COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

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In the Matter of:

THE APPLICATION OF BARKLEY LAKE WATER DISTRICT, (1) FOR A CERTIFICATE THAT PUBLIC CONVENIENCE AND NECESSITY REQUIRES THE CONSTRUCTION OF NEW PLANT FACILITIES; AND (2) SEEKING APPROVAL OF THE ISSUANCE OF CERTAIN SECURITIES; AND (3) FOR AN ORDER AUTHORIZING ADJUSTMENT OF WATER SERVICE RATES AND CHARGES	)	CASE NO. 8937

O R D E R

IT IS ORDERED that the Staff Report (Appendix A), dated March 22, 1984, attached hereto and made a part hereof, be and it hereby is made a part of the record in this case.

IT IS FURTHER ORDERED that the above case be and it hereby is set for hearing on the 8th day of May, 1984, at 1:00 p.m., Eastern Daylight Time, in the Commission's Offices at Frankfort, Kentucky.

IT IS FURTHER ORDERED that Barkley Lake Water District shall give notice of the hearing in accordance with the provisions of 807 KAR 5:011, Section 8 (Tariffs).

Done at Frankfort, Kentucky, this 6th day of April, 1984.

PUBLIC SERVICE COMMISSION

For the Commission

ATTEST:

Secretary

APPENDIX - A

R E P O R T

TO: Claude G. Rhorer, Jr., Director
Division of Utility Engineering
and Services

THRU: Byrnes C. Fairchild, Chief Engineer
Water and Sewage Section

FROM: Robert N. Arnett RNA
Public Service Engineer
Water and Sewage Section

RE: Case No. 8937
Review of the engineering hydraulics submitted
by Barkley Lake Water District

DATE: March 22, 1984

BRIEF

The purpose of this report is to discuss the engineering data and hydraulic calculations presented by the Barkley Lake Water District ("Barkley Lake") to justify its proposed construction of a 450,000-gallon standpipe near Cadiz, Kentucky. On November 13, 1983, the Public Service Commission received an application from Barkley Lake for approval of the construction of a 450,000-gallon steel water storage tank and approximately 8,750 linear feet of 6-inch diameter water pipeline and a booster pump station with 2-150 gallon per minute pumps. Also included with Barkley Lake's petition was a request for approval of a financing plan and a request to increase rates to its customers.

Copies of the final plans and specifications to be used to advertise the proposed improvements for bids were filed with Barkley Lake's application. In an attempt to determine if the

proposed improvements would "be used and useful in rendering service to the public" additional engineering data was requested from Barkley Lake by Order dated December 20, 1983. Barkley Lake's response to the information request was received January 16, 1984. The engineering and hydraulic data supplied by Barkley Lake's engineering consultant, Elrod-Dunson, Inc., was reviewed by staff and was found lacking in sufficient detail for a "complete understanding of the situation." Mr. John Henry Rogers, Chairman of Barkley Lake, was informed of this fact and a conference with the Commission's engineering staff was suggested by a January 31, 1984, letter from Secretary Heman.

An informal conference was held with Terry Compton and John Goff of Elrod-Dunson, Inc., and Robert N. Arnett of the Commission staff on February 23, 1984, at the Commission's offices in Frankfort. The discussion at this meeting revolved around the type and detail of the engineering documentation desired for staff review. At this conference, Elrod-Dunson agreed to supply additional engineering information to aid in the review of the engineering portion of this case. On March 7, 1984, additional engineering information was filed by Elrod-Dunson, Inc.

BACKGROUND INFORMATION

Barkley Lake began operation in the late 1960's with approximately 630 customers. Barkley Lake presently serves about 2,337 retail customers in Trigg and Caldwell counties. In addition, Barkley Lake supplies water to the Lake Barkley State Resort Park and the Christian County Water District. The water

distribution system includes a water treatment plant, 4 storage tanks, and about 286 miles of pipeline (See Figure 1). The 4 storage tanks: a 250,000-gallon elevated tank at the water treatment plant, a 200,000-gallon standpipe near Pete Light Springs Road, a 150,000-gallon storage tank near Cerulean and a 50,000-gallon elevated storage tank near South Road provide a total of 650,000 gallons of storage. However, after subtracting the minimum tank level requirements, we find that only 420,000 gallons of this storage can be considered as useful storage. Water in storage below minimum levels will not provide minimum requirements for service pressure.

