OFFICIAL PROCEEDINGS

OF THE

EIGHTEENTH ANNUAL
CONVENTION

OF

The National District Heating Association

HELD AT

WEST BADEN SPRINGS HOTEL,
WEST BADEN, INDIANA

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D. L. GASKILL, *Secretary*.

PART II

RECENT EXPERIENCES OF MEMBER COMPANIES WITH STEAM DISTRIBUTION SYSTEMS

Steam Main Construction, 1926, at Rochester, New York, by the Rochester Gas & Electric Corporation

The following is not intended as an argument either for or against the use of welding in the construction of steam mains, but is a statement of the activities of the Rochester Gas & Electric Corporation along that line, which we believe will be helpful to the Association.

Prior to 1925 the principal welded work in steam-main construction of this company consisted of three overhead lines built for 225 pounds pressure, one being a 6″ line 2,500 feet in length, another an 8″ line 2,500 feet long, and the third being a 10″ line 1,500 feet long. These lines were welded in solid throughout including in some cases the valves. In addition to this a great many welds were made on shorter lines of various sizes up to 14″ pipe.

All welding up to this time had been acetylene, and while an outright or serious failure had not occurred, there were a number of cases where leaks developed after the lines had been in service, although the welds had been subjected to hydraulic and hammer tests before being put in service. This may have been due to the methods used by the welders. These failures were mostly confined to lines which were ten (10) inches in diameter or larger which would seem to indicate that they were due to improper methods in maintaining a uniform heat on the work and thus leaving the weld with internal shrinkage stresses. These cases were not numerous, there being only two out of about one hundred welds (100) on a 10″ line 1,500 feet long. They were, however, sufficiently numerous on the larger sizes to cause some concern for lines which it was proposed to install underground.

In the spring of 1925 the installation of the distribution system for the Lawn Street Station was begun. This system in most cases was to consist of three pipes, one a high pressure designed for 375 pounds, one a low pressure for 25 pounds, and the other a return line. These lines were to be placed beneath the pavements of some of the best streets. Under such circumstances it was highly important that no leaks should develop after the lines were completed and the pavements replaced.

For this district electric arc welding was used almost entirely. The high-pressure lines consist of extra heavy black steel pipe with electric cast steel expansion joints and similar gate valves welded solidly in the line and all bends, tees or crosses were fabricated by welding so that no gaskets whatever are used except beneath the bonnets of gate valves which are in manholes.

The low-pressure lines consist of full-weight black steel pipe with flanged cast iron expansion joints and similar gate valves. In this line the pipe is welded from manhole to manhole but gaskets are of course used in the flanged connections to the cast iron fittings. The construction of the return line is similar to that of the low-pressure line. The return line consists of extra heavy wrought iron pipe.

In the past two years the Rochester Gas & Electric Corporation have installed over 30,000 feet of pipe in sizes from 20″ down, equivalent to over 20 miles of 4″ pipe. Only two leaks have developed after the lines were in service and these were in service connections made in manholes after the manholes were built and where insufficient clearance existed to allow the operator a fair chance to work.

The Technique of Electric Welding

Welding is such an important part of district heating work that the Committee feels it necessary to present the most recent practice in this art to the Association. In this respect we are fortunate in securing the following excellent résumé from Mr. E. R. Benedict of the American District Steam Co.

"A very important difference in the electric arc welding of pipe from that of oxy-acetylene welding is in the scarfing of the pipe. The pipe for arc welding should have a bevel of only 30 degrees from the vertical for real economy, instead of 45° as generally used, and as illustrated in Figure No. 6. Nearly 50 per cent more metal must be deposited by the operator if the usual 45° scarf is used as for oxy-acetylene welding.

"This surplus metal added to the 45° scarfed pipe adds nothing to the strength of the weld and in all probability detracts from it as a surplus of heat must be added to the weld to deposit the extra metal.

"The 30° bevel leaves sufficient room for the operator to penetrate to the bottom of the weld so that the inner edges of the pipe are thoroughly bonded.

"At the same time, the more acute scarfing does not require such a

It is not suggested that this method of treating boiler feed water is ideal, or that it can compete in results obtained with either soft water or with the modern chemical methods of treatment when soft non-scale-forming waters are produced. It does produce results above those attained with ordinary feeding of raw water, and there are many plants where equipment now installed or space available will not permit the more modern equipment.

REPORT ON FIRST YEAR'S OPERATION OF 3000 K.W. NON-CONDENSING TURBINE IN LAWN ST. HEATING PLANT OF ROCHESTER GAS & ELECTRIC CORPORATION

By C. E. HAGUE

At the convention of the National District Heating Association, held at West Baden, Indiana, in 1925, Mr. R. D. DeWolf presented a report on the operation of a 2800 K.W. non-condensing turbine used for supplying low pressure steam to the steam-distribution system of the Rochester Gas & Electric Corporation.

This report discussed the operation of the turbine and some of the advantages in the use of this machine. This turbine is still in operation, and its performance has been satisfactory for the purpose toward which its use has been directed.

When the company built the Lawn Street Steam Heating Plant, a non-condensing turbine was included in the equipment supplied. Figure No. 1 shows this turbine.

The equipment installed in this plant was described at the convention last year in a paper by Mr. Woodruff, and need not be repeated here.

Steam is supplied to the heating mains as High and Low Pressure. The high pressure is maintained so as to deliver approximately 100 pounds to the customers. The low-pressure steam is supplied to the mains at from 5 to 20-pound gauge, depending upon the steam demand.

For reducing the boiler pressure of 375 pounds to the 100 pounds—130 pounds and 5 to 20-pound mains, reducing valves with automatic controlling devices have been provided. These are shown in Figure No. 2. "A" controls the 100-pound high pressure—"C" the low pressure—"D" the 130-pound pressure, while "B" is a spare which may be used on either the 100-pound line or the low pressure, as may be required. All reductions are made directly with but one reducing valve, and no difficulty has been encountered in their operation. Stop valves are placed on these lines so that these valves may be repaired without any interruption to the service.

The turbine (Figure No. 1) is a G. E. non-condensing, 11 stage Turbo Cenerator, horizontal type, 3600 R.P.M. With the initial steam pressure at 350 pounds 550° F. and the exhaust pressure 25 pounds absolute the capacity is 3000 K.W. 80% power factor. The generator current is 4150 V, 3-phase, 60 cycles, and is delivered into a 4150 V-bus structure within the station. This bus structure is connected with the company's system, so that any surplus current over and above that needed for the auxiliary equipment is sent into the system and becomes a credit against the operating costs of this plant.

All station auxiliaries, with the exception of 1 high pressure steam pump and 1 low pressure steam pump, are electrically driven.

The regulation of the turbine may be either hand controlled or automatically controlled from the back pressure. The back-pressure control, Figure No. 3, is located on the operating floor quite removed from the turbine, and consists of a spring-balanced diaphragm connected to the heating mains. This diaphragm actuated by the h. & l. pressure reacts in the turbine governor and thus regulates the steam supplied to the turbine to meet the demands of the heating load. The back pressure can be regulated to any desired point between 4 pound- and 20 pound-gauge, with a variation of ¼ pound up or ¼ pound down. This regulator can be tripped out at any time and the turbine hand controlled when desirable. In case of emergency, the turbine can carry full load by exhausting the surplus steam to atmosphere, and therefore has an added value as a standby to the electrical system of the company.

