

MECHANICAL DESIGN MANUAL SUMMARY SHEET

SUBJECT: BOILERS

DESCRIPTION: GENERAL PRESENTATION OF BOILER TYPES AND HOW EACH HAS A USAGE. COMPONENTS REQUIRED.

APPLICATION: GOOD AND BAD FEATURES FOR VARIOUS TYPES OF BOILERS.

SPEC SECTION: 15500

APPLICABLE CODES: BOILERS ARE ALL DESIGNED AND BUILT ACCORDING TO THE ASME BOILER CODE. KJWW DOES NOT DESIGN BOILERS, JUST USE THEM IN OUR SYSTEMS.

MUST FOLLOW INSURANCE COMPANY REQUIREMENTS SUCH AS FACTORY MUTUAL, ETC. GAS PIPING TO COMPLY WITH LOCAL UTILITY COMPANY REQUIREMENTS.

DATE: AUGUST 22, 1991

PREPARED BY: SAM WRAY

## STEAM BOILERS

BY

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August 22, 1991

GENERAL: The problems of a safe and efficient steam generating plant means solving several problems inherent with steam, heat, water, air, and pressure. Water, especially with dissolved air, is aggressive to steel at high temperatures, therefore corrosion is a problem. This is only one of the problems, but each will be dealt with separately.

The top priority in any Boiler installation is SAFETY, therefore common sense, and following code recommendations is a must.

### BOILER RATINGS:

1 Boiler Horsepower = 33,600 BTU/Hr.  
1 Boiler Horsepower = (approx) 33.5 Pounds/Hour steam  
100 BHP = 3350 #/Hr  
10,000 #/Hr = 300 BHP

The above ratings are based on feeding the boiler with 212 deg water. Use caution on Process Boilers!!

Each BHP should have approx 5 square feet of heating surface.

NOTE: Boiler may be rated larger than the burner, but never have the burner larger than the boiler!!

Superheated steam--What is it and how do you get it? Used for operating turbines for power generation.

### \* COMPONENTS THAT MAKE UP A STEAM GENERATING SYSTEM:

1. Boilers
2. Boiler safety valves
3. Boiler safety controls
4. Boiler burner
5. Fuels
6. Boiler feed pumps
7. Condensate return system
8. Deaerator
9. Traps
10. Boiler stack
11. Economizer
12. Chemical treatment
13. Boiler blow down
14. Turbulators
15. Fuel handling equipment

*HOSPITALS NORMALLY USE 65 PSIG + STEAM*

#### CHEMICAL TREATMENT:

1. Boiler Water treatment.
2. Condensate line treatment.

#### BOILER TYPES AND THEIR SELECTION:

##### Cast Iron Sectional:

Cast Iron sectional boilers are a general use in small systems that range up to 2,000,000 btu/hour. The chief use of these boilers is to replace existing boilers, as they can be assembled in place and do not require a large building opening.

##### Good points:

Since these boilers are made of Cast Iron, they are not as subject to corrosion as a steel boiler.

Although sold with atmospheric burners, KJWW specifies only power burners unless for small residential uses.

##### Problems:

Small steaming cavity, therefore good for small closed loop systems only.

Dirty systems cause the boiler to surge.

Maximum pressure on steam is 15 psig.

##### Fire Box type Boilers:

These boilers are a fire tube boiler and are development of the railroad locomotives. They are very common in schools and hospitals built in the 40's and 50's. Many of these boilers are set on high bases of steel or brick so that they could be coal fired.

##### Good Points:

Long life expectancy, as it is a steel boiler and can be welded and rewelded forever. Mud legs can be replaced for about \$15,000 on a 200 hp boiler.

Due to it's design, any height can be achieved under the boiler for firing various fuels such a coal, sawdust, oat hulls and etc. When using these fuels, specify large flues to prevent clogging. Maybe a soot blowing arrangement is in order.

With the extended base, it is easy to fire coal or sawdust while burning natural gas at the same time. They are used with stokers with a gas burner above the grate.

Has a large water volume and surface area therefore can be used in dirty systems or systems that have a high percentage of make-up water.

#### Problems:

The design of the "mud legs" create natural pockets for corrosion. Unless maintained exceptionally well, these legs will require replacing every 15 to 20 years.

Maximum pressure for these boilers is approximately 150 psig.

Maximum size is approximately 550 hp. This is due to the transporting problems on a truck.

Subject to thermal shock.

