T H E S I S

AN IMPROVED SYSTEM OF LOADING PIG IRON IN BOX CARS

for

the Degree of

Bachelor of Science in Mechanical Engineering,

under

Professor R. C. Mathews

by

Claire Cole Fisher

1921

The Problem.

To design a system of loading pig iron in box cars, including the necessary preliminary handling, suitable for an isolated blast furnace plant of one hundred and fifty to two hundred tons daily capacity, which shall effect economy by reducing the number of men required, the amount of exertion per man, and the total time required.

AN IMPROVED SYSTEM OF LOADING PIG IRON IN BOX CARS.

The need for an efficient type of box car loader for pig iron has been felt for some time, but it was not until the recent great war that the need became imperative. The ruling of the Interstate Commerce Commission that box cars must be used for handling pig iron brought it to a head.

Many devices were suggested to meet the need, but as pig iron commanded such a high price, hand labor was still profitable. Besides, none of these devices had the merit of successful users to vouch for them, and no firm will install a costly device without proof that it will work, unless the need is indeed very great.

At the particular plant at which the writer was located, the problem presented more difficulties than usual inasmuch as the old methods of handling were in use throughout the entire plant. The power plant was overloaded, thus eliminating any extensive use of electricity as a possible factor in solving the problem. Labor was very scarce and unreliable.

Some simple mechanical device was necessary and one which must not be too expensive.

A brief description of the old method of loading box cars is desirable here. The iron is poured into "pig beds," laid out in the sand floor of the "cast house." As soon as the pigs are cool enough to approach, men go over the beds, separating the pigs from the "sow" by means of blows struck with heavy double-handled hammers. The pigs are raked up out of the beds, in such a way as to insure further cooling, and are then carried by hand to the edge of the cast house and dumped over a low wall on to a "breaker block," which breaks the pigs into two half pigs. As there is a notch cast in the pig, they break with little or no difficulty. Box cars are then brought up on a track alongside and the half pigs must be carried in by hand, and generally are stacked up in the ends. This system worked, but there were drawbacks. As the work of lifting the pigs is very hard, each half pig weighing about forty-five pounds, a big labor turnover had to be met. The superintendent would be satisfied if each man would report only five days a week.

Frequently a man would work only two days in seven. Thus a considerable force of extra men must always be employed, so that the plant would not be crippled if several "iron carriers" failed to appear.

The first improvement in the handling of pig iron was the introduction of better methods of casting. The most successful, and now widely used development, is the pig-casting machine. This consists essentially of an endless chain conveyor, on which are mounted pig-moulds of cast iron. The conveyor passes under a stream of molten iron from the blast furnace, thence to a cooling trough where the iron passes under water, and then up an incline to a chute, or direct into a car. A less expensive improvement is to lay out the pig beds in the sand automatically. A big roller with patterns on its face is arranged to run on guides across the top of the sand bed and thus impress the moulds in the sand. While this saved labor elsewhere, it afforded no improvement in the method of handling and loading the pigs. Still another method, for economy, was scientific management. Various bonus and other systems for stimulating the efforts of laborers were tried. While each of the above is successful in reducing cost

through saving in time or labor required, they do not meet the problem at hand, that of loading the pigs into box cars, although the men who were set free from other tasks were available to do this work.

The best load on a box car is from forty to fifty tons, of which half must be loaded over each set of trucks, as required by the Interstate Commerce Commission. The following system is developed to accomplish this end, thus fulfilling the requirements of the law.

The method of handling which is presented herewith provides for an electric crane to lift the pigs by a magnetic chuck and carry them to a platform from which a chute runs into the box cars. There are four of these platforms (see drawings number one and two), one for each of the casts of the day. In order to load into either end of the car, the chutes are made extra wide at the top and converge toward the box car door. Only one end of a car will be loaded at a time. By making the chute wide at the upper end, sharp angles in the path of the pigs are avoided. Two breaker-blocks are installed, one for use when loading one end of the car and the other

when loading the opposite end. By making the chute wide at the upper end it is possible to serve a long loading platform, which must be large enough to hold one entire cast. From the end of this chute a smaller incline section, with flat bottom and curved sides, conveys the pigs by gravity to the final trough. (See drawings four and five.) This trough is movable, and can be swung from side to side as may be found necessary in trimming the car. The smaller curved section (see drawing number six) is called the "arc" and is arranged so it may be used to turn the pigs to either end. This is done by making the two ends of the arc alike, but reversed. When it is desired to turn the pigs into the other end of the car, the arc is reversed, and the delivery end being bolted to the chute, thus directing the pigs to the other end of the car, as shown on drawing number five. The stand "C" is mounted on wheels and carries a roller on which rests the upper end of trough "B" and lower end of arc "A", thus providing for easy changes in the arrangement.

In order to prevent pigs from falling through or catching in the small angular space between the

arc and the end of the chute, an apron of sheet metal is hinged to the end of the chute, so it laps over the end of the arc, thus closing the opening. This apron hangs out of the way when not in use, but can be quickly swung up to rest on the bottom plate of the arc.

