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THE HANDLING OF LOCOMOTIVE COAL AND ASHES.

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The intelligent application of modern methods to the handling of locomotive coal and ashes has become one of the important features of modern railroad operation.

The endeavour of the present paper is to treat briefly on current practice and designs for coaling and ash-handling plants. Plans of stations representative of five methods are shown, with a brief presentation of the salient features and operating cost of each. Most of the latter figures are of general interest only, a few of them having been estimated. In order to facilitate comparison of costs, most of the figures furnished by the railroad companies being total costs for a single year, the writer has endeavoured, as far as possible, to analyze these according to information personally obtained regarding the actual working of the various stations.

The total expense for handling coal, which has been reduced to a tonnage basis, includes:

Fixed charges.
Operating charges.
Maintenance charges.
Pro-rata charges.

The fixed charges, which comprise interest, depreciation, insurance, and taxes, have been taken as 10% of the total initial cost of the plant. Maintenance and operating charges vary so widely with local and climatic conditions, that, considering also the short time over which the costs obtained extend, they can hardly be considered exact, and certainly not applicable, except as an indication of general results. Pro-rata charges are estimated as follows: The proportion of the time of yardmaster, clerks, etc., is distributed to the different departments on a labour output basis, and the per cent. added to the cost of handling coal and ashes is the proportion of the above wages based on the ratio which the labour charges for each of these departments bears to the total labour charges of all the departments of the yard. By several railroads, this amounts to about 20% of the labour charge for the coal and ash handling plants.

The chief objects aimed at in the choice and design of a type of coaling station are:

a. The minimization of delays to engines. Rapid and systematic handling, when the daily number is large, is very important. Several types of plant now in operation are designed to supply coal, water, and sand simultaneously to as many as 12 locomotives. Ashes, too, are sometimes removed by the same machinery which handles the coal, though, except in the case of the locomotive crane, this plan is generally unsuccessful on account of the excessive wear and corrosion of the moving parts of the carrier. A separate plant is therefore usually installed for this purpose.

b. The minimization of handling costs. Many factors and local conditions enter into this question, among which are:

(1) The physical location of the plant with regard to coal supply.
(2) The available ground space which in some cases is limited in length by the distance between yard terminals.
(3) The possibility of future extension.
(4) The number of locomotives handled daily.
(5) The type of coal cars, *i.e.*, whether the majority are self-clearing or require shoveling.

These factors also govern the question of the bin capacity necessary. An ample storage supply ensures against interruption of shipments or delays due to breakdowns, derailments, and plant repairs, but adds materially to the initial cost. The track arrangement also, while affording free movement, should be as compact as possible.

Handling of Ashes.—The selection of the type of ash pit practically depends on one factor, *viz*., the number of locomotives to be handled daily, for, whereas two minutes may suffice for the operation of taking fuel, 30 minutes to one hour, depending on the type of locomotive and season of the year, may be consumed in getting an engine over the ash pit.

The Locomotive Crane.—The locomotive crane system is found in certain localities to be admirably adapted to the rapid and economical coaling of locomotives, and is extensively used for the handling of ashes. Among its many advantages is its usefulness in the handling of other materials, such as sand, ore, etc., and that, when fitted with a crane-hook, it may be transported from place to place and employed as a light wrecking crane.

The crane has the functions of hoisting, rotating, and travelling under its own power. One operator consists of a supporting frame and boom, drums, engines, boilers, etc., the latter rotating oppositely to and counterbalancing the loaded bucket. The truck supporting the machinery is of standard gauge, and is driven by gearing from the engines.

The grab bucket used for handling coal and ashes has the advantage of a certain excavating power when seizing the material, so that flat-bottomed cars and ash pits can be scraped almost completely clear, causing a great reduction in the cost of labour.

At coaling stations of this type, the coal is either transferred by the crane directly from cars to the engine tender, or from storage, if such be provided. This generally consists of either a ground pile, pockets, or pits.

In the first case coal is taken from the cars by crane and piled by the side of the track within easy reach. As much as 10,000 tons can be thus held for emergency requirements.

Pocket storage is generally provided either for the purpose of weighing the amount taken by each engine or to insure extra rapid fueling. An overhead bin adjacent to the fueling tracks is subdivided into pockets of known capacity, provided with sloping bottoms, gates, or chutes. These are filled and kept so by the crane during slack hours either from pile storage or from cars.

Pit storage is also sometimes provided beneath the tracks, where a large number of self-clearing cars is available. The crane transfers coal direct from these pits to tender.

At the Cleveland yards of the Erie Railroad the crane takes coal from the cars on a side track and delivers it to the tender while the ashes are being removed from the engines.

For this purpose there is provided beneath the locomotive track a concrete pit sloping outwards, so that the ashes will fall into the clear space at the side, from which they are lifted and dumped into cars by the crane.

The crane makes over fifty trips per hour, and operates a 2-ton grab bucket. Such a coaling station requires only the services of one man, although two are frequently used—one to operate the crane, and the other as helper in the coal car to clear the corners and guide the bucket.

The following figures represent the coal handling capacity of this crane:

a. Average number of locomotives fueled per day.. 25
b. Average tonnage per 12 hours... 168
c. Maximum actual tonnage per 12 hours.. 180
d. Total tonnage for year 1906.. 60,500

The initial cost of the crane was $7,400, and the cost of bucket, pits, etc., is estimated at $4,500. The handling costs, per ton, are made up as follows:

Average tons handled per day..	166	
Fixed charges, per ton..	2	cents
Operating charges, labour..	2	"
Operating charges, power and supplies..	3.5	"
Maintenance charges..	0.3	"
Pro-rata charges..	0.4	"
Total cost per ton..	8.2	"

(N.B. No ash handling costs were available for this plant.)

Other locomotive crane plants show the following costs:

COAL HANDLING.

LOCATION	Buffalo	Leipsic	Bellevue	Ft. Wayne	Conneaut	Stoney Pt	Cleveland	Mina	
Year..........................	1905	1905	1905	1905	1905	1905	1906	1906	
Aver. tons per day..............	176	116	230	153	106	45	166	218	
Fixed charges..................	1.9	1.7	1.8	1.8	3.7	7.9	2.	1.5	cents
Operating charges..........	4.7	6.1	3.6	5.1	3.0	5.5	5.5	3.5	"
Maintenance charges........	0.5	0.2	0.7	0.5	0.4	0.2	0.3	0.1	"
Pro-rata charges..............	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	"
Total charge per ton..........	7.5	8.4	6.5	7.8	7.5	14.0	8.2	5.5	"

ASH HANDLING.

No. of locos. cleaned per day..	20	13	26	17	12	5	19	25	
Cost per loco. cleaned.........	4.8	...	3.8	22.4	3.3	4.7	...	...	cents

It is well, perhaps, to call attention to the fact that, in the above cases, the cost of handling ashes does not include any proportion of the fixed charges.

The actual cost per ton is not so important as a comparison of costs between old and new methods of doing the work. In the case of the Erie plant, at Cleveland, the reduction per ton due to the installation of a locomotive crane was about 12 cents. At this plant there is another crane not in service at present.

Belt Conveyor.—The inclined belt conveyor is a very well-known type, an example of which is found at the Cleveland yards of the Pennsylvania Lines West. The general layout is shown in plate No. 1.

This plant consists of a single pocket of 500 tons capacity fed by a belt from a track hopper. This is situated beneath the coal car track, and directs the coal on to a steel trough of trapezoidal section, from which it is delivered to the belt by an automatic feeder making about 35 strokes per minute. (See plate No. 2.)