To safeguard the turbine and reduce the attention required, equipment has been provided for automatically shutting it down in case of low oil pressure, hot bearings, or overheated air in ventilating dust.

Figure No. 4 shows three of these devices mounted on the exciter and of the generator. Each device consists of a Tycos Index Thermometer with a capillary bulb for locating at any desired point. The operating condition is shown by the pointer A, which is also the contact-making element. A second movable arm B, which can be set at the critical point is the second contact-making element. Then if, for example, the temperature of a bearing or part arises to the critical point, a contact is made, closes a tripping-out circuit which cuts the turbine off the line and trips the throttle valve, shutting down the turbine.

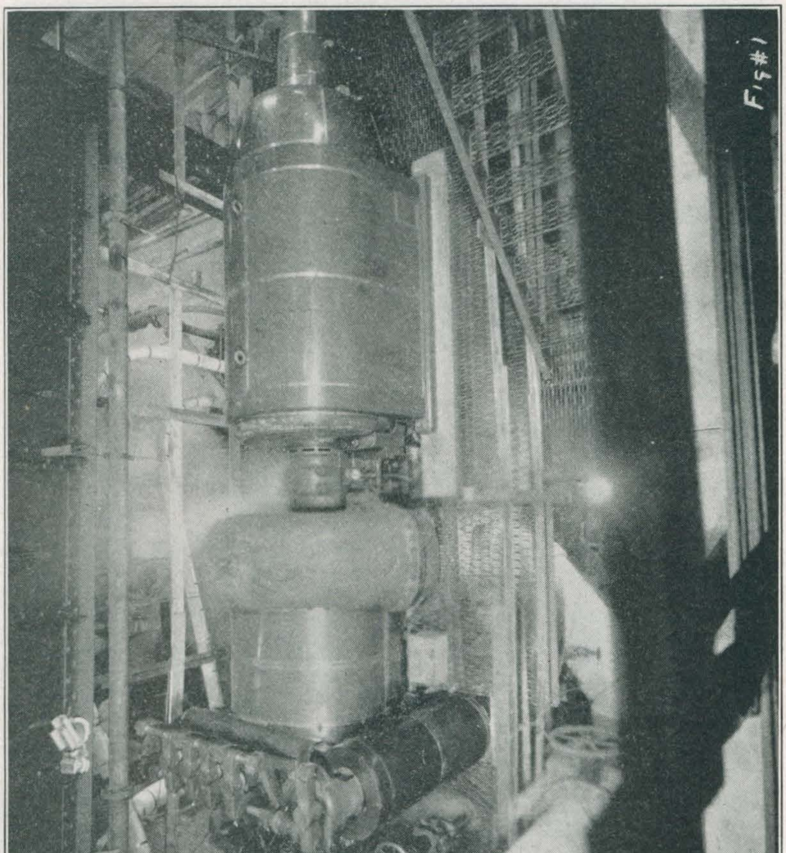
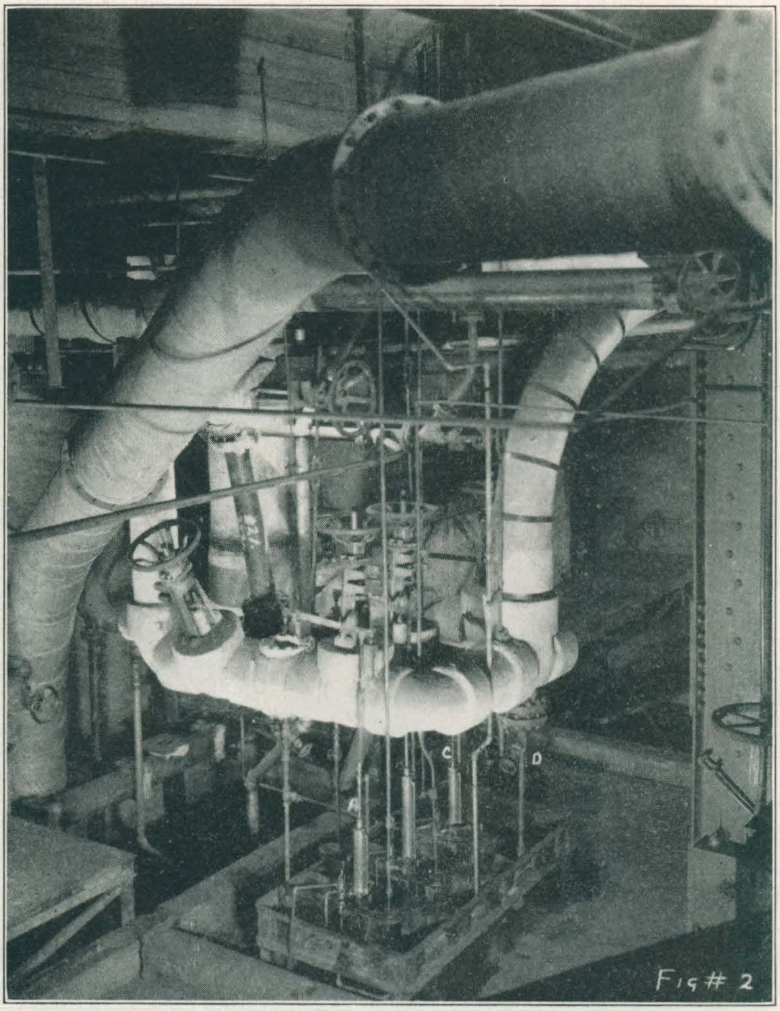


