THESIS,

DESIGN FOR A STEAM PLANT

ONE HUNDRED THIRTY-FIVE HORSE POWER,

FOR DEGREE OF B. S. SCHOOL OF M. E.

BY

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1886.
THE DESIGN.

For a basis upon which to make our calculations in designing this plant we assume that the engines will indicate one hundred thirty five horse power cut off at one quarter stroke and will not be used cutting off at later than three fourths. Thus designing the plant to furnish the engines with steam at this later point of cut off. The initial pressure in each case to be twenty five lbs.

Assuming that five lbs will be lost by back pressure and throttling. This gives us a boiler pressure of eighty pounds. From this above we find the volume and weight of steam.
used to be three hundred seventy nine cubic feet, which weighs eighty two and one half pounds, per minute. Assuming that one pound of Illinois coal will evaporate nine pounds of water at this pressure and that twelve pounds of coal are burned per square foot of grate surface per hour we find that forty five square feet of grate surface are needed.

The diameter of shells, and also lengths, are found by assuming that the steam occupies one third the volume of the shell and has a life of twenty seconds, all allowing forty four square feet heating surface per square foot of grate and a calorimeter of review we find the number of litres needed.
SPECIFICATION

for plant to furnish steam for an engine indicating 135 horse power.

Type. There are to be two horizontal return tubular boilers set in a battery.

Dimensions The boilers shall each be sixteen (16') feet long between outer side surfaces of heads and sixty (60”) inches in diameter.

Shell. The shell shall be five sixteenth (5/64”) inches thick of homogeneous steel of uniform quality, having a tensile strength of not less than 55,000 lbs. per sq. in., nor more than 65,000 lbs. per sq. in., and elongation of 30% in a piece originally two (2”) inches long. The name of maker, brand and tensile strength must be
Hoods

Plainly stamped on each plate. The heads shall be of same quality as plates of shell in all particulars and shall be one-half (1/2) inch thick.

Flanges

The flanged must be turned in a neat manner with an internal radius of not less than two (2") inches and must be free from checks and flaws.

The holes shall be riveted with 9/16-inch rivets throughout. All girth seams are to be single riveted. Pitch of rivets 1 1/8 inches (1 3/8" approx.). Overlap 1/4 inches. All horizontal seams are to be double riveted and rows of rivets staggered. Pitch 2 1/8 inches. Distance between rows 1 1/8 inches. Overlap 1/4 inches. The rivet holes are to be punched so as to come fair. No drift pins to be used in construction.
Calking.

All seams are to be calked on both sides and no and no acide or other chemicals are to be used in forming them, and no fitting pieces are to be inserted. All calking to be done by the armory round wood tool.

Tubes.

Each boiler is to contain fifty seven (57) best lap-welded tubes, sixteen (16) feet long, three and one half inches outside diameter and to be between 0.12 inches and 0.15 inches in thickness.

The tubes are to be set in vertical rows and in rows inclined sixty (60°) degrees from vertical. The centers shall be four and five eights (4 5/8") inches apart. No tube shall be nearer than three (3") inches from the shell. The tubes shall be set with Dudgeon expander and both ends headed over.
Braces.

There are to be twenty-two (22) braces in each boiler—seven (7) three (3) feet long and four (4) five (5) feet long for each head. They shall be made of refined iron with dimensions as shown in Fig. 1. The pipes are to be turned.

Fig. 1
Scale 2" = 1'

Man-holes.

There shall be one 18" by 15" manhole in each boiler located as per drawing, each manhole to have around it on the inside an elliptic ring 3" by 3/4. Rivets to be countersunk flush on both sides. Parts where gaskets come to be faced. Manhole plates
Hand-holes.

There shall be one hand-hole in each boiler 6" by 8" located as per drawing, each hand-hole shall have around it an elliptic ring 2" by 1/2" placed on inside of boiler. Rivets to be countersunk flush on inside. Parts where jackets come to be faced. Hand-hole plates to be of cast iron and secured by bolts and arches.
Feed-pipes.

There shall be a horizontal one and one fourth (1\(\frac{1}{4}\)) inch pipe led transversely across the tops of the battery, then down ward on each side, then forward on a level with the third row of fire tubes from top, thence to smoke box and into boiler as shown in drawings. The pipe fittings in smoke box shall be as shown in Fig. 3. The brassing where pipes enter boiler shall be one and three fourths (1\(\frac{3}{4}\)) inches. The pipes shall extend two (2) feet back from front head and then be supported from tubes above. These pipes shall be perforated with forty (40) one fourth (\(\frac{1}{4}\)) inch holes so drilled as to project the water downward and toward the center of the boiler.
Dry Pipe.

A dry pipe five (5") inches in diameter and ten (10) feet long to be placed in each boiler near the top. The top of dry pipe to be drilled with two hundred and fifty (250) holes 3/8 inches in diameter, equally distant apart.

Nozzles.

Each boiler to have two (2) cast iron steam nozzles one for safety valve and one for steam pipe connected as per drawing.

Safety-valves.

There shall be one four-inch safety valve fitted to the rear nozzle of each boiler, with weights and lever for a pressure of ninety (90) lbs steam. The valve seats to be of gunmetal.

Stop Valves.

There will be one four-inch (4") stop valve connecting the front nozzle of each boiler with four-inch steam pipe.

Wall Plates.

Each boiler is to have four cast iron lugs, two on each side, the rear lugs to rest in four transverse rollers one inch in diameter which are to rest
on suitable wall plates. The front legs to rest on suitable wall plates without rollers.

A two 12" pipe is to be placed on each boiler as shown in drawing. It is to be attached with a cast iron flange riveted to bottom of shell. It is to be closed by a gate valve.

The fronts are to be of cast iron of design shown in drawing. The words "University of Illinois" to be cast on front as follows: "University of Illinois" on left boiler symmetrically cast to the word "Illinois" shown on right boiler front. The word "of" on ornament between the words University and Illinois. The date 1856 is to be cast on each front as indicated.

Each boiler is to be provided with an steam gauge of standard make eight (8) inches in diameter located as per drawing, one water column with water glass and gauge cock. All pipe connections with
Damper

Each boiler is to be fitted with a damper fitted in the uptake. Damper to be provided with friction attachments to hold it in any position and also provided with suitable hand attachments easily accessible at boiler front. The edge of damper when closed shall be Three fourths inch from wall of uptake.

The flue of each boiler shall be made of one eighth (1/8) inch iron. The back wall of uptake shall enter main flue at an angle of forty five (45°) degree and forty (40°) inches back of front wall.

The main flue shall be made of one eighth (1/8) inch iron. It shall be Thirty five (35") inches in diameter and shall extend back twenty four (24) feet from boiler front.

The settings are to be provided with all stays, rods, bolts, nuts, washers, anchors, bolts.
and also beam and grate bars.

At rear of each boiler there shall be located in the brickwork a cast-iron door and door frame. The door to be two (2) feet square and provided with a liner plate.

All brickwork to be set on solid stone foundations resting on hardpan.

Neither paint nor fatty is to be put on any part of the boilers until the same are delivered and tested.

The size and description of parts are to conform substantially to the details of the accompanying plan.

All the material and workmanship to be subjected to the inspection and approval of the inspecting engineers.
Sectional View E.F.  
Front Elevation.  

BOILERS FOR AN ENGINE OF 135 HP.  

Scale in Feet.