This is built of steel plates to fit the trough section, is mounted on rollers, and has a reciprocating movement actuated by a crank driven from the lower belt drum shaft. At one end of its stroke it uncovers the hopper opening and pushes the coal that falls through along the trough until it falls on to the belt. The feeding action is intermittent, and is automatically regulated by the speed of the belt. Around the lower part of the belt are wooden guards to prevent the coal from spilling as it falls from the trough.

The belt is made of cotton duck faced with rubber, ⅜" thick by 30" wide, and runs about drums on 200 ft. centres. The slope is about 25°, according to the usual practice, and it is troughed by means of 3 roll idlers, set 5 ft. 3 in. apart. The inclination of the outer rolls is about 20°, and lubrication is effected by grease cups, which also help to protect the journals from grit. The belt will deliver 100 tons per hour at a speed of 200 ft. per minute, but in daily operation averages 50 tons in 42 minutes, with a speed of 125 ft. per minute, the power consumption being about 15 H. P. The average life of one of these belts is from 2½ to 4 years.

The belt and its supports, together with a 2-ft. gangway, are completely housed, the housing being supported midway by a wooden trestle tower. Beneath the belt runway is the engine room containing the belt-driving drums, which are geared to an 18 H. P. simple horizontal engine making 110 revolutions per minute. Steam is supplied from the roundhouse boilers (a distance of about 500 ft.) by an overhead pipe protected by a galvanized iron casing.

In a shed beneath the coal wharf the sand for the locomotives is screened and dried in a small oven, from which it drops through a bell hopper into an air-tight chamber. It is then shot up by means of compressed air (also supplied from the shops) to a steel storage tank at the top of the bin, from which it is piped to the engines as needed.

The coal pocket itself is a wooden structure 24 ft. square by 83 ft. high, with undercut gates and iron-hooded chutes feeding a through and an outside track.

To prevent trouble due to accumulation of slack, the bins are designed with hopper bottoms, and the coal is delivered from the belt by means of adjustable chutes directly to the points of supply. The slack is thus used as it is delivered, whereas, a straight fall would cause the large lumps to roll to the mouths of the chutes, while the slack would collect and finally slide out in large masses, interfering seriously with train performance.

All slack adhering to the descending side of the belt is removed by a rotating brush.

The original cost of this plant was $13,000, and it is in operation for 10 hours per day.

Average number of locomotives fueled per day..	50 to 75
Average tons handled per day (1906)..	260
Maximum tons handled per day on a monthly basis.	570

The labour connected with this plant includes one engineer in charge of the machinery, and two laborers.

The handling costs for 1906 are made up as follows:

Average tons handled per day..	258	
Fixed charges..	1.4	cents
Operating charges..	2.8	"
Maintenance charges (belt renewal)..	0.2	"
Pro-rata charges..	0.2	"
Total cost per ton..	4.6	"

Ash pits are in general divided into two classes:

1. *Shovelling Pits.*—These are of the ordinary open-sided type, with or without a depressed track for ash cars.

2. *Mechanically Operated Pits.*—Under this heading come:

(*a*) The Locomotive Crane;
(*b*) The Bucket Conveyor; and
(*c*) The Overhead Trolley, which also is found in several

different forms. In some cases it consists of a single or several concrete pits (according to the number of cleaning tracks) spanned by an overhead trolley track. Locomotives discharge fire-box cinders and flue dust simultaneously into pit tubs, which are then elevated by suitable machinery and dumped into a pocket or directly into an ash car on an adjoining track. A form of this type is installed at the Cleveland yards, and is shown on plate No. 3.

At this station there are three locomotive dumping tracks with track hoppers, each 18 ft. long, and having a longitudinal pit extending beneath the tracks for 16 ft. on each side of the hopper, so that a locomotive headed in either direction may have the fire cleaned over the track hopper, and the flue dust dumped into tubs running in the longtitudinal pit at the same time.

For quenching the ashes, water pipes perforated with small holes are laid around the sides of each hopper.

Running beneath the hoppers is a cross pit, 12 ft. deep by 6ft. wide by 48 ft. long, in the bottom of which is a 3 ft. gauge track, on which runs a truck and detachable bottom-dump bucket of about one-quarter ton capacity.

Stationed in the pit is a man who operates the hopper gates and chutes, and moves the bucket, when filled, to the open end of the transverse pit. Here a hoisting cable, driven by a 15 H. P. engine and winding drum, is attached by a crane hook to the bucket. It is then lifted out of the pit and, locking by means of an automatic latch with a small carriage, runs along the overhead inclined way until vertically over the adjoining ash car track.

The dumping of the ash-bucket is automatic, and is best explained by describing its construction which is based on the principle of ice-tongs.

The bucket is built in two parts, and attached to the sides, near the top, are two arms which cross in the middle and hinge with a bolt, to which is also fastened a ring. When in suspension, the weight of the bucket, acting at the hinge, keeps the sides closed together. When over the ash car, two projecting plates on the runway engage the arms and, by pressing them down, force apart the two halves of the bucket.

This method combines several advantageous features, simplicity, compactness, and low operating cost. The power for the hoisting machinery is supplied by a 15 H. P. engine, and the whole system, outside of the actual dumping of the locomotives, can be operated by two men. The pits, while presenting a minimum area to surface drainage, are very cheap to install, the first cost being about

$5,000.00. During 1906, the number of locomotives handled was upwards of 18,000, and the cost per locomotive was as follows:

Fixed charges..	2.4	cents
Labour of operating plant..	27.5	"
Cost of power and supplies..	1.1	"
Maintenance..	.2	"
Pro-rata charges..	5.6	"
Total cost per locomotive cleaned... ..	36.8	"

Bucket Conveyor.—The next type of station is the combined bucket elevator and conveyor.

The Lakeshore and Michigan Southern Railway, at Elyria, Ohio, has a main line wharf of 500 tons capacity, bridging four main tracks, as shown on plate Nos. 4, 5, and 6.

There are two independent bucket systems which are practically alike in all details, and will, therefore, not require separate discussion.

The wharf is a wooden structure supported on steel construction; 80 ft. long by 29 ft. wide, the upper runs being 62 ft. above the tracks.

Under each coal track at the side of the wharf is a steel hopper built in two compartments with plunger feeder under each opening, which delivers the coal at regular intervals to the carrier. The object of having two compartments and feeders is to divide the flow of coal, so that the feeders work alternately, the rate of delivery thus corresponding to the capacity of the buckets. This allows of increased speed without danger of overloading either feeder or carrier.

The feeders are, in their simplest form, steel plates, mounted on rollers, which derive a reciprocating motion from a crank connected to the foot shaft of the carrier.

From the feeders, which make 60 strokes per minute, the coal drops into the horizontal steel trough or "run," from which it is elevated by the buckets (which are enclosed in a vertical steel casing) to the upper runs. One system of this plant has a crusher interposed between the feeder and the horizontal run. There are four 125-ton pockets, and over each a discharge gate consisting of a section of the trough operated by rack and pinion from the upper platform.

The buckets of these conveyors are of the standard gravity discharge type, spaced 3 ft. apart. They are V-shaped, and are attached rigidly to a double-strand steel link chain of 12 in. pitch, with flanged rollers at the articulations of the links. The speed of the buckets is about 65 ft. per minute, and each system is designed to handle 100 tons of run-of-mine coal per hour.

For measuring the amount of coal delivered to each engine each bin is mounted on one-hundred and sixty-five ton capacity recording scales. After each draft the scales are balanced, and the difference of weight of the pocket is noted against the number of the engine.

The arrangement and style of under cut gate and reverse coal spout are shown in plate No. 7. These, unlike most others, are not operated by the locomotive firemen, but are connected by a system of chain-connected levers (shown for one bin only) operated by an attendant who is located in the structure at a point where he commands a view of the engines passing under the pockets. The gates and spouts are interlocking, so that a gate cannot be opened until after the spout is lowered, and the spout cannot be raised before the gate is closed.

