This is an advance copy of a paper which will be read at the March 1913 meeting of the Western Railway Club. It is sent to you in advance so that you may prepare a discussion of it. It is subject to revision by the author, and is to be treated as entirely confidential until after it is presented at the meeting.

BRING THIS COPY TO THE MEETING.

THE NEW LOCOMOTIVE LABORATORY AT THE UNIVERSITY OF ILLINOIS

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An accurate knowledge of locomotive performance is as necessary to the railway operating officer and to the locating engineer as to the locomotive designer, and in periods of rapid progress in locomotive development the need of such knowledge becomes the more urgent. To satisfy this need there has been continually put forth, even in the earliest days of the locomotive's career, much well directed and fruitful effort which has contributed no small share to its improvement. In the beginning, such effort had for its chief purpose the improvement of the mechanical features of locomotive design rather than improvement in its economical performance; but in later years, under the demand for decreased operating costs, this effort has been directed chiefly toward developing accurate information about the performance of the locomotive boiler and engines and of the machine as a whole.

Of course much important information concerning performance is embodied in the ordinary statistics of operation which are available to every railway officer. Changes in locomotive design which effect radical changes in performance show themselves unmistakably in such statistics. Changes in performance less radical but nevertheless important are however frequently so disguised in such statistics as to baffle even the best informed. As a source of data concerning locomotive performance, ordinary operating statistics are at best difficult to interpret and, had we been compelled to rely upon them solely, our knowledge of performance would be very meagre indeed.

Until about twenty years ago the only other source of accurate and specific information concerning locomotive performance was the data derived from specially arranged road tests. Such road tests were conducted as early as 1835-1840 and they have ever since been a fruitful source of important knowledge. For certain purposes they will never be displaced. Anyone who has conducted such tests is well aware of their difficulty and expense. Every measurement connected with the determination on the road of boiler and engine performance of the locomotive is much more difficult than in the stationary plant. The measurement of coal and water and the taking of indicator cards, for example, are very difficult operations under the conditions of road service, and operations whose accuracy can be assured only by great effort and skill.

Nevertheless when the importance of the purpose warrants the expense, the difficulty of making road tests would be willingly incurred if their usefulness were not otherwise limited. It is however greatly limited by the fact that on the road many of the conditions of operation are entirely beyond control; and consequently even the most skillfully and conscientiously conducted road tests sometimes fail to produce conclusive evidence. In comparing two locomotives of similar design by means of road tests, small differences in their performance are frequently overbalanced by differences in the conditions surrounding the tests which are entirely unavoidable. For such reasons it is practically impossible, for example, to satisfactorily determine by road tests, the difference in the economy of using two similar kinds of coal, or to determine the effect upon steam consumption of changes in valve gear design. The limitations and disadvantages of road tests are not thus emphasized through any lack of appreciation of the extent of their contribution to the art of locomotive engineering, but to make clear their inherent inadaptability to some purposes. On the other hand, they offer the means of settling certain questions which cannot easily be treated in a locomotive testing plant and for such purposes they will not be displaced.

The locomotive testing plant fortunately has placed at our disposal a means for studying the locomotive which has made good the deficiencies of road testing. The first locomotive testing plant was built twenty-one years ago at Purdue University. It was designed by Dr. W. F. M. Goss, who was at that time in charge of the schools of engineering at that institution. Everyone interested in locomotive engineering knows of the epoch making record of that plant and is familiar with the voluminous and illuminating information developed there by Dr. Goss during his connection with Purdue University and in later years by Dean C. H. Benjamin and Professor L. E. Endsley. The work of this laboratory, during its twenty years of operation has continually given us original and timely information concerning all phases of locomotive performance, which has had a most significant influence on locomotive design both in this country and abroad, and which will always stand to the great credit of those responsible for the inception and activity of this laboratory. Not the least of the good influences of this plant is the encouragement which its success has offered to other experimenters to establish similar laboratories. At present there are four such testing plants in this country and two in Europe.*

* The Purdue plant, erected in 1891, was followed in 1894 by a temporary plant, at South Kaukauna, Wisconsin, on the Chicago & Northwestern Railway, designed under the direction of Mr. Robert Quayle. This was succeeded in 1895 by a permanent plant, designed by Mr. Quayle and erected at the C. & N. W. shops in Chicago. In 1899 Columbia University, having been given an atlantic type locomotive by the Baldwin Locomotve Works, provded for t a testing plant which is erected in th ir mechanical engineering laboratory. In 1904 the Pennsylvania Railroad nstalled at the Louisiana Purchase Exposition at St. Louis, what was at that time the largest and most elaborate plant yet built. This was removed after the Exposition to Altcona, Pa., where it has since been in almost constant operation. In 1904 there was also erected in the Putiloff Works at St. Petersburg, Russia, a similar plant designed by Messrs. M. V. Golobcloff and S. T. Smirnoff. The following year there was erected in England another plant under the direction of Mr. G. J. Churchard of the Great Western Railroad, at the Swindon Works of that company.

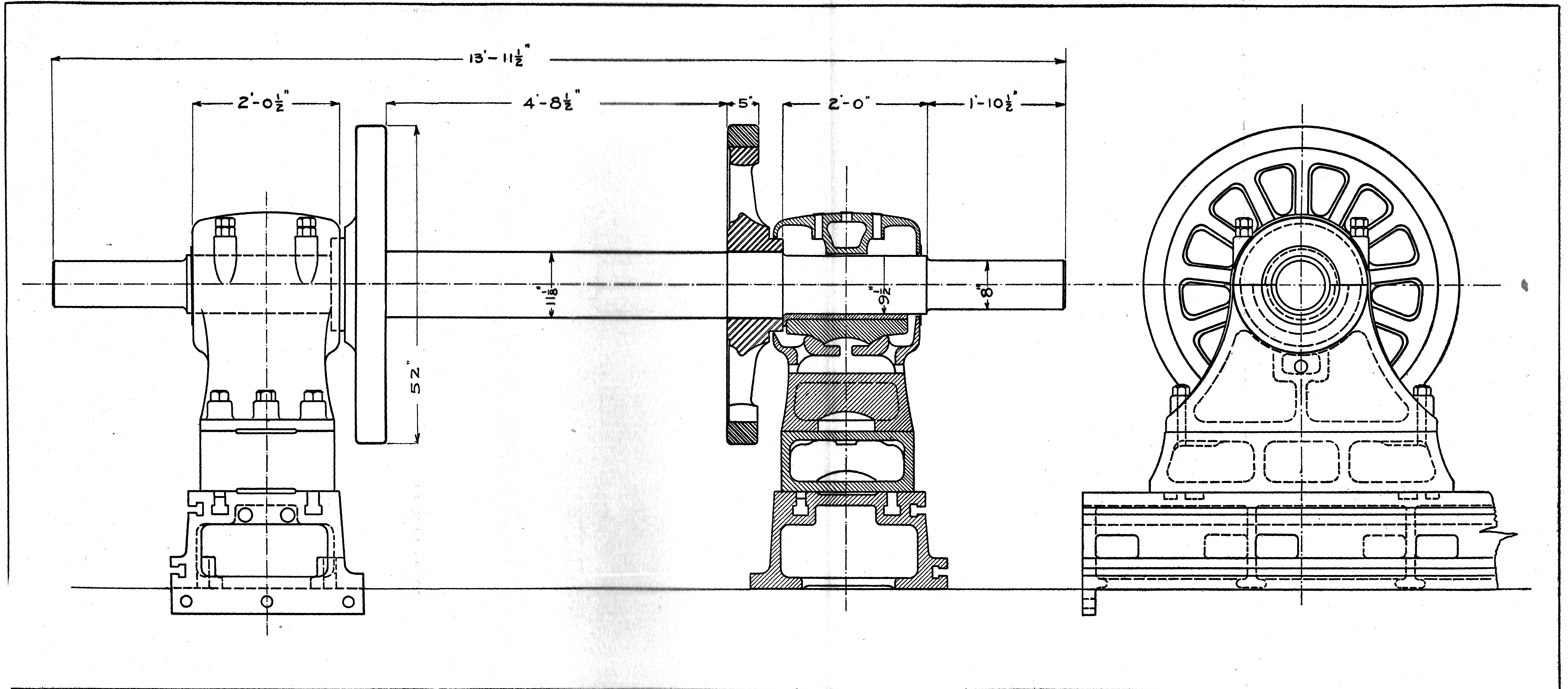


Fig 2—One Pair of Supporting Wheels, with Axle, Bearings and Bed Plate.