According to Elrod-Dunson, Inc. Barkley Lake has two problems with its existing water system. They are: (1) Inadequate water storage capacity to meet average daily demands, and (2) Insufficient treatment facilities to meet peak demands. The proposed construction is setup to alleviate problem (1). Barkley Lake has made application with the Farmers Home Administration for funds to make improvements to its existing water treatment plant. An improvement accomplished last summer was the construction of an additional 8" raw water line to the plant. Also Barkley Lake has obtained the Natural Resources and Environmental Protection Cabinet's approval to "high-rate" its sand filters. The long-term solution to existing problems is a plant improvement/expansion project.

FIELD OBSERVATION AND DATA COLLECTION

As mentioned previously, the staff has reviewed the initial engineering information submitted by Barkley Lake's engineering

consultant and has found it insufficient for an adequate engineering evaluation of the proposed waterworks improvements. In order to provide additional data on the water system's operational characteristics, Elrod-Dunson, Inc. submitted additional hydraulic information, reportedly "calibrated" to actual field measurements of pressure taken in January and February 1984.

The pressure recordings were reportedly made at four locations on Barkley Lake's system in order to continuously monitor the systems operational pressure. Copies of the pressure charts supplied by Elrod-Dunson, Inc. at ground elevation (feet above sea level - "feet ASL") for the Water Treatment Plant Tank (493 feet ASL); Pete Light Tank (620 feet ASL), South Road Tank (630 feet ASL); and near the "tap point" for the proposed line (430 feet ASL) are attached.

CALCULATIONS AND DATA INTERPRETATION

Barkley Lake is proposing to construct a 450,000-gallon steel standpipe with a height of 106.5 feet and an overflow elevation of 704 feet ASL. Since 300,000 gallons of this tank's capacity will be below the minimum level requirement, only 150,000 gallons is considered to be useful. Water storage in a distribution system is necessary to help meet peak demands; maintain relatively uniform water pressures; to eliminate the necessity for continuous pumping; and to make use of economical pipe sizes. Considerations for water storage requirements should include peak daily demand, maximum hourly demand, and the capacity of normal and standby pumping equipment.

Information concerning the need for additional storage as stated in the Engineering Report prepared by Elrod-Dunson, Inc. is as follows:

Total Pumped To System	252,593,000 gallons
Less Wholesale Use	-47,463,400 gallons
Total System Demand of Barkley Lake	205,129,600 gallons

$$\text{Average Daily Demand} = \frac{205,129,600 \text{ gallons}}{365 \text{ days}} = 562,000 \frac{\text{gallons}}{\text{day}}$$

Total Storage Needed	562,000 gallons
Total Existing Useful Storage	420,000 gallons
Storage Deficiency	142,000 gallons

Based on the proposed tank construction of which about 150,000 gallons would be useful, the storage deficiency would seem to be satisfied. These figures, based on pumpage quantities should however, be compared to figures based on usage. The billing analysis included in the Engineering Report provides the following information on usage.

Total Water Sold	160,928,400 gallons
Less Wholesale Use	-47,035,500 gallons
Total System Demand of Barkley Lake	113,892,900 gallons

$$\text{Average Daily Demand} = \frac{113,892,900 \text{ gallons}}{365 \text{ days}} = 312,000 \frac{\text{gallons}}{\text{day}}$$

These numbers do not indicate a storage deficiency. They do not, however, include an allowance for water lost in the distribution system. An allowance of 15% would increase the average daily demand for the system by about 55,100 gallons. The revised demand of about 367,100 gallons is less than the 420,000 gallons of existing useful storage; and does not indicate a storage deficiency.