Power is supplied to one conveyor by a 32 H.P. gasoline engine making 200 revolutions per minute. For the other system power is derived from a 60 H.P. gasoline engine making 160 revolutions per minute.

Rope transmission is used throughout.

The plant is operated by an engineer, a fireman, and two laborers.

The following figures represent the operation of this plant:

a. Average No. of locomotives fueled per day.	60 to 70
b. Average daily tonnage—summer..	300
c. Total tonnage for year 1906..	88,250

This plant, as originally installed, consisted of the main structure and one conveyor system, and cost $34,000. Later, the second conveyor was installed at an estimated cost of about $15,000, but as one conveyor only is in continuous operation at present, the fixed charges have been estimated for the original cost of $34,000.

Average No. of tons handled per day...	242	
Fixed charges..	3.9	cents
Operation charges..	2.8	"
Maintenance charges..	2.1	"
Pro-rata charges..	0.4	"
Total cost per ton...	9.3	"

Trestle Plant.—An example of the trestle wharf is found at the Collinwood, Ohio, yards of the L.S. & M.S. Railway, and is shown on plate No. 8.

This plant consists of a plain trestle (with inclined approach), provided with two one-hundred ton pockets, with two hundred tons auxiliary storage in the shape of loaded self-clearing cars on top of the trestle. It is located between two tracks, one for freight and the other for passenger locomotives.

On this trestle is also a sand bin of 30 car loads' capacity, from which the sand flows into the drying house, and is shot up by compressed air to an overhead tank.

The storage part of the trestle is 200 ft. long and 35 ft. above the ground level. It is approached by an inclined trestle 560 ft. long forming a 6% slope. The object of this design is to necessitate but one shift, *i.e.* to replace the empty cars on the trestle with loaded ones, once in twenty-four hours.

The object of having two separate pockets is to provide not only sufficient trestle storage, but, as the number of locomotives handled daily to the wharf is large, to allow two locomotives on each track to be coaled simultaneously without increasing the length of the pockets. A natural mixture of the coal is maintained, as at the Cleveland belt conveyor plant, by means of adjustable chutes directing the flow to the points of discharge.

The operation of this plant is shown by the following figures:

a. Average tons of coal handled per day—summer	550
Average tons of coal handled per day—winter.	900
Average tons of coal handled per day—fall....	700
b. Total tons of coal handled during 1906..	231,700
c. Time to unload fifty ton cars by shoveling.. ..	2½ hrs.
d. Average No. of locos. handled daily—summer..	50
Average No. of locos. handled daily—winter....	65
e. Average tons of coal taken per locomotive:	
Yard engines..	5 to 8
Freight and passenger engines..	8 to 15
Average..	10

The labour force consists of 3 laborers and a foreman, who also has charge of the ash-pit gang.

The original cost is estimated at $15,000 and the handling costs for 1906 are as follows:

Tons handled per day...	635
Fixed charges...	0.7 cents
Operating charges...	4.1 "
Maintenance charges..	0.1 "
Pro-rata charges...	0.4 "
Total cost per ton..	5.3 "

The method of elevating the coal is a distinct disadvantage to the trestle system for, disregarding the expensive nature of the inclined approach, the employment of a locomotive to haul a long and heavy load of coal cars up a 6% grade is a most uneconomical method. Power is wasted not only in elevating the dead weight of the cars themselves but also in their return to the ground level under the force of gravity.

The ash pits are of the ordinary open-sided type with depressed track generally installed where the ashes are handled by shoveling. There are two sets, one accomodating four freight locomotives, and the other four passenger locomotives.

The handling capacity of the pits is as follows:

Average number of locomotives having fires cleaned per day..	58
Total number of locomotives having fires cleaned per year..	21,000

The cost of handling ashes is estimated as follows:

Fixed charge..	4.8	cents
Labour..	26.1	"
Power, supplies, etc...	1.2	"
Pro-rata charge..	4.8	"
Total cost per locomotive cleaned.. ..	35.7	"

Vertical Lift Type.—An interesting plant of recent design and installation is that installed by the Pennsylvania Lines West at Alliance, Ohio, which is shown in plate No. 9. It is a wharf of 350 tons bin capacity, fed by two vertical cars from track hoppers. The hoppers feed alternately to each car, one of which ascends loaded as the other descends. The hopper gates and chutes are controlled by a chain drive from an operating room placed on the track level between the vertical shafts. Beneath this room are situated the cable drum and 25 H.P. driving motor controlled by the operator from the room above. The hoisting cables are wound oppositely on the drum so that the weight of one car balances that of the other.

Each car holds 3 tons, and is built with a sloping bottom and a door which is automatically unlatched by a tripping device at the head of the shaft, and swings out chuting the coal into the bin. On starting to descend, it is automatically shut and latched.

The cars are brought to rest by brakes controlled from the operating room. The handling capacity of the buckets at a speed of 60 ft. per min. is 100 tons per hour., the total vertical lift being

83 ft. The plant is in continuous operation. The whole arrangement is very simple, and requires but one attendant and a laborer to look after the cars.

The initial cost of this wharf was $18,000, and the average number of locomotives fueled daily is about 50, but, as the plant had only been running 6 weeks when visited, further costs were unobtainable.

From the point of view of simplicity and compactness, this type certainly possesses undoubted advantages. The labour cost is small, and the absence of complicated machinery should reduce the power and maintenance costs to a very low figure. The system is built with capacities as high as 700 tons, but where larger capacity is needed, the bucket conveyer system is substituted.

The ash handling plant installed at these yards is in every way the counterpart of the Cleveland plant except that electric power is used.

Without attempting to draw any definite conclusions, it may not be considered out of place to make a brief comparison of the relative advantages and objections of the above types of coaling station.

In the first place, the locomotive crane has offered a very successful and moderately cheap method of handling coal and ashes in locations where the demands are not excessive. Its practical limit is said to be about 70 locomotives a day, as the capacity of the bucket is necessarily below 5 tons, and the number of trips per hour is restricted to about 50.

It is not as rapid as plants having gravity discharge from storage, but, as the engine is necessarily held over the ashpit for about 40 min., this feature is hardly objectionable as delays to engines can be obviated by providing pockets.

The system proves a very flexible one on account of the diversity of arrangements possible. One disadvantage of open-air storage in pockets or pits, however, is the liability of the coal and gates to be frozen up in cold weather. With the necessary tracks, pits, and pockets, it will be found that this sort of plant has a considerable first cost. Its operating cost depends upon the work which can be provided at spare times. Its value is great in emergency situations, and at points where, because of impending changes, the construction of a permanent plant is unwise. With a large terminal where a conveyor plant is used, a locomotive crane can be very valuable to handle cinders and sand, and also coal during a possible breakdown of the conveyer. Then again not only can it unload direct from flat bottom cars, handle ashes as well as coal, move to any spot desirable to stop the locomotive, but if superseded by a different system, can be easily moved to another point. These are a few of the points of interest concerning the locomotive crane, but within its proper sphere of capacity, it seems to prove one of the very best now in use.

The inclined belt conveyor has also several features of advantage. Besides having as low a first cost as any other handling system, the simplicity of the machinery reduces greatly the operating and maintenance expense, the latter, being mainly an allowance for belt renewal. A belt will handle large quantities of coal noiselessly and with little breakage, requires but about two-thirds the power of a chain conveyor, while practically the only attention necessary is occasional lubrication of the moving parts, and the taking up of slack. The troughing should not be so great as to cause the belt to crack, nor the coals so large as to cause the belt to run out of line and chafe at the edges.

Of course this system takes up considerable ground, but in certain locations, where plenty of space is available, a better storage yard for coal cars can be provided by this than by other types as the receiving hopper is placed at some distance from the storage bin.