Fig #1


C
D
A
FIG # 2

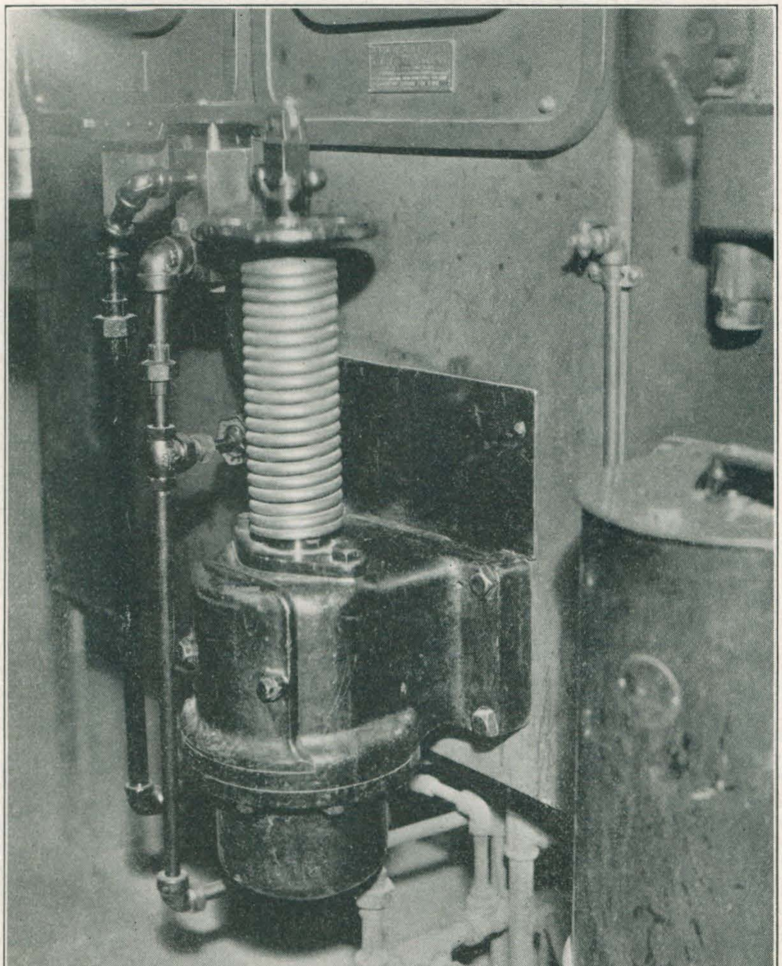
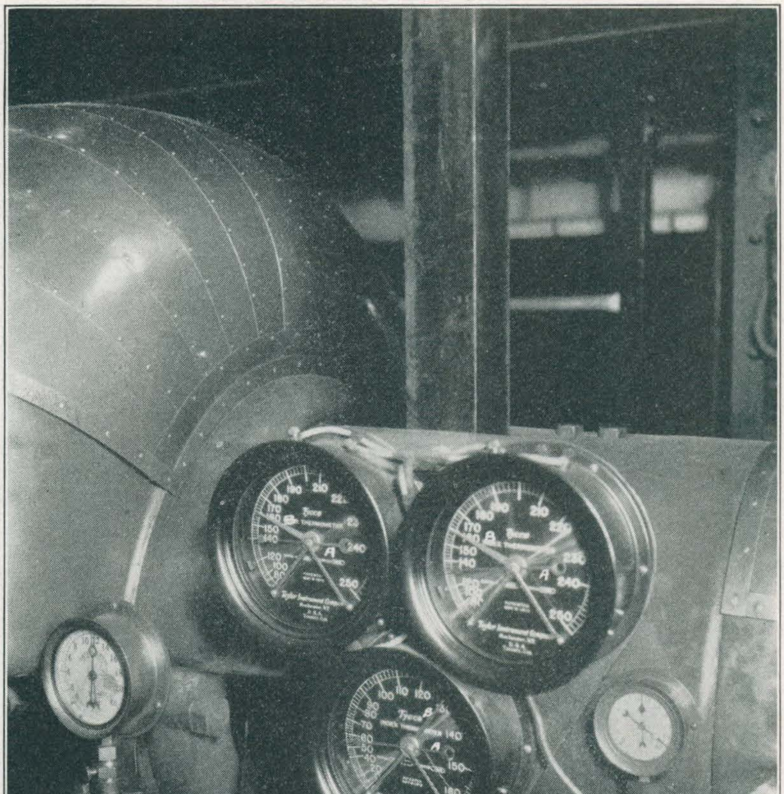


FIG # 3


Fig# 4

OPERATING PERIOD APRIL, 1926, to MARCH 1, 1927

Month	Pounds Steam Generated	Pounds Steam to Low Pressure	Pounds Steam to Turbine	K. W. H. Generated	K. W. H. Auxiliaries	Turbine Hours	Peaks Gen. 1000's	Peaks S. Out. 1000's
1926								
April	23,370,600	15,899,400	10,339,000	303,360	79,990	476¾	64.0	60.0
May	11,729,800	6,444,100	1,845,500	39,000	32,170	84	62.0	47.0
June	3,529,500	1,562,250	22,500				24.0	22.0
July								
August								
September								
October	14,735,900	10,338,100	2,097,000	47,040	29,414	89	64.0	60.0
November	25,762,000	18,026,800	11,035,400	304,980	87,080	425	120.0	71.0
December	35,328,000	25,334,000	21,465,000	705,840	108,090	682	106.0	87.0
1927								
January	39,879,000	28,417,600	27,112,000	759,060	126,390	740	102.0	89.0
February	37,835,200	26,359,900	21,808,500	619,560	124,739	632	115.0	110.0
	192,170,000	132,382,500 68.8% Total	95,724,900 49.7% Total 72.3% L. P.	2,778,840	601,952	3128¾ 55.4%	120.0	110.0

Figure 5

This type of device seems to be an improvement over other types, in that it gives visible indications of conditions at all times, at which action will occur. as well as an easy way of making trial tests by moving the contracting pointer around to the closing or critical point.

There is also provided for the generator an air cooler of the closed-circuit type, wherein the air is cooled and recirculated. The cooling water used for cooling the air is delivered into the feed-water tank for boiler purposes, also a reheater for the turbine exhaust before it goes to the low-pressure line. This reheater uses live steam for reheating, and adds 40° to 50° to the steam leaving the reheater.

Figure No. 5 is a table showing the operation from April 1, 1926, to March 1, 1927, excepting a period from June 16th to September 26th, when this station was not in service and the load was carried by another plant, now dismantled. During this period of time, this station has produced 192,170,000 pounds of steam. Of this total, 132,382,500 pounds was fed into the low-pressure system, or 68.8% of the total, and 95,724,900 pounds (49.7% of the total) was put through the turbine. This again is 72.3% of the low-pressure steam. In this same period of operation, the turbine generated 2,778,840 K.W. Hrs. or a K.W. for 34.44 pounds of steam.

The auxiliary consumption of this same period was 601,952 K.W. Hrs., leaving a balance of 2,176,800 K.W. Hrs. delivered into the company's system, and is a credit against the operating cost of the station. The turbine ran 3,128¾ hours out of a total of 5,640 hours, or 55.4% of the total time.

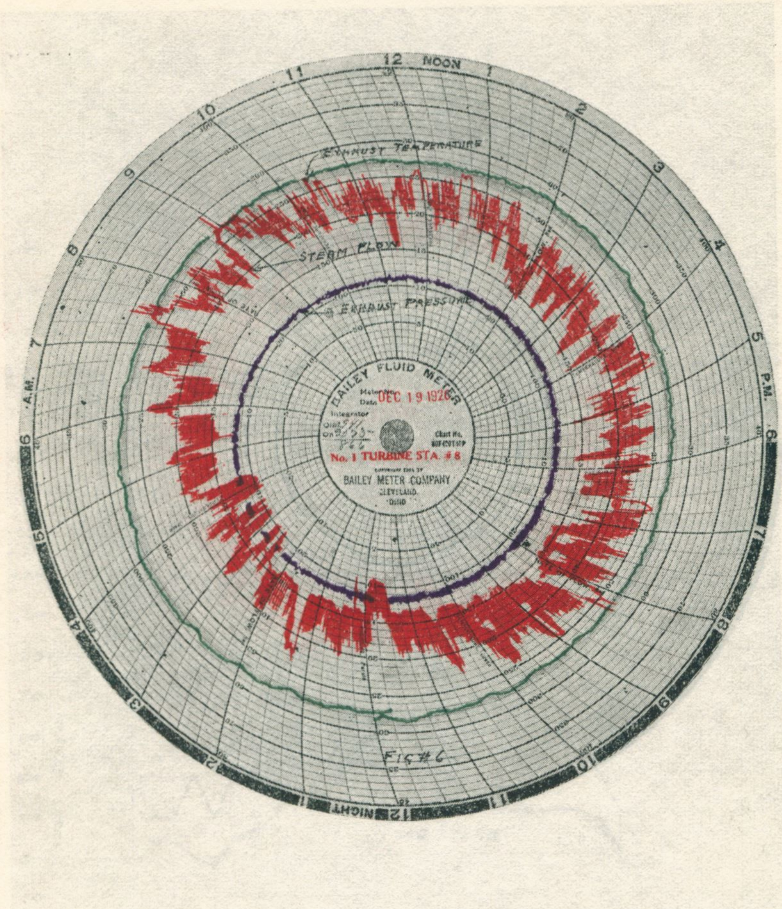
It has been the practice of this company to keep the turbine on the line as much as practical, and to take it out only when the load is so reduced that the operation has reached a critical point—this point being an arbitrary one between 120 to 180 K.W. load, as below this point there may be a condition when the load is so low that motoring is possible, and this is not desirable.