If usage plus a reasonable allowance of 15% for losses in distribution do not indicate a storage deficiency - but pumpage quantities do - then losses in the distribution system must be excessive. The 91,664,600 gallons difference between water pumped and water sold indicates that 36.3% of the water pumped is lost in the distribution system. This 36.3% loss exceeds the standard PSC allowance of 15% by 21.3% or about 173,500 gallons per day. This excessive leakage is greater than the indicated storage deficiency of 142,000 gallons. (This information is also from the Engineering Report)

Total Pumped To System	252,593,000 gallons
Total Sold	160,928,400 gallons
Total Unaccounted For	91,664,600 gallons

While the above numbers do not justify the need for additional water storage on Barkley Lake's system there could still be other reasons which require additional storage. One such reason could be the resort nature of the area and the associated seasonal demands. In addition, there are no existing facilities in the immediate area of the proposed tank site. A storage tank as proposed could, therefore, be of significant benefit to the system. Reportedly, the tank is being placed where customers complained of water outages and low pressure last summer. However, documentation was not provided on the effect this tank would have in resolving these problems.

In order to have some idea how the new tank would operate on the system, Elrod-Dunson, Inc. filed several hydraulic analyses within the Engineering Report. However, when reviewing the analyses, which were done with the aid of a computer, several discrepancies were noted. It was felt that the analyses did not present an accurate

picture of the existing system or the system as proposed (installation of line, pump, and tank). As stated earlier, a conference was suggested and was held on February 23, 1984, and these discrepancies were discussed. Elrod-Dunson, Inc. at this conference stated that additional hydraulic information would be filed in this case. This information was filed with the Commission on March 7, 1984. Included were the following analyses:

Existing System - Average Yearly Flow - Pumps On - Tanks Full
Existing System - Peak Flow - Pumps On - Tanks Full
Proposed System - Peak Flow - Pumps On - Tanks Full

Also included were pressure recorder charts reportedly from three of the existing tanks sites and from the line near the proposed "tap" for the new construction. (These locations and elevations were discussed earlier).

In order to have an idea of how the system will function with the new tank, additional hydraulic analyses would be needed for review. However, since only three hydraulic analyses were submitted, the review and subsequent comments are based on the hydraulic information submitted.

Computer hydraulic analyses can be a very reliable method for depicting the operation of a water distribution system. However, in order to have confidence in the results of a computer hydraulic analysis, the computer model must first be calibrated to match field conditions. The usual procedure is to start with known and/or estimated input data for the existing system such as: pipe size, tank information, pipe roughness, pump information, customer demands, etc. Pressure recordings are made over a certain

time period (usually 24 hours) and the model reworked until the pressures calculated by the computer match the pressures measured in the field. Usually a properly calibrated model will depict pressures that are within ±5 psig of measured pressures.

Elrod-Dunson, Inc. submitted three hydraulic analyses and 4 pressure charts reportedly to verify that the computer model was calibrated. Prior to reviewing the hydraulic analyses, the pressure charts should be reviewed and interpreted and compared to the computer model for the existing system. The following information shown in Table I will be helpful in reviewing and interpreting the pressure recorder charts:

TABLE I

LOCATION	GROUND ELEVATION (FEET ASL)	OVERFLOW ELEVATION (FEET ASL)	PRESSURE* RANGE (PSIG)	HYDRAULIC GRADIENT (FT.)
Tank-Treatment Plant	493	620	54	617.7
Pete Light Tank	620	704	35	700.8
South Road Tank	630	760	54	754.7
Proposed Tap	430	N/A	75	603.2

*Pressure On Charts Depicts Constant Pressure For A 24 Hour Period

When reviewing the above table and attached charts, it seems strange that the pressure at a tank would remain constant. Normally the pressure over a 24-hour period would vary up and down as the tank "worked" or emptied and filled. This constant pressure would seem to indicate that Barkley Lake is able to satisfy any demand and still keep these tanks almost full. This would seem to once again fail to justify the need for an addtional tank to satisfy average demand.