The belt system, however, has not the flexibility of the chain conveyor which lends itself to the formation of many types of station, and can be adapted to almost any arrangement or local conditions. The latter takes up very little ground space, and can handle from 30 to 500 tons an hour, though it has a tendency to break up very soft coal.

Its main disadvantage is a somewhat higher initial cost than other systems, though stations with an actual daily working tonnage of about 75 tons can be built for $16,000 or $17,000; Second, operation is inexpensive, but maintenance varies considerably, according to the care taken with the machinery. This contains many working parts and, as the strains are pretty severe, the excessive wear at the link-articulations, unless very well lubricated, will cause considerable uneven elongation to take place. This seriously affects the life and efficiency of the system, and repairs and restoration of parts may greatly increase the cost of maintenance. Many of these plants, however, are in operation at present, and, when well cared for, they give excellent service at a reasonable cost.

The trestle system, with gravity discharging pockets, and a steep or light grade approach (according as the cars are placed by yard engines, or by some other power), has, perhaps, the most widespread use of all the types of plants already described. Its advantages are cheapness and simplicity of design and operation. In location where a large number of locomotives are handled and two tracks only are to be served, it has proved very satisfactory and economical.

An item of importance not mentioned before is the necessity for fire protection. This, together with the recent and prospective increases in the price of labour and timber, have tended to increase the desire to have better plants built of steel or reinforced concrete.

Regarding the question of locomotive coaling plants in general, it seems that, for small terminals, the two bucket lift locomotive crane, or a trolley hoist, using a bucket of the clamshell type seems suitable, while for larger plants the trestle or a conveyor plant is desirable. In most cases, however, not the economy of the plant but the economy of the yard is found to be the determining factor in fixing the particular kind of plant to be used, it being necessary to use systems adapted to the space available at the terminals, regardless of small economies and differences in types.

TABLE OF COSTS OF DIFFERENT METHODS OF HANDLING LOCOMOTIVE COAL & ASHES

Railroad	Location	Type of Plant	Year	Tons of Coal Handled: Per Year	Tons of Coal Handled: Per Day	Initial Cost $	Fixed Charges per Ton ¢	Operating Cost per Ton: Labor ¢	Operating Cost per Ton: Power & Supplies ¢	Operating Cost per Ton: Total ¢	Maintenance per Ton ¢	Pro-Rata Charges per Ton ¢	Total Cost per Ton ¢	Locomotives Cleaned: Per Year	Locomotives Cleaned: Per Day	Cost of Handling Ashes per Loco ¢
New York Chicago & St Louis	Buffalo N Y	Locomotive Crane	1904	52 200	143	12 000	4 3	2.0	2.9	4 9	0 2	0 4	9 8	5800	16	6 0
			1905	64 850	176		1 9	2 0	2.7	4 7	0 5	0 4	7 5	7150	20	4 8
	Leipsic		1904	40 000	110	7100	1 8	2.0	4.1	6 1	1 0	0 4	9 9	4450	12	—
			1905	42,400	116		1 7	2 0	4.1	6 1	0 2	0 4	8 4	4710	13	—
	Bellevue		1904	76,500	220	14900	1 9	2.0	2 0	4 0	0 5	0 4	6 8	8500	23	4 6
			1905	84,100	230		1 8	2.0	1 6	3 6	0 7	0 4	6 5	9340	26	3 8
	Ft Wayne Ind		1904	53,500	146	9 900	1 8	2 0	4 5	6 5	2 1	0 4	10 8	5940	16	24 0
			1905	55,800	153		1 8	2 0	3.1	5 1	0 5	0 4	7 8	6200	17	22 4
	Conneaut Ohio		1905	38,200	106	14 000	3 7	2 0	1 0	3 0	0.4	0 4	7 8	4250	12	3 3
	Stoney Island		1905	16,600	45	18 200	7 9	2.0	3.5	5.5	0 2	0 4	13 0	1840	5	4 7
Erie	Cleveland Ohio		1906	60 500	166	12 000	2 0	2 0	3.5	5.5	0 3	0 4	8 2	6720	19	—
L.S.&M.S	Mina		1906	79,700	218	12 000	1 5	2 0	1.5	3.5	0.1	0 4	5 3	8850	25	—
Penn Lines	Cleveland Ohio	Belt Conveyor	1908	94,000	258	13,000	1 4	1 1	1.7	2 8	0 3	0 2	4 6	18680	51	36 8
L.S.&M.S	Elyria Ohio	Bucket Conveyor	1906	88,300	242	34 000	3 9	2 0	0.8	2.8	2 1	0 4	9 3			—
L.S.&M.S	Collinwood Ohio	Trestle	1908	731,700	685	15 000	0.7	2 0	2 1	4 1	0 1	0 4	5 3	21,000	58	35 7


TRACK HOPPER
COAL RECEIVING TRACK
COAL WHARF
203'
130'
500 TONS CAPACITY
50'
16'
18'
16'
16'
TRACK PIT
ASH HOPPER
GRATINGS OVER TRANSVERSE PIT
TRACK PIT
TRACK PIT
ENGINE HOUSE
ASH CAR
OVERHEAD TRACK
PLAN OF ASH PITS
GRATINGS OVER TRANSVERSE PIT
TRACK PIT
WATER SUPPLY
TURNTABLE
ASH CAR
PENNSYLVANIA LINES WEST OF PITTSBURGH—CLEVELAND, OHIO
GENERAL LAYOUT OF YARDS

Plate 1.