In actual practice, the operation would be about as follows: The men break the pigs away from the sow, by the method already described; the electric crane carries the pigs to the loading platform (see drawing number two). Here men lift the pigs and drop them on the breaker blocks. The broken pigs then slide down along the edge of the chute, around the arc, fall a short distance on to the trough from which they drop on to the floor of the car.

By the use of this chute without the arc and trough, gondola cars can be loaded very quickly and profitably. The car is brought under the chute, the apron on the end is allowed to drop over the side of the car. Both breaker blocks are used at the same time and the car is trimmed by varying its position on the track.

The men needed in loading box cars are: three to break the pigs; one on the crane; one,

perhaps two, to drop the pigs down the chute; and one to trim the car. Since the same three men that break the pigs loose are available for the rest of the work, only three men, besides the regular craneman, are required.

Under the old method, three men broke the pigs loose from the sow, one man raked them up to cool, these same four men carried the pigs a distance ranging from five to twenty feet, dropped them on the breaker blocks where they often piled up in masses so high as to seriously interfere with the proper functioning of the blocks. From this point four other men carried the half pigs by hand, or small "iron-barrows," into the cars. The total of eight men were used, each of whom did the hardest kind of manual labor.

Under the proposed plan, only three men are required to do hard work and four all told.

In addition there is a saving in time. The following table shows approximately the time required for the various operations.

Operation:	Old Plan:	Proposed Plan:
Breaking pigs loose,	1.00 hours	1.00 hours
Raking up to cool,	0.75 hours	0.00
Carrying out to breakers,	3.00 hours	1.00 hours
Loading into cars,	4.25 hours	1.50 hours
Total time,	9.00 hours	3.50 hours

The work can thus be done in less than half the time, with half the men. Most of the hard manual labor is avoided, there being no carrying at all, and the iron is lifted only when it is dropped on the breaker block. The laborers' actual time is also shortened. The same pay could very well be given to men for the shorter time, for only half as many are required, and "iron carrying" would be raised from a despised job to a prized one. The management saves on the shorter time.

(Note: The above table, as well as all other data, is based on a cast of forty to fifty tons, which is the normal cast, four times a day, of a two-hundred ton furnace.)

Construction Notes.

The chute (see drawing number three) is to be rigidly constructed of oak planking with a wearing surface of sheet steel one-eighth inch thick. The breaker blocks are to be made of best grade cast iron, with short steel rail top cast in place. The top of the platform is to be made of sixty pound steel rails, resting on eight inch I beams, as shown on the drawing.

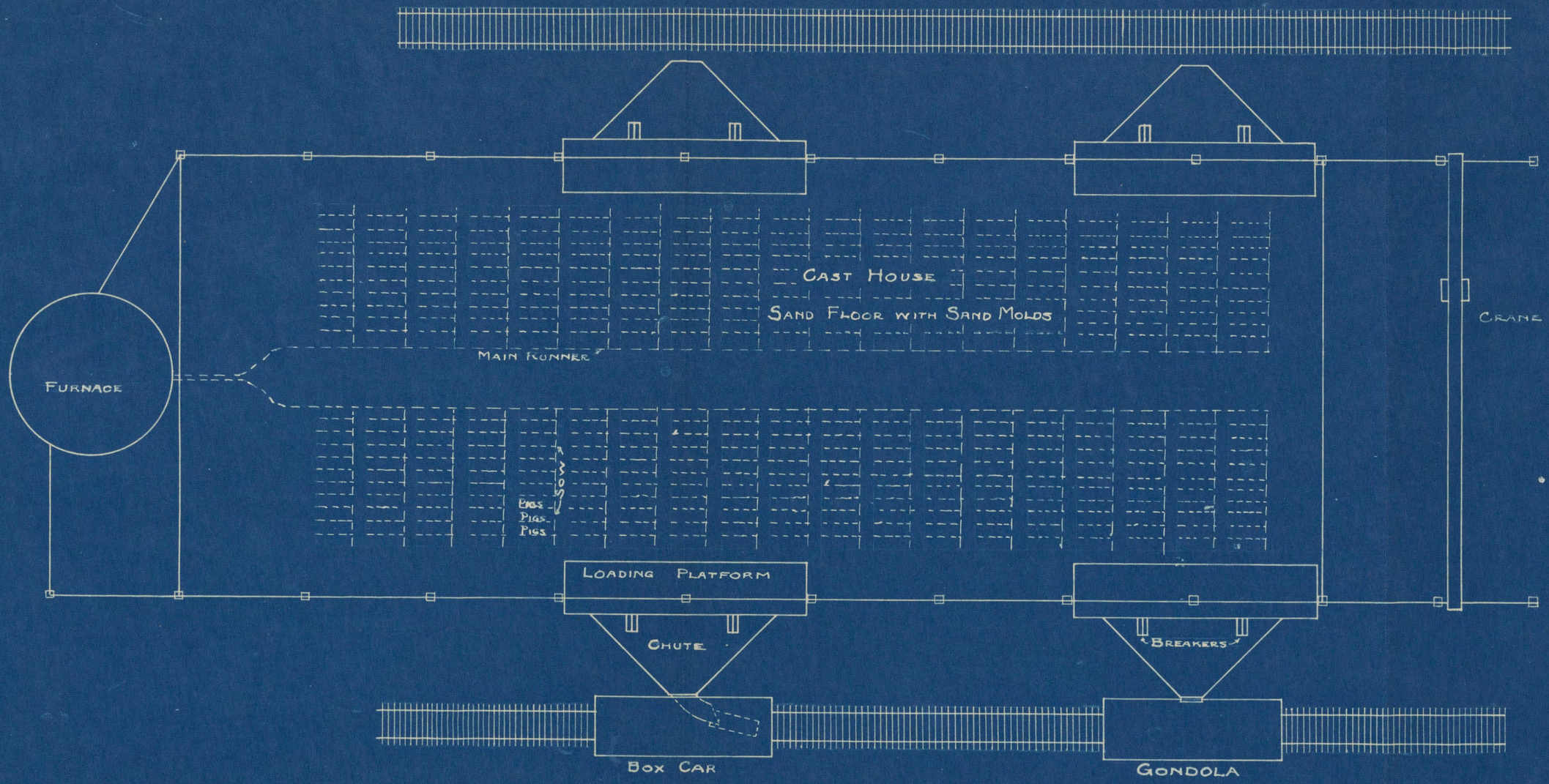
The arc is to be made of sheet steel, bent and cut to the dimensions given (see drawing number six) and with a rigid bracing as shown. Best grade of steel to be used throughout. (Note: The construction of the arc is such as to allow a sheet of one eighth inch steel to be used as a renewable wearing surface on same, if such is desired.)

