

THE DISPOSAL OF BY-PRODUCT GAS-PRODUCER
TAR BY BURNING UNDER BOILERS

by

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INTRODUCTION

The sheet mill of the Aluminum Company of America at Alcoa, Tennessee maintains a gas-producer plant for the purpose of furnishing fuel to their various gas fired annealing and preheating furnaces. The conditions are such that a gas which has been cleaned is essential. This cleaning process leaves by-product tar to be disposed of.

Past experience has proven that the amount of tar produced would not justify its sale commercially without the use of storage facilities which were not available, and which it was not deemed justifiable to install. The tar was disposed of, therefore, by pumping it into a nearby sinkhole and burning it there at regular intervals as it accumulated. This method of disposal was not only a waste of a valuable product, high in heat value, but also caused considerable trouble and expense, and created an objectionable nuisance in the form of a heavy black smoke which did much damage to the appearance of property.

After a thorough study of the problem it was decided that the only local method by which the tar could be disposed of advantageously and economically was to burn it under the boilers. It was the purpose of this thesis, therefore, to determine whether or not it were possible to burn the tar in this manner, and, if possible, the methods and conditions essential to the most efficient and satisfactory combustion.

Due to the fact that there was no data or information available on this subject this thesis consists almost entirely of experimental work. Many different types of burners were tried. Several installations and

arrangements of piping and equipment were experimented with. It was due chiefly to the willingness of the Aluminum Company to undergo considerable trouble and expense in the manufacturing, purchasing, and installing of different equipment that the final successful solution of this problem was reached.

Much credit is also due the various burner manufacturers, chiefly the W. N. Best Corporation, and the National Airoil Burner Company, for valuable information and suggestions on adapting their oil burners to the use of tar.

GENERAL SURVEY OF THE FIELD

Tar has been used as a fuel for some time. There is, however, very little printed matter available on the subject. It is used chiefly as an open-hearth fuel, usually in connection with coke oven gas. There is considerable information available as to its use in this connection. The conditions here, however, are so different from those encountered in the present case that the available experimental data is of little or no assistance.

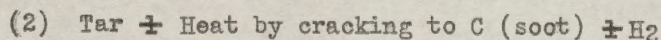
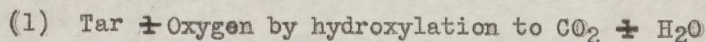
The problem which we faced in this case was that of burning the tar in connection with coal without smoke. The limited supply of tar makes it necessary that it be used in connection with coal in order to carry the load continuously. The plant runs on a twenty-four hour operation basis.

GENERAL THEORY

Before actual combustion the tar must first be changed by vaporization into the elementary fuel, i.e., "gaseous hydrocarbons." Smokeless combustion of these gaseous hydrocarbons will result if the hydrocarbons are in intimate contact with sufficient oxygen, and if the mixture is kept at a high temperature for a sufficient time to allow this oxygen to enter the hydrocarbon molecule, or to allow hydroxylation.

Hydroxylation is the combustion of hydrocarbons with oxygen to form alcohols and aldehydes previous to, and as a preliminary step, in burning to CO , CO_2 or water. The initial addition of oxygen to the hydrocarbon molecule forms an alcohol with which more oxygen reacts, forming an aldehyde. This aldehyde breaks into combustible gases, CO and H_2 , or it may burn completely to CO_2 and H_2O . This process is termed hydroxylation because the first addition of oxygen to the hydrocarbon molecule gives the hydroxyl grouping ($-\text{OH}$) characteristic of alcohols.

If there is a local deficiency of oxygen the hydrocarbons will "crack" or thermally decompose to give carbon (soot) and hydrogen, resulting in a smoky flame. If the gases are cooled too quickly the same result will take place. In the combustion there is, therefore, a race between the two reactions:



For the successful combustion of tar the conditions must be such that the speed of the first reaction is stimulated while the second is repressed.

The main problems in tar burning are, therefore: (1) maintaining a uniform flow of heated tar to the burners, (2) thoroughly atomizing the tar, and (3) mixing it with the proper amount of air. The primary purpose of the burner is to atomize the fuel thoroughly and to prepare it for intimate mixing with air. The conditions of the plant, the furnace design, and the type of fuel used should govern the choice of a burner.

DISCRIPTION OF METHOD AND APPARATUS USED

When it was decided to attempt to burn this tar, a complete study of it was made. Upon analysis it was found to have the following properties,

- (1) Viscosity 147 seconds Saybolt at 212° F.
- (2) Flash point 215° F
- (3) Burning point 265° F
- (4) Percent moisture about 8.6

The viscosity was determined in an Engler viscosimeter. Due to the nature of the tar this instrument was better adapted than the Saybolt instrument for handling it. Since the Saybolt viscosity is almost universally the one used, the Engler viscosity values were transferred to Saybolt. This transfer was made by means of the following formula:

$$S_t = \frac{E_t}{F}$$

Where S_t is the number of seconds required for 60 c.c. of the fluid to pass through the Saybolt viscosimeter orifice at the specified temperature. E_t is the number of seconds required for 200 c.c. of the fluid to pass through the Engler viscosimeter at the specified temperature. F is a constant depending upon the value of E_t ; in this case it was 1.37. E_t by several tests averaged 201.4 seconds.

$$S_t = \frac{E_t}{F} = \frac{201.4}{1.37} = 147.0 \text{ seconds}$$

The flash and fire point was determined by means of the Cleveland Open Cup.

The per cent of moisture was determined by fractional distillation. It was found to vary through rather wide limits in samples taken at different times. The 8.6 per cent as given represents the average of the tests made. The fractional distillations also showed the following results:

Light oils passing off below 170° F - 6.1 per cent

Oils passing off from 170° F to 270° F - 22.6 per cent

Oils passing off from 270° F to 350° F - 23.8 per cent

The oils passing off below 212° F are not included. They were also removed before the flash and fire point determinations were made.

The heat value proved to be 16,890 B.T.U. per pound. The tar weighed 9.86 pounds per gallon making the heat value 164,000 B.T.U. per gallon.

Two tests to determine the per cent of free carbon gave the following results.

Test number 1 -- 2.23 per cent

Test number 2 -- 2.21 per cent

These tests proved the tar to compare favorably with fuel oil. The heat value was somewhat lower than good grade oil, which runs about 19,000 B.T.U. per pound. Their viscosities at high temperatures do not differ greatly; the tar, however, becomes more viscous rapidly as the temperature is lowered, the pour point being reached at about 64° F. The flash and fire point of the tar were both much lower than is found in fuel oil due to the presence of light oils.

This analysis indicated nothing which should prevent the successful burning of tar if properly handled. To handle the tar the system shown in Figures 1 and 2 was installed. The tar storage tank was placed just outside the power plant wall, between it and the gas plant (see Fig. 2) The tar was forced to the burners by means of low pressure steam on the free surface in the tank, through pipe lines which were steam jacketed their entire length.

The first burners tried were built in the plant and are shown in Figures 3 and 1. The burner in Fig. 3 was first used. As can be seen it is a combination mechanical and steam atomizing unit. The second burner (Fig. 1) depends upon steam entirely for its atomizing ability. The burners were mounted in the front of the boiler setting just above the fire doors. They entered the furnace through a small round hole in the setting just large enough to accommodate the burner.

The boiler used for experimenting was a 400 H. P. horizontal water tube Babcock and Wilcox boiler, which was operating at that time at about 50 per cent rating. One-half of the grate area had been bricked up, leaving a grate ten feet wide and four feet deep as shown in Fig. 4. The height from grate bars to tubes was five feet.

Neither of these burners proved satisfactory. They were not capable of atomizing the tar properly. The tar instead of emerging from the burner in a fine spray would run or blow out of the tip in large drops where it would burn in the furnace with excessive smoke. The burners also caused much trouble due to clogging and carbonizing. This stopped the

fuel passage. The first burner shown in Fig. 3 was especially subject to this clogging. The ordinary globe valve which was used to regulate the fuel supply to the burner would also become stopped up with foreign substances, and residuum in the tar, cutting off the supply.

After operating with these burners for a few weeks it was decided that several principles of the system were wrong and would not prove satisfactory, namely:

1. As mentioned above, the burners would not atomize the tar, and became clogged at frequent intervals.

2. The globe regulating valve was not satisfactory.

3. With the steam jacket the entire length of the tar line it was impossible to regulate the temperature of the fuel. It was far too hot upon reaching the burner for proper combustion. This caused hammering and intermittent burning which was very objectionable.

4. It was impossible to get the proper amount of air into the furnace for proper combustion. As stated before the limited supply of tar necessitated it being burned in connection with coal in order to carry the load continuously.

If only enough air be admitted through the fire bed, therefore, for the proper combustion of the coal, there will not be enough present for the tar. This lack of oxygen will cause the 2nd or undesirable reaction described on page four which results in soot and excessive smoke. On the other hand if enough air is admitted through the fire bed to furnish the necessary oxygen to the tar the efficiency of the coal combustion is ruined.

5. The flame was inclined to spread and either burn out the fire bed or impinge on the tubes. The former interfered with the coal combustion,

while the later caused smoke.

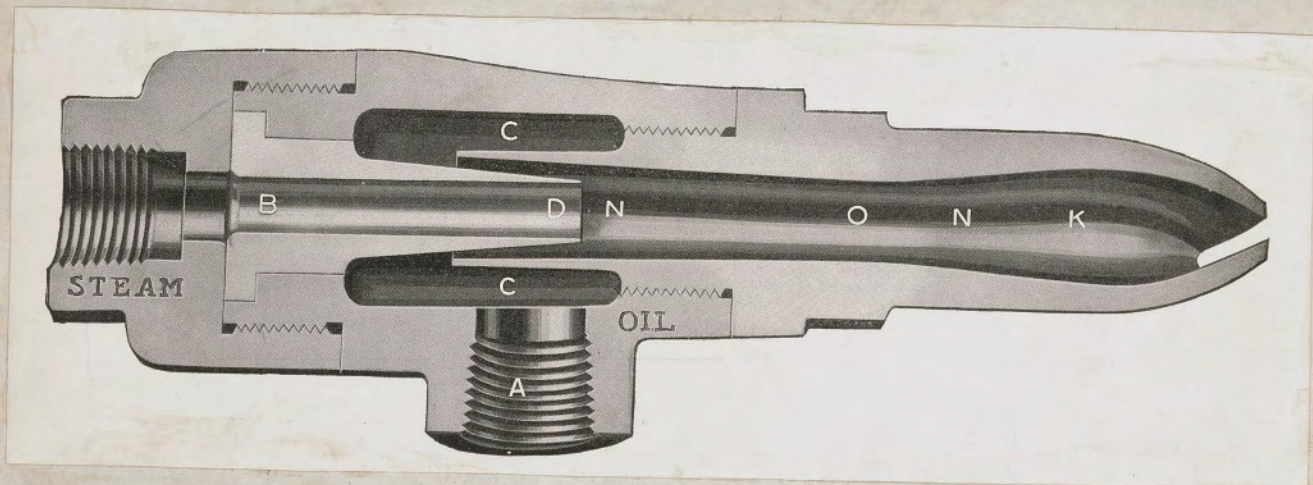
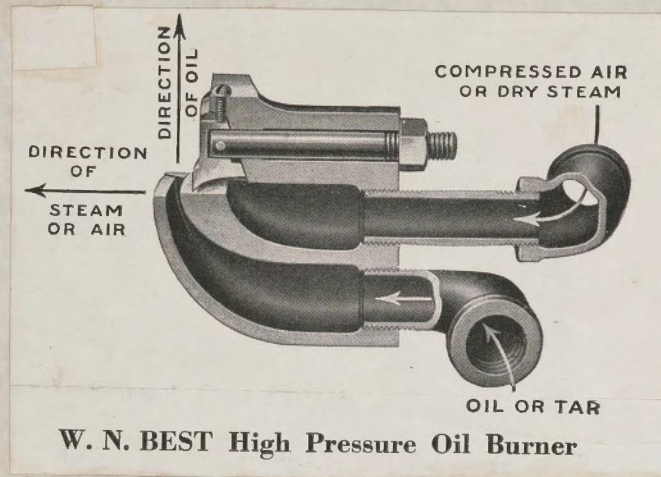
6. The steam pressure on the tar supply tank proved to be unsatisfactory due to the fact that the tar was kept at too high a temperature, and because of the excessive condensation. The steam would condense in the tank, the water mix with the tar, and enter the burner in "slugs." This would cause the burner to go out, and to burn intermittently. The burner would, at times, go out for a considerable length of time due to this water, and when the tar began entering the furnace again there would be a small explosion which was exceedingly injurious to the setting.

7. Much trouble was experienced by the ends of the burners burning off when not in use. To prevent this it was necessary to leave the steam valve partially open at all times and this was objectionable for several reasons.

The first step in the redesigned equipment was an effort to secure a burner which would properly atomize the fuel. With this in view letters were written to several of the leading burner manufacturers stating the characteristics of the fuel which was to be burned, and asking for recommendations on their burners, and which burners in their opinion, would burn it. Of the large number of firms written to, some three or four replied stating that they manufactured burners which would handle the fuel successfully. The others stated that they would not recommend their burners for burning this particular fuel.

A careful study was made of the burners recommended, and two were selected which, due to their simplicity of design, seemed to be the most likely to prove satisfactory. These were the burners manufactured by the W. N. Best Corporation and the National Airoil Burner Company. These two

burners are shown in the figures below.



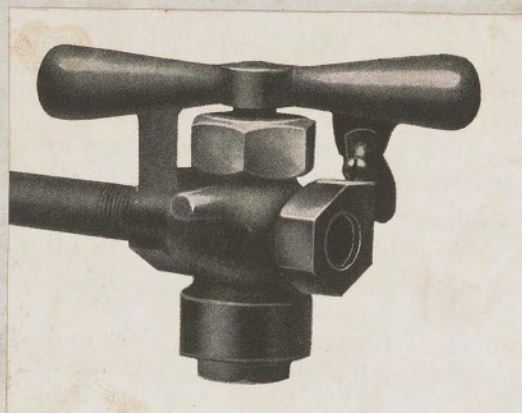
NATIONAL AIROIL BURNER

The National Airoil Company offered to furnish a burner for experimenting, while the Aluminum Company purchased a Best burner.

The Airoil burner was never used due to the successful operation of the Best burner, and to the fact that the Airoil Company recommended

the installation shown in figures 6 and 7, which was much more difficult to install than the side installation recommended by the Best Company (Figs. 4 and 5)

The second difficulty was overcome by the replacement of the globe regulating valve by the regulating cock shown below.