On an existing boiler, if it was designed for coal firing, then turbulators may improve the heat transfer which will improve the efficiency.

Since the bottom of the boiler is firebrick, this must be maintained in good repair. Special care is required to design this base correctly to prevent damage to the boiler room floor.

Typically these boilers are larger in size than the same capacity scotch-marine boiler.

#### Scotch Marine Boilers:

These boilers, as the name implies, were developed for marine service and then adapted to the building industry. They are fire-tube type boilers and the fuel is burned in the "Morrison" or furnace tube. Since this tube is completely surrounded with water, maximum heat transfer is achieved.

#### Good Points:

Very compact, as 750 hp boilers can be shipped by truck.

Maximum steam pressure is approx 250 psig.

Good efficiency. Standard is approx 83%.

Not subject to shock as much as other boilers.

Can be fired with gas or light oil. Have problems with heavy oils with some units. Kewanee claims to have a design that will burn coal???

The design is rugged, and many of the waste heat boilers used in incinerator plants are scotch marine type.

Problems:

Maximum steam pressure is 250 psig.

Maximum steam capacity is 750 BHP (25,000 #/Hr)

One piece construction, therefore difficult to get into and out of a boiler room. (Can be cut and rewelded, but is expensive.

Turndown on oil is not too great, but a minor problem.

WATER TUBE BOILERS:

These boilers are designed for high pressure systems. They are used in the generation of electrical power. They are built by using a minimum of 2 drums, the upper steam drum and the lower mud drum. Between these drums are connected the tubes that carry the water and steam.

Good Points:

Good for high pressures up to critical pressures.

Unlimited size.

Can be used to burn any fuel as each is more or less custom designed.

Small units, up to approx 250 BHP, can be packaged.

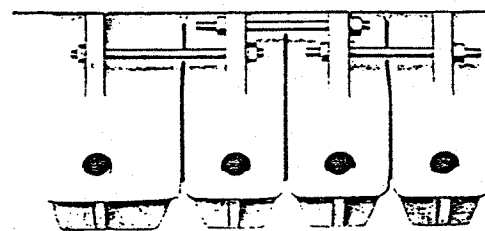
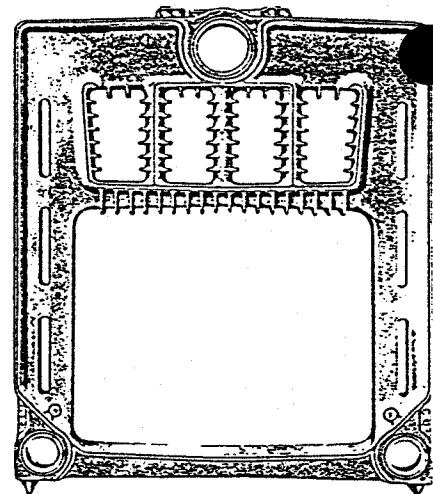
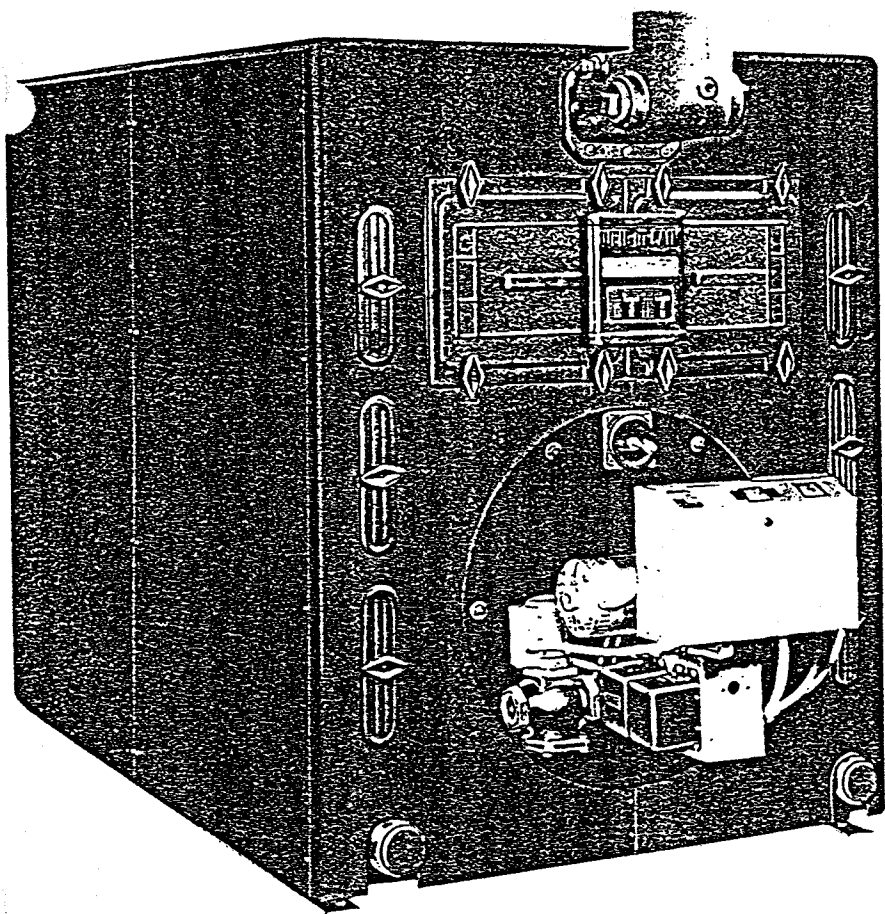
Can superheat steam.

