DWG NO 204136 E

DESIGNATION OF SYMBOLS

A	ACCESS DOOR - ECON (FRONT & REAR) CLAMPED
B	ACCESS DOOR - ECON (TOP) BOLTED
C	ACCESS DOOR - CAVITY BEHIND TUBE BANK (FRONT ONLY) CLAMPED
D	ACCESS DOOR - S.H. CAVITY (FRONT & REAR) CLAMPED
E	ACCESS DOOR - UPPER FRONT WALL HEADER CLAMPED
F	ACCESS DOOR - UPPER REAR WALL HEADER CLAMPED
G	S.H. TUBE RENEWAL DOOR (FRONT ONLY) CLAMPED
H	12"×16" MANHOLE (S.D.-FRONT & REAR)(W.D. - FRONT ONLY)
J	IK SOOTBLOWER UNIT
K	G9B SOOTBLOWER UNIT
L	OIL BURNERS - B&W 3M SARATOGA WITH RACER ATOMIZERS
M	PREHEATED AIR INLET CONNECTION
N	½" S.B. SCAVENGING AIR CONN. (SCRD COUPLING) G9B UNIT
P	2" S.B. " " " " " IK UNIT
Q	2" - ECONOMIZER DRAFT CONN. (SCRD)
R	2" - FURNACE DRAFT CONN. (SCRD)
S	1" - WINDBOX DRAFT CONN. (SCRD)
T	1" - STEAM SMOTHERING CONN. (SCRD & CAPPED)
W	INSPECTION LIGHT
X	OIL LEAKAGE OBSERVATION PORT
Y	2" OIL LEAKAGE DRAIN CONN. (SCRD & CAPPED)
Z	B&W WORK TERMINATES HERE
AA	2½" WATER WASH DRAIN CONN. (SCRD & CAPPED)
BB	ACCESS DOOR - CAVITY AT TUBE BANK (FRONT & REAR) CLAMPED
CC	ACCESS DOOR - FURNACE ROOF CAVITY - CLAMPED
DD	ACCESS DOOR - CAVITY ABOVE S.H. (FRONT ONLY) CLAMPED
EE	ACCESS DOOR - BOTTOM S.H. VESTIBULE - CLAMPED

REVISIONS

REVISION NO.	DESCRIPTION	DATE	APPROVAL
1	ADDED CONT 415-4736 DLR/REO	12/4/73	
2	DELETED CONT 415-4732 FROM TITLE BLOCK. ADDED CONT 415-4741, INTERCHANGED MK Nº'S 243 ON BNR'S DLR/DLE	1/11/74	
3	ZONE 3-D CHG'D LGTH OVER S.B. 5-1 & S-2, ZONE 2-G CHG'D 3⅜" TO 2⅞" DLR/RMR	2/8/74	
4	ADDED CONT 415-4742 DLR/RMR	4/8/74	
5	ADDED CONT 415-4749 DLR/REO	12/5/74	
6	ADDED CONT 415-4752 TFS/DEL	2/24/75	
7	DELETED CONTRACTS 415-4749 & 415-4752 DLD/RMR	3/10/76	

GENERAL NOTES

1. ALL EXTERNAL PIPING AND EQUIPMENT MUST BE KEPT AT LEAST 18" FROM MANHOLES, DOORS AND REMOVABLE PANELS.
2. LAGGING OF EXPOSED PRESSURE PARTS NOT BY B&W.
3. THE BOILER CASING IS SELF-SUPPORTING AND IS ONLY DESIGNED FOR THE ADDITIONAL EXTERNAL LOAD OF 10,000 LBS AT THE UPTAKE FUNNEL AND 5,000 LBS AT THE AIR INLET. TIE BARS BETWEEN THE BOILER CASING AND ANY OTHER STRUCTURE SHOULD NOT BE ADDED WITHOUT WRITTEN PERMISSION OF THE B&W CO.
4. ESTIMATED WEIGHT OF BOILER:
   DRY _____ 246,100 LBS
   WET _____ 265,800 LBS
5. CUSTOMERS CONNECTION TO BREECHING & AIR INLET OPENINGS TO BE STRENGTH WELDED TO MEMBERS.

REFERENCES

SECTIONAL FRONT VIEW	204131E
SECTIONAL PLAN VIEW	204132E
SECTION THRU FURNACE AND SECTION AT FRONT WALL	204133E
SECTIONAL SIDE VIEW THRU S.H.	204134E
SECTIONAL SIDE VIEW THRU ECON	204135E
ARRGT. OF TERMINAL CONNECTIONS FURNACE SIDE & FRONT VIEWS	204137E
ARRGT OF TERMINAL CONNECTIONS REAR VIEW	204138E
BOILER SEATING	204139E

PLAN VIEW

VIEW E-E

SECTION A-A

SECTION B-B

SECTION C-C

SECTION D-D

SECTION F-F

FRONT VIEW

L.H. BOILER SHOWN
R.H. BOILER OPPOSITE

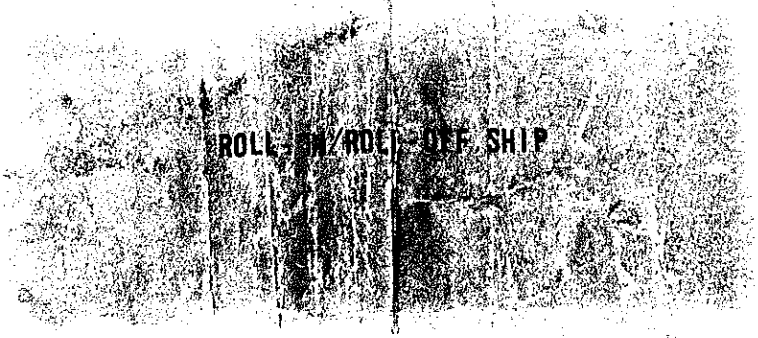
FURNACE SIDE VIEW

REAR VIEW

DWN. BY R.P. GEIS	GENERAL ARRANGEMENT	THIS DRAWING IS THE PROPERTY OF THE BABCOCK & WILCOX CO. POWER GENERATION DIVISION AND IS LOANED UPON CONDITION THAT IT IS NOT TO BE REPRODUCED, COPIED OR LENT IN WHOLE OR IN PART, OR USED FOR FURNISHING INFORMATION TO OTHERS, OR FOR ANY OTHER PURPOSE DETRIMENTAL TO THE INTEREST OF THE BABCOCK & WILCOX CO. AND WILL BE RETURNED UPON REQUEST.	
CHKD. BY D.L. ERBLAND			
PASSED BY [redacted]			
APPVD. BY [redacted]			
STD. SPL. 2-18-73 DATE			
415-4742		DWG. NO. 204136	REV. E 7
415-4741			
415-4736			
DO NOT SCALE - USE DIMENSIONS ONLY.	SCALE 3/8" & 1" = 1' 415-4731	I & M DIV.	FORM BDM 1067 K-2

INSTRUCTIONS FOR THE OPERATION AND MAINTENANCE OF THE MAIN BOILERS INSTALLED IN

NAVSEA 220



SUN SHIPBUILDING AND DRY DOCK CO.

Chester, Pa. 19013

Purchase Order J-44186-B

Hull No. 674

The Babcock & Wilcox Company

Industrial and Marine Division

Contract No. 415-4741

MARCH, 1976

TABLE OF CONTENTS

SECTION 3. OPERATION OF BOILER UNIT - Cont'd.

TABLE OF CONTENTS - Cont'd.

TABLE OF CONTENTS Cont'd.

SECTION 6. INSPECTION AND CLEANING - Cont'd.

SECTION 7. CARE AND MAINTENANCE OF FURNACE LINING

SECTION 8. STORAGE DURING OUT-OF-SERVICE PERIODS

LIST OF ILLUSTRATIONS

SECTION 1
GENERAL DESCRIPTION OF UNIT

There are two, two-drum, front-fired, vertical bank, single-set boiler units installed in this vessel. Each unit consists of the steam generating unit proper plus the equipment necessary for efficient performance. One of these units is illustrated in Figures 1 through 9. Operators should refer to the ship's set of boiler drawings for details of construction. The main features are described below.

Boiler

The boiler proper consists of a 60 inch steam drum with hemispherical heads and a 27 inch water drum with elliptical heads. The drums are connected by a generating bank of 21 rows of 1-1/4 inch O.D. in-line tubes staggered when entering the steam drum and bent at the ends so they enter the drums radially for expanding and belling. The bank is so arranged that the furnace gases make a single pass over it before entering the economizer. There are two rows of 2 inch O.D. tubes between the furnace and the superheater which screen the superheater from the direct radiation of the furnace gases. In addition, there is one row of 2 inch O.D. tubes between the superheater and the 1-1/4 inch O.D. bank tubes for supporting superheater guides. One of the screen rows is also used for supporting the superheater guides.

Superheater

The vertical superheater is made up of a series of 1-1/4 inch O.D. U-bent tubes arranged in three loops, four passes, and connecting two horizontal superheater headers which are supported at the front and the rear of the boiler. Casing access panels are provided in the bottom of the boiler to permit access to superheater headers and also to the steam side of the tubes through the handholes in the headers. The superheater is so arranged that all of the steam produced passes through it. The U-tubes extend for a distance of 8 ft. 9 inches centerline to centerline of tubes inside the boiler and are guided by two rows of 2 inch O.D. guide tubes, each guide tube having spacer castings attached. Superheater tubes and guide castings are replaceable without removing superheater guide screen or other boiler tubes. The superheater tubes in all passes are secured by welding to headers in an approved manner. The path of steam flow through the superheater is indicated in Figure 25. Superheater control and drains for the superheater are also shown on this drawing, and their proper operation is discussed on page 3-5.

There are two (2) horizontal IK 525-A soot blowers located in the superheater cavity for each boiler. These soot blowers enter through the front of the boiler and extend approximately the full length of the superheater.

Steam Drum Internals

The steam drum of the boiler is fitted with the following internal equipment shown in Figures 10, 11, and 12. If these internals are removed during periods of inspection and repair, be certain that they are replaced correctly in accordance with the drawings in the ship's set of boiler plans. Perforations on the internal feed line, dry pipe, surface blow pipe, and chemical feed pipe should be lined up as indicated on these drawings. The normal water level is at the horizontal centerline of the steam drum.

Internal Feed Line

The 5 inch internal feed line is that part of the feed line within the steam drum. It extends approximately 90 percent of the drum length, is located with its horizontal centerline 12 inches below the normal water level, and is connected to the feed supply nozzle. The feed pipe has one row of 1/2 inch diameter holes along the top of the pipe to introduce the feedwater into the drum evenly throughout the length. The internal feed pipe should be installed with the feed holes pointing vertically upward.

Dry Pipe

The 6 inch dry pipe is suspended along the top centerline inside the steam drum. It is perforated along its upper surface with seven rows of 3/8 inch diameter holes, and drain holes are provided in the bottom of the pipe at each end.

Steam enters the dry pipe through the upper perforated area and leaves the pipe through the connection which leads from the top of the drum to the superheater. The dry pipe has the dual function of reducing moisture carryover and providing for an even withdrawal of steam from the water surface.

Surface Blow Pipe

The surface blow pipe is used to remove grease, scum, and light solids from the boiler water through the surface blow line connection. The surface blow pipe is located with its horizontal centerline two inches below the normal water level. It is a 3/4 inch diameter pipe perforated along its top centerline by 4-3/8 inch holes. The surface blow pipe should be installed with the holes pointing vertically upward.

Chemical Feed Pipe

The 3/4 inch chemical feed pipe is used to inject boiler chemicals into the steam drum while the boiler is in operation and also as a sampling pipe

Chemical Feed Pipe - Cont'd.

for testing the boiler water. It extends almost the entire length of the drum, is located with its horizontal centerline six inches below the normal water level, and connects to the chemical feed piping nozzle at the end of the drum. A row of 33-1/8 inch diameter holes is drilled along the horizontal centerline. The chemical feed pipe should be installed with the holes pointing towards the uptake side of the drum.

Swash Plates

Vertical swash plates are located in the lower half of the steam drum at approximately the center point.

The purpose of these plates is to reduce excessive surging of water in the drum from one end of the steam drum to the other when the vessel is undergoing a pitching motion.

Manifold Baffle and Cyclone Steam Separators

DESCRIPTION

The steam drum is fitted with a total of 13 horizontal cyclone steam separators distributed along the length of the steam drum and attached to a manifold or girth baffle to assist in producing dry steam.

The design of the cyclone separators is such that all separators are interchangeable in the various holding slots. A secondary scrubber consisting of corrugated scrubber elements in an enclosure is located at the top of the drum centered about the main steam outlet. Immediately above these elements is a perforated baffle plate sized to allow for uniform steam distribution along the scrubber elements. An additional perforated plate is located between the outlet of the cyclone separators and the scrubber elements.

The manifold baffle extends around the lower half of the inside of the steam drum and runs parallel to the longitudinal steam drum axis. This baffle is sealed at both ends as well as at its top a short distance above the horizontal drum centerline by a continuous weld to make a water-tight joint. It is important that these joints be kept tight in order to maintain dry steam.

Operation

A mixture of steam and circulating water from the boiler tubes enters the space between the drum shell and manifold baffle. From this space, the steam and water mixture enters the separators tangentially. Centrifugal force of the mixture whirling around inside of the cylinder separates the steam and water. The steam then flows horizontally through the center of the cylinder through the perforated sheet, and up through the secondary separator scrubber elements and perforated plates located near the top of the drum. At this point, the small amount of moisture remaining has been removed from the steam and is returned to the saturated water. Dry steam then flows to the main steam outlet. As a result of the swirling action of the water and steam mixture in the cyclinder, the separated water moves downward through the perforated holes in the bottom of the cylinder and flows down through the spout where it is discharged into the water section of the steam drum.

Auxiliary Desuperheater

The auxiliary desuperheater is used to supply desuperheated steam to the auxiliary steam lines. It is located in the steam drum with the horizontal centerlines of tube bundles 11-3/32 inches to 18-1/32 inches beneath the normal water level. The auxiliary desuperheater is of the hairpin loop tube bundle-type, consisting of nineteen (19) 3/4 inch O.D. x .095 inch thick Croloy 1-1/4 tubes averaging approximately 14 ft. 3 inches in length.

For replacement of flange connection gaskets, use the following:

The internal inlet and outlet desuperheater flanges require flexitallic gaskets measuring 7-1/2 inches I.D. x 8 inches O.D. x .125 inch thick style R4-9P-M6-3. The internal flanges on the desuperheater outlet connecting piping require flexitallic gaskets measuring 6-5/16 inches I.D. x 6-13/16 inches O.D. x .125 inch thick style R4-9N-M6-5.

Control Desuperheater

As part of the superheat control system, a control desuperheater is located in the water drum with the horizontal centerline of tube bundles 6-1/2 inches below the horizontal water drum centerline. It consists of a hairpin loop tube bundle-type, consisting of seventeen (17) 3/4 inch O.D. x .095 inch thick Croloy 1-1/4 tubes averaging 14 ft. 6 in. in length. See Section 3, page 3-3 for description and operation characteristics of this control desuperheater.

Control Desuperheater - Cont'd.

For replacement of flange connection gaskets, use the following:

The internal inlet and outlet flanges require flexitallic gaskets measuring 5-5/8 inches I.D. x 6-1/4 inches O.D. x .125 inch thick style R4-M6-1.

Vortex Eliminator

Vortex eliminators consist of a series of grid-like plates arranged in a semi-circular shape to conform to the lower half of the steam drum. One vortex eliminator is located at each end of the steam drum where it is fitted over the neck of the downcomers. Their purpose is to reduce the "swirling" action of the water entering the downcomers. See Figure 12.

Furnace

The boiler furnace is composed of three walls, a roof, and a floor. The front, side, and rear walls are water cooled with bare tube construction. The side wall bends upward toward the steam drum and, thus, forms the furnace roof. The combination screen and floor tubes consist of two rows of two inch O.D. tubes expanded and belled into the side wall header at one end and the steam drum at the other end. The floor portion of these tubes is covered by five inches of refractory. This construction may be seen in Figures 1 through 8 Details of brickwork construction are included among the ship's set of boiler drawings. Also, see page 2-3.

The side wall and roof consists of forty-six (46) two inch O.D. tubes on 2-1/4 inch centers expanded and belled into the side wall header and the steam drum. The side wall header is supplied with water from the steam drum by two 8-5/8 inch O.D. downcomers, one at each end of the header. The downcomers are welded into nozzles on the steam drum and side wall header. The side wall header acts as a reservoir that supplies water to both the side wall tubes and the floor tubes.

The front wall consists of twenty (20) two inch O.D. bare tubes on 4-7/8 inch centers expanded and belled into a 9-1/4 inch O.D. lower header below the floor level and a 9-1/4 inch O.D. upper header at the roof line. Ten, two inch O.D. riser tubes then lead from the upper header to the steam drum. The lower front wall header is supplied with water by a 6-5/8 inch O.D. downcomer that is connected to the steam drum. The downcomer is welded to nozzles on the steam drum and header.

Furnace - Cont'd.

The rear wall consists of forty-four, two inch O.D. bare tubes on 2-1/4 inch centers expanded and belled into a 9-1/4 inch O.D. lower header below the floor level and a 9-1/4 inch O.D. upper header at the roof line. Twenty-two, two-inch O.D. riser tubes then lead from the upper header to the steam drum. The lower rear wall header is supplied with water by a 6-5/8 inch O.D. downcomer that is connected to the steam drum. The downcomer is welded to nozzles on the steam drum and header.

The above arrangements give complete side wall, front wall, rear wall, and floor tube circulation independent of the main circulation circuit in the boiler generating tubes. Refer to "Tube Data" on page 2-4 and the ship's set of drawings for tube details.

Casing

The boiler is air encased at the front, rear, sides and roof. The brickpan is also air encased. Heated air is admitted to the chamber across the roof of the setting. The heated air passes forward and down the double front where it is supplied to the oil burners.

Removable casing panels are located at convenient points to permit access for inspection and cleaning.

Oil Burner

Three Saratoga-type burners consisting of radial door air registers, twelve inch impellers, and equipped with B&W Racer steam atomizers and automatic shut-off valves, are installed in the boiler double front. One burner is hinged for furnace access. These burners are illustrated in Figures 19 through 21. Their construction and operation are described in Section 4.

Economizer

The primary economizer is of the B&W stud tube, extended surface, continuous loop, flared-type arranged in the uptake after the last row of boiler generating tubes, as shown in Figure 1. It is sixteen rows wide and eight rows high and consists of 1-1/2 inch O.D. studded tubes. The inlet and outlet headers are seamless forged steel each fitted with one handhole in the end of the header for inspection. The tubes are seal welded externally to the headers.

The top inlet header is fitted with a welded end inlet connection and flanged vent connection. An orifice 7/16 inch in diameter has been drilled in the inlet header where each tube enters. The purpose of the orifice is to insure proper flow distribution.

Economizer - Cont'd.

The bottom outlet header is fitted with a welded end outlet connection and a flanged drain connection. Suitable access doors are provided at the front and rear of the economizer casing. Details may be seen in Figures 17 and 18. Operation of the economizer is discussed in Section 5.

The secondary economizer, similar to the primary in construction but of a different size, is shown in Figures 28 and 29.

Boiler Auxiliary Equipment

SAFETY VALVES - CROSBY

The steam drum safety valves consist of two, 2 inch Figure 2H3-HN-MS-55 spring-loaded valves and one, 1-1/2 inch Figure 1-1/2 F 2-1/2-HNP-MS-55 spring-loaded pilot valve located on the top centerline on the steam drum as shown in Figure 7.

The superheater pilot actuated safety valve (not shown) is a 2 inch Figure 2H3-HNB-MS-58 valve located in the superheater outlet piping. Details on the operation and maintenance of these valves can be found in Tab Index 1.

WATER GAGE - JERGUSON

There are two direct reading water gages located on the front end of the steam drum. These gages are flange connected, 3/4 inch Figure 1816B with an 18 inch clear vision. Details on the operation and maintenance of this equipment may be found in Tab Index 2.

SOOT BLOWERS - DIAMOND

Model G9B steam soot blowers with all necessary piping, valves, and fittings are provided. They are all of the air motor driven-type and in sufficient number to adequately sweep all sections of the boiler and economizer where soot may collect. Material for the elements are suitable for the maximum temperature to which they will be exposed. Two retractable long lance-type soot blowers Model IK-525-A, are installed in the superheater cavity of each boiler. Soot blower locations may be found in Figure 1. Sequence of operation and detailed instructions can be found in Tab Index 3. See Figure 28 for Model G9B blowers in the secondary economizer.

Miscellaneous Valves and Fittings

Each boiler is fitted with valves and fittings, some of which may be seen in Figure 9. Operators should become familiar with the position and function of all valves and fittings connected with boiler operation.

Miscellaneous Valves and Fittings - Cont'd.

Bulletins on the following equipment may be found in Tab Index 4:

Yarway Steam Strainer
Wager Smoke Indicators
Rockwell-Edward Valves
T. C. Wilson Tube Expanders

SECTION 2

SPECIFICATION AND BOILER DATA

(PER BOILER)

Specifications S S. KAIMOKU

The boilers were built in accordance with rules and regulations of the U.S. Coast Guard and American Bureau of Shipping. Inspection was by U.S.C.G. and A.B.S.

Design Pressure

Boiler	1070 psi
Superheater	1100 psi
Economizers	1200 psi
Auxiliary Desuperheater	1100 psi
Control Desuperheater	1100 psi
Air Casing	30 in. H_2O

Test Pressures

Boiler - Hydrostatic Test Pressure	1650 psi
Superheater - Hydrostatic Test Pressure	1650 psi
Economizers - Hydrostatic Test Pressure	1815 psi
Desuperheater (Control and Auxiliary) - Hydrostatic Test Pressures	1650 psi
Casing Static Air Pressure	30 in. H_2O

Physical Data

Boiler Heating Surface Including Waterwalls	7900 sq. ft.
Waterwall Heating Surface	1060 sq. ft.
Superheater Heating Surface	1635 sq. ft.
Primary Economizer Heating Surface	2155 sq. ft.
Secondary Economizer Heating Surface	5500 sq. ft.
Furnace Volume	1120 cu. ft.

Safety Valve Settings

2 inch Steam Drum Safety Valves	1050 & 1070 psig
1-1/2 inch Steam Drum Pilot Safety Valve	1030 psig
2 inch Superheater Pilot Actuated Safety Valve	1050 psig

Rate of Operation	Normal	ABS Maximum	110% Overload
Total Steam Lbs/hr/blr	96,200	108,250	119,250
Superheated Steam Lbs/hr/blr	95,100	107,150	117,250
Desuperheated Steam Lbs/hr/blr	1,100	1,100	2,000
Boiler Drum Press Psig	945	962	980
Superheater Outlet Pressure Psig	880	880	880
Superheater Outlet Temp. Degrees F.	910	910	910
Primary Econ. Inlet Temp. H_2O Deg. F.	337	341	345
Secondary Econ. Inlet Temp. H_2O Deg. F.	285	285	285
Oil Flow Lbs/burner/hr	2,257	2,537	2,803

As an approximation, an increase in superheat temperature of about 4 degrees F. can be anticipated for a decrease in feedwater temperature of 10 degrees F. The reverse is also true. Under conditions of varying feedwater temperature, the operator must exercise extreme care to avoid exceeding the maximum firing rate or the maximum steam temperature in order to prevent overheating.

Nominal changes in combustion air temperature will not have any noticeable effect on steam temperature.

Location of Opening	Fitting Size	Binder Size	Gasket Size and Type	Fitting Washer	Quantity Per Boiler
Steam Drum	12" x 16"		Flexitallic		2
Water Drum	12" x 16"		Flexitallic		1
Lower Rear Wall Hdr.	J-40	Mk.W-343	Flexitallic	2-1/4" OD	11
Upper Rear Wall Hdr.	J-40	Mk.W-343	Flexitallic	2-1/4" OD	11
Lower Front Wall Hdr.	J-40	Mk.W-343	Flexitallic	2-1/4" OD	10
Upper Front Wall Hdr.	J-40	Mk.W-343	Flexitallic	2-1/4" OD	10

Boiler Closure Data - Cont'd.

Location of Opening	Fitting Size	Binder Size	Gasket Size and Type	Fitting Washer	Quantity Per Boiler
Side Wall Header	J-40	Mk.W-343	Flexitallic	2-1/4" OD	16
Superheater Hdr. Inlet-Outlet	J-40	Mk.W-343	Flexitallic	2-1/4" OD	20
Superheater Hdr. Intermediate	J-40	Mk.W-343	Flexitallic	2-1/4" OD	20
Primary and Secondary Econ. Headers	41A	Mk.42A	Klingerit	1-1/2" OD	4

Furnace Refractory and Insulation

Area	Thickness	Material
Front Wall	4-1/2"	Firebrick
	1-1/4"	Insulating Firebrick
	1-1/2"	Medium Temp. Insulating Block
	5-16"	Asbestos Cement
Side Wall	2-1/2"	Firebrick
	2-1/2"	Insulating Firebrick
	2"	Medium Temp. Insulating Block
	3/8"	Asbestos Cement
Roof	2-1/2"	Firebrick
	2-1/2"	Insulating Firebrick
	3"	Crushed Dense Firebrick
	3"	Medium Temp. Insulating Block
	1/4"	Asbestos Cement
Rear Wall	2-1/2"	Firebrick
	2-1/2"	Insulating Firebrick
	2"	Medium Temp. Insulating Block
	1/4"	Asbestos Cement
Floor	2-1/2"	Firebrick
	2-1/2"	Firebrick
	6-5/8"	Crushed Dense Firebrick

Tube Data
Refer to Figs. 1 and 28

Mark	Amount	O.D.	Thickness	Description
T-1	1174	1-1/4"	.095"	Generating Tubes
T-2	8	2"	.134"	Curtain Wall Tubes
T-3	59	2"	.134"	Screen and Floor Tubes
T-4	30	2"	.134"	Superheater Guide Tubes
T-5	46	2"	.134"	Roof and Sidewall Tubes
T-6	44	2"	.134"	Rearwall Tubes
T-7	20	2"	.134"	Frontwall Tubes
T-8	22	2"	.134"	Rearwall Riser Tubes
T-9	10	2"	.134"	Frontwall Riser Tubes
T-10	2	6-5/8"	Sch.120	Front and Rear Downcomer Tubes
T-11	2	8-5/8"	Sch.100	Sidewall Downcomer Tubes
T-13	177	1-1/4"	.134"	Superheater Tubes 1st through 4th passes Croloy 1-1/4
T-14	16	1-1/2"	.165"	Primary Economizer Tube Sections, 8 rows high
T-15	12	1-1/2"	.165"	Secondary Economizer Tube Sections 20 rows high

SECTION 3
OPERATION OF BOILER UNIT
GENERAL PREPARATION FOR SERVICE

Drying Out the Setting

In order to prevent spalling or cracking of the furnace brickwork and poured castable baffles and corbels, it is important that they are not subjected to sudden temperature shock when the boiler is initially lighted off.

Since after installation the refractory will retain a certain amount of moisture, this must be driven off slowly by firing at a reduced rate not in excess of 550 lbs. of oil per boiler per hour for approximately three to five hours. This should be done with only one burner in use, preferably light-off burner No. 1. If steam vapor begins to issue from the steam drum vent, the burner should be secured and the boiler kept idle for about one hour. Then, resume firing in the same manner, and after three to five hours of drying out the refractory in this manner, the boiler can be prepared for normal light-off and raising steam pressure.

Under no circumstances should panels which are lined with refractory at the shipyard be hermetically sealed off with a cover plate. The refractory and insulation in the panels should be thoroughly dried out in a kiln or heating furnace at a temperature of 200-250 degrees F. The cover plate shall have vent holes. Any moisture sealed off within the panel by a hermetically tight cover plate cannot vent off, and sufficient pressure can be built upon the panel to cause it to rupture.

Cleaning of Boilers - Boiling Out Prior to Going Into Service

The shipbuilder will have to determine the boiling-out procedure to follow.

The following is a description of a boiling-out procedure that Babcock and Wilcox has knowledge of having been followed on installations where the boiler is being operated during the boiling out process.

Before being placed in preliminary operation, the unit should be boiled out using chemicals in the following concentrations, in terms of the quantity of water in the unit at normal working level.

1.	Trisodium Phosphate (Na_3PO_4) 12 H_2O	1 oz./1.5 gal. H_2O
2.	Caustic Soda (NaOH)	1 oz./15.9 gal. H_2O
3.	Wetting Agent	2 gal/1,000 gal. H_2O

Cleaning of Boilers - Cont'd.

Unit	Approximate Capacity Gallons Per Boiler
Boiler filled to normal water level	3,132
Boiler filled to top of drum including economizer	4,344
Superheater (not including connecting pipe)	264
Primary economizer (isolated)	87
Secondary economizer (isolated)	195

The unit should be filled to the normal working level with water of a quality equal to or approaching that of the feedwater to be used in subsequent regular service. The difference between the temperature of the filling water and the drum metal shall not be more than 50 degrees F.

The chemicals to be used for the boiling-out process should be completely dissolved in hot water before being pumped into the unit. It is desirable to pump the dissolved chemicals into the boiler through the regular chemical feed connection or through the boiler drum vent, provided chemicals pumped via the vent do not have to pass through a dry-pipe or scrubber. The water drum side and rear blowdown connections may also be piped up to facilitate pumping, dumping, and flushing out of the unit. Provisions should also be made in the boiling-out piping arrangement so that part of the chemical solution can be introduced into the economizer through the connection provided on the economizer outlet header. This will bring the concentration of the water in the economizer up to that recommended for the water in the boiler proper.

The rate of firing of the boiler during the boiling-out process should be such that approximately four hours is taken to raise the temperature of the water to 212 degrees F. to allow for drying out of refractories. In no case should oil firing exceed a rate of 550 lbs. oil/blr/hr.

The recommended steam pressure for boiling out is 50 percent of the normal working pressure. Once vapor has formed, this pressure should be reached slowly and at a minimum and consistent rate of firing. A definite duration for the boiling-out period cannot be set to cover all units. However, experience indicates that a period of 36 to 48 hours at the recommended chemical concentration and boiler pressure is sufficient. After completion of the boiling-out period, the unit should be allowed to cool slowly while draining and flushing out in preparation for placing the boiler into initial operation.

Upon completion of boiling out, all boiler handhole fitting gaskets should be renewed. An inspection of the water sides should be made to insure that a satisfactory boiling out has been obtained. If not, it should be repeated until all internal preservative has been removed and the boiler water sides pass inspection for satisfactory cleanliness.

Control Desuperheater

Since this boiler is equipped with a control desuperheater which is of the integral-type shown in Figure 25 for controlling steam temperature, sufficient supply and circulation will be provided through it from the superheater to remove any preservative provided the control valve P is manually placed in the open position to provide the necessary circulation.

Hydrostatic Test

Operators are referred to U.S. Coast Guard marine engineering regulations and material specifications for regulations concerning tests and inspections.

Hydrostatic tests are applied to the boiler unit under various conditions.

The initial hydrostatic test pressure on this boiler unit should never exceed 1,605 psi which is 1-1/2 times the design pressure.

Quadrennially hydrostatic testing is required at a pressure not to exceed 1,338 psi which is 1-1/4 times the design pressure.

Hydrostatic testing after major repair should be as required by U.S. Coast Guard.

Annual testing, if made, seldom exceeds working pressure to preclude disturbing safety valve settings.

The following items explain the essentials of the hydrostatic test procedure as applied to these boilers.

1. The standard gage or inspector's gage should be attached as required by the inspector.

2. Secure the stop valves to all boiler equipment not required to be subjected to the test, and open the drains or equalizing valves from this equipment, water gages, etc.

3. Be sure that all gasketed joints are properly made up with the gasket faces smooth and clean. Do not use graphite or compound on flexitallic gaskets. When installing handhole fittings, apply a high temperature anti-seize lubricant, such as "Molycote G," to the thread of the handhole fitting studs. Tighten the nuts on handhole plates hand tight plus about one-half to a full turn with the standard wrench. Follow up any joints which show leakage as they develop under the hydrostatic test.

4. Open the drum vent A. The superheater header drains S, T, U, and V and the superheater steam circulating valve E should be closed. Valve P in the control desuperheater outlet piping should be open. See Figure 25.

Hydrostatic Test - Cont'd.

5. Close main and auxiliary steam stop valves and arrange to prevent hydrostatic pressure on one side and steam pressure on the opposite side of the valves.

6. Gag the safety valves. Take up on the gags so they are snug but do not over-tighten, as to do so can result in bending or distorting the valve stem.

7. Slowly fill the boiler through the auxiliary feed line with water at a temperature not below fireroom temperature and not over 180 degrees F. If raw water is used, the boiler will have to be dumped and refilled with distilled and deaerated water. Close the drum vent when it starts to spill over. When the superheater, auxiliary desuperheater, and control desuperheater are filled and pressure starts to build up, crack open drain valves S, T, U, and V momentarily to expel any entrapped air, and then close them. See Figure 25.

8. As the pressure builds up, operate the pump very slowly so that the pressure is at all times under control. During this period, make a careful inspection of all expanded and gasketed joints. Leaky handhole plates can usually be made tight by taking up with the regular wrenches. Do not use extensions on the wrench handles. To do so will ruin the gaskets.

9. Hold the pressure at the test valve as required and when the inspection is completed, stop the pump completely and relieve the pressure slowly by opening a drain valve. Vent the boiler through the drum vent and drain the superheater completely through the superheater drains S, T, U, and V. See Figure 25.

10. When the test is completed, remove the blanks and gags and put back into service the equipment which was shut off from the static pressure.

11. The auxiliary and control desuperheater should be tested separately by isolating and testing them to a hydrostatic pressure of 1,650 psi. See page 2-1 for test pressure under "Specification and Boiler Data."

Casing Air Test

After the hydrostatic test has been completed and all access panels have been replaced, the outer casing shall be tested for tightness with uptakes blanked off and burners open to the highest rate casing inlet pressure. This test shall be witnessed by the B&W Construction Consultant who will inspect outer casing joints for leakage.

PREPARATIONS FOR LIGHTING OFF

General

1. The combustion chamber and gas passages should be clean and in good repair. Remove the stack cover, if fitted.

Preparations for Lighting Off - Cont'd.

2. Auxiliary equipment, including the forced draft fan, fuel oil pump, fuel oil heater, steam gage, and water gages, should be checked to assure that they are in proper operating condition.

3. Make a systematic check to see that all valves are correctly set. Valves for the following should be CLOSED: Main and auxiliary stop valves; water gage drains; side, front, and rear water wall drains; bottom blow; chemical feed, surface blow, economizer vent and drain, and control desuperheater outlet valve.

Valves for the following should be OPEN: Steam gage; water gages; drum vent; economizer inlet and outlet stop valves; superheater header drains, superheater circulating connection, auxiliary desuperheater inlet stop and feedwater regulator. Ease up the main and auxiliary stop valve stems without lifting the valve discs off the seats so as to prevent sticking when the valves heat up. Examine the hand gear of the safety valves and operate it so far as can be done without lifting the valves.

4. Prepare the air preheater for operation.

Filling the Boiler

In filling the boiler before firing, it is advisable to use the auxiliary feed line to be certain that its valves and connections are in working order. The water should be distilled and deaerated and not more than 50 degrees F. above or below the temperature of the drum metal at the time of filling.

Normal water level is at the midpoint of the drum. At this point, 2-1/2 inches (approximately three nuts) are visible in the upper gage. Operators should note that the gage glasses are offset from this position and should accustom themselves to reading both water gages as a unit. Water should be introduced until a height of 4-1/2 inches (four nuts) is visible in the lower gage glass. This will allow for "swell" (or rise in level) as the boiler reaches line pressure and temperature conditions.

Superheater Circulating Line, Drains, and Control Desuperheater Piping

LIGHTING OFF AND RAISING PRESSURE - SUPERHEATER COMPLETELY DRAINED

A system of superheater drains and superheater circulating steam is provided, as shown in Figure 25.

Important! These boilers are equipped with superheaters in which the superheater tubes rise vertically from two separate horizontal superheater headers. Therefore, drainage is not common to both headers from any single drain. It is absolutely essential that both superheater headers be independently and completely drained of all condensate prior to lighting off and raising pressure or when returning a boiler to service when it has been at stand-by under pressure. The following is a description of the superheater drain and circulating system. The procedure for their use must be strictly adhered to in order to assure positive superheater protection.

Superheater Circulating Line - Cont'd.

1. When on manual operation during start-up and when bringing the boiler up to pressure and prior to cutting in the boiler to supply either auxiliary or main steam, the control desuperheater automatic control valve P should be in the closed position. This is to insure that all protective steam generated will travel through all passes of the superheater. When the boiler is on the line and is up to pressure and temperature and actually supplying steam to the plant, the valve should then be cut in for automatic steam temperature control.

2. The superheater header drains S, T, U, and V at the front and rear are provided for drainage of the superheater and to keep the headers clear of condensate. Prior to lighting off, open the steam drum vent A and open wide drains S, T, U, and V, and make certain both superheater headers are completely drained. Then, close in on drains S, T, U, and V, and leave them cracked slightly open to keep the headers clear of condensate which will form while raising pressure. Do not leave them wide open, as to do so will cause short circuiting of the protective superheater circulating steam with possible overheating and damage to the superheater.

3. Open the superheater steam circulating valve E. This connection discharges to the atmospheric escape pipe and must always be used when lighting off and raising pressure.