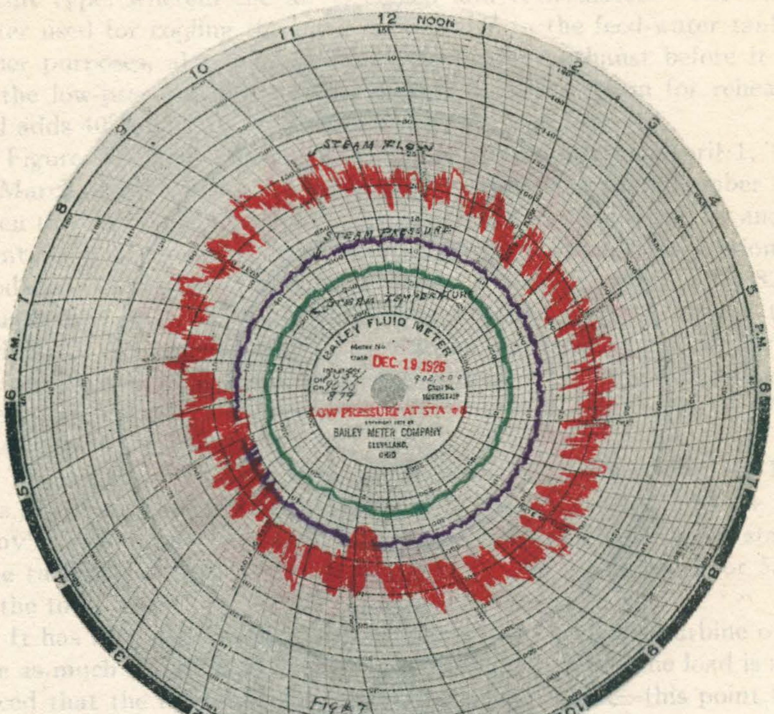
A number of curves are appended which may be of interest to the members.

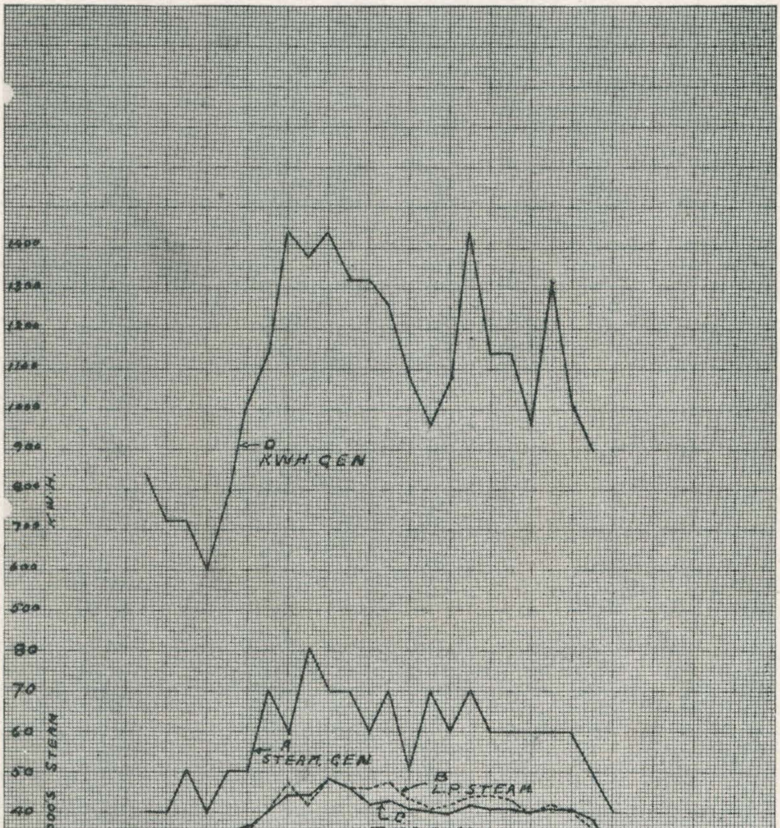
Figure No. 6 is a chart of the turbine operation for December 19, 1926, typical of an average day.

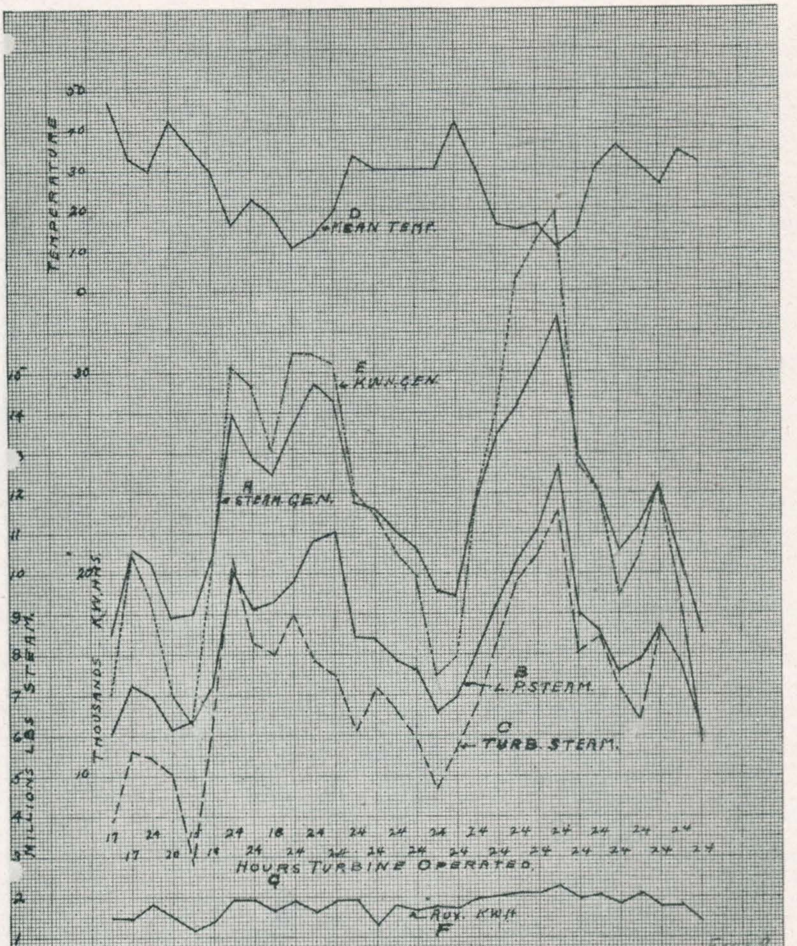
Figure No. 7 is a chart of the low-pressure line for the same day.