Problems:

On large field erected units, the labor is expensive.

Small steaming surface, therefore not good to use for process steam.--unless

Water treatment is more critical with these boilers.



MAX 15 steam  
30 water

55-65%  
efficiency

### CAST IRON SECTIONAL BOILER

Good for hot water systems  
or small steam systems.  
Not good for larger steam systems.

Too much cold water and  
temp fluctuations can crack  
cast iron sections.

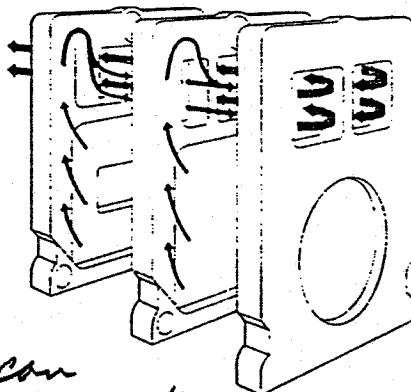
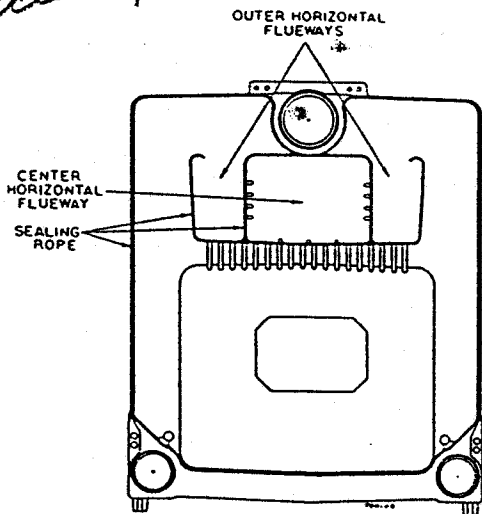
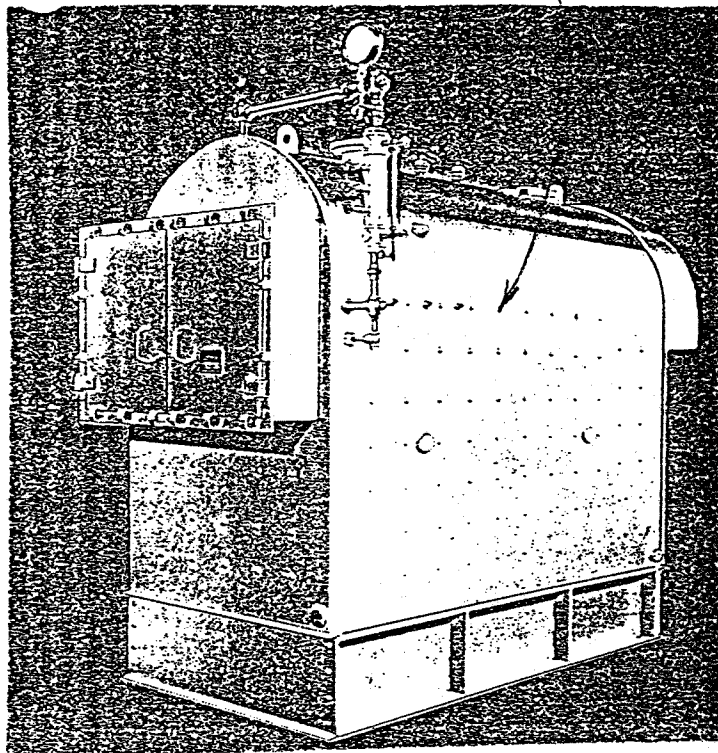
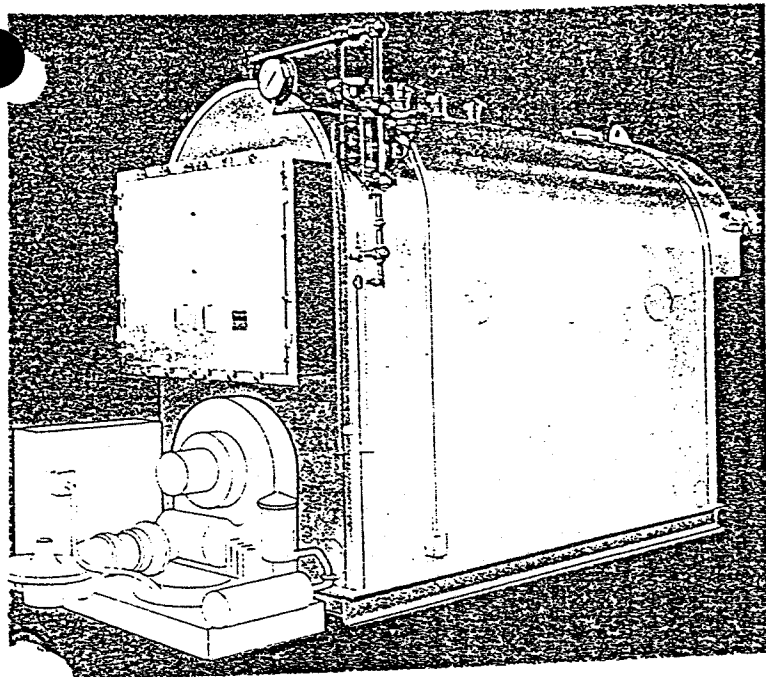


