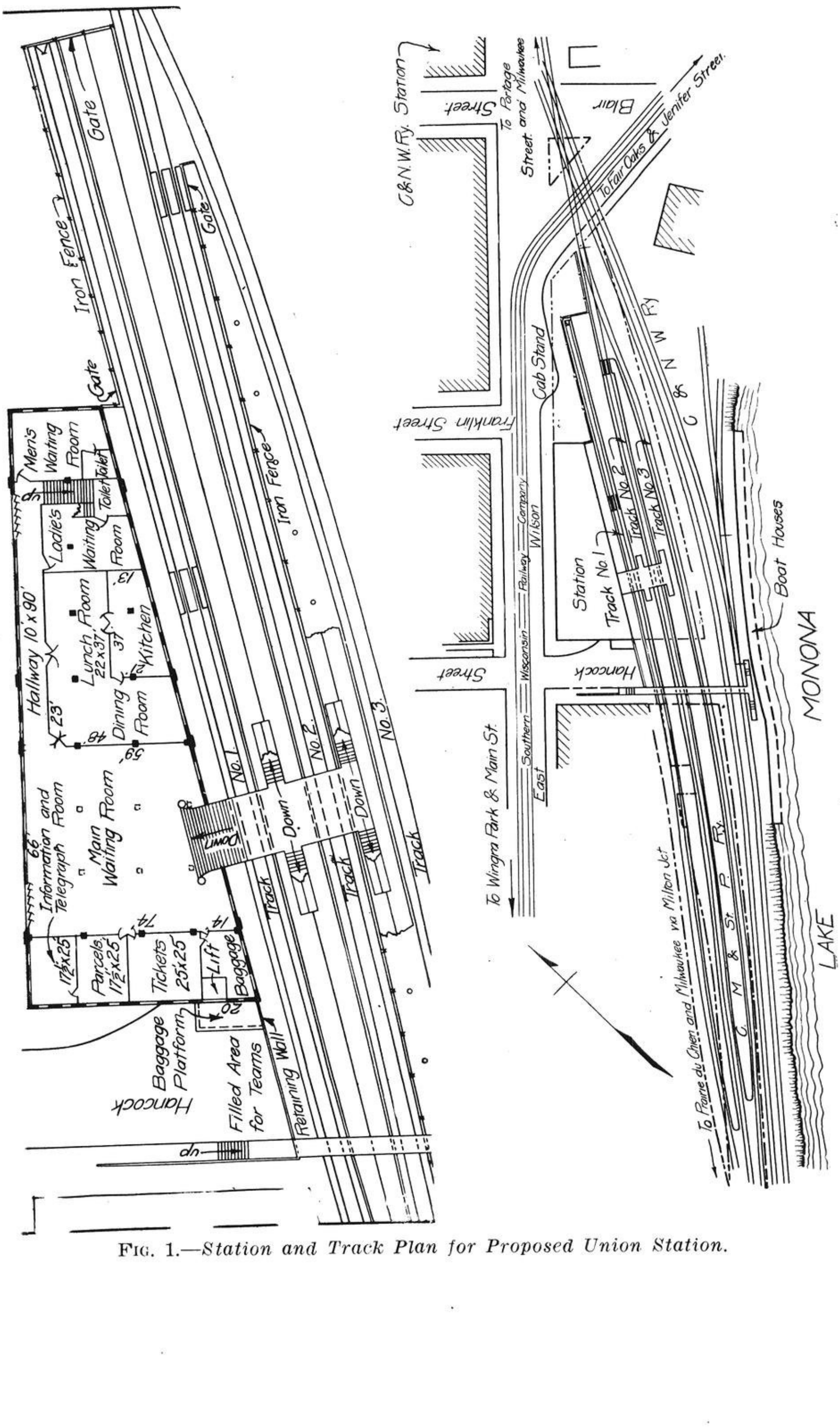


FIG. 1.—*Station and Track Plan for Proposed Union Station.*

at grade. There are in Madison about fifty-two street crossings upon nine of which there are street railway tracks. Either the situation may be treated as a whole, or each crossing may be considered a problem in itself.

Since the matter of grade crossings was not the main object of this study and the time available for investigation was limited, this problem has not received the attention necessary for the formation of final conclusions. However, the brief investigation that the authors have made leads them to the conclusion that the crossings will be eliminated separately, as conditions call for such elimination, rather than in a wholesale manner.