The justification for the existence of locomotive testing plants lies in the fact that in them only can the locomotive be run under conditions which may be rigidly controlled and varied at will. It it also true that in the test plant the difficulty and expense of making tests are both greatly reduced; but this in itself is less important than the control of the operating conditions which test plant service puts in the hand of the experimenter. In the laboratory, the load and speed may be held uniform throughout any period of time or they may be made to vary according to any predetermined program. Variations of wind velocity and air temperature are eliminated. All the advantages which laboratory tests have over road tests lie in this power to control conditions. As a consequence of this control practically all questions relating to boiler performance can be better and more easily settled in the testing plant than on the road and the same remark is equally true of questions touching engine performance. There are but few problems relating to fuels which cannot be more easily attacked and more conclusively settled in the testing plant than on the road; and certain problems—like the determination of engine friction—which lie beyond the reach of the experimenter who must rely on road tests, can be successfully attacked in the locomotive labora-

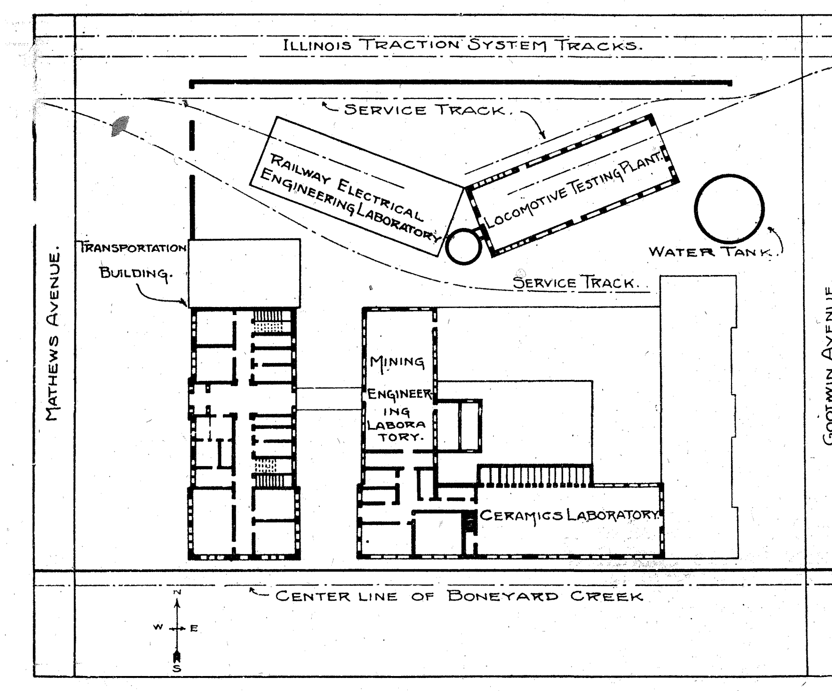


Fig. 1—Group Plan of the New Buildings in the Transportation Group.

tory. Supplemented occasionally by road tests made by means of a dynamometer car, the locomotive testing plant makes possible a knowledge of locomotive performance as exact as that which is available concerning the stationary steam engine, the turbine, and the gas engine. Locomotive laboratories have had and will continue to have an important influence on the development of the locomotive. An addition to the small number of existing laboratories is therefore an event of interest to all railway officers, and it has seemed appropriate to present to the members of the Western Railway Club a description of the new plant which has been recently erected at the University of Illinois and which will be first put in operation next month.

At its last session, the Legislature of the State of Illinois included among its appropriations for the University of Illinois the sum of $200,000 to be used for new buildings for the College of Engineering. The president and the trustees of the University after weighing the claims and needs of the other engineering departments decided to use this fund in erecting a transportation building and a locomotive laboratory for the department of railway engineering. The plan thus projected has now been realized and the railway engineering department has available for its work two of the buildings of the group shown in plan in Figure 1. The new laboratory is the building shown in the upper right hand corner of this cut. Presentation of information concerning the building itself will be deferred in order that we may proceed at once to the description of its equipment.

Any locomotive laboratory consists essentially of, first, a means for so supporting the locomotive that its wheels may be rotated and that the power developed may be absorbed and either dissipated or transferred; second, a means for anchoring the locomotive when so mounted and for measuring the tractive effort developed; third, means for supplying and measuring coal and water; and finally, means for disposing of the gases and steam from the front end. The supporting mechanism consists in this plant, as in all others, of wheels whose position may be varied to conform to the spacing of the locomotive's driving wheels. In this case the supporting wheels are 52″ in diameter, providied with plain tires and mounted on 11⅛ inch axles. The axles and tires are of the highest grade of heat-treated carbon steel and were furnished by the Midvale Steel Company. The use of 52″ supporting wheels involves rotating speeds as high as 500 revolutions per minute in testing high speed locomotives. Such speeds may give rise to difficulty in the operation of the bearings although they have been designed with regard thereto. In anticipation of such difficulty however, provision has been made (in the design of the bearing pedestal (for using 72″ diameter supporting wheels, if it later proves desirable to do so. The axles are supported at each end just beyond the wheels, in bearings 9½″x20″ which are provided on the under side of the journal only. These bearings are carried in self