This regulating cock is provided with a V shaped, knife-edged opening in the plug, which not only has a shearing action on the tar, but enables the operator to secure the finest possible adjustment. The adjusting screw enables the cock to be set so that it can be closed when the burner is stopped and returned to the same adjustment when again started.

Very little difficulty due to stoppage was experienced with this valve. All trouble could be overcome by opening the cock wide for a few seconds and then returning it to the working position.

The third difficulty was remedied by removing the steam jacket from the tar pipe. A steam coil heater was then made as shown in figure 8. This heater was placed in the tar line between the strainer and the burner

(see Fig. 8 for strainer.) The heater was fitted with a thermometer well and the temperature of the tar could be regulated to any desired value, by the amount of steam admitted to the coil.

The fourth difficulty proved the hardest to overcome; that of getting the proper amount of air into the furnace for efficient combustion of both the tar and coal.

The Best burner proved capable of properly atomizing the oil. This, however, did not solve the problem of getting enough air through the coal bed for the tar combustion without interfering with the efficiency of the coal combustion.

After several experiments, the plan of having the burner enter the furnace through an opening as shown in Fig. 4 instead of through a small hole just large enough to accommodate the burner proved satisfactory.

This opening was made in the side of the furnace wall as shown in the figure. The burner in this opening has much the same effect as that of a steam jet used to help bring about smokeless combustion of coal. When the burner was in operation it proved capable of drawing in enough air for the proper tar combustion, through this opening, without interfering with the efficiency of the coal combustion. It is interesting to note that the flow of air through this opening could be accurately regulated by the position of the burner in the opening. By moving the burner in and out it was possible to get just the right amount of air for the combustion of the tar. With the help of stack gas analysis it was easy to find the proper position of the burner in the opening for any amount of tar being burned.

The difficulty of the flame striking the coal bed and the tubes was overcome by having the Best Company fit a special tip to the burner. This special steam tip was fitted in such a manner that the burner would throw a broad flat flame which completely covered the furnace, but did not strike the fire bed, the tubes, or the furnace walls. This was true even when the burner was operating at maximum capacity.

The trouble caused by steam condensing in the supply tank and mixing with the tar, and by the steam keeping the tar at a high temperature was overcome by putting the tank under air pressure instead of steam pressure.

When this change was made, a steam coil was placed in the tank as a safety measure to prevent the tar from becoming too viscous to flow through the system. This was thought advisable due to the fact that the tank is located outside of the boiler room, and in the winter the tar might become cooled before it is used up.

The last difficulty, that of the burner tip melting when not in use, was overcome by mounting the burner on swivels as shown in Fig. 5. When the burner is not in use it is swung back out of the opening, and the opening closed by placing in it a piece of fire brick cut to the proper size and shape. The type of opening for burner entrance made this swivel mounting especially desirable. With this mounting it is easy to swing the burner to any desired position in the opening as described above.

OPERATION

In burning the tar it is first heated by steam coils in the gas plant storage pit and pumped with a centrifugal pump to the 250 gallon tank, which is located just outside the boiler room wall on a level with the floor. In this tank it is kept under an air pressure of about twenty pounds per square inch. (This pressure was found to be the most satisfactory).

The pressure on the free surface of the tar forces it up through the pipe line into the strainer, from there to the heater, the stop valve, the regulating cock, and into the burner. Steam at boiler pressure (150 lbs. per sq. in) is used here for atomizing. As a rule the heating of the tar to facilitate pumping from the gas plant is sufficient to keep it warm enough to flow to the burner, since the supply tank is well insulated. If, however, for any reason it is not burned at once and remains in the tank until it becomes so viscous that it will not flow to the heater, it is then heated in the tank by means of the steam coils.

By means of the heater the tar fed to the burner is kept at a temperature of 180° F, or slightly higher. After much experimenting it was found that this temperature was the most satisfactory. By keeping the temperature down and the pressure around twenty pounds per square inch it was possible to operate with the regulating cock open at least half way. This prevented some trouble due to stoppage which was encountered when the temperature or pressure got too high, due to the fact that the regulating cock had to be closed most of the way to prevent too much fuel from flowing to the burner.

The burner is operated as much as the supply of tar will allow. It is possible to carry the entire load with the tar, but due to the limited supply, it is burned in connection with coal. The coal is fired very light; usually just enough to keep the grate covered.

Compressed air was tried as an atomizing agent and found to be somewhat more satisfactory than steam. Its higher cost, however, counteracts the increase in efficiency. It takes 18 cu. ft. of air at 80 lbs. per sq. in. to atomize 1 gal. of this fuel. The cost is about \$.0058 per gallon. For steam atomization it requires an average of 2.5 per cent of the total generated steam, at a cost of \$.0022 per gallon. If air at low pressure could be used there would probably be a saving over steam for atomizing. This is impossible, however, as pressures below 80 lbs. per sq. in. can not be depended on to atomize this fuel.

It is rather difficult to start this burner when the furnace is cold. It ignites readily, however, when the furnace is hot. The atomizing steam is turned on first, then the tar. In stopping the burner the tar is also cut off first. In this way all tar is removed from the burner preventing its carbonization in the burner thereby stopping it up. The air pressure on the supply tank is held constant by means of a pressure reducing valve; while the tar temperature can be maintained at the desired value by means of the tar heater as explained previously.

Very few difficulties arose after the above changes in, and rearrangement of equipment had been made. It was found, however, that

the strainer screen at first designed was of too small a mesh. It was changed to about 16 mesh and a larger screen substituted; no further trouble was experienced. The burner when once operating correctly seemed to give the best results with the damper almost entirely closed. It could not be started, however, with the damper in this position without excessive smoking.

CALCULATIONS

During the past year that the burners have been in operation they have burned an average of slightly over 600 gallons of tar per day. From the preliminary tests the heat value was found to be 164,000 B.T.U. per gallon.

$$164,000 \times 600 = 98,400,000 \text{ B.T.U.}$$

If the average heat value of the coal used is taken as 14,000 B.T.U. per pound then the coal equivalent of the tar burned per day is

$$\frac{98,400,000}{14,000} = 7,020 \text{ lb. or } 3\frac{1}{2} \text{ tons.}$$

A twenty-four hour boiler test during average running conditions showed a thermal efficiency of 69.49 per cent. This amount of tar, therefore, represents the following pounds of steam evaporated:

$$\text{Boiler pressure} = 150 \text{ lbs. per sq. in.}$$

$$\text{Feed water temperature} = 198^{\circ} \text{ F.}$$

$$\text{Quality at heater} = 98.5 \text{ per cent.}$$

$$198 - 32 = 166 \text{ B.T.U. already in feed water.}$$

$$i = i' + x_r = 337.8 + .985 \times 858.3$$

$$i = 337.8 + 845 = 1182.8 \text{ B.T.U. to make one lb. of steam from } 32^{\circ} \text{ feed water.}$$

$$1182.8 - 166 = 1016.8 \text{ B.T.U. actually needed to make one pound of steam.}$$

$$98,400,000 \times .6949 = 68,400,000 \text{ B.T.U. transferred to water.}$$

$$\frac{68,400,000}{1,017} = 68,400 \text{ lbs. steam generated per day by tar alone.}$$

This shows a saving of $3\frac{1}{2}$ tons of coal or 68,400 lbs. of steam per day due to the use of the by-product tar. This can be considered as a clear saving due to the fact that the old method of disposal cost as much as it does to get the tar to the burner under the present system.

The actual records of the Aluminum Company during the past year show a saving of a little better than \$1.00 per hour that the burner is in operation. The burner operates a minimum of 450 hour per month, which makes a savings of at least \$450.00 per month.

CONCLUSIONS

These experiments prove that it is possible, with suitable equipment properly operated, to burn this particular type of fuel under boilers, efficiently without smoke, with or without coal. The only thing preventing the continuous, or exclusive use of tar being the limited supply.

This should point the way to a substantial saving for industries which like the Aluminum Company have by-product tar in quantities insufficient for distillation, and with no market for same. It will convert an objectionable waste product, which must be disposed of, into a valuable fuel.

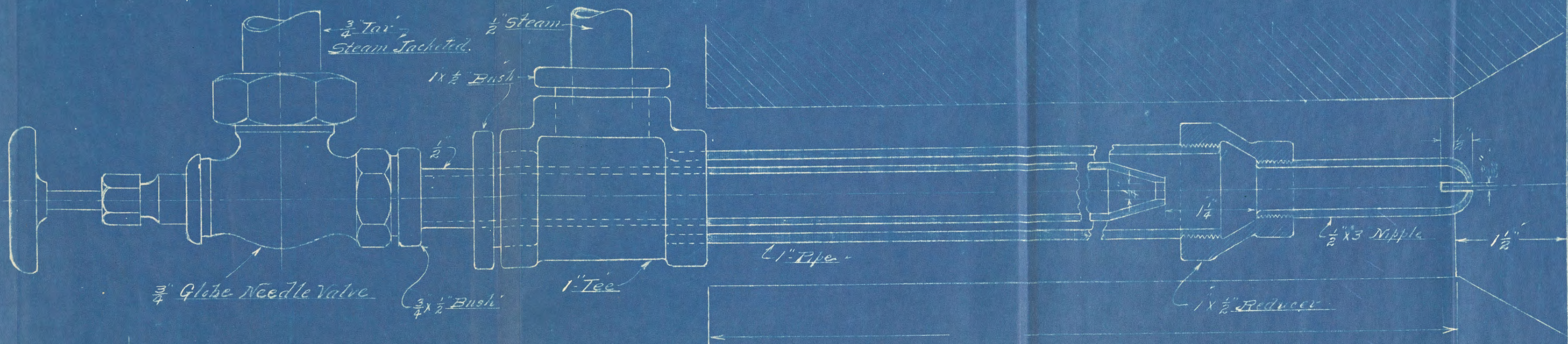
It might be of interest to the reader to know that recently the same type burners have been installed in the two stoker fired boilers of the Aluminum Company. The general type of installation is the same. There were few changes and modifications made to adapt the burners to the particular boilers and to the forced draft conditions. The burners have proven as successful as those in the hand fired boilers. An arrangement has also recently been made whereby the supply of tar will be greatly increased, allowing the burners to operate with greater regularity and more constantly.

For continuous operation the present strainer should be replaced by one which can be cleaned without interfering with the flow of tar. Such a strainer is shown in Fig. 9. This type of strainer will be installed when the amount of operation will warrant it.

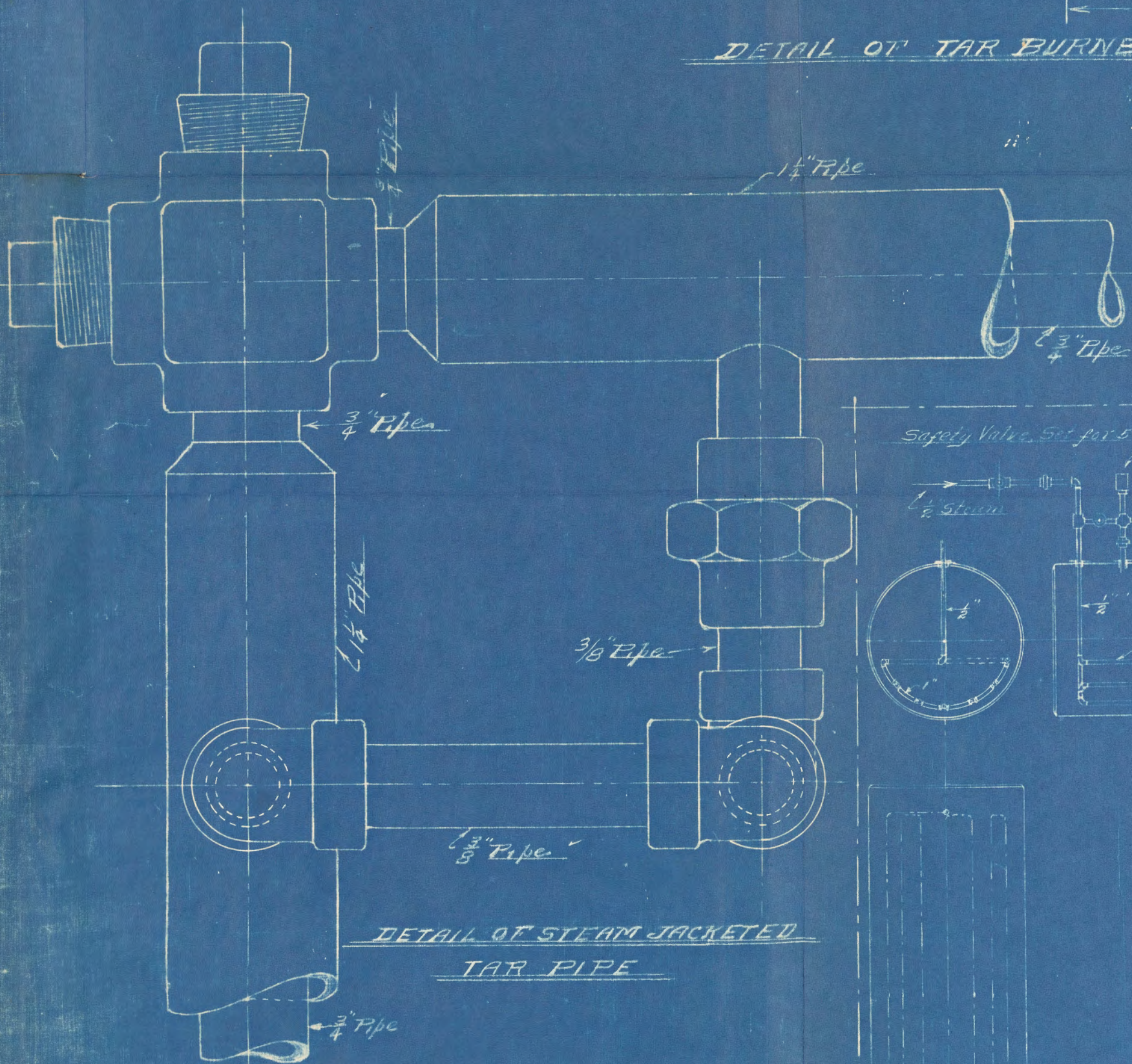
If the supply tank were placed on top of the boilers there would be an advantage of having the tar flow to the burner by gravity, also of keeping the tar warm at all times. These advantages might, however, be counter-balanced by the additional power required to pump the tar to the higher level. At present very little air is required to hold the desired pressure on the tar in the supply tank.