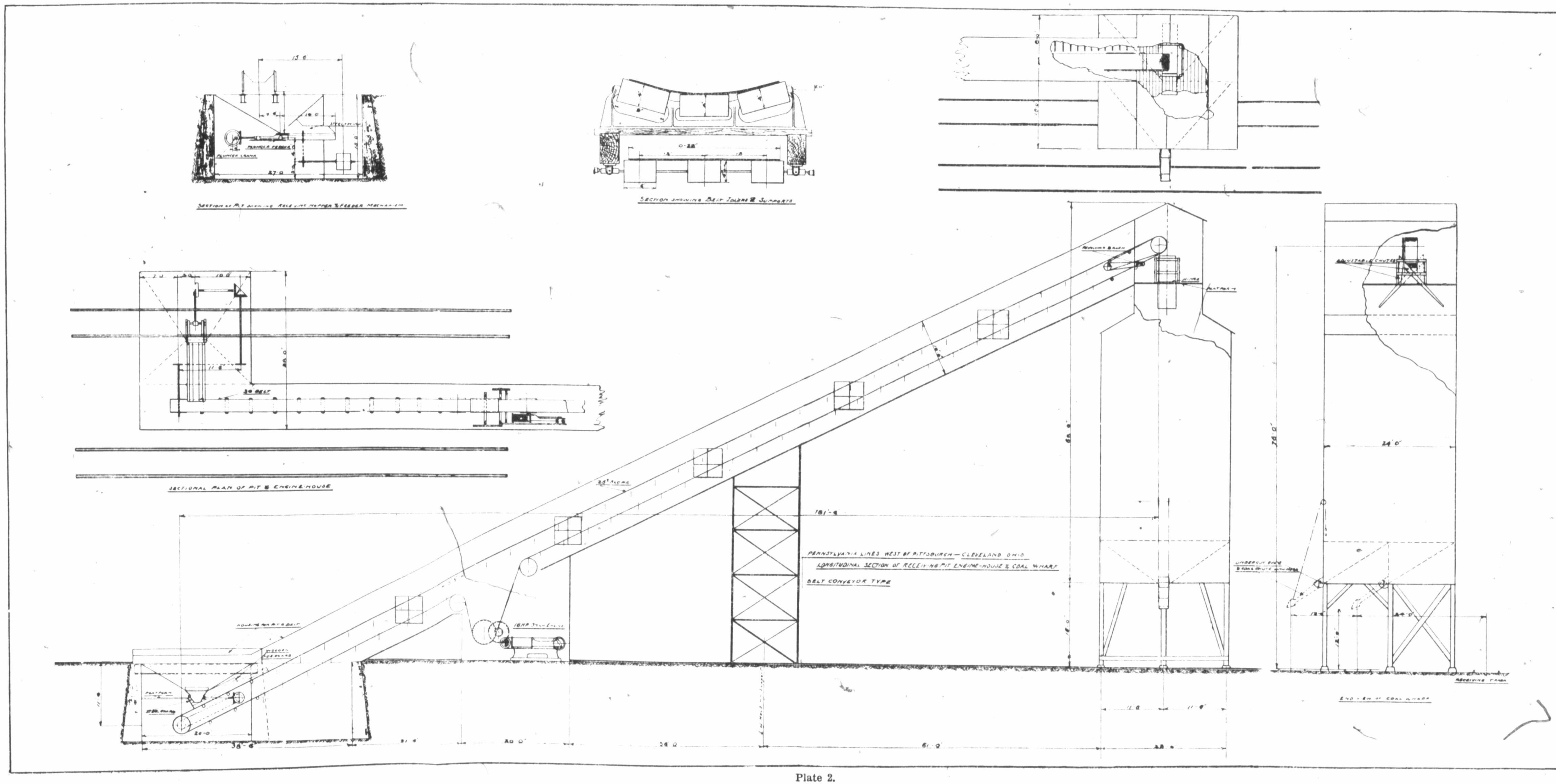
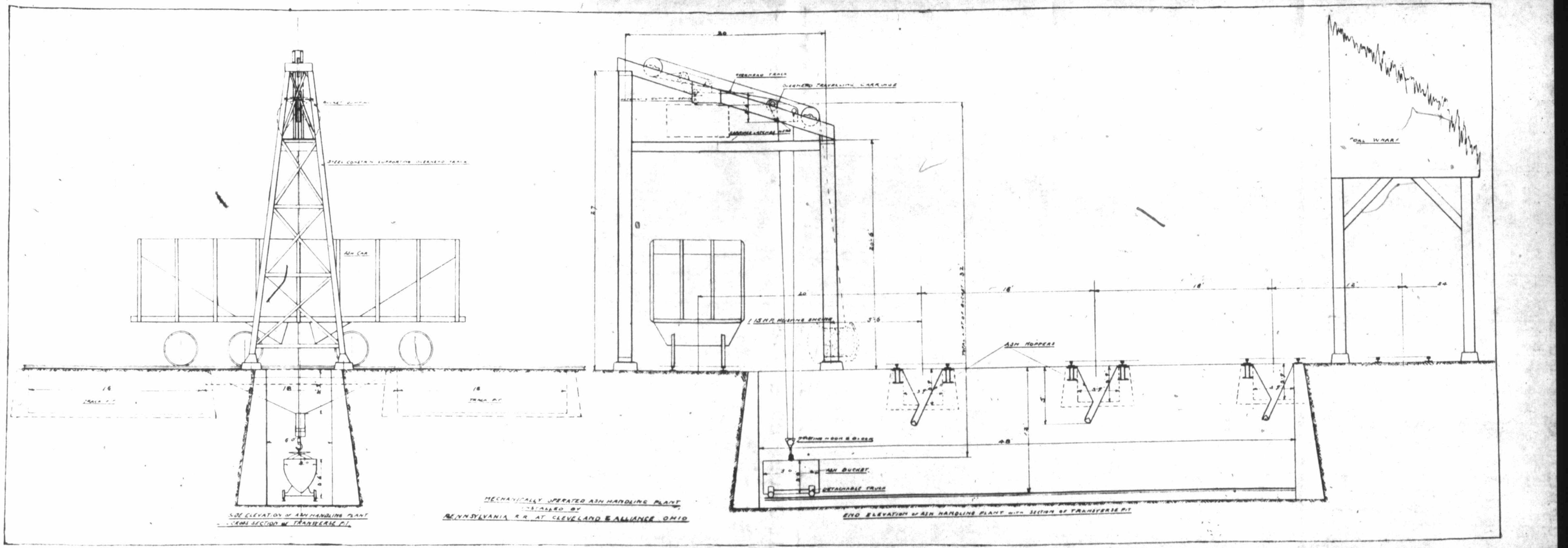

PENNSYLVANIA LINES WEST OF PITTSBURGH — CLEVELAND OHIO
LONGITUDINAL SECTION OF RECEIVING PIT ENGINE-HOUSE & COAL WHARF
BELT CONVEYOR TYPE
SECTIONAL PLAN OF PIT & ENGINE-HOUSE
181'-9
24'0"

Plate 2.



ASH CAR
ASH HOPPERS
COAL WHARF
ASH BUCKET
DETACHABLE TRUCK
SIDE ELEVATION OF ASH HANDLING PLANT
CROSS SECTION OF TRANSVERSE PIT
MECHANICALLY OPERATED ASH HANDLING PLANT
INSTALLED BY
PENNSYLVANIA R.R. AT CLEVELAND & ALLIANCE OHIO
END ELEVATION OF ASH HANDLING PLANT WITH SECTION OF TRANSVERSE PIT

Plate 3.