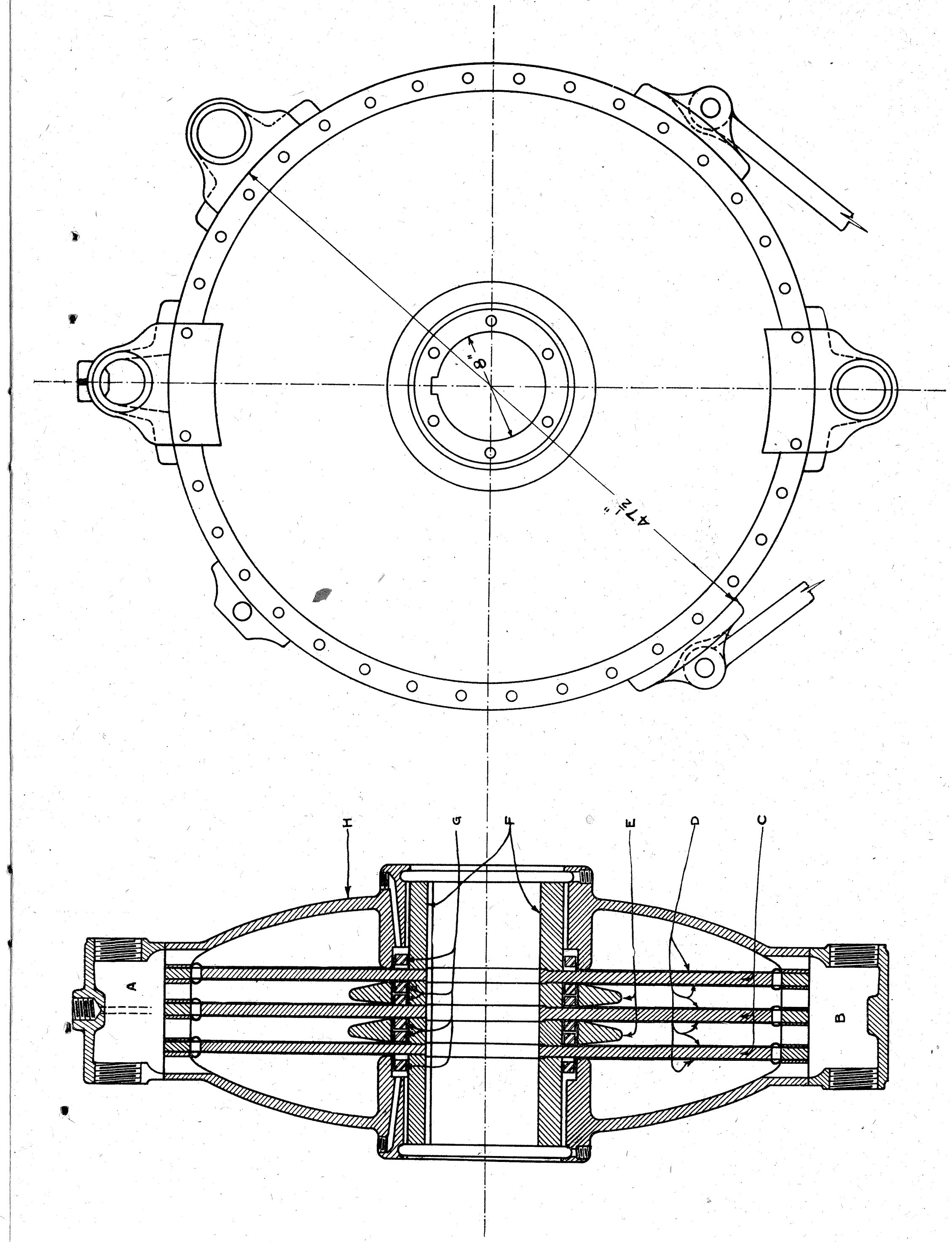


Fig. 3—One of the Brakes. Mounted on the ends of the supporting axles these brakes absorb the power developed by the locomotive.

aligning shells which are supported in pedestals of exceedingly heavy construction. Oil is provided at two points in the bearing cap, where it is supplied under head from an elevated supply tank. The bearing pedestals rest on massive cast iron bed plates which run the entire length of the testing pit, and are secured thereto by the bolts whose heads are held in slots running the length of the bed. The pedestals may therefore be shifted to any desired position on the bed. The general design of the axle, wheels, bearings and bed plate is well represented in Figure 2. Each of these units, consisting of an axle, two wheels, and two bearings constitutes the supporting element for one pair of locomotive drivers. So supported, the driving wheels may turn; and there remains to be provided a means for absorbing the power developed at the driving wheel rim.

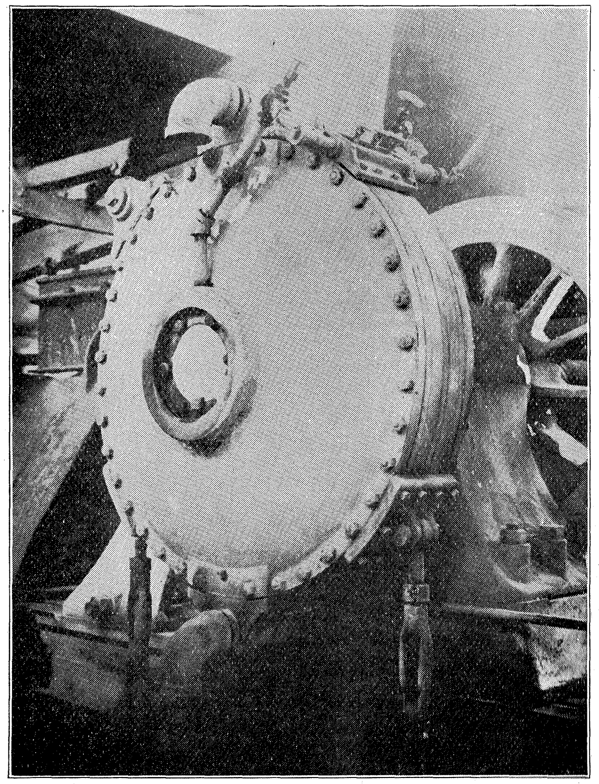


Fig. 4—An Exterior View of One of the Brakes. The water piping and oil piping are removed. This view shows also one of the bearings and a supporting wheel.

The brakes shown in figures 3 and 4 furnish this means. They are of the type used in all other American testing plants, and were designed and furnished by Professor G. I. Alden of Worcester, Mass., under general specifications prepared by the designer of the plant. One of these brakes is mounted on each end of each supporting axle. Each brake consists essentially of three cast iron discs (C) which are keyed to the supporting axle, and which rotate between water cooled copper diaphragms (D) carried in a stationary casing (H). Th cast hub F and the three discs form an integral rotating element which is keyed to the axle and turns with it. The casing and its diaphragms are prevented from rotating by means of links attached to the bed plates which appear in Figure 4. The diaphragms provide within the casing three compartments within which the cast iron discs rotate. The surfaces of the discs and of the diaphragms are lubricated by oil fed in at the periphery of the discs and taken off at the hub. The diaphragms form also within the casing four water compartments which have no communication whatever with the compartments within which the discs rotate. Water is fed into these water compartments at B and is taken off at A. The pressure existing in these water spaces may be varied at will by means of suitable valves in the brake piping. The operation of the brakes is as follows: Power received from the driving wheels of the locomotive is transmitted through the supporting

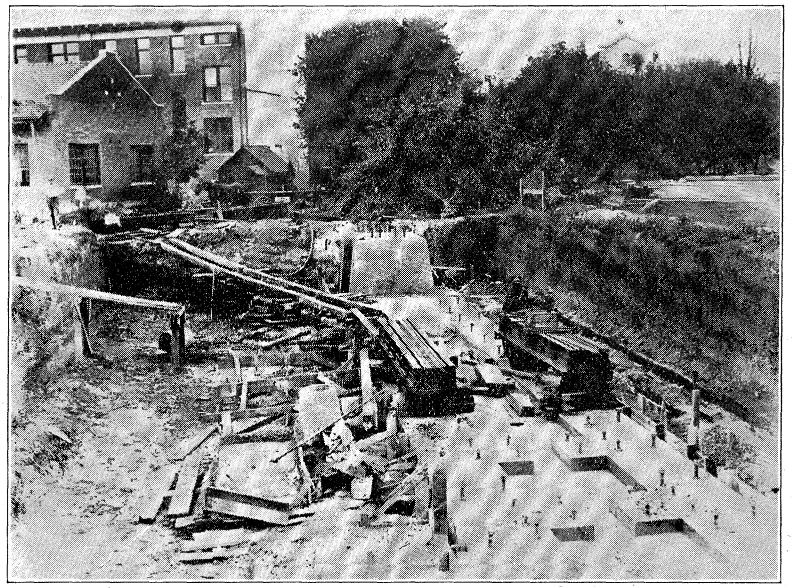


Fig. 5—Foundation for the Supporting Mechanism and for the Dynamometer. This foundation is of reinforced concrete. Two of the bed plate sections are being put in place.