Conclusions

The authors make the following recommendations:

1. That the Chicago, Milwaukee and St. Paul Railway Company and the Illinois Central Railroad Company construct a joint station along the lines indicated, together with such new tracks and connections as are necessary.
2. That the city of Madison co-operate with the railway companies to the extent of closing Hancock street across the tracks, provided that the railways construct a footbridge across the tracks for the benefit of those wishing to reach the boathouses.
3. That the Chicago and Northwestern Railway Company join in the construction of the footbridge at Hancock street, since it will cross the tracks of that company.
4. That the West Madison stations of the St. Paul and Illinois Central be abandoned for passenger business.

It is believed that with these plans carried out the two railways most concerned will be in a much better position to compete for traffic and will reduce maintenance and operating costs, while the city of Madison will enjoy all the conveniences that would be offered by a union station.

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EDITORIALS

It has been the time honored custom of the editor of the *Wisconsin Engineer* to sing a long, sad swan song, to write a masterful sob story, in this the last number of the volume. Perhaps this was a good custom. Perhaps it was only a custom without the pleasant qualification. In any event there shall be none of that for you this year, seniors. True, we are sorry to see you leave us, for our friendships have been not only pleasant but worth while in every respect. On the other hand your departure leaves us the seniority, and certainly that is cause for pleasure. Your going makes us consider that there are just so many less positions left available for us when our turn comes. Likewise your departure leaves us just so many more positions of trust in our college world that we shall be called upon to fill as capably as you have filled them.

We realize that you must feel a pang of regret when you leave the old campus after the commencement days are gloriously over. We can appreciate the parting of the ways of friendships. We can appreciate how the University grows an increasingly distant memory every day after graduation, how its reality seems to fade after *you* have left its halls. But the fall after you leave brings another horde of freshmen, potentially as good as any of you. There will still be just as many of us here just as good as you are, who throb, as you have while here, with great ambitions for WISCONSIN. The school does not cease to exist when you sever your visible connection with it.

The future position of the College of Engineering among its competitors depends more upon what you are after you leave its halls than upon all that you do and say while you are here. A college is measured by its alumni, and not only by their ability, but by their loyalty. With too many men, the first pay envelope marks the first step in the severing of the ties he should have with his *Alma Mater*. Loyalty means more than cheers for the Cardinal while you are yet an undergraduate and thrills down your back after you graduate when you read of the successes of the football team. What we need at Wisconsin is Alumni, Alumni, and more Alumni. Alumni who dare sacrifice something for her sake. Alumni who dare to take her part in a defence against her enemies, who would be ashamed to sit back and let matters run their course, and shake their heads in disapproval of the situation, and the doubt of its solution. Alumni who make every effort to keep in intimate touch with the vital life of the campus, who feel its pulse, who breathe its spirit, who know its troubles, and who lend the loyal hand to lift.

In another month the Engineering school will have another increment of graduates. We do therefore charge every man of you who goes from this campus with a realization of the new responsibilities that you must assume as an alumnus of this college. Where are you going to be when Wisconsin is under the fire of political guns, the buffer for upstate petty politicians, the toy of legislatures? Where are you going to be when the undergraduates need a new stimulus of traditions that only the old grad can instill? Where are you going to be when the college makes some small appeal to you for service that may mean some sacrifice of time or means? Where are you going to stand when the undergraduates call upon you for help either in spirit, person, or pocketbook? What is to be your attitude toward the College you are just leaving when you have reached the goal of your four years' race, have received the sheepskin, and begin the longer race of life? Is your *Alma Mater* the machine which ground you out a finished product, or the great mother that brought you into the world of intellect ready to run that race?

* * *

Keep up the singing on the steps, men. We have been mouthing for some time an editorial of instigation, but we are indeed glad to be able to write one of congratulation, and of encouragement. We need the songs to cement the spirit of the College into perfect unity. There is nothing like good songs to make the day go smoother. But keep them clean, fellows. Do not let the taint creep in. The good spirit comes from good songs, from the best songs. And why wait for a leader. He is to be congratulated for getting us started, and leading us so far. But do we need a baton for good lusty college songs?

CAMPUS NOTES

Professor D. W. Mead, head of the Hydraulics Department, spoke before the Sunday evening assembly at Music Hall early in the month. His talk, as it well deserved, was one of the best received of the year. He propounded the chief factors of success in practical life in a manner which made a strong impression upon his audience. His advice was practical of itself, and was seasoned by a long and successful experience. Among others, he pointed out as factors of success: Good judgment based upon long experience, a reasonable self-confidence but also a knowledge of self-limitations, the quality of stick-to-it-iveness, a correct ethical attitude, an earnestness in one's work, and a wide circle of friends.