If the pressures in Table I are compared to the pressures in the hydraulic analysis entitled "Existing System - Average Yearly Flow - Pumps On - Tanks Full" the pressure at these points appears to match. However, to be sure that calibration has been accomplished more pressure readings would have to be made and different conditions modeled. (i.e. pumps off)

While it is not abundantly clear that the computer model is in fact calibrated, let's assume for the sake of argument that it is. We then need to compare the existing system hydraulic analysis with the proposed system hydraulic analysis to check for the effects of the new construction. There are four noticeable points when comparing the proposed system to the existing system. They are as follows: (1) The Pete Light tank fills under peak demand on the proposed model and empties under peak demand on the existing model. (2) The proposed tank can be filled under peak demand with the proposed pump in operation, (3) It is hydraulically closer from the existing tank at the water treatment plant to the area of the proposed construction such that demand for water has been shifted from the Pete Light tank to the tank at the water treatment plant, and (4) The pressure at several points on the system is actually lower after the improvements are made according to the computer model. This apparently occurs due to operation of the proposed pump. The most noticeable drops in pressure occur around the area of the Lake Barkley State Resort Park and the area of last summer's water outage. Lake Barkley State Resort Park which has its own pumps and tank, can reportedly put a very large demand on Barkley Lake's system and can also cause low pressure

on Barkley Lake's system when Lake Barkley State Resort Park's pumps are in operation. A very serious pressure problem could occur if both the proposed pump and Lake Barkley State Resort Park's pumps are in operation concurrently.

The problem with reviewing only the operating scenarios filed is that we do not know how the new tank is going to function when the proposed pump is off which would be expected sometime during the day. In order to verify that the proposed tank is going to be "used and useful," this information is mandatory.

Another noticeable problem with the information filed is that the specifications require 2 pumps each capable of delivering 150 gallons per minute at 185 feet total head with 10 HP motors. However, with the proposed pump operating the computer model at one point shows the proposed pump delivering about 189 gallons per minute at 230 feet total head. Since the proposed tank is full the flow delivered by the proposed pump would be at a minimum due to the higher head involved in pumping to a near full tank. As such, when the tank is less than full the proposed pump would deliver more water against the lesser head. If the computer model is correct and a pump with the operating point of 189 gallons per minute at 230 feet total head has to be used, the pump specified would not work because it would be near what is known as "shut-off head." At "shut-off head" there is no flow. Based on the above, either the model is wrong or the pump specified was not properly selected. Possibly the pumps are operating in parallel but this was not stated. This would still lead to the same conclusions, however.

CONCLUSIONS

Based on my review and interpretation of the engineering and hydraulic information filed, the following conclusions are reached:

(1) The need for additional storage facilities on Barkley Lake has not been sufficiently addressed.

(2) The expected operation of the proposed storage facilities has not been adequately demonstrated.

(3) Barkley Lake has failed to adequately document that public convenience and necessity require the proposed construction.

(4) There apparently is an above average amount of unaccounted-for water on Barkley Lake's system.

This report makes the following recommendations:

(1) Barkley Lake's application for a certificate of public convenience and necessity should be denied.

(2) Barkley Lake should begin immediate efforts to reduce its unaccounted-for water.