4. After the boiler is lighted off and steam issues from the drum vent, close valve A.

5. The flow of protective circulating steam through the superheater must must be maintained by keeping valve E to the atmospheric escape pipe open until the boiler is up to full pressure and on the line supplying steam, or until such a time as when prior to full boiler pressure being reached, the auxiliary steam desuperheater is cut into the auxiliary steam system and is supplying sufficient desuperheated steam to the plant, that protective steam flow through the superheater is maintained by these means. With the foregoing conditions established, valve E can then be closed, and drain valves S, T, U, and V may also be closed.

If for any reason the boiler is taken off the line and intermittently fired to keep the boiler at stand-by under pressure, the superheater headers must be blown clear of all condensate by use of valves S, T, U, and V, and the steam circulating valve E must be opened before again lighting off.

Table - Time-Pressure Relationship

Bringing a boiler on the line from cold iron or following a severe loss in pressure requires prudent operation to prevent overheating of superheater tubes as well as excessive thermal stresses, particularly in the steam drum. Boiler firing rate must be limited to 550 lb/hr when raising pressure until the boiler is up to pressure and on the line supplying steam to the plant or until this condition has been reached prior to full boiler pressure by cutting in the auxiliary steam system and operating sufficient steam operated auxiliaries to provide positive steam flow through the superheater.

The following time-pressure relationship should be used as a guide for safe operation when raising pressure from a cold iron condition to line pressure or from some intermediate pressure to line pressure.

Elapsed Time (Minutes)		Drum Pressure (PSIG)
Zero		Zero
60		Zero - Vapor at drum vent
80	not more than	15
100	not more than	35
120	not more than	65
140	not more than	105
160	not more than	175
180	not more than	265
200	not more than	395
220	not more than	565
240	not more than	765
250	not more than	880 - Line pressure

If the boiler is cut in prior to reaching line pressure, the firing rate may be increased or the other burner may be lighted-off and the firing rate increased to meet steam demand and to continue raising pressure. However, any increase in firing rate may be consistent with maintaining the proper time-pressure relationship.

LIGHTING OFF AND BRINGING BOILER UP TO LOAD - STEAM AND AUXILIARY POWER AVAILABLE

Lighting Off

Read carefully Section 4 of this manual to become familiar with the makeup and operation of the oil burners. Make up one of the atomizer assemblies with sprayer plate size 6Y-41-52-50-80SH and insert it into the register on the No. 1 light-off oil burner.

Raising Pressure

After lighting off as described in the above reference, continue firing steadily using the No. 1 light-off burner. Do not alternate burners while raising pressure. After about one hour when steam issues from the drum vent, adjust the burners and the oil pressure to bring the unit to line pressure as indicated below. When the steam pressure on the drum has reached 15 psi, close the vent on the top of the drum.

Important! It is absolutely essential to the protection of the superheater when lighting off and raising pressure that the table of "Maximum Permissible Fuel Oil Pressures," as shown on page 4-11, Section 4, be strictly adhered to. Also, refer to Time-Pressure Relationship table on page 3-7.

When lighting off with the boiler at zero pressure and the temperature of water in the boiler at approximately 100 degrees F., the firing should be controlled so as to obtain a vapor from the drum vent after approximately one hour. Approximately one and one-half to two hours should be taken to raise steam from zero pressure to normal operating pressure.

It is important that this length of time be taken to prevent undue temperature changes which may cause unnecessary strains in parts of the installation and shorten the life of the furnace brickwork. The procedure outlined above will give adequate protection to the superheater tubes, provided the superheater circulation connection and drains are operating as directed.

Checking Steam Gage

As soon as steam is observed blowing from the steam drum vent, the steam gage assembly should be checked for possible stoppage. To do this, make sure the valves in the line between the steam drum and the steam gage are open. As soon as the steam drum vent valve has been closed, check the steam gage to see that it is registering pressure correctly. If not, do not continue firing until this condition is corrected by checking with a test gage and replacing boiler pressure gage, if necessary.

Checking Water Level

During the period of raising pressure, the gage glasses should again be checked for proper operation. Slowly open the valve in the drain line and drain the glass of water; then, shut the valve and watch the action of the water level. If the action appears sluggish or uncertain, do not continue firing the boiler until assured that the glasses are indicating properly.

As the pressure builds up, the water level will rise due to the expansion of the heated water. Extreme care must be taken that the level is not abnormally high when the boiler is cut in, as there will be danger of water being carried over into the superheater, possibly causing damage either to the superheater, steam line joints, or steam-driven equipment. As a precautionary measure, the water level should never be allowed to rise to the extreme top of the visible range of the glass during the starting up period, and if necessary, the boiler should be blown down to normal water level shortly before line pressure is reached. See page 3-13 for precautions when blowing down.

Checking Uptake Temperature

Frequently check the uptake temperature while bringing the boiler to line pressure. Any sudden increase in temperature may indicate that a fire has developed in the uptake passage of the boiler.

Gasketed Joints

When raising steam for the first time on a new unit or after a unit has been opened for cleaning or overhaul, and after the unit has been brought up to working pressure and temperature, it is important to follow up securely on all handhole plate joints. Refer to page 6-8 for procedure on installing gaskets.

Temperature Differentials

In order to reduce thermal strains in the piping materials, the following restrictions on temperature differentials are recommended:

1. When connecting a boiler to a steam line which is "cold," the steam line should be thoroughly warmed before cutting in, so that its temperature is within at least 100 degrees F. of the boiler outlet steam temperature.

2. When connecting a boiler to a steam line which is already in use, the boiler outlet steam temperature of the boiler being cut in should be within 100 degrees F. of line temperature.

Placing Boiler on Line

When the boiler pressure rises to within approximately 15 psi of line pressure, open all drains on the main steam lines from the boiler. If a by-pass line is provided around the superheater outlet main stop valve, this should be opened to allow the pressure to equalize and warm up the line.

As the boiler reaches line pressure and is ready to cut in on the main steam line, momentarily blow the superheater drains Q, R, S, and T wide open to the bilge and cut the boiler into the auxiliary steam line. After the boiler is cut in on the auxiliary line, the superheater outlet main stop valve may be slowly opened to the full open position.

After the boiler is on the line and delivering steam, all drains, vents, and the superheater circulating line should be closed following the procedures outlined under "Preparation for Lighting Off," Section 3, page 3-4. The main feed check and feed stop valves should be opened wide, and the feedwater control placed in operation.

LIGHTING OFF AND BRINGING BOILER UP TO LOAD DEAD SHIP CONDITIONS

General

When lighting off and bringing a boiler up to pressure and temperature under dead ship, cold furnace conditions, precautions must be taken to insure satisfactory combustion to preclude any possibility of unburned fuel oil deposits accumulating in the furnace or on the boiler generating surfaces.

Certain blended fuel oils may contain a high percentage of asphaltic-type residues and cause burning difficulties under cold furnace conditions, such as may exist when lighting off under dead ship conditions or when the boiler has been out of service.

When such heavy residual fuels are in use aboard ship, the atomizing temperature of the fuel, as indicated by a viscosity test, is not necessarily a true indication of the burner properties of such a fuel in a cold furnace. The lighter end of the fuel oil blend may burn off leaving the heavy residual of the fuel to deposit out in an unburned state. Therefore, under such conditions, no attempt should be made to light off using this type of fuel under either straight mechanical or steam atomizing burners, even though a source of atomizing steam may be available.

Under the above conditions, the boiler should be lighted off using Diesel oil, and fired with Diesel oil only, until it is on the line supplying steam, and furnace temperatures are sufficiently high to allow changing over to the ship's bunker oil.

Preparation of Boiler - Dead Ship Conditions

1. Prepare the boiler according to the instructions under "Preparation for Lighting Off," page 4-5.

2. Supply air to the boilers as follows:

   a. If auxiliary (Diesel, electric, or shore connection) power is available, use the motor driven blower operated at its lowest practicable capacity.

   b. If power is not available for the blower, means should be provided for supplying natural draft to the boiler windbox by removing an outer casing access panel or opening wide all registers and register inspection and light-off doors. Open fireroom accesses or ventilating ducts to provide as much natural draft as possible.

   c. Purge the furnace for at least five minutes if the blower is used and for at least fifteen minutes if natural draft is used.

3. Supply oil to the burner as follows:

   a. Diesel oil or "distillate" oil will usually insure atomization at temperatures above approximately 35 degrees F.

   b. Make sure all oil burner valves to each individual burner are closed.

   c. If auxiliary electric power is available, use the motor driven fuel oil service pump.

   d. Circulate the oil through the oil lines and oil header until all air and dead oil have been expelled. Shut the oil recirculating valve and provide a fuel pressure to the supply header in accordance with the table on page 4-11, "Maximum Permissible Fuel Oil Pressures," for the type of atomization being used.

4. Using a clean and properly assembled atomizer, light off the No. 1 burner using a well-lighted torch, positioning the torch flame so it will fan in over the atomizer tip.

5. If ignition is not obtained within a few seconds, secure the burner and allow the furnace to purge. Then, light off again and when ignition is established, readjust the oil pressure.

6. If lighting off on natural draft, it will be necessary to closely watch the flame and adjust the oil pressure in proportion to the available natural draft. As soon as power is available to operate the forced draft blower, the changeover to forced draft operation should be made, and the means provided for natural draft operation should be secured.

Preparation of Boiler - Cont'd.

7. Where this type of dead ship light-off is used, due to heavy residual fuel being customarily used aboard the vessel, continue firing with Diesel oil until sufficient furnace temperature has been reached to support combustion of the residual fuel, and sufficient steam pressure has been reached to heat this fuel to the proper temperature.

Diesel Oil Operation Using Steam Or Compressed Air for Atomization

1. The boiler may be lighted off under dead ship conditions using Diesel oil and shore steam for atomization, provided the shore steam is of reasonably dry quality, and a pressure of 135 psi can be maintained at the atomizer.

2. If shore steam of the necessary pressure and quality is not available, the boiler can be lighted off using Diesel oil and compressed air for atomization.

A compressed air connection can be provided in the atomizing steam header. Supply compressed air at 90-100 psi at the burner coupling. The air should be clean and free of condensate and the pressure steady. Light off with Diesel oil, handling the compressed air and fuel supply valves in the same manner as for steam atomizing operation when obtaining ignition. NOTE: When firing Diesel oil and using compressed air for atomization, the sprayer plate capacity will be greater. Therefore, with the steam atomizing sprayer plate in use, do not exceed the recommended Diesel oil flow as shown in the table on page 4-11, "Maximum Permissible Fuel Oil Pressures," until positive steam flow has been established through the superheater. To do so can result in exceeding the maximum allowable firing rate for raising pressure on a cold boiler. Once sufficient boiler pressure is reached to cut in the atomizing steam supply, this burner can continue to be fired using Diesel oil and steam atomization until such a time as the changeover to Bunker C fuel.

Diesel Oil Operation Using Straight Mechanical Sprayer Plate

In the event steam or compressed air is not available for atomization, the size 4212 FYH-4 straight mechanical sprayer plate is used for lighting off and raising pressure using Diesel oil. When on straight mechanical atomization, it is necessary to use an adapter with the sprayer plate. This is done by screwing the adapter plate on to the internal tube. The sprayer plate is placed against the end of the adapter plate, and the end cap is then placed over the sprayer plate and screwed on to the outer barrel.

Refer to the table, "Permissible Fuel Oil Pressures When Lighting Off," on page 4-11 for allowable fuel oil pressures when firing Diesel oil.

REGULAR OPERATION

General

The attainment of optimum boiler efficiency depends to a large degree on correct operation and good maintenance of the entire boiler, particularly with regard to the internal and external cleanliness of the boiler, as well as the oil burning equipment, boiler fittings, boiler auxiliaries, gages, and controls.

Water Treatment

Present day marine practice recognizes the necessity of intelligent boiler water conditioning in maintaining internal cleanliness of the boiler unit. As a result, very little trouble is experienced today from the results of scale deposition and internal corrosion.

The problem of maintaining internal cleanliness of the boiler unit is different for each installation. Reliable concerns specialize in this branch of work and from chemical analysis of boiler waters and boiler feedwater, can determine suitable treatment and furnish necessary instructions, testing kit, and controls so that a proper boiler water condition may be maintained.

Blowing Down

Amount and frequency of blowing down in present day marine practice is determined from chemical analysis of boiler water samples taken from the side water wall salinometer connection.

Sludge should not be allowed to accumulate in the water wall headers or in the water drum. Sludge should be removed from the water drum by use of bottom blow valve and from the water wall headers by the water wall drain valves. The water drum bottom blow valve may be used with the boiler in service and on the line provided the firing rate at the time does not exceed 50 percent of the designed normal full power firing rate. Blowdown shall consist of dropping the water level to three inches below the normal working level. However, all fires must be secured when blowing down the front, side, and rear water walls. The surface blow may be used at any time, but the amount of surface blowdown should not exceed that which will drop the water level below that of the surface blow pipe which is located two inches below the normal water level which is on the horizontal centerline of the steam drum.

Soot Blowing

Systematic external cleaning should be maintained as a regular feature in the operation of the boiler unit. Refer to the soot blower instructions located under Index Tab 3 for details of construction and operation.

The soot blower system incorporates automatic sequence controls which operate soot blower units in sequence of the direction of gas flow.

Soot Blowing - Cont'd.

While in regular service the external heating surfaces should be periodically examined. If slag or soot deposits tend to accumulate on any particular portion of the heating surface, it will be necessary as an adjunct to the use of the soot blowers to periodically hand lance such portions or to use the recommended method of water washing. See pages 6-4 through 6-7.

Gage Glasses

Gage glasses should be periodically checked to determine that they are indicating the true water level. This can be accomplished by bobbing the water in the glass by quickly opening and shutting the valve in the gage glass blowdown line. Prolonged and too frequent blowdown of the gage glass can result in increased maintenance of gage glass parts. For detailed instruction, refer to Tab Index 2.

Safety Valves

The superheater safety valve is set and should be kept so set, that under any load condition it will open before the safety valves on the boiler drum. Refer to Tab Index 1 for Safety Valve Care and Operation.

Prevention of Steam in Economizer

It is important to prevent the economizer from steaming since this may cause water hammer with subsequent leakage at handhole fittings. Therefore, the feed flow through the economizer should never be completely stopped so long as the boiler is being fired. Even when high water exists, some flow through the economizer should be maintained while the water level is being lowered.

Operation of the Superheater Control System

The purpose of the superheat control system is to maintain a constant steam temperature at the superheater outlet of 910 degrees F. when operating at 80 percent and above of the boiler full power firing rate. When due to an increase in firing rate above 80 percent of full power, the steam temperature rises above 910 degrees F., the automatically controlled valve P opens, and a proportionate amount of steam is taken away from the 2nd pass outlet of the superheater and flow through the control desuperheater M and N and through the automatic temperature control valve M to the 4th pass inlet of the superheater where it mixes with the major portion of steam that has passed through the 3rd pass of the superheater. The system should be operated as follows:

1. For operation when the superheater outlet steam temperature is at or below 910 deg. F., the control valve P will remain closed.

2. The control valve P automatically opens to prevent the superheater outlet temperature from exceeding 910 degrees F.

Operation of Superheater Control System - Cont'd.

3. The control valve P should have a 3/16 inch vent hole through the disc to provide a continuous flow when the valve is closed or other means provided, such as limiting control valve travel toward the closed position, to insure a continuous steam flow sufficient to prevent condensate building up in the control desuperheater.

EMERGENCY OPERATION

Low Water

In case of low water, an automatic low water cut-off system will sound an alarm and shut off the oil burners. In case of automatic low water control failure, the primary object will be to extinguish the oil burners manually as quickly as possible.

Should the water in the glass drop from sight, any decision to keep the boiler in operation, even for a brief period, should be made by the person responsible for the boiler. He should be fully aware of the conditions at the time and should make certain that no additional water is supplied to the boiler until he is satisfied that the steam drum or tubes have not been damaged. and the automatic low water cut-off system is again in operation.

This boiler is equipped with automatic low water cut-off system that will sound an alarm and then automatically cut out the burners. If the automatic low water cut-off system does not correct the low water emergency, then the above manual operation should be put in effect.

Loss of Pressure

If a severe loss of pressure on the unit occurs, steps should be immediately taken to change the mode of operation from automatic to remote manual with the unit either completely shut down or operated at a low rate while the cause of pressure loss is determined and corrective measures taken. The unit should then either be lighted off following prescribed procedure on page 4-6 or carefully operated remote manual to initiate positive pressure recovery at which time it can be restored to automatic operation.

Loss of Fire

If for any reason the fires go out, the oil burner shut-off valves should be closed immediately and the cause determined. The furnace should be thoroughly purged according to the instructions under "Preparations for Lighting Off," page 3-4. A torch should be used to relight the burners; do not attempt to light off from hot brickwork. The light-off procedure should follow steps 1-14, as specified on page 4-6 supplemented by use of the torch.

Loss of Forced Draft

In the event of failure of the forced draft for any reason, the oil burner shut-off valves should be closed immediately and the cause determined. The furnace should be thoroughly purged with fresh air upon restoration of the air supply before lighting off again. If the loss of forced draft has caused smoky operation for any considerable period, it is recommended that the soot blowers be operated as soon as practicable after the boiler has been put back on the line.

Forced Shutdown

In case of boiler tube failure or other emergency necessitating a forced shutdown, proceed as follows:

1. Secure all burners.

2. Shut off the fan and close all dampers and burner air registers, consistent with safety to personnel.

3. Shut off completely any output of steam from the boiler.

4. Do not attempt to feed water to the boiler; shut off feedwater supply.

5. Allow the boiler to cool down gradually. When the pressure has dropped to zero, the subsequent or continued cooling should follow the usual procedure for a scheduled shutdown. Do not empty the boiler until the furnace has cooled to a temperature at which a man can enter and remain in the furnace.

Semi-Forced Shutdown

In cases where a tube leak is not of sufficient magnitude to demand immediate removal of the unit from service, the procedure outlined for forced shutdown should be adopted as soon as other phases of plant operation permit.

Fire in Economizer or Uptakes

In the event of fire developing in the economizer or uptakes, follow the procedure outlined under "Operating Difficulties," page 5-1.

Securing and Taking Unit Out of Service

1. In order to prevent possible damage to the steam drum from temperature strains, the pressure on the boiler should be reduced in accordance with a definite pressure-time relationship.

Securing and Taking Unit Out of Service - Cont'd.

1. Cont'd.

   When securing the boiler at line pressure down to zero pressure, the pressure should not be less than 500 psi after the first hour, not less than 200 psi after the second hour, and approximately ten psi after the third hour.

2. Whenever practicable, shortly before burners are secured, the firesides of boiler shall be cleaned of accumulated soot through the use of the soot blowers. Soot blowers are to be used only while fires are lighted.

3. Transfer the combustion controls of the boiler being taken off the line to remote manual operation. If another boiler is being operated in tandem with the boiler being secured first, transfer the load to the other boiler. Refer to Combustion Control Manufacturer's instruction for handling of controls.

4. After the initial reduction in steaming load, burners may be cut out in sequence. The fuel oil pressure and combustion air must be kept under control by readjusting each time a burner is cut out of service.

5. Securing burners - each burner should be secured as follows:

   a. Close the root valve at the fuel oil header.

   b. Close the root valve at the atomizing steam header.

   c. Remove the atomizer and steam clean it while still hot in the steam cleaning bracket.

6. Keep one blower in operation until all oil burners are cut out, and the furnace has been purged of combustion gases.

7. When the other boiler being left on the line has taken the steaming load, secure the last burner in the boiler being cut out. Secure the forced draft blower. Then, close the superheated steam boiler cut-out valve and auxiliary steam cut-out valve.

   Let the boiler pressure fall off without the use of any venting or discharge of steam to the auxiliary exhaust system. When the boiler pressure has dropped below line pressure, crack open superheater header drains to the bilge sufficiently to keep the superheater headers clear of condensate.

   When boiler pressure has fallen to about 10-15 psi, open the steam drum vent to atmosphere.

8. Restore feedwater level as necessary as boiler pressure falls and raises to the top of the glass before securing the feed supply.

   The feedwater regulator control should not be placed on remote manual until the water level is raised to allow for shrinkage as boiler pressure falls off.

SECTION 4
OPERATION AND MAINTENANCE OF OIL BURNERS

GENERAL DESCRIPTION

Characteristics

The characteristics of this burner are different than those of the straight mechanical type, and oil flow rates are higher than with straight mechanical operation for equivalent fuel oil pressures. Therefore, it is important for the protection of the boiler and superheater that the operator familiarize himself with the contents of this instruction manual. The limitation of firing rates when lighting off and raising steam, as shown in this manual, should be strictly followed.

This is a wide-range burner, and the one size of steam atomizing sprayer plate provided will cover the full range of operation.

This burner is capable of being operated at extremely low firing rates using either steam or compressed air for atomization of the fuel without loss of good combustion or ignition as long as the proper fuel oil temperature and proper air supply (air to oil ratio) is maintained.

When using the size of steam atomizing sprayer plate supplied for this vessel, satisfactory burner operation with a fuel oil pressure as low as 40 psi is permissible, provided proper fuel oil temperature and combustion air supply is maintained.

When maneuvering, or at any time during Port Operation, or Normal Operation at sea, it should not be necessary to secure burners unless the steam demand is less than that produced with all burners in service at the permissible minimum fuel oil pressure of 40 psi.

For all fuel oil pressures, the atomizing steam pressure is constant and should be maintained at 135 psi at the atomizer; otherwise, fuel capacity will be affected and not as indicated in the sprayer plate curve for any given fuel oil pressure.

Oil Burner Assembly

This burner is made up of two principal components, the air register and the atomizer assembly, which are as shown in Figures 19 and 21. When ordering parts, give the contract number shown on the nameplate on the burner register cover plate. A list of material with identifying part numbers is shown in Figure 20.

Air Register Assembly

The air register used in these burners is of the Saratoga radial door-type; the arrangement can be seen in Figure 19. The main features of construction are the rotary air doors (102), the impeller plate (46), the bladeless cone (14), and burner throat (116). Air enters the burner from the surrounding double front and is controlled by the rotary air doors (102). The air doors are actuated by means of the gear and pinion mechanism extended through a bushing in the cover plate and terminating in a crank handle (36). The crank handle is fitted with a trigger so that the doors may be held in either the fully open or fully closed position.

A portion of the air passes through the slot openings in the impeller plate (46) and is mixed with the oil spray from the atomizer, the mixture then being directed so that it is enveloped by and mixed with the larger quantity of air passing across the bladeless cone (14). The mixture of combustion air is then directed around the flame and into the furnace by the refractory tile throat (116). The heat of the tile throat aids to maintain steady combustion.

Atomizer Assembly

The atomizer assembly in conjunction with the automatic shut-off valve and its atomizer coupling is shown in Figure 21.

The fuel oil and atomizing steam is supplied to the atomizer shut-off valve body (76), which has its separate steam and oil paths. The atomizer is made up to the atomizer valve body by means of the coupling yoke (96) and its threaded cap screw and Tee handle (98). Sealing of the oil and steam connections against leakage is accomplished by means of the Teflon Gasket (81) which fits into the recesses of the steam and oil connections in the atomizer body, and also by means of the double-ported gasket (85) which fits across the face of the shut-off valve coupling body.

The atomizer valve stems (71) in the shut-off valve body are spring loaded and are designed to open against the spring (74) when the atomizer body is properly tightened in place. When correctly maintained, and there is no malfunction of these parts, removal of the atomizer body causes the valves to close. This feature prevents oil and steam flow if the shut-off valves in the supply lines are inadvertently left open when removing the atomizer body.

A snap ring (126) is provided on the atomizer barrel (79) which limits forward travel of the barrel and prevents its parting from the atomizer body (76) should the sprayer plate become disengaged from the internal tube (78) upon which it is threaded.

Sprayer Plate

Each steam atomizing sprayer plate is identified by a symbol stamped on the edge of the sprayer plate, such as 6Y-41-52-50-80SH. The complete symbol should be used when ordering sprayer plate replacements. The identification of the numbers comprising the symbol is as follows:

6Y - Designates number of exit holes
41 - Designates drill size of exit holes
52 - Designates drill size of steam holes
50 - Designates drill size of oil holes
80 - Designates included angle of exit holes
SH - Designates small uni-joint, high capacity
REX-AA - Designates material used

A straight mechanical sprayer plate (size 4212 FYH-4 slot) with adapter is furnished for lighting off when steam (or compressed air) is not available for atomization. Refer to Figure 21.

OPERATION OF RACER STEAM ATOMIZING OIL BURNER

Steam Atomization

The Racer atomizer sprays the oil into the furnace in a very fine mist by the use of steam, which is the sole atomizing force. Variations in capacity are obtained by increasing or decreasing the oil pressure being supplied to the atomizer and thence to the oil flow paths which intersect with the atomizing steam paths within the sprayer plate. Accordingly, steam must be used the entire time the steam atomizing sprayer plate is in service, except at such times specified herein when compressed air may be used as the atomizing medium.

The oil, under header supply pressure and temperature, enters the shut-off coupling at the valve body oil inlet connection on the left-hand side of the coupling. The atomizing steam at a constant 135 psi supply enters the shut-off coupling at the steam inlet connection on the right-hand side of the coupling. The oil is then directed to the annular space between the outer barrel and the internal tube, while the steam is admitted to the bore of the internal tube. The oil and steam, therefore, follow separate paths until they reach the sprayer plate. The oil then enters the multiple oil paths within the sprayer plate and then intersects with the atomizing steam that has been projected through the separate multiple steam paths within the sprayer plate. The intersection of the oil and steam within their respective exit paths results in atomization of the fuel being wholly completed within the exit passages. The resultant mixture is then discharged out of the exit paths and forms a number of discharge jets in the form of a finely atomized spray of fuel which is outwardly expanding and conical in shape. Breaking up of the oil spray into a number of discharge jets provides greater surface exposure of the fuel particles to the surrounding air for combustion and results in good combustion over the full capacity range of the burner provided proper oil-air ratio is maintained.

Compressed Air Start-Up Connection

As it is possible to light off during start-up and operate the steam atomizers using the steam atomizing sprayer plates with compressed air for atomization, a tee may be installed as a permanent compressed air connection. This can be a one-half inch connection and can be installed in the atomizing steam supply header with a one-half inch shut-off valve and quick detachable compressed air fitting.

Oil Burner Adjustment

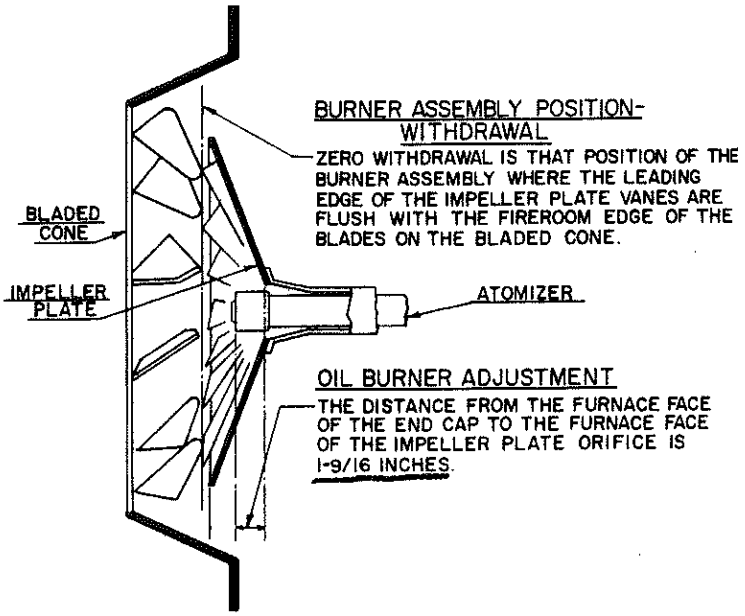
It is necessary for the satisfactory performance of this burner that the proper relationship of the furnace end of the atomizer to the central orifice of the impeller plate be maintained. This relationship should not be altered and is set so there is a minimum of carboning at the atomizer tip while still maintaining good combustion.

This adjustment should be such that an atomizer properly made up in the shut-off coupling and fitted with its gaskets, steam atomizing sprayer plate, and end cap, the distance from the furnace face of the end cap to the furnace face of the impeller orifice is 1-9/16 inches. See illustration on page 4-5. This adjustment is the same for all burners of this particular installation and is obtained by loosening the regulating rod lock ring (64) and screwing the regulating rod (47) in or out of the shut-off valve coupling until the required dimension is obtained. This setting is the same when using the steam atomizing sprayer plate or the straight mechanical sprayer plates.

Burner Assembly Position - Withdrawal

The burner assembly is adjusted and set so that the burner is operated at zero withdrawal for all rates of operation, and this setting should not change.

Zero withdrawal is that position of the burner assembly where the leading edge of the impeller plate vanes are flush with the fireroom edge of the blades on the bladed cone. It is not necessary to withdraw the burner assembly toward the fireroom when cutting burners in and out, such as during maneuvering. To do so can impose unnecessary strains on the oil and atomizing steam supply leads with resultant leakage at their joints. This position of zero withdrawal is the same for operating with either the steam atomizing or straight mechanical sprayer plates. See illustration on the following page.



ATOMIZER TIP AND IMPELLER PLATE SETTINGS

Preparation for Lighting Off

1. The combustion control should be placed on Remote Manual Operation when lighting off and raising pressure.

2. Close the root valves at the atomizing steam and fuel oil supply header and also the atomizing steam and fuel oil shut-off valves at the oil burner coupling.

3. Where the source of atomizing steam is from the other boiler, line up the atomizing steam to provide 135 psi steam pressure at the atomizer.

Preparation for Lighting Off - Cont'd.

3. Cont'd.

   If the atomizing steam source is not from the other boiler, and from such a source as shore steam, and is sufficient for heating the Bunker C fuel but is not of sufficient pressure or quality for steam atomization, compressed air may be used for atomization of the heated Bunker C fuel. The compressed air supply should be reasonably dry and capable of maintaining a steady compressed air pressure of 90-100 psi at the burner. The handling of the burner using compressed air is the same as for when steam is used for atomization. However, the maximum allowable fuel oil pressures when lighting off under various modes of operation should not exceed those shown in the table on page 4-11.

4. Circulate the Bunker C fuel through the system and bring the temperature of the fuel at the burners up to the temperature at which the required viscosity for good atomization will be obtained. For average Bunker C fuel, this will be in the range of 100 to 135 SSU.

5. If lighting off using steam atomization, drain the atomizing steam lines of all condensate and let the lines warm up to insure dry steam to the burners.

6. Purge the setting by opening air register doors wide and bring the air pressure at the windbox to about five inches of water. After about five minutes, cut the windbox air pressire down to about one-half inch of water and close all air registers except the one to be used for lighting off.

7. Install a clean atomizer in the burner, making sure that it is fitted with a clean steam atomizing sprayer plate seated properly in the end cap, and that the end cap is snugly tightened but not over-tightened. The atomizer body steam and oil recesses must be fitted with the Teflon gasket, and the full face double-ported gasket must be in place over coupling face. Before tightening the atomizer, make sure that the projections of the atomizer steam and oil inserts line up with ports in the shut-off valve coupling; otherwise, the atomizer will not make up properly and the matching surfaces can be damaged causing leakage.

Lighting Off

When the foregoing steps have been followed, the burner is lighted off as follows:

Lighting Off - Cont'd.

1. With the fuel oil at the proper temperature, close the recirculating valve and set the fuel oil pressure regulating valve to give the recommended lighting off oil pressure at the burner, as indicated on page 4-11, "Maximum Permissible Fuel Oil Pressures When Lighting Off." If the fuel oil temperature falls below that for good atomization, the recirculating valve should be cracked open to restore the temperature, and the fuel oil pressure should be readjusted as necessary.

2. If using steam for atomization, open the root valve at the atomizing steam header and also the atomizing steam shut-off valve at the burner coupling. Let the steam blow through the atomizer long enough to warm it up and to insure that dry steam will be provided at ignition. If using compressed air for atomization, open the root valve at the header and also the shut-off valve at the side of the burner coupling to admit compressed air to the atomizer.

3. Open the air doors just wide enough to admit a torch, position a well-lighted torch at the opening in the impeller plate hub so the torch flame will fan in over the atomizer tip. Then, open the root valve at the fuel oil header and open the fuel oil shut-off valve at the burner coupling. If ignition does not occur within five seconds, secure the oil, leave the atomizing steam on, and purge the setting before attempting to light off again. See Step 11 when using compressed air for atomization. When lighting a burner, always turn on the atomizing steam (or compressed air) first, then, the fuel.

4. With ignition established, open the air register doors wide and check to see that the flame is not burning too far away from the impeller plate. If necessary, flick the air doors rapidly to bring the flame back close to the impeller plate. Then, readjust the fuel oil pressure to the maximum permitted as shown in the table on page 4-11 and readjust the combustion air supply for proper oil-air ratio.

5. Do not exceed the maximum permissible fuel oil pressures when lighting off and raising pressure until the boiler is up to pressure on the line and a positive steam flow has been established through the superheater. Exceeding the permissible firing rates, as shown in the table on page 4-11, can result in over-heating of the superheater. For use of the superheater drains for the protection of the superheater, see Figure 16.

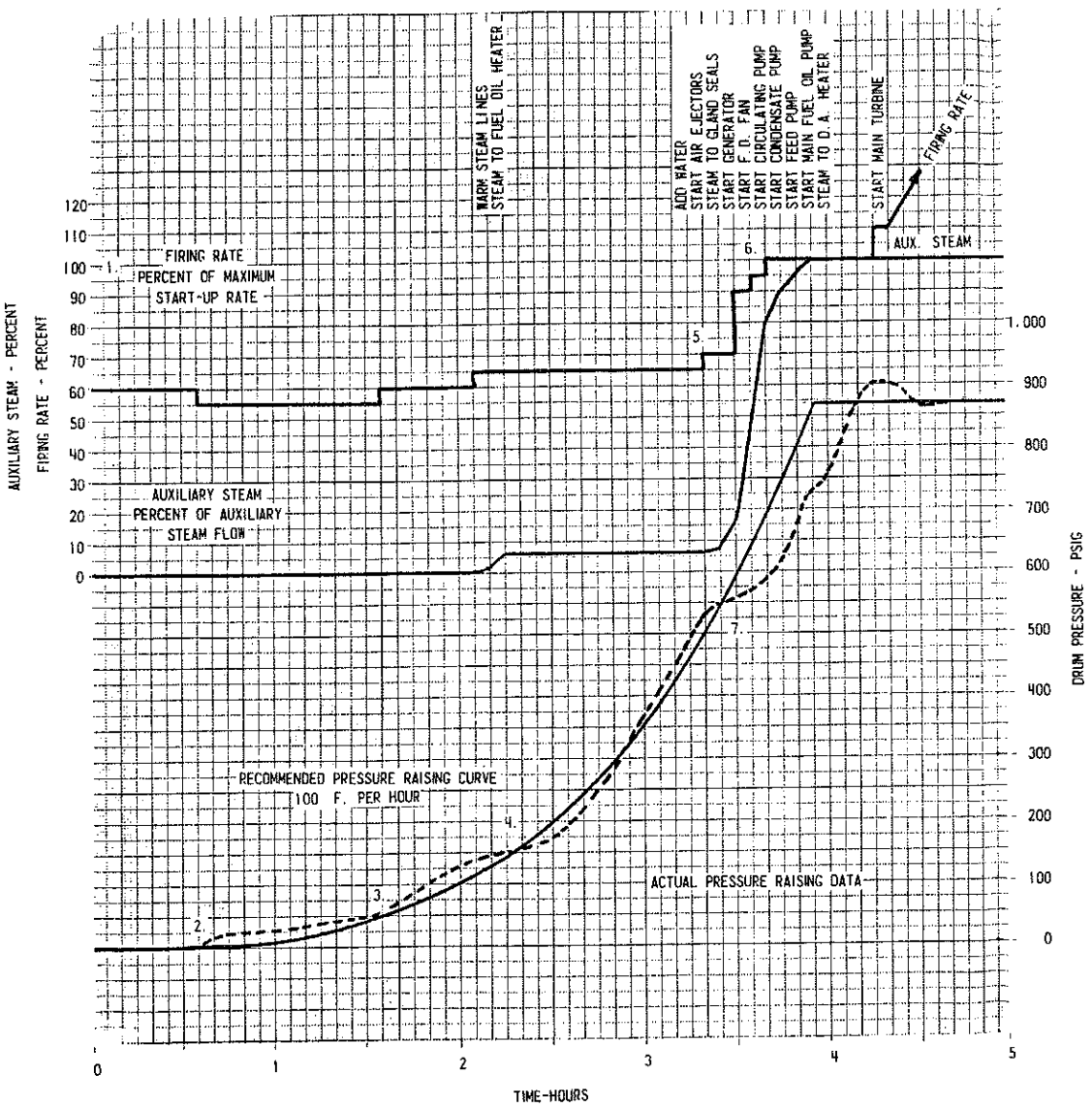
   Considering the boiler start-up as part of the over-all ship's power plant start-up, it will be necessary to warm up and place in operation many of the steam using auxiliaries prior to reaching full operating pressure. Using steam through the auxiliary desuperheater during the pressure raising period is desirable for superheater cooling, provided the steam using auxiliaries are placed in service slowly, one at a time. Ideally, the last auxiliary would be cut in just prior to reaching operating pressure in accordance with the time-pressure table on page 3-7.

Lighting Off - Cont'd.

5. (cont'd.)
The exact firing rate required to raise pressure on the boiler and supply the auxiliary steam cannot be preduced because each plant is unique regarding the quantity of the auxiliary steam it uses. It is expected that the recommended maximum oil pressure at the burner and associated firing rate given on page 4-11 will be satisfactory for the initial start-up.