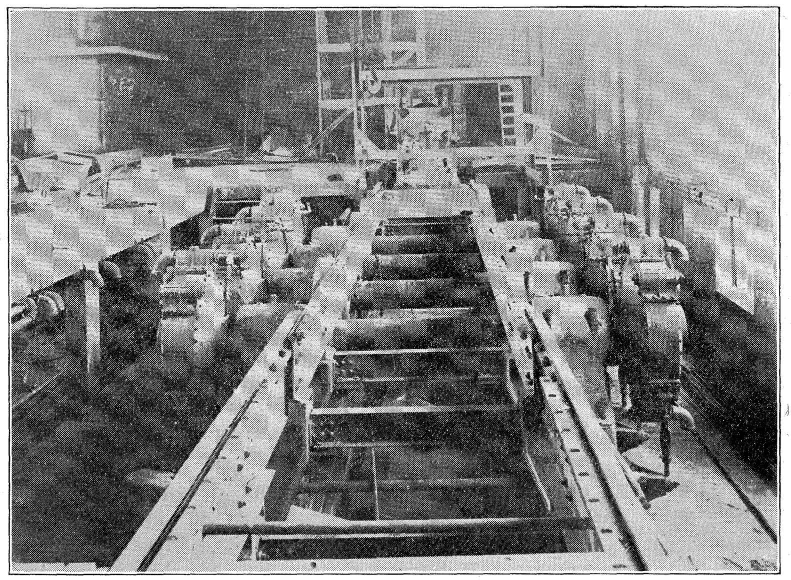


Fig. 6—The Rear End of the Testing Pit. Showing the removable track, the supporting wheels, the bearings and the brakes in position for testing a consolidation locomotive.

wheels and axle to the cast iron brake discs; these in turn transmit it by friction to the surfaces of the copper diaphragms against which they rub. By varying the water pressure, the friction between the discs and the diaphragms may be varied in accordance with the amount of power to be absorbed. The entire power of the locomotive is thus dissipated at the surface of the diaphragms and carried away as heat in the water which circulates through the brakes. Each brake is designed to develop a resisting torque of 18,000 pounds-feet which is more than is likely to be transmitted to it by the most heavily loaded locomotive driver. The exterior appearance of these brakes is shown in Figure 4, which shows also a bearing and one of the supporting wheels.

The machinery thus far described, which serves only to support the locomotive and to absorb its power, is all carried on a foundation located at the basement level of the building. The foundation is shown in Figure 5, which is a reproduction of a photograph taken before construction on any other part of the laboratory was commenced. This foundation is a slab of reinforced concrete 93 ft. long and 12 ft. wide, varying in thickness from 3½ ft. at the front to 5 feet at the rear. It is surmounted at the rear end by a pyramidal base which serves as the anchorage for the dynamometer. The mounting machinery thus far described is shown in Figure 6 arranged for the reception of a consolidation locomotive.

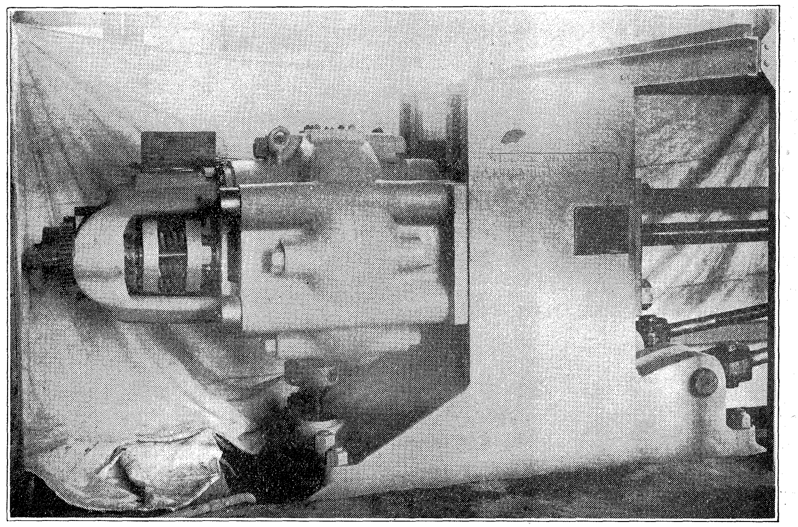


Fig. 7—The Weighing Head and the Housing of the Dynamometer.

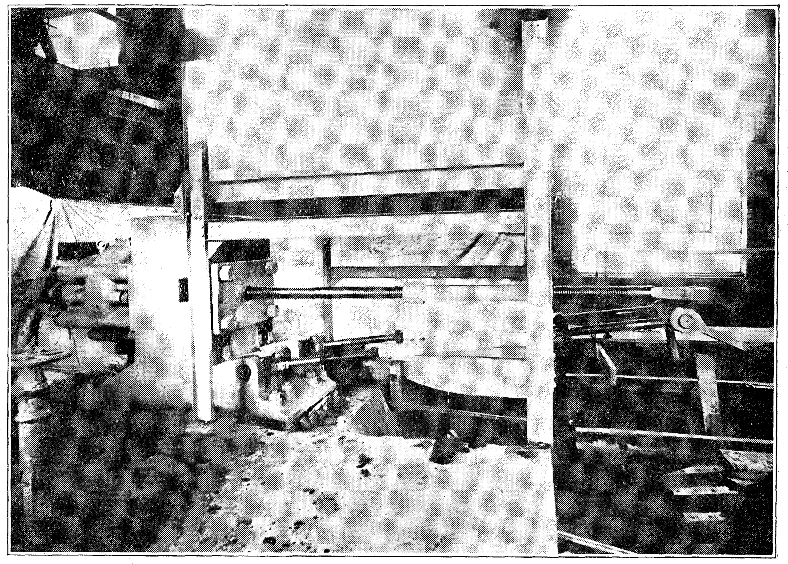


Fig. 8—The Dynamometer and Drawbar. The two outside connections are safety attachments. The firing platform appears at the right in front of the dynamometer.

The highest point of the supporting wheels is at the level of the main floor of the building, which is the same as the rail level of the exterior track. The locomotive to be tested is backed into the laboratory over the track shown in position in this view, the tender having been removed. Over the last section of track the drivers run on their flanges leaving the treads free to engage the supporting wheels. When the drivers are properly placed and the locomotive securely anchored this track section is removed. Thus mounted, the locomotive is anchored, by means of a massive drawbar, to the dynamometer which appears in the middle background of Figure 6. It is thereby prevented from moving either forward or backward from its proper position on the supporting wheels.

This dynamometer, whose chief function is to permit the tractive effort of the locomotive to be measured, is shown in Figures 7 and 8. It is of the well known Emery type designed and built by the William Sellers Company of Philadelphia. While its principles of operation are simple its design is complicated, and a detailed description lies beyond the scope of this paper. It will suffice to say that it consists essentially of the "weighing head" shown at the left in Figure 7, carried on the housing there shown, and of a weighing scale not included in the picture. Within this weighing head is an enclosed oil chamber with a flexible wall, which receives and balances any force transmitted from the locomotive. The pressure of the oil in this chamber varies with the load and is transmitted through a copper tube of small bore to a similar smaller oil chamber, the pressure within which moves the beam of a substantial but very sensitive scale. The force transmitted to the dynamometer is thus weighed. In design this instrument is very similar to that of the original dynamometer furnished for the Purdue University Plant by the same builders. Its capacity however is about four times as great, namely 125,000 lbs.* Up to this limit it will measure with great accuracy any force transmitted to it from the locomotive. One feature of especial interest in the design of the scale lies in the fact that the adjustment of the poise weight on the scale beam is accomplished automatically. This has permitted for the first time in this type of instrument the development of a device whereby the amount of the force weighed on the scale is autographically recorded. The capacity of this instrument is about 15,000 lbs. in excess of the greatest tractive effort which could be imposed upon it by even the most powerful Mallet locomotive now in existence. In this connection it may be remarked that the plant has been designed throughout so that it can receive for test the largest existing locomotives even of the Mallet type; and at the same time all the equipment and the building itself have, in size and capacity, sufficient margin to allow for a very considerable increase in the size, and weight, and power of locomotives before a point is reached when new designs will exceed the capacity of the plant.