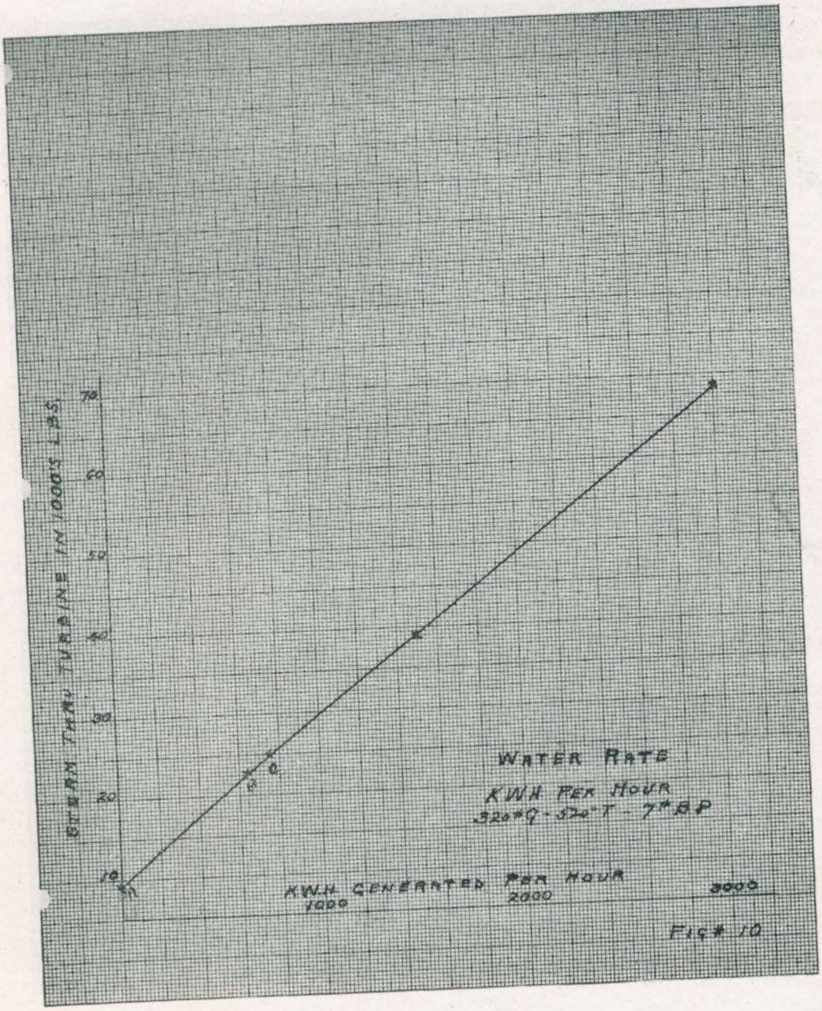
Figure No. 8—A set of curves for one day—December 19, 1926, showing "A" hourly steam generated—"B" hourly steam to turbine—


12 NOON
EXHAUST TEMPERATURE
STEAM FLOW
EXHAUST PRESSURE
BAILEY FLUID METER
DEC 19 1926
No. 1 TURBINE STA. # 8
BAILEY METER COMPANY
CLEVELAND
OHIO
A.M.
P.M.
12 NIGHT
FIG #6


12 NOON
STEAM FLOW
STEAM PRESSURE
STEAM TEMPERATURE
BAILEY FLUID METER
DEC. 19 1926
LOW PRESSURE AT STA #6
BAILEY METER COMPANY
CLEVELAND, OHIO
A.M.
P.M.
12 NIGHT
Fig #7


K.W.H.
1000'S STEAM
KWH. GEN
STEAM GEN
L.P. STEAM
TURB. STEAM
AM
P.M.
12 2 4 6 8 10 12 2 4 6 8 10 12
80
70
60
50
40
30
20
10
DEC.-1926
Fig # 8


TEMPERATURE
D
MEAN TEMP.
E
KW.H.GEN.
A
STEAM GEN.
B
L.P. STEAM.
C
TURB. STEAM.
THOUSANDS K.W.H.S
MILLIONS LBS STEAM
HOURS TURBINE OPERATED
G
AUX. KW.H.
F


STEAM THRU TURBINE IN 1000'S LBS.
70
60
50
40
30
20
10
C
B
A
WATER RATE
KWH PER HOUR
320# G - 520° T - 7# B.P.
K.W.H. GENERATED PER HOUR
1000
2000
3000
FIG# 10

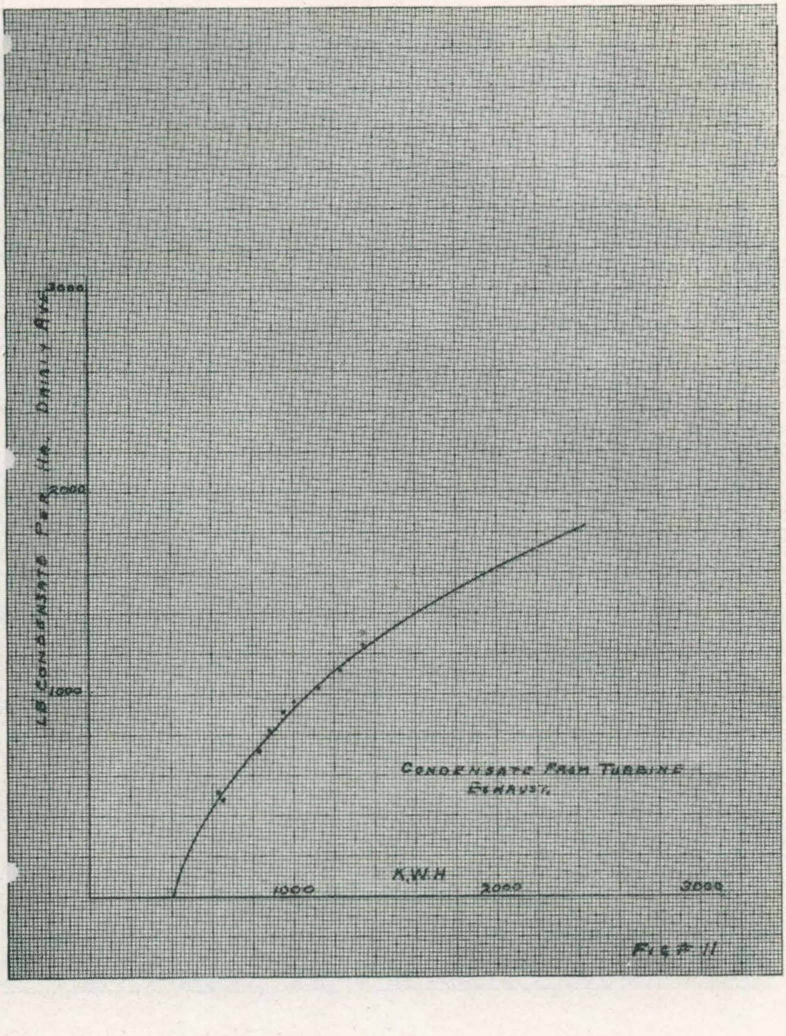

Lb Condensate Per Hr. Daily Ave.
3000
2000
1000
Condensate From Turbine
Exhaust.
K.W.H
1000
2000
3000