FIGURE 2

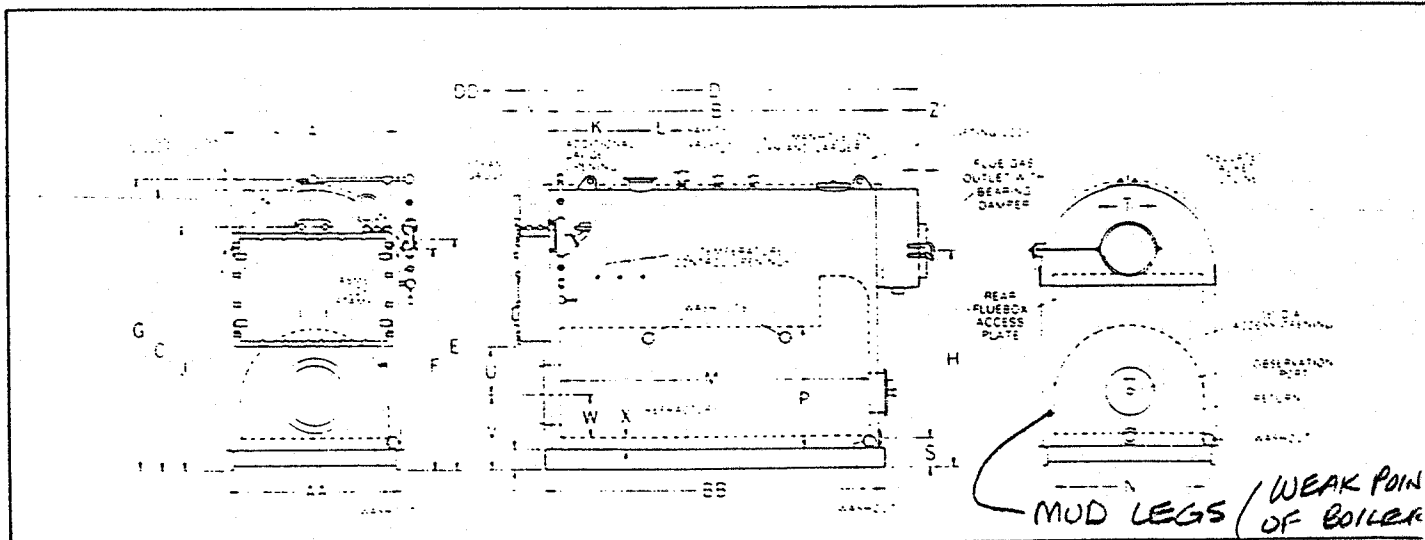
Modular so they can  
be used in renovations to  
go thru doorways, down  
stairs, etc. 8

STAY BOLTS - KEEP PRESS FROM EXPANDING SIDES



Can burn anything in this boiler.