BIBLIOGRAPHY

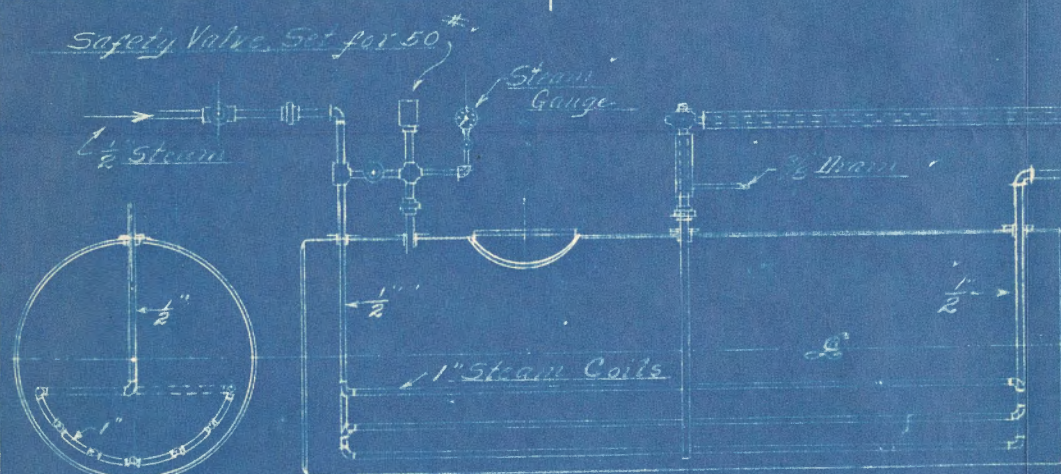
1. Fuel ----- J. S. S. Brauce
2. Fuels and Their Combustion ----- Haslam & Russell
3. Burning Liquid Fuel ----- W. N. Best
4. Steam Power Plant Engineering ----- Gebhardt
5. American Petroleum Industry ----- Bacon & Homor
6. Gas Chemist's Handbook -----
7. Engine Room Chemistry ----- A. H. Gill
8. Handbook of Ship Operation ----- Hughes
9. Manufacturers Catalogues -----



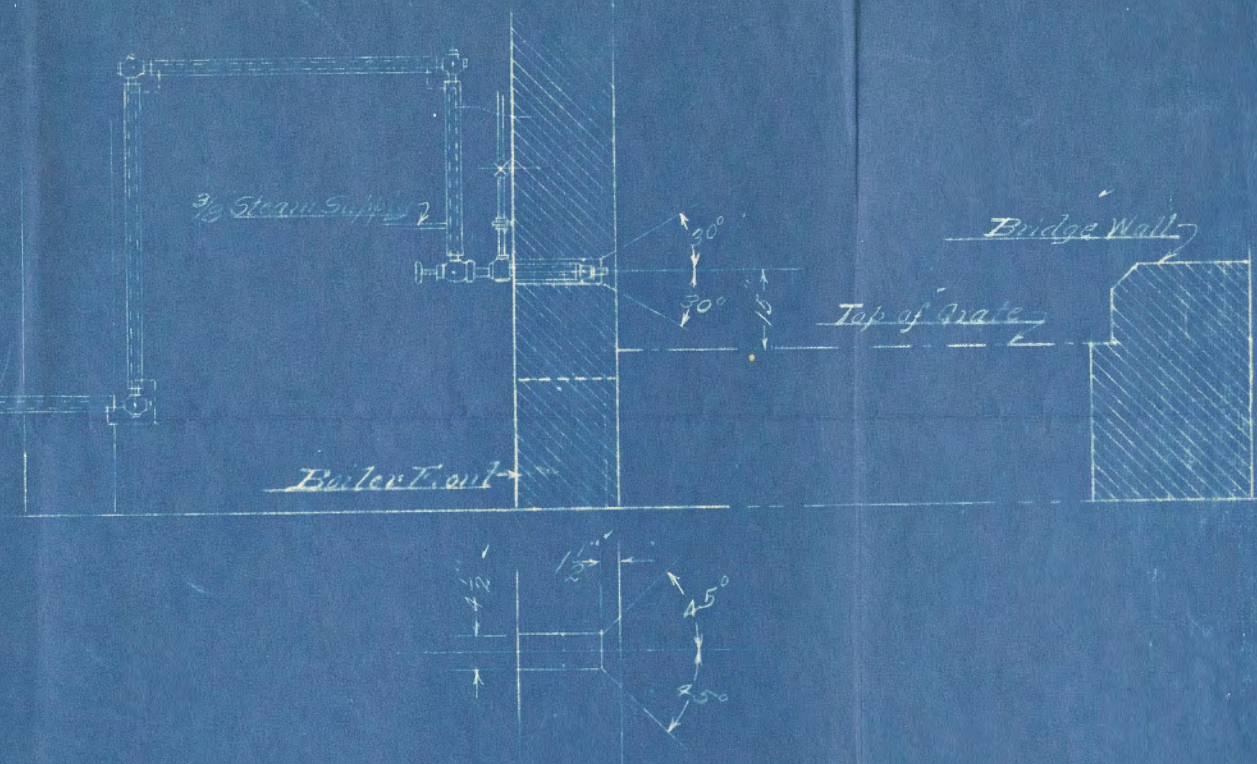
DETAIL OF TAR BURNER



DETAIL OF STEAM JACKETED
TAR PIPE



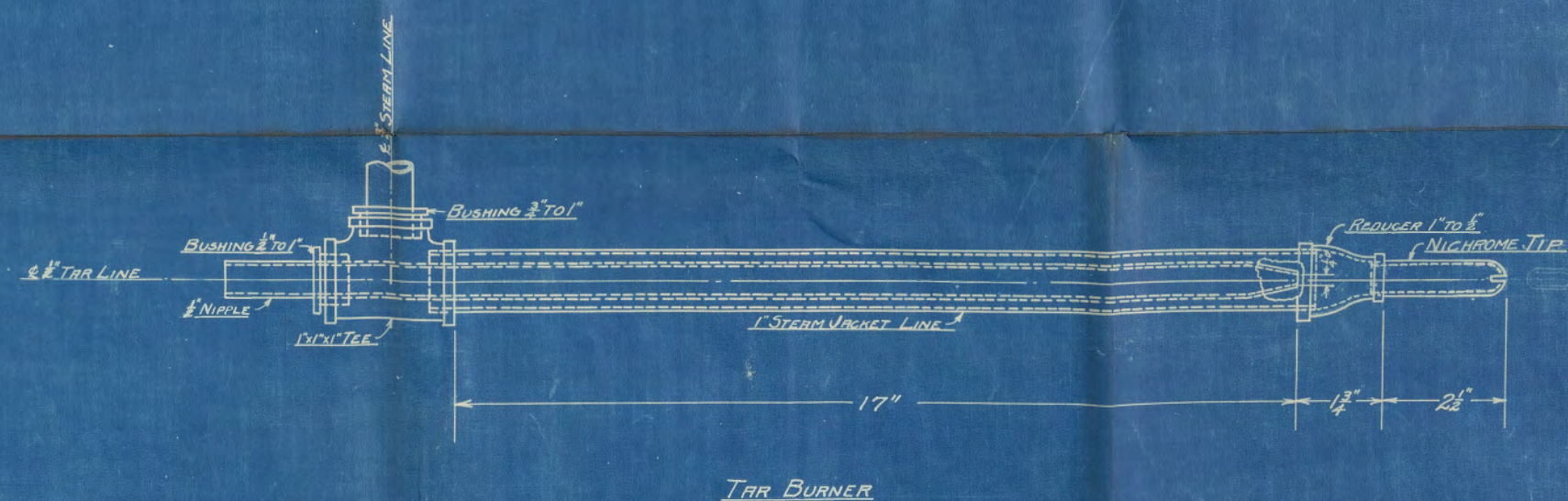
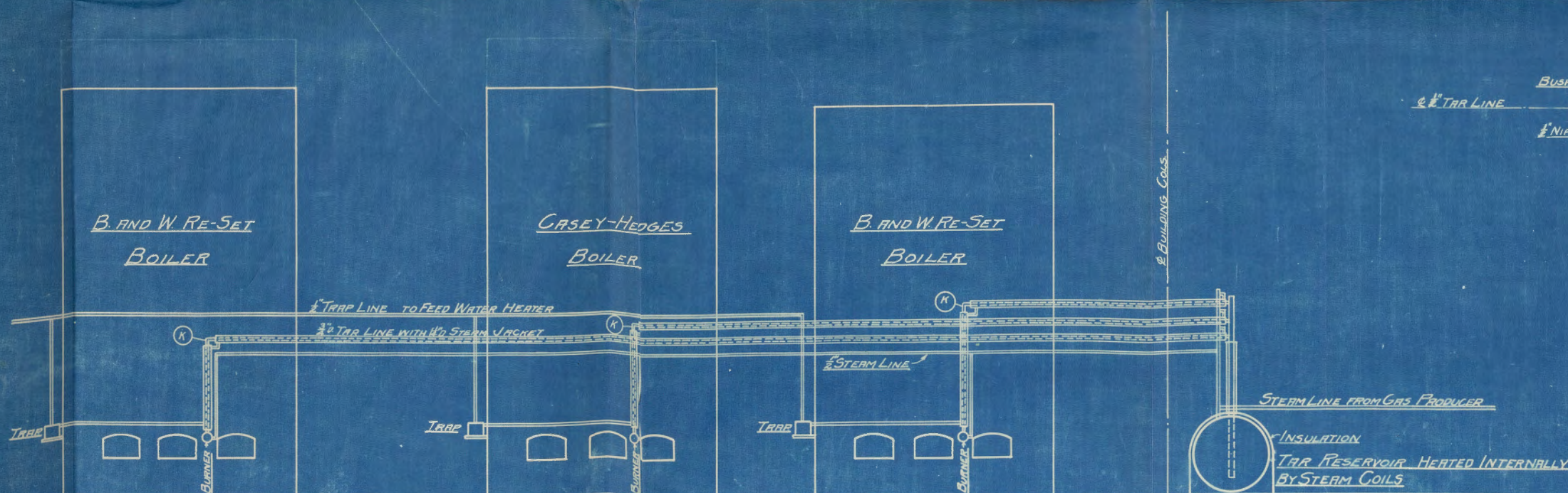
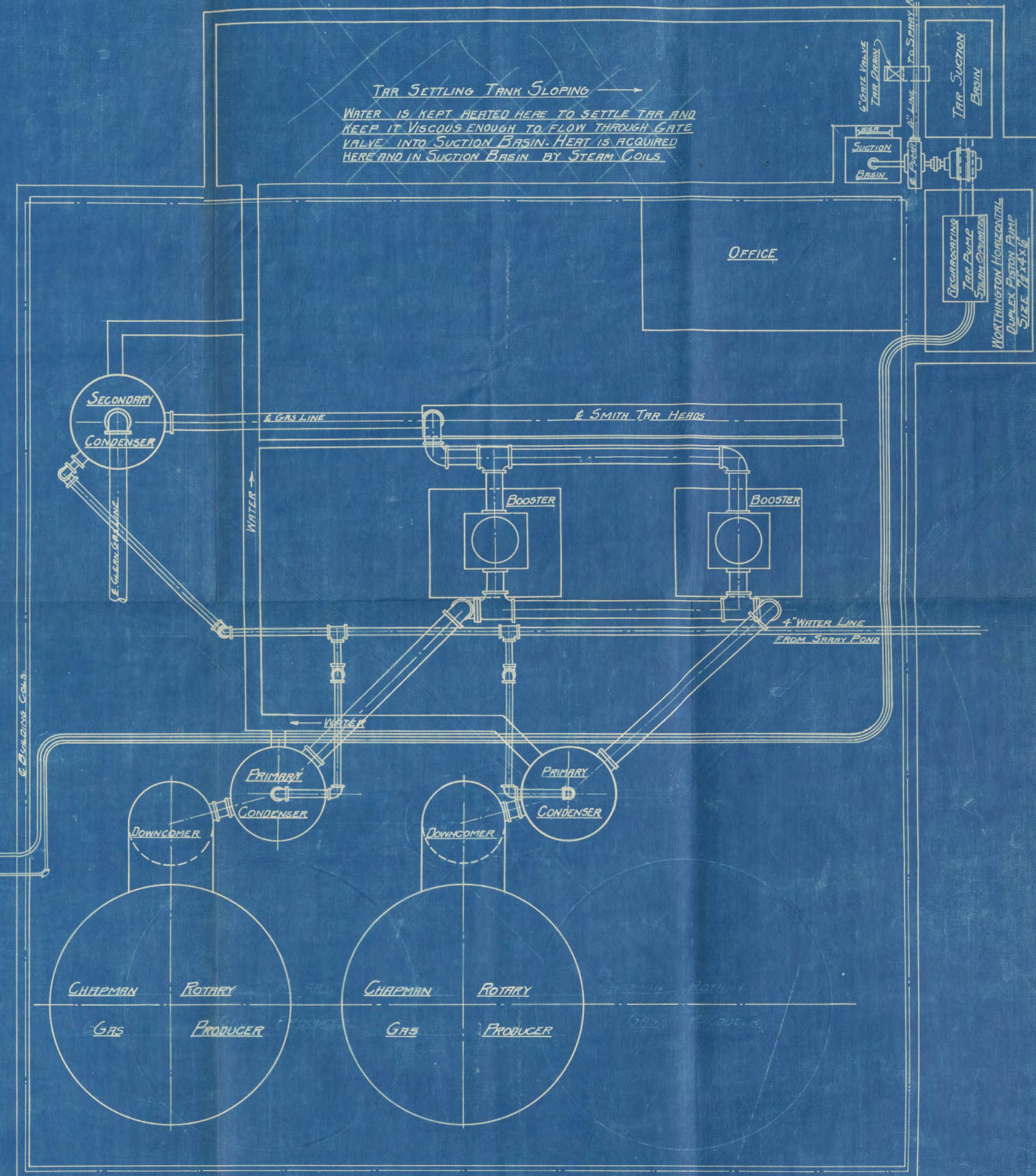
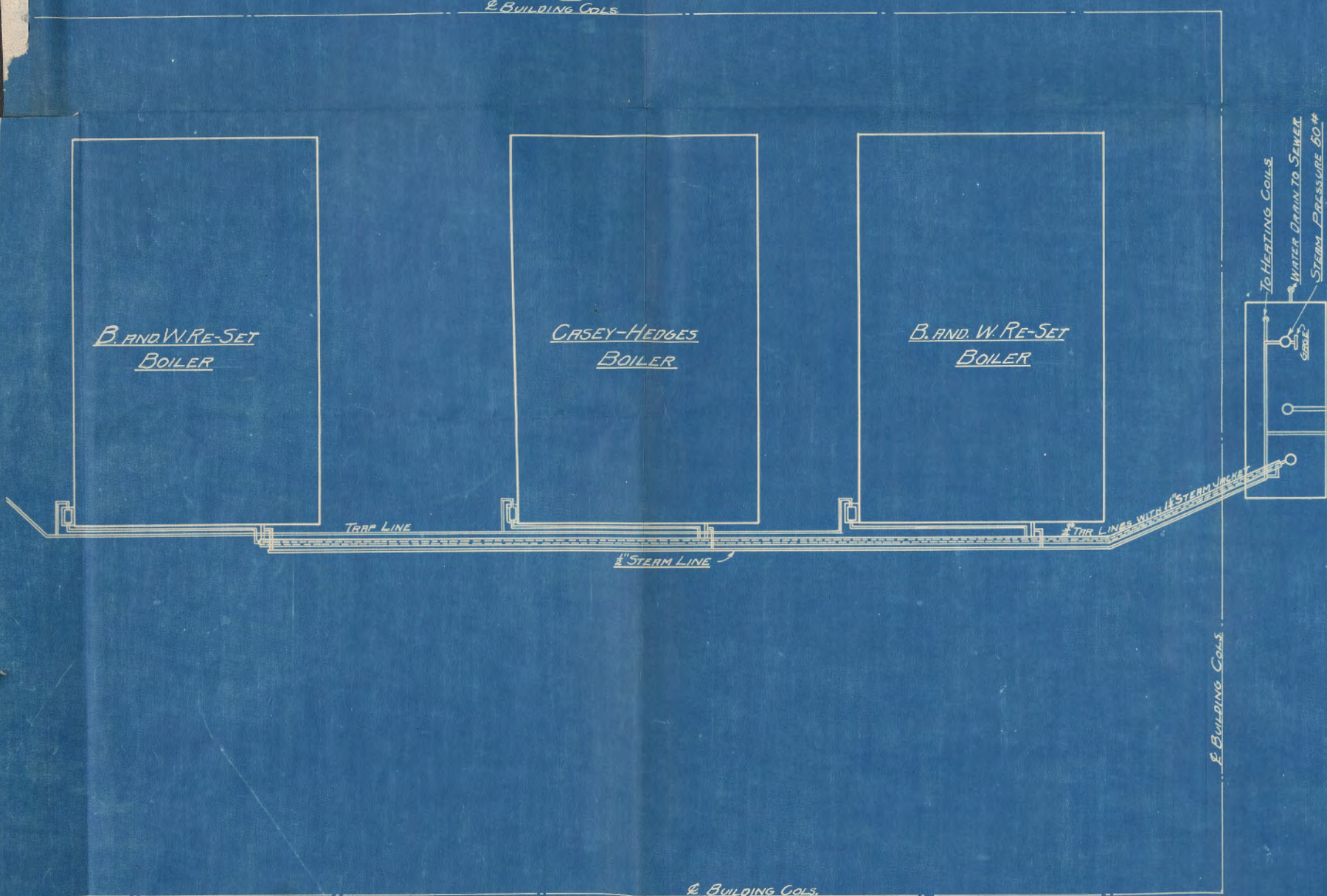
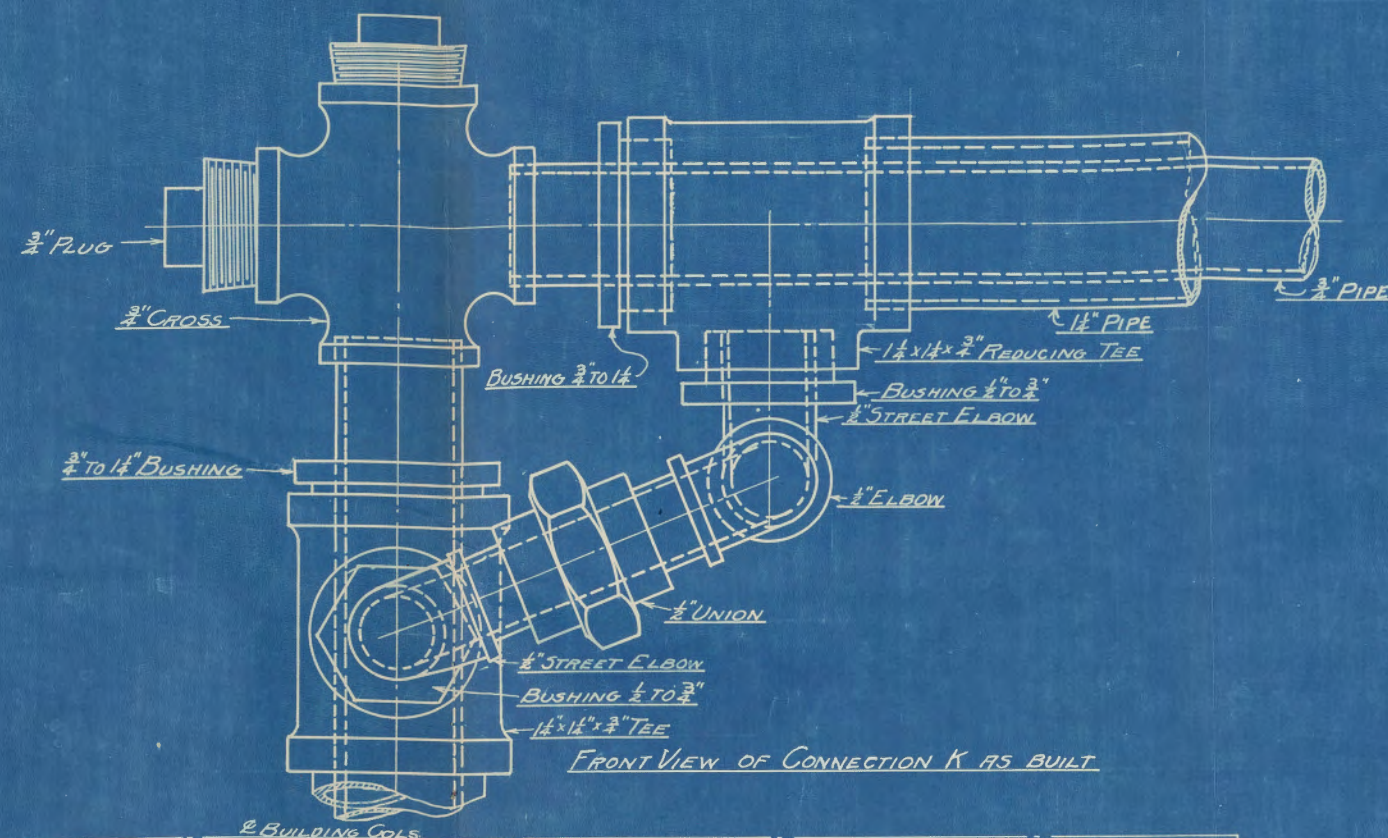
TAR TANK