The trough (see drawing number seven) is to be made of sheet steel, bent as shown and braced with I beams as shown. The foot pieces, two in number, to be of best grade cast iron, and to conform to the dimensions shown on drawing number eight.

The stand (see drawing number nine) is to be made to dimensions shown and with all necessary braces either riveted or riveted and welded. The wheels and roller to be finished the size as shown. Wheels are to be welded or fastened with set screws to the axles. The roller and its small axle to be one piece.

General Construction Notes.

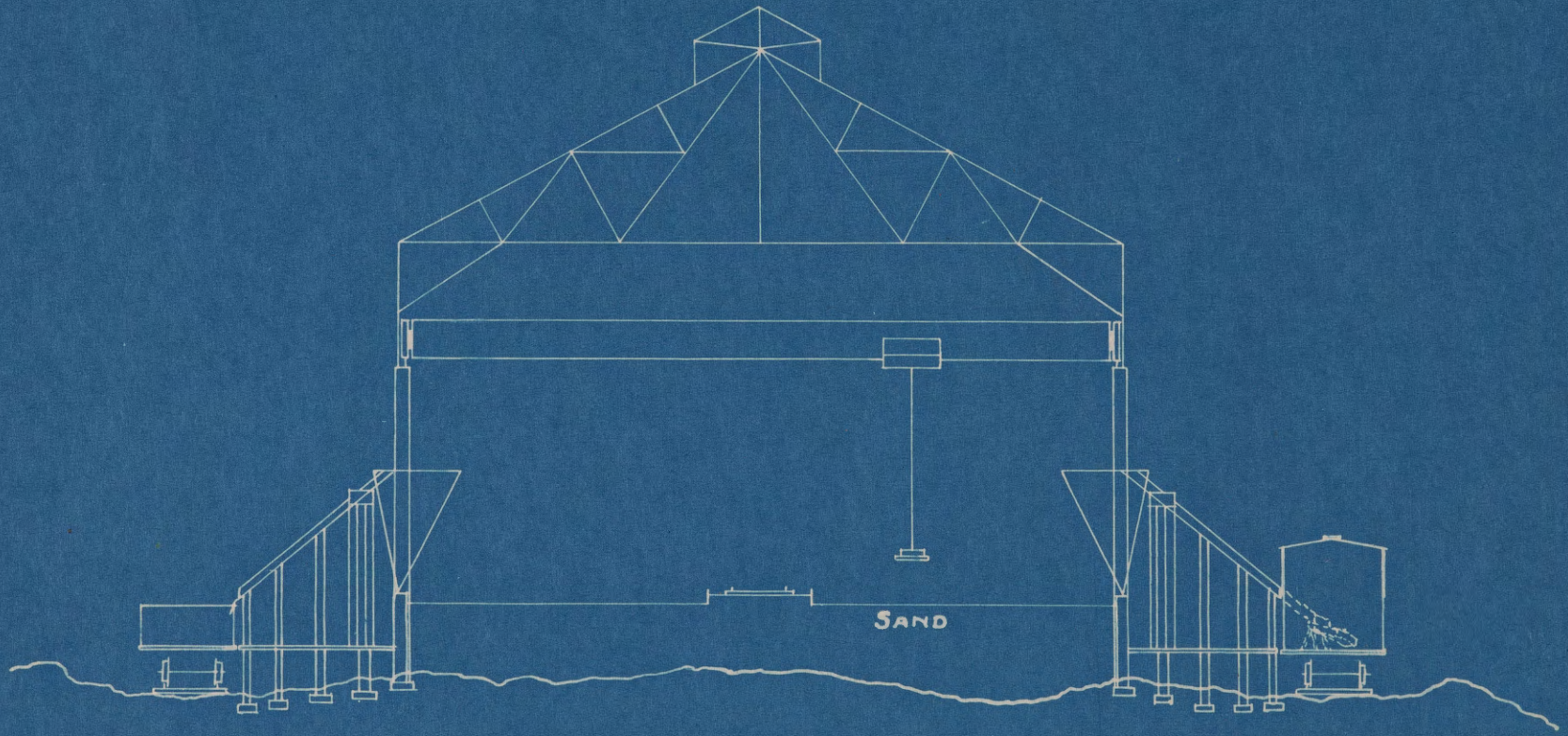
All rivets and bolts to be countersunk on the side subject to friction from the sliding pigs; all rivets, unless otherwise specified, are to be three quarter inch in diameter on three inch centers. All material and workmanship to be of the best grade, and to conform with the standards of good practice.