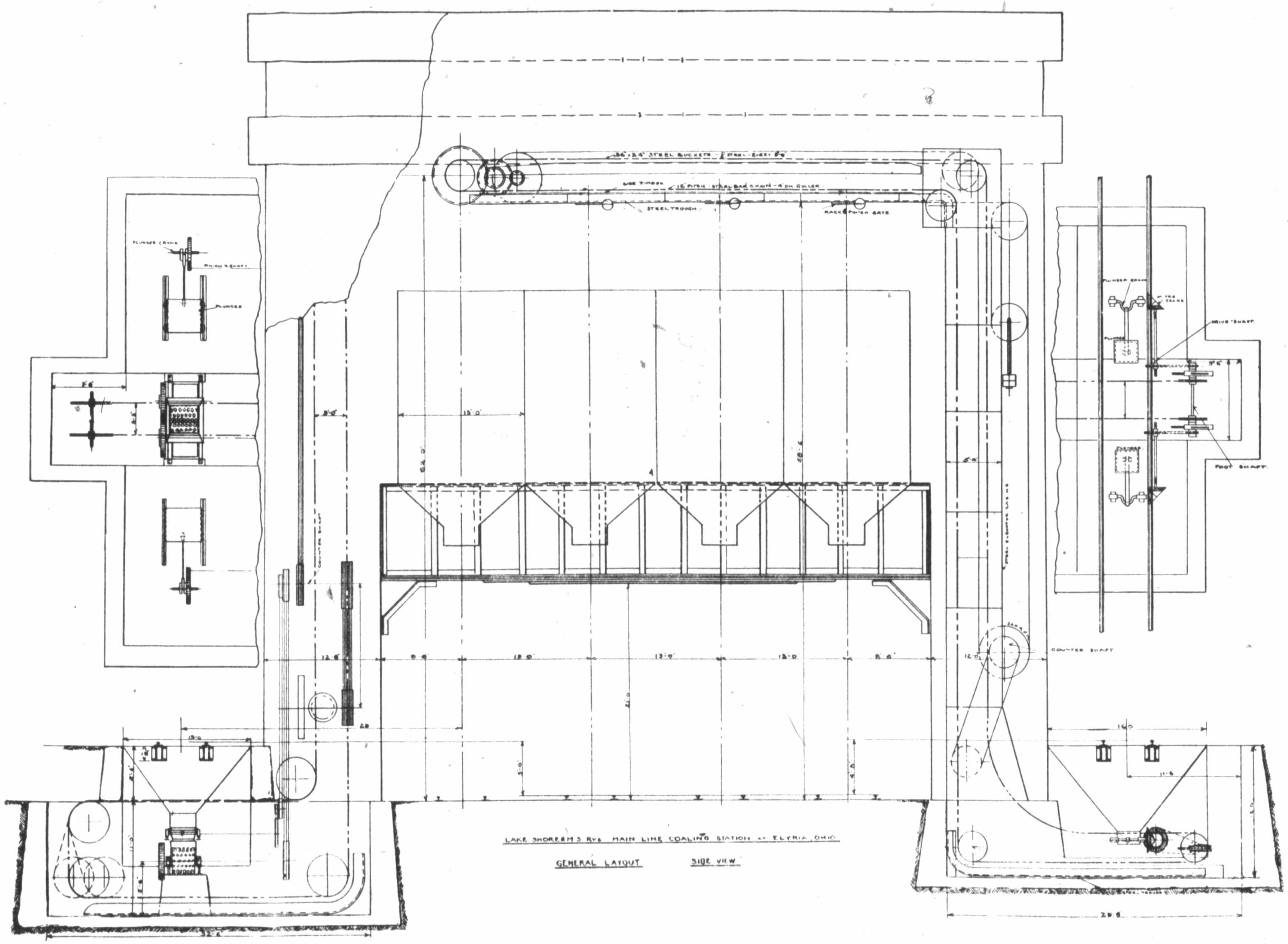

LAKE SHORE & M S RYS MAIN LINE COALING STATION AT ELYRIA, OHIO
GENERAL LAYOUT
SIDE VIEW

Plate 4.

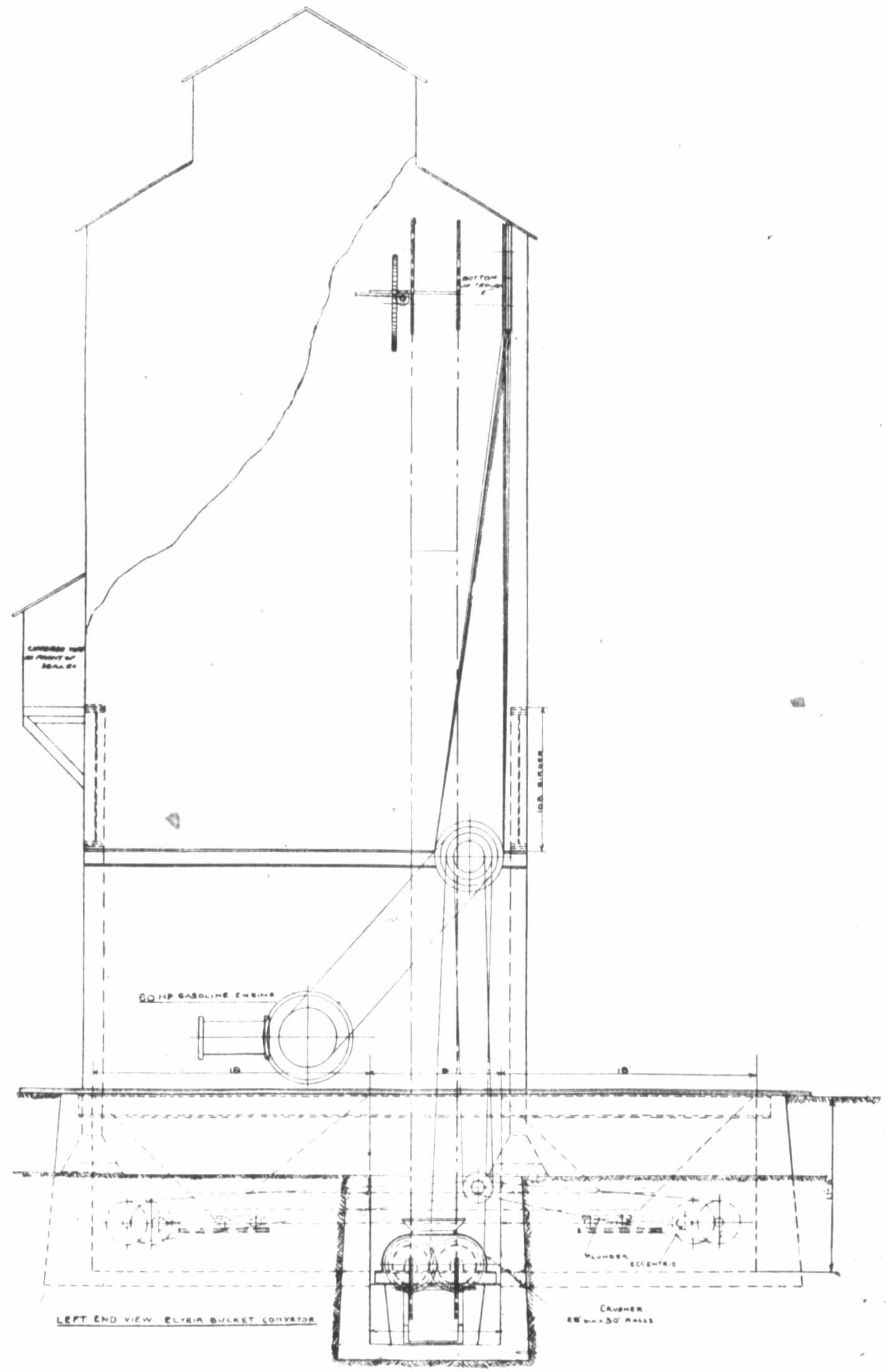
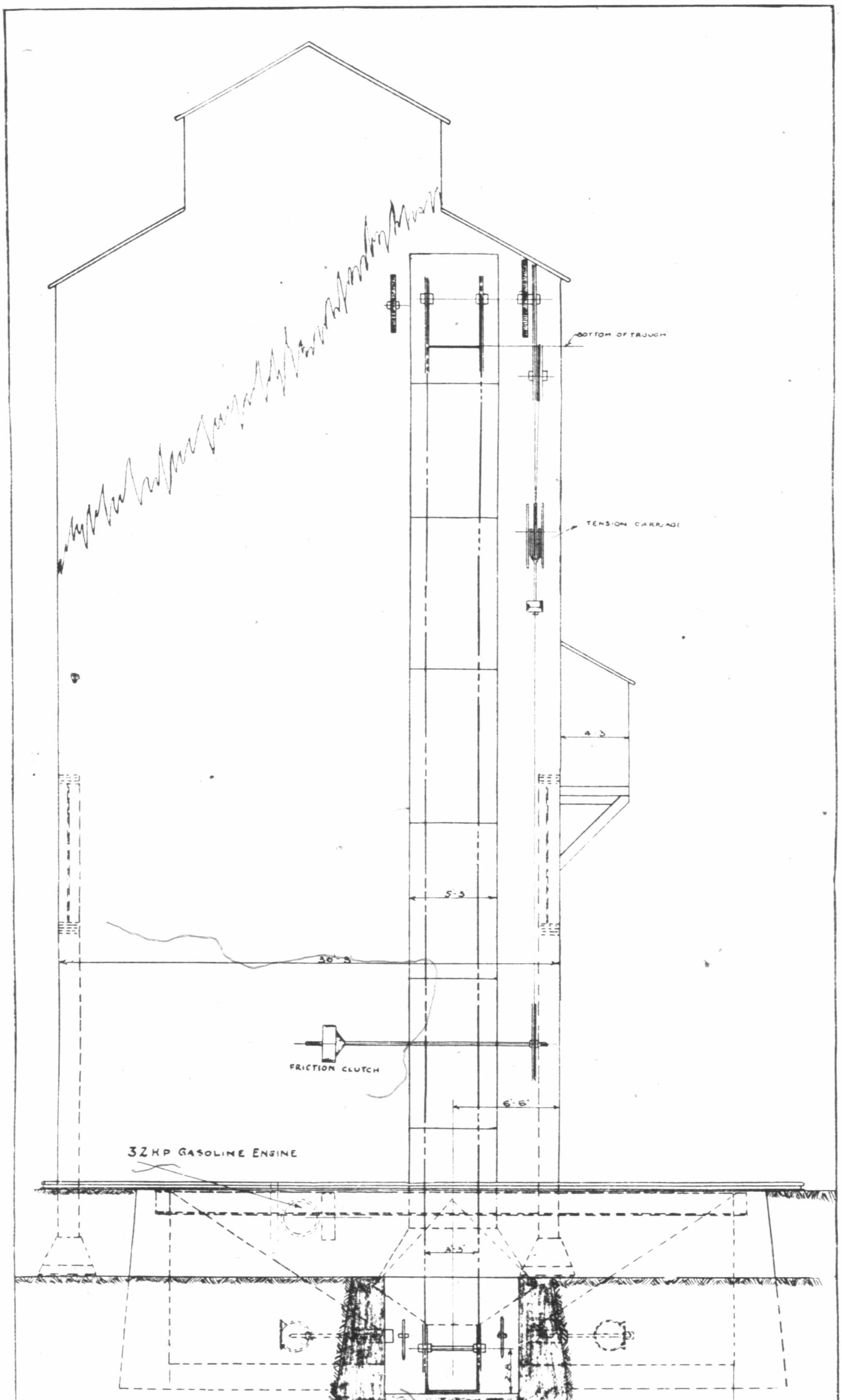