For superheater protection during the pressure raising period, it is important that the flue gas temperature entering the superheater be limited to 950 degrees F. until sufficient steam flow is established to cool the superheater tubes. A recommended pressure raising schedule will be established for this equipment the first time it is fired up to operating pressure. For illustration purposes, a typical plot of pressure raising data is given on page 4-9. The illustration is a general one and does not include every detail of raising pressure on this boiler. It does show graphically important instructions for the protection and proper operation of the boiler during the pressure raising period.

TYPICAL PRESSURE RAISING DATA



1. LIGHT OFF BURNER - FLUE GAS TEMPERATURE TO SUPERHEATER LIMITED TO 950 DEGREES F.
2. REDUCE FIRING RATE 5% - STEAM PRESSURE INCREASING TOO FAST.
3. INCREASED FIRING RATE 5%.
4. INCREASED FIRING RATE 5% - COMPENSATE FOR WARM-UP STEAM.
5. INCREASE FIRING RATE IN SMALL INCREMENTS TO KEEP UP WITH STEAM USAGE.
6. FLUE GAS TEMPERATURE TO SUPERHEATER LIMITED TO 950 DEGREES F. UNTIL SUPERHEATER TUBE METAL INDICATES IT IS BEING COOLED BY STEAM FLOW.
7. FIRING RATE AT THIS POINT SHOULD ONLY BE INCREASED TO MAINTAIN AN ACTUAL PRESSURE-TIME RELATIONSHIP PARALLEL TO THE IDEAL. CAUTION MUST BE EXERCISED AT THIS POINT. OVERFIRING TO BRING THE ACTUAL PRESSURE UP TO THE IDEAL COULD CAUSE SUPERHEATER TUBE DAMAGE FROM OVERHEATING.

Lighting Off - Cont'd.

6. Do not alternate burner position while raising pressure, but keep the same burner in service so as to warm up the refractory burner throat to aid in combustion during cold boiler light-off conditions.

7. Allow approximately one hour to bring a cold boiler up to where steam vapor is formed. Allow approximately four or more hours to bring the boiler up from zero to line pressure.

8. If firing is stopped for any appreciable time, condensation may take place in the superheater. The drains should be reopened and superheater circulating steam re-established prior to relighting the burner.

9. The one size of steam atomizing sprayer plate provided, 6Y-41-52-50-80SH, is used for all rates of operation from minimum to maximum firing rates. The straight mechanical sprayer plate 4212 FYH-4, is to be used at light-off only when no steam or compressed air is available for atomization.

10. During pressure build-up, maintain a proper water level in the steam drum.

11. **Caution!** USING COMPRESSED AIR FOR ATOMIZATION AND BUNKER C FUEL

    When using compressed air for atomization of Bunker C fuel and the boiler is being fired intermittently, always remove the secured atomizer and steam clean it or replace it with a clean one each time the boiler is lighted off again. This will prevent clogging of the atomizer and sprayer plate by the fuel which will congeal rapidly due to cooling effect of the compressed air when there is no continuous flow of heated oil through the atomizer.

12. When on manual control of fuel oil and combustion air, an increase in fuel should be preceded by an increase in combustion air, and, conversely, a decrease in fuel should be followed by a decrease in combustion air.

13. If an atomizer is secured and is not needed, it should be removed and not left made up in the register.

14. When securing an atomizer, first close the root valve at the fuel oil supply header and then the fuel oil shut-off valve at the burner coupling. Then, secure the root valve at the atomizing steam header and the atomizing steam (or compressed air) shut-off valve at the burner.

Maximum Permissible Fuel Oil Pressures

When lighting off a cold boiler and raising pressure with one burner in operation, be guided by the following table of maximum permissible fuel oil pressures when firing Bunker C or Diesel fuel on either steam air, or straight mechanical atomization. For sprayer plate curves, see Figure 22.

Sprayer Plate Size - 6Y-41-52-50-80SH

One Burner Operation			Pressures to Burner - PSI *Fuel Oil Pressure	
Atomizing Medium	Fuel	Steam or Air	Light-Off	Maximum
Steam Atomization	Bunker C	135 at atomizer	40	60
Steam Atomization	Diesel	135 at atomizer	40	50
Air Atomization	Bunker C	90-100	40	45
Air Atomization	Diesel	90-100	30	40

Sprayer Plate Size - 4212-FYH-4

Straight Mechanical Atomization	Bunker C	None	150	250-260
Straight Mechanical Atomization	Diesel	None	150	225-235

*The fuel oil pressures listed on this page are based on not exceeding a firing rate of 550 lbs. oil/blr./hr. when using the steam atomizing sprayer plate 6Y-41-52-50-80SH or the cold start straight mechanical 4212-FYH-4. The fuel oil pressures when using Bunker C fuel oil are based on a viscosity of 135 SSU. The initial light-off fuel pressures are based on restricting fuel oil flow to only that required to obtain good ignition.

Straight Mechanical Atomization

1. In the event start-up and raising pressure on the boiler cannot be accomplished by the normal mode of operation using the steam atomizing sprayer, a straight mechanical, size 4212-FYH-4 sprayer plate, is provided.

2. When on straight mechanical atomization, it is necessary to use an adapter in combination with the sprayer plate. The changeover is accomplished by replacing the steam atomizing sprayer plate with the straight mechanical screw-on adapter and the straight mechanical sprayer plate which is held in place against the adapter by the atomizer end cap.

Straight Mechanical Atomization - Cont'd.

3. When on straight mechanical operation, the size 4212-FYH-4 sprayer plate capacity is less than that of the steam atomizing sprayer plate for equivalent fuel oil pressures. Therefore, the fuel oil pressure should be in accordance with that recommended in the table on page 4-11.

4. When sufficient steam pressure has been raised on straight mechanical operation to heat the Bunker C fuel and supply 135 psi atomizing steam at the atomizer, change over to operation on steam atomization following the procedures outlined on page 4-6, using the steam atomizing sprayer plate.

5. When on straight mechanical operation, the automatic combustion control must be kept on manual, and the fuel oil and combustion air controlled by manual or air manual control.

Fuel and Steam

Satisfactory atomization depends upon the fluidity or viscosity of the fuel. For this type of atomizer, the oil should be within the ranges of 15 to 21 Seconds Saybolt Furol (18 seconds optimum), 100 to 135 Seconds Saybolt Universal or 3 to 5 Degrees Engler (4 degrees optimum).

For operation over the maximum range of capacities, the fuel should be available at a pressure of 300 psi gage at the oil header, while dry saturated steam should be available at a constant pressure of 135 psi gage for the atomizing steam supply at the atomizer.

The oil supplier can furnish the reference viscosity. In the U.S., this is reported in SSF@ 122 def. F. (Saybolt Seconds Furol); in Europe, it may be reported Degress Engler or Seconds Redwood. The approximate atomizing temperature can then be obtained from the curves shown on page 4-16.

Efficiency of Combustion

The efficiency of the combustion equipment is a measure of how well it is designed and operated so as to produce complete combustion with a minimum amount of excess air.

These burners are designed so that smokeless operation should be possible with 15-20 percent excess air, depending upon the capacity at which the burner is operated.

The combustion efficiency of the burner may be checked by means of the Combustion Analyzer to measure the percentage of CO_2 in the flue gas, and from this, in conjunction with the accompanying Excess Air Curves, page 4-17, the

Efficiency of Combustion - Cont'd.

percent excess air can be determined. The Excess Air Curves apply strictly to the fuel oil for which they were calculated, but can be used with very good accuracy for all fuel oil in present marine use.

Good combustion implies:

1. A maximum of 15-20 percent excess air

2. Complete combustion as indicated by a trace of smoke from the stack and zero percent CO.

The details of burner operation, as described above, should be closely checked to produce good combustion since continued operation with improper combustion can appreciably increase fuel consumption.

To use the Excess Air Curves, it is necessary to know the hydrogen content of the oil. If this value is unknown, it may be closely approximated by reference to the specific gravity or the American Petroleum Institute (API) gravity which is available from the oil supplier. The following tabulation indicates this proportionality.

REFERENCE GRAVITY REPORTED BY OIL SUPPLIER

Specific Gravity = $\frac{\text{Weight of Oil @ } 60^{\circ} \text{ F.}}{\text{Weight of Pure Water @ } 60^{\circ} \text{ F.}}$	A.P.I. Gravity = $\frac{141.5}{\text{Specific Gravity } (60^{\circ}/60^{\circ})} - 131.5$	Approximate Hydrogen Content (% by Weight)
1.030	5.9	9.0
1.015	7.9	9.5
.998	10.3	10.0
.982	12.6	10.5
.962	15.6	11.0
.939	19.2	11.5
.913	23.5	12.0
.878	29.7	12.5
.830	38.9	13.0

Care and Maintenance

CARE AND CLEANING OF ATOMIZER AND SPRAYER PLATE

1. It is essential to the good performance of this steam atomizing oil burner that care be exercised in the cleaning and handling of the sprayer plate and atomizer parts.

Care and Maintenance - Cont'd.

2. The back face of the sprayer plate flange forms an oil-tight joint with the machined and lapped end of the atomizer barrel. These matching surfaces must be protected against nicks or burrs to insure an oil-tight joint. Atomizers stored in the burner rack without sprayer plates fitted should have the end cap left on to protect the end of the barrel.

3. The inserts in the steam and oil parts of the atomizer body and the projection of the steam and oil shut-off valve stems in the coupling should not be allowed to become marred. Failure to properly align the atomizer so that the atomizer inserts mesh properly with the coupling valve stems prior to tightening will result in damage to these parts.

4. If the pistons or inserts do become damaged, renewal is necessary as any attempt to machine off scarred metal will reduce effective travel, and full opening of the valve pistons will not take place.

5. Do not attempt to over-tighten the tee handle coupling when making up an atomizer in the coupling. If the Teflon gaskets and the double-ported gaskets are in place and in reasonably good condition and the atomizer is properly lined up, a steam and oil-tight joint will be obtained without applying undue force in tightening.

Steam Cleaning the Atomizer

1. Once the system has been cleared of mill scale and foreign deposits in the steam and oil lines and burner parts, this burner should operate relatively free from pluggage of the steam or oil paths in the sprayer plate, and frequent cleaning is not necessary. The steam strainer in the atomizing steam leads to each burner, and at the steam cleaning bracket, should be checked periodically, and kept clean and in good atomization.

2. The atomizer is normally steam cleaned without removing the end cap or sprayer plate.

   Atomizers which are secured and not needed for service should be removed from the burner register and steam cleaned while still hot. The atomizer should then be stored in its rack and allowed to cool to room temperature before disassembly of the end cap and sprayer plate. The sprayer plates and end caps are of hardened material and should not be removed from the atomizer and quenched in a cleaning solvent while still hot. Quenching will affect the hardness of the sprayer plate and promote greater wear.

Steam Cleaning the Atomizer - Cont'd.

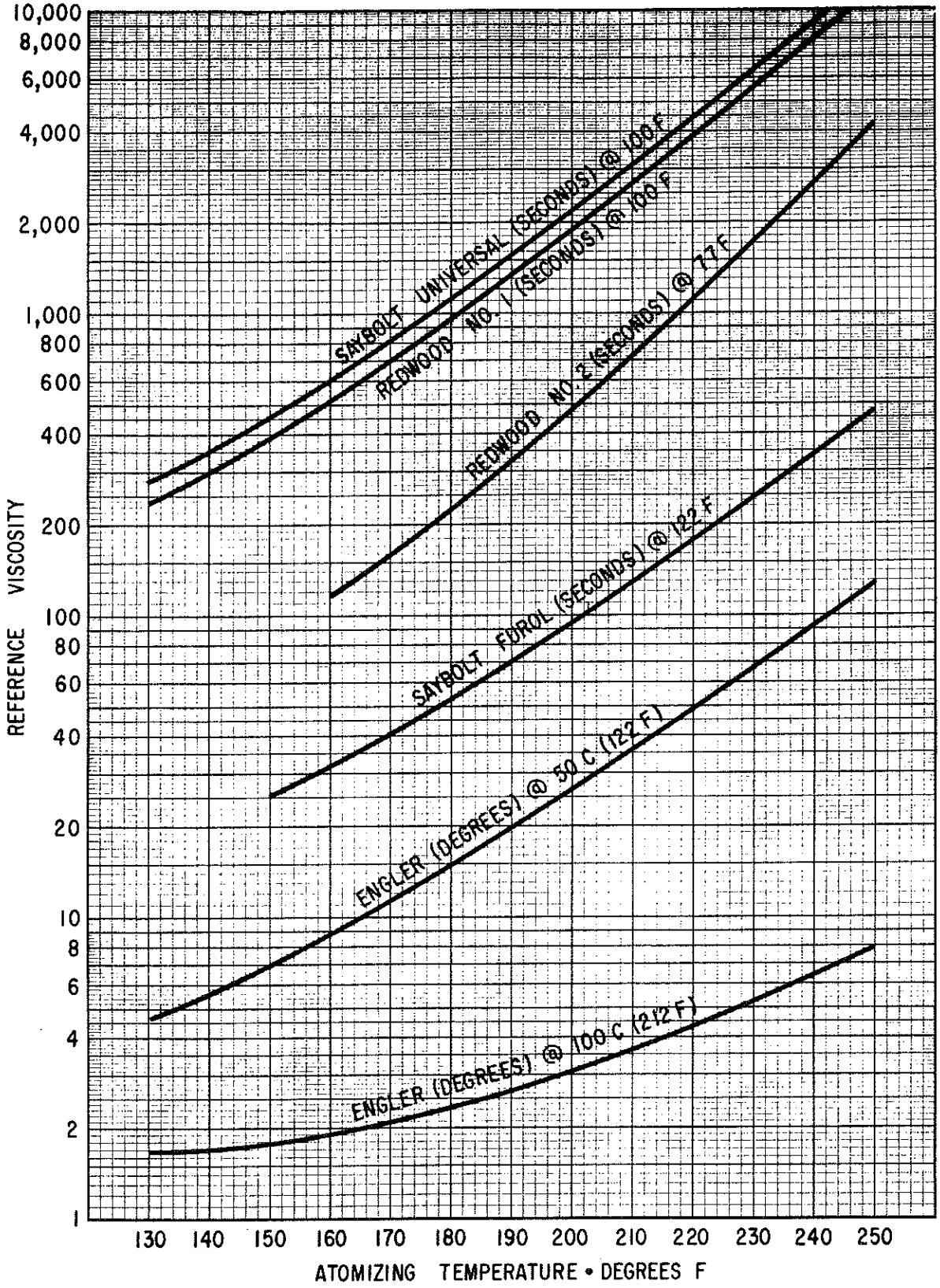
3. Pluggage of a steam hole in the sprayer plate will result in loss of atomization of oil within the jet where the pluggage occurs. This will result in a discharge of a jet of unatomized oil into the furnace and can cause the formation of carbon or deposits of unburned oil on the burner parts or furnace floor and walls. The atomizer should be immediately secured and replaced with a clean one.

   Usually a plugged sprayer plate cannot be effectively cleaned without removing it from the atomizer. First, steam clean the assembled atomizer and after it has cooled, then remove the sprayer, soak it in a cleaning solvent, and carefully clean the oil and steam holes using a pipe cleaner or a soft wire. Do not use hard metallic cleaning tools.

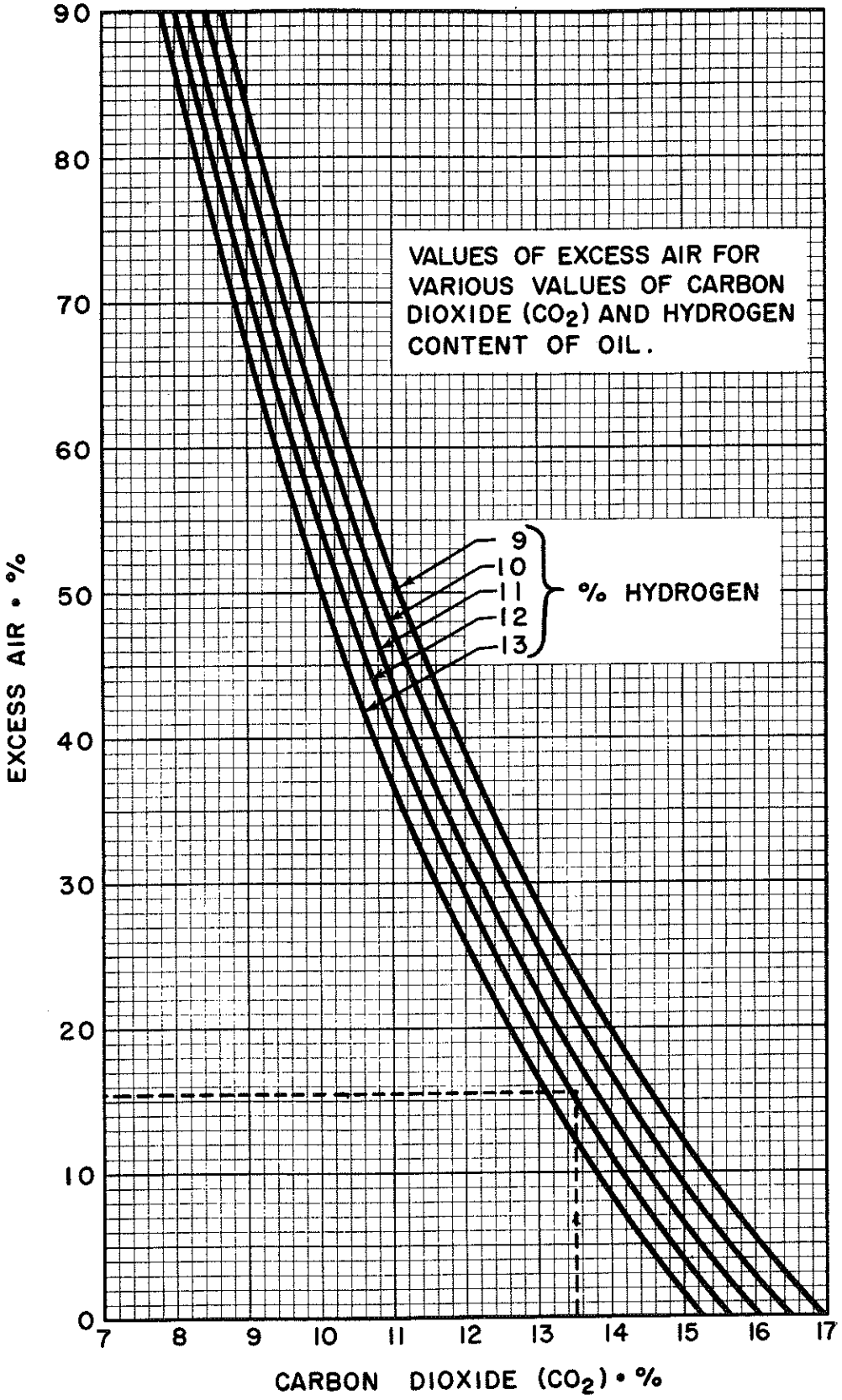
Renewal of Sprayer Plates

1. With reasonable care and attention, the sprayer plates will give satisfactory service without abnormal wear taking place. Excessive wear will be indicated by a noticeable dropping off of the fuel oil pressure required to hold steam pressure for a given rate of boiler demand. This is due to the sprayer plate wear taking place in the oil exit paths with a resultant increase in capacity of the sprayer plate for a given fuel oil pressure. Under such conditions, the worn sprayer plates should be renewed.

2. Do not use worn sprayer plates with new sprayer plates at the same time. This will result in unequal quantities of fuel oil being fired between burners, and smoking or unbalanced operation can result. Sprayer plates should be replaced in sets, and the worn plates should be removed from the fireroom and discarded.



TYPICAL BUNKER FUELS
APPROXIMATE ATOMIZER TEMPERATURE
TO BRING OIL TO A VISCOSITY OF 135 SSU
(SAYBOLT UNIVERSAL SECONDS)



EXCESS AIR CURVES

SECTION 5
OPERATION AND MAINTENANCE OF ECONOMIZER
GENERAL

Description

The B&W primary economizer installed on the boiler may be seen in Figure 1. It consists of 16 assemblies arranged side by side in the uptake after the last row of generating tubes. Each assembly consists of 1-1/2 inch O.D. studded tubes, eight rows high, arranged in a continuous loop between the upper inlet header and the lower outlet header. The exposed length is 10 feet, 2 inches. Refer to Figure 17.

The B&W secondary economizer supplied for the boiler may be seen in Figure 28. It consists of 12 assemblies arranged side by side, and located on the deck above the boilers. Each assembly consists of 1-1/2 inch O.D. studded tubes, 20 rows high, arranged in a continuous loop between the upper inlet header and the lower outlet header. The exposed length is 13 feet, 6 inches.

The tubes of each economizer are studded with rectangular fins in order to increase the rate of heat transfer through the unit. The top and bottom tubes of each assembly are externally welded into the headers, and the assembly is supported by support plates at the front and rear. Each header is provided with one handhole in the exposed header ends to allow access for inspection.

Operation

Feedwater enters the secondary economizer inlet header at 285 degrees F. The water passes through this economizer in a downward direction through each circuit to the outlet header, thence to the inlet header of the primary economizer. The feedwater enters the primary economizer at 337 degrees F. at the normal rate and passes downward through this economizer to the outlet header and then to the steam drum. Hot gases pass over the studded tubes from the bottom to the top of the economizers, and thence to the uptakes.

A vent connection is provided on each economizer inlet header. A drain line is provided on each economizer outlet header, for the purpose of draining the unit for inspection, cleaning, and repair.

OPERATING DIFFICULTIES

Efficiency and proper operation of the economizer depend to a large degree upon good maintenance and correct operation of the entire boiler unit as described in this manual, particularly with regard to the oil burning equipment, the condition of the feedwater, cleanliness of the uptakes, and cleanliness of the internal and external surfaces of the economizer. These factors are elaborated upon in the articles which follow.

Economizer Fires

INDICATIONS OF ECONOMIZER FIRE

If a soot fire should develop, the indications will be as follows:

1. Sudden, unexplainable increase in uptake gas temperature

2. Flame visible in the smoke indicators

3. Possible loss of feedwater pressure and feedwater supply to boiler due to overheated and ruptured economizer tube

4. Overheating of casing or uptake in the zone of the economizer

When an economizer fire is detected, the following action should be taken immediately:

1. Secure all oil burners, close burner air doors , and remove atomizers.

2. Secure forced draft blowers.

3. Do not use the soot blowers when it is suspected that there is a fire in the gas passage, for such action at this time may lead to serious explosion by stirring up soot deposits.

4. Remove the boiler from the line and open the superheater circulating line, if necessary, to prevent an excessive rise in steam pressure. Crack superheater drain to bilge.

5. Provided no tubes have ruptured as a result of the fire, immediate steps should be taken to establish a continuous flow of feedwater through the economizer, and the water level in the steam drum should be raised to nearly the top of the visible limit of the gage. Feed flow through the economizer must be maintained until the economizer fire is extinguished and the water level controlled by discharging overboard by means of the boiler bottom blow valve.

6. Do not attempt to open access door in the uptake as a means of smothering the fire with CO_2 or other suitable extinguisher for this type of fire. To do so may supply more oxygen to the fire and cause a sudden flare-up with possible injury to personnel.

   The smoke indicator should be opened up and the lens removed. The extinguisher should then be discharged through the smoke indicator opening. If the fire still persists, a hose connected up to the steam smothering system can be used in the same manner through the smoke indicator opening, or a water hose with a fog nozzle or attachment which will produce a fine spray, can also be used.

Economizer Fires - Cont'd.

7. After the fire is extinguished, the economizer and economizer casing should be examined to determine the extent of any damage, and prior to any decision to return the boiler to service, a hydrostatic test should be applied.

8. When clean and tight, the economizer will again be ready for regular service.

Precautions to Avoid Economizer Fires

1. Oil burning equipment and the combustion air supply should always be operated so as to assure good combustion conditions. This will prevent smoking or diluting the combustion gases with too much excess air, particularly under lighting off and low load operating conditions. It will also assist in preventing the deposition and accumulation of unburned combustible material, either on the external heating surface or in the gas passage surfaces.

2. All external heating surfaces and gas passages should be frequently and periodically examined. If examination shows that deposits tend to accumulate at any particular location despite periodic soot blowing, it will be necessary to arrange regular hand cleaning for such sections of the unit.

3. Do not use the soot blowers when it is suspected that there is a fire in the gas passage, for such action at this time may lead to serious explosion by stirring up soot deposits.

4. Under port, or low load operating conditions, load changes are frequently experienced, necessitating the cutting in and out of burners as required. When operating under such conditions, the fuel oil pressure, fuel oil temperature, quantity of air supplied, and flame appearance should be kept under close observation so as to assure proper atomization and burning of the fuel oil.

5. Whenever it becomes necessary to secure all burners on a boiler or should the burners be extinguished due to low pressure, water in the oil, etc., the furnace and gas passages must be thoroughly purged before an attempt is made again to light a burner.

6. Careful attention to the above precautionary measures will normally minimize the possibility of delayed or accidental burner ignition and furnace explosions. Furnace explosions, while generally of a minor character, may be of sufficient magnitude to short flames up into the gas passages and cause the ignition of accumulated combustible material.

Causes of Leakage at Joints and Handhole Plates

Economizer leakage difficulties at tube seats and handhole plates primarily result from:

1. Handhole plates not seated or followed up properly

2. Repeated temperature shocks resulting from intermittent feedwater flow while the boiler unit is under fire

3. Fires occurring in the economizer; such fires may result in cracked or ruptured tubes, especially when the economizer is not completely full of water.

Precautions to Avoid Leakage at Joints and Handhole Plates

1. Follow the procedure given to avoid economizer fires.

2. Keep the external surfaces clean by following the procedure given under "Corrosion of External Surfaces," starting below.

3. Be certain the economizer is completely full of water before the boiler is lighted off.

4. While the boiler is under fire, the feedwater flow through the economizer should never be completely stopped, i.e., the feed check valve should never be fully closed or the feed pump completely stopped.

5. Check handhole plates, gaskets and seats before installing the plates, to assure that these parts are clean and free from foreign particles. Make sure handhole plates are properly centered, securely pulled up, and then followed up both under hydrostatic test and the boiler under steam.

Causes of Corrosion of External Surfaces

1. Economizer metal temperature becoming lower than the dew point of the flue gases.

2. Presence of sulphur bearing soot accumulations.

3. Presence of moisture from leakage, rain, or other source.

Precautions to Avoid Corrosion of External Surfaces

1. Maintain the temperature of the feedwater entering the economizer at least at 270 degrees F. at all times to prevent flue gas dew point corrosion.

Precautions - Cont'd.

2. Soot blowers should be used at frequent intervals to maintain the external heating surfaces practically free from soot or other unburned carbon deposits under all conditions of operation. The time interval between soot blowing periods should be as determined by the individual requirement of the boiler as observed under service conditions. Soot blower piping should be warmed up and drained thoroughly before soot blower units are used. Steam supply line valves to the soot blower piping and head valves in the soot blower units should be maintained tight in order to prevent steam and condensate leakage into the boiler when the soot blowers are not in use. The presence of any condensate in the piping or soot blower elements, in addition to promoting corrosion may also result in tube erosion from impingement when the soot blowers are used.

3. The economizer should be hand-cleaned or water-washed whenever the boiler is taken out of service for periodic inspection and routine cleaning.

4. As soon as any tube or handhole leakage is detected, all joints should be immediately made tight. In addition to causing rapid corrosion, such leakage may erode and cut the tube or handhole seat and make the subsequent repair job difficult.

Causes of Corrosion of Internal Surfaces

1. Excessive dissolved oxygen in the feedwater

2. Improper water conditioning

Precautions to Avoid Corrosion of Internal Surfaces

1. Check the deaerating heater to assure that it is operating properly. Make periodic tests of the water fed to the economizers to assure that it is maintained free of oxygen.

2. Maintain the proper water alkalinity of the water in the economizer when the boiler is idle and completely filled with water.

Causes of Water Hammer Action

Water hammer is caused by intermittent feedwater flow to the economizer while the boiler is being fired. When the flow is entirely stopped, steam may form in the economizer. When the flow is resumed, the flow of incoming water compresses the steam and sets up a water hammer action, which, if sufficiently severe, may result in tube leakage or other damage.

Precautions to Prevent Water Hammer

1. See (4) under "Precautions to Avoid Leakage at Joints and Handhole Plates," page 5-4.

2. If water hammer action occurs, it can be stopped by appreciably increasing the feedwater flow through the economizer and keeping the water at the proper level by use of the blow valve, if necessary. See page 3-13 for precautions when blowing down.

Procedure for Plugging an Economizer in Case of Leakage Refer to Figure 24

If for any reason one of the economizer elements should develop a leak, temporary repairs can be made by plugging the ends of the element stubs in the inlet and outlet headers after the element has been cut away.

To install the sleeve-type economizer plug, proceed as follows:

1. Cut the leaky tube a distance of 3-5/8 inches from the inside face of the inlet and outlet headers. Make a second cut to suit as shown; then, remove the loose sections. (See Sketch "B-1," Figure 24.)

2. Slip the plug sleeve as far as possible over the stubs remaining in the headers. Insert the expander and proper mandrel. Attach the 1/2 inch ratchet wrench and prepare to expand the stub into the sleeve. Before starting to expand, withdraw the sleeve forward about 1/16 inch. (See Sketch "B-2," Figure 24.)

3. When the stub has been properly expanded into the sleeve, remove the expander and screw a pipe plug into the sleeve. The pipe plug threads should be treated with a good commercial threading compound prior to insertion. (See Sketch "B-3," Figure 24.)

Procedure for Installing a New Economizer Element in Primary Economizer Refer to Figures 17, 18, and 24

1. If necessary, remove soot blower heads, piping elements, wall boxes, and other interfering equipment.

2. Remove economizer vestibule access panels and structurals at top, front, and rear of economizer.

3. Cut remaining portion of element previously plugged, a distance of 2-3/8 inches from the inside face of the inlet and outlet headers. (See Sketch "C-1," Figure 24.)

Procedure for Installing - Cont'd.

4. Prepare remaining portion of stub at inlet and outlet headers for welding. (See Sketch "C-2," Figure 24.)

5. The primary economizer is composed of 14 elements S-1, one element S4L and one element S4R. When renewing all elements, support plates at front and rear should be cut from top to bottom and weld broken at top and center panel support.

   Center support need not be cut but weld should be broken at top and center panel. When renewing either of the two end elements, the gas side of end support plates should be cut but other side should be unbolted and end support portion cut off and welded to new section that will be installed. (See Figure 17.)

6. Take cognizance of the fact that when renewing S-1 elements, they are composed of bottom tube section ET-1, lower tube section ET-2, center tube section ET-3, and top tube section ET-4. (See Figure 18.)

7. There are fourteen, S-1 elements. When renewing the two S-1 elements, immediately adjacent to the left and right of the economizer soot blower, the end loop sections ET-5L or ET5R must be removed from S-4 elements in order to install the new S-1 elements. After these particular S-1 elements have been installed, weld new replacement loop end S-5 to the elements of S-4 that were altered to make these elements complete. See Views "A-A" and "B-B," Figure 18.

8. When renewing elements S-4, they are composed of bottom tube section ET-1, lower tube section ET-2, center tube section ET-3, tube section ET5L, or R, and top tube section ET-4. (See Figure 18.)

9. Insert assembled new element into cavity created by non-existence of original element.

10. When new element has been replaced, reweld support plates at front and rear. Also, reweld supports at top and center panels. Rebolt to end support if side element has been renewed.

11. Replace vestibule access panels and structurals at top, front, side, and rear of economizer.

12. Replace soot blower heads, piping elements, wall boxes, and other equipment removed originally.

LEAKING AT HANDHOLE

When a leak appears at a handhole, an inspection should be made to determine the cause.

LEAKING AT HANDHOLE - Cont'd.

After draining the economizer headers, remove the handhole plate. Inspect the seat landings of both the handhole plate and handhole opening. Both surfaces should be clean and smooth. Any pits or scars must be removed by accurate surface grinding or refacing. Any handhole plate which is so badly nicked or scarred that it cannot be easily reconditioned should be renewed.

Procedure for Installing a New Economizer Element in Secondary Economizer Refer to Figures 28 and 29

1. If necessary, remove soot blower heads, piping elements, wall boxes, and other interfering equipment.

2. Remove economizer vestibule access panels and structurals at top, front, and rear of economizer.

3. Cut remaining portion of element previously plugged, a distance of 2-3/8 inches from the inside face of the inlet and outlet headers. (See Sketch "C-1," Figure 24.)

4. Prepare remaining portion of stub at inlet and outlet headers for welding. (See Sketch "C-2," Figure 24.)

5. Economizer is composed of ten elements S-1, one element S5-L and one element S5-R. When renewing all elements, support plates at front and rear should be cut from top to bottom and weld broken at top and center panel support. Center support need not be cut, but weld should be broken at top and center panel. When renewing either of the two end elements, the gas side of end support plates should be cut, but other side should be unbolted and end support portion cut off and welded to new section that will be installed. (See Figure 28.)

6. Take cognizance of the fact that when renewing the S-1 elements, they are composed of one tube section ET-1, six tube sections ET-2, two tube sections ET-3, and one tube section ET-4. (See Figure 29.)

7. There are ten, S-1 elements. When renewing the two S-1 elements, immediately adjacent to the left or right of the economizer soot blowers, the end loop members ET-5L or ET-5R must be removed from the S-5 elements in order to install the new S-1 elements. After these particular S-1 elements have been installed, weld new replacement loop ends S-6 to elements of S-5 that were altered to make these elements complete. (See Views "A-A," "B-B," and "C-C," Figure 29.)

8. When renewing S-5L or S-5R elements, it should be noted that they are composed of one tube section ET-1, six tube sections ET-2, one tube section ET-5L or ET-5R, and one tube section ET-4. (See Figure 29.)

Procedure for Installing - Cont'd.

9. Insert assembled new element into cavity created by removal of original element, line up element, and weld ends of elements to existing tube stubs. (See Sketches "C-3," and "C-4," Figure 24.)

10. When new element has been replaced, reweld support plates at front and rear. Also, reweld supports at top and center panels. Rebolt to end support if side element has been renewed.

11. Replace vestibule access panels and structurals at top, front, side, and rear of economizer.

12. Replace soot blower heads, piping elements, wall boxes, and other equipment removed originally.

SECTION 6
INSPECTION AND CLEANING

The boiler unit should be taken out of service periodically for routine inspection, cleaning, and repair. The interval between outages is best determined by experience.

Control Desuperheater Water Side Cleaning

It is essential that periodic inspections of the control desuperheater be made, and the external surfaces of the tubes, connecting flanges, and support plates be kept clean of any deposits. Particular attention should be directed to keeping the inlet section of the control desuperheater completely free of external deposits.

Precautions During Erection and Repair

Operators are cautioned with regard to the following practices:

1. Do not use or permit the use of non-ferrous metallic tools on any boiler pressure parts. In lieu of the non-ferrous metallic striking tools, plastic or leather mallets may be employed or wooden blocks may be used along with steel tools.

2. Do not use paints containing lead, zinc, and/or sulphur on any boiler pressure parts.

3. Remove all metal identification tabs from all boiler pressure parts during assembly.

   The danger involved in the presence of non-ferrous metallic materials is that with temperatures involved in service, welding, stress relieving, and heating for bending, etc., the non-ferrous metals will penetrate tube walls intergranularly causing weakening of the metal and embrittlement.

4. In the case of pressure parts made of stainless steel alloys, steel stamping, center punching, and bending involving severe cold working of the material is prohibited.

Safety Precautions

When making an internal inspection of any unit, or when cleaning the interior of the heating surfaces, care must be taken to guard against the possibility of steam or hot water entering the boiler through open drains or valves connected with similar parts of other units which are under pressure at the time, or through careless opening of any steam or water valve to the unit.

INTERNAL INSPECTION AND CLEANING

Scale

A careful inspection of the tubes should be made for scale. Scale formation will prevent proper transfer of heat, causing a rise in temperature of metal which may result in warping or overheating of the tubes and their subsequent failure.

The removal of deposits can best be accomplished by the use of the tube cleaners furnished with the boiler. Light deposits can usually be removed with the expanding type wire brush. Use of the steel cutter-type head should not be necessary, except where scale deposits are actually noted. In such cases, removal may be facilitated by filling the boiler with water in which there has been placed 50 pounds of soda ash to each 1,000 gallons of water, starting a slow fire, and allowing the water to boil for 24 hours without allowing any pressure on the boiler. The unit should then be cooled slowly, drained, and the tube cleaner used immediately.

The use of other chemical cleaning methods for the purpose of loosening scale is considered dangerous practice and should be performed only under the supervision of the responsible water treatment engineer.

Oil

Even extremely small quantities of oil on internal heating surfaces will produce the same effects as scale, viz prevention of the proper transfer of heat and possible resultant failure of the tubes. Therefore, if the inspection reveals the presence of oil, immediate steps must be taken to stop the introduction of oil into the feedwater system and to remove that which has already accumulated.

Removal of oil from the boiler internal surfaces may be accomplished by a boiling-out procedure, as described on page 3-1.

Corrosion

Inspection should be made of all pressure parts for signs of corrosion. If any pitting, rusting, or caustic embrittlement is noted, the cause of such corrosion should be determined, and steps promptly taken to properly control the feedwater in order to prevent continued attack.

During out-of-service periods, care should be taken that condensate is not allowed to accumulate in any part of the equipment, such as drums, superheater or economizer, from a leaky valve, ineffective draining, or other source.

Serious corrosion is very likely to occur under such conditions, particularly when these parts are exposed to air.