FIRE BOX BOILER (LOCOMOTIVE BOILER)

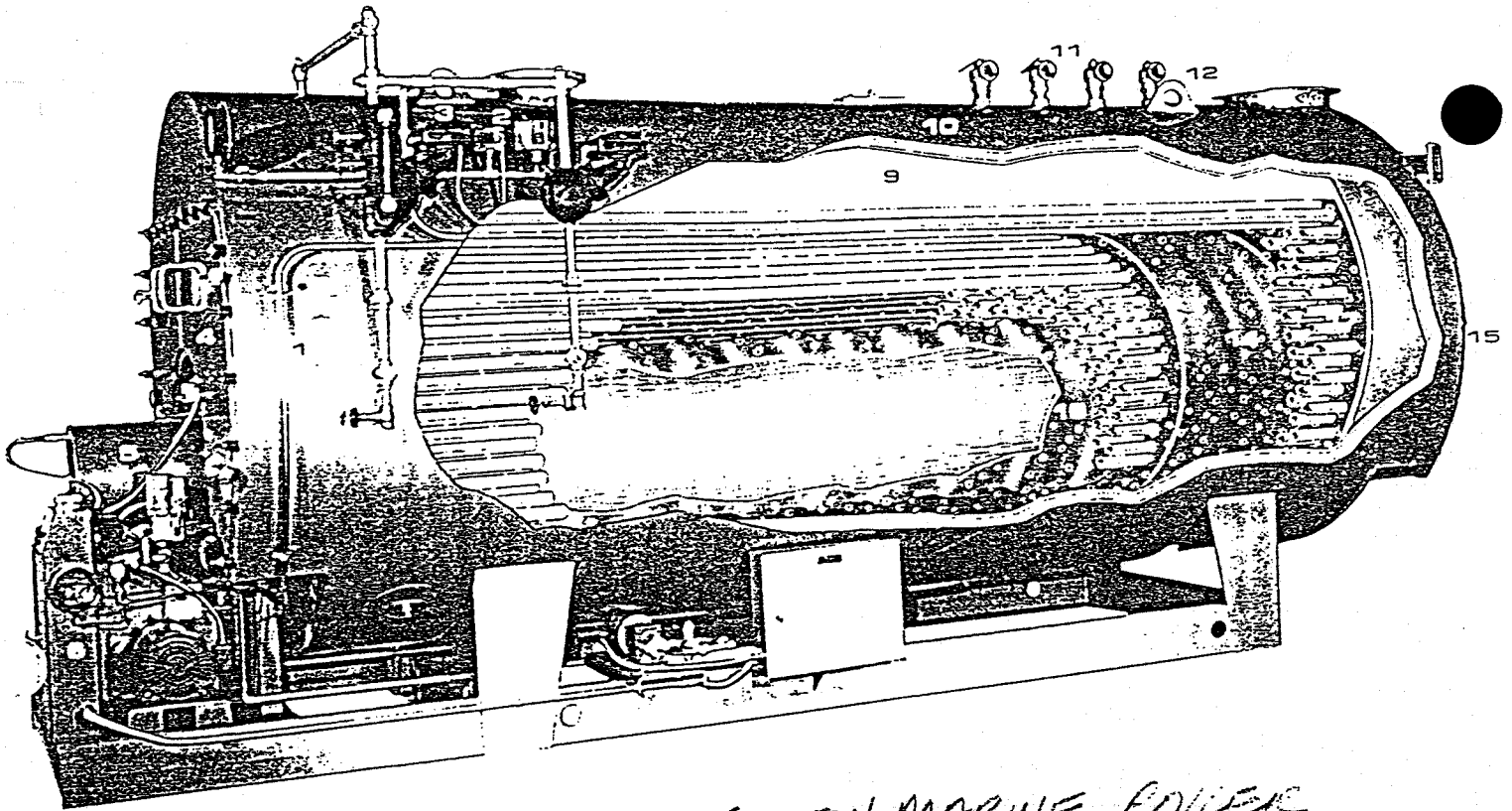


DIMENSIONS - (feet-inches)