PLAN

SHOWING LOCATION OF THE

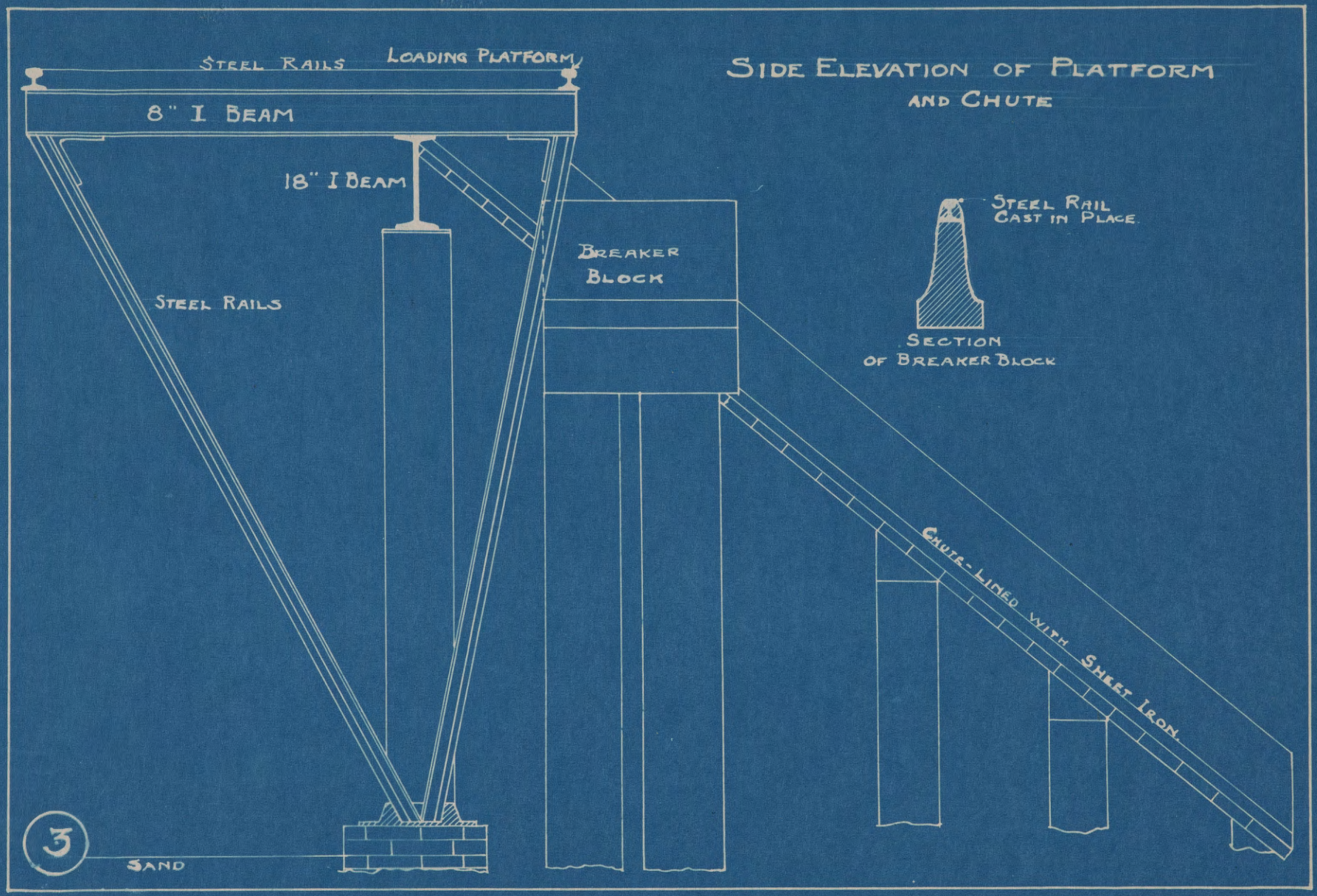
LOADERS



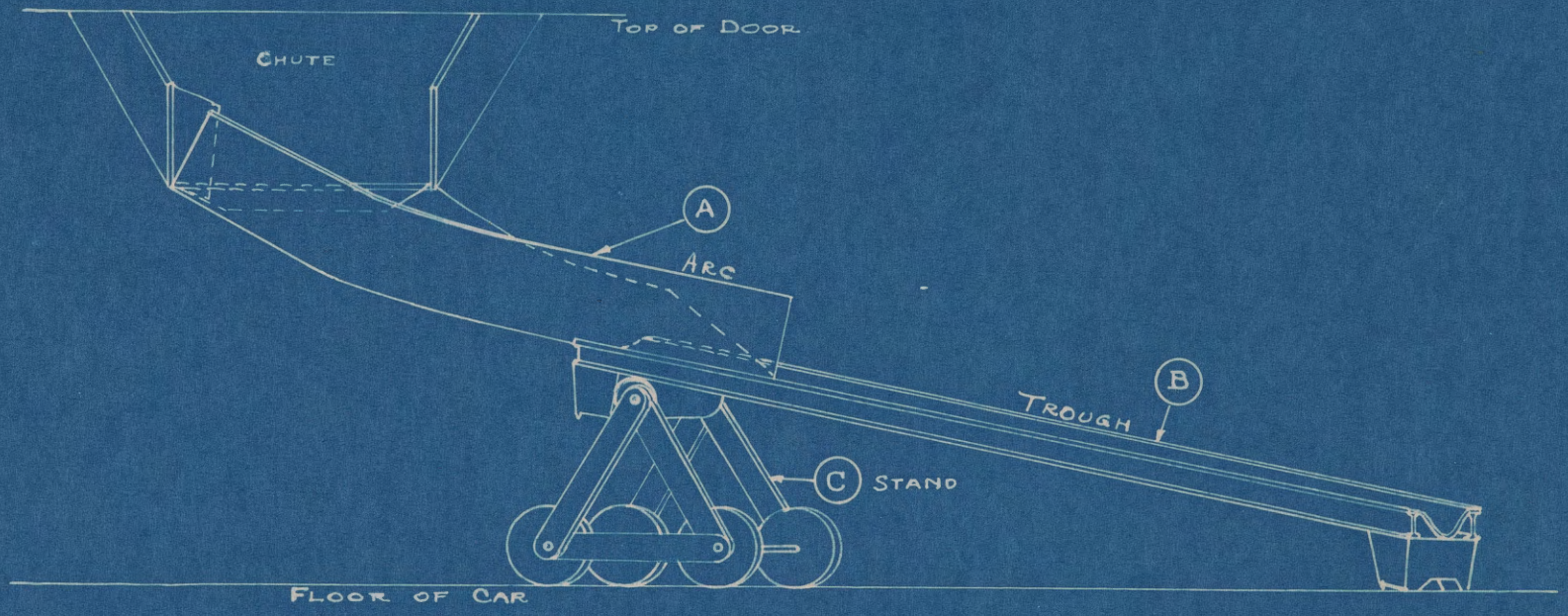
END ELEVATION

LOADERS IN OPERATION.

2


STEEL RAILS
LOADING PLATFORM
8" I BEAM
18" I BEAM
STEEL RAILS
BREAKER BLOCK
SIDE ELEVATION OF PLATFORM AND CHUTE
STEEL RAIL CAST IN PLACE.
SECTION OF BREAKER BLOCK
CHUTE - LINED WITH SHEET IRON.
3
SAND