EXTERNAL INSPECTION AND CLEANING

General

A careful inspection should be made of the external pressure part surfaces for any evidence of overheating or corrosion. Inspection for external corrosion should also be made of all surfaces exposed to the action of the gases or to the action of the soot deposited by these gases. The severity of the attack ordinarily will depend on the metal temperatures, sulphur content of the fuel, and the presence of moisture. Soot or slag accumulations on external surfaces and in corner pockets should be removed by means of air or steam lances, scrapers, or by water washing.

Soot Blowers

A careful check of the soot blowers should be made during the boiler shutdown. Tubes near the soot blower elements should be inspected closely for any signs of metal loss due to steam cutting as a result of soot blower element misalignment or improper cam setting. Valves in the soot blower piping and in the soot blower head assemblies should be checked for tightness so as to prevent leakage of condensate into the elements with resultant erosion or corrosion. Scavenging air lines and fittings should be inspected.

Hand Cleaning (Steam Lancing)

BANK AND ECONOMIZER SURFACES

Sufficient access doors and casing panels should be opened or removed to provide access to all essential parts. Then prior to cleaning, the economizer and boiler heating surfaces should be thoroughly examined so that all deposits and concentrations of combustible material are located.

The cleaning operation should start at the top of the boiler unit and progress toward the furnace. Particular attention should be given to cleaning and inspecting the area between the water drum and uptake boiler wall where there may be a concentration of combustible and corrosive material. This area should be inspected fairly frequently until a definite inspection schedule has been established.

Superheater Heating Surfaces

These boilers are provided with superheaters especially designed to provide adequate and convenient access for hand cleaning. The general procedure is as follows:

Superheater Heating Surfaces - Cont'd.

1. Obtain access to furnace through hinged oil burner. Lance the superheater from furnace through screen tubes.

2. Remove outer and inner access doors to the superheater cavity in the boiler front and rear. Lance the superheater from the superheater cavity.

3. Remove outer and inner access doors in boiler front and rear to bank side cavity. Lance rear legs of superheater from the bank side cavity.

   It is not necessary to wait until the boiler is cold, as steam lancing may be accomplished with the boiler shut down but still hot. Should the superheater require a more positive form of cleaning, such as water washing, this operation may be accomplished when the boiler has cooled down.

Precautions When Hand Cleaning

As the furnace is reached in the cleaning process, all loose accumulations on the floor should be removed as soon as possible in order to prevent any fine soot from being picked up by the draft in the furnace and thereby redeposited on the cleaned heating surfaces.

Water Washing

The cleaning of external boiler heating surfaces by means of water washing will often be found necessary where the use of fuel oils having a high ash or vanadium content cannot be avoided. Fuel oils under this classification lead to troublesome deposits adhering to the superheater surfaces in particular. Such deposits form a densely bonded mass which may not be removed by ordinary means, such as the use of soot blowers or periodic air or steam lancing.

Slagged up or plugged superheater lanes interfere with boiler performance and boiler life. The effects of this may be summarized as follows:

1. Slagged superheater will show a marked increase in the air pressure required at the windbox.

2. The boilers cannot be operated at high rates unless sufficient excess fan pressure is available to take care of the increased resistance to gas flow through a plugged or partially plugged superheater.

3. Plugged areas of the superheater will concentrate gas flow through the remaining open spaces. "Laning" will result. This causes high gas velocities in the open gas lanes and may cause overheating of the tubes.

Water Washing - Cont'd.

Gases may also by-pass around, under, or over the superheater and can easily burn out header protection plates, drum protection plates, support plates, soot blower bearings, and elements as a result of the so-called "torching" of high velocity action.

4. Inefficient operation of the entire plant will result due to improper temperature distribution and poor combustion efficiency in the boiler itself, as well as from materially lowered steam temperature to the main engine from the superheater outlet.

Water washing results in clean heating surfaces and promotes efficient operation for those units where uninterrupted service is desired.

Since nearly all of the slag formed in a tube bank consists essentially of a non-soluble base bonded by a relatively water soluble binder, the use of water under pressure accomplishes the dual purpose of (a) loosening the binder, and (b) flushing away the loosened insoluble residue. Generally, water washing may be started as soon as the unit has cooled down enough for a man to enter and remain in the furnace. Water washing will not damage the furnace brickwork or insulation, provided routine precautions, as listed in procedure below, are observed, and provided the unit is thoroughly and slowly dried out immediately after washing. Essentially, then, water washing consists of the following steps:

1. Supply fresh water at a temperature as close to 100 deg. F. as possible. It has been determined from long experience that the optimum water temperature of 100 deg. F. is best suited for the purpose of water washing.

2. The water at approximately 100 deg. F. should be delivered to a very simply designed lance at sufficient pressure to remove the deposits. Different sections of the unit will demand different pressures as shown in the following outline:

   (a) Since superheater surface deposits are of the greatest density and are usually bonded to the tubes, these deposits are more difficult to remove. Therefore, water pressures up to 1,000 psi at 100 deg. F. will be required to do a satisfactory job.

   (b) Since the screen tubes of the generating bank are adjacent to the superheater, it is practical to use the same water pressure and temperature on this section as that recommended for the superheater.

   To clean the gas side surfaces of the superheater, a thorough job can be done from within the furnace and the superheater and bank cavities.

Water Washing - Cont'd.

This procedure is required if superheater tubes become so badly slagged that a direct forceful water spray is necessary at close range. While water washing is generally done in the shipyards, it can also be done by the vessel's crew at sea, if necessary.

3. Following the above directions, direct the stream from the lance on the deposits in such a manner that, with the recommended pressure and temperature, the accumulations will be most expeditiously removed. The most efficient direction of the water washing stream must be determined by experience for any particular condition. It takes from 4-10 hours to water wash a boiler unit, depending upon the extent of slag accumulations (for average conditions 6-8 hours) except when vanadium slag is present, the time must be extended. Economically, water washing is cheap and fast; physically, it is thorough. A good water washing job will leave all tubes "factory" clean the full depth of the tube bank. Further, because of the comparatively clean surfaces resulting from the water washing, the unit remains cleaner for a longer operating period, due to the fact that there are fewer areas on which new slag can adhere to solidly.

4. After water washing has been completed, dry the unit and refractory setting thoroughly. It usually takes from 8-12 hours when using a very light fire, such as that obtained from one burner operated intermittently with a lighting-off size sprayer plate.

The following is pertinent to the preceding four steps:

TEMPERATURE OF WATER: Experience indicates that when using water at 100 degrees F., the maximum solubility of fireside deposits will be obtained in a minimum period of time. Water at this temperature does not necessitate insulating the lance and is, therefore, easier to handle.

The direct contact or deaerating-type heater may often be used to an advantage as a source of the water washing supply.

OPERATING PRESSURES: Various available pumps can be used for supplying the necessary pressures. Where deposits are found to be difficult to remove, increase the recommended pressures accordingly. Fireside deposits will accumulate on top of the water drum around the generating tubes. Care must be taken to thoroughly remove these deposits, using the same method and pressure temperature conditions as used for the superheater.

LANCE DETAILS: A steam lance is supplied with the boiler tools. If this lance is unavailable, a suitable lance can be made from a sufficient length of approximately one inch diameter wire bound steam hose to which is attached a nozzle. The nozzle can be made up from various lengths of 3/8 inch standard pipe.

Water Washing - Cont'd.

One type of nozzle would incorporate a capped end. The pipe should have several 1/8 inch or 3/16 inch holes drilled along one side only close to the capped end. The cap should not be drilled. Several types of nozzles may be required for any one boiler and may be designed as required for various conditions.

LANCING SEQUENCE: When it is intended to wash the entire unit, the superheater deposits should first be thoroughly soaked and allowed to stand while the sections above the superheater are being washed. Washing should then be started at the top of the unit (economizer) working downward through the superheater and furnace screen, including the surface of the water drum around the generating boiler tubes. It is very important to clean out all deposits along the length of the water drum to prevent the possibility of external corrosion in this area. The front casing door at the water drum level near the uptake side casing should be removed after the economizer has been cleaned to facilitate water washing of the water drum area.

When washing the economizer, the surrounding uptake area should also be washed. When washing the economizer, a canvas laid over the outer top row of boiler tubes will keep the water and debris out of the water tube bank and furnace. Canvas used for such purposes usually rots quickly and, therefore, must be washed thoroughly (preferably with a mild soda solution) before being dried and stowed away. Although it is not generally practical or desirable, a canvas covering may be used on the refractories. Spraying or coating of refractory walls with any type of water-resisting material is not considered practical. Care should be exercised in preventing the lance water from striking any refractory surfaces.

Upon reaching the previously soaked superheater slag, direct the nozzle spray for the most effective penetration by having it impinge directly upon the slag accumulations. As these deposits are loosened, the use of dull slice bars is helpful in removing these loosened particles where they cling to tube banks. Once water washing has started, the tubes must be cleaned to bare metal, otherwise, subsequent cleaning will be very difficult.

REMOVAL OF ACCUMULATED WATER: Drain connections are provided in the furnace to drain the washing water from the unit. These furnace drains should be connected to the bilge or ballast pumps. Slag deposits which accumulate on top of the Kaocast pour in the cavity below the superheater and on top of the water drum should be removed.

DRYING: The entire unit must be dried out upon completion of the water washing procedure. In fact, water washing should not be started if a suitable drying out period cannot follow. For drying, use a slow fire over a period of time, depending upon the amount of the refractory surface in the boiler. The fire should be sufficient to maintain the temperature of the boiler water at a point at which a light vapor is apparent at the open vent in the boiler drum. Water in the boiler should be carried at its normal level, and the superheater drains should be wide open. Refractories become properly dried out with this procedure

Procedure for Making Up Casing Joints

The following procedure is recommended for making up the joints on inner casing doors and access panels:

1. Thoroughly clean the landing surfaces of the boiler inner frame and of the door or panel.

2. Apply high temperature Permatex No. 2 to the surfaces of both the inner frame and the door.

The following procedure is recommended for making up the joints on outer casing doors and access panels:

1. Thoroughly clean the landing surfaces of the outer frame and of the door or panel.

2. Apply Pres-Seal packing to the surfaces of both the outer frame and the door.

3. After being applied to the surfaces, the Pres-Seal packing should be allowed to set.

4. Close the door and tighten the dogs evenly, taking care that the door is centered on the frame surfaces, and that the pressure applied does not cause all the packing to be squeezed out from between the surfaces.

5. Remove the excess packing from the edges of the door while leaving a small fillet along the edges.

6. Leaks which may be found under test can be repacked with Pres-Seal packing.

Recommended Procedure for Installing Spiral Wound Asbestos Metallic Gaskets

1. The seat landing of the handhole fitting and handhole opening must be perfectly clean and true. Any pits, indentations, or scars must be removed by accurate surface grinding or refacing. Power driven wire brush wheels can be used to good advantage in cleaning up seats which have surface deposits. Any handhole fittings which are nicked or badly scarred and cannot be easily reconditioned should be replaced.

2. The thread on both the fitting and nut should be wire brushed and chased down with a die. The use of a high temperature thread lubricant, such as Molycote "G," will assist in obtaining a free running thread that will not seize under temperature.

Recommended Procedure - Cont'd.

3. Due to plus or minus tolerances, some gaskets will fit over some fittings easier than others; also, for the same reasons some fittings may pass through certain handholes easier than others. Therefore, various gaskets and fittings should be matched together until the best combination of fit is obtained. The fitting then selected for a certain location should always be used at that one location.

4. If any difficulty at all is experienced in passing the fitting through the handhole opening with the gasket attached, no attempt should be made to force it through by hammering upon it. The fitting should be passed through the opening without the gasket upon it and the gasket then installed on the fitting within the header.

5. With the fitting and gasket in position, the fitting should be "rocked" slightly to make certain it is seating evenly against the handhole seat and is not hung up. It should then be held snugly in this position by pulling outward by hand on the stud or by holding it in position through an adjacent handhole opening, at the same time placing the binder, washer, and nut upon the stud and tightening by hand until the fitting is seated snugly. The nut should then be only very slightly tightened using the proper handhole wrench.

6. While filling the unit for hydrostatic test (see page 3-3) all fittings should be examined for signs of leakage. The fitting and header area adjacent to the fitting can be "shocked" lightly with a hammer to assist in seating the fitting while building up hydrostatic pressure. Additional slight taking up on the nut, first by hand and then with a wrench, will be necessary as the pressure loading on the gasket increases with the increase in hydrostatic pressure which should be built up slowly.

7. When the full hydrostatic test pressure is reached, the pressure loading on the gasket is nearly sufficient in itself to provide a satisfactory joint. Therefore, the final tightening up of all fittings with the handhole wrench should be carefully followed out. Only a relatively light pull on the wrench is sufficient to provide the additional gasket loading required to obtain a tight joint. Excessive tightening or the use of a hammer to drive up the wrench will result in over-compression and ultimate failure of the gasket. Any leakage which shows up when following the aforegoing recommended procedure is then due to an improperly installed gasket or filling of surface defects in the seat which have not been removed. Using excessive tightening methods will not overcome such leakage more than temporarily, if at all. The only satisfactory procedure is to relieve the hydrostatic pressure, remove the troublesome fitting, and correct the real source of leakage.

Renewal of Superheater Tubes and Removal of Superheater Guide Castings

1. Refer to Figure 6, General Arrangement No. 204136E. Remove the outer and inner clamped access doors marked "D" and "B-B" located at front and rear of boiler. Remove the clamped access doors marked "EE" below the superheater headers as shown in view "E-E." Swing open the No. 1 hinged burner on the boiler front. Enter the superheater cavity through door "D."

2. Two platens of superheater loop tubes across the width of the superheater are to be cut out by burning flush with the top of the refractory pour that protects the superheater headers from the furnace gases. See drawing 204131E, Figure 1. Raise the superheater tubes vertically to disengage from attachments on RC row screen tubes and/or attachments on adjacent row of superheater tubes. Refer to drawing 193083E. Arrangement of Screen Tubes, Figure 26; drawing 11570B, Figure 27; drawing 193084E, Figure 27A. Tubes may be removed by passing between furnace screen tube lanes. Guide castings which are installed in the direction perpendicular to gas flow must be cut off to allow tubes to pass between screen tube lanes. Refer to the notes on drawing 11570B, Figure 27. Remove tubes from the furnace through access door marked "G" located at the boiler front in Figure 6, General Arrangement.

3. For multiple tube replacement, it may be possible to remove and replace tubes through the superheater cavity access door. If this is determined to be possible, then the guide castings installed perpendicular to gas flow need not be removed.

4. Remove the superheater header protection refractory in the area of tube butts remaining after burning away superheater tubes. Use milling cutter to remove seal welds inside of superheater header at each tube end and knock out the remaining butt ends.

5. Three superheater tubes in each loop section to be renewed must be tied together. Bring the new superheater tubes into the furnace through access door marked "G" located at the boiler front in Figure 6, General Arrangement. Always move three superheater tubes in loop section to be renewed into position at the same time.

6. Move the cluster of three superheater tubes between screen tubes and thread them through the refractory protection and then into position in the superheater headers. Prior to placing tube ends in the header tube seats, align guide castings with adjacent castings on superheater tubes and/or RC screen tubes. Repeat at each location where the superheater tubes have been removed.

Renewal and Removal - Cont'd.

7. Expand tube ends into headers and seal weld as explained in Figure 16, Arrangement of Superheater No. 193082E.

8. Replace the castable refractory protection around the new tubes installed.

SECTION 7
CARE AND MAINTENANCE OF FURNACE LINING

General

In order to get maximum life from furnace linings, it is necessary to hold sudden changes in temperature to a minimum and to prevent direct impingement of the flame on the brickwork.

Water striking hot brickwork is the most damaging condition that can be encountered with the refractory. Any leaks in the boiler may cause spalling. Cold air should not be allowed to leak into the setting and as soon as a burner is shut down, the register should be closed to prevent air from chilling the throat ring and surrounding refractory. The life of all refractory will be greatly increased if the setting could be heated gradually. When a boiler is removed from service, the setting should be allowed to cool slowly.

After repairs have been made on a boiler which result in wetting the setting, the same care should be used in drying out the furnace, as was exercised when the boiler was first put into service. See page 6-7 for drying out after the water washing procedure is completed.

When the burners are in proper adjustment, there should be no direct impingement of the flame on the wall. Should the flame strike the wall, the reducing action accompanied by the high temperatures of the flame itself will materially shorten the life of the refractory.

Inspection and Repair

Whenever the boiler is taken out of service, it is advisable to inspect the brickwork carefully and immediately make any repairs which may be indicated by the inspection. If bricks become loose and work their way into the furnace, they should be replaced in position and covered with a suitable plastic refractory.

Refractory burner tile should be checked regularly for erosion and spalling in order to keep the burners in proper operation. The surface of the refractory throats must be maintained at an angle of 45 degrees from the centerline of the burner.

Eroded or spalled brickwork should be repaired as soon as practicable. This will prevent an expensive repair job which may be necessary if the condition is allowed to prevail. Brick which is slightly spalled or eroded can be built up with plastic refractory, but badly affected brick should be removed and replaced by new brick.

Inspection and Repair - Cont'd.

It is essential that when brick replacements are made, the same type of brick is used in order to eliminate expansion troubles and to provide proper bearing for the brick above. Each grade of brick has different bearing and refractory properties. Refractory materials are expensive and, therefore, should be kept in a clean, dry place where they will not become chipped or broken. With dirty or greasy brick, it will be difficult to obtain proper bond when they are installed.

Application of Plastic Materials

Furnace corbels and other areas using plastic refractory materials must be properly maintained to minimize undercutting from slag deposits and to provide proper baffling of the gases. In the furnace construction of this boiler, Floorcast, Kaocast, ahd Plastic Moldable are employed, as shown on the ship's set of boiler drawings. For repairing or patching spalled areas, operators should adhere to instructions as given on these drawings for preparation and application of the materials. Also, see page 3-1 for drying out new settings.

When emergency repairs are made and patching is done in a hot furnace, it is essential to cover the patched areas of a large mass with wet burlap to prevent rapid drying during the period. In cold weather, the plastic must not be allowed to freeze during this period.

SECTION 8
STORAGE DURING OUT OF SERVICE PERIODS

There are four recommended methods for storage of these boilers during out of service periods. The first, dry storage, is to be used when the boilers are to be out of service for a considerable period of time. The remaining three methods are for stand-by or idle status. In all cases the boilers should first be steamed in service in order that sufficient circulation will be provided to stablize boiler water conditions and eliminate the presence of oxygen from the water in the boiler unit.

Dry Storage

Under this method of lay-up, the boiler external heating surfaces should be thoroughly cleaned from uptakes down to the furnace, preferably by water washing. The unit should then be slowly and completely dried out using a slow fire with care being taken not to soot up the heating surfaces again.

The boiler should then be completely drained when the pressure parts have cooled to 150 degrees F.; warm or heated air should be circulated through the superheater and boiler by means of portable blowers with the steam drum, water drum, and water wall headers opened up to promote air circulation.

When the internal parts are thoroughly dried out, the unit should be closed up tight to exclude air and moisture. Trays containing a desiccant should be placed inside the steam and water drums to absorb the moisture in the air trapped by closing up the boiler.

A desiccant of indicating silica gel or activated alumina using approximately 80 lbs/1,000 cu. ft. of volume is very satisfactory for this purpose. If calcium chloride is used, the trays should not be more than three-quarters full of the desiccant to be sure that there will be no overflow of the corrosive liquid after the absorption of moisture. Any line which might leak moisture back into the unit should be blanked off or disconnected. Inspection should be made at regular intervals and the desiccant trays replenished as necessary.

Stand By Wet Storage

Before the unit is taken off the line, test and then establish the boiler water chemistry in accordance with the prescribed limits. The sodium sulfite concentration for lay-up conditions should also be 30 to 50 ppm. When securing the unit, do not let the steam pressure drop below 33 psig. At 33 psig, start filling the boiler through the feed system with hot deaerated water from the deaerating feed tank keeping all vents and drains closed. Boiler water should not be allowed to spill over into the superheater. Therefore, before completely filling the boiler

proper, backfill the superheater (through the connection provided) with hot, deaerated water from the deaerating feed tank until the unit is completely filled and under a hydrostatic pressure of 33 psig. The pressure should be held on the boiler constantly during the period of idle status. Any use of vents should be momentary during the filling and pressurizing procedure to insure that any trapped air is released.

Steam Blanket Method

Boilers to be placed in idle storage by the steam blanket method should be provided with a source of pressurizing steam at approximately 125-150 psig. This may be from another steaming boiler or from a source of shore steam of good quality. This steam should be introduced through the superheater inlet piping or superheater inlet nozzle so that the superheater will be protected. After the boiler has been secured and its pressure has dropped below the steam blanket supply pressure, the steam blanket supply is cut in. All vents and drains should be kept closed and the boiler and superheater allowed to fill with condensate. The steam blanket connection is left open to the unit as long as it is on idle status. The boiler water chemistry should be checked daily and held within the prescribed limits.

When returning the boiler to service, the superheater should be completely drained to the bilge and the water level in the steam drum brought to that required for lighting off. This water should also go to the bilge and should not be returned to the system.

Nitrogen Storage Method

The oxygen-free nitrogen storage method can be used with very satisfactory protection against waterside corrosion for either long or short term idle storage and is an inexpensive system to install.

With such a method, the boiler can be held at normal water level or emptied completely as long as a nitrogen gas pressure of 5 to 15 psi is maintained on the unit at all times during the idle status. If the boiler, terminal valves, and fittings are tight under normal hydrostatic pressure, they should be sufficiently tight for this type of storage.

Loss of nitrogen through normal leakage is slight. Nitrogen gas is non-toxic, and any leakage into the ship's spaces would not constitute a hazard. After initial filling of the boiler with nitrogen gas accomplished by means of a tee located in the steam drum vent connection properly valved for isolation purposes, a bank of perhaps three nitrogen cylinders piped up to the boiler steam drum vent connection

Nitrogen Storage Method - Cont'd.

through a check valve and pressure reducing valve will constantly replenish any loss. This will provide a constant gas pressure on the unit for a considerable length of time.

PROCEDURE FOR NITROGEN STORAGE - BOILER HELD AT NORMAL WATER LEVEL

The nitrogen is admitted to the unit when the boiler pressure has dropped below that at which the nitrogen pressure is to be held and all terminal valves and fittings have been secured. After the boiler is initially charged, the superheater drains should be opened briefly to insure that the superheater is completely under nitrogen pressure. The economizer vent and drain valves should be tightly closed so that it will remain entirely full of water.

PROCEDURE FOR NITROGEN STORAGE - BOILER, SUPERHEATER, AND ECONOMIZER COMPLETELY EMPTY

Admit the nitrogen when the boiler pressure has fallen below that at which the nitrogen pressure is to be held and the terminal superheater outlet stop valve, auxiliary steam stops, and feedwater stops have been secured. The economizer vent and drain valves and the boiler bottom drain valves at all locations except the superheater are opened wide to the bilges or overboard and the incoming nitrogen gas is allowed to displace the water in the boiler. When all water has been displaced. secure all drains and vents. Open the superheater drains briefly to insure that the superheater is completely charged with nitrogen, then secure.

With the unit completely under nitrogen pressure, then cut in the bank of replenishment cylinders and adjust the nitrogen reducing valve to maintain a constant gas pressure of 10 psi (25 psi absolute).

To ready the boiler for service it is only necessary to secure and disconnect the nitrogen supply and bring the water level to that required for lighting off. With the customary venting of the steam drum and superheater when raising steam pressure, any nitrogen in the steam drum and superheater will be displaced by the steam generated.

The economizer, where the boiler is so equipped, will be vented by the feedwater fed to the unit.

Nitrogen is commonly available in 5 foot cylinders filled at 70 degrees F. to a pressure of 2,200-2,400 psi. One such cylinder has enough nitrogen to occupy a volume of approximately 145 cubic feet at 10 psi gage (25 psi absolute). The pressure reducing valve should be a nitrogen regulator single flow-type and suitable for reducing from 2,200-2,400 psi to 5 to 15 psi.

Nitrogen Storage Method - Cont'd.

Assuming a boiler having a total water capacity as follows, the number of nitrogen cylinders required to initially charge one boiler can be approximately determined.

Boiler filled to normal water level	3,132 gallons
Boiler filled to top of drum, including economizer. . . .	4,344 gallons
Superheater (not including connecting piping)	264 gallons
Primary economizer - isolated	87 gallons
Secondary economizer - isolated	195 gallons

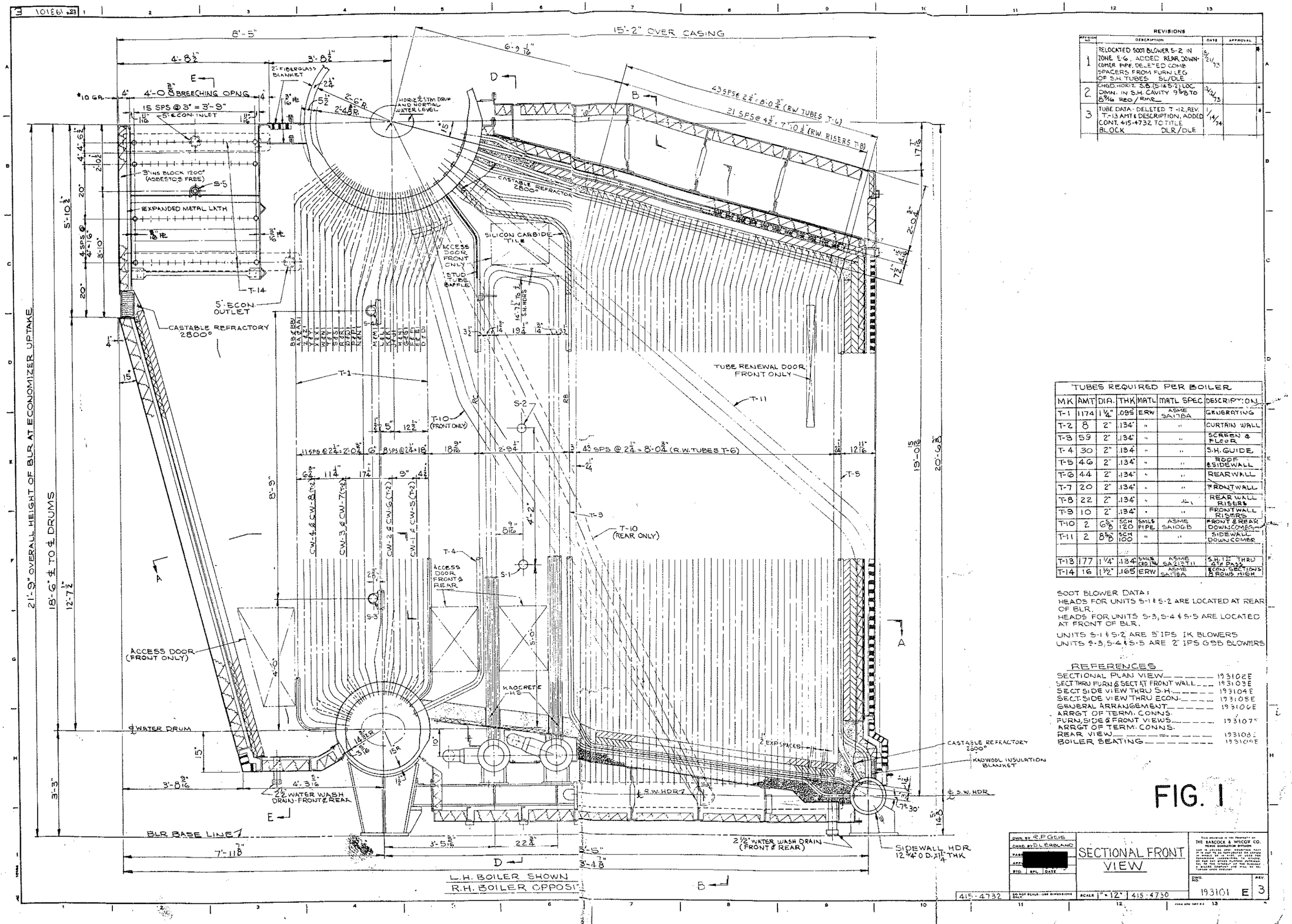
For a total capacity of the boiler, superheater, and economizer of 4,608 gallons, this is equivalent to a total volume of approximately 616 cubic feet. Assuming that the unit will be held under a constant gas pressure of 10 psi gauge, the number of nitrogen cylinders required would be approximately 4-1/4 clinders per boiler.

General

When boilers are to be called on for service on such short notice that wet storage is not practicable or are required to be held at stand by, such as lay-over in port when all boilers are not required to meet the port load, such boilers should be held under a steam pressure of 100 psi and only as much water fed to the boiler as is required to keep the water level in sight of the glass. The superheater drains should be operated in such a manner as to prevent any build up of condensate in the superheater.

During any extended lay-up, the furnace settings should be kept closed and regular inspection made to guard against the possibility of "sweating and corrosion" of the external surfaces of the pressure parts and internal surfaces of the pressure parts and the internal surfaces of the boiler casing. To accomplish this, it may be necessary to provide electric heaters in the furnace and on top of the economizer to prevent the condensation of moisture on the fireside surfaces. A stack cover should be tightly secured in place to prevent introduction of moisture down the stack. Whenever conditions permit, this is to be done.

Should the vessel be deactivated or placed in the lay-up fleet, all furnace floor refractory and insulation should be removed and the furnace floor tubes exposed up to their tube seats. These tubes should then be wire brushed and painted with a protective coat of aluminum paint or other anti-corrosive coating.



REVISIONS			
REVISION NO.	DESCRIPTION	DATE	APPROVAL
1	RELOCATED SOOT BLOWER S-2 IN ZONE E-6, ADDED REAR DOWNCOMER PIPE, DELETED COMB SPACERS FROM FURN LEG OF S.H. TUBES SL/DLE	5/21/73	
2	CHGD. HORIZ. S.B. (S-1 & S-2) LOC. DIMN. IN S.H. CAVITY 9⅝ TO 8¾ REQ/RMR	12/4/73	
3	TUBE DATA - DELETED T-12, REV. T-13 AMT & DESCRIPTION, ADDED CONT. 415-4732 TO TITLE BLOCK DLR/DLE	1/14/74	

TUBES REQUIRED PER BOILER

MK	AMT	DIA.	THK	MATL	MATL SPEC.	DESCRIPTION
T-1	1174	1¼"	.095	ERW	ASME SA178A	GENERATING
T-2	8	2"	.134"	"	"	CURTAIN WALL
T-3	59	2"	.134"	"	"	SCREEN & FLOOR
T-4	30	2"	.134"	"	"	S.H. GUIDE
T-5	46	2"	.134"	"	"	ROOF & SIDEWALL
T-6	44	2"	.134"	"	"	REAR WALL
T-7	20	2"	.134"	"	"	FRONT WALL
T-8	22	2"	.134"	"	"	REAR WALL RISERS
T-9	10	2"	.134"	"	"	FRONT WALL RISERS
T-10	2	6⅝" O.D.	SCH 120	SMLS PIPE	ASME SA106B	FRONT & REAR DOWNCOMERS
T-11	2	8⅝" O.D.	SCH 100	"	"	SIDEWALL DOWNCOMER
T-13	177	1¼"	.134"	SMLS CRO 1¼	ASME SA213T11	S.H. IN THRU 4TH PASS
T-14	16	1½"	.165	ERW	ASME SA178A	ECON. SECTIONS 4 ROWS HIGH

SOOT BLOWER DATA:
HEADS FOR UNITS S-1 & S-2 ARE LOCATED AT REAR OF BLR.
HEADS FOR UNITS S-3, S-4 & S-5 ARE LOCATED AT FRONT OF BLR.

UNITS S-1 & S-2 ARE 3" IPS IK BLOWERS
UNITS S-3, S-4 & S-5 ARE 2" IPS GSB BLOWERS

REFERENCES

SECTIONAL PLAN VIEW	193102E
SECT THRU FURN & SECT AT FRONT WALL	193103E
SECT SIDE VIEW THRU S.H.	193104E
SECT SIDE VIEW THRU ECON.	193105E
GENERAL ARRANGEMENT	193106E
ARRGT OF TERM. CONNS.	
FURN. SIDE & FRONT VIEWS	193107E
ARRGT OF TERM. CONNS.	
REAR VIEW	193108E
BOILER SEATING	193109E

FIG. 1

DWN BY R.P.GEIS
CHKD BY D.L.ERBLAND
PAT'D [redacted]
APP'D
STD. SPL. DATE

SECTIONAL FRONT VIEW

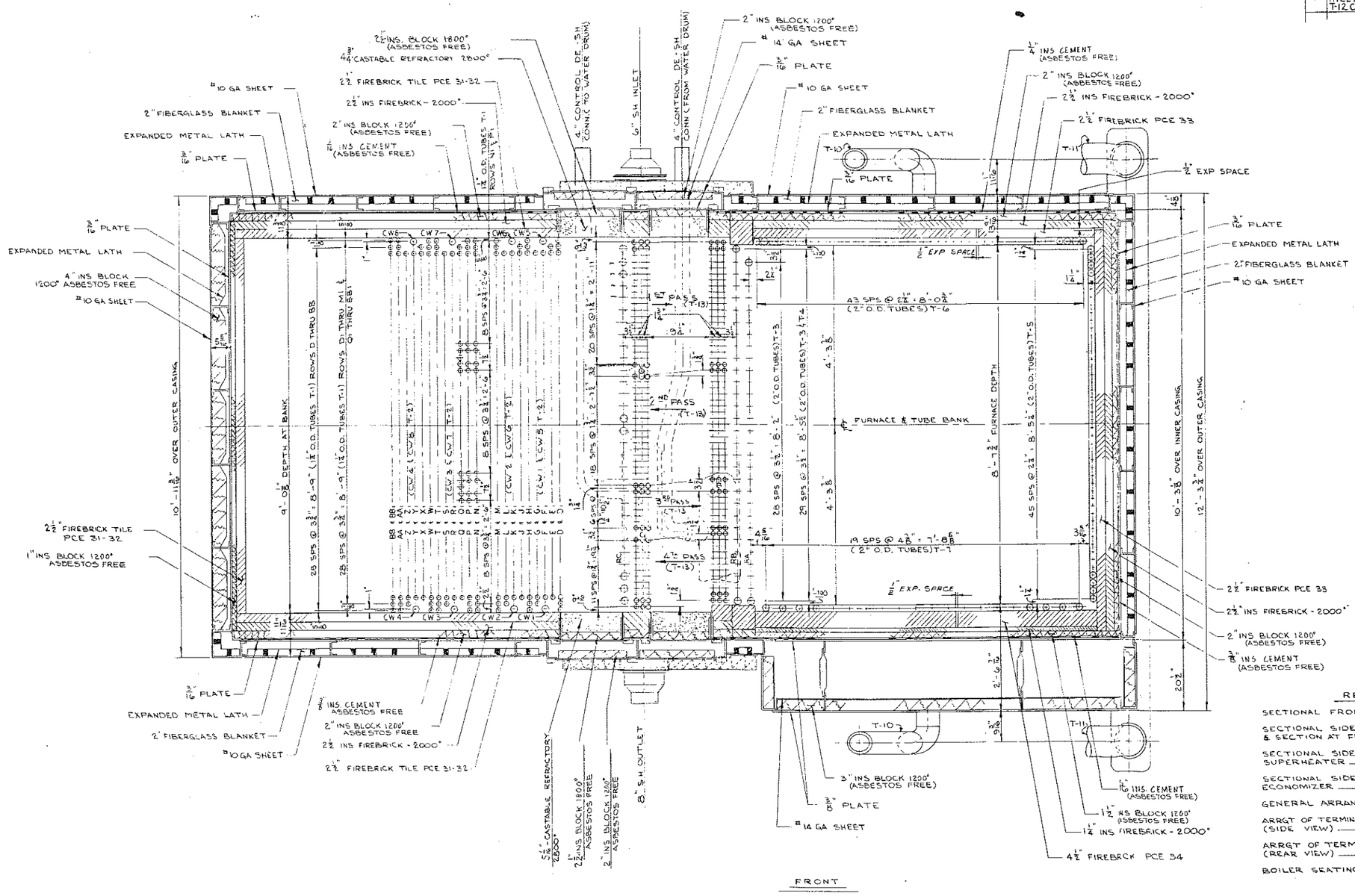
THE BABCOCK & WILCOX CO. POWER GENERATION DIVISION

DWG. NO. 193101 REV. E 3

415-4732 DO NOT SCALE-USE DIMENSIONS ONLY SCALE 1" = 12" 415-4730

3201E61

REVISIONS			
REVISION NO.	DESCRIPTION	DATE	APPROVAL
1	ADDED CONT. 415-4732 TO TITLE BLOCK, S.H. AT PASS T-12 CHG'D TO T-13 DLR/DLE	1/14/74	



SECTION A-A

L.H. BOILER SHOWN
R.H. BOILER OPP.