60 HP GASOLINE ENGINE
18
18
PLUNGER
ECCENTRIC
LEFT END VIEW ELYRIA BUCKET CONVEYOR
CRUSHER

Plate 5.



BOTTOM OF TROUGH
TENSION CARRIAGE
4'-3"
5'-3"
30'-3"
FRICTION CLUTCH
6'-6"
32 HP GASOLINE ENGINE
34'-0"
RIGHT END VIEW. — ELYRIA BUCKET CONVEYOR PLANT

Plate 6.

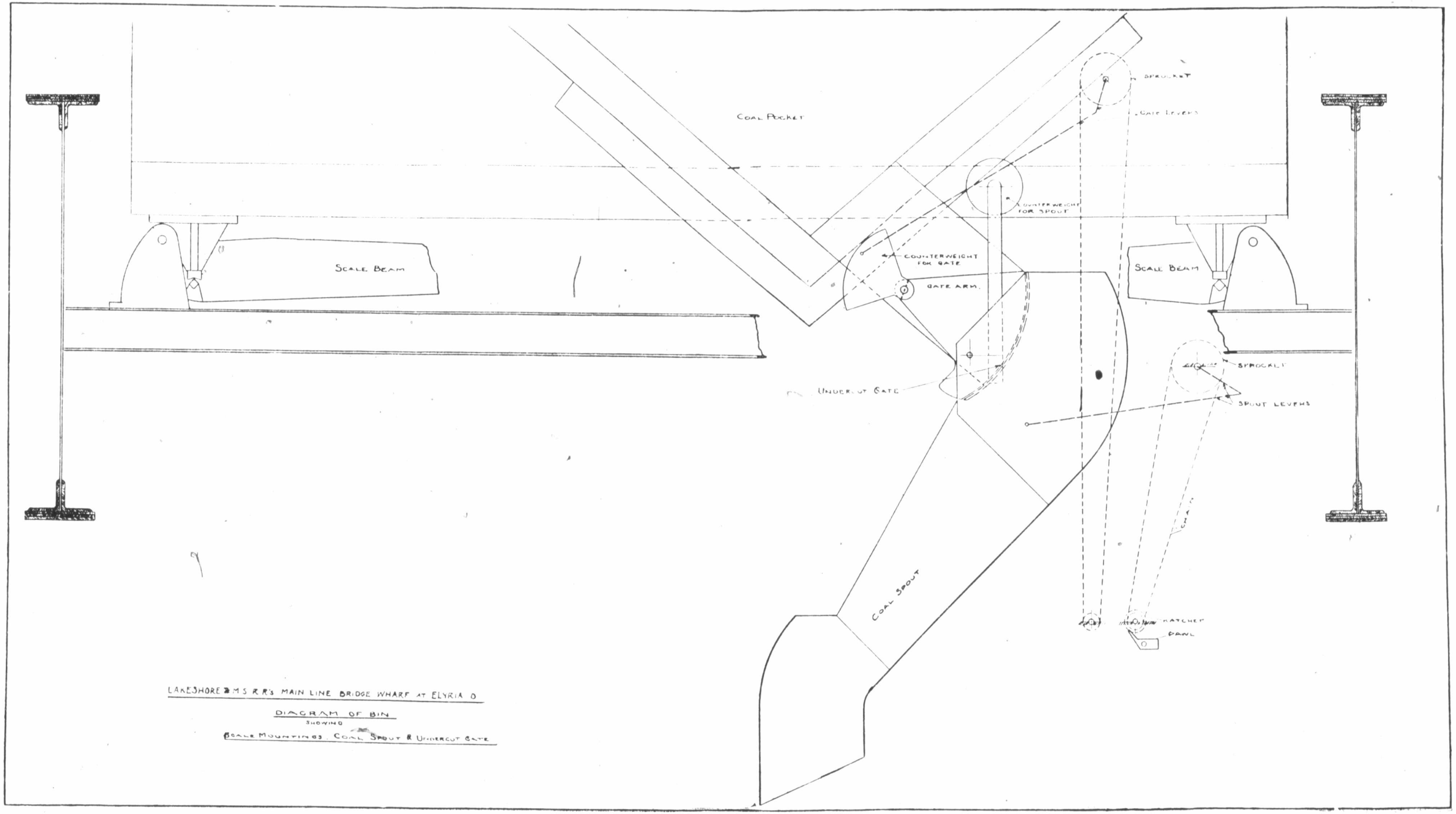
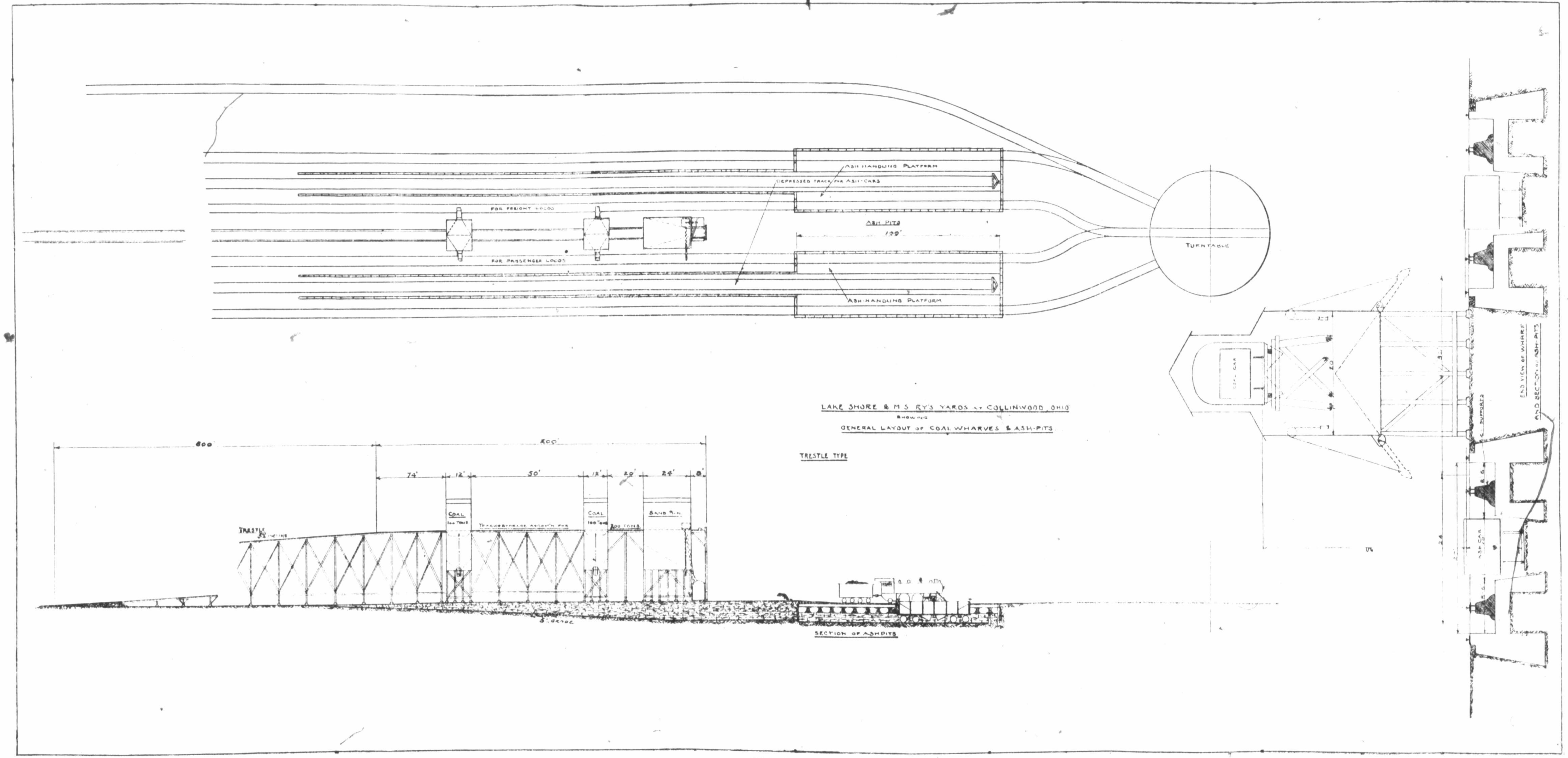