(5b) ½" - 1 Foot

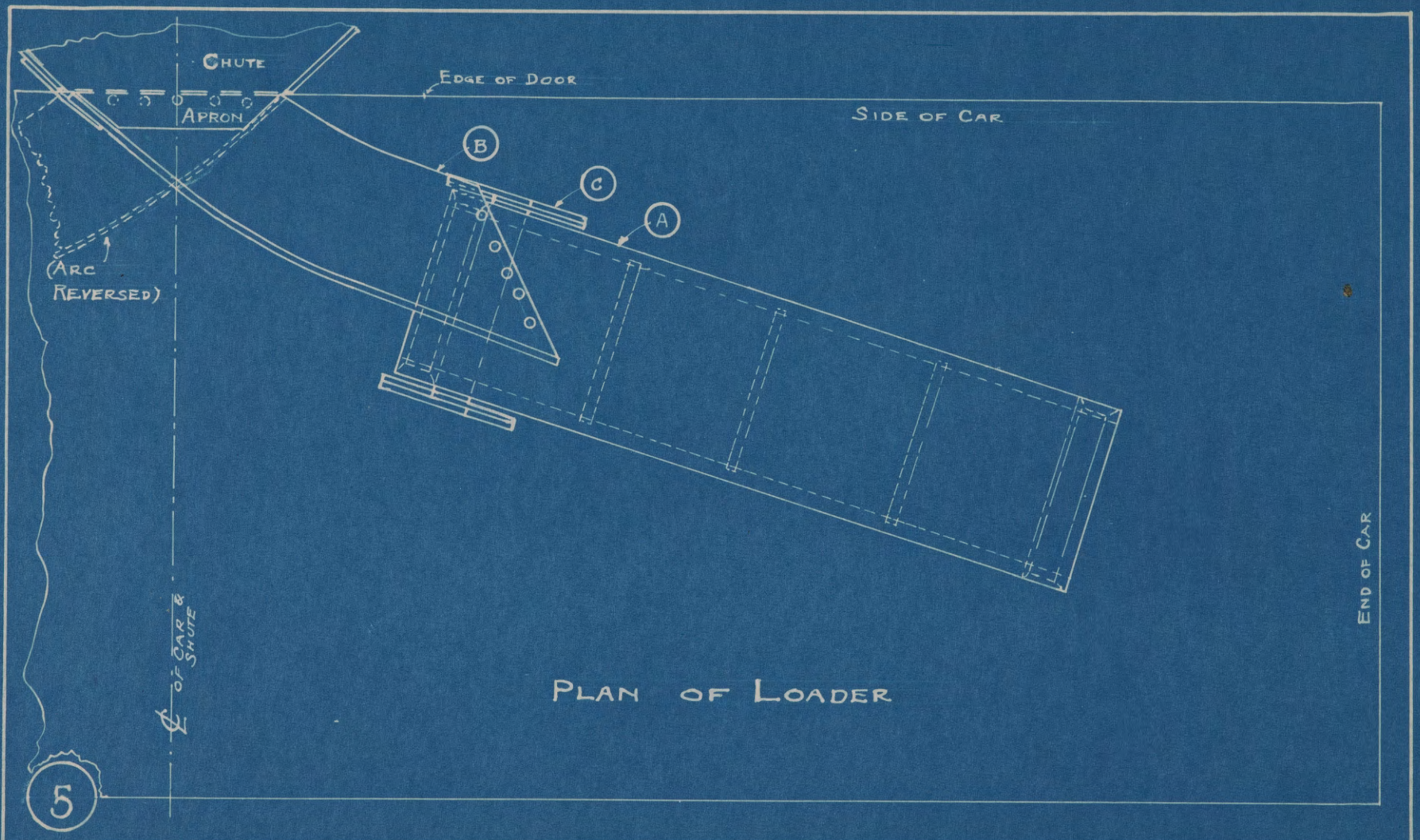


Elevation of Loader.