PROPOSED TANK, LINE, AND PUMP STATION

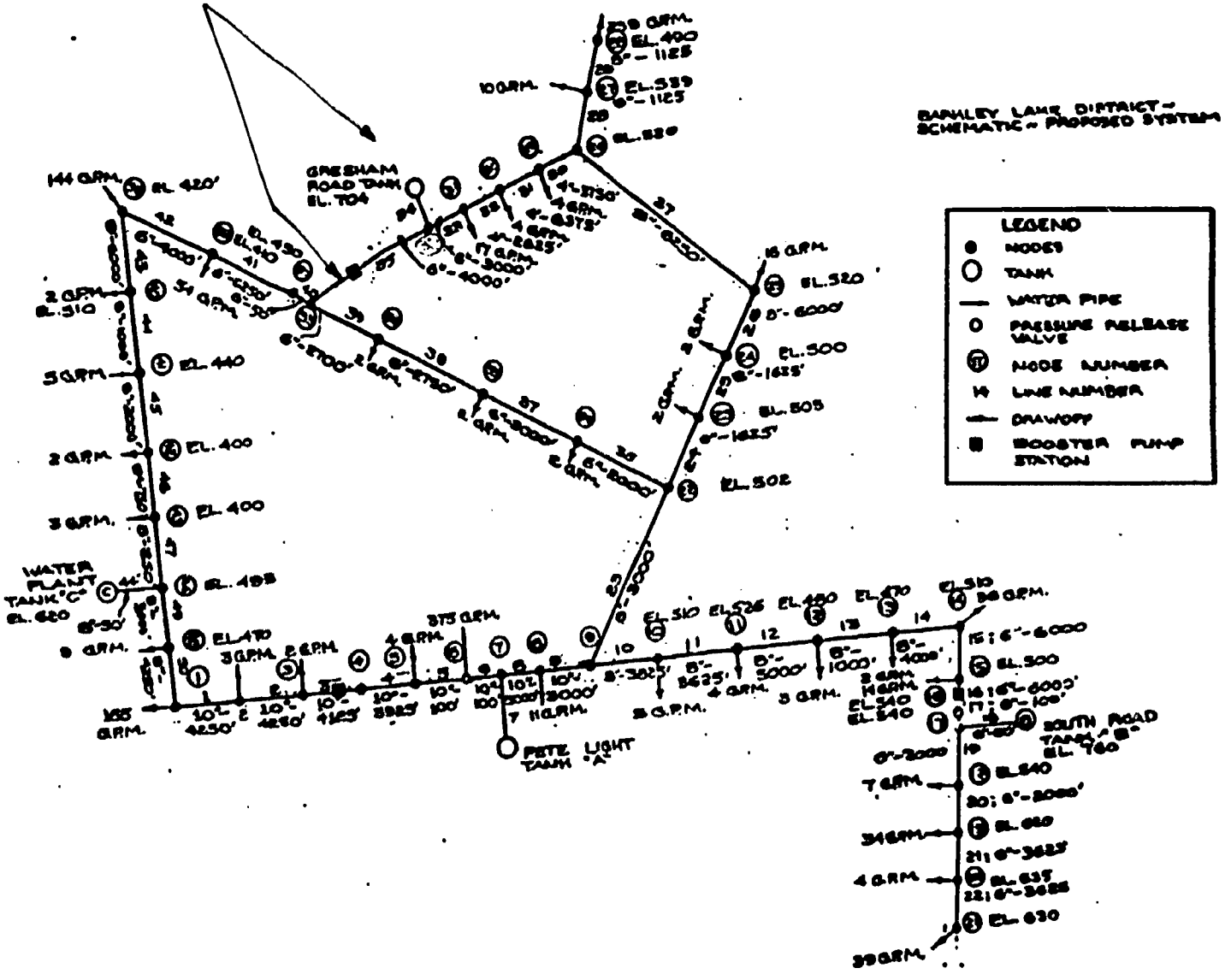