Made For
The Richardson Co.
Melrose Park Ill.
Thoma & Dreyer Co. Engrs
Chicago Ill.

DO NOT SCALE DRAWING
USE DIMENSIONS ONLY
The United States Aluminum Co.
THE TARBURNING SYSTEM
For Boiler Room.

FIG. 1

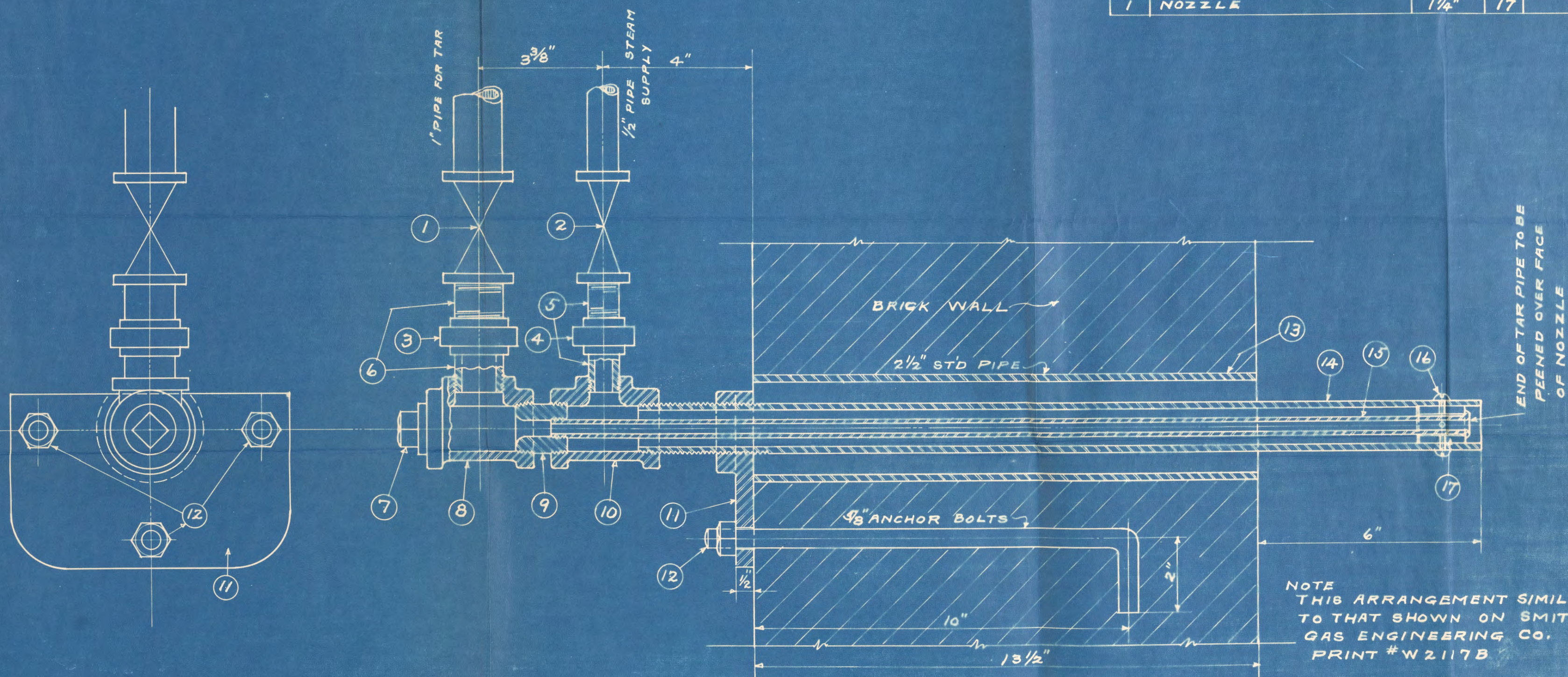


The United States Aluminum Co.
ALCOA SHEET MILL
TITL TAR BURNING PIPING
DIAGRAM

DO NOT SCALE THIS DRAWING
USE DIMENSIONS ONLY

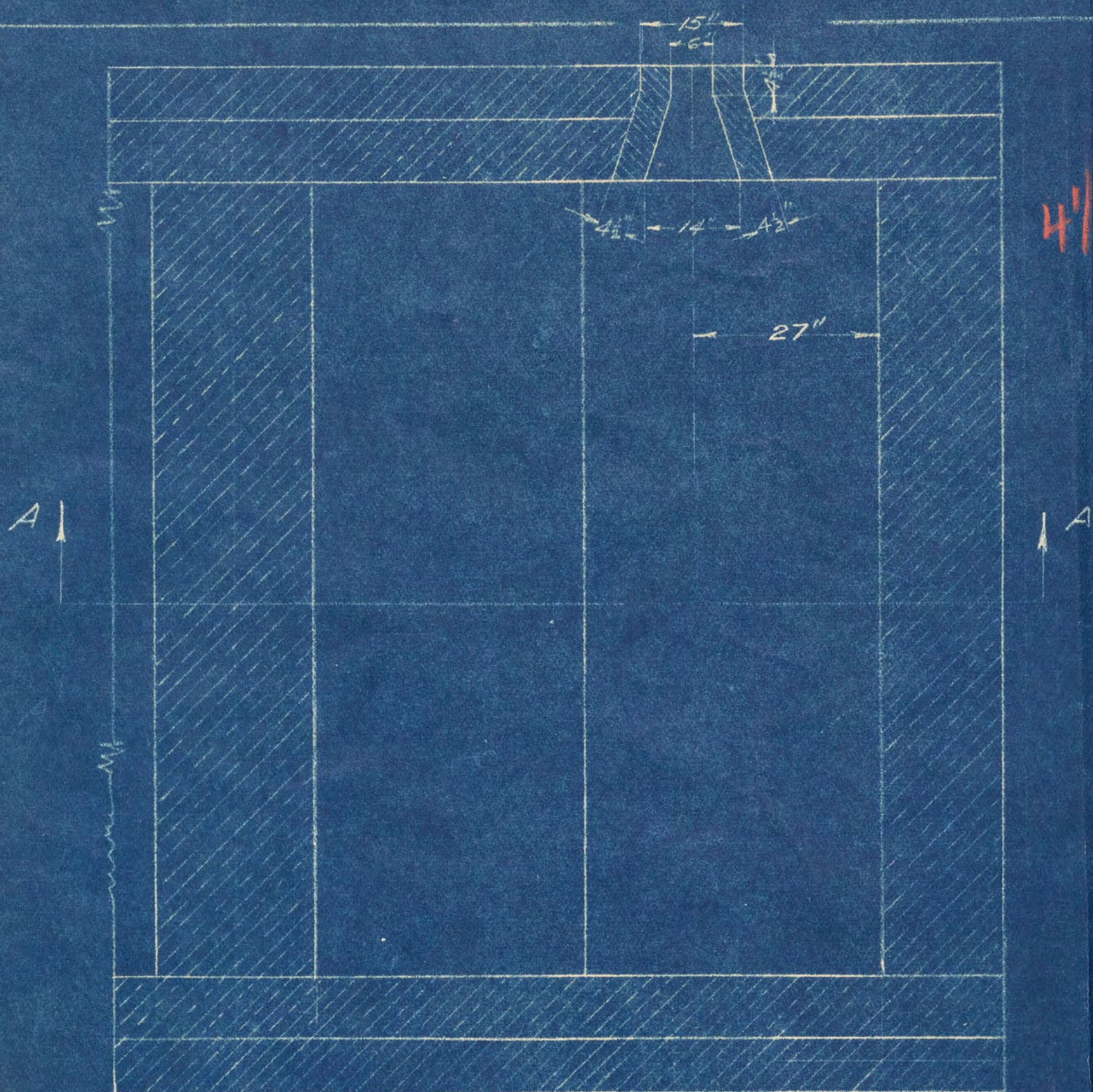
FIG. 2

BILL OF MATERIAL				
NO.	DESCRIPTION	LENGTH	MARK	D'W'GS
1	1" CRANE #320 COCK		1	
1	1/2" VALVE		2	
1	1" UNION		3	
1	1/2" "		4	
2	1/2" NIPPLE	3"	5	
2	1" "	3"	6	
1	1" PLUG		7	
1	1" x 1" x 1" TEE		8	
1	TAR CONNECTION		9	D-4778AT
1	1" x 1" x 1/2" TEE		10	
1	C.I. ANCHOR PLATE		11	L-4777AT
3	5/8" ANCHOR BOLTS WITH NUTS		12	
1	2 1/2" STD PIPE	13 1/2"	13	
1	1" PIPE 1 THD	22 3/4"	14	D-4778AT
1	1/4" PIPE - 1 THD	24 1/2"	15	D-4778AT
4	#10-24 RD. HD. MCH. SCREWS	3/8"	16	
1	NOZZLE	1 1/4"	17	