4

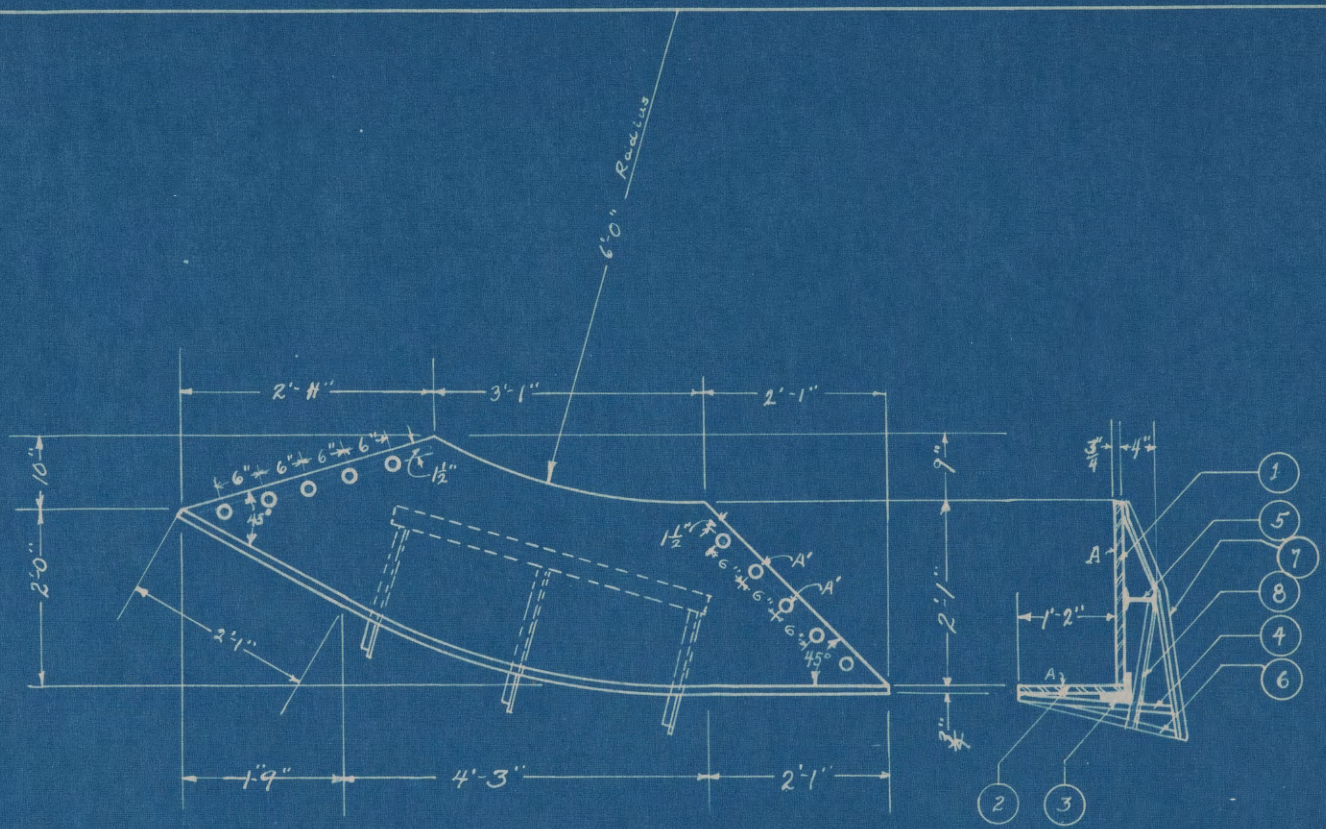
(5)

SCALE $\frac{1}{2}$" = 1 FOOT.