* * *

The above list is one which should be ever before us, for as Professor Mead said, "The greatest success lies in a well balanced life." In this connection it might be well to remember the old Grecian maxim, "Nothing too much," or as it is put today, "Avoid excess." Professor Mead possibly had this in mind when he modified "self-confidence" by "reasonable." A lack of self-confidence would be a very fundamental deficiency, but we must not forget that there is another extreme—and the presence of the latter, in the case of college men, is every bit as probable as the presence of the former.

* * *

Mr. S. LeFeore, speaking on Prospecting, Mining, and Ore-dressing, was one of the attractions on the lecture list during the last month. Some special features of his talk were the magnetic survey, the safty-first movement in mining, and the operation of the magnetic separator. The talk was well illustrated by motion pictures of mining life.

* * *

Mr. Allen Hazen, noted hydraulician and consulting engineer of New York City was secured to address the civil engineers on water supply engineering. His talk bore chiefly on the method of handling hydraulic data. The speaker made the point that data relative to the flow of rivers could not be handled by a definite rule of thumb, and then went on to describe the statistical method in use at present. The application of the theory of probability was interestingly presented. The lecture committee was especially fortunate in securing Mr. Hazen.

* * *

On Friday, April 9th, the U. W. Engineers' Club initiated eight new men and ended an evening of fun by making their presence known at the Orpheum.

* * *

We note that the members of the Wisconsin branch of the A. S. M. E. have blossomed forth with new pins. The badges are of a neat and appropriate design.

* * *

The visit of the mine rescue car of the United States Bureau of Mines offered a rare opportunity to all engineering students and especially to the miners. A week's expert instruction was offered in mine rescue methods, useful knowledge to any engineer. Every one of us should at least have inspected the car, and taken the course if possible. Let's learn to appreciate opportunities now.

* * *

Baseball is under way on the lower campus. As usual the engineers are an important factor in the race. We won't urge you to cut classes to root for the team, for your inclinations are most likely too strong in that direction. Changing the time of the games from two to four o'clock has lessened the necessity for cutting when we wish to enjoy the games. Ernie Lange has charge of the team and is always on the lookout for good material. If you have ability do not fail to report.

* * *

Mr. G. A. Morison, Sec. of the Bucyrus Co. of Milwaukee spoke in the auditorium at the 11 o'clock hour on Wednesday, April 14. He described the development and application of excavating machinery. Of especial interest was the clear explanation of the exact relations of the subject to the various branches of engineering. The talk was the most coherent and best outlined of the year.

The Engineers' Club has been a regular Founder's month. On March 31 Professor Mack was the guest of the evening. Professor Mack is known among the boys as the Father of the club, and the occasion of the twentieth birthday of the club was taken as a fitting time to present him with a silver loving cup in recognition of his deep interest, advice and assistance. The week following the club was honored by a visit from Mr. Alexander, who has recently been appointed to the Railroad Commission, and whose picture recently appeared on these pages. Mr. Alexander was primed with reminisences of '97 and the founding of the club, and some of the boys who have made a place for themselves. He had some very timely advice for undergradutes that was exceedingly gracefully given, and ended his talk with a discussion of some of the problems of handling men in large groups under the schedule system.

DEPARTMENTAL NOTES

RAILWAY ENGINEERING

The Illinois Steel Company has donated a set of rail sections. The set comprises sections from 40 pounds to 100 pounds per yard, inclusive, and conforms to the American Society of Civil Engineers' standard.

* * *

The class in Railway Signalling made an inspection trip to the interlocking plant at the Monona Yards on Saturday, March 13th.

* * *

The class on Railway Maintenance, on Saturday April 10th, visited the Forest Products Laboratory for the purpose of inspecting the equipment used in treating railway ties for preservation against decay.

* * *

The class in signaling and interlocking, on Saturday, April 17th, inspected the interlocking plant of the Chicago and Northwestern Railway located at Lake Monona. Mr. John N. Bidwell, signal engineer for the State Railroad Commission, accompanied the party to explain the various details of the plant.

* * *

Field work has commenced in the course in Railway Curves. A special feature of this work, introduced recently by Mr. Hopkins with good results, has been the marking of the curves on the ground by means of white cord stretched from stake to stake. The stakes are also painted white. The result is that the student receives a good visual representation of the curve.