Fig # 11

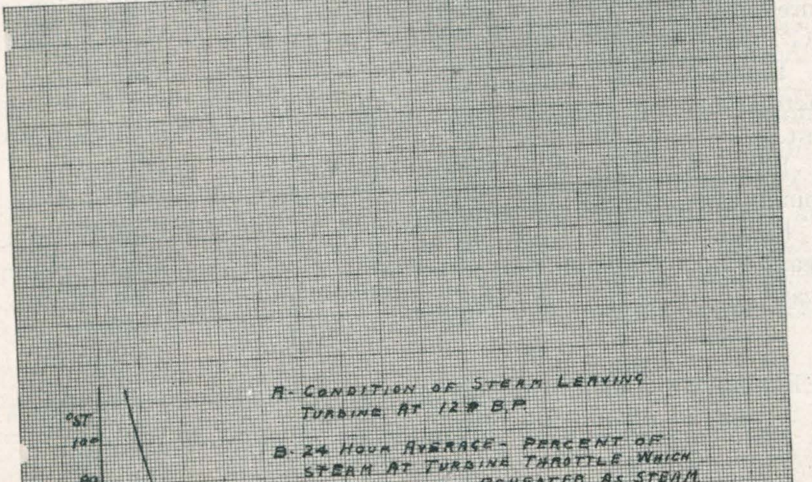

A- CONDITION OF STEAM LEAVING TURBINE AT 12# B.P.
B- 24 HOUR AVERAGE - PERCENT OF STEAM AT TURBINE THROTTLE WHICH PASSES OUT OF REHEATER AS STEAM.
°ST
100
80
60
40
20
%DRY
100
98
96
94
A
B
KW LOAD
1000
2000
3000

FIG #12.

"C" hourly steam to low-pressure line, and "D" hourly load on the turbine.

Figure No. 9—A set of curves for a month—November 26, 1926 to December 26, 1926. "A" Daily steam generated—"B" Steam to low pressure—"C" Steam through the turbine—"D" Main daily temperature—"E" K.W. Hrs. generated—"F" K.W. Hrs. used for auxiliary—"G" Hours turbine in operation.

Figure No. 10—Water-rate curve of the turbine showing the manufacturer's rating with the points A, B, C, showing checks made under test.

Figure No. 11—Curve showing condensate from turbine exhaust, pounds of condensate per hour against K.W. Hr. load on turbine.

Figure No. 12—Curve of steam conditions—"A" Condition of steam leaving turbines at 12″ B.P.—"B" 24-hour average per cent of steam to turbine throttle which passes out of reheater as steam.

FEED WATER TREATMENT IN THE BEACON STREET HEATING PLANT OF THE DETROIT EDISON COMPANY

By LEO F. COLLINS

In treating this subject, an effort has been made to limit as far as possible confusing chemical terminology. The success attained will be left to the judgment of the reader. However, since the treatment of water is in its very essence a chemical problem, it becomes necessary to include some of the diction of that science.

It is unquestionably true that a perfect treatment which will cover all cases has as yet not been evolved. The usual existance of magnified local conditions require specific antidotes. Their resultant action may inject into the steam impurities which can be classed as totally objectionable, a necessary evil or a matter of no import. Under whichever caption these impurities exist depends upon the ultimate use of the steam. For this reason it is not assumed that the scheme herein described is the zenith of treating achievements, nor that it has no room for improvement. It can be said with immunity nevertheless, that this approaches more closely than any other method thus far tried, the demands of a Central Heating station.

To create the correct perspective in the mind of the reader for the reasons for the different components of this treating scheme it is perhaps

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Kansas City, Missouri.

Plant No. 8—Plant No. 1 and 2.
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Portland, Oregon.

Plant No. 9—Lawn Street Plant, Station No. 8.
Rochester Gas & Electric Corporation.
Rochester, New York.

SECTION 1—PLANT 9

Company.	Rochester Gas and Electric Corp.
Heating Plant.	Station No. 8.
Location.	Lawn Street.
Total ground area of plant.	Total Area—15,340 sq. ft. Present plant—7,520 sq. ft.
Total ground area of coal unloading and storage.	None.
1. Date of initial operation.	1. October 15, 1925.
2. Rated installed boiler capacity in H. P.	2. 2,244 H. P.
3. Yearly load factor for which plant was designed.	3. 29%.
	4. Grade of coal for which plant was designed.
A. Percentage of ash.	A. 10 Per cent ash.
B. Percentage of moisture.	B. ¾ Per cent moisture.
C. B. T. U. per pound.	C. 13,500 B. T. U. per pound.
D. Percentage of sulphur.	D. 1.5 Per cent sulphur.
5. Is coal received at plant by R. R., boat or truck.	5. By truck.
6. Make-up water for which station was designed.	6. Rochester City Water.
A. Percentage of make-up.	A. 70 Per cent make-up.
B. Average yearly temperature.	B. 48 Degrees F.
C. Solids in solution and suspension in gr. per gal.	C. 4.0 Grains per gal. approx.
D. Alkalinity expressed in parts $CaCO_3$ per million.	D. 60 Parts per million.
E. Acidity expressed in parts of H_2SO_4 per million.	E. None.
7. Number of boilers installed.	7. Two boilers.
A. Per cent installation.	A. Two boilers, third to be installed summer, 1927.
B. Ultimate installation.	B. Six boilers.
8. Characteristics of boiler plant.	8. Characteristics of boiler plant.
A. How many firing aisles.	A. One aisle—ultimate two aisles.
B. Volume of boiler house in cu. ft.	B. 600,000 Cubic feet.
C. Are larries used for distribution coal to stoker hopper.	C. No larries.

SECTION 2—PLANT 9

8. (Continued.)
   D. What coal bunker capacity is provided in building.
   E. Is coal storage provided on plant grounds.
   F. How are ashes removed from boiler-house basement.
   G. Are main steam lines above boilers, at firing-aisle floor, or below firing-aisle floor.
   H. Are boiler settings steel encased.

8. (Continued.)
   D. 1,100 Tons.
   E. No.
   F. Vacuum ash conveyor.
   G. Above firing aisle.
   H. No.

---

9. Stoker equipment.
   A. Underfeed stokers.
      (a) Number of retorts.
      (b) Number of tuyeres.
      (c) Hand-operated dump grates.
      (d) Power-operated dump grates.
      (e) Clinker grinders.
      (f) Type of stoker.
      (g) Stoker driven by.
      (h) Clinker grinder driven by.
   B. Chain-grate stoker.
      (a) Units per boiler.
      (b) Length of each unit from coal grate to water backs.
      (c) Width of each unit.
      (d) Grate surface per boiler in sq. ft.
      (e) Type of stoker.
      (f) Stoker driven by.
      (g) Is forced draft used.