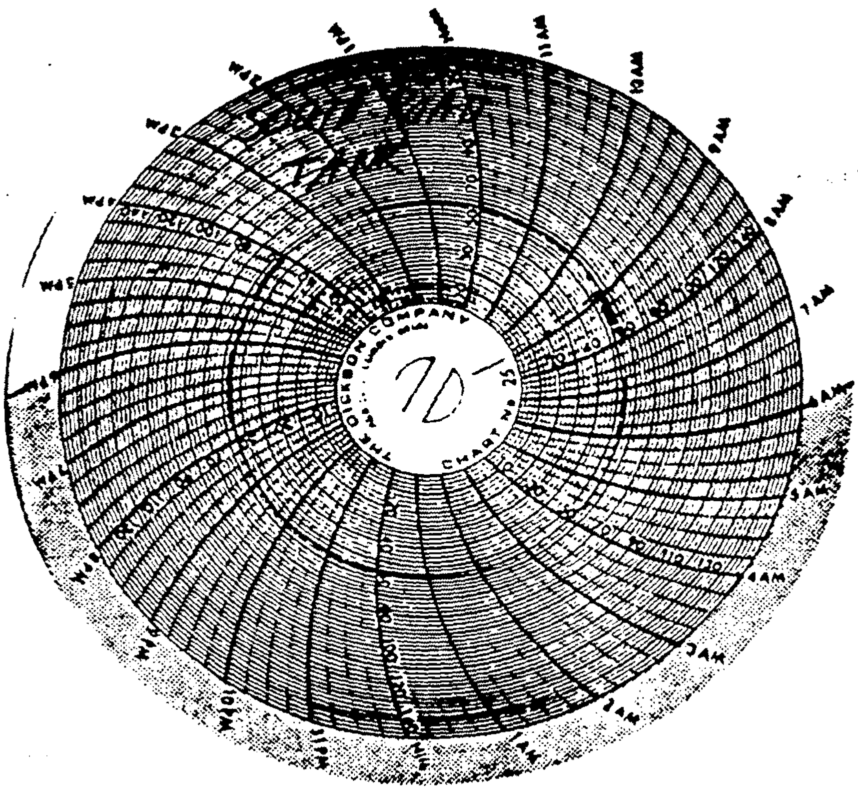
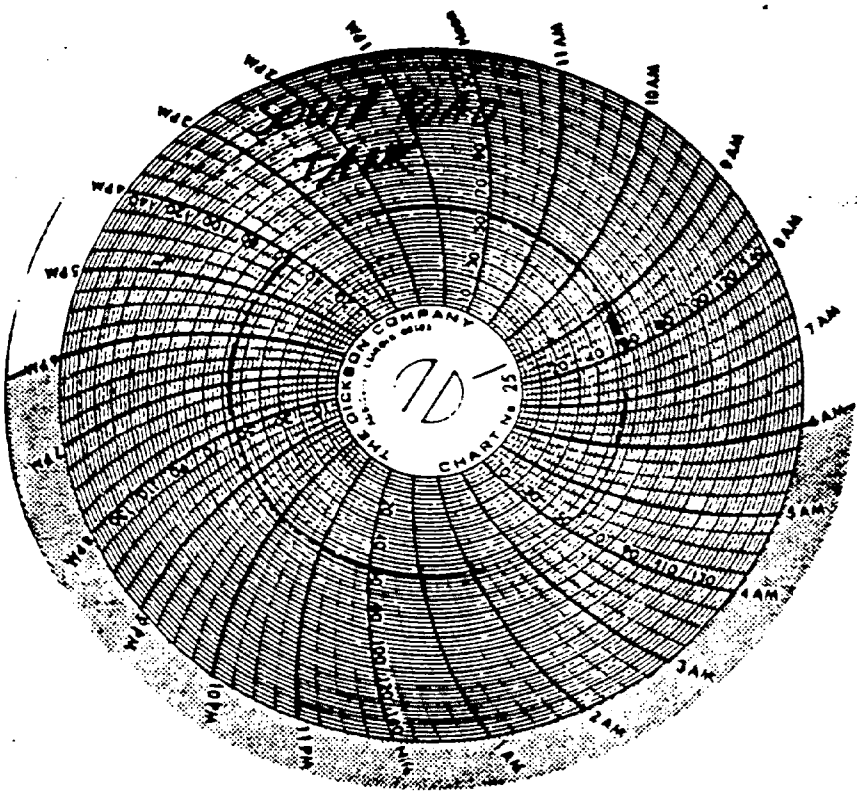