*The maximum capacity of the dynamometer used in the Pennsylvania Railroad Company's plant at Altoona is 80,000 lbs.

It would unduly lengthen this description to describe in detail such minor features of the plant as the means for weighing and supplying the water to the boiler and brakes, and for storing and weighing the coal. These and all other details of the plant have received the most careful consideration in order to insure their accuracy, convenience, and durability. They include the weighing tanks, hydraulic elevator, scales, coal room, and firing platform whose general design and arrangement is shown in Figures 10 to 14. The water supply perhaps warrants further mention. The general water supply of the University is from driven wells, the demand upon which approaches at times their full capacity. No other source of cooling water for the brakes is available. Water from the brakes could not therefore be wasted, and provision has been made for cooling and recirculating it. For this purpose there will be built in the ground outside the building (see Fig. 1) a reinforced concrete reservoir of 100,000 gallons capacity. A supply pump for the brakes draws water from this reservoir, pumps it through control valves to the brakes, whence it returns through another set of control valves to a sump located in the basement of the laboratory. Another pump returns it from here to the reservoir. The feed water is drawn from this reservoir by a separate pump, passed to the weighing tanks and feed tank and thence to the injectors. This feed water, of course, is wasted and must be restored to the reservoir between tests by drawing on the general university supply.

Those elements of the equipment which have been thus far described are similar to the corresponding elements in other locomotive laboratories although they differ from them in the details of their design and exceed them in size and capacity. In the design of the means for disposing of the exhaust gases, however, new problems were presented and new solutions have been reached. In view of the importance of determining accurately the total fuel lost in the exhaust gases, it was early decided to try to incorporate in the design of this plant some means for entrapping *all* of the solid matter contained in the gases passing the locomotive front end. This purpose has previously been served by collecting in a sampling tube the solid matter which passes a small section of the exhaust gas stream, and pro-rating the loss of solid fuel thus determined over the entire stream section. This method is not always convenient, and under certain conditions its results are open to some doubt. The preliminary design of a spark trap or cinder collector which would pass the total volume of gas and exhaust steam from the largest modern locomotive when working at high power, made it clear that such a collector would be too large to be located conveniently within the building. A second fundamental consideration in designing the exhaust system was the necessity of providing a stack of sufficient height to insure that the exhaust gases would be

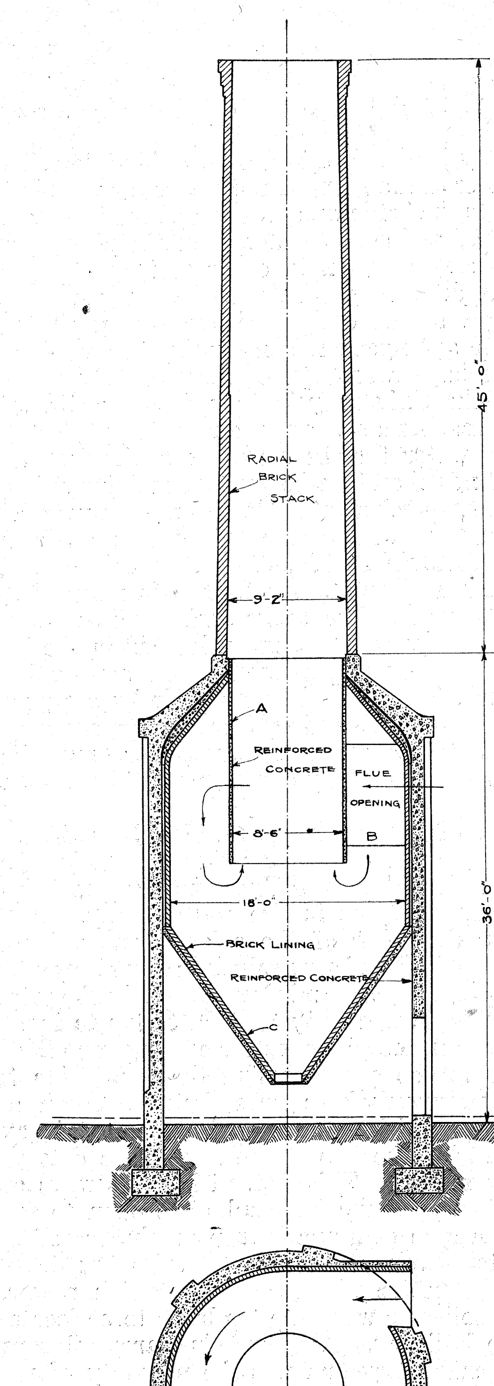


Fig. 9—A Cross Section Through the Cinder Collector and the Stack.