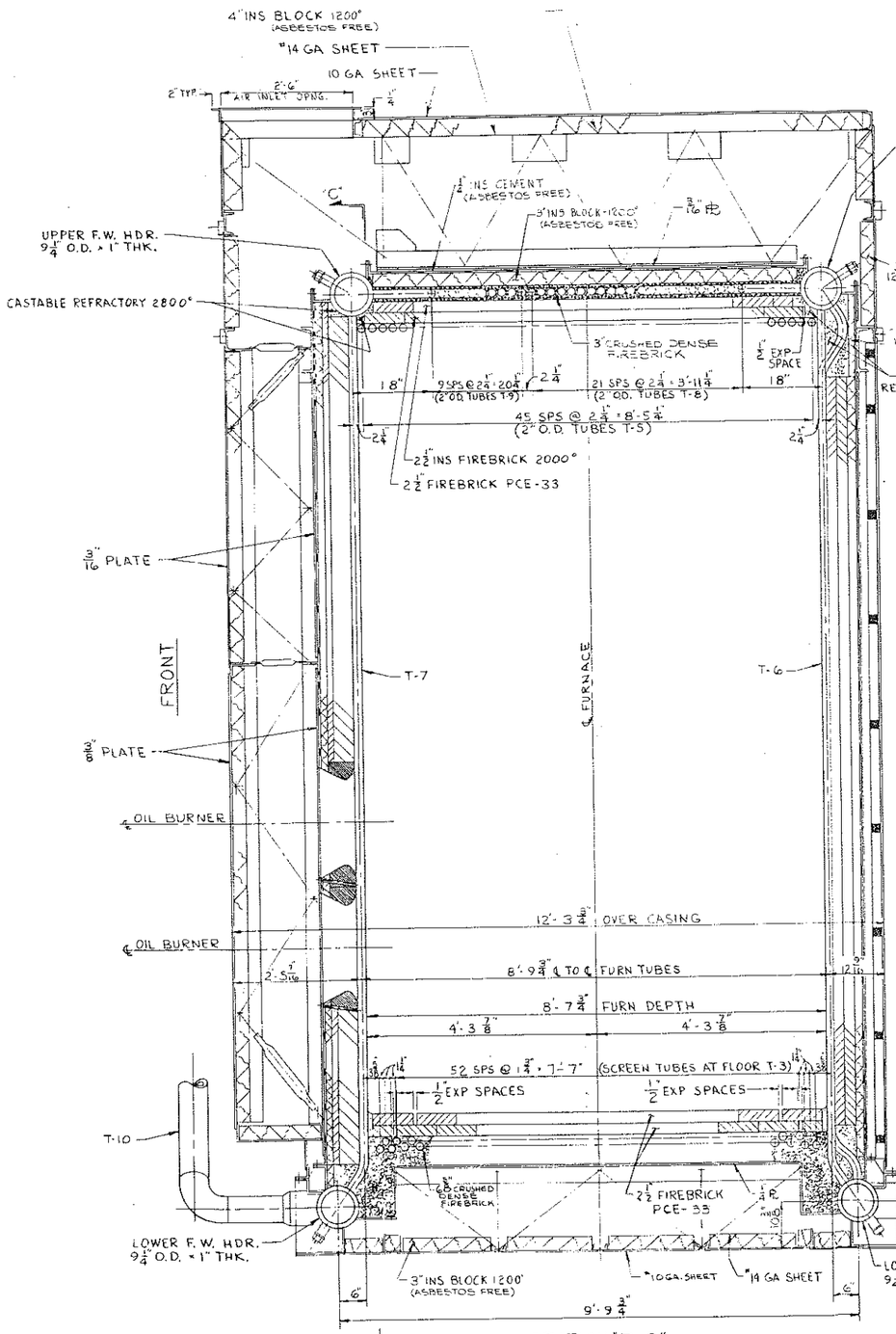
REFERENCE

SECTIONAL FRONT VIEW	193101E
SECTIONAL SIDE VIEW THRU FURNACE & SECTION AT FRONT WALL	193103E
SECTIONAL SIDE VIEW THRU SUPERHEATER	193104E
SECTIONAL SIDE VIEW THRU ECONOMIZER	193105E
GENERAL ARRANGEMENT	193106E
ARRGT OF TERMINAL CONN (SIDE VIEW)	193107
ARRGT OF TERMINAL CONN (REAR VIEW)	193108E
BOILER SEATING	193109E

FIG. 2

DWN BY R.P.GEIS CHKD. BY D.L. ERBLAND PASSED [redacted] APPVD RTD. APPL. DATE 6-29-73	SECTIONAL PLAN VIEW	THE BABCOCK & WILCOX CO. POWER GENERATION DIVISION DWG. NO. 193102 E REV. 1
DO NOT SCALE-USE DIMENSIONS	SCALE 1"=12"	415-4732 415-4730

REVISIONS			
REVISION NO.	DESCRIPTION	DATE	APPROVAL
1	ADDED CONT. 415-4732 TO TITLE BLOCK, INTERCHANGED MK NO'S 2 & 3 ON BNR'S DLR/DLE	1/14/74	

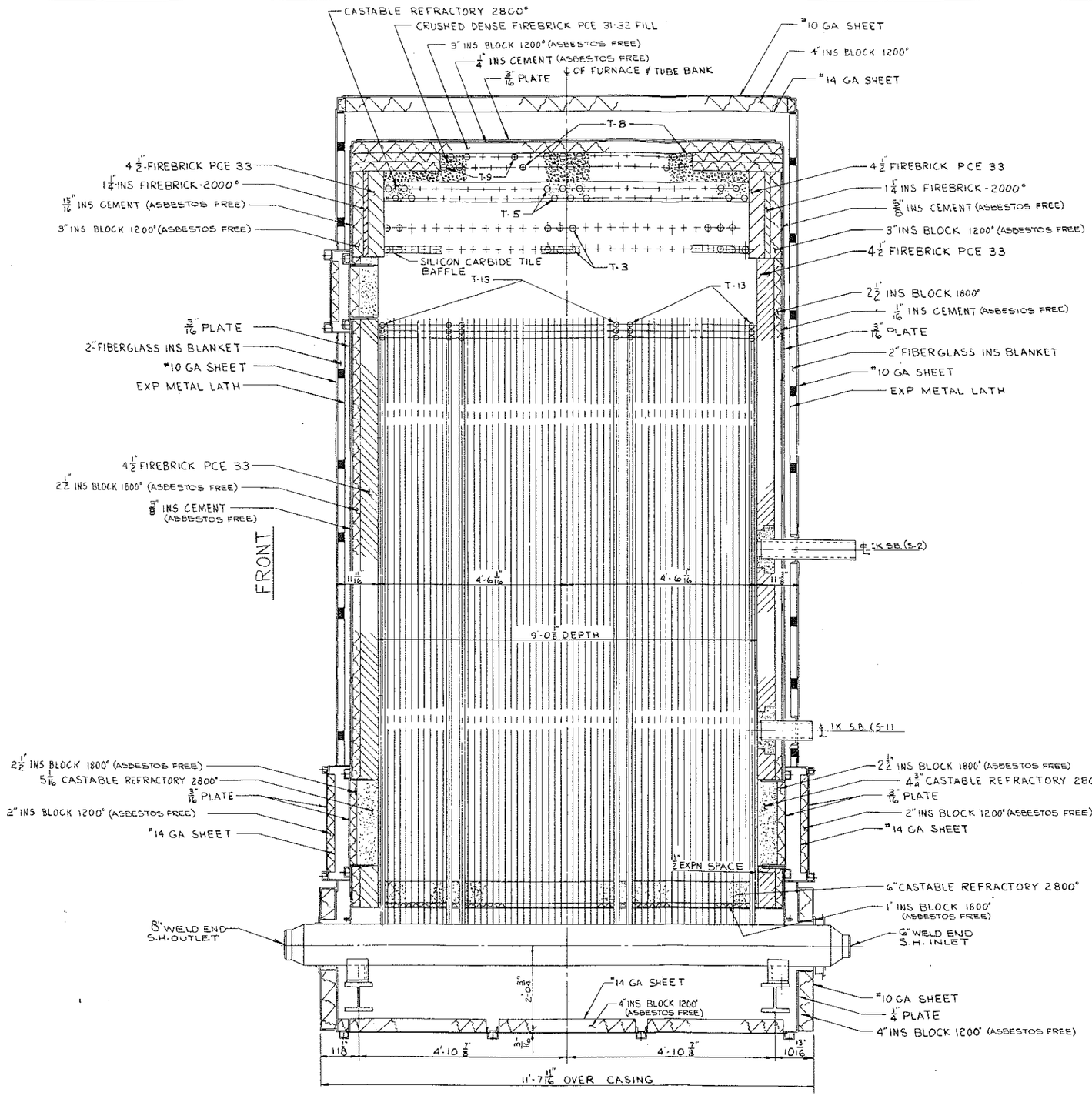


REFERENCES

SECTIONAL FRONT VIEW - - - - 193101E
SECTIONAL PLAN VIEW - - - - 193102E
SECTIONAL SIDE VIEW THRU S.H. - 193104E
SECT. SIDE VIEW THRU ECON. - - 193105E
GENERAL ARRANGEMENT - - - - - 193106E
ARRGT. OF TERM. CONNS.
FURN. SIDE & FRONT VIEWS - - - - 193107E
ARRGT. OF TERM. CONNS.
REAR VIEW - - - - - - - - - - 193108E
BOILER SEATING - - - - - - - - 193109E

FIG. 3

DWN. BY R.P. GEIS	THE BABCOCK & WILCOX CO. POWER GENERATION DIVISION	SECTION THRU FURNACE & SECTION AT FRONT WALL	
CHKD. BY D.L. EBERLAND			
PARTS [redacted]			
APPVD. [redacted] STD. [redacted] DATE 6-29-73			
DO NOT SCALE THIS DRAWING		SCALE 1"=12"	415-4730
415-4732			DRG. NO. 193103 E REV. 1



SECTION "D-D"
L.H. BOILER SHOWN
R.H. BOILER OPPOSITE

REVISIONS

REVISION NO.	DESCRIPTION	DATE	APPROVAL
1	ADDED CONT 415-4732 TO TITLE BLOCK, SH 1 & 1ST PASS CHG. T-12 TO T-13 DLR/DLE	1/11/74	

REFERENCES

SECTIONAL FRONT VIEW	193101E
SECTIONAL PLAN VIEW	193102E
SECT. THRU FURN. & FRONT WALL	193103E
SECT. SIDE VIEW THRU ECON.	193105E
GENERAL ARRANGEMENT	193106E
ARRGT. OF TERM. CONNS. FURN. SIDE & FRONT VIEWS	193107E
ARRGT. OF TERM. CONNS. REAR VIEW	193108E
BOILER SEATING	193109E

FIG. 4

DWN. BY R.P.GEIS
CHKD. BY [redacted]
PASSED BY
APPVD. BY
STD. DWG. 6-8-73 DATE

DO NOT SCALE - USE DIMENSIONS ONLY

SECTIONAL SIDE VIEW THRU SUPERHEATER

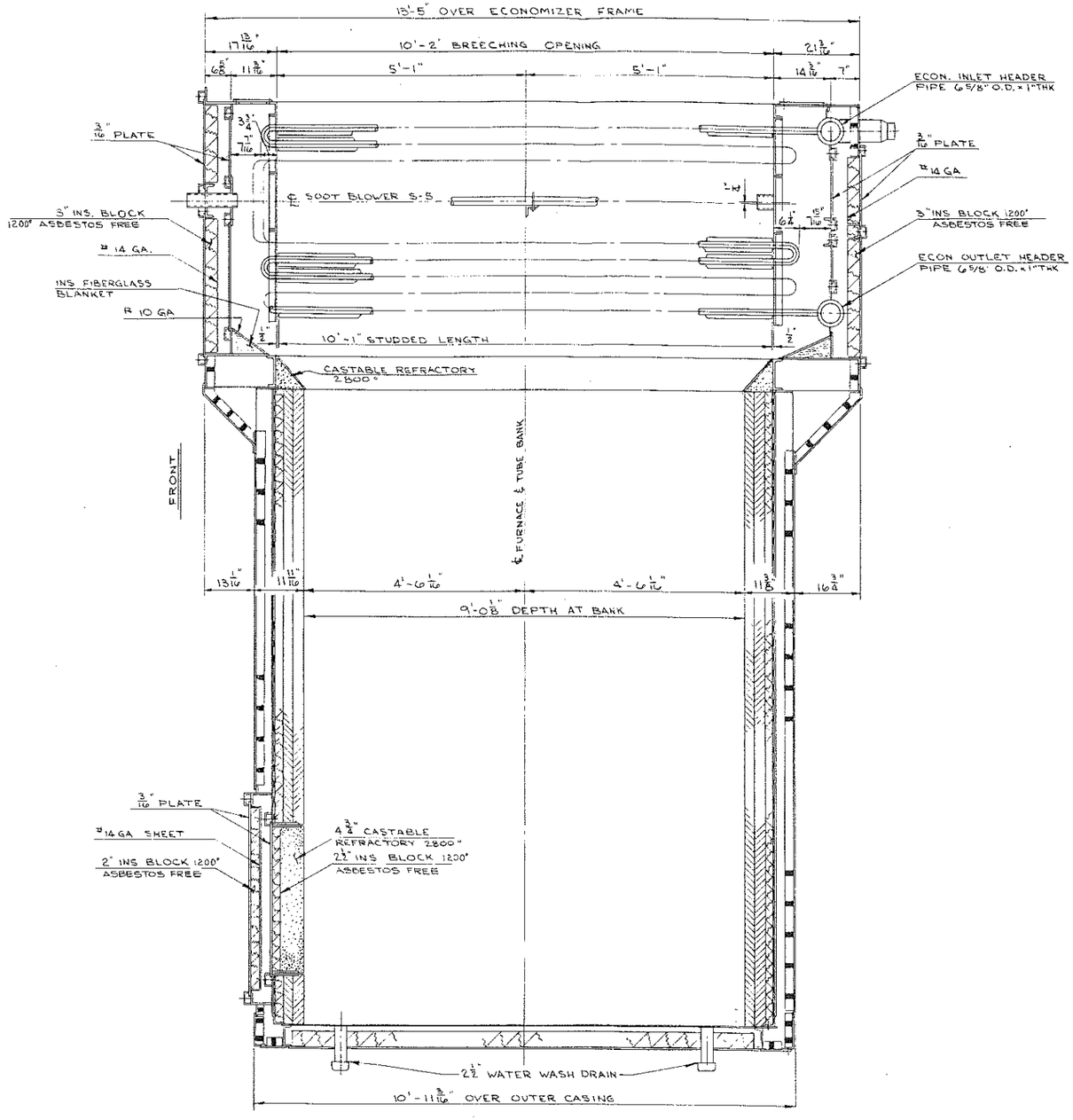
THE BABCOCK & WILCOX CO. POWER GENERATION DIVISION

SCALE 1"=12" 415 4730

415-4732

DWG. NO. 193104 E REV. 1

REVISIONS			
REVISION NO	DESCRIPTION	DATE	APPROVAL
1	ADDED CONT 415-4732 TO TITLE BLOCK DLR/DLE	1/14/74	



SECTION E - E
(THRU ECONOMIZER)
L.H. BOILER SHOWN
R.H. BOILER OPPOSITE

REFERENCE

SECTIONAL FRONT VIEW	193101E
SECTIONAL PLAN VIEW	193102E
SECTIONAL SIDE VIEW THRU FURNACE & SECTION AT FRONT WALL	193103E
SECTIONAL SIDE VIEW THRU SUPERHEATER	193104E
GENERAL ARRANGEMENT	193106E
ARRGT OF TERMINAL CONN (SIDE VIEW)	193107E
ARRGT OF TERMINAL CONN (REAR VIEW)	193108E
BOILER SEATING	193109E

FIG. 5

DWN. BY R.P. GEIS
CHKD BY D.L.F. ROLAND
PASSED [redacted]
APPVD
RTD. BPL 6-27-74

SECTIONAL SIDE VIEW THRU ECONOMIZER

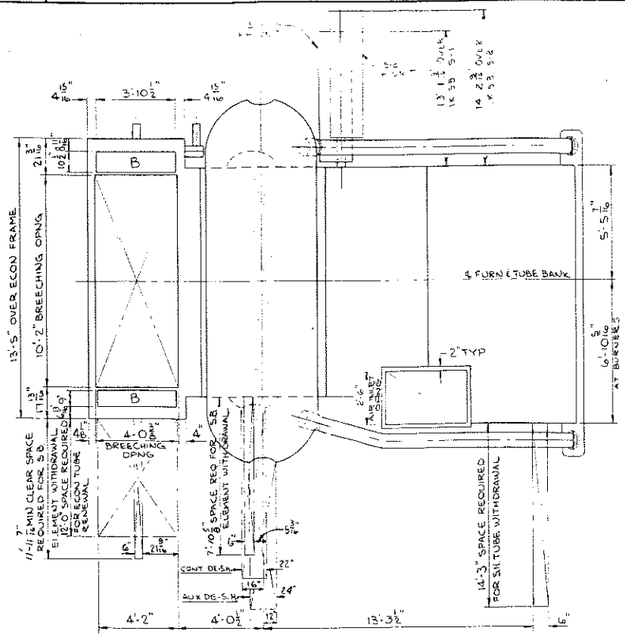
THE BABCOCK & WILCOX CO. POWER GENERATING DIVISION

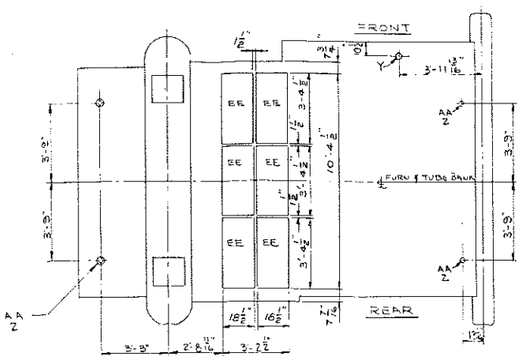
DRG. NO. 193105 E REV. 1

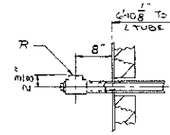
415-4732

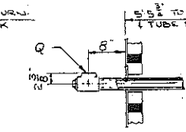
DO NOT SCALE. USE DIMENSIONS ONLY.

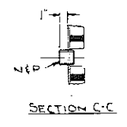
SCALE 1" = 1/2" | 415-4730

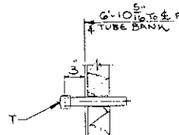


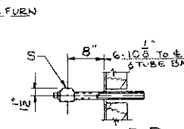












DESIGNATION OF SYMBOLS

A	ACCESS DOOR - ECON (FRONT & REAR) CLAMPED
B	ACCESS DOOR - ECON (TOP) BOLTED
C	ACCESS DOOR - CAVITY BEHIND TUBE BANK (FRONT ONLY) CLAMPED
D	ACCESS DOOR - S.H. CAVITY (FRONT & REAR) CLAMPED
E	ACCESS DOOR - UPPER FRONT WALL HEADER CLAMPED
F	ACCESS DOOR - UPPER REAR WALL HEADER CLAMPED
G	S.H. TUBE REMOVAL DOOR (FRONT ONLY) CLAMPED
H	12"x16" MANHOLE (S.D. - FRONT & REAR) W.D. - FRONT ONLY)
J	1K SOOTBLOWER UNIT
K	G9B SOOTBLOWER UNIT
L	OIL BURNERS - B&W 3M SARATOGA WITH RACER ATOMIZERS
M	PREHEATED AIR INLET CONNECTION
N	½" S.B. SCAVENGING AIR CONN. (SCRD COUPLING) G9B UNIT
P	2" S.B. " " " " " 1K UNIT
Q	2" - ECONOMIZER DRAFT CONN. (SCRD)
R	2" - FURNACE DRAFT CONN. (SCRD)
S	1" - WINDBOX DRAFT CONN. (SCRD)
T	1" - STEAM SMOTHERING CONN. (SCRD & CAPPED)
W	INSPECTION LIGHT
X	OIL LEAKAGE OBSERVATION PORT
Y	2" OIL LEAKAGE DRAIN CONN. (SCRD & CAPPED)
Z	B&W WORK TERMINATES HERE
AA	2½" WATER WASH DRAIN CONN. (SCRD & CAPPED)
BB	ACCESS DOOR - CAVITY AT TUBE BANK (FRONT & REAR) CLAMPED
CC	ACCESS DOOR - FURNACE ROOF CAVITY - CLAMPED
DD	ACCESS DOOR - CAVITY ABOVE S.H. (FRONT ONLY) CLAMPED
EE	ACCESS DOOR - BOTTOM S.H. VESTIBULE - CLAMPED

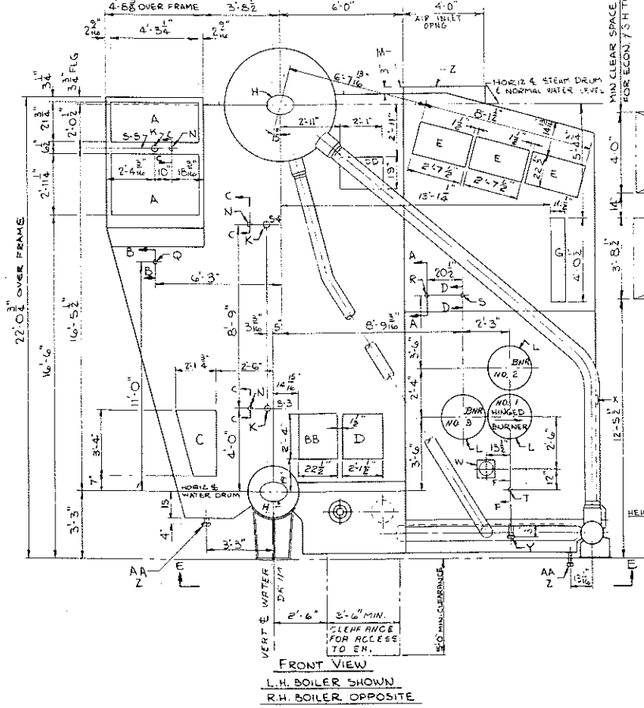
REVISIONS

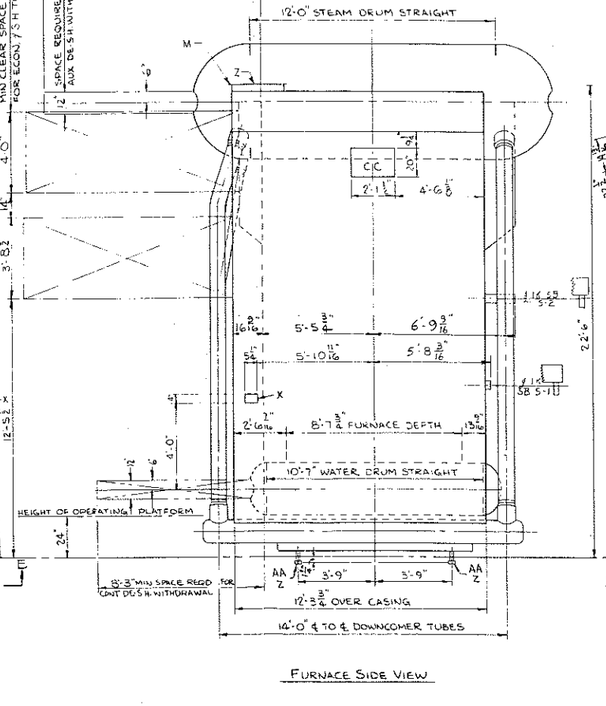
REVISION NO.	DESCRIPTION	DATE	APPROVAL
1	ZONE 4-A REV DIM OVER 1K SB 5-1 & 5-2. ZONE 7-G ADDED DIM OVER SB SLEEVE DLR/RAE	12/10/73	
2	ADDED CONT 415-4732 TO TITLE BLOCK, INTERCHANGED MK Nº 243 ON BNR'S DLR/DLE	1/14/74	

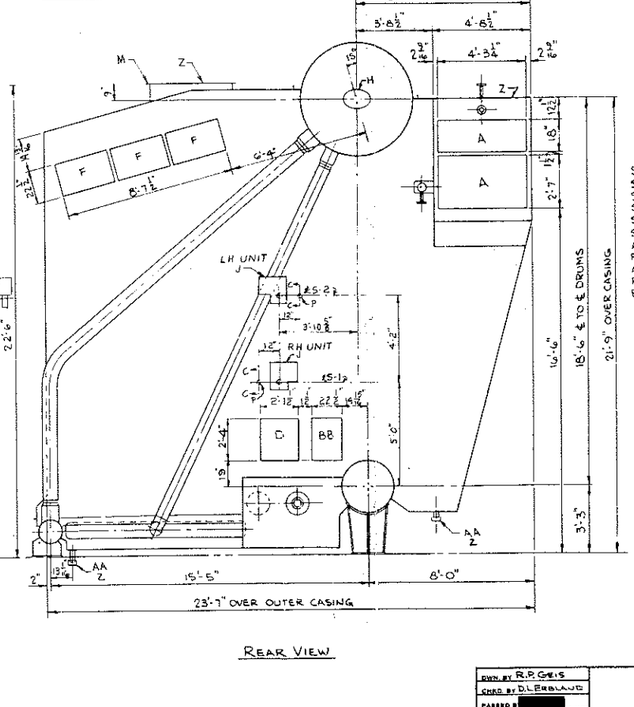
GENERAL NOTES

1. ALL EXTERNAL PIPING AND EQUIPMENT MUST BE KEPT AT LEAST 18" FROM MANHOLES, DOORS AND REMOVABLE PANELS.
2. LAGGING OF EXPOSED PRESSURE PARTS NOT BY B&W.
3. THE BOILER CASING IS SELF-SUPPORTING AND IS ONLY DESIGNED FOR THE ADDITIONAL EXTERNAL LOAD OF 10,000 LBS AT THE UPTAKE.

   TIE BARS BETWEEN THE BOILER CASING AND ANY OTHER STRUCTURE SHOULD NOT BE ADDED WITHOUT WRITTEN PERMISSION OF THE B&W CO.
4. ESTIMATED WEIGHT OF BOILER:
   DRY ..... 246,100 LBS
   WET ..... 265,800 LBS
5. CUSTOMER'S CONNECTION TO BREECHING & AIR INLET OPENINGS TO BE STRENGTH WELDED TO MEMBERS.







REFERENCES

SECTIONAL FRONT VIEW	193101E
SECTIONAL PLAN VIEW	193102E
SECTION THRU FURNACE AND SECTION AT FRONT WALL	193103E
SECTIONAL SIDE VIEW THRU S.H.	193104E
SECTIONAL SIDE VIEW THRU ECON.	193105E
ARRGT. OF TERMINAL CONNECTIONS FURNACE SIDE & FRONT VIEWS	193107E
ARRGT OF TERMINAL CONNECTIONS REAR VIEW	193108E
BOILER SEATING	193109E

FIG. 6

DWN. BY R.P. GEIS	THE BABCOCK & WILCOX CO. POWER GENERATION DIVISION	GENERAL ARRANGEMENT	DWG. NO. 193106 E REV. 2
CHKD. BY D.L. EIBLAND			
PASSED BY [redacted]			
APPVD. BY			
STD. SPL.	DATE 2/24/72		

415-4732 — DO NOT SCALE - USE DIMENSIONS ONLY — SCALE ⅜" & 1" = 1'-0" — 415-4730

3Z01E61 DWG

REVISION NO.	DESCRIPTION	DATE	APPROVAL
1	ADDED CONT 415-4732 TO TITLE BLOCK DLR/DLE	1/1/74	

13'-0 STEAM DRUM STRAIGHT

2"-1500# DRUM PILOT VALVE CROSBY 16 F 22 HWJ-MS-SS

2"-1500# SAFETY VALVE CROSBY 6 K 6 HWJ-MS-SS

2"-600# DRUM VENT CONN

¾"-600# STEAM GAGE CONN.

6"-600# FLG MAIN STEAM OUTLET

4"-600# FLG. LOW WATER CUTOFF

1"-600# FLG. F.W. REG.

2½"-600# FLG. Nº 1816B JERGUSON WATER GAGE 18" VISIBLE GLASS

1"-1500# FLG. CHEMICAL FEED

2"-1500# FLG. SURFACE BLOWOFF

℄ STEAM DRUM ℄ NORMAL WATER LEVEL

1½"-600# FLG. WATER GAGE DRAIN VALVE CONN.

2½"-600# FLG Nº 1816B JERGUSON WATER GAGE 18" VISIBLE GLASS

3"-600# FLG LOW WATER CUTOFF

1"-600# FLG. F.W. REG.

1"-600# FLG WATER GAGE DRAIN VALVE CONN

5" AUX. DE-S.H. OUTLET WELD END

5" MAIN FEED WELD END

5" AUX DE-S.H. INLET WELD END

FRONT MANHEAD

℄ S.H. INLET OUTLET HDR.

℄ S.H. INLET HDR.

8" WELD END S.H. OUTLET

2½"-1500# FLG S.H. HDR. DRAIN

VIEW A-A

TERMINAL DESCRIPTION	OUTSIDE DIA.	DIA. "D"	MIN. THK.	MATL
4"-CONTROL DE-S.H. INLET	4½"	3.910"	.295"	NOTE #1
4"-CONTROL DE-SH OUTLET	4½"	3.910"	.295"	NOTE #2
5"-MAIN FEED	5 9/16"	4.687"	.438"	"
5"-ECONOMIZER INLET & OUTLET	5 9/16"	4.687"	.438"	"
5"-AUX. DE-SH OUTLET	5 9/16"	4.687"	.438"	"
5"-AUX. DE-SH INLET	5 9/16"	4.687"	.438"	NOTE #1
6"-SUPERHEATER INLET	6 5/8"	5.833"	.378"	"
8"-SUPERHEATER OUTLET	8 5/8"	7.328"	.629"	"

NOTE #1-ASME SA335P11 OR ASME SA182F11
NOTE #2-ASME SA106 GR B OR ASME SA105-2

FOR NOTES SEE DWG 193108E

REFERENCES

SECTIONAL FRONT VIEW	193101E
SECTIONAL PLAN VIEW	193102E
SECTION THRU FURNACE & SECTION AT FRONTWALL	193103E
SECTION THRU SUPERHEATER	193104E
SECTION THRU ECONOMIZER	193105E
GENERAL ARRANGEMENT	193106E
TERMINAL CONNECTIONS REAR VIEW	193108E
[illegible]	193109E

37½°±2½° MIN. THK. 10" DIA. "D" ±.005" OUTSIDE DIA.

℄ WATER DRUM

2"-1500# FLG S.H. HDR DRAIN

8" WELD END S.H. OUTLET

1½"-1500# FLG. BOTTOM BLOW

3"-1500# FLG. S.H. HDR. DRAINS

1"-1500# FLG. FRONTWALL HDR. DRAINS

1"-SOCKET WELD SALINOMETER CONN.

1"-SOCKET WELD SIDEWALL HDR. DRAIN CONN.

℄ FRONTWALL HEADER

FRONT VIEW

℄ FURNACE & TUBE BANK

FRONT

12'-3¾" OVER CASING

8'-7¾" FURNACE DEPTH

10'-7" WATER DRUM STRAIGHT

℄ WATER DRUM

℄ S.H. HEADERS

℄ SIDEWALL HEADERS

BOILER BASE LINE ℄

4'-10⅞" To ℄ FRONTWALL HEADER

4'-10⅞" To ℄ REARWALL HEADER

14'-0" ℄ To ℄ DOWNCOMER TUBES

4"-WELD END CONTROL DE-S.H. OUTLET

4"-WELD END CONTROL DE-S.H. INLET

6"-WELD END S.H. INLET

3"-WELD END S.H. HDR. DRAIN

1"-WELD END S.W. HDR. DRAIN

1"-1500# FLG. REARWALL HDR. DRAIN

1"-1500# FLG. FRONTWALL HDR. DRAIN

FURNACE SIDE VIEW
L.H. BOILER SHOWN
R.H. BOILER OPPOSITE

FIG. 7

DWN BY R.P. GEIS
CHKD [redacted]
PARSE
APPVD
STD. SPL. DATE

DO NOT SCALE. USE DIMENSIONS ONLY

415-4732

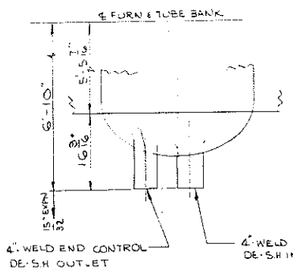
ARRANGEMENT OF TERMINAL CONNECTIONS FURNACE SIDE & FRONT VIEWS

SCALE 1"=12" 415-4730

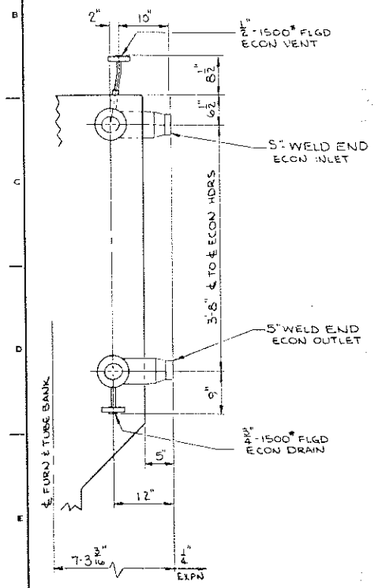
DWG NO. 193107E REV. 1

THE BABCOCK & WILCOX CO. POWER GENERATION DIVISION

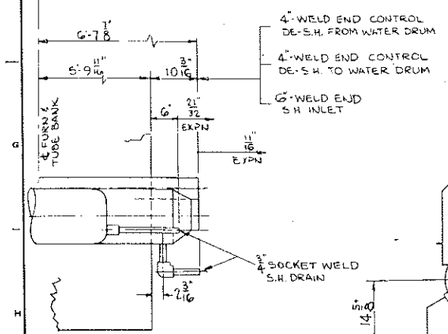
REVISIONS				
REVISION NO	DESCRIPTION	DATE	APPROVAL	
1	NOTE "5-REWRITTEN. DE/DLE	6/21/73		
2	ADDED CONT 415-4732 TO TITLE BLOCK DLR/DLE	1/14/74		



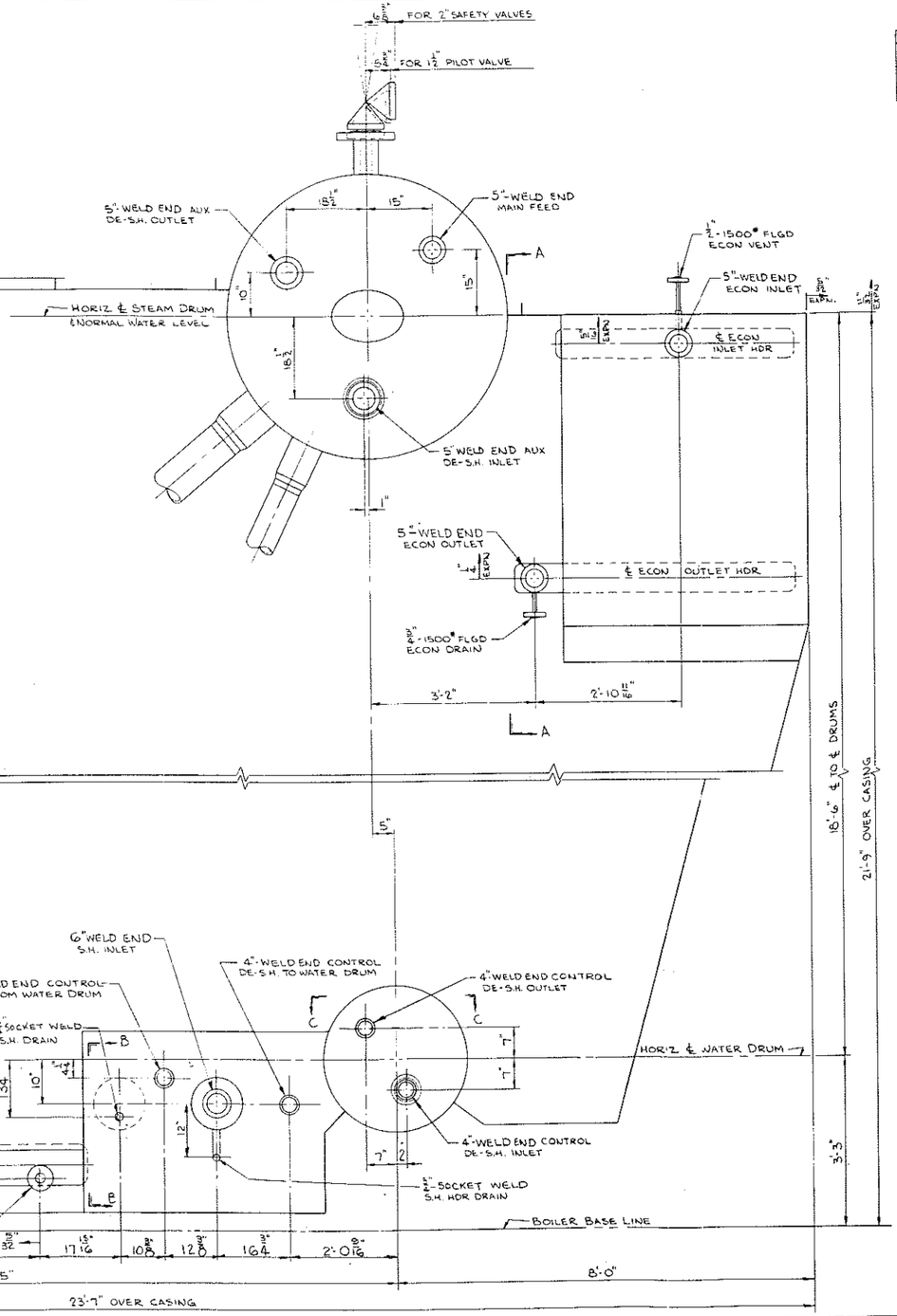
VIEW "C-C"



VIEW "A-A"



VIEW "B-B"



REAR VIEW
L.H. BOILER - SHOWN
R.H. BOILER - OPPOSITE

GENERAL NOTES

1. ALL FLANGES UNLESS OTHERWISE NOTED ARE ASA STD. WITH 1/16" RAISED FACE TO MFG. STD. AND ARE TO HAVE 32 SERRATIONS PER INCH 1/64" DEEP.
2. DIMENSIONS OVER VALVES INCLUDE 1/8" FOR EACH GASKET.
3. ALL FLANGE BOLT HOLES ARE TO STRADDLE HORIZ. & VERTICAL CENTERLINES.
4. LAGGING OF EXPOSED PRESSURE PARTS NOT BY THE B & W CO.
5. THIS UNIT IS DESIGNED TO GENERATE 90,200 LBS STM/BLR/HR AT NORMAL AND 115,250 LBS STM/BLR/HR AT OVERLOAD BASED ON A FEED TEMPERATURE OF 285°F.
6. S.H. UNLOADING SAFETY VALVE - CROSBY 2"-1500# FLGD TYPE 2H3 HNB-MS-58 FURNISHED BY B&W CO. AND INSTALLED IN CUSTOMER'S STEAM PIPING.
7. RELIEVING CAPACITY OF SAFETY VALVES

2 DRUM SAFETY VALVES	78,214 LB/HR
1 DRUM PILOT ACTUATED	14,860 LB/HR
1 SUPERHEATER S.V.	30,412 LB/HR
TOTAL	123,486 LB/HR

8. ALL EXPANSIONS LESS THAN 5/8" OMITTED.
9. FOR TERMINAL WELD END DETAIL SEE 193107E

BOILER DATA

BOILER DESIGN PRESSURE	1070 PS.I.
OPERATING PRESSURE AT S.H. OUTLET	880 PS.I.
STEAM TEMPERATURE AT S.H. OUTLET	910°F
BOILER SAFETY VALVE SETTINGS	1050 1070 PSI
S.H. PILOT VALVE SETTING	1030 PSI
S.H. UNLOADING SAFETY VALVE SETTING	1030 PSI
OPERATING PRESSURE AT STEAM DRUM FOR THREE RATES	
NORMAL =	942 PS.I.
ABS MAX. =	965 PS.I.
OVERLOAD =	982 PS.I.