BOILER DIMENSIONS	7L280-KX	7L281-KX	7L282-KX	7L283-KX	7L284-KX	7L285-KX	7L286-KX	7L287-KX	7L288-KX	7L289-KX	7L290-KX	7L291-KX	7L292-KX	7L293-KX
Shell Diameter - Inside	40"	40"	46"	46"	50"	50"	56"	56"	66"	66"	72"	72"	76"	80"
A - Boiler - width	42 1/2"	42 1/2"	47 1/2"	47 1/2"	51 1/2"	51 1/2"	57 1/2"	57 1/2"	67 1/2"	67 1/2"	74"	74"	78"	82"
B - length	73"	84 1/2"	79 1/2"	91"	91"	109 1/2"	108"	121"	101 1/2"	121 1/2"	121 1/2"	139"	142 1/2"	145"
C - height	61 1/2"	61 1/2"	71 1/2"	71 1/2"	86 1/2"	86 1/2"	93"	93"	105"	105"	120 1/2"	123 1/2"	129 1/2"	147"
D - length overall	95"	106 1/2"	100"	114"	115"	131 1/2"	130"	145"	138"	158 1/2"	141 1/2"	167"	176 1/2"	179"
E - Water line height	51 1/2"	51 1/2"	68 1/2"	68 1/2"	74"	74"	71 1/2"	71 1/2"	81"	85"	106"	101 1/2"	111 1/2"	128"
F - Water column height	58"	58"	65 1/2"	65 1/2"	71 1/2"	71 1/2"	78"	78"	87 1/2"	91 1/2"	102 1/2"	107 1/2"	117 1/2"	125"
G - Steam supply height	74 1/2"	74 1/2"	84"	84"	81 1/2"	81 1/2"	98"	98"	101 1/2"	115"	129"	133"	141 1/2"	150"
H - Flue gas outlet height	54 1/2"	54 1/2"	62"	62"	68"	68"	72 1/2"	72 1/2"	80"	86 1/2"	99"	102 1/2"	109"	118"
J - Coil connection height	61"	63"	61 1/2"	61 1/2"	76"	76"	80"	80"	90"	96"	107"	111"	120"	129"

Kewanee Type "C" typically 3 pass.