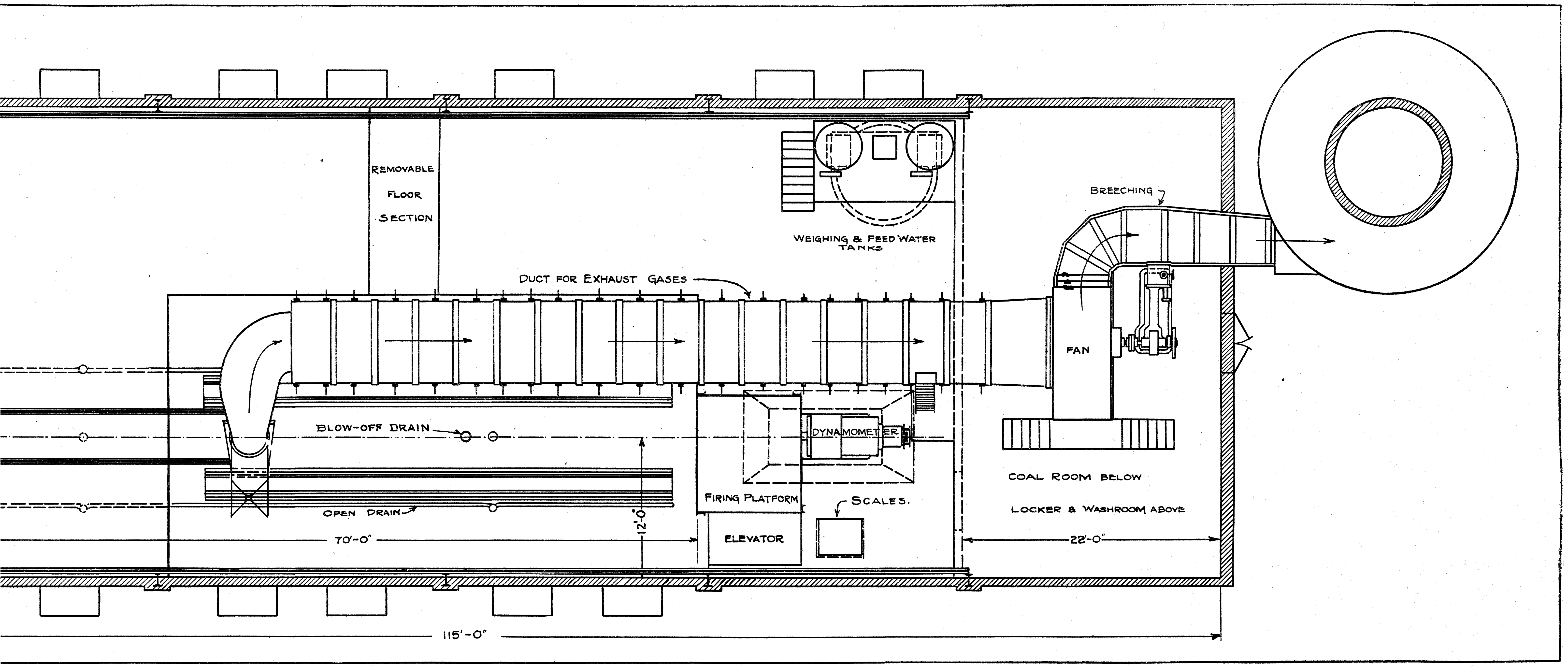


Fig. 10—A Longitudinal Section Through the Laboratory, Showing the General Features of the Building Design and the Position and Relation of the Apparatus

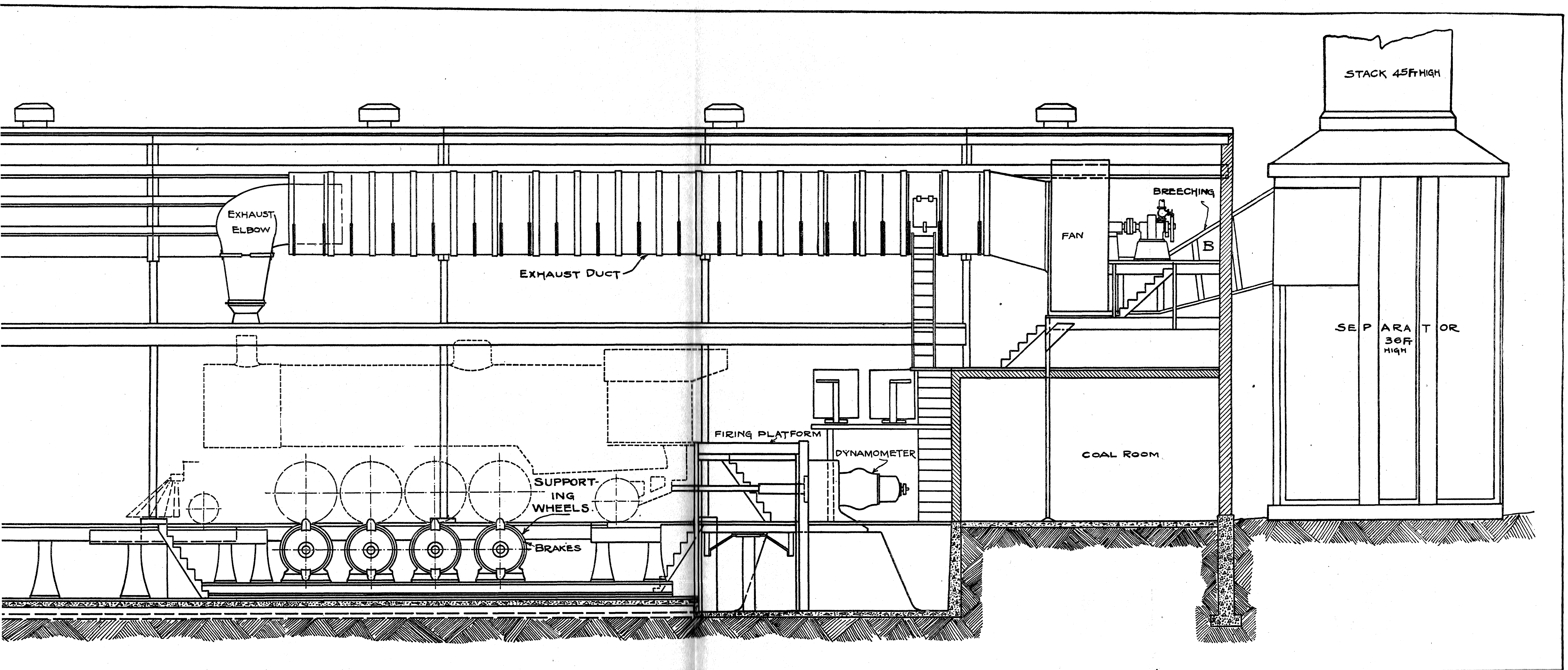


Fig. 11—A Sectional Plan of the Laboratory.

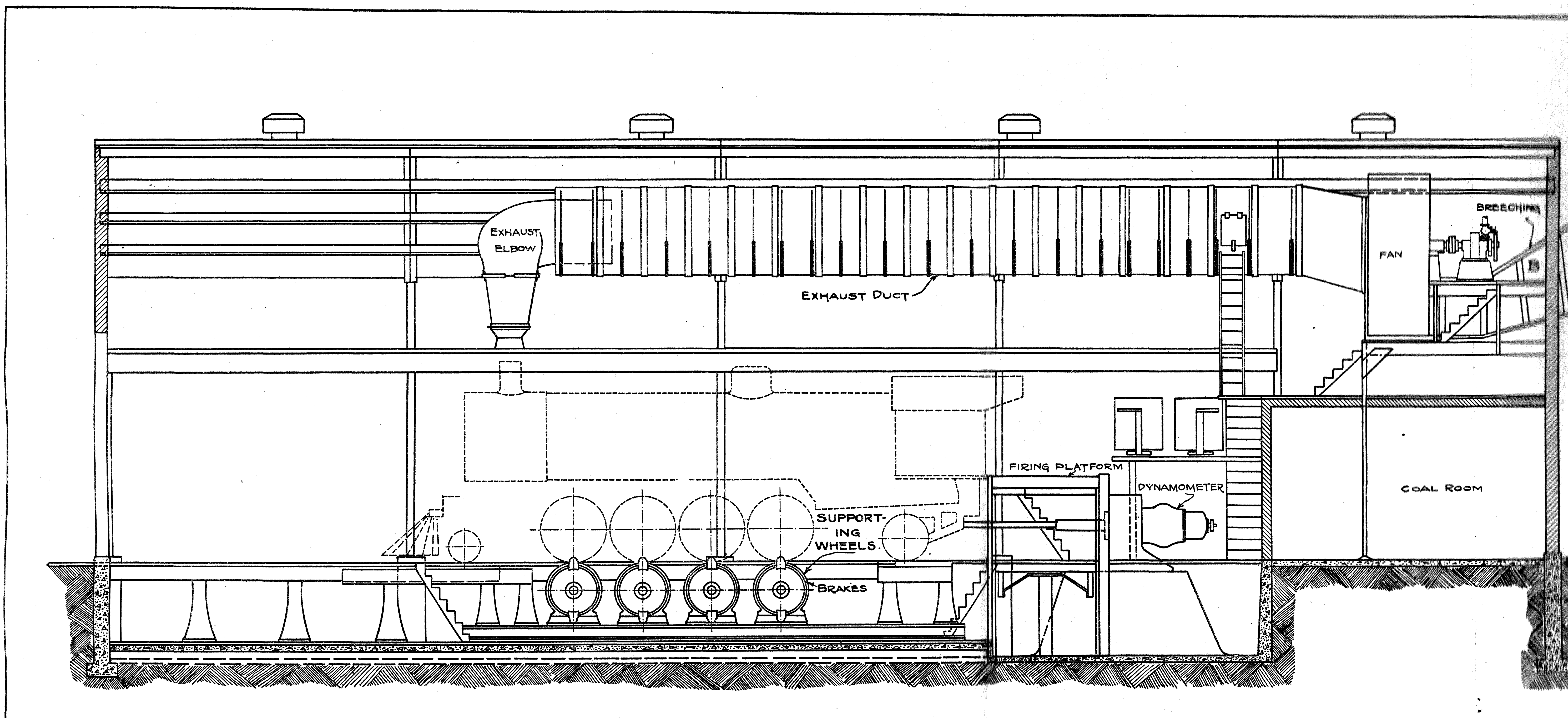
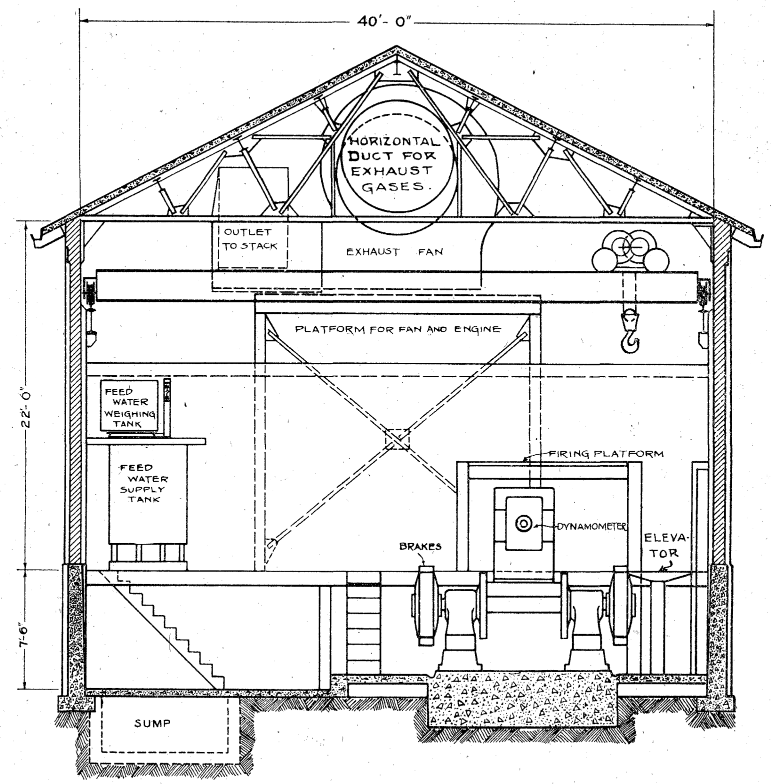