PLAN OF LOADER

5



DETAIL OF ARC (B)

SCALE ½" = 1'-0"

NOTE :-

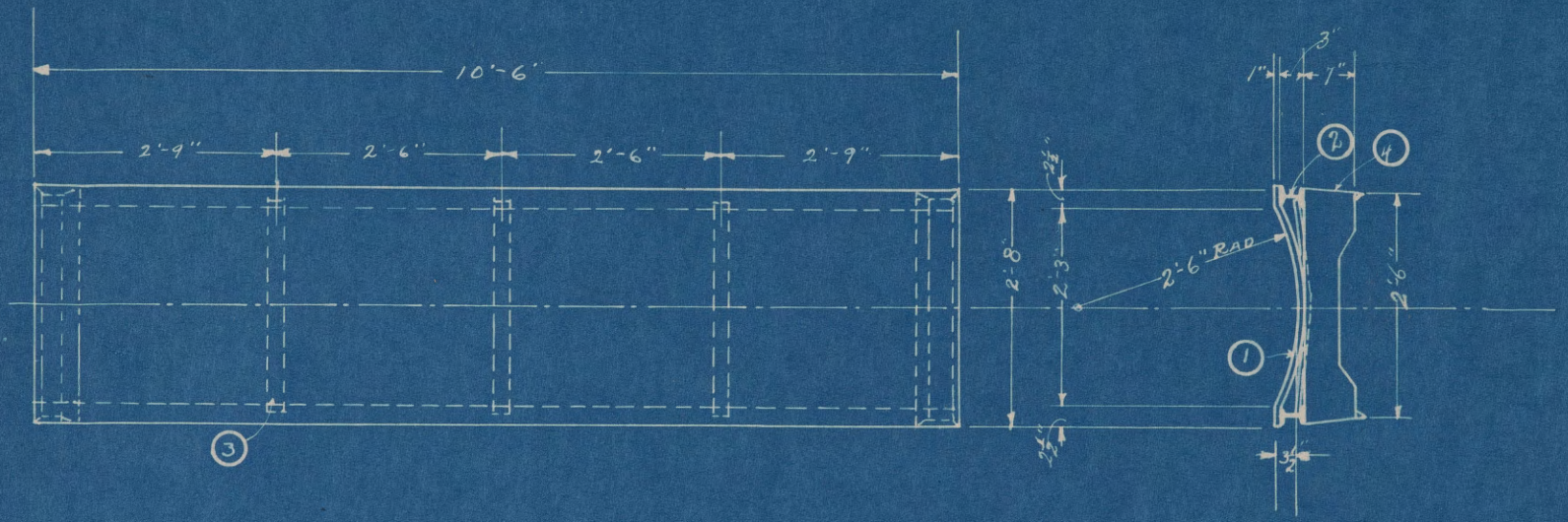
ALL JOINTS RIVETED.

RIVETS ON SURFACE A-A MUST BE COUNTERSUNK

HOLES A'-A' ARE 1⅛" DRILL, CSK ON SIDE A-A

BILL OF MATERIAL			
No.	Amt.	Size	Material
1	1	8'-1" x 2'-10" x ¾"	STEEL
2	1	8'-8" x 1'-3" x ¾"	"
3	1	8'-8 x 3x2" x ¼"	L IRON
4	3	1'-10" x 1½" x ¼"	L "
5	1	3'-9" x 4" x 7½#	I BEAM
6	3	2'-0" x 1½" x ¼"	L IRON
7	3	3'-0" x 1½" x ¼"	L "
8	3	1'-6" x 1½" x ¼"	L "