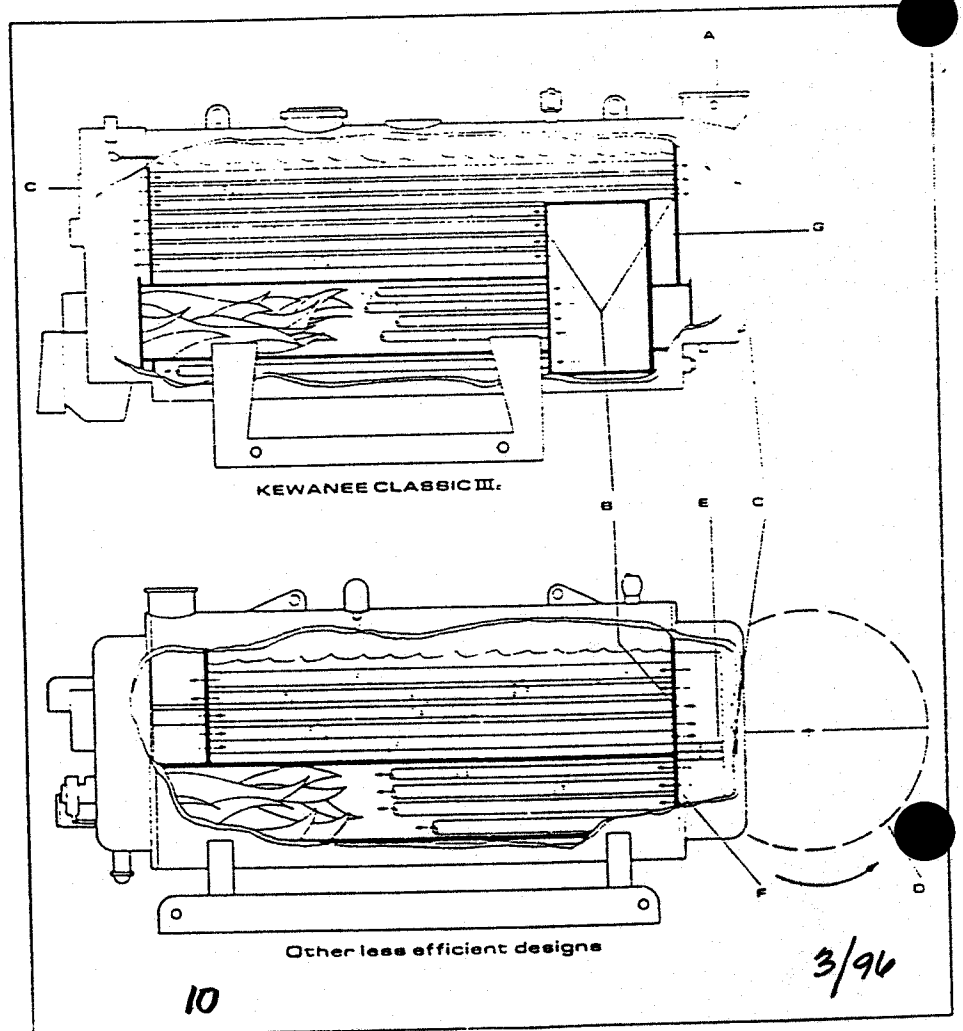
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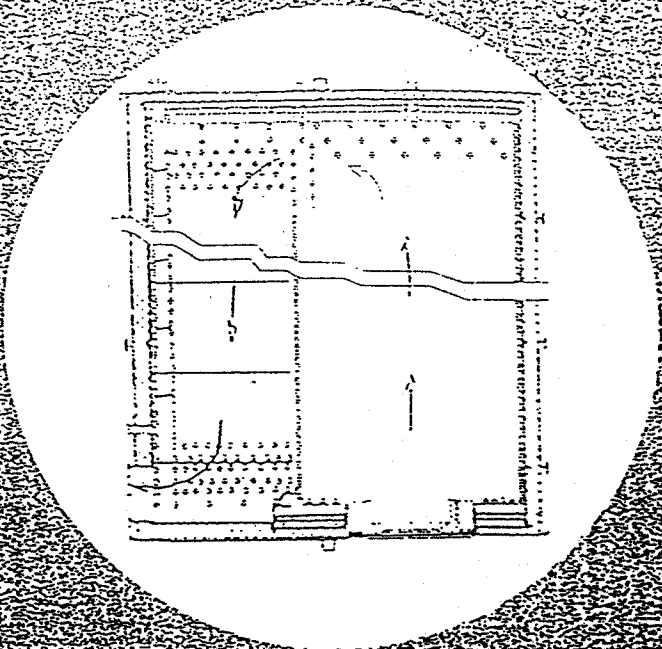
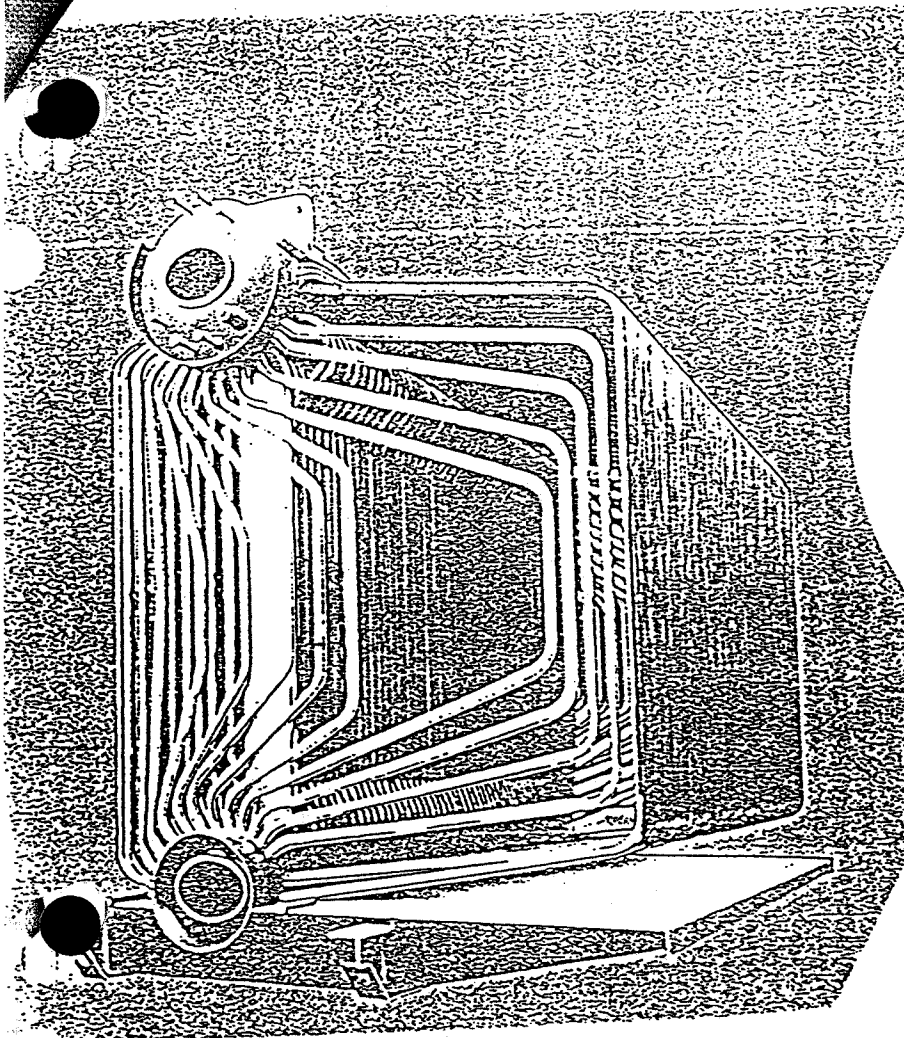
SCOTCH MARINE BOILER