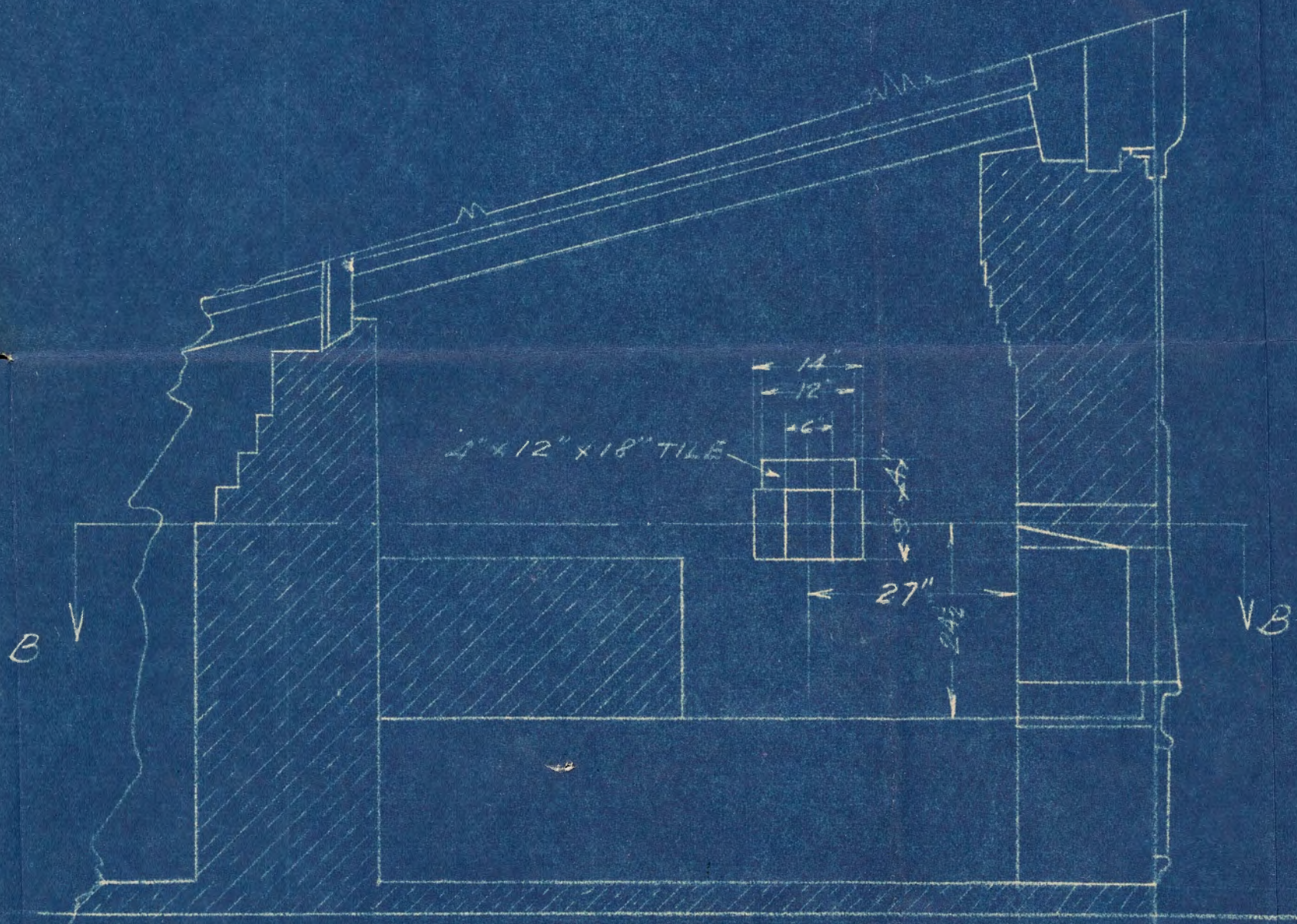
The United States Aluminum Co.
ALCOA SHEET MILL
TITLE TAR BURNER FOR
USE ON BOILER

FIG. 3



Use
4 1/2" firebrick
on sides of opening

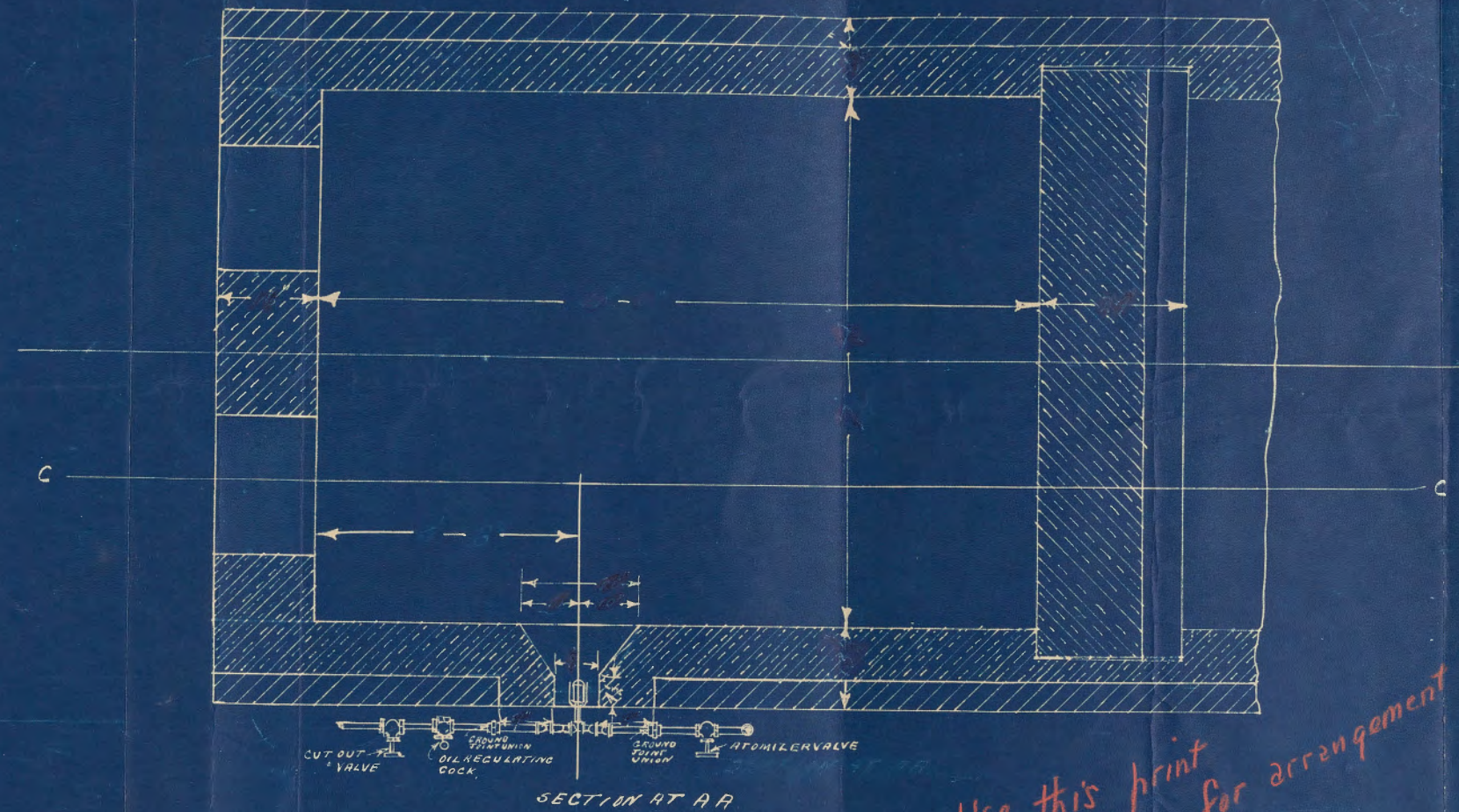
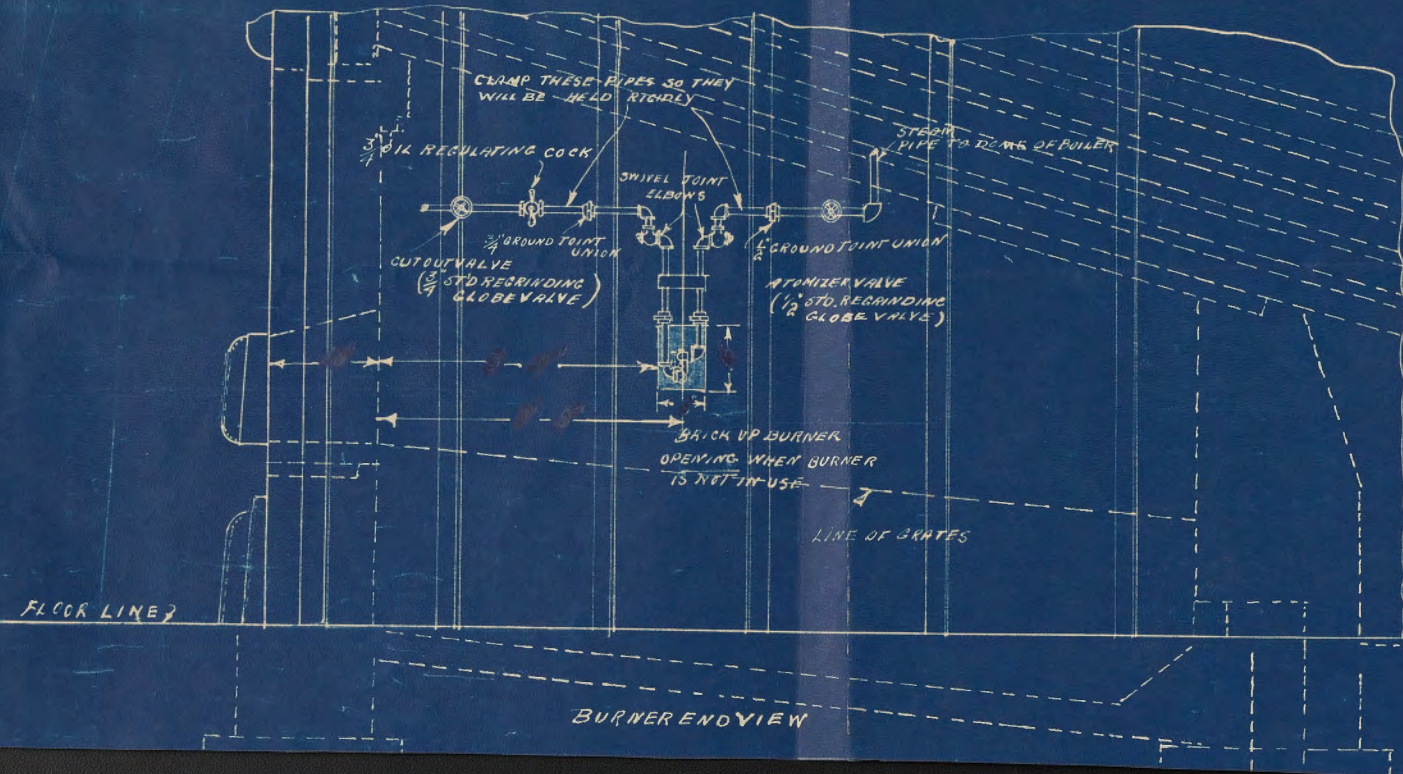
SECTION BB