STEAM AND GAS ENGINEERING

Professor H. J. Thorkelson has left the position as head of the Steam and Gas Engineering Department to accept the position of Business manager of the University. Professor Thorkelson has been connected with the Department for twelve years. Entering as an instructor in 1903, he was promoted to assistant professor in a few years; six years ago he was made associate professor; and for the past two years has been head of the Department. The loss of Professor Thorkelson from the Department will be very keenly felt because of his effectiveness in classroom work and because of the esteem in which he is held by students, alumni and members of the Department.

During the past semester considerable gas engine apparatus has been added to the laboratory to carry on the work in the new course in gas engine testing which was added to the department this year. The new apparatus is as follows: 8 H. P. St. Marys oil engine, manufactured by the St. Marys Machine Co., St. Marys, Ohio; J. I. Case 35 H. P. automobile engine; Waukesha 40 H. P. truck engine; 12 H. P. 2 cylinder Gray marine engine and water brake. This gas engine course has been very successful this year, about thirty-five Commerce and Letters and Science students having elected the work, and it gives promise of having even greater success in the future.

Mr. McMillan, who is conducting research work on heat transmission through steam pipe coverings, is more than half way through the investigation, and the results should be ready for publication sometime during the summer.

Mr. Berggren has about completed the testing work on the investigation of the variation in the co-efficient of Pitot tubes for different sizes of pipe, and will have this material ready for publication before fall.

Professor G. L. Larson, University of Idaho, who is taking his Mechanical Engineering degree in the Department this year, is conducting some very interesting work on air washing in the ventilating system at the University High School. The results of this investigation will also be ready for publication about the same time as the other work. Messrs. Bauer and Blanding are assisting Professor Larson in this research work as part of their thesis.

Some of the theses of especial interest being conducted in the department this semester are as follows: Messrs. Oldenburg, Roth and Gesell have completed a test on the power plant of the Pawling and Harnishfeger Company at Milwaukee; Messrs. Fletcher and Anderton are making some interesting tests on kerosene carburetors for automobile engine work; Holtum and Clancy are running a supplementary thesis on some of the research work done by Mr. McMillan in his heat insulation tests in determining the temperature gradient between temperature of the steam inside of a steam pipe and the temperature of the outside of the covering. The results of this thesis will probably be published with Mr. McMillan's work.

CHEMICAL ENGINEERING

Dr. C. A. Mann is conducting some tests on the agreement of various methods of analyzing rubber fire hose. This problem was suggested by one of the cities of the state.

Professors O. L. Kowalke and O. P. Watts will present papers before the April meeting of the American Electrochemical Society:

O. L. Kowalke and D. S. Grenfell on "The Temperature of Reaction of Carbon and Acheson Graphite."

O. P. Watts on "Electric Cleaning and Plating of Metals from the Same Solution."

Among the interesting these being worked out this semester the following promise some valuable data:

Messrs. M. S. and N. B. Thompson on the efficiency of various methods of washing of precipitates in filter presses of the frame and plate type.

Mr. J. B. Edwards on the suitability of Cobalt as an element for thermocouples.

Mr. H. B. Heyn on binders for magnesia for crucibles.

Mr. J. Trantin, Jr., on iron-silicon alloys to resist the corrosive action of zinc chloride solutions.

Mr. L. S. Loeb on factors governing copper cyanide plating solutions.

Mr. A. J. Helfrecht on the comparison of various "high power" nickel plating solutions.

The Northern Chemical Engineering Laboratories announce the adoption of the shorter name C. F. Burgess Laboratories.

Mr. Alfred C. Shape, '12, has been promoted and transferred to the acid department of the Prime Western Spelter Co., Tiltonville, Ohio, where he is in charge.

Mr. Ming Ho Li, ch e '13, is the engineer in charge of the Open Hearth Department of the Hanyan Steel Works, Hupeh, China.

Mr. Kenneth W. Erickson, '13, visited the University recently. He is stationed at Streator, Ill., as the chemical engineer for the American Bottle Works.

SHOPS

The Mechanics Institute Course, which is running for the second time this year, is engaging the attention of the Machine Shop. It is an eight weeks' course designed to prepare mechanics of exceptional ability and fitness for teaching various branches of manual arts in the industrial schools of the state. There are enrolled at present twelve men, all skilled workmen, drawn from various trades such as machinist, carpenter, cabinetmaker, etc., each of whom receives a stipend of sixty dollars towards defraying his expenses during his eight weeks' attendance. They receive instruction in free hand drawing, mechanical drawing, teaching of manual arts, and shop work in some branch other than their regular trade. Thus the carpenters are taking bench work in iron and steel and work on the lathe and milling machines and in the forge room.