FIGURE 1


THE DICKSON COMPANY
CHART No 25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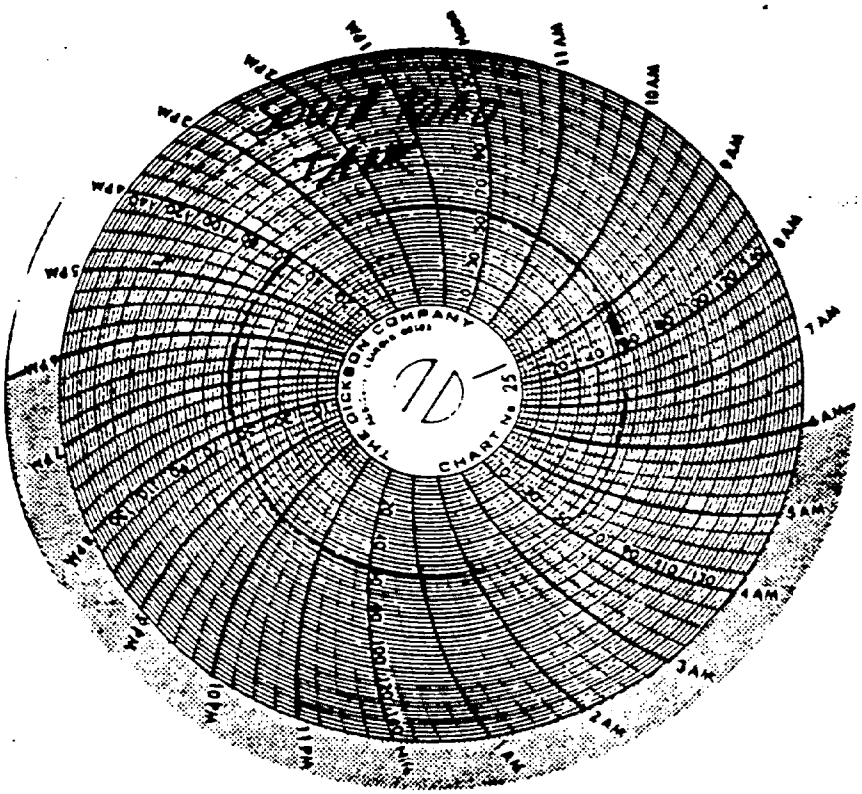
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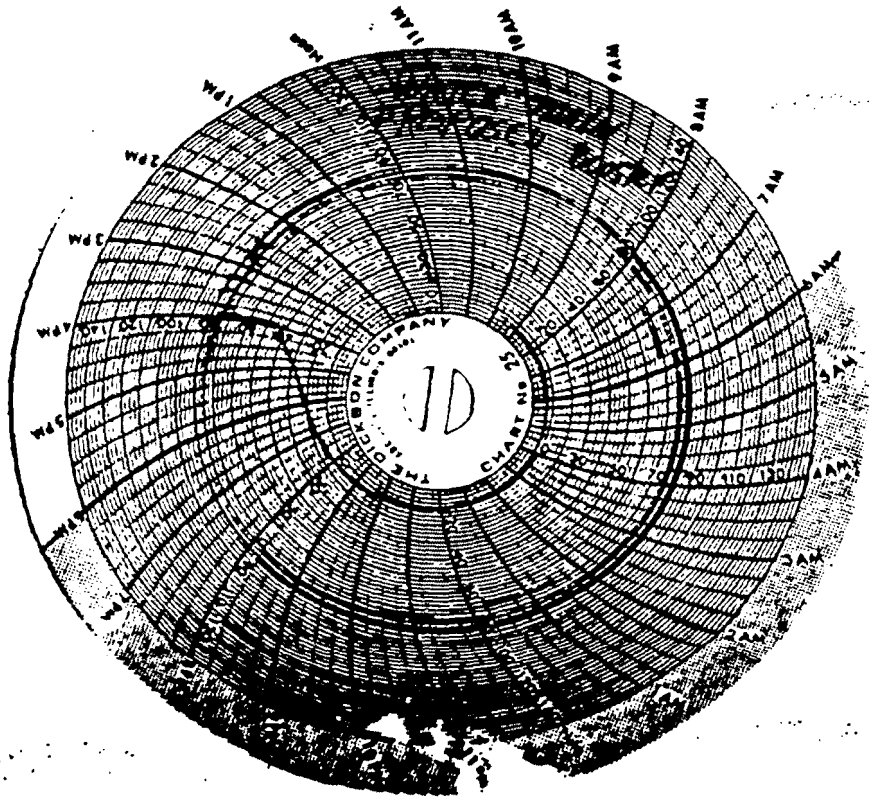