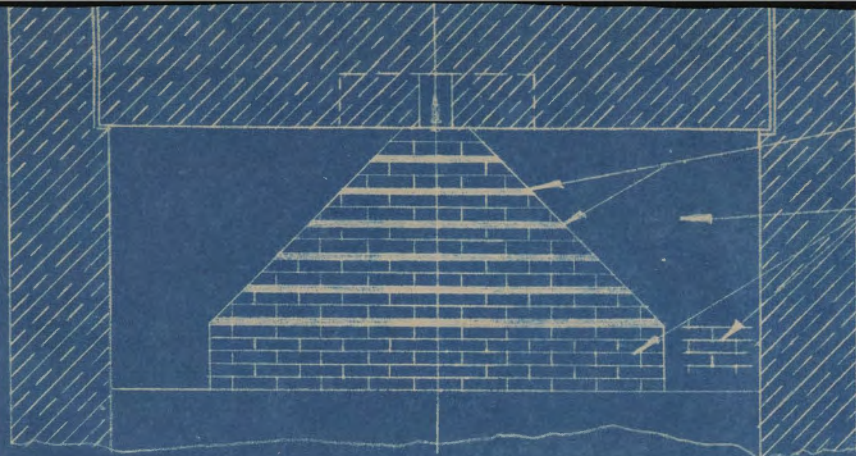
SECTION AA

W. N. BEST CORP.	
HP	
B&W BOILER	
DESIGNED BY	500
TRACED BY	3-15-20
CHECKED BY	7118
APPROVED BY	

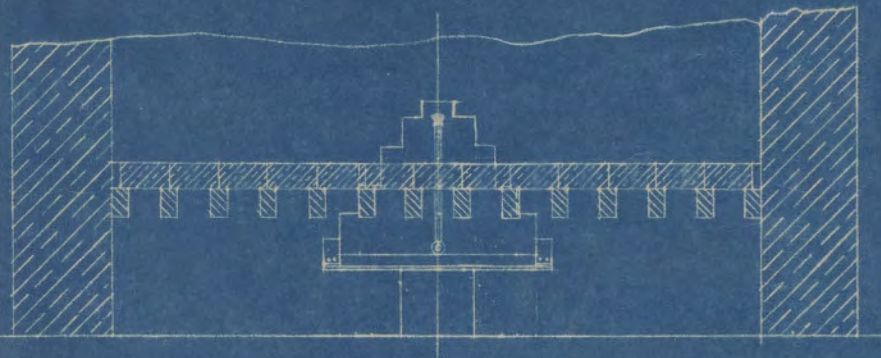
R 52B-4



Use this print for arrangement of piping

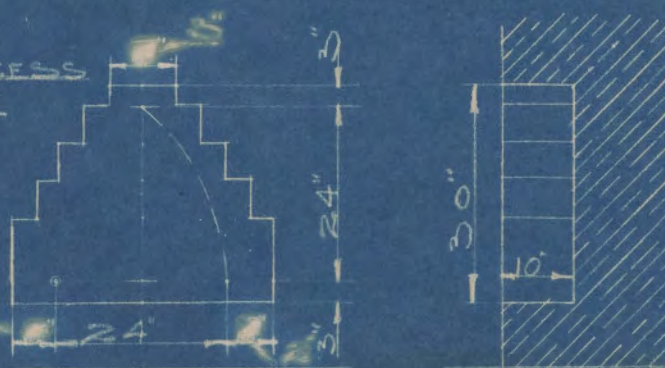


PLAN OVER BRICKWORK



SECTION THRU BRICKWORK

DETAIL OF RECESS
IN BRICKWORK

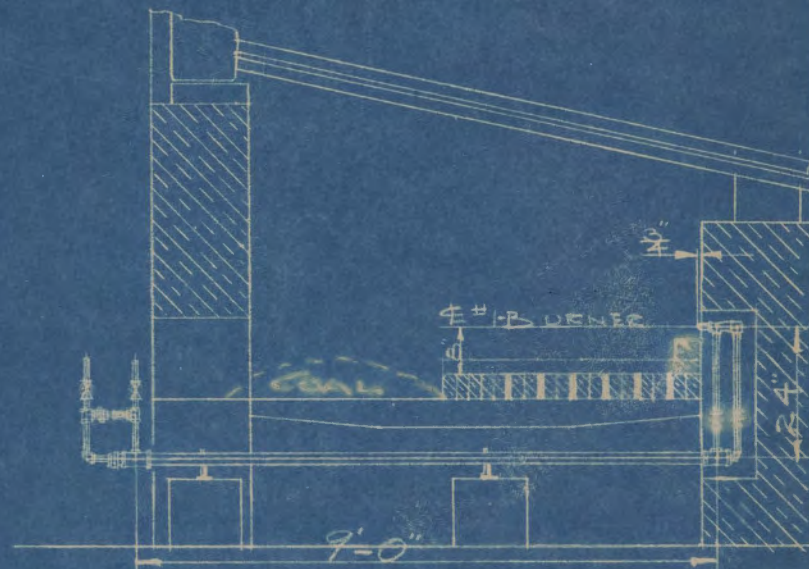


FLOOR LEVEL

NOTE!

SHADED SPACES INDICATE AIR OPENINGS

PAVED BRICK



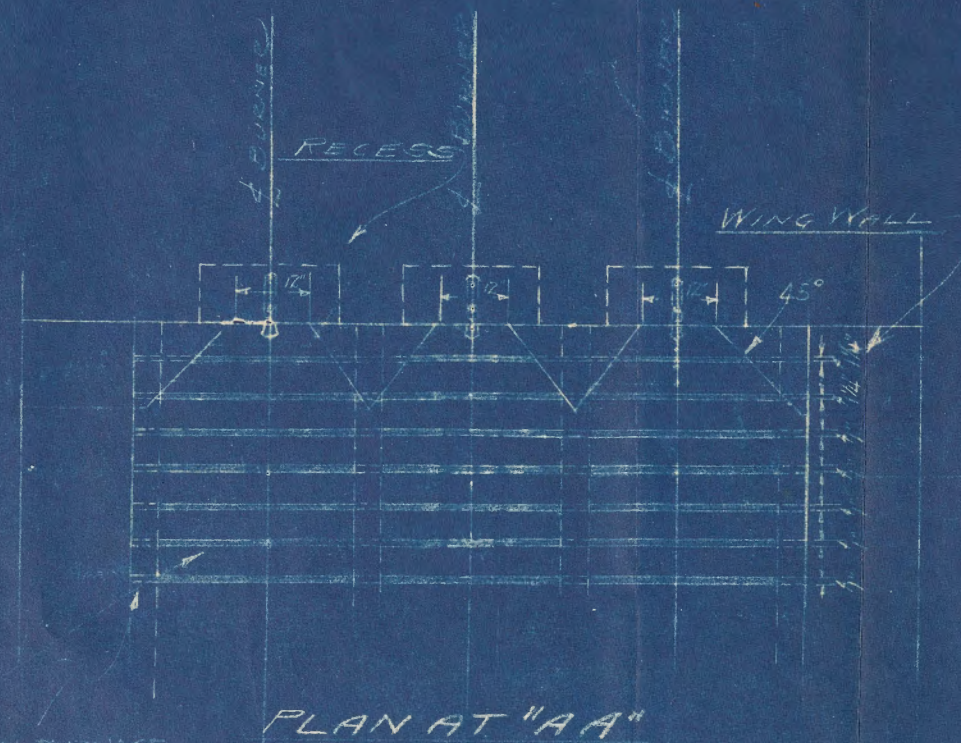
SIDE SECTION

NATIONAL AIROIL BURNER CO.

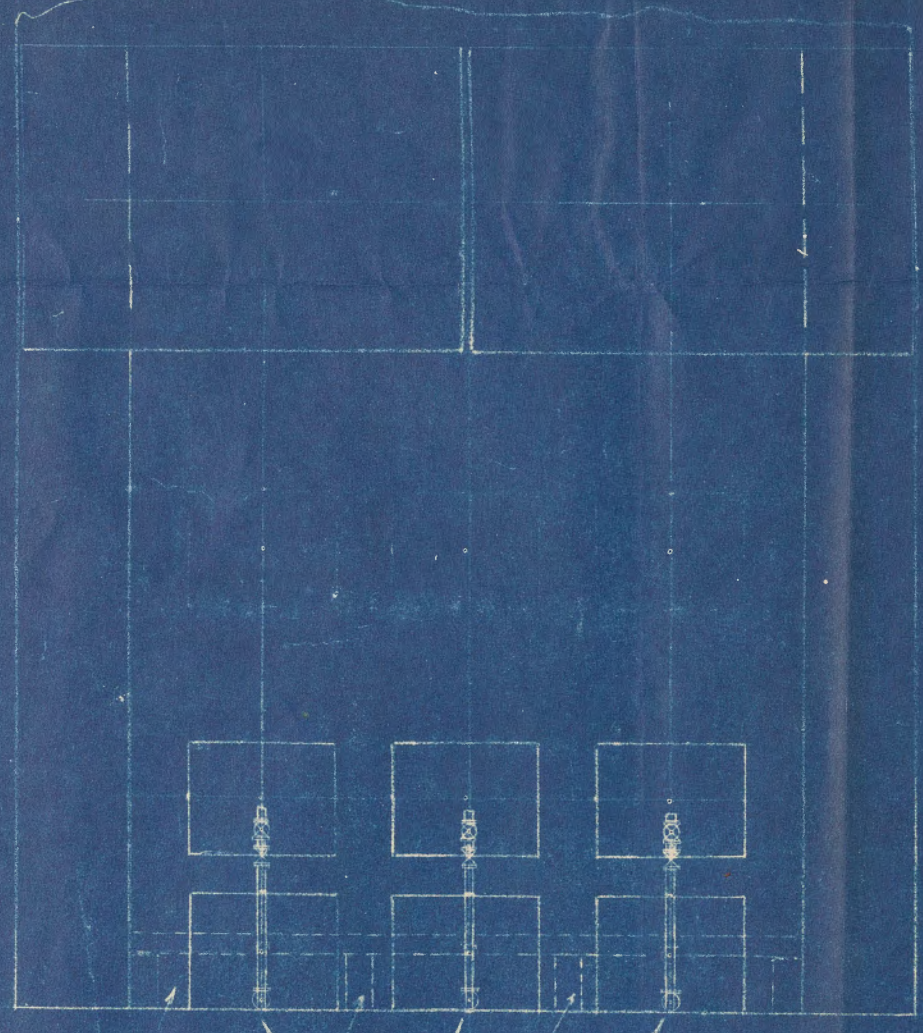
OIL BURNERS AND OIL BURNING EQUIPMENT
9TH AND THOMPSON STS., PHILA., PA.

ARRGT. OF BURNER & FURNACE OF 400
H.P. BOILER SHOWING METHOD OF
BURNING COAL & OIL SIMULTANEOUSLY
— TYPICAL INSTALLATION —

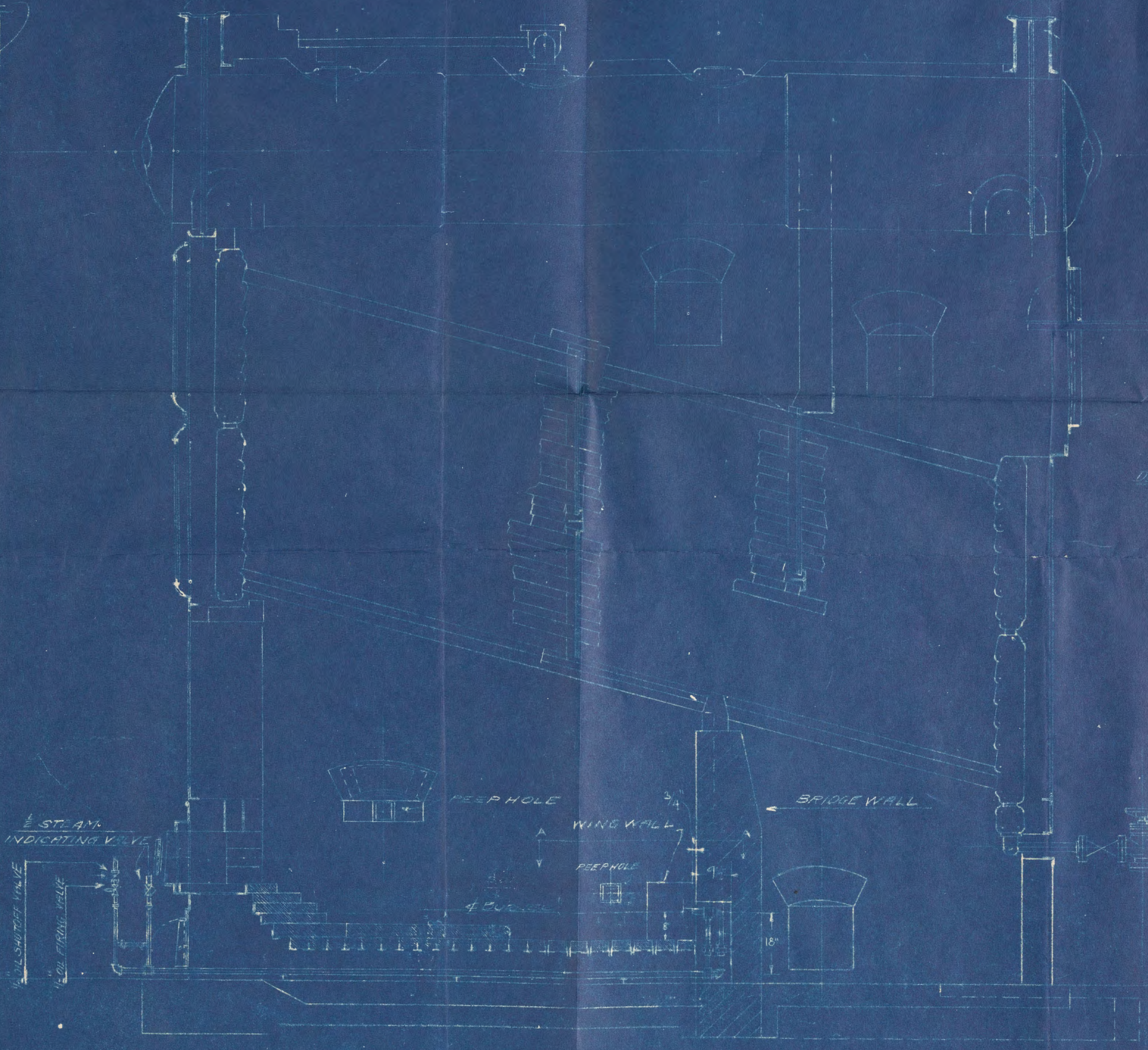
DRAWN BY R. R.	TRACED BY <i>CR</i>	CHECKED BY
DATE 4-5-28	SCALE $\frac{3}{8}" = 1'$	DRG. NO.
APPROVED <i>H. J. Cooley</i>	Sk-469	



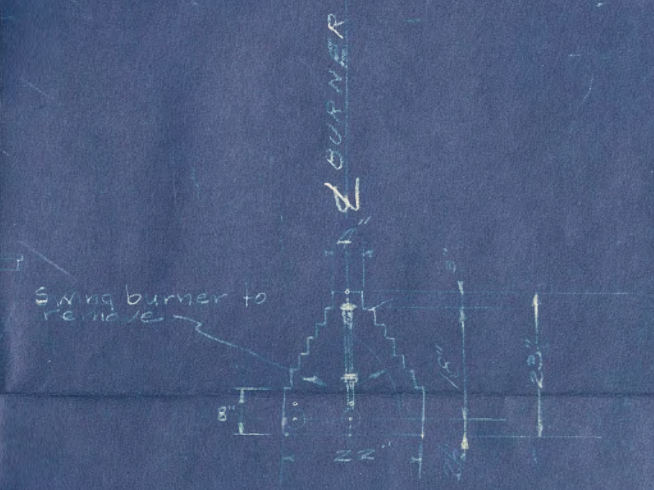
PLAN AT "AA"



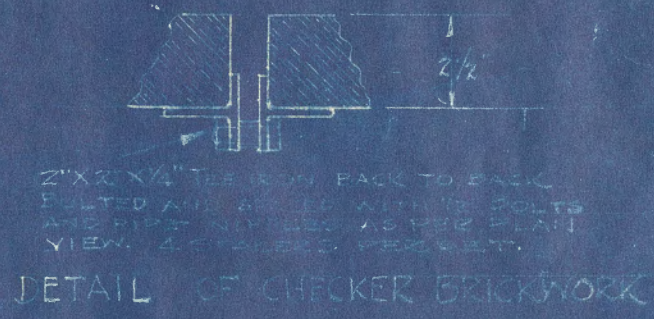
FRONT ELEVATION



ELEVATION THROUGH BOILER



DETAIL OF CHECKER IN BRIDGE WALL AND BURNER ELEVATION

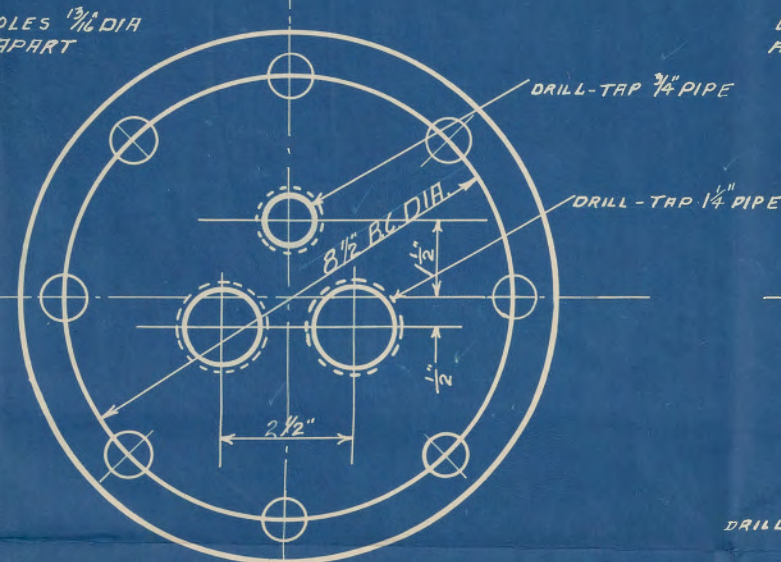


NATIONAL ALCOIL BURNER CO.
 OIL BURNERS AND OIL BURNING EQUIPMENT
 9TH AND THOMSON STS., PHILA., PA.
 ARRANG. OF FURNACE FOR BACKSHOT
 BURNER FOR 500 IP
 B.S.W. BOILER
 STD. OIL CO. N.J. CHARLESTON, S.C.