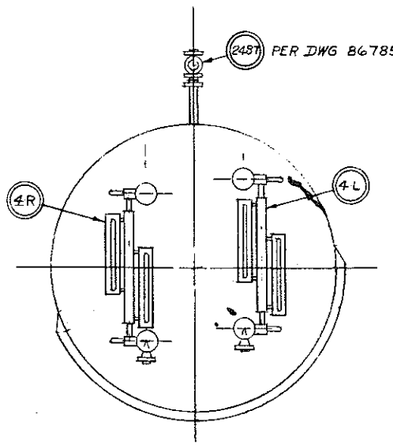
REFERENCES

SECTIONAL FRONT VIEW	193101E
SECTIONAL PLAN VIEW	193102E
SECTION THRU FURNACE AND SECTION AT FRONT WALL	193103E
SECTIONAL SIDE VIEW THRU SUPERHEATER	193104E
SECTIONAL SIDE VIEW THRU ECONOMIZER	193105E
GENERAL ARRANGEMENT	193106E
ARRANGEMENT OF TERMINAL CONNECTIONS FURNACE SIDE AND FRONTS VIEWS	193107E
BOILER SEATING	193109E

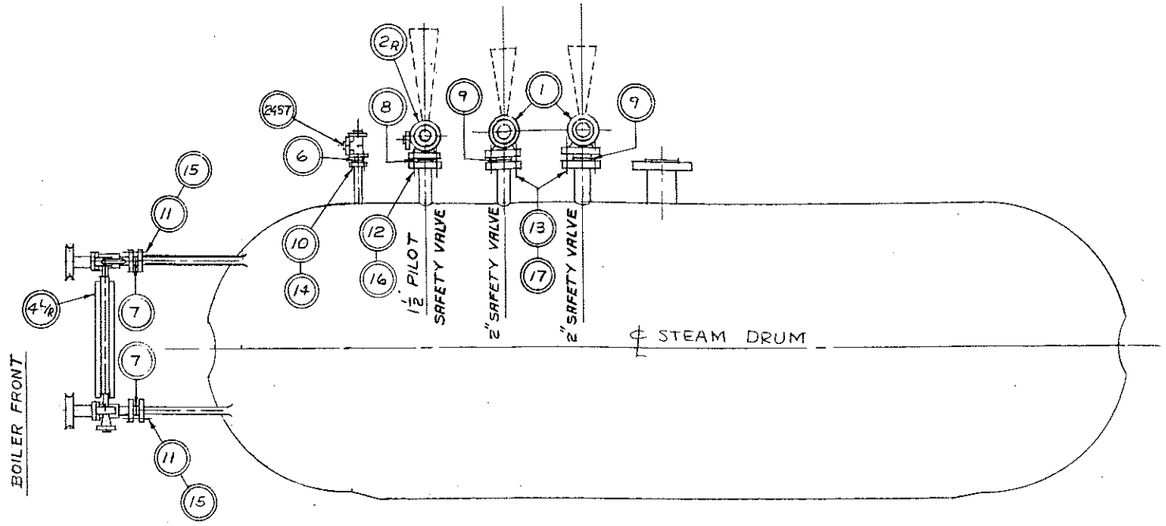
FIG. 8

DWN BY R.P.GEIS	ARRANGEMENT OF TERMINAL CONNECTIONS REAR VIEW	THE BABCOCK & WILCOX CO. POWER GENERATION DIVISION	
CHKD BY D.LERKLAND			
PARREL [redacted]			
APPVD			
STD.	DATE 6-29-73		
DO NOT SCALE - USE DIMENSIONS ONLY	SCALE 1"=1'2"	415-4730	DRG. NO. 193108 E REV. 2

415-4732



ARRGT SHOWN FOR LH BOILER
ARRGT OPPOSITE FOR RH BOILER



REVISIONS

REVISION NO	DESCRIPTION	DATE	APPROVAL
1	NOTED REF DWG'S FOR CONTRACT 415-4695/98. ADDED AND NOTED REF DWG'S FOR CONTRACTS 415-4730 & 415-4731 DLR/DLE	9/24/73	

NOTES

1. SH. SAFETY VALVE TO BE INSTALLED IN THE CUSTOMER'S LINE. INLET FLANGE IS IN ACCORDANCE WITH 1500 PSI.
2. GASKET MATERIAL STAINLESS STEEL
3. STUD MATERIAL A.S.T.M. SA-193 GR B-16
4. ALL HEX NUTS AMER STD HVY SA-194-2H.
5. FLANGES ARE TO HAVE $\frac{1}{4}$" RAISED FACE WITH 32 SERRATIONS PER INCH- $\frac{1}{64}$" DEEP.
6. DRUM PILOT VALVE, RH MOUNTING, IS SHOWN FOR LH BOILER. DRUM PILOT VALVE, LH MOUNTING, IS OPPOSITE FOR RH BOILER. INLET FLANGE IS IN ACCORDANCE WITH 1500 P.S.I.

LIST OF MATERIAL - QUANTITIES FOR ONE BOILER

MK NO	QTY	DESCRIPTION	MATL	REMARKS
1	2	2" CROSBY DRUM SAFETY VALVE FIG 2H3-HN-MS-55	C.S.	1500 PSI INLET FLG.
2 L/R	1	1½" CROSBY PILOT SAFETY VALVE FIG 1½F2½-HNP-MS-55.	C.S.	NOTE #6
3	1	2" CROSBY SH SAFETY VALVE FIG 2H3-HNB-MS-58	CHROME MOLY	NOTE #1
4 L/R	2	¾" JERGUSON WATER GAGE. FIG 1816 B 18" VISIBILITY		600 PSI INLET FLG
2487	1	½" x ½" x ½" DRUM VENT STEAM GAGE TEE	C.S.	600 PSI FLGD
6	1	GASKET ⅞" I.D. x 1¼" O.D. x 2⅛" RING O.D. 600 P.S.I.	NOTE #2	FLEXITALLIC CG-6B
7	4	GASKET 1" I.D. x 1 9/16" O.D. x 2⅝" RING O.D. 600 P.S.I	"	FLEXITALLIC CG-6C
8	1	GASKET 2" I.D. x 2 3/4" O.D. x 3 7/8" RING O.D. 1500 P.S.I.	"	FLEXITALLIC CG-15F
9	2	GASKET 2 9/16" I.D. x 3 3/8" O.D. x 5⅛" RING O.D. 1500 P.S.I.	"	FLEXITALLIC CG-15G
10	4	½" STUD x 3" LG THRD 13 UNC-2A FULL LGTH	NOTE #3	
11	16	⅝" STUD x 3 3/8" LG THRD 11 UNC-2A FULL LGTH	"	
12	4	1" STUD x 5 7/8" LG THRD 8 UNC-2A FULL LGTH	"	
13	16	⅞" STUD x 6 1/8" LG THRD 9 UNC-2A FULL LGTH	"	
14	8	½" HVY HEX. NUT	NOTE #4	
15	32	⅝" HVY HEX. NUT	"	
16	8	1" HVY HEX. NUT	"	
17	32	⅞" HVY HEX. NUT	"	
18	1	SET OF DIAMOND SOOTBLOWER EQUIPMENT		
19	1	"WAGER" VISUAL SMOKE INDICATOR		3 UNIT TYPE

REFERENCE DRAWINGS

FOR CONTRACT 415-4695/98 ONLY
- ARRGT & DETAIL OF BOILER PIPING — 154410 E
- ARRGT OF TERMINAL CONNECTIONS FURNACE SIDE & FRONT VIEWS — — — 151697E
- ARRGT OF TERMINAL CONNECTIONS REAR VIEW — — — — — — — — — 151698E

FOR CONTRACT 415-4730
- ARRGT & DETAIL OF BOILER PIPING — 193087E
- ARRGT OF TERMINAL CONNECTIONS FURNACE SIDE & FRONT VIEWS — — — 193107E
- ARRGT OF TERMINAL CONNECTIONS REAR VIEW — — — — — — — — — 193108E

FOR CONTRACT 415-4731
- ARRGT & DETAIL OF BOILER PIPING — 193087E
- ARRGT OF TERMINAL CONNECTIONS FURNACE SIDE & FRONT VIEWS — — — 204137E
- ARRGT OF TERMINAL CONNECTIONS REAR VIEW — — — — — — — — — 204138E

FIG. 9

DWN. BY D.E.C.
CHKD. BY E.A.DISER
PASSED [redacted]
APPVD. [redacted]
STD. | SPL. | DATE

DO NOT SCALE-USE DIMENSIONS ONLY.

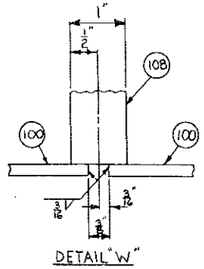
ARRANGEMENT OF VALVES & FITTINGS

SCALE 3/4" = 1'-0" 415-4695/98

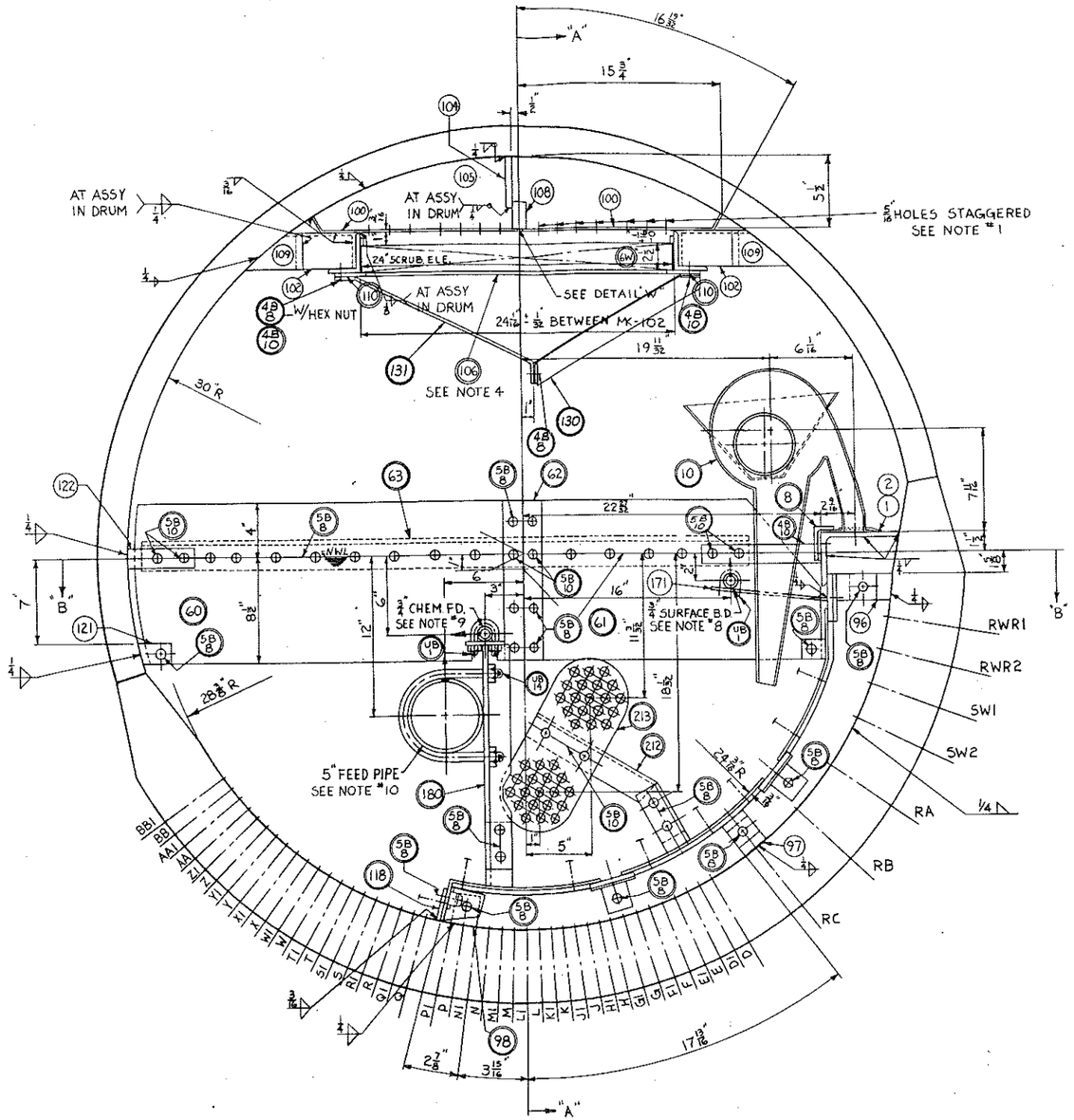
DWG. NO. 108745 D REV. 1

FORM 40H 1067 D-C

REVISIONS			
REVISION NO.	DESCRIPTION	DATE	APPROVAL
1	ZONE C-6,7 ADDED SCREEN TO SCRUBBER AND REMOVED 5B8 @ 1 ADDED WELD SYM. ZONE 3E AG/AB	6/1/74	[redacted]



DETAIL "W"



SECTION "C-C"

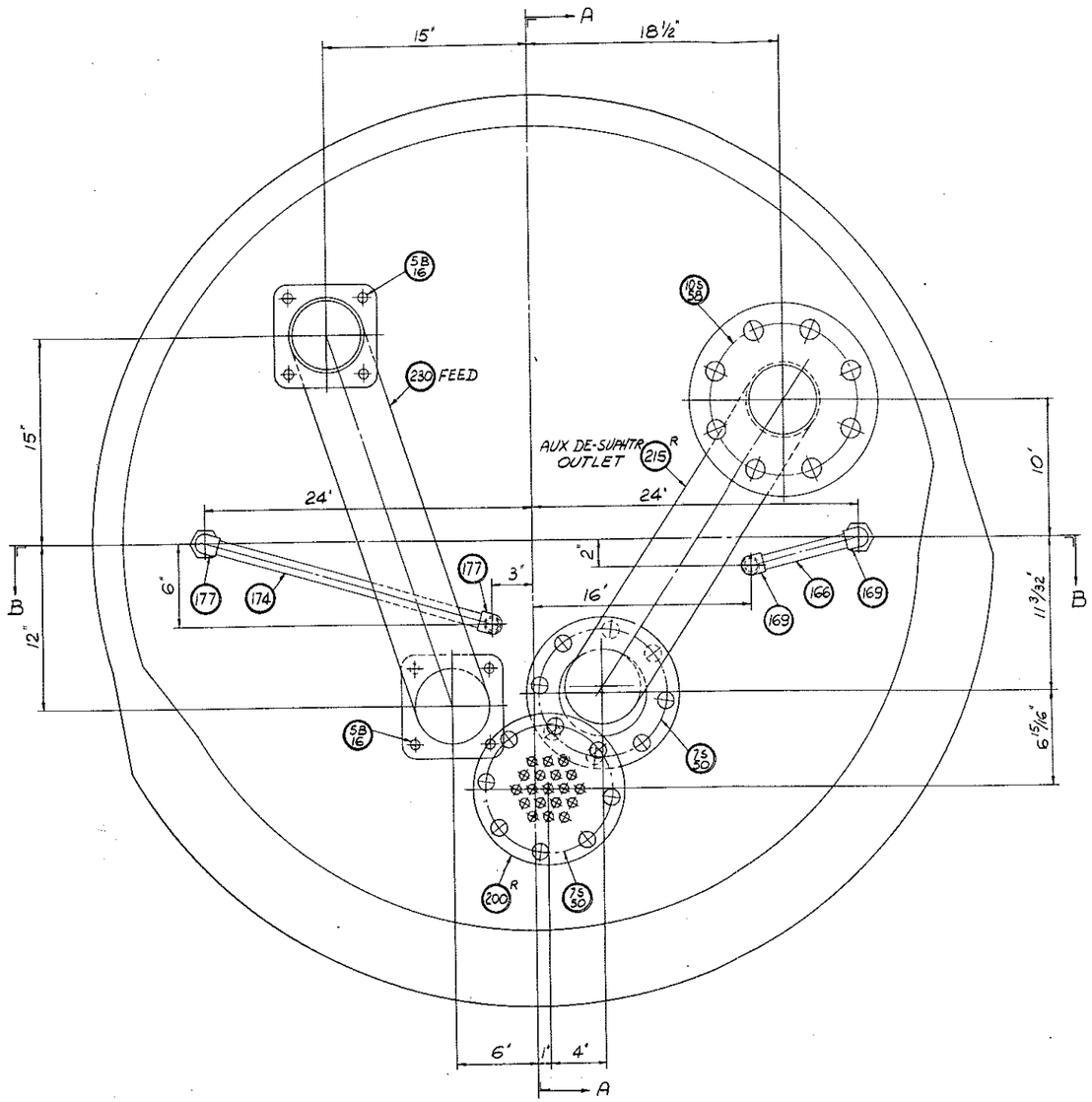
NOTES
1. PERFORATED PLATE WITH 5/16" DIA HOLES 336 TOTAL.
2. FOR SECTIONS A-A & B-B SEE 205226E FOR "D-D" SEE 205225E
3. 15" × 2 1/2" × 24" SCRUBBER ELEMENTS PER 79365D MK-6W.
4. SEAL BAR 1/2" × 1/4" × 25" WELD TO END PLATES AFTER ELEMENTS ARE TIGHT IN PLACE.
5. CIRCULAR DIMS. TAKEN ON INSIDE OF DRUM.
6. ◯ DENOTES SHIPPING UNITS
7. FOR 5/0 SEE PAGES 31 THRU 44.
8. 3/4" SCH. 40 SURFACE BLOW W/4-3/8" HOLES ON TOP & 1-3/8" HOLE FOR DRAIN ON BOTTOM &
9. 3/4" SCH. 40 CHEM. FEED W/33-1/8" HOLES ON HORIZ. & TOWARD LEFT & 1/4" DRAIN IN CAP.
10. 5" SCH 40 FEED W/102-1/2" HOLES ON TOP & & 1-1/2" DRAIN BOTTOM & END PL.

FIG. 10

DWN. BY	UNDERWOOD	ASSY OF INTERNALS 60" DRUM	THE BABCOCK & WILCOX CO. POWER GENERATION GROUP
CHKD. BY	A. BACSI		
PANEL	[redacted]		
APPVD.	DATE 6-14-74		
SYS.	415-4741-10		DWG. NO. 205224 E REV. 1
DO NOT SCALE - USE DIMENSIONS ONLY	SCALE 75		

REVISIONS

REVISION NO.	DESCRIPTION	DATE	APPROVAL



SECTION D-D

ARRG'T FOR RH BOILER SHOWN
ARRG'T FOR LH BOILER OPPOSITE

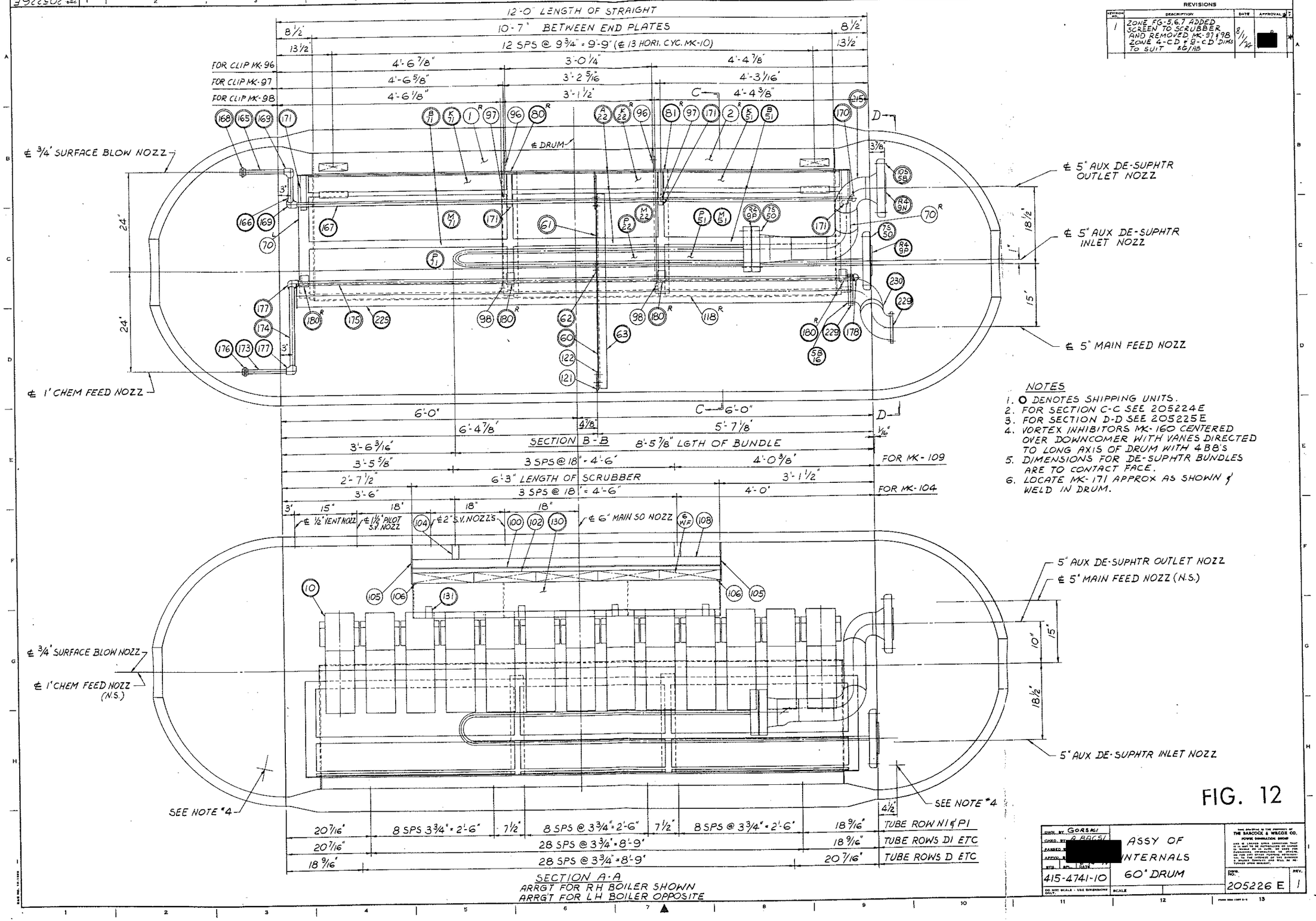
NOTES

1. FOR SECTIONS A-A & B-B SEE 205226E
2. FOR S/O SEE PAGES 31 THRU 52
3. ⬡ DENOTES SHIPPING UNITS.

FIG. 11

DWN. BY GORSKI	ASSY OF INTERNALS 60" DRUM	THE BABCOCK & WILCOX CO. POWER GENERATION GROUP
CHKD. BY A. BACSI		
APPD. [redacted]		
STD. [redacted] DATE 6-14-72		
415-4741-10		DWG. NO. 205225 E REV. O
DO NOT SCALE - USE DIMENSIONS ONLY.	SCALE	

REVISIONS			
REVISION NO.	DESCRIPTION	DATE	APPROVAL
1	ZONE FG-5,6,7 ADDED SCREEN TO SCRUBBER AND REMOVED MK-97 & 98 ZONE 4-CD & 8-CD DIMS TO SUIT &G/AB	8/1/74	[redacted]

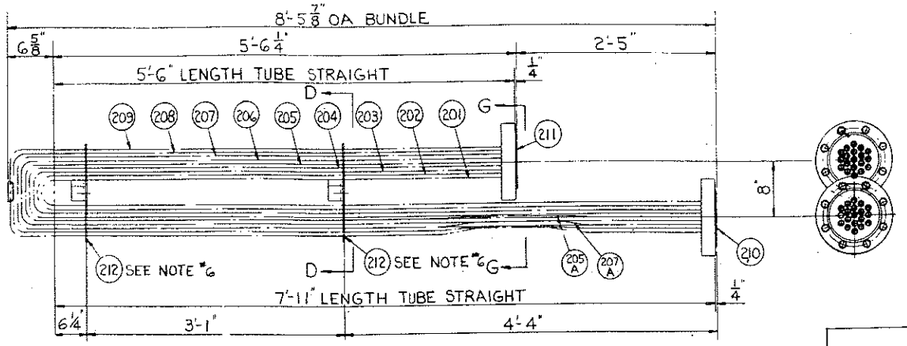


NOTES

1. ○ DENOTES SHIPPING UNITS.
2. FOR SECTION C-C SEE 205224E
3. FOR SECTION D-D SEE 205225E
4. VORTEX INHIBITORS MK-160 CENTERED OVER DOWNCOMER WITH VANES DIRECTED TO LONG AXIS OF DRUM WITH 4 BB'S
5. DIMENSIONS FOR DE-SUPHTR BUNDLES ARE TO CONTACT FACE.
6. LOCATE MK-171 APPROX AS SHOWN & WELD IN DRUM.

FIG. 12

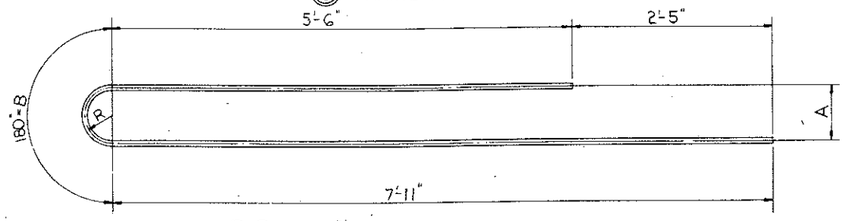
DWN. BY	GORSKI	THE BABCOCK & WILCOX CO. POWER GENERATION GROUP	
CHKD. BY	[redacted]		
PASSED BY		ASSY OF INTERNALS 60" DRUM	
APPVD. BY			
MTG. APP.	DATE		
415-4741-10		DWG. NO. 205226 E	REV. 1
DO NOT SCALE - USE DIMENSIONS ONLY	SCALE		



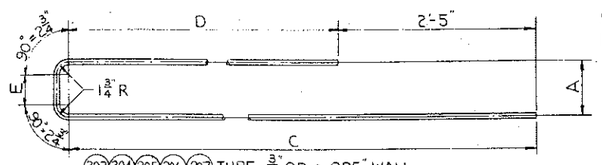
TUBE BUNDLE

(200 R) AS SHOWN FOR RH BOILER

(200 L) OPPOSITE FOR LH BOILER



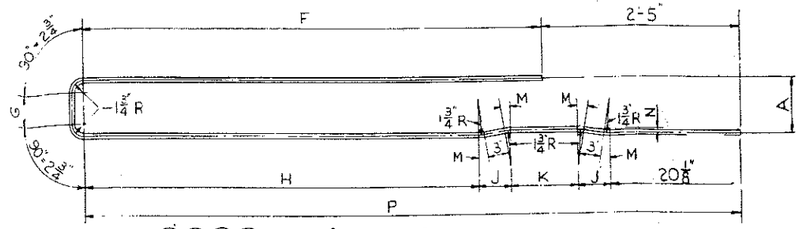
201 202 TUBE 3/4" OD x .095" WALL
SEE TABLE I



203 204 205 205A 207 TUBE 3/4" OD x .095" WALL
SEE TABLE II

TABLE II

QUAN	MK NO	A	C	D	E	DEV LGTH	FIN LGTH	ORD LGTH
3	203	5 3/4"	8'-0 1/8"	5'-7 7/8"	2 1/4"	14'-3"	14'-2 5/8"	14'-2 5/8"
2	204	6 7/8"	8'-0 11/16"	5'-7 11/16"	3 3/8"	14'-5 1/4"	14'-4 7/8"	14'-4 7/8"
2	205	8"	8'-1 1/4"	5'-8 1/4"	4 1/2"	14'-7 1/2"	14'-7 1/8"	14'-7 1/8"
2	206	9 1/8"	8'-1 13/16"	5'-8 13/16"	5 5/8"	14'-9 3/4"	14'-9 3/8"	14'-9 3/8"
2	207	10 1/4"	8'-2 3/8"	5'-9 3/8"	6 3/4"	15'-0"	14'-11 3/8"	14'-11 3/8"



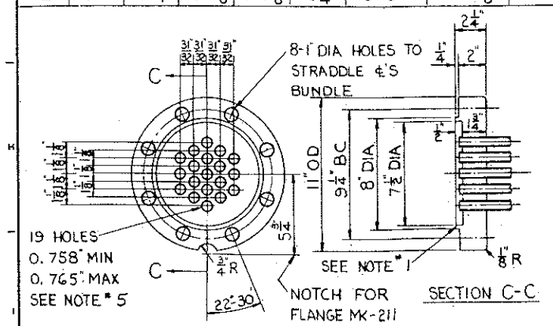
205A 207A 208 209 TUBE 3/4" OD x .095" WALL
SEE TABLE III

TABLE III

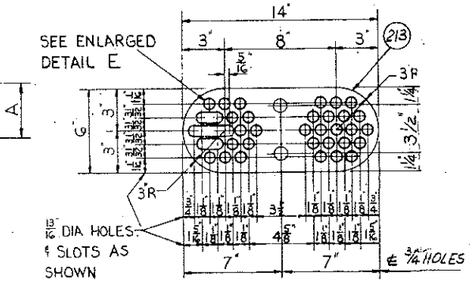
QUAN	MK NO	A	F	G	H	J	K	M	N	P	DEV LGTH	FIN LGTH	ORD LGTH
1	205A	8"	5'-8 1/4"	4 1/2"	4'-11 7/16"	3 11/32"	11"	5°-46'-3/16"	5/16"	8'-1 1/4"	14'-7 9/16"	14'-7 5/32"	14'-7 1/4"
1	207A	10 1/4"	5'-9 3/8"	6 3/4"	5'-0 9/16"	3 19/32"	10 1/2"	10°-44'-21/64"	5/16"	8'-2 3/8"	15'-0 1/8"	14'-11 11/16"	14'-11 3/4"
2	208	11 3/8"	5'-9 15/16"	7 7/8"	5'-1 1/8"	3 11/32"	11"	5°-46'-3/16"	5/16"	8'-2 15/16"	15'-2 5/16"	15'-1 29/32"	15'-2"
1	209	12 1/2"	5'-10 1/2"	9"	5'-1 11/16"	3 27/32"	10"	15°-47'-15/32"	5/16"	8'-3 1/2"	15'-4 11/16"	15'-4 3/16"	15'-4 1/4"

TABLE I

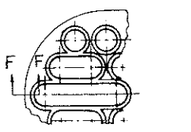
QUAN	MK NO	R	A	B	DEV LGTH	FIN LGTH	ORD LGTH
1	201	1 3/4"	3 1/2"	5 1/2"	13'-10 1/2"	13'-10 1/8"	13'-10 1/8"
2	202	2 5/16"	4 5/8"	7 1/4"	14'-0 1/4"	13'-11 7/8"	13'-11 7/8"



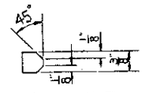
211 210 FLANGE



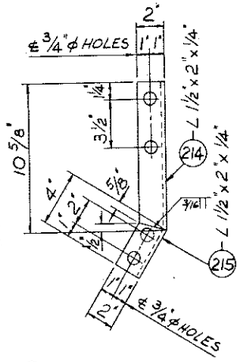
SECTION D-D



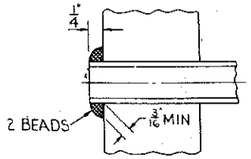
ENLARGED DETAIL E



SECTION F-F



212 SUPPORT PLATE



METHOD FOR WELDING TUBES TO FLANGE SEE NOTE "4

MATERIAL	MARK NUMBERS
SA 213 T11	201 THRU 209
SA 182 F11	210 & 211
A 36	213
M 1020	214

1. CONTACT FACES OF FLANGES TO HAVE 32 SERRATIONS PER INCH, 1/64" DEEP REMAINDER OF FLANGE OF HAVE A 250 FINISH
2. DE-SH DESIGN PRESSURE:
   1100 PSI @ 542°F & 220 PSI @ 910°F
3. DE-SH HYDROTEST PRESSURE = 1650 PSI
4. TUBE ENDS TO BE EXPANDED, SEAL WELDED, THEN LIGHTLY RE-EXPANDED
5. NO SHARP CORNERS, EDGES OF TUBE HOLES MUST BE SUFFICIENTLY ROUNDED TO PREVENT CUTTING OF TUBES WHEN EXPANDING
6. TUBES TO BE THREADED THRU MK-212 AS SHOWN BEFORE FLANGES ARE WELDED ON
7. FOR ARRANGEMENT OF STEAM DRUM INTERNALS SEE 205224E, 205225E & 205226E
8. FOR ARRANGEMENT OF STEAM DRUM EXTERNALS SEE 187373E
9. FOR DETAIL OF STEAM DRUM EXTERNALS SEE 187376E & 187377E
10. ○ DENOTE SHIPPING UNITS

REVISIONS

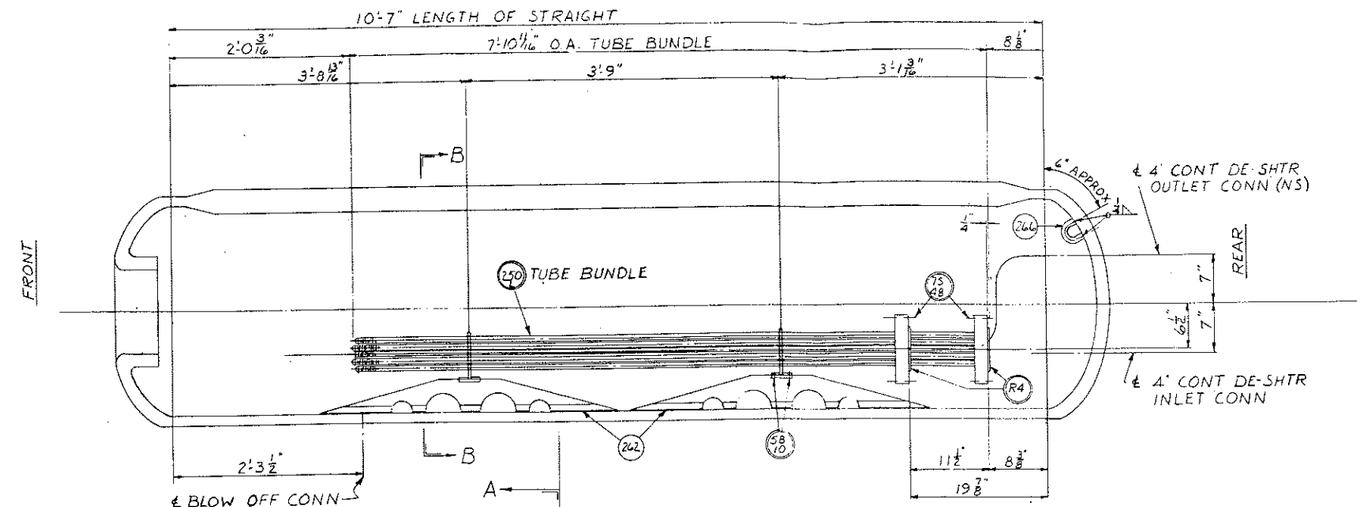
REVISION NO	DESCRIPTION	DATE	APPROVAL

FIG. 13

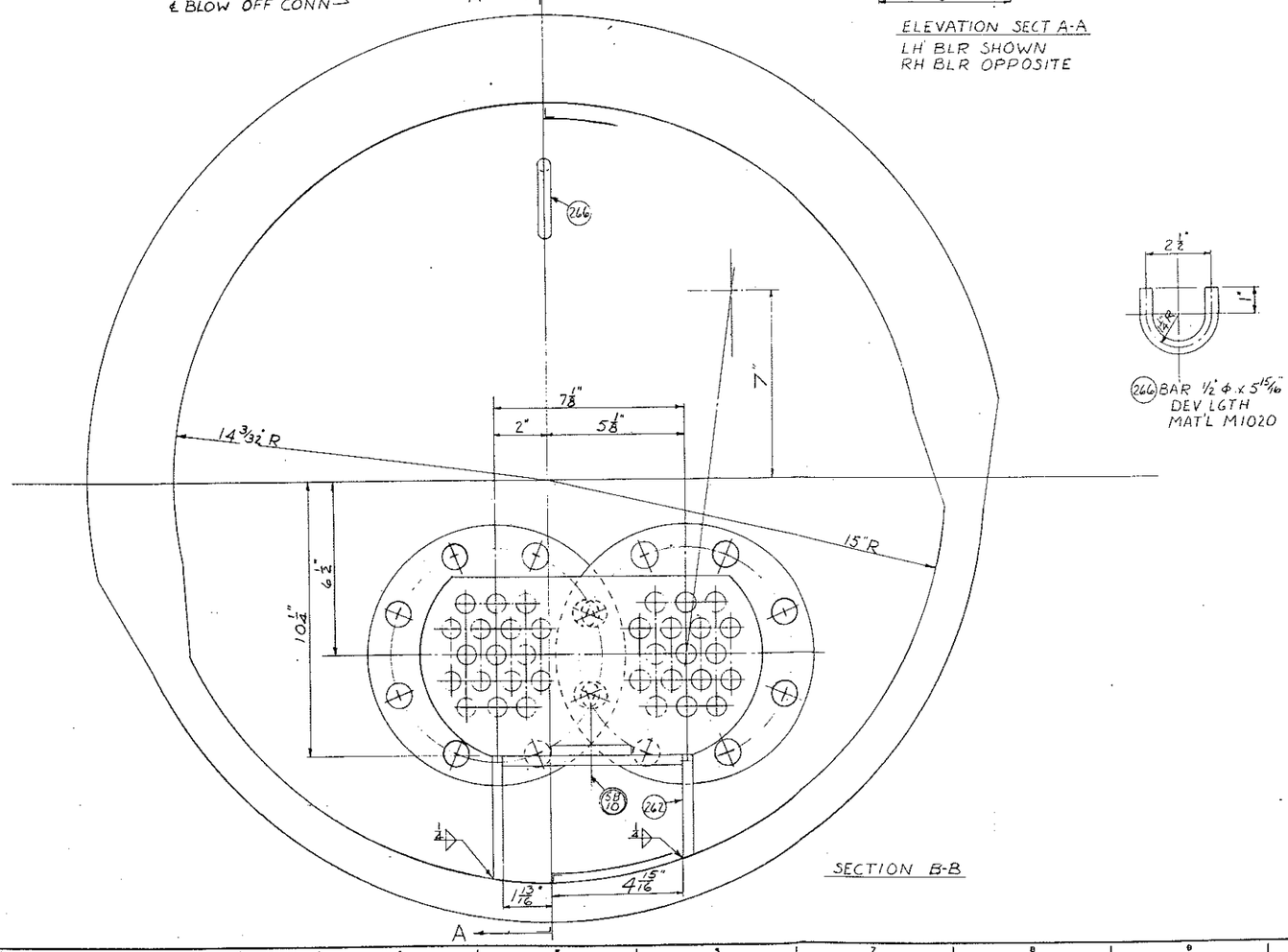
DRWN BY GORSKI	ARRGT & DTAIL AUX DE-SUPHTR 19-3/4" OD TUBES	THE BABCOCK & WILCOX CO.
CKED BY [redacted]		
FABRD BY		
APPVD BY		
STD DATE 6-14-72		
415-4741-10	SCALE	205229E REV. 0

REVISIONS

NO.	DESCRIPTION	DATE	APPROVAL



ELEVATION SECT A-A
LH BLR SHOWN
RH BLR OPPOSITE



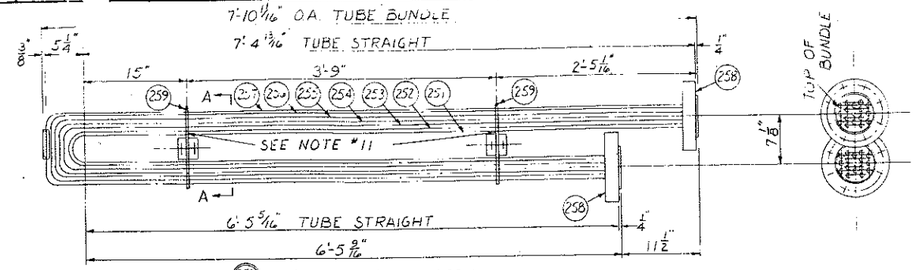
SECTION B-B

GENERAL NOTES

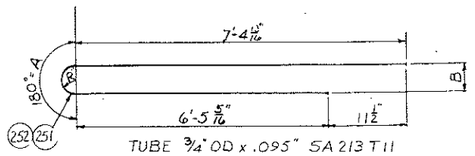
1. ALL PARTS WELDED TO DRUM TO BE STRESS RELIEVED WITH DRUM
2. EACH UNIT TO BE TRIAL FITTED IN DRUM IN SHOP & MATCH MARKED FOR FIELD INSTALLATION.
3. DE-SHTR DESIGN PRESS
   1100# @ 542°
   200# @ 861°
4. DE-SHTR HYDRO TEST PRESS 1650 PSI IN SHOP.
5. FOR DETAIL OF DE-SHTR SEE 187412E
6. FOR ARRGT OF LWR DRUM SEE 123591D
7. FOR LIST OF MAT'L SEE 5/0 PAGES 53 & 54
8. ⓞ DENOTES SHIPPING UNITS.