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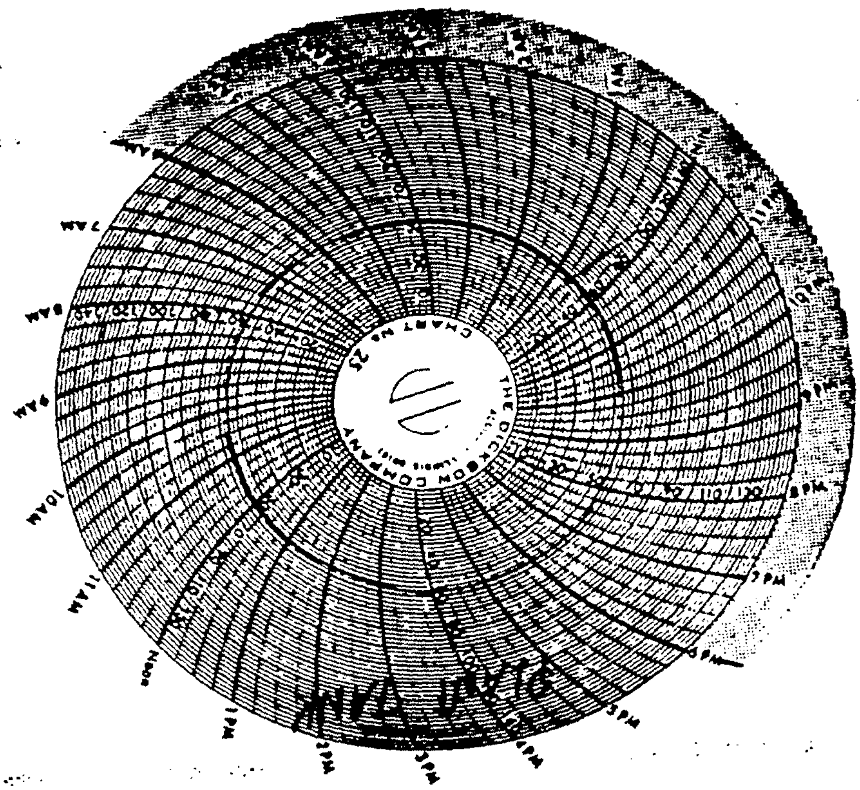
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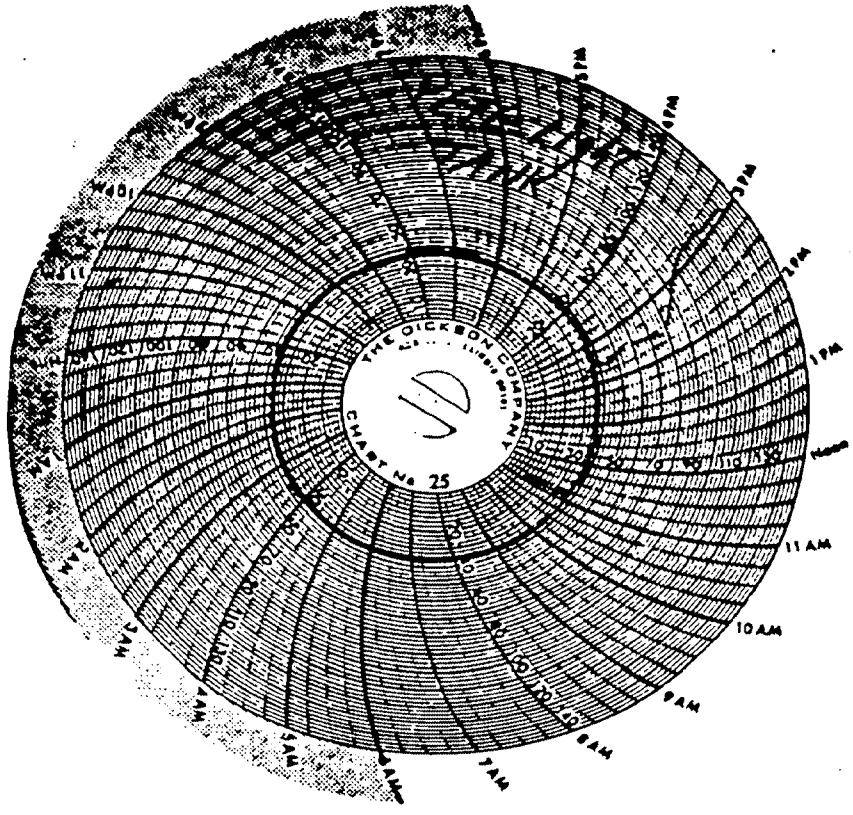
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