6

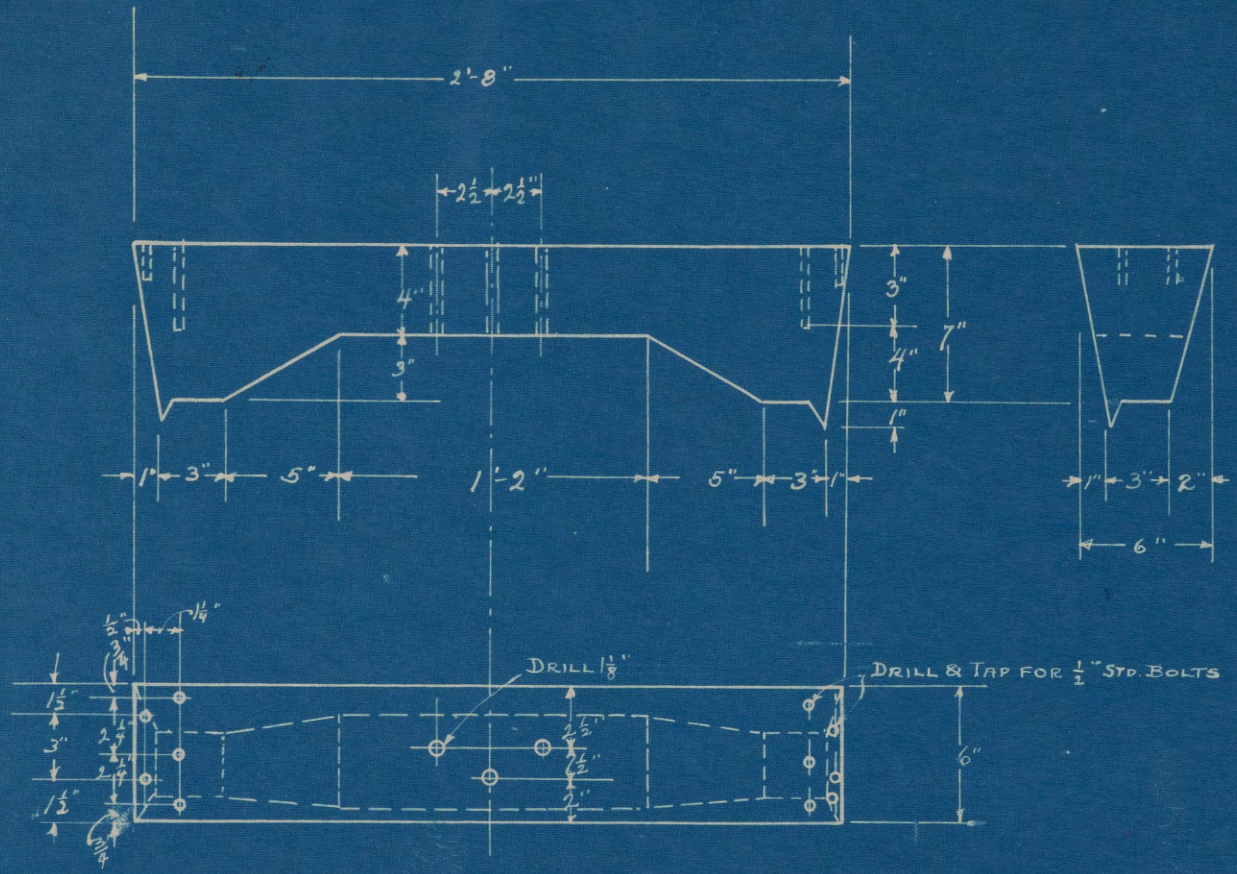


DETAIL (A)

THE TROUGH.

SCALE ½" = 1'-0"

BILL OF MATERIAL REQUIRED			
No.	AMT.	SIZE	MATERIAL
1	1	10'-6" x 3'-0" x 1"	SHEET STEEL
2	2	10'-6" x 3" - 5½#	I BEAM
3	3	2'-10" x 2" x ¼"	STRAP STEEL
4	2	PATTERN No 5594	C I.
FOR No. 4 — SEE NEXT PAGE			

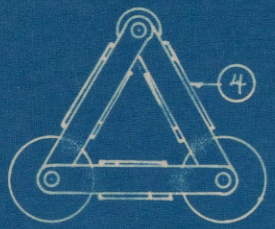


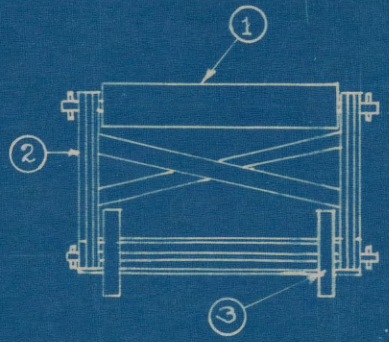
DETAIL OF FOOT.

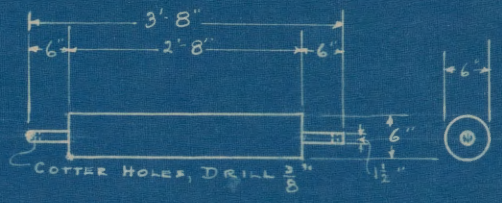
PATTERN No. 554. SCALE ½" = 1FT.

TWO REQ'D. CAST IRON.

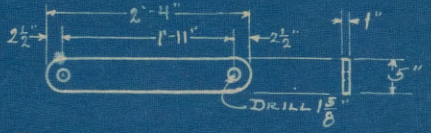
8



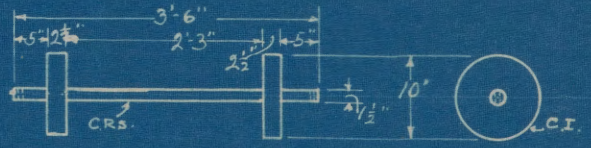




(1) ROLLER, 1 REQD, C.R.S.



(2) SIDE BARS, 6 REQD, C.R.S.



(3) WHEELS & AXLE, 2 SETS REQD.

(4) BRACES TO FIT, C.R.S.

DETAIL OF STAND (C)