9. Stoker equipment.
   A. None used.

---

10. Ash hoppers.
    A. Cubic yards capacity.
    B. Type of construction of ash hoppers.
    C. Type of gate.

10. Ash hoppers.
    A. 19 Cubic yards.
    B. Reinforced concrete, steel supported.
    C. Baker Dunbar hydraulic gates.

---

11. Powdered fuel.
    A. Furnace.
       (a) Type.
    B. Feeders.
       (a) Number per boiler.
       (b) Type.
       (c) Drive.

11. Powdered fuel.
    A. Furnace.
       (a) Air cooled front and side walls, water screen side and rear walls. No water screen at bottom.
    B. Feeders.
       (a) Unit system, 1 feeder per mile, two 7,000 lb. per hr., and one 2,000 lb. per hr. mills per boiler.

SECTION 3—PLANT 9

11. (Continued.)
   C. Burners.
      (a) Number per boiler.
      (b) Kind.
      (c) Type, horizontal or vertical.
      (d) Distance from tip of burner to furnace floor.
      (e) Distance from burner from side wall.
      (f) Distance from end burner to side wall.
   D. Blower. (Primary air.)
      (a) Number per boiler.
      (b) Characteristics of blower.
         1. Maximum capacity.
         2. Speed in R. P. M.
         3. Driven by.
         4. Type of blower.
   E. How do you eliminate dust in outgoing flue gas.

---

12. Forced-draft fan.
   A. Total capacity per cu. ft. per min.
   B. Maximum pressure available in stoker wind box.
   C. Are there individual air ducts and forced-draft fans for each boiler.
   D. Do all forced-draft fans discharge into a common air duct.
   E. Characteristics of individual forced-draft fans.
      (a) Maximum capacity.
      (b) Speed in R. P. M.
      (c) Driven by.
      (d) Type of forced-draft fan.
   F. How is air supply to stoker controlled.

---

13. Boilers.
   A. Total square feet of heating surface in all boilers.
   B. Square feet of heating surface in each boiler.

11. (Continued.)
   C. Burners.
      (a) Five per boiler.
      (b) Special Lopulco fan tail.
      (c) Vertical.
      (d) 30 Feet.
      (e) Distance of burner from front wall, 3 feet 4 inches.
      (f) 3 Feet 6 inches.
   D. Blower. (Primary air.) See exhauster.
      (a) 3 One per mill, integral with small mill, separate with large.
      (b) Characteristics of blower, large mill.
         1. Large Mill, 3,600 C. F. M. at 11 in. of water test.
         2. 1,150 R. P. M.
         3. 20 H. P. slip-ring motor.
         4. Raymond Mill Exhauster.
   E. Soot hoppers at base of economizer and stack and scraper conveyer in horizontal run in flue.

---

12. Forced-draft fan. (Secondary air.)
   A. 36,000 C. F. M.
   B. 5½ Inches.
   C. Installed on only one boiler. The other boiler receives secondary air from natural draft.
   D.
   E.
      (a) 36,000.
      (b) 2,200 R. P. M.
      (c) Turbine 100 H. P.
      (d) Damper and variable speed.

---

13. Boilers.
   A. 22,438 sp. ft.
   B.

Boiler	9,580 sq. ft.
Integral economizer	1,639 sq. ft.
Rated Surface	11,219 sq. ft.

SECTION 4—PLANT 9

13. (Continued.)	13. (Continued.)
C. Square feet heating surface per stoker retort.	C.
D. Spuare feet heating surface for each 16 sq. ft. of chain-grate surface.	D.
E. Average height of combustion chamber in feet.	E. 31 Feet.
F. Volume of each combustion chamber in cubic feet. (The fuel is included as part, if, the volume of the combustion chamber.)	F. 10,000 Cubic feet.
G. Cubic feet of furnace volume per 10 sq. ft. of boiler-heating surface.	G. 8.8 Cubic feet.
H. Air or water-cooled furnace walls.	H. Air cooled—front and side walls water cooled—side and rear walls.
I. Steam conditions for which boiler was designed.	I. Steam condition for which boiler was designed.
(a) Drum pressure per square inch gauge.	(a) 380 Pound gauge.
(b) Total steam temperature leaving superheater degrees F.	(b) 540 Degrees F.
J. Type of boiler.	J. Bigelow Hornsby.
(a) Number of tubes wide.	(a) 8-8-8-6-6 Arrangement.
(b) Number of tubes high or deep.	(b)
(c) Length of tubes.	(c) 336 Tubes 17′ 11½″ long, and 420 14′ 1½″ long.
K. Superheater heating surface in square feet.	K. 2,420 Square feet.
L. Square feet of superheater heating surface per square feet of boiler-heating surface.	L. 0.216.
M. Type of superheater.	M. Foster.
N. Maximum output in per cent of rating.	N. 425% Rating.

14. Boiler accessories.	14. Boiler accessories.
A. Type of feed-water regulators.	A. Copes.
B. Number, size and type of safety valves for each boiler.	B. Numbers, size and type of safety valves for each boiler.
(a) On boiler drums.	(a) 5 Consolidated D. S. 4½″ spring loaded.
(b) On superheater.	(b) 1 2½″ spring loaded.
C. Number and type of soot blower elements for each boiler.	C. 10 Half width and 4 full width Diamond valve in head.

SECTION 5—PLANT 9

15. Economizers.
    A. Total heating surface of economizers in square feet.
    B. Square feet of economizer surface per square feet of boiler-heating surface.
    C. Is the economizer of the integral type or installed in a separate housing.
    D. Is the economizer cast iron or steel.
    E. Is there one economizer for each boiler.
    F. Square feet of heating surface in each individual economizer.
    G. Type of economizer.
    H. Is by-pass for flue gases provided.
    I. Method of cleaning outer surface of the economizer tubes.

16. Air preheaters.
    A. Total heating surface of all preheaters in square feet.
    B. Square feet of preheater surface per square feet of boiler-heating surface.
    C. Is there one preheater for each boiler.
    D. Location of preheater.
    E. Type of preheater.
    F. Is by-pass for flue gas provided.
    G. Method of cleaning preheater surface.
    H. Maximum of air temperature obtained.

15. Economizers.
    A. 9,414 Square feet low-pressure economizer.
    B. 0.387.
    C. Integral included in boiler, 1,639 sq. ft. each—additional low-pressure economizer tabulated below.
    D. Cast iron.
    E. Yes.
    F. 4,707 Square feet.
    G. Green, special baffled type.
    H. No.
    I. Manual.

16. Air preheaters.
    A. Note—Air is preheated in air passage on front and side walls on each boiler and in a casing around the flue on boiler No. 1.