Kewanee  
WET BACK BOILER  
OTHER MFRS  
DRY BACK BOILER

Never go to full  
fire until water  
is above 180°F,  
Operate at constant  
temp water to  
increase boiler  
life



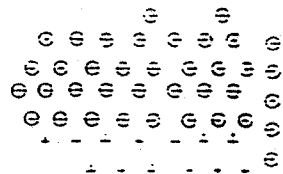
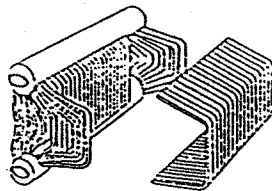
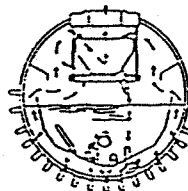
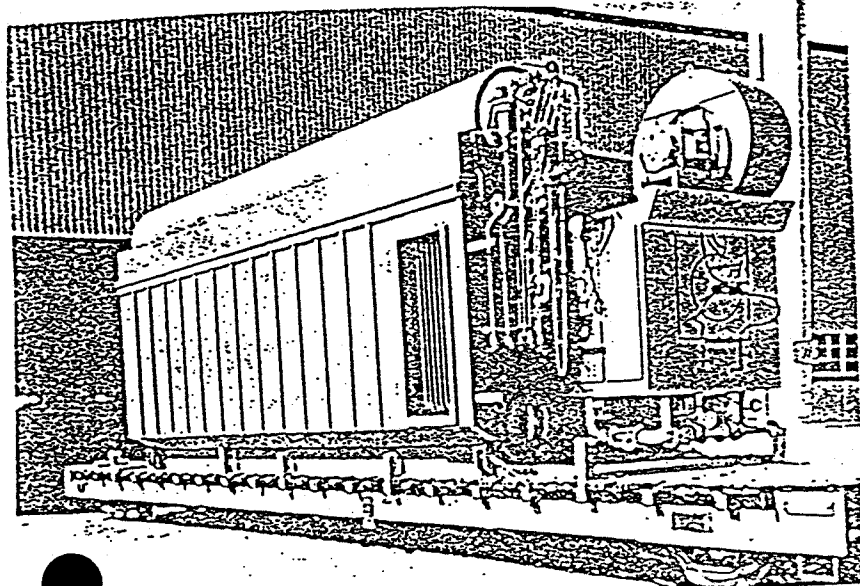




Rear furnace wall protection  
with 70% black surface coverage

WATER TUBE BOILER  
unlimited in size

Used in powerhouses  
Powerhouses use  
ionized feed water



Large water tube boiler ready for shipment.  
Courtesy of Nebraska Boiler Co., Inc. Division of National Dynamics Corp.

Advantage: high pressure and  
unlimited size.  
Disadvantage: Will not tolerate  
grease oil - coats  
tubes and lowers efficiency