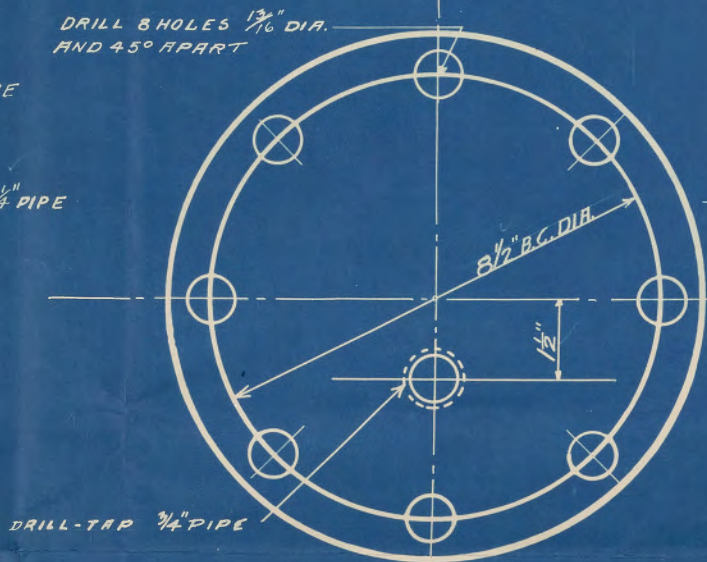
DESIGNED BY F. J. H.	TRACED BY F. J. H.	CHECKED BY JFS
DATE 5/23/23	SCALE 1/2" = 1 FT.	DRG. NO.
APPROVED F. J. Coady		B207

(FILE NO. 2)

DRILL 8 HOLES $\frac{1}{16}$ " DIA.
AND 45° APART



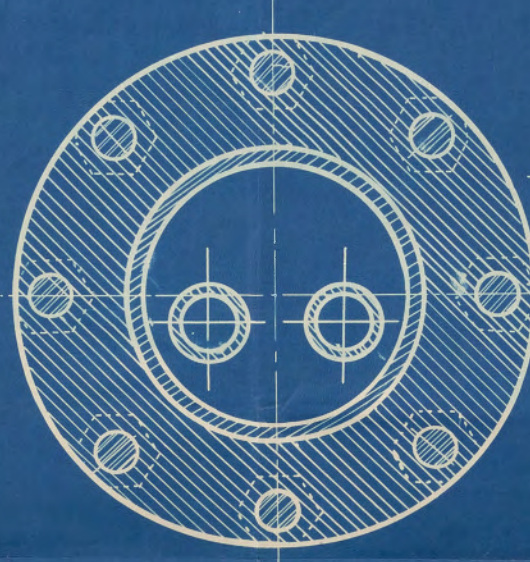
DRILL 8 HOLES $\frac{1}{16}$ " DIA.
AND 45° APART



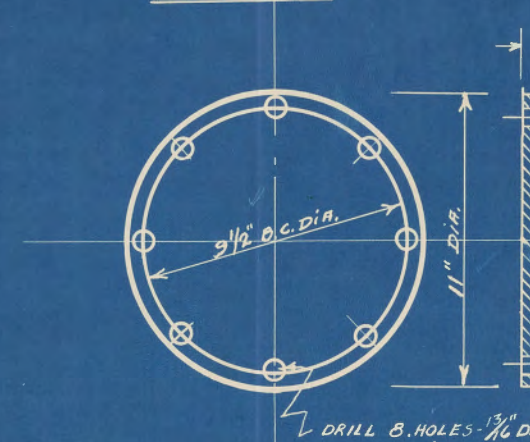
③ 5X10 STD. C.I. BLIND FLANGE
ONE DRILLED-TAPPED

AMT.	DESCRIPTION	LENGTH	P.M.	DWG. NO.
1	PIPE CAP		1	
1	BLACK PIPE		2	
1	5X10 C.I. FLANGE		3	
1	5X10 C.I. FLANGE		4	
1	RETURN COIL (DETAIL)		5	
1	1/2" X 3/8" BUSHING		6	
2	1/4" X 1" BUSHING		7	
1	5" STD. PIPE (FLANGED)	42"	8	
16	3/4" MACH. BOLTS	2 3/4"	9	

④ 5X10 STD. C.I. BLIND FLANGE
ONE DRILLED-TAPPED

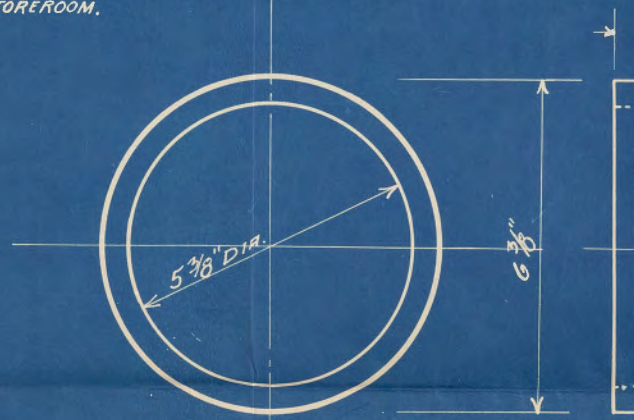


SECTION A-A

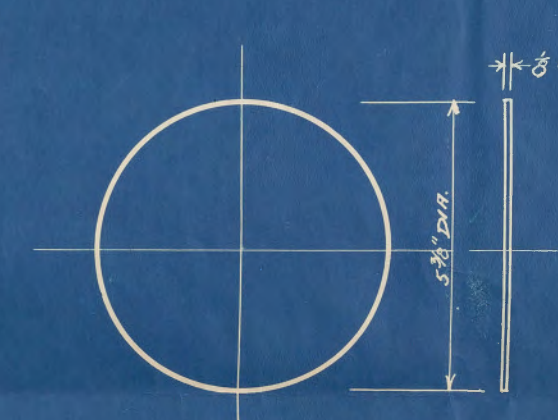


⑪ USE 6"X12" STD. CAST IRON BLIND FLANGE
ONE AS SHOWN

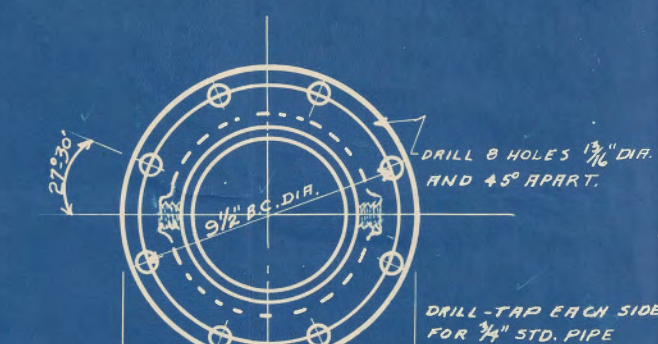
NOTE
MAKE TWO SCREENS, ONE OF
40 MESH AND ONE OF 16 MESH
BOTH COPPER WIRE FROM
STORE ROOM.



⑫ STEEL RING 2 REQ'D.



⑭ 1/8" STEEL PLATE 2 REQ'D

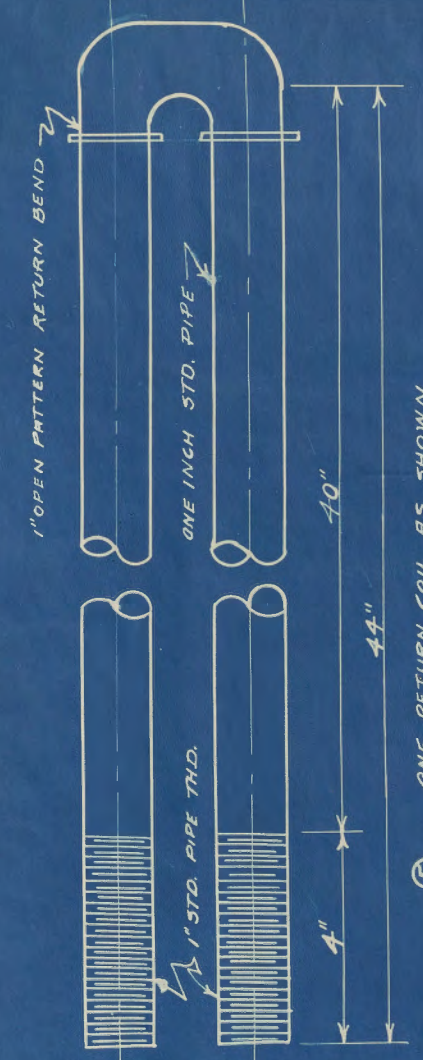
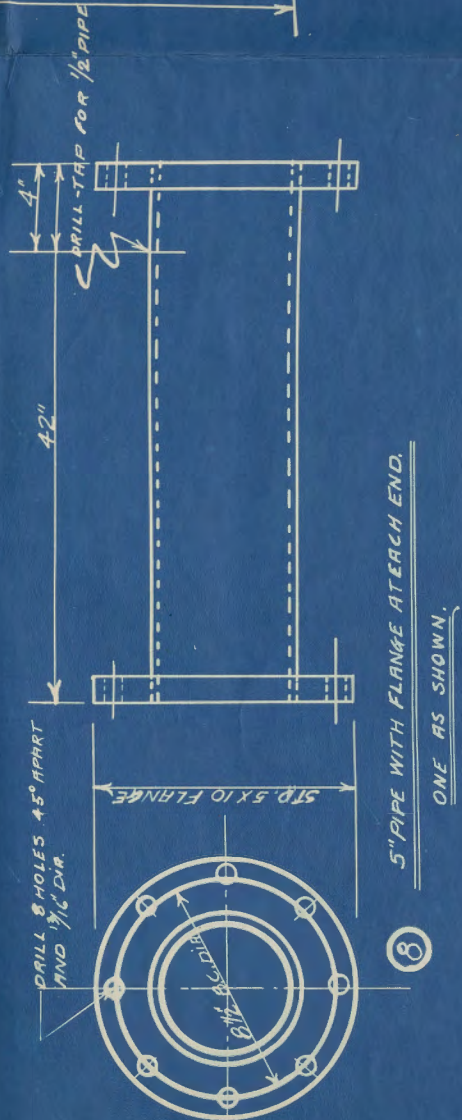
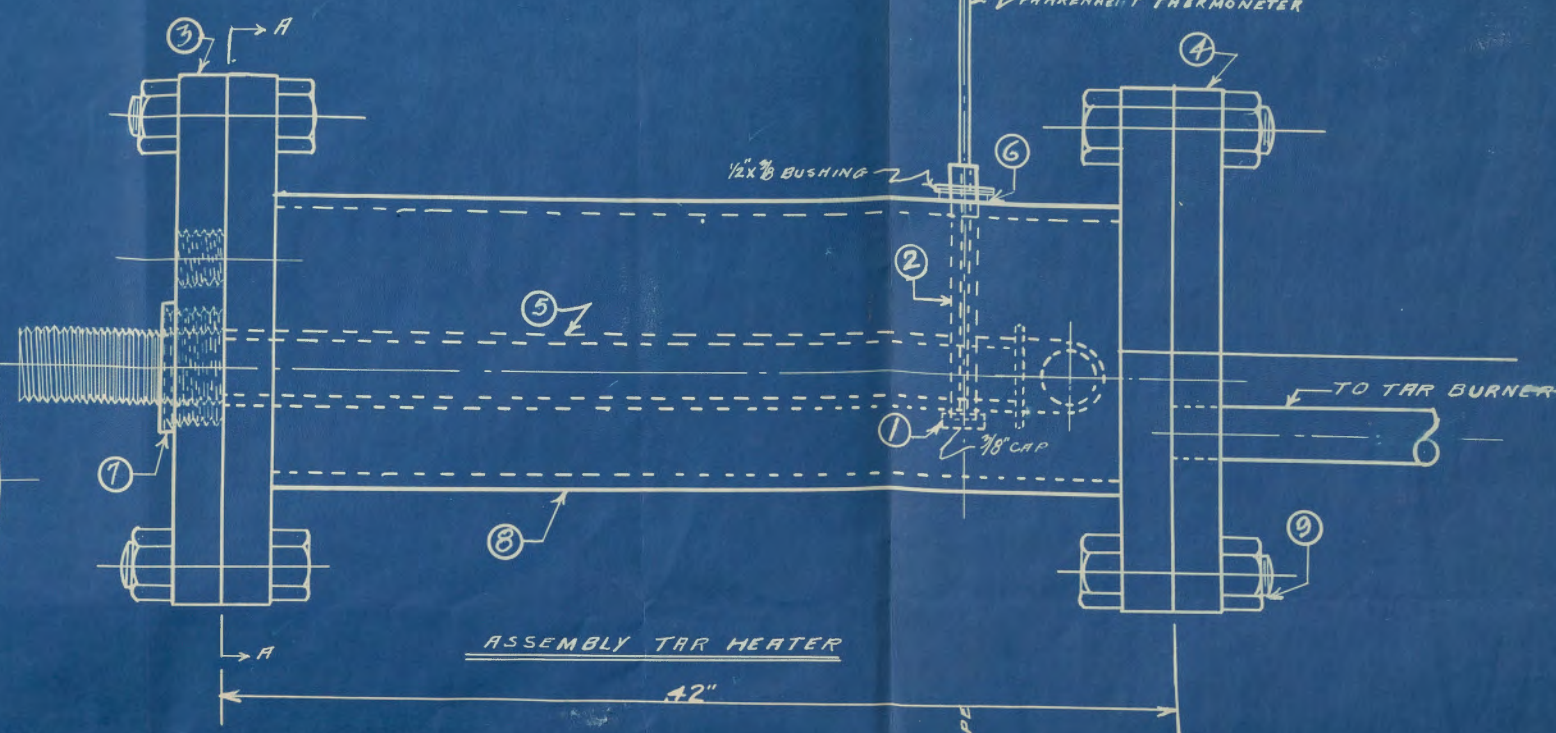