The course is in charge of the Department of Manual Arts, a division of the College of Letters and Science, but the College of Engineering plays an important part in the work, for instruction in forge, foundry, machine shop, and pattern work is given in our machine shop. The course is proving to be a very successful solution of a part of the problem involved in securing suitable teachers for our industrial schools.

For the benefit of those not familiar with recent legislation in Wisconsin, it may be said that industrial schools include evening instruction in industrial and common school subjects, and day-time instruction for children between the ages of fourteen and sixteen who are engaged in gainful occupations and are working under permits issued by school boards, and instruction for apprentices.

A thesis undertaken by Gibert and Klotz has for its object the investigation of the effect upon journals and bearings made of various materials when these bearings run dry. The materials used for journals include plain steels of varying carbon content, both annealed and heat-treated; and for bearings, various standard bearing bronzes and babbitts. A 10,000 pound Olsen oil testing machine is being fitted up for this work, and interesting results are expected.

SUCCESSFUL WISCONSIN ENGINEERS

Youth again comes to the front and another one of the boys claims attention by virtue not only of his youth but of the size of his work.

Harold E. Ketchum, c '08, formerly superintendent of construction for the Graff Construction Company of Seattle, but now associated with the Hunkin-Conkey Construction Company, is the man of the hour.

Mr. Ketchum had charge of the construction of the 12th Street Viaduct at Kansas City, a double-decked reinforced concrete trafficway, half a mile long and in one place 110 feet high. The viaduct is built on an incline to connect the West Bottoms of Kansas City with the higher Retail District. The upper deck is on a five and one-half per cent. grade, with a thirty foot roadway, two street car tracks, and one sidewalk. The lower deck is built on a three per cent. grade with a thirty foot roadway. The contract price of the structure was $610,000. The remarkable fact is that the work was completed on time, owing to the efficient scientific management of Mr. Ketchum. A definite amount of work was set for each day, which was usually completed within the regular hour, but which more than once required night crews for completion. The effect of the final disposition of the payrolls was kept in mind when the different materials were specified and as a result a large proportion of the money remained in Kansas City.

Mr. Ketchum has been engaged to direct the construction of what will be the largest concrete structure in the United States, the Detroit Superior High Level Bridge, a $1,000,000 contract. This structure is a double deck affair, the lower deck providing six car tracks, and the upper being used for all other traffic. Mr. Ketchum was offered the position without solicitation after one hundred and fifty engineers all over the country had applied.

A necessary but perhaps questionable characteristic of a successful construction engineer is revealed in a letter from Mr. Ketchum to his father, at the time that the former was engineer for the Canadian Northern Railroad. Mr. Ketchum says, "I do not see Charlie very often. He is doing well, but is too kind hearted to be a labor boss."

ALUMNI

GENERAL ALUMNI NOTES

O. Laurgaard, c '03, irrigation engineer on the Tremalo Project, Laidlaw, Montana, has published a final report of the construction, to the Desert Land Board of the state of Washington. The report is well indexed and very businesslike.

E. A. Moritz, c '04, engineer for the U. S. Reclamation Service, has published a book called "Working Data for Irrigation Engineers." Every branch of engineering has its problems requiring the frequent use of certain fundamental data and this book fulfills the needs of irrigation engineers.

ADDRESSES

J. G. Hirsch, c '08, is still with the Bates & Rogers Const. Co. of Chicago at Prince Rupert, B. C., Canada, and is well impressed with the wonderful resources of the great Northwest.

H. C. Estberg, e '07, former manager of the Greeley Gas & Fuel Co., is now with the Utah Gas & Coke Co., Salt Lake City, Utah.

We received word from the Universal Portland Cement Co. of Chicago, that Mr. F. H. Oakes, c '08, died after a very short illness.

F. S. Halladay, c '13, formerly land surveyor, is now chief engineer for the Green Bay and Western Railroad.

L. McLaren, m '14, is with the C. E. Dellenbargen Co. of Joliet, Ill., manufacturers of popcorn and candy machinery. He says he feels like a full fledged business man already.

TABLE OF CONTENTS

The Fire Chief Will Tell You

that the sections of your city in most peril from fire are the warehouse and factory districts. The insurance man will tell you that the warehouse and factory districts represent the greatest financial investments and pay the highest premiums.

Why?

Because many of the buildings in these districts are not of fireproof construction. In an increasing degree, however, fireproof structures of reinforced concrete are supplanting factories and warehouses of obsolete, non-fireproof types.

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THE LINK

Between the Engineering Grad and his Alma Mater

What one FIRST GRAD wrote

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> However I will find some other way rather than this: and I therefore enclose my check.

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