SECTION 6—PLANT 9

17. Induced-draft fan.	17. Induced-draft fan.
A. Total capacity of all induced-draft fans in C. F. M. at temp. in deg. F.	A. 146,000 C. F. M. at 435 deg. F.
B. Maximum draft available from induced-draft fans.	B. 3.2 Inches static.
C. Characteristics of individual induced-draft fans.	C. Characteristics of induced-draft fan.
(a) Number and type of fans.	(a) Two Green No. 9, Type B. S., single width.
(b) Speed in R. P. M.	(b) 90—325 R. P. M.
(c) Is fan single inlet or double inlet.	(c) Single inlet.
D. Induced-draft fan driven by.	D. Per fan, one 15 H. P., 690 R. P. M., and one 75 H. P., 1,150 R. P. M., each variable speed. The 15 H. P. carries fan up to maximum of motor, the 75 is then thrown on and as it comes up to speed of the 15 H. P. a magnetic clutch throws in and the power is thrown off the 15 H. P., which rides idle on the shaft up to full speed of the 75 H. P. Herringbone gears used between motors and fan.
E. How is draft fan controlled.	E. Dampers and variable speed motors.
F. Is there one induced-draft fan for each economizer.	F. Yes.
G. H. P. of motors, turbines, etc., installed for driving forced and induced-draft fans.	G. H. P. of motors, turbines, etc., installed for driving forced and induced-draft fans.
(a) Total H. P. of all motors, turbines, etc., driving forced-draft fans.	(a) 100 H. P., secondary air; 80 H. P., primary air.
(b) Total H. P. of all motors, turbines, etc., driving induced-draft fans.	(b) 180 H. P.
18. Stacks.	18. Stacks.
A. Number of stacks.	A. One.
B. Inside diameter of base.	B. 11 Feet 7 inches.
C. Inside diameter of top.	C. 9 Feet.
D. Top of stack above grate surface.	D. 252 Feet above furnace bottom.
E. Is stack mounted on structural steel.	E. Yes; 82 feet above grade.
F. Type of stack.	F. Reinforced concrete, brick lined for 30 feet.
19. Boiler-feed pumps.	19. Boiler-feed pumps.
A. Total capacity of all feed pumps G. P. M.	A. 800 G. P. M.
B. Characteristics of individual boiler-feed pumps.	B. Characteristics of individual boiler-feed pumps.
(a) Capacity, type, and speed of individual pumps.	One 500 G. P. M., 920 feet, 5-stage, 2,300 R. P. M. One 300 G. P. M., 920 feet, 6-stage, 1,750 R. P. M.

SECTION 7—PLANT 9

19. (Continued.)
    (b) Boiler-feed pumps driven by.

    C. Differential-feed pressure is controlled by.

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20. Heaters.
    A. Type of heater.
    B. Number of heater.
    C. Are heaters opened or closed.
    D. Source of exhaust steam for use in heaters.
    E. Type of meter for measuring weight of feed water.
    F. What provision for elimination of air from feed water.

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21. Equipment for purifying make-up water.
    A. Type of equipment.

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22. Main steam piping.
    A. Joints.
        (a) Are field welds used.
        (b) If field welds are used, is pipe lapped or butted.
        (c) Are vanstone joints with gaskets used.
        (d) Are vanstone joints with welded tips used.
    B. Valves.
        (a) Type of main-gate valves.
        (b) Type of boiler stop-check valves.
        (c) Type of valves for control of soot-blower elements.
        (d) Type of blow down used in connection with boilers.
        (c) Type of reducing valves.

19. (Continued.)
    (b) 200 H. P. turbine.
    150 H. P. motor.
    C. Copes feed-water regulator, but no differential-pressure governor.

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20. Heaters.
    A. None.
    B.
    C.
    D.
    E.
    F.

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21. Equipment for purifying make-up water.
    A. None.

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22. Main steam piping.
    A. Joints.
        (a) No.
        (b)
        (c) No.
        (d) Sargol joints used.
    B. Valves.
        (a) Chapman, O. S. & Y., electric cast steel, monel trimmed.
        (b) Elliott X. D. Horizontal pattern.
        (c) Cast steel body, monel trimmed.
        (d) Yarway on boiler, Edward on water screen.
        (e) Ruggles-Klingemann.

SECTION 8—PLANT 9

23. Source of auxiliary power supply.
 A. Characteristics of power used for auxiliaries.
  (a) A. C. or D. C.
  (b) Voltage.
 B. Total capacity of house turbine in K. W. and K. V. A.
  (a) Number, capacity and type of house turbines.

24. Turbines.
 A. Number and K. W. of all turbines, exhausting into steam main.
 B. Is generator A. C. or D. C.
 C. Is main exhaust or bleeder used to feed the system.
 D. Pressure at which steam is bled or exhausted into system.
 E. Characteristics of individual turbines.
  (a) Speed.
  (b) Type.

Raw Coal-Handling Equipment

25. Capacity of coal-handling equipment in net tons, per hour.
 A. For direct delivery to bunkers.
 B. For deliveries to storage pile.

26. Capacity for storage of coal in net tons.
 A. Bunkers in boiler house.
 B. Storage pile adjacent to station.

23. Source of auxiliary power supply.
 A. Characteristics of power used for auxiliaries.
  (a) A. C.
  (b) 213 Volt—3 phase.
 B. None installed.
  (a) None.

24. Turbines.
 A. One 3,000 K. W. generator.
  One 200 H. P. driving stand by feed pump.
  One 42 H. P. driving stand by low head pump.
  One 100 H. P. driving secondary air fan.
 B. A. C.
 C. Exhaust.
 D. 7 to 14 lbs., depending upon demand.
 E. Characteristics of individual turbine-generator.
  (a) 3,600 R. P. M.
  (b) General Electric, Curtis, 11 stage.

Raw Coal-Handling Equipment

25. Capacity of coal-handling equipment in net tons per hour.
 A. 25 Tons per hour.
 B. By truck.

26. Capacity for storage of coal in net tons.
 A. 300 Tons overhead. 800 Tons storage in basement.
 B. None.

SECTION 9—PLANT 9

27. Type of equipment for coal handling.	27. Type of equipment for coal handling.
A. For unloading coal.	A. Dumped from auto truck.
B. For storing out and reclaiming coal.	B. From bottom of storage bunker onto apron conveyor.
C. For crushing coal.	C. None.
D. For elevating coal to bunkers.	D. Pivoted bucket conveyor.
E. For distributing coal to bunkers.	E. Movable trip.
28. Capacity of equipment for coal handling.	28. Capacity of equipment for handling coal.
A. For storing out and reclaiming.	A. 25 Ton from storage bunker.
B. For unloading.	B. Unknown.
C. For crushing coal.	C. None.
D. For elevating coal to bunkers.	D. 25 Ton.
29. Pulverized coal equipment.	29. Pulverized coal equipment.
A. Driers.	A. Driers.
(a) Type.	(a) None.
(b) Waste heat or steam grid.	(b) None.
B. Pulverizers.	B. Pulverizer.
(a) Type.	(a) Raymond Unit Mills. two 7,000 lbs. and one 2,000 lbs. per boiler.
(b) Screen or air separator.	(b) Air separator.
(c) Capacity.	(c) 16 Ton total.
(d) Driven by.	(d) 75 H. P. and 20 H. P. motors.
C. Exhausters.	C. Exhausters. See Blower.
(a) Type.	(a) Raymond, on shaft of 2,000 lb. mill. Separate on 7,000 lb. mill.
(b) Drive.	(b) 20 H. P. variable speed A. C.
D. Conveyors.	D. Conveyors.
(a) Type.	(a) None.
E. Bunkers.	E. Bunkers.
(a) Tons per boiler.	(a) None.
(b) Level indicator.	(b) None.
30. How is incoming coal weighed.	30. Weighed in truck on way to plant.