Coal Pocket
Sprocket
Gate Levers
Counterweight for Spout
Counterweight for Gate
Gate Arm
Scale Beam
Scale Beam
Undercut Gate
Sprocket
Spout Levers
Coal Spout
Ratchet
Pawl
LAKESHORE & M S R R's MAIN LINE BRIDGE WHARF AT ELYRIA O
DIAGRAM OF BIN
SHOWING
SCALE MOUNTINGS, COAL SPOUT & UNDERCUT GATE

Plate 7.



ASH HANDLING PLATFORM
DEPRESSED TRACK FOR ASH-CARS
FOR FREIGHT LOCOS
FOR PASSENGER LOCOS
ASH PITS
199'
ASH-HANDLING PLATFORM
TURNTABLE
LAKE SHORE & M S RY'S YARDS AT COLLINWOOD, OHIO
SHOWING
GENERAL LAYOUT OF COAL WHARVES & ASH-PITS
TRESTLE TYPE
600'
200'
74'
12'
50'
12'
20'
24'
8'
COAL
100 TONS
COAL
100 TONS
200 TONS
SAND BIN
TRESTLE
SECTION OF ASH PITS
END VIEW OF WHARF AND SECTION OF ASH-PITS

Plate 8.

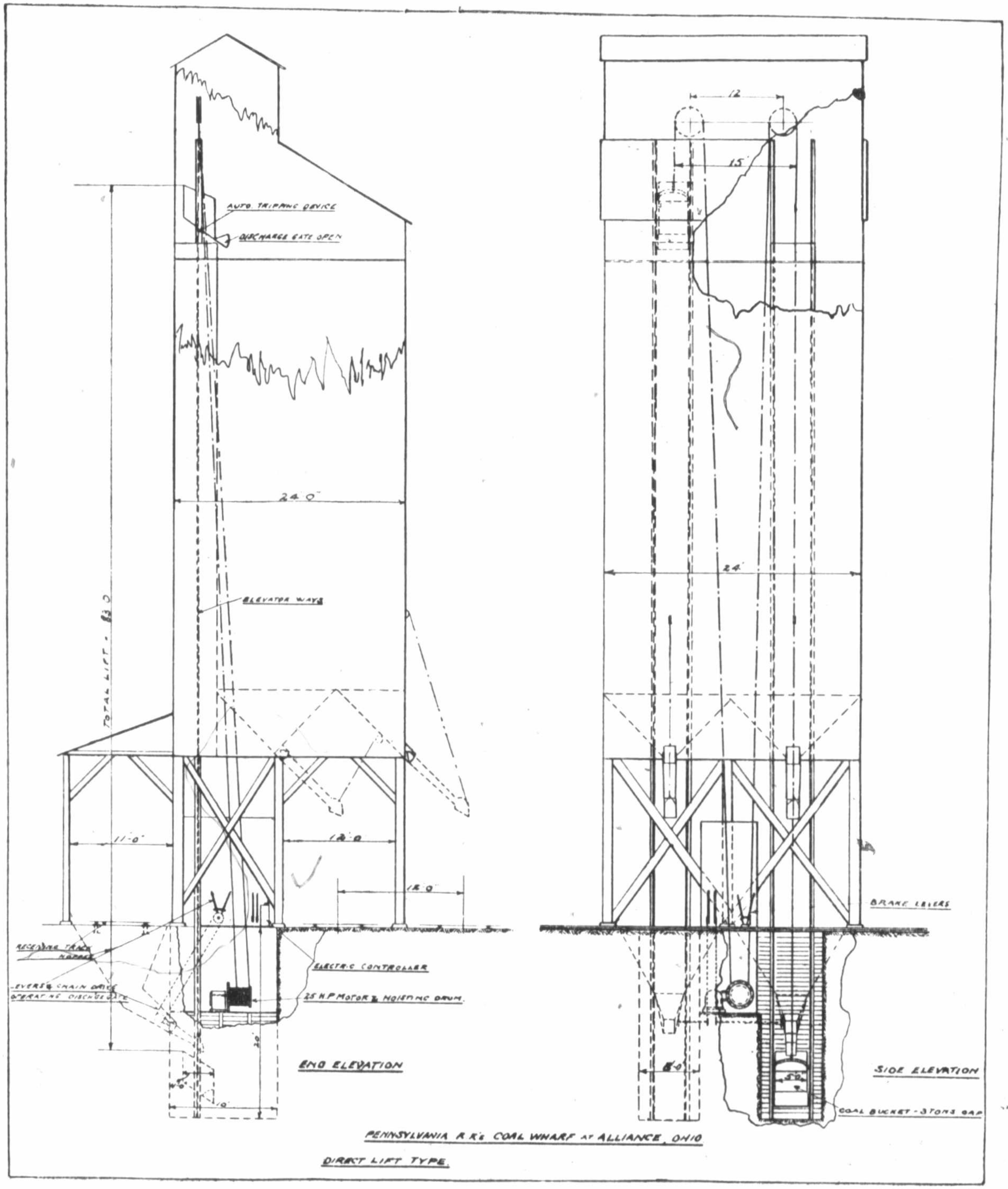

AUTO. TRIPPING DEVICE
DISCHARGE GATE OPEN
24'0"
ELEVATOR WAYS
11'-0"
12'0
12'0
ELECTRIC CONTROLLER
25 H.P MOTOR & HOISTING DRUM.
END ELEVATION
12
15
24
BRAKE LEVERS
SIDE ELEVATION
5'0
COAL BUCKET - STOPS GAP
PENNSYLVANIA R.R's COAL WHARF AT ALLIANCE, OHIO
DIRECT LIFT TYPE.

Plate 9.