Fig. 11—A Sectional Plan of the Laboratory.

discharged high enough above ground to prove inoffensive to occupants of neighboring residences and university buildings. It was decided that this would require a stack about eight feet in diameter and at least eighty feet high. Further study made it apparent that these two decisions could be embodied in one structure combining the cinder separator and the stack. This has been accomplished in the construction represented in cross section in Figure 9, which is located outside of and at the rear of the laboratory. The system will be most easily understood in following (by reference to Figures 10 and 11) the course of the exhaust gases as they emerge from the locomotive stack. They are discharged thence into a steel exhaust elbow which carries the gases up and over to the center of the building, where they are received in a horizontal duct running through the center of the roof trusses. The gases are drawn through this elbow and duct by an exhaust fan, located near the roof at the rear end of the building. Probably the heaviest cinders will be dropped in this duct, but the velocity within it is such that all but the heaviest particles of solid matter will be carried on through the fan. Whatever does accumulate here may be removed through traps provided in the bottom of the duct, and weighed. From the fan, the gases and the remaining solid matter are passed through a breeching or flue to the separator above referred to, the action within which may be best explained by recurring to Fig. 9. The cinder laden gases enter this separator at B and in order to leave they must pass downward and around the sleeve A. In so doing they are given a whirling motion which causes the cinders to move toward the wall along which they drop to the hopper below, while the gases pass downward and out to the stack through the mouth of the sleeve. The cinders collecting at the bottom of the hopper are drawn off and weighed. This separator is surmounted by a 45 foot radial brick stack from which the gases are finally discharged 81 feet from the ground.

The corrosive nature of the mixture of exhaust gas and steam has made it necessary to avoid the use of metal throughout this exhaust system. The exhaust elbow within the building necessarily has been made of steel, and will need occasionally to be renewed. The duct, however, is of asbestos board ("Transite") which will resist corrosion. It is 7 ft. in diameter, and made up of separate sections so that its length may be varied. The fan has a runner 6 ft. in diameter, and will pass, at maximum speed, 140,000 cubic feet of gas per minute. The breeching between fan and separator is built of transite, and has a minimum cross sectional area of about 24 square feet. The outer shell of the separator is built of reinforced concrete. To protect the shell from corrosion, it is lined throughout with a hard burnt red brick. Between this lining and the shell is a 2″ air space to act as an insulator to protect the shell from undue heating. Any leakage of gas through the lining into this space is vented to the outside air through openings which are provided in the shell, and which serve also to circulate



LOCOMOTIVE TESTING PLANT

Fig. 12—A Cross Section through the Middle of the Laboratory.

cool air through the air space. The inside sleeve and hopper are both built of reinforced concrete. The stack itself is unlined, but is laid up in acid proof cement. It is expected that this whole system will not only permit the collection of all solid matter and thus enable front end losses to be determined in a manner beyond criticism; but that it will also dispose of the smoke so that it will be unobjectionable and at the same time act as a muffler and eliminate objectionable noise from the locomotive stack discharge.

The main features of the building which houses this equipment are shown in Figures 10 to 14. It is 40 ft. wide and 115 ft. long, with a height under the roof trusses of 22 ft. A basement with a 6 ft. 9 in. clear depth extends throughout all but 22 ft. of its entire length. The construction is fireproof throughout. The walls are laid up both inside and out with red faced brick, the roof is of reinforced concrete covered with slate, and all floors are of rein-

forced concrete also. The building is unusually well lighted by windows in the side walls which extend nearly the full height of these walls and occupy almost two-thirds of the wall area. All

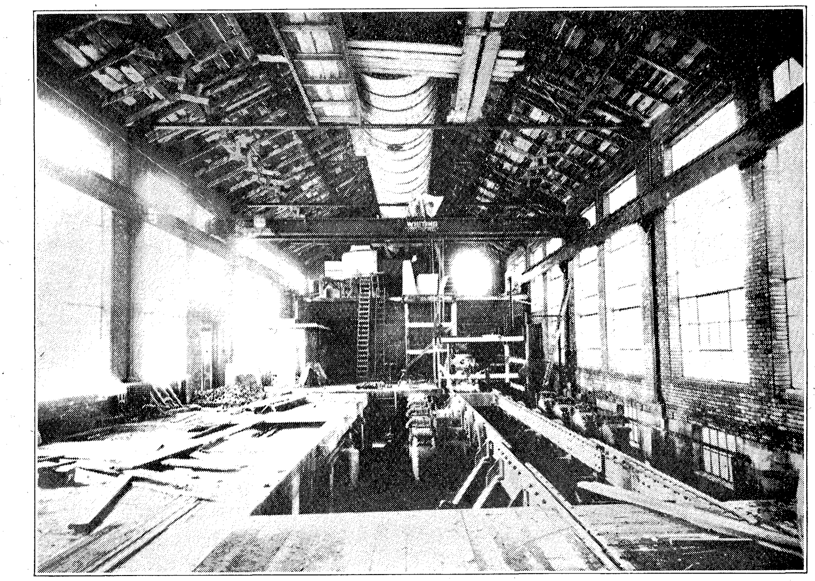


Fig. 13—An Interior View of the Partially Completed Laboratory, Looking Towards the Rear.