AMT.	DESCRIPTION	LENGTH	P.M.	DWG. NO.
1	STRAINER BODY		10	
1	6"X12" C.I. BLIND FLANGE		11	
2	STEEL RINGS		12	
2	SCREENS 8"X17 3/8"		13	
2	STEEL PLATES		14	
2	1/2" W.I. RODS	6 3/8"	15	
8	3/4" X 3" MACHINE BOLTS		16	

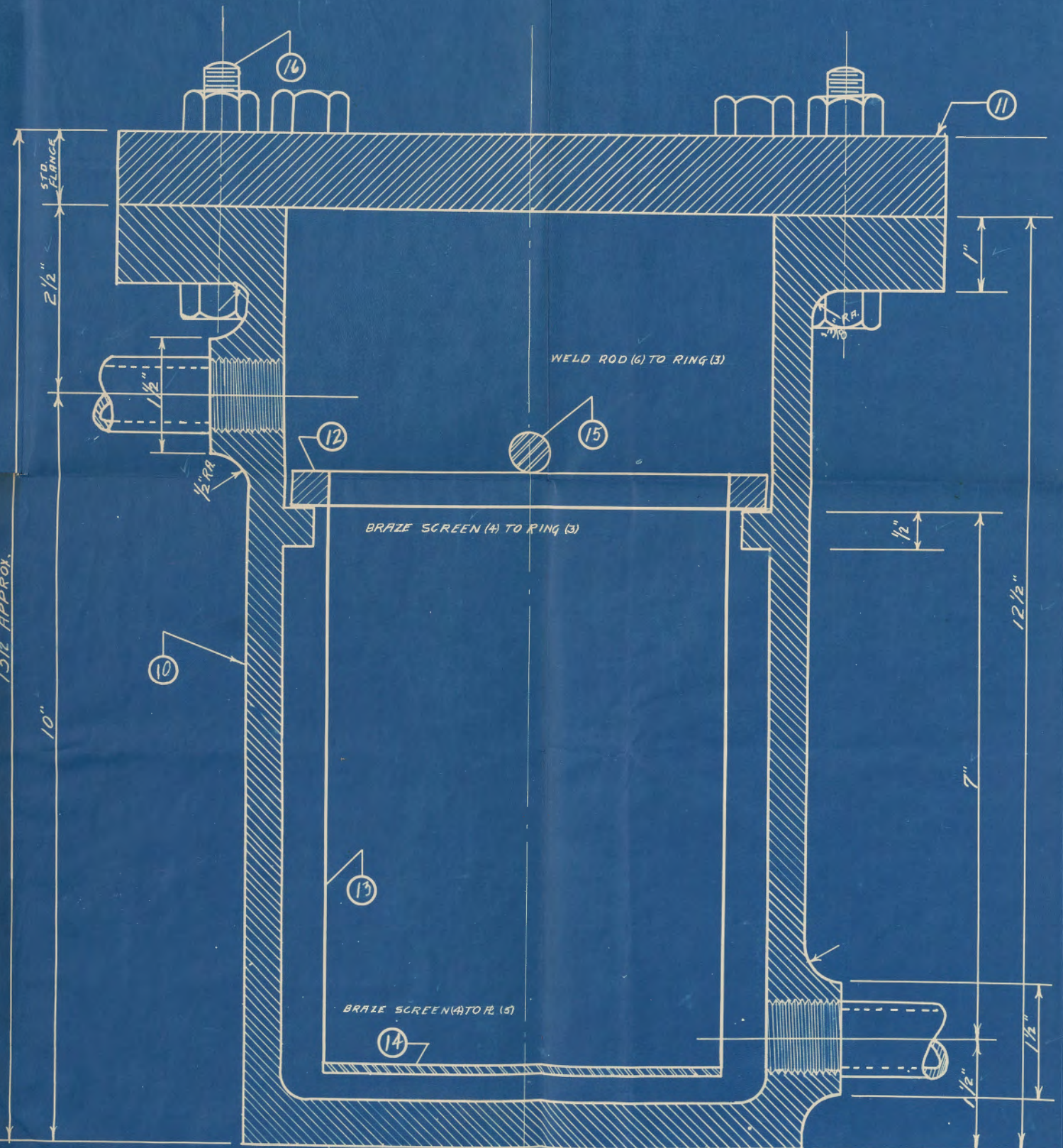
GREY IRON CASTING
PATTERN 2 AT. 943
APPROX. WT. 31#

The United States Aluminum Co.
ALUMINUM STRAINER AND HEATER
FOR TAR BURNING SYSTEM
IN BOILER HOUSE

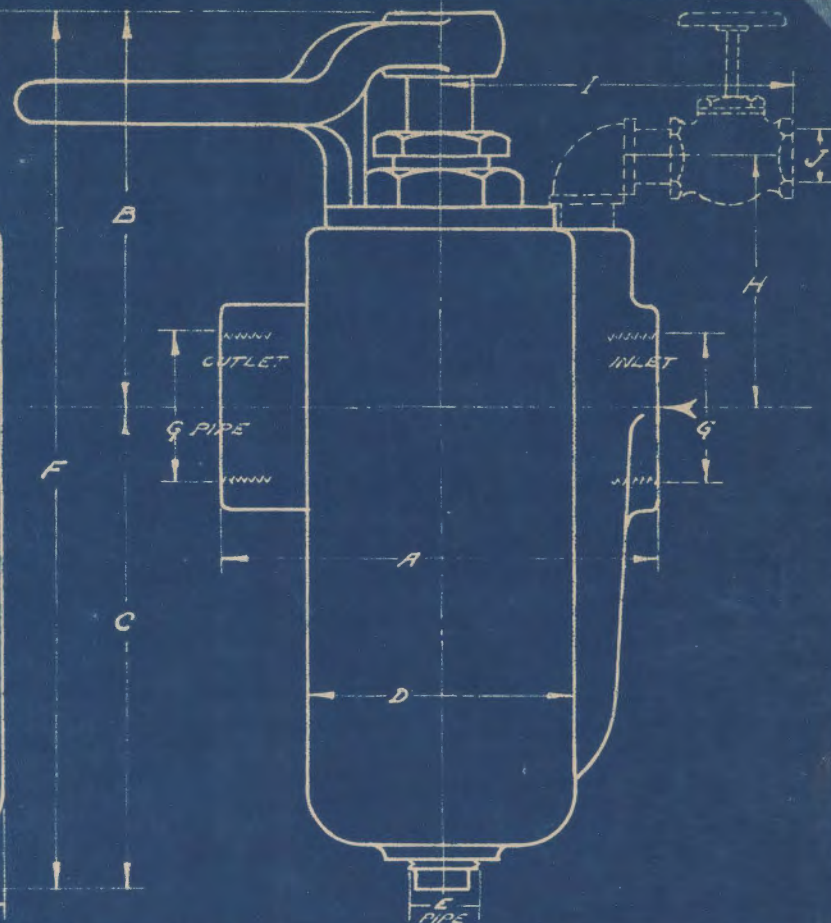
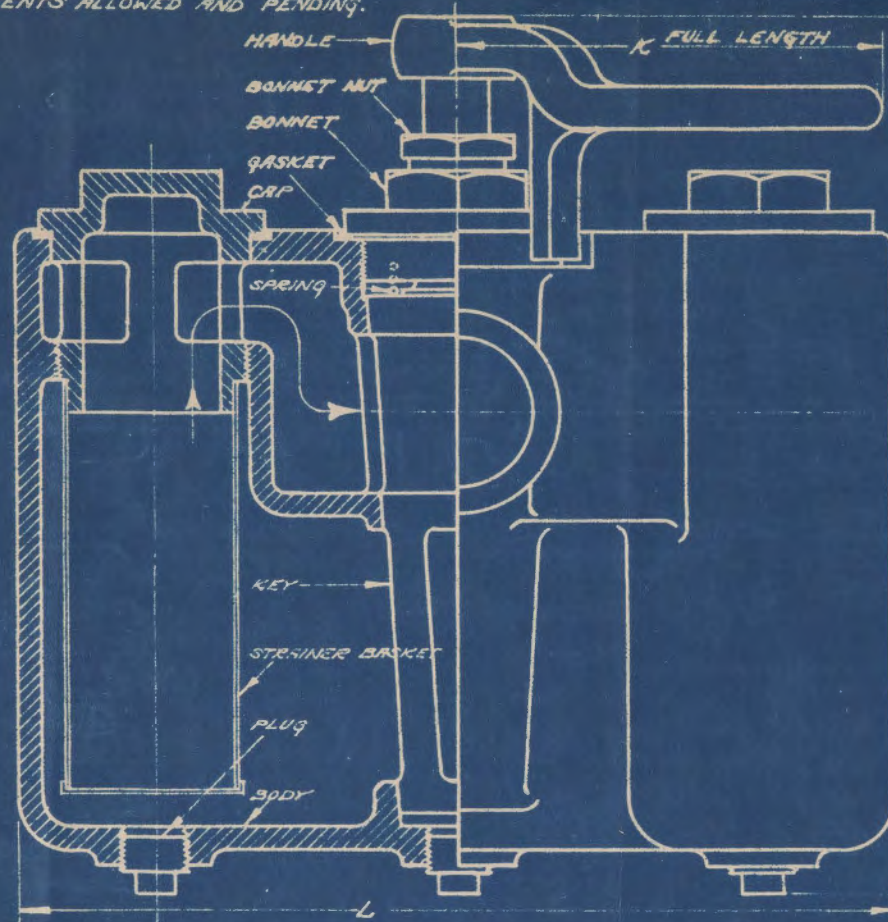
FIG. 8



ASSEMBLY TAR STRAINER



PATENTS ALLOWED AND PENDING.



CONSTRUCTION

SPECIALLY ADAPTED FOR FUEL OIL SYSTEMS

BODY CAST IRON TESTED TO 400 LBS LIQUID PRESSURE.

SCREEN PERFORATED SHEET BRASS.

MESH $\frac{1}{32}$ FOR PUMP SUCTION AND $\frac{1}{64}$ FOR PUMP DISCHARGE.

ENDS SCREWED.

OPERATION

OIL PASSES INTO THE BODY THRU OUT-OUT COCK AND THRU THE ONE STRAINER INDICATED BY THE DIRECTION OF THE LEVER HANDLE. THE FLOW IS TRANSFERRED TO THE OTHER STRAINER BY MERELY TURNING THIS COCK A QUARTER OF A REVOLUTION UNTIL IT COMES TO A STOP OVER THE OTHER

STRAINER. THE DIRECTION OF FLOW IS ALWAYS FROM OUTSIDE TO INSIDE OF SCREEN. SEDIMENT THEREFORE ACCUMULATES AT OUTSIDE THEREOF. A BLOW-OFF CONNECTION IS PROVIDED FOR BLOWING OUT OR DRAINING ACCUMULATED SEDIMENT.

WHERE VISCOUS SOLIDS ARE PRESENT, THE CAP AT TOP MAY BE TAKEN OFF AND THE SCREEN ATTACHED THERE TO, REMOVED FROM TIME TO TIME FOR CLEANING WITH KEROSENE.

A SMALL STEAM CONNECTION IS PROVIDED AT INLET SIDE FOR CLEANING WITH OUT REMOVAL OF CAP. THE OUT-OUT COCK IS DESIGNED TO PUT THE STEAM THRU THAT PART OF THE STRAINER WHICH IS OUT OF SERVICE. WITH THE BLOW-OFF CONNECTION OPEN THIS QUICKLY & THOROUGHLY REMOVES ALL SEDIMENT FROM THE STRAINER BODY & SCREEN.

SIZE	A	B	C	D	E	F	G	H	I	J	K	L
2"	7 $\frac{1}{2}$ "	6 $\frac{1}{2}$ "	7 $\frac{3}{8}$ "	4 $\frac{1}{2}$ "	3 $\frac{1}{2}$ "	13 $\frac{7}{8}$ "	2"	4 $\frac{1}{16}$ "	6 $\frac{1}{4}$ "	1 $\frac{1}{2}$ "	11"	13 $\frac{3}{4}$ "
4"	8"	7 $\frac{1}{2}$ "	12 $\frac{1}{4}$ "	5"	3 $\frac{1}{2}$ "	19 $\frac{3}{8}$ "	4"	5 $\frac{1}{16}$ "	6 $\frac{3}{8}$ "	1 $\frac{1}{2}$ "	11"	14 $\frac{1}{2}$ "

STRAINER

FOR ANTHONY NEBULYTE OIL BURNERS

THE ANTHONY COMPANY
LONG ISLAND CITY

LIQUID FUEL ENGRS
NEW YORK

DRAWN	5-23-27	E.M.
TRACED	5-23-27	E.M.
CHECKED	5-24-27	W.H.
APPROVED	5-19-27	W.H.

DUPLIX PATTERN

SR

APPROVAL.

The foregoing thesis is hereby approved as a creditable study of an engineering subject, carried out and presented in a manner sufficiently satisfactory to warrant its acceptance as a prerequisite to the degree for which it has been submitted. It is to be understood that by this approval the undersigned does not necessarily endorse or approve any statement made, opinions expressed, or conclusions drawn therein, but approves the thesis only for the purpose for which it is submitted.

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