FIG. 14

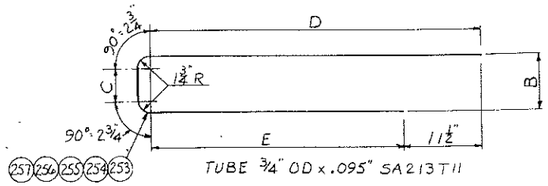
DWN BY E.C. 6-3-75	ARRANGEMENT CONT. DE-SUPHTR 30" DIA DRUM 17-3/4" OD TUBES	THE BABCOCK & WILCOX COMPANY BGRM DIVISION
CHKD BY A. BACCI		
PASSED BY W.J.R.S.C/F		
APPVD BY KELLAR/F 6-24-75		
STD. | APPL. | DATE		DWG. NO. 187411E REV. 0
415-4730-20		
415-4731-20		
DO NOT SCALE-USE DIMENSIONS ONLY.	SCALE	



(250 L) CONT DE-SHTR ASSY
ARRGT SHOWN FOR LH BLR
ARRGT OPPOSITE FOR RH BLR

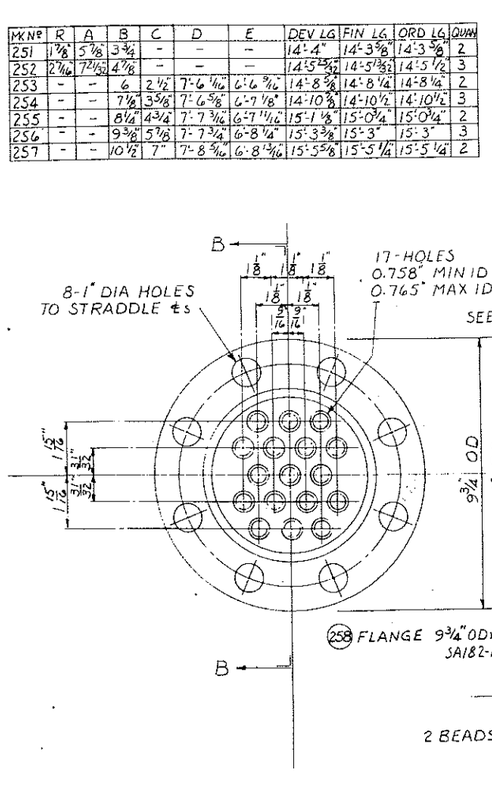


TUBE 3/4" OD x .095" SA213 T11

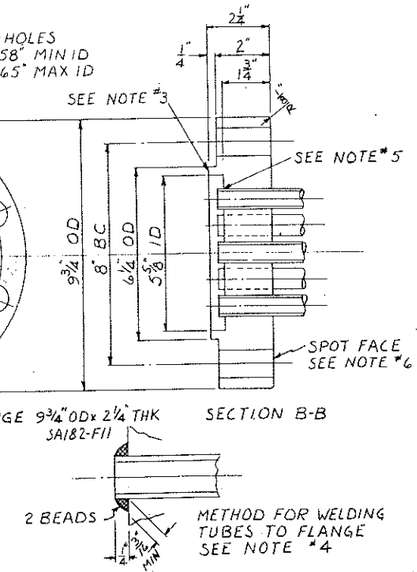


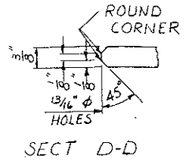
TUBE 3/4" OD x .095" SA213 T11

MK Nº	R	A	B	C	D	E	DEV LG	FIN LG	ORD LG	QUAN
251	1 7/8"	5 7/8	3 3/4	-	-	-	14'-4"	14'-3 5/8"	14'-3 5/8"	2
252	2 7/16	7 21/32	4 7/8	-	-	-	14'-5 23/32	14'-5 23/32	14'-5 1/2	3
253	-	-	6	2 1/2"	7'-6 1/16	6'-6 9/16	14'-8 5/8	14'-8 1/4	14'-8 1/4	2
254	-	-	7 1/8	3 5/8	7'-6 5/8	6'-7 1/8"	14'-10 5/8	14'-10 1/2	14'-10 1/2	3
255	-	-	8 1/4"	4 3/4	7'-7 3/4	6'-7 11/16	15'-1 1/8	15'-0 3/4"	15'-0 3/4"	2
256	-	-	9 3/8	5 7/8	7'-7 3/4	6'-8 1/4"	15'-3 3/8	15'-3"	15'-3"	3
257	-	-	10 1/2	7"	7'-8 5/16	6'-8 13/16	15'-5 5/8	15'-5 1/4	15'-5 1/4	2

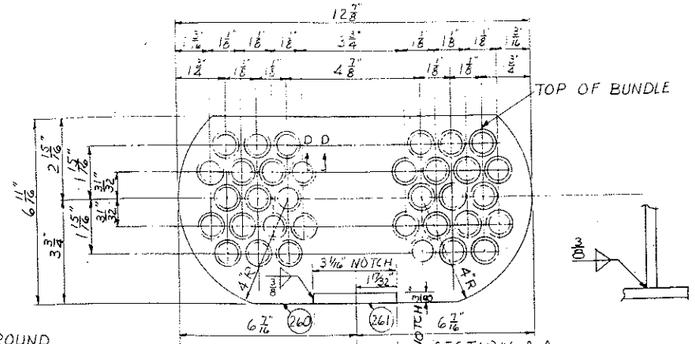


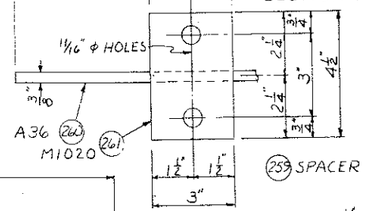
(258) FLANGE 9 3/4" OD x 2 1/4" THK SA182-F11 SECTION B-B

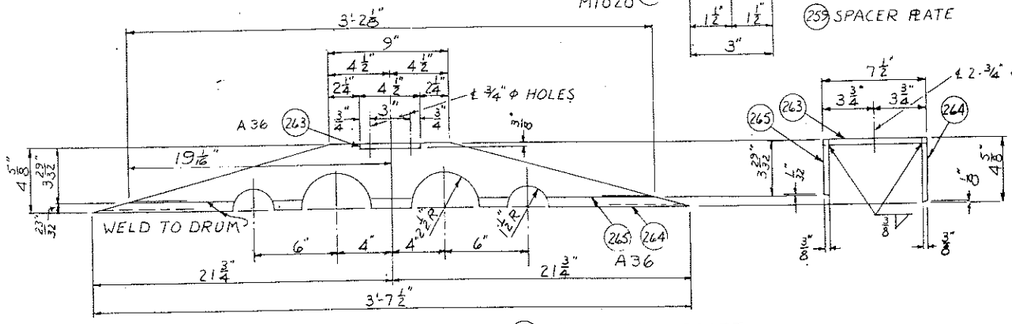




SECT D-D







(262) DE-SUPHTR SUPPORT

NOTES
1. DE-SHTR DESIGN PRESSURE
   1100 PSI @ 542° F
   200 PSI @ 861° F
2. DE-SHTR HYDRO TEST PRESSURE 1650 PSI IN SHOP
3. CONTACT FACE OF FLANGE TO HAVE 32 SERRATIONS PER INCH 1/64 IN. DEEP. REMAINDER OF FLANGE TO HAVE 250 FINISH.
4. TUBE ENDS TO BE EXPANDED, SEAL WELDED, THEN LIGHTLY RE-EXPANDED.
5. NO SHARP CORNERS, EDGE OF TUBE HOLES MUST BE SUFFICIENTLY ROUNDED TO PREVENT CUTTING OF TUBES WHEN EXPANDING.

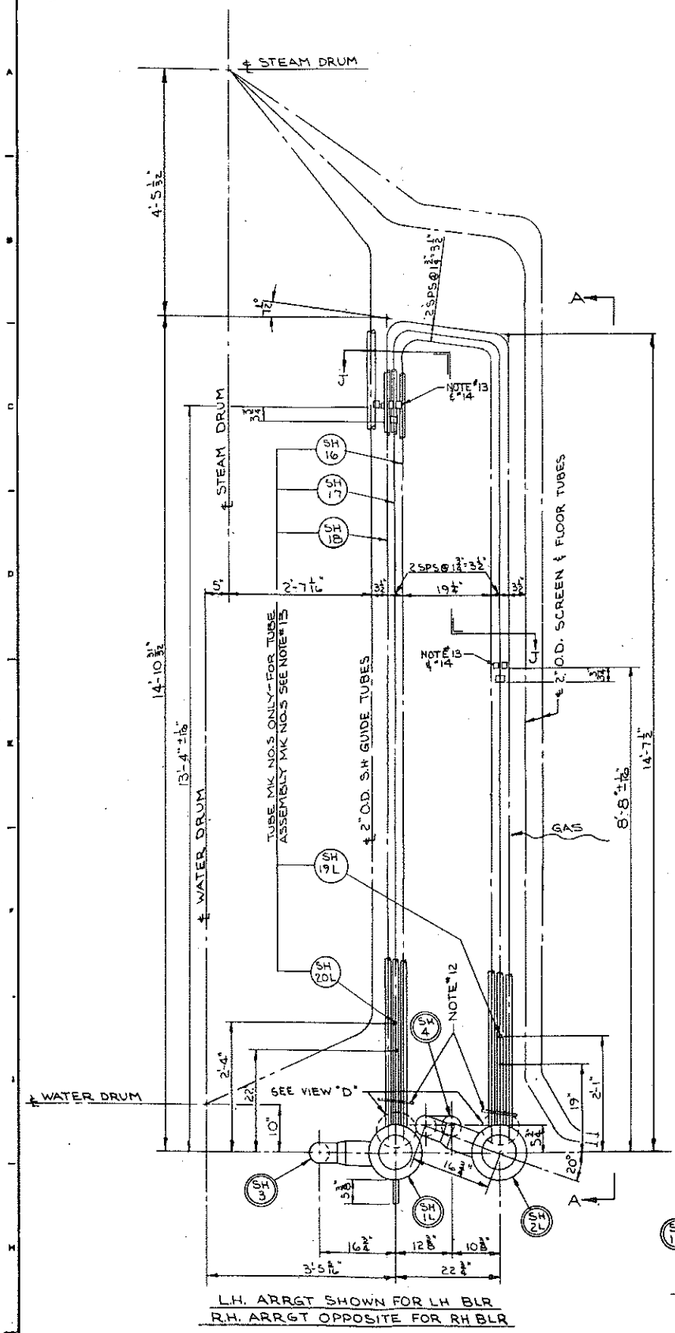
6. ◎ DENOTES SHIPPING UNIT
7. FOR LIST OF MATERIAL SEE S/O PAGES 53 & 54
8. FOR ARR'GT IN LOWER DRUM SEE 187411E
9. FOR DET LOWER DRUM SEE 187370E & 187371E
10. FOR DETAIL DRUM CONNS SEE 187378E & 187379E
11. TUBES TO BE THREADED THRU SPACER PLATES BEFORE FLANGES ARE WELDED TO TUBES

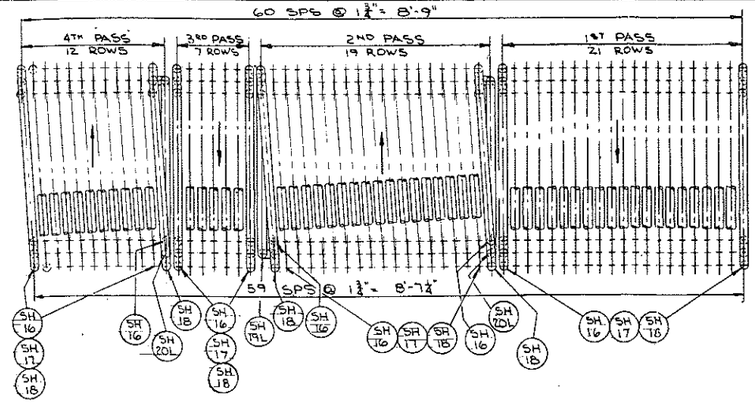
REVISIONS

REVISION NO	DESCRIPTION	DATE	APPROVAL

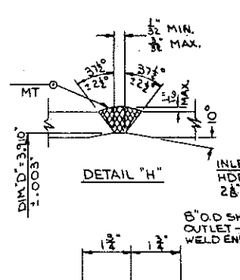
FIG. 15

DRN. BY E.C. STRANG	ARR'GT & DETAIL	THE BABCOCK & WILCOX CO.
CHKD. BY A.BACSI	17-3/4" OD TUBE	
ENGR. BY WORSO/F	CONTROL DE-SHTR	
APPVD. BY KELLAR/F		
STD. APPL. DATE 29-75		
415-4730-20		
415-4731-20	SCALE	187412 REV.





VIEW C-C
TUBE MK NO'S INDICATED ONLY
SEE NOTE #13



DETAIL "H"

SECTION "B-B"

VIEW "D" (TYP)
SEE NOTE #7

SECTION "E-E" SHOWN
SECTION "F-F" OPP
(EXCEPT AS NOTED)
REQUIRED AT REAR CONN ONLY

VIEW "A-A"

REVISIONS			
REVISION NO.	DESCRIPTION	APPROVAL	
1	ZONE 5-D CHGD RT TO MT DLR/REQ	8/26/74	
2	NOTE 7B - REVISED DLD/RHE	10/11/74	

NOTES

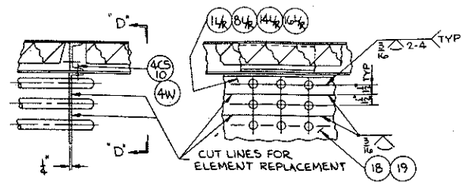
1. DESIGN PRESSURE IS 1100 PSI.
2. ALL TUBES ARE 1 1/4" O.D. x .134" THK SA 213 T11
3. TUBES BENT TO 4" R.
4. TUBE ENDS ARE TO BE CUT AT RIGHT ANGLES TO THEIR AXIS & MACHINED PER VIEW "D".
5. THE ENDS OF ALL TUBES ARE TO BE LIGHTLY CHAMFERED TO REMOVE ALL BURRS.
6. THAT PORTION OF TUBE WHICH WILL BE IN CONTACT WITH THE TUBE SEAT IS TO BE CLEANED AS NECESSARY IN THE FIELD. (NOT BY B & W CO.)
7. TUBES ARE TO BE JOINED TO HDRS IN THE FIELD AS FOLLOWS:
   A. INSTALL TUBE IN HEADER
   B. EXPAND TUBE IN HEADER.
   C. PREHEAT TO 300°F. USE ELECTRODE E 8015 B2 L FOR ALL S.H. TUBE ASSEMBLIES
   D. ALL TUBES ARE TO BE WELDED WITH A MINIMUM OF TWO (2) LAYERS. EACH LAYER IS TO CONSIST OF TWO (2) PASSES AS INDICATED IN VIEW "D"
   E. LIGHTLY RE-EXPAND TUBES AFTER WELDING.
8. FIELD WELD NUTS TO DIAPHRAGMS PER SECT "L-L" ON HDR DETAIL DWG, AFTER EXPANDING TUBES ADJACENT TO DIAPHRAGMS.
9. ASSEMBLE NUTS ON HANDHOLE FITTINGS WITH NON-SEIZING COMPOUND MOLYCOTE "G" OR EQUAL.
10. SPLIT RING SHALL BE WELDED TO FORM SOLID RING AFTER FITTING AND PRIOR TO FINAL INSERTION IN PIPE.
11. SUPERHEATER TO BE HYDROSTATICALLY TESTED TO 1650 PSI, AFTER ASSEMBLY.
12. SUPERHEATER TUBE CLOSURE PL'S TO BE INSTALLED IN ACCORDANCE WITH PLAN VIEW PER DWG 154451E DURING SUPER HEATER ASSY
13. FOR TUBE ASSY. MK NO'S, LOCATION OF S.H. GUIDE CASTINGS, AND SECTION "J-J" SEE DWGS. 1930B4E.
14. FOR ASSEMBLY OF S.H. GUIDE CASTINGS SEE DWG 111870 B.
15. WHEN TUBE RENEWAL POINT BE MADE BETWEEN ADJACENT RA AND RB SCREEN TUBES, THE SIDE ARM CASTINGS SHOULD BE REMOVED FROM THE REPLACEMENT OUTER LOOP SUPERHEATER TUBES. SUPPORT OF THE FREE STANDING TUBE PLATTEN IS OBTAINED BY WELDING ADJACENT REPLACE CASTINGS (PATTERN No. 111569 BA) TO EACH OTHER FROM THE CAVITY. TUBE PLATTENS MAY BE JOINED IN THIS MATTER PROVIDED BOTH PLATTENS ARE IN THE SAME PASS.

FIG. 16

REFERENCES

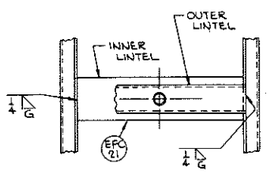
DET. OF S.H. INLET-OUTLET HDR ——— 154407E
DET. OF S.H INTERMEDIATE HDR ——— 154408E
STRUCT. DETAILS FOR S.H. HDRS ——— 154409E
DET. OF DE-S.H. PIPING ——— 116250C
ASSY OF SUPERHEATER GUIDE CASTINGS - 111570B & 1930B4E

DWN BY TF SHAUB	ARRANGEMENT OF SUPERHEATER	THE RANDOLPH & WHEELER CO.	
CHKD BY REQ			
PASSED BY [redacted]			
APPD BY			
DTD 10-10-74 DATE		SIZE	REV.
DO NOT SCALE THIS DRAWING	SCALE 1" = 1'-6" 12	415-4741/42	1930826E 2

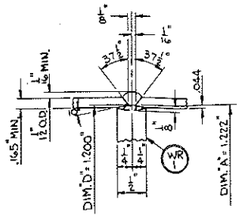


VIEW "C"
TYPICAL FOR ELEMENT REPLACEMENT

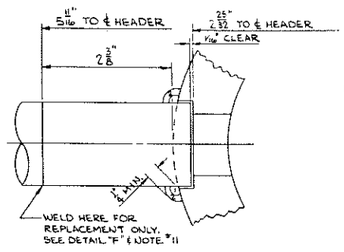
VIEW "D-D"
FOR ELEMENT REPLACEMENT



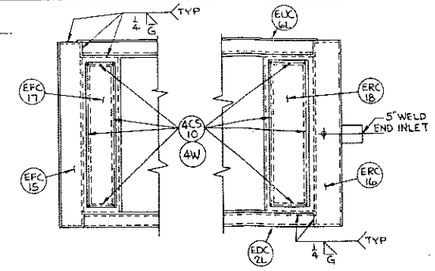
VIEW "E-E"



DETAIL "F"
FOR REPLACEMENT ONLY
SEE NOTE #12



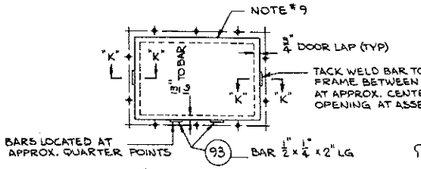
DETAIL "G"
SEE NOTE #3



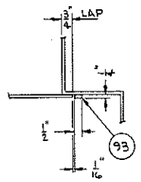
VIEW "H-H"

VIEW "J-J"

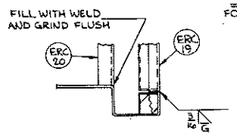
REVISIONS				
REVISION NO	DESCRIPTION	DATE	APPROVAL	
1	ADDED NOTE 18 AND CONT Nº TO REF DWGS DE/REG	12-2-13		
2	CHGD 1/4" PRES-SEAL TO 1/2" PRES-SEAL IN NOTE #10. DE/DLE	3-25-14		



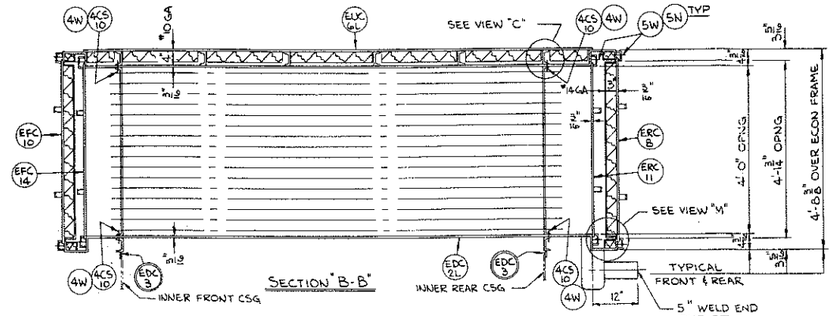
TYPICAL VIEW SHOWING LOCATION OF BARS FOR CENTERING UNLINED DOORS

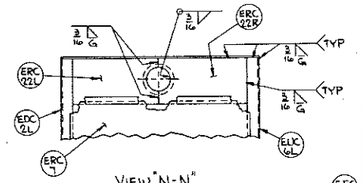


SECTION "K-K"

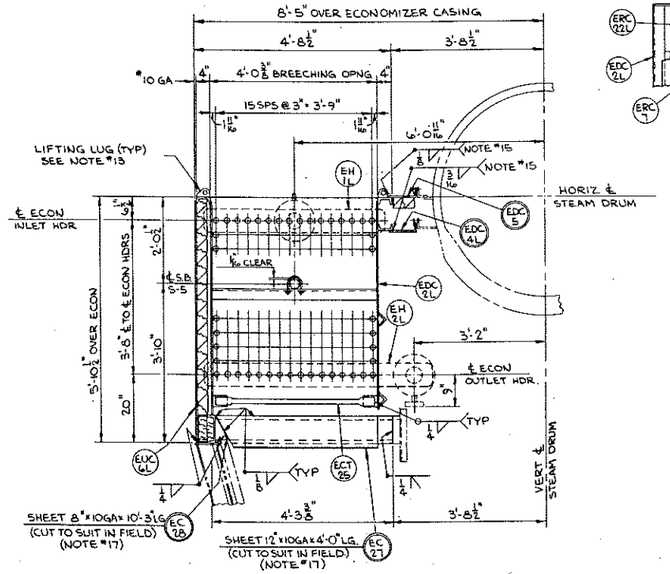


VIEW "M"
TYPICAL JUNCTIONS AT INNER AND OUTER DOOR LINTELS

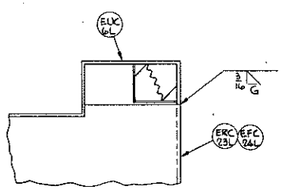




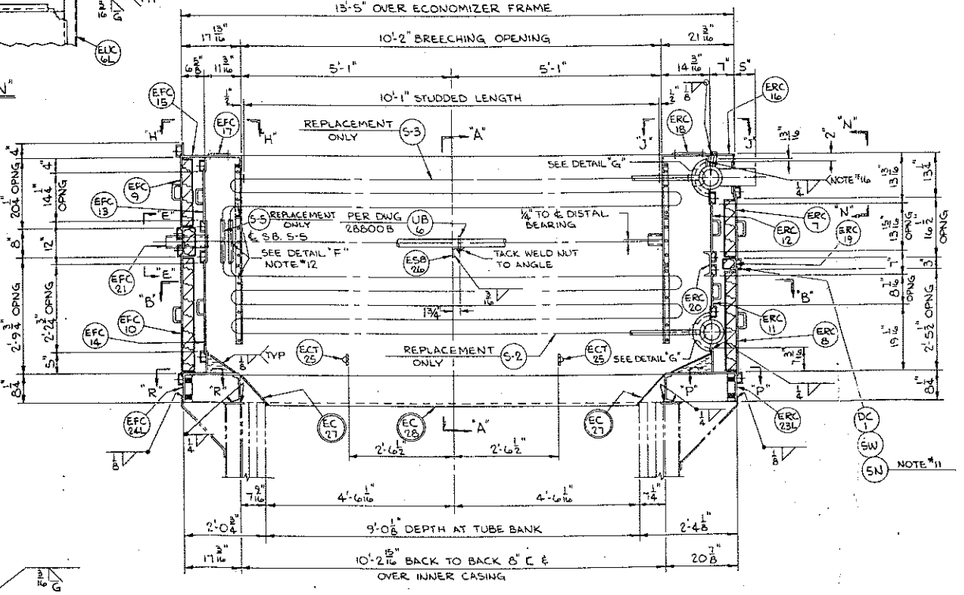
VIEW "N-N"



SECTION "A-A"



SECTION "P-P" SHOWN
SECTION "R-R" OPPOSITE



EA 1/4" SECTIONAL SIDE ELEVATION
LEFT HAND ARRGT SHOWN
RIGHT HAND ARRGT OPPOSITE

GENERAL NOTES

1. ECONOMIZER DESIGN PRESSURE = 1210 P.S.I.
2. TUBE MATERIAL - CARBON STEEL USCG T1778A 1 1/2" O.D. x .165" THK.
3. PROCEDURE FOR SEAL WELDING TUBES TO HEADERS:
   A - PREHEAT TO 70° F MINIMUM
   B - WELD WITH 3/32" DIA ELECTRODE B1W (E7015 A1) - WELD IS TO BE DEPOSITED WITH A MINIMUM OF TWO (2) LAYERS.
   C - NO STRESS RELIEVING REQUIRED
   D - HYDROSTATIC TEST PER NOTE #4
4. ECONOMIZER IS TO BE HYDROSTATICALLY TESTED TO 1815 P.S.I. AFTER ASSEMBLY OF TUBES TO HDRS.
5. ALL CASING LAPS 3/4" UNLESS NOTED OTHERWISE.
6. ALL JOINTS BETWEEN STRUCTURAL MEMBERS ARE TO BE WELDED AFTER BEING ASSEMBLED AND ALIGNED. ALL CONTINUOUSLY WELDED JOINTS MUST BE 100% AIRTIGHT.
7. ASSEMBLE NUTS ON HANDHOLE FITTINGS WITH NON-SEIZING COMPOUND MOLYKOTE "G" OR EQUAL.
8. CLAMPS FOR INNER AND OUTER ACCESS DOORS ARE TO BE CUT FLUSH WITH DOOR OPENINGS.
9. INNER DOORS ARE TO BE SEALED WITH PERMATEX #2 IN THE SHOP.
10. OUTER DOORS ARE TO BE SEALED WITH 1/2" PRES-SEAL IN THE SHOP.
11. ALL DOOR CLAMPS ARE TO BE MK-DC-2 PER DWG. 464274 UNLESS NOTED OTHERWISE.
12. PROCEDURE FOR FIELD WELDING TUBES TOGETHER FOR REPLACEMENT INSTALLATION ONLY:
    A - WELDING RING - CARBON STEEL
    B - PREHEAT TO 70° F MINIMUM.
    C - WELD WITH 3/32" ELECTRODE B1W (E7015 A1)
    D - NO STRESS RELIEVING REQUIRED.
13. LIFTING LUGS ARE TO BE REMOVED AFTER ECONOMIZER IS SECURELY POSITIONED ON BOILER AND BEFORE INSTALLATION OF CUSTOMER'S UPTAKE CONNECTION.
14. ALL FIELD WELDS ARE CARBON STEEL TO CARBON STEEL.
15. FOR ADDITIONAL FIELD WELDS SEE DWG 154411E
16. WELD MUST BE COMPLETED BEFORE INSTALLING FRAME MEMBER ERC 22 L/R.
17. PIECES MK EC-27 & EC-28 TO BE FIELD INSTALLED AFTER REFRACTORY.
18. USCG MATERIAL SPEC FOR CONTRACT 415-4695/98, ASME MATERIAL SPEC FOR CONT 415-4730 & ALL FUTURE CONTRACTS.