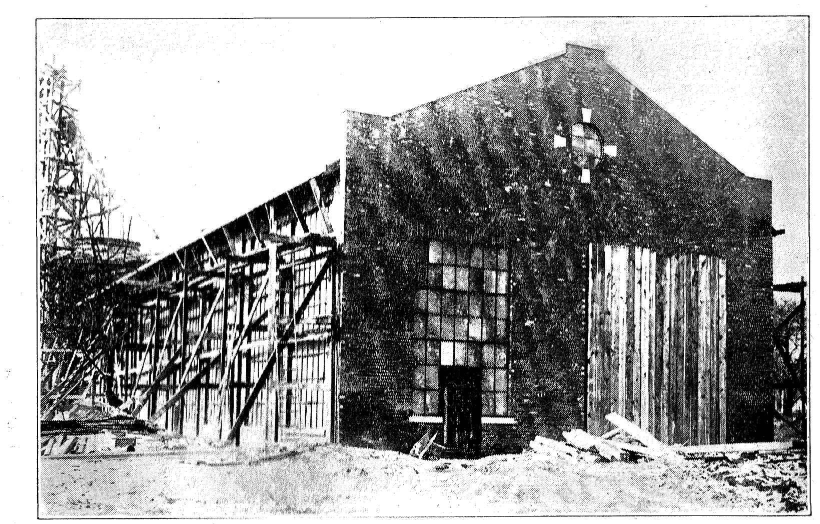


Fig. 14—An Exterior View of the Laboratory.

portions of the building, except the space occupied by the coal room in the west end, are served by a 10-ton traveling crane.

In the design of this plant the University has profited by the generous advice and assistance of those in charge of the laboratories at Lafayette and Altoona. Drawings and records of experience and of initial difficulties have been courteously placed at our disposal; and if in some details we shall have avoided similar difficulties, it will be largely due to this assistance which it is a pleasure thus to acknowledge. It is a pleasure also to acknowledge the part taken in perfecting the details of the design, by Mr. F. W. Marquis, Mr. H. H. Dunn, and Mr. H. B. Ketzle, members of our own railway department staff.

It is no part of our plan to own a locomotive for service in this laboratory. The whole plant has been designed with the intention of making it suitable to test new designs as they appear, in the confidence that the railroads and builders would be willing to keep upon the plant locomotives of recent design, concerning whose performance all railroad officials desire information; and we have proceeded in this plan with very generous assurance from those interested that we should not be disappointed in this expectation. The first locomotive to be tested is one of the consolidation type owned by the Illinois Central Railroad. It will be received within a few days and the plant is expected to be in operation by the middle of April. This locomotive is loaned to the University through the courtesy of Mr. W. L. Park and Mr. M. K. Barnum, whose encouragement and interest in this and many other connections we are glad to acknowledge. As is the case with the results of the work of all other university laboratories, the results obtained on this testing plant will be made public and freely available.

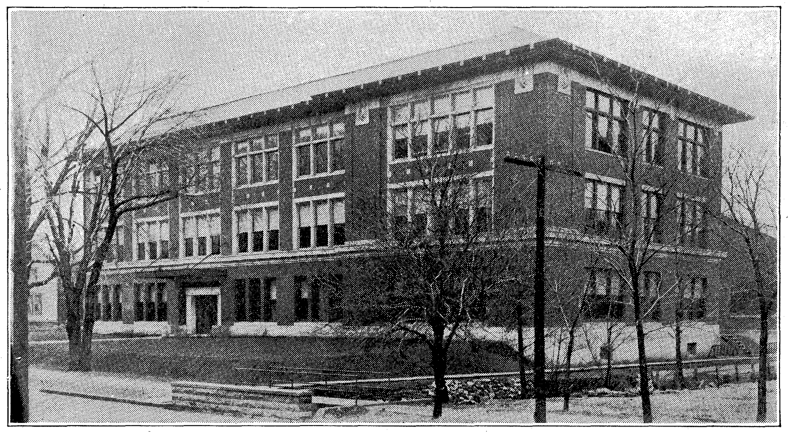


Fig. 15—The New Transportation Building.

THE TRANSPORTATION BUILDING.

The new locomotive testing plant is a most important addition to the equipment of the railway engineering department and will greatly strengthen its instruction and increase its opportunities for research. There has been added to the facilities of the railway engineering department another new building which in its influence on education for railway service at the University will doubtless prove to be in many respects an even more significant addition than the locomotive laboratory itself. This Transportation Building, as it has been named, is the largest of the group shown in Figure 1, and referred to at the beginning of the paper. The construction of this building was made possible by the same legislative act which provided funds for the laboratory. Construction was begun on this building last May, and was finished in August. The building has been occupied since the beginning of September of last year.

The Transportation Building was designed by Mr. W. Corbys Zimmerman, State Architect, according to general instructions and specifications prepared under the direction of Dean W. F. M. Goss. The plans provided for a building one hundred and eighty-five feet long and sixty-five feet wide. At present forty-five feet at the north end of the building are omitted, since at the time construction was started, the land upon which this portion will finally stand was not owned by the University. The building has three stories and is built of red brick with Bedford Limestone trimmings. The general features of the exterior design are shown in Figure 15. The construction is fireproof, consisting of a tile protected steel skeleton, brick walls, tile partitions, and concrete floors. The roof is of reinforced concrete covered with slate. The interior finish and all furniture is of oak, the floors are of maple with the exception of that of the hall on the first floor which is of tile. The building is conceded to be one of the most attractive of the Engineering group and thoroughly appropriate for its purposes. The railway engineering department at present shares the use of this building with the departments of mining, engineering and general engineering drawing. The building provides class rooms, drafting rooms, a library, small laboratories, and offices for the use of all three departments. It is planned to be occupied eventually by the railway department alone.

In Figure 1 there is shown another new building situated behind the Transportation Building. This contains at present the laboratories of the mining engineering department and the department of ceramics, which form for these departments additions to their equipment as important as are those previously described, for the department of railway engineering. This whole group forms a most significant addition to the facilities of the College of Engineering and one which will have an important influence on the work of the departments concerned. Contemplated future extensions of this group are indicated by the lighter lines in Figure 1. They include, it will be noticed, a building similar to the locomotive laboratory which will be devoted to laboratory work in railway electrical engineering. It is expected that in the course of time the departments of mining engineering and ceramics will have larger quarters elsewhere, and that the entire group of buildings shown in the plan will be devoted eventually to the work of the railway engineering department.

In addition to the new equipment here discussed the railway department has for some years owned a dynamometer car fitted for service on steam roads, an electric test car for instruction and research on electric roads, a brake shoe testing machine, and a drop testing machine. It is believed that this apparatus, the new Transportation Building and Locomotive Laboratory, with the facilities of the other laboratories of the College of Engineering, taken together, provide at the University of Illinois more complete and more adequate facilities for instruction for railway service than are elsewhere available, and that they offer opportunities for research in railway problems which are nowhere excelled. The staff of the railway department appreciates the obligations which these opportunities place upon it and feels confident that it may discharge them with some measure of success, if it continues to receive from railway officers the same interest and cooperation which have been given the department during the six years since it was organized. The action of the University Administration in making at this time such an investment for railway engineering instruction is a fitting recognition of the importance of the railway interests and marks a most significant advance in technical education.