REFERENCE

FOR CONT 4695/98 -
- DETAIL OF ECONOMIZER HEADERS ___ 154402E
- ASSY & DETAILS OF ECON TUBE SECTIONS 154403E
- DETAIL OF ECON SUPPORT PLATES ___ 154404E
- ARRGT OF ECON DRUM SIDE CSG & BAFFLE PLATE ___ 154411E
- DETAILS OF ECON DRUM SIDE CSG & BAFFLE PLATE ___ 154412E
- ARRGT OF ECON UPTAKE SIDE CSG ___ 154413E
- DETAILS OF ECON UPTAKE SIDE CSG ___ 154414E
- DETAILS OF ECON CSG. ___ 154415E

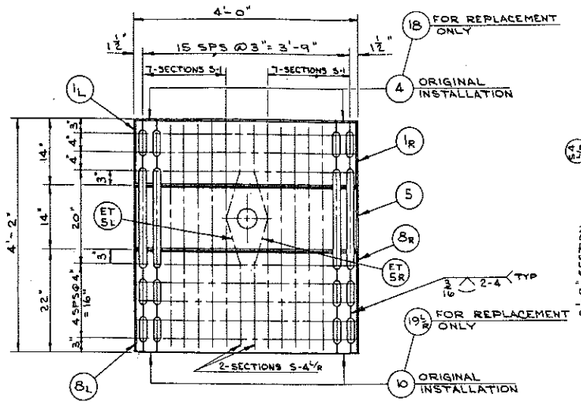
FOR CONT 4730/31 -
- DETAIL OF ECONOMIZER HEADERS ___ 193110E

FIG. 17
Primary Economizer

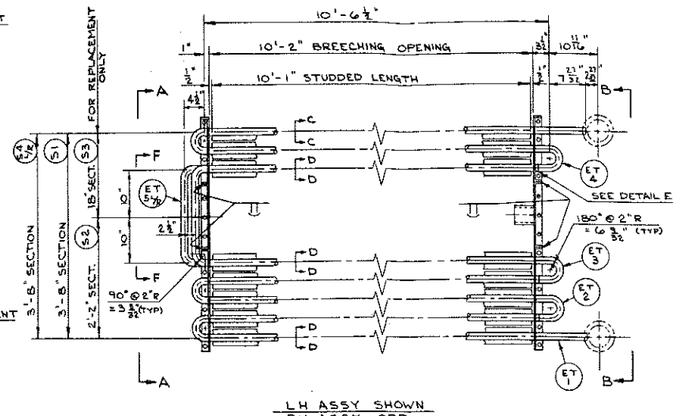
DWN BY D.L. ERBLAND		ARRANGEMENT OF Primary ECONOMIZER	THE DRAWING IS THE PROPERTY OF THE BABCOCK & WILCOX CO. POWER GENERATION DIVISION
CHKD BY WHG			
PASSED B [redacted]			
APPVD B [redacted]			
STD.	SPL.	DATE 12-1-69	
DO NOT SCALE - USE DIMENSIONS ONLY		SCALE 3/4, 1 1/2	3-12	415-4695/98	DRG. NO. 154401E REV 2

BBR 154403E

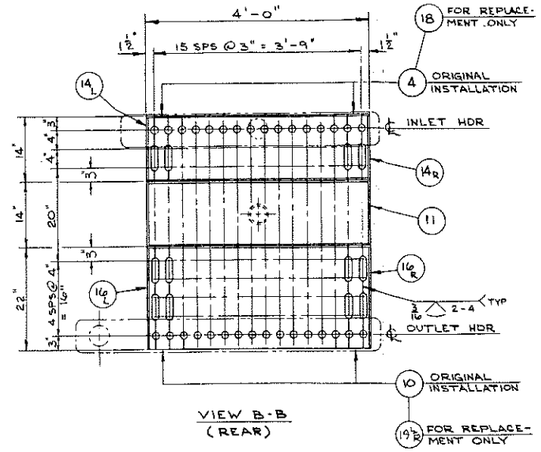
REVISION NO	DESCRIPTION	DATE	APPROVAL
1	DETAIL "E" CHG'A SPEC. N° NOTE 2 MODIFIED AND ADDED NOTE 7 228/880	7/23/73	
2	ADDED NOTE 8 & CONT NR TO REF. DWGS. DE/REO	8/6/73	
3	DETAIL "E" CHG'A WELD FROM 1/16 MIN TO 1/16 MAX.	10/16/74	



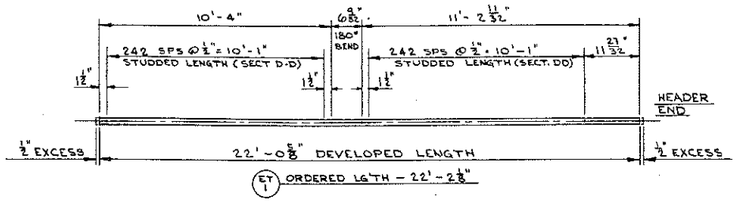
VIEW A-A
(FRONT)

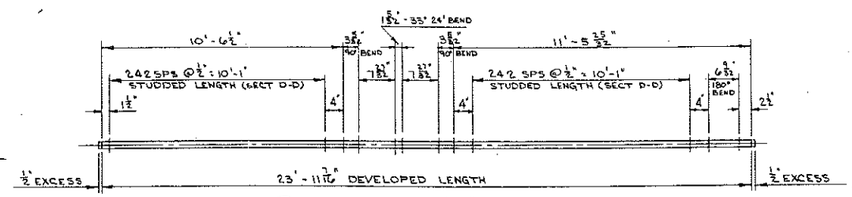


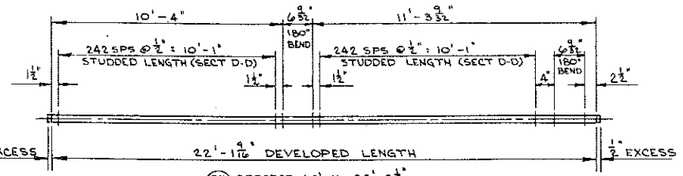
LH ASSY SHOWN
RH ASSY OPP

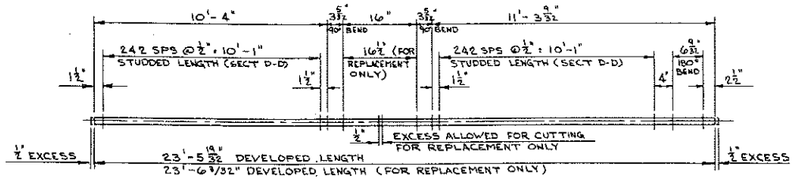


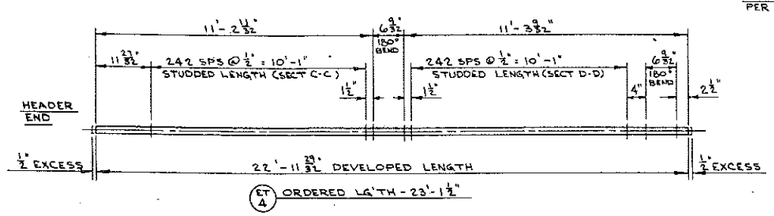
VIEW B-B
(REAR)

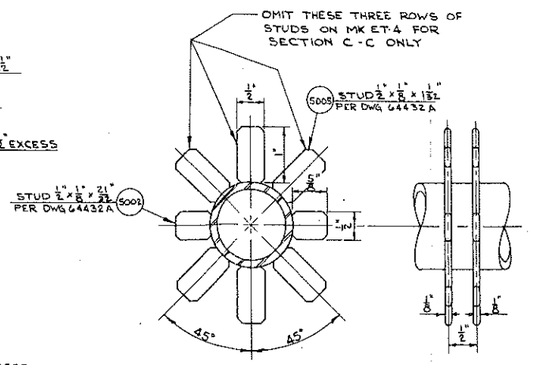




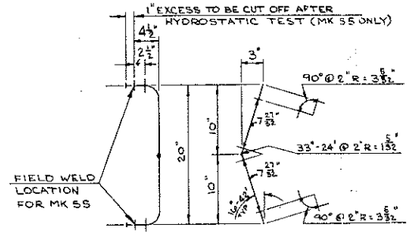




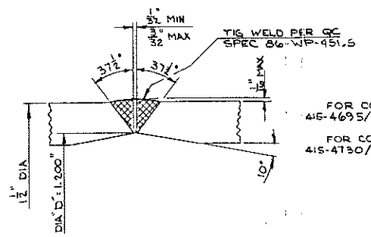




SECTION C-C (SHOWN & NOTED)
SECTION D-D (AS SHOWN)



VIEW F-F
BEND DETAIL FOR MK ET 5 L/R & DETAIL OF REPLACEMENT SECTION MK 55
LH DETAIL SHOWN - RH OPPOSITE
S5 REPLACEMENT SECTION
2'-4 5/32" DEV LGTH
2'-6 1/4" ORDERED LGTH



DETAIL-E
SHOP WELD

NOTES

1. DESIGN PRESSURE OF ECONOMIZER = 1210 PSI
2. TUBE MATERIAL - CARBON ERW STEEL USCG 51.25 T178A - 1 1/2" OD X .165" THK. FOR CONTRACT 4795/98 ONLY
3. TUBES ARE ORDERED TO THE THEORETICAL DEVELOPED LENGTH PLUS 1/2" EXCESS ON EACH END, PLUS 1/2" EXCESS ALLOWED FOR SHRINKAGE.
4. ALL TUBES ARE TO BE BENT TO A 2" RADIUS.
5. 1/2" EXCESS ON EACH END OF TUBE IS FOR TRUE-UP AND MILLING AFTER TUBES HAVE BEEN BENT. TUBE ENDS ARE TO BE CUT AT RIGHT ANGLES TO THEIR AXIS.
6. HYDROSTATIC TEST ECONOMIZER ASSEMBLY AFTER WELDING TUBES TO HEADERS.
7. TUBE MATL FOR CONT. 4730 & SUBSEQUENT CONTRACTS: CARBON ERW STEEL SA-178A - 1 1/2" OD X .165" THK
8. USCG MATERIAL SPEC. FOR CONT. 415-4695/98: ASME MATERIAL SPEC FOR CONT 415-4730 & ALL FUTURE CONTRACTS.

REFERENCE DRAWINGS

FOR CONT 415-4695/98 - DETAIL OF ECON. SUPPT. PLATES 154404E
DETAIL OF ECON. HEADERS 154402E
ARRGT. OF ECONOMIZER 154401E
FOR CONT 415-4730/31 - DETAIL OF ECON. HEADERS 193110E

FIG. 18
Primary Economizer

DWN BY D. EVANS	ASSY & DETAILS OF ECONOMIZER TUBE SECTIONS	BBR 154403E REV. 3
CHKD BY RICHARDS		
PASSED [redacted]		
APPVD		
STD. SPL. 11-12-69 DATE		
DO NOT SCALE - USE DIMENSIONS ONLY	SCALE 1-3-1-1-0 415-4695/98	

THE BABCOCK & WILCOX CO. POWER GENERATION DIVISION
THIS DRAWING IS THE PROPERTY OF THE BABCOCK & WILCOX CO. IT IS NOT TO BE REPRODUCED OR SHOWN TO OTHERS OR USED FOR ANY WORK NOT AUTHORIZED BY THE BABCOCK & WILCOX CO., OTHERWISE, THAN TO THE INTEREST OF THE OWNER TO WHOM SUBMITTED AND WILL BE RETURNED UPON REQUEST.

158246E

NO.	DESCRIPTION	DATE	APPROVAL
1	ZONE 14, ADD "L" DIM FOR ATOMIZER. CHG'D ATOM ASSY DWG NO FROM 104599D~JTW/cc	2/5/70	[redacted]
2	ADDED SYM "123, ZONE G-13 (TILE) ~ JTW/EDL	12/1/70	[redacted]
3	SYM "17" WAS "16" DL/ps	3/4/72	[redacted]
4	CHG'D O.D. COVER #6 WAS 2'-2.34" ADDED BLADES TO #14	9/11/73	[redacted]
5	CERTIFIED MANUFACTURING CHG REVD MC-61, REM'D DRAIN PIPE MC-104 ~ ADD PLUG MC-52~ 15⅞ DIM ZONE G8 WAS 15/8 DL	12/6/74	[redacted]

NOTE "A"

TO AVOID DAMAGE OR MIS-ALIGNMENT TO AIR DOORS, CLOSE SAME BEFORE RETRACTING IMPELLER PLATE AND VALVE ASSY. ADVANCE IMPELLER PLATE AND VALVE ASSY. BEFORE OPENING AIR DOORS.

A = BURNER "PROTRUSION" = 1 9/16"

B = BURNER WITHDRAWAL = 1" FLAT

1-3⅝" DIA. HOLE ON 9¾" R. FOR (234)

AIR DOOR OPERATOR

22½°

TO OPEN

3" DIA. TYP.

2'-2.34" O.D.

POKEHOLE DOOR (65)

LIGHTING & PEEP DOOR (55A)

NOTE#1

NOTE#2

NOTE#3

NOTE#4

NOTE#5

NOTE#6

SEE NOTE "A"

$15\frac{7}{16}" \pm \frac{1}{32}"$

$20\frac{1}{2}"$

$\frac{3}{8}"$

$6\frac{1}{4}"$

19"

18"

BURNER TIP TO EXTEND $1\frac{3}{16}"$ BEYOND FURNACE SIDE OF IMPELLER PLATE HUB WHEN FIRING

DWG REFERENCES

FOR ASSEMBLY OF COVER PLATE AND REGISTER RING SEE DWG 94756C
FOR ASSEMBLY OF OIL SUPPLY LINE SEE DWG 70186B
FOR ASSEMBLY OF VALVE & ATOMIZER SEE DWG 70034D
FOR BURNER LIST OF MATERIAL SEE DWG 158247E
FOR DRILLING TEMPLATE SEE DWG 62111B
THE "L" DIMENSION ON DWG 70034D = $34\frac{1}{4}"$

NOTE

1-ALL PARTS SHOW TRUE RADIAL DISTANCE FROM CENTERLINE. FOR TRUE LOCATION SEE FRONT VIEW.
2-DRILL FOR ¼" SPRING PIN 1½" LG (41) AFTER ASSY. SO THAT W/AIR DOORS IN FULL OPEN POS. TRIGGER (37) IS ENGAGED IN STOPNOTCH AT EXTREME END OF QUADRANT (31).
3-FOR ASSY AIR DOOR GEARING & GEAR QUAD SEE DWG 94756C.
4-AFTER ASSY OF DOOR DETERMINE LOCATION OF PINION RING, CSK HOLE FOR (2) SET SCR (66) IN PIPE (108).
5-DRILL & TAP FOR ¼ x ⅜ HEX SOC SET SCREW (39) 20 UNC-3A STNLSS STL ASA-B18.3
6-PKG. AROUND REGULATING ROD TO BE INSTALLED AFTER SAME IS IN POSITION.

FIG. 19

DRN BY B. JONES	ASSEMBLY OF SARATOGA TYPE OIL BURNER W/ RACER TYPE ATOMIZER & CHECK VALVE	THE BARCOCK & WILCOX COMPANY
CHKD [redacted]		
415-4695/55-31		158246 E 5

3908102

LIST OF MATERIAL FOR ONE BURNER

PC. NO.	NAME	NO REQD	MATERIAL	MATERIAL SPECS	SIZE	DWG NO
1	COVER PLATE HUB	1	CAST STEEL	MIL-S-15083CLCW	PATT. B-66987	70151C
2	COVER PLATE	1	STEEL	A-283GR D	2'-2 7/8" DIA. × 1/4" THK	100145D
3	SEPARATOR	1	STEEL	SA-53GR A	1 1/4" SCH 40 PIPE × 3"	"
5	SHEET	1	STEEL	A-415	16GA. THK × 3" × 14 3/16"	"
6	HEX NUTS	10	STEEL	A-307M	1/2"-HVY.-13UNC-2B	"
7	HEX NUTS	22	STEEL	A-307M	3/8"-HVY.-16UNC-2B	"
8	SEPARATORS	4	STEEL	SA-106B TP B	1/2" SCH40 PIPE × 3" LG	"
9	COVER LINING PLATE	1	STEEL	A-415	12GA THK × 2'-0 3/4" DIA	"
10	BARS	3	STEEL	M 1020	3/4" DIA. × 3"	"
11	REGISTER RING	1	STEEL	A283D	2'-0 13/16" DIA × 1 3/16"	119779D
12	STRUTS	4	COLD ROLL STEEL	C1018CF	7/8" DIA. × 17 1/8" LG	75468A
14	BLADED CONE	1	COMMERCIAL	BW-1501 ALLOY	PATT. B66142	70048D
15	HUB GASKET	1	SINGLE JACKET COPPER ASBESTOS	COMMERCIAL	6 3/8" OD × 4 7/16" ID × 1/16"	49080A
16	LOCKWASHERS	8	POS STEEL	ASA B27.1	5/16" LOCKWASHER	158246E
17	SHEET	1	STEEL	A-415	16GA THK × 3" × 6'-5 3/4"	100145D
18	DOWEL STUDS	4	COLD ROLL STEEL	C1018CF	1/2" DIA × 1 1/8" (1/2-13NC-3)	49079A
19	INSULATION BLOCK	10	MED-TEMP (TWO LAYERS 1/2" THK)	COMMERCIAL	1 1/2" × 6" × 18"	100145D
20	CAP SCREW HEX HD	2	STEEL	A307	1/2" DIA × 1 1/4" (1/2-13-UNC 2A)	158246E
21	MACH SCR FLAT HD	3	STEEL	ASA B18.3	#10 × 3/8" LG (#10-24UNC 2A)	"
22	POKE HOLE FRAME	1	CAST STEEL	SA-216 WCB	PATT. 33928 BA	33928B
23	BOLTS HEX HD	8	25-20 ALLOY TYPE 304	A 276 TP304	5/16" DIA × 3/4" LG 18 UNC-3A	158246E
24	HEX NUTS	8	25-20 ALLOY TYPE 310	A 276 TP310	5/16"-18UNC-2B	"
25	HEX HD CAP SCREW	3	STEEL	A307	1/2" DIA × 1 1/4" LG 13UNC-2A	"
27	STUD POKE HOLE	2	COLD ROLL STEEL	C1018CF	3/8" DIA × 1 7/8" 16UNC-3A T.F.L.	MS222261
28	SET SCR. HEX SOC CUP PT	1	ALLOY STEEL	ASA B18.3	5/16" DIA × 3/8" LG 18UNC-3A	158246E
29	BOLT HEX HD	4	STEEL	A307	3/8" DIA × 1" LG 16UNC-2A	"
30	COUPLING STUDS	2	STEEL	A307	1/2" DIA × 10 1/2" LG 1/2 13UNC-2A	"
31	CRANK HANDLE QUAD	1	CAST STEEL	SA-216WCB	PATT. 2070FA	51360B
33	BUSHING NUT	1	COLD ROLL STEEL	C1018CF	1 1/2" HEX × 3/8" THK 1 1/2-12UNF-3B	49061A
34	PINION GEAR	1	FORGED CARBON STEEL	COMMERCIAL	5/8" ID × 2" P.D. × 2 1/4" OD × 1/2"	49062A
35	SPRING	1	SPRING STEEL	COMMERCIAL	17 BWG × 12 3/16" DEV LGTH	49063A
36	CRANK HANDLE	1	CAST STEEL	SA-216WCB	PATT. B58761	51361B
37	TRIGGER	1	CAST STEEL	SA-216WCB	PATT. B58909	51362B
38	PIN	1	ALLOY STEEL	SST	1/4" SPRING PIN × 1 1/2" LG	51363B
39	SET SCR. HEX SOC. CUP PT.	1	ALLOY STEEL	ASA-B18.3	1/4" DIA. × 3/8" 20 UNC-3A	158246E
40	SET SCR. HEX SOC. CUP PT.	1	ALLOY STEEL	ASA-B18.3	1/4" DIA. × 1/4" 20 UNC-3A	"
41	PIN	1	ALLOY STEEL	SST	1/4" DIA. SPRING PIN × 1 1/2" LG	"
55A	R.H. DOOR-PEEP HOLE	1	CAST STEEL	MIL-S-15083CLCW	PATT. B-66985	60241C
43	PACKING	1	GRAPHITED ASBESTOS	COMMERCIAL	3/16" DIA × 6 1/2"	158246E
44	SHAFT BUSHING	1	NAVAL BRASS COMPA	COMMERCIAL	3/4" I.D. × 1 1/2" O.D. × 4 11/16"	49064A
45	PINION GEAR SHAFT	1	COLD ROLL STEEL	C1018CF	3/4" DIA. × 6 13/64"	49065A
46	IMPELLER PLATE	1	COMMERCIAL	BW1501 ALLOY	PATT 1013 BA	1013B
47	REGULATING ROD	1	STEEL	SA-178C	2" TUBE × .134" × 2'-1/8" F.L.	51366B
49	WASHER-HUB	1	STEEL	A415	2 1/32" I.D. × 3 1/2" O.D. × 1/8"	49066A
52	F.H. SCREWS	4	25-20 ALLOY TYPE 310	A276 TP310	1/4" DIA. × 7/8" 20UNC-2A	158246E
53	HEX NUTS	4	25-20 ALLOY TYPE 310	A276 TP310	1/4" DIA. HVY. 20UNC-2B	"
54	DOOR-FRAME	2	CAST STEEL	MIL-S-15083CLCW	PATT. B66986	49067A
55	L.H. DOOR-PEEP HOLE	1	CAST STEEL	"	PATT. B66985A	60241C
56	GLASS RETAINER	2	CAST STEEL	"	PATT. B66983	49068A
58	GASKET-PEEP DOOR	2	WIRE WOVEN CLOTH ASBESTOS	COMMERCIAL	4 1/2" I.D. × 5 1/2" O.D. × 1/8" THK.	49069A
59	STUD (THD FULL THD)	4	COLD ROLL STEEL	C1018CF	3/8" DIA. × 2 1/4" 16UNC-2A	51359B
60	WING NUTS	6	STEEL	COMMERCIAL	3/8"-16UNC-2B	"
61	SPOOL	1	STEEL	A283D	2'-2" DIA × 3 9/16"	119778D
62	GLASS	2	BLUE PYREX GLASS	COMMERCIAL	2 7/16" SQ. × 1/8" THK.	51359B
63	ROUND HD SCREWS	8	STEEL	ASA-B18.6	#10 × 3/4" #10-24-UNC-2A	"
64	LOCKRING	1	COLD ROLL STEEL	C1018CF	3" DIA. × 3/4" LG.	33923B
65	POKE HOLE DOOR	1	STEEL	A36	4 1/2 × 3/8 × 6 3/8	T18009A
66	SET SCR HEX SOC DOG PT.	2	ALLOY STEEL	ASA-B18.3	1/4" DIA. × 1/2" 20UNC-3A	158246E
67	PLASTIC SEAL COMP	1/2 LB	SEALING COMP. TEMP SEAL	COMMERCIAL	FOR PEEP DOOR GLASSES	"
68	GASKET-POKE HOLE	1	WOVEN ASBESTOS	COMMERCIAL	6 3/8" × 4 1/2" × 1/16" 3 3/4 I.D.	18008A
69	HEX NUTS	4	STEEL	A307	9/16"-12UNC-2B	158246E
72	HEX HD BOLT	6	STEEL	A307	1/2" DIA. × 1 3/4" LG. 13UNC-2A	201806E
101	AIR DOOR PINION RING	1	COLD ROLL STEEL	C1018CF	2 7/8" I.D. × 3 15/16" O.D. × 7/8"	51357B

LIST OF MATERIAL FOR ONE BURNER CONT.

PC NO	NAME	NO REQD	MATERIAL	MATERIAL SPECS	SIZE	DWG NO
102	AIR DOORS	8	STEEL	A569	8 1/4" × 12GA × 15 3/4"	77734C
103	PINS	8	COLD ROLL STEEL	C1018CF	1/2" DIA × 7/8"	"
105	BEVEL GEAR PINION	8	CAST STEEL	MIL-S-15083CLCW	1.6 P.D. × 1 7/16" D 5/16" FACE	51358B
106	GEAR QUADRANT	1	CAST STEEL	"	PATT 1041FA	80509B
107	AIR DOOR RING SUPPORT	1	SMLESS STEEL	SA-53-GR A	2 1/2" SCH 40 PIPE × 9 13/16" LG	75469A
108	AIR DOOR GEAR RING	1	FORGED STEEL	COMMERCIAL	23/32" × 4.925" DIA.	70152C
114	COVER PLATE GASKET	1	SINGLE JACKET COPPER ASBESTOS	COMMERCIAL	26 3/4" O.D. × 2'-1" I.D. × 1/16" THK	85869A
117	SEGMENT TILE	8	BW80 DENSE OR EQUAL	COMMERCIAL	PATT. 1222 FB	1222F
118	HOOK BOLT	8	NICHROME TPA CL A OR B	A276 TP310	3/8" DIA. × 3 13/16" LGTH (HB-1)	1006B
123	EYE HOOK LUG	8	STEEL	A415	1" × 1/4" × 2"	49055A
234	SCANNER MOUNT	1	"	SA53A	3" SCH 40 PIPE × 8" LG.	100145D
235	CAP	1	FORGED STEEL	COMMERCIAL	3" PIPE CAP	"
173	STUDS	16	STEEL	M-1020	3/8" DIA. × 1 1/2" LG. T.F.L. 3/8-16UNC	158246E
5	NAME PLATE	1	CAST BRASS	COMMERCIAL	3 3/8" × 6 1/2" × 1/16" THK	61392A
				"		
92	PLUG SCR'D CSK HEX SOC	1	STEEL		3/4"	158246E
B	1/2" VALVE-STEAM	1	STEEL	"	ROCKWELL ANG. FIG 849	201806E
G	1/2" VALVE-OIL	1	"	"	" " 849	"
D	1/2" STRAINER	1	CAST STEEL	"	YARWAY FIG #921 W/STNLSS STL SCREEN	"
E	1/2" PIPE PLUG	1	FORGED STEEL	"		"
F	1/2" FLEXIBLE METALLIC HOSE FREDERICK COWAN CO.	2		"	24" LG - 1/2" END FITTINGS	"
G	1/2" CHECK VALVE-STEAM	1	STEEL	"	EDWARDS FIG. 2672	"
H	1/2" NIPPLE	3	STEEL	SA-106 GR B	1/2" SCH 80 PIPE × 1 1/2" T.B.E.	"

FOR MB-4732 AND SUBSEQUENT CONTRACTS

4,9,15,17 32,47,48,26 51,64,70,71 73,74,75,76 76A,77,78,79 80,81,82,83 84,85,87,96 96A,97,98,99 125,126,127	ASSEM. OF ATOM. & VALVE 70034D
	DWG 104622D HINGE ASSY R.H. PC. NOs 3,4,5,6,7,8,9,10,11,12,14 & 15 HINGE ASSY LH PC. NOs 3,4,5,6,7,8,9,10,11,13,14 & 15
18,96,96A, 97,99	LIST OF TOOLS FOR (1) ONE SHIP ASSEM OF CLEANING BRKT - 70160B 1-REQ'D

	NAME	NO REQD	MATERIAL		SIZE	DWG NO
—	DISMANTLING BRKT	1	CAST STEEL		PATT B-55869	MS-216488
—	ATOMIZER WRENCH	1	FORGED STEEL		603A OPEN END	
—	" "	1	" "		809A CLOSED END	
	" "	1	" "		808 BOX WRENCH	—
	PIN SPANNER WRENCH	1	" "		FOR 3" DIA. #406	1334A
	ADAPTER PL WRENCH	1	" "		608 OPEN END	

REVISIONS

REVISION NO.	DESCRIPTION	DATE	APPROVAL
1	ADDED PC. G L.A.	1/14/7	
2	CERTIFIED MANUFACTURE CHG ~ ADD PC #92 ~ REM'D PC #104 ~ CHG'D DWG Nº PCS #11, #61 & #106 CHG'D MAT'L SPEC & SIZE PC #102 #114 #62 — DWG NO 70160B (ZONE G9) WAS 1450D DL/FT	12/6/74	[redacted]

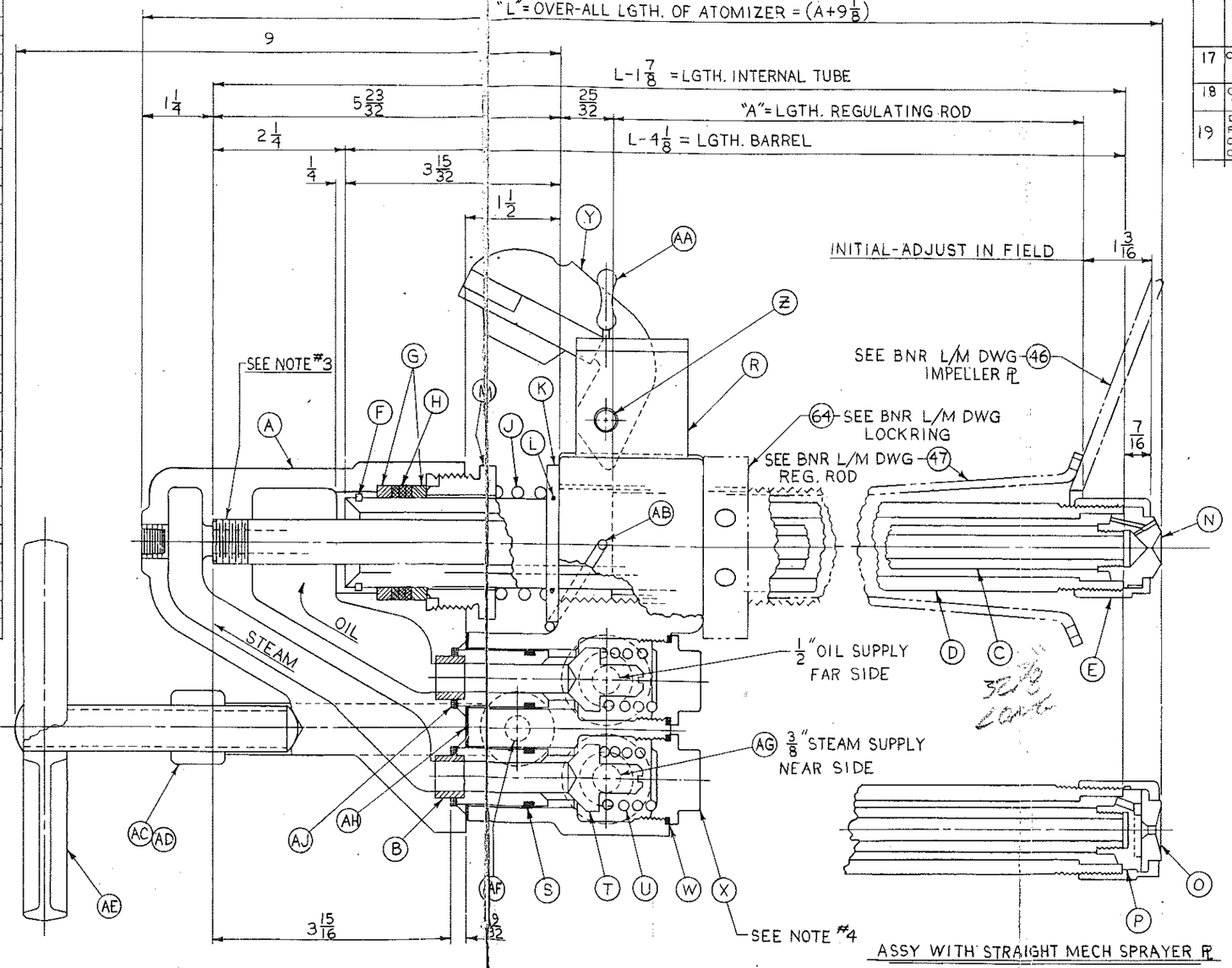
FIG. 20

DWN. BY F. TOTH CHKD BY [redacted] PASSED [redacted] APPVD. BY STD. ✓ EFL. 9-6-23 DATE	LIST OF MATERIAL SARATOGA TYPE OIL BURNER	THE BABCOCK & WILCOX CO.	
415-4730/31-31	SCALE —	DWG. NO. 201806E	REV. 2

DWG. 70034D

REFERENCE LIST

SYM	AM'T	DESCRIPTION	MAT'L	PC. Nº	DWG Nº
A	1	ATOM BODY	CAST ST'L CLASS "B"	76	1109C
B	2	BUSHING INSERT	STEEL	76A	1109C
C	1	INTERNAL TUBE	SMLS ST'L	78	51395B
D	1	BARREL	SMLS ST'L	79	51396B
E	1	END CAP	4150 ST'L	87	51397B
F	1	SNAP RING	STD SQ SECT 1 7/16 SHAFT OPEN TYPE	126	SERIES 1
G	2	FOLLOWER RING MK-1	STEEL	17	63425A
H		PACKING	SEE NOTE #2	15	
J	1	SPRING	SPRING ST'L GR2 TYPE "B"	80	85871A
K	1	COLLAR	STEEL	83	49051A
L	1	PACKING	GRAPHITE ASB UM 702	84	49051A
M	1	GLAND MK-1	STEEL	4	63426A
N	1	SPRAYER PL	REX AA	9	51394B
O	1	MECH SPRAYER PL	4150 MOD	93	70673C
P		MECH ADAPTER PL	4150 ST'L	88	51365B
R	1	ATOM VALVE BODY 1034DD	CAST ST'L CLASS "B"	75	1034D
S	2	"O" RING 3/4" I.D. x 1" O.D. x 1/8"	SEE S/O	77	
T	2	ATOM VALVE STEM	C.R. ST'L	71	70225B
U	2	SPRING MK-1	INCONEL X	74	30762A
W	2	GASKET	COPPER	125	75499A
X	2	END PLUG	STEEL	70	85922A
Y	1	REG. ROD COVER B66981	CAST ST'L	48	66245C
Z	1	SPRING PIN 3/8" x 1"	STNLS ST'L	51	
AA	1	THUMB SCREW 3/8" x 3/4" LG.	STEEL	32	STYLE "D"
AB	1	SPRING	SPRING ST'L	73	35523A
AC	1	COUPLING YOKE 1250FA	CAST ST'L CLASS "CW"	96	70216B
AD	1	HELICOIL INSERT 3/4"-10 x 3/4" LG	STNLS ST'L	96A	70216B
AE	1	TEE BOLT MK-3	A216 WCB	98	70526A
AF	2	SHOULDER SCREW	4140	99	30554A
AG	AS REQ'D	REDUCING BUSHING 1/2" x 3/8"	FORGED ST'L	82	
AH	1	GASKET 1/16" THK DBL PORTED	TEFLON	85	35539A
AJ	2	GASKET	TEFLON	81	75498A



ASSY WITH STRAIGHT MECH SPRAYER PL

REVISIONS

REVISION NO.	DESCRIPTION	DATE	APPROVAL	BY
16	REDRAWN~CONVERTED VARIABLE DIM. TO OVER-ALL LGTH. OF ATOM.~UPDATED REF. LIST~DWG Nº SYM J, T, & X WAS 2787E~AC WAS 1250F~ADDED DWG Nºs TO SYM U & AB~JTW/AAZ	1/23/70	[redacted]	3
17	CHG TO SHUTOFF IN TITLE BLOCK WAS CHECK, REMOVED DWG Nº & MK Nº OF PC 82 SYM AG 83/COX.	6/3/71	[redacted]	A
18	CHG MAT'L SYM AH WAS GAR 7021 BY [redacted]	7/1/72	[redacted]	
19	DELETED DWG. Nºs. IN REF. LIST FOR SYM'S - H, S, & Z. IN NOTE Nº 2 CHG'D SUPER SEAL Nº 2 TO CHEMLON STYLE Nº C06 JED	12/5/73	CHW/CHA	

NOTES:

1. ASSEMBLED ATOMIZER TO SATISFACTORILY WITHSTAND HYDROSTATIC TEST PRESSURE OF 600 P.S.I.
2. ONE SET (3 RINGS/SET) PKG. RING JOHN CRANE CHEMLON STYLE Nº C06 1 1/2 I.D. x 1 7/8 O.D. x 3/16 SQ.
3. USE Nº 2 CRANE PLASTIC LEAD SEALING COMPOUND ON INTERNAL TUBE THREADS.
4. APPLY MOLYCOTE "G" TO THREADS AT ASSY.

FIG. 21

DWN. BY FLYNN	ASSEMBLY RACER TYPE STEAM ATOMIZER W/SHUTOFF VALVE	THIS DRAWING IS THE PROPERTY OF THE BABCOCK & WILCOX CO. POWER GENERATION DIVISION - AND IS LOANED UPON CONDITION THAT IT IS NOT TO BE REPRODUCED IN COPIES IN WHOLE OR IN PART, OR USED FOR FURNISHING INFORMATION TO OTHERS, OR FOR ANY OTHER PURPOSE DETRIMENTAL TO THE INTEREST OF THE BABCOCK & WILCOX COMPANY AND WILL BE RETURNED UPON REQUEST.
CHKD. BY DELANO		
PASSED BY ZBYTOVSKY		
APPVD. BY FALK		
STD. BPL. DATE 7-9-64		
STANDARD	SCALE 12"=1'-0"	DWG. NO. 70034D REV. 19
DO NOT SCALE - USE DIMENSIONS ONLY.		

LOCKED DRAWER DRAWING

BRUNING 10184

NORM	UNIT	HAND	REQD	STOCK NO	ARTICLE AND DESCRIPTION	PART NO
N					26-7/8" OD X 25" ID X 1/16" THK	
N					*	
N						
N					BURNER ASSEMBLY:	
N					ASSEMBLY RACER TYPE STEAM ATOMIZER W/CHECK VALVE,	
N					DRAW #70034D, REV 16:	
0	EA	____	____	SYM XX,	BURNER ASSEMBLY COMPLETE	
4	EA	____	____	SYM A,	ATOMIZER BODY, PC 76, DWG #1109C	
20	EA	____	____	SYM B,	BUSHING INSERT, PC 76A, DWG #1109C	
8	EA	____	____	SYM C,	INTERNAL TUBE, PC 78, DWG #51395B	
4	EA	____	____	SYM D,	BARREL, PC 79, DWG #51396B	
4	EA	____	____	SYM E,	END CAP, PC 87, DWG #51397B	
6	EA	____	____	SYM F,	SNAP RING, PC 126, SERIES 1	
12	EA	____	____	SYM G,	FOLLOWER RING MK-1, PC 17, DWG #63425A	
50	EA	____	____	SYM H,	PACKING, TEFLON O-RING, SIZE 2-325	
12	EA	____	____	SYM J,	SPRING, PC 80, DWG #85871A	
6	EA	____	____	SYM K,	COLLAR, PC 83, DWG #49051A	
10	EA	____	____	SYM L,	PACKING, PC 84, DWG #49051A	
4	EA	____	____	SYM M,	GLAND MK-1, PC 4, DWG #63426A	
4	EA	____	____	SYM N,	SPRAYER PLATE, PORT, 5Y-51-57-53-80SH, REX-AA	
9	EA	____	____	SYM N,	SPRAYER PLATE, SEA, 6Y-41-52-50-80SH, REX-AA	
3	EA	____	____	SYM R,	ATOMIZER VALVE BODY, PC 75, DWG #1034D	
30	EA	____	____	SYM S,	O-RING, 3/4" ID X 1" OD X 1/8", PC 77, DWG #70034D	
12	EA	____	____	SYM T,	ATOMIZER VALVE STEM, PC 71, DWG #70225B	
12	EA	____	____	SYM U,	SPRING MK-1, PC 74, DWG #30762A	
20	EA	____	____	SYM W,	GASKET, PC 125, DWG #75499A	
6	EA	____	____	SYM X,	END PLUG, PC 70, DWG #85922A	
1	EA	____	____	SYM Y,	REGULATOR ROD COVER, PC 48, DWG #66245C	
6	EA	____	____	SYM Z,	SPRING PIN, 3/8" X 1", PC 51, DWG #70034D	
4	EA	____	____	SYM AA,	THUMB SCREW, 3/8" X 3/4" LG, PC 32, STYLE D	
4	EA	____	____	SYM AC,	COUPLING YOKE 1250FA, PC 96, DWG #70216B	
6	EA	____	____	SYM AD,	HELICOIL INSERT, 3/4"-10 X 3/4" LG, PC 96A,	
N					DWG #70216B	
4	EA	____	____	SYM AE,	TEE BOLT MK-3, PC 98, DWG #70526A	
12	EA	____	____	SYM AF,	SHOULDER SCREW, PC 99, DWG #30554A	
300	EA	____	____	SYM AH,	GASKET 1/16" THK DOUBLE PORTED, GARLOCK 7021,	
N					PC 85, DWG #35539A	
50	EA	____	____	SYM AJ,	GASKET, TEFLON, PC 81, DWG #75498A	
N					*	
N						
N					SOOT BLOWER AIR LINE LUBRICATORS:	
N					NORGREN TYPE L12 OIL-FOG LUBRICATORS, DESIGNER SERIES WITH	
N					3/4" F.P.T. INLET & OUTLET CONNS, avail: MOTION INDUSTRIES:	
N						
0	EA	____	____		TYPE L12 OIL-FOG LUBRICATOR WITH 1/2 PINT METAL RESERVOIR	
N					RESERVOIR TO BE EQUIPPED WITH SIGHT GLASS	
N					*	
N						
N					HAND HOLE FITTINGS, GASKETS, ETC FOR SUPERHEATER:	
N						
6	EA	____	____		HAND HOLE FITTING, J40-47, MK 40-47, per DRWG# 89681C	
24	EA	____	____		GASKET, HAND HOLE, SUPERHEATER, HH INCONEL, FLEXITALLIC GOLD	
N					MK 40-7, For service above 1000#	
6	EA	____	____		BINDER, HAND HOLE, MK W343, per DRWG #7122C	
6	EA	____	____		WASHER STEEL, CH 1-5/16" I.D. X 8 GAUGE X 2-1/4" O.D.	
12	EA	____	____		NUT, STEEL, HEAT TREAT, HEX HEAVY, 1-1/4" 8UN2B SA 194-1 CH.	
N					*	
N						