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FIELD TEST

Wintroath Pumps, Inc., Deep-Well Turbine

and

United Iron Works, 4-Stage Centrifugal Booster

Wintroath

1939

Plans filed # 6203 - *1081 X*
1082 X
1083 X
1084 X
Mrs Carter

Wintroath Pumps, Inc., Deep-Well Turbine

FIELD TEST:

and

United Iron Works, 4-Stage Centrifugal Booster

The Field Tests to determine the efficiency and the rate of consumption of power for each 1,000 gallons of water pumped as required by the Contract No. 1057-E, under which these pumps were purchased, were performed on the last two days of July, 1939, and the first day of August.

Since the time set for the completion of this contract was practically at hand, the actual pumping test had to be performed in a manner to overcome some difficulties that were caused by a lack of completion in other items of the Water Supply Project, of which these pumps were only a part, the principal difficulty encountered was that created by a shortage of power from the power plant, due to the fact that the Diesel Engine unit, which constituted a part of the Water Supply Project, had not been installed. The delay in the installation of this power unit was due to the fact that a change had to be made in the type of engine purchased as soon as it was learned that natural gas would not be available for this engine in time to test the pumps. Another difficulty was the lack of water measuring facilities, also due to the fact that shipment of the Venturi Meter and its accompanying gauges had also been delayed for about a month. To obviate the first difficulty, that is, the lack of power, arrangements were made through the Commanding Officer to reduce the power load as much as possible by eliminating uses of power within the Post which were not essential. This arrangement could be made only by taking power from the power plant after the time set at approximately 10:00 o'clock in the evening when the last of the larger users of power, that is, the motion picture theatre, had finished its nightly run. Following this plan, all arrangements were completed at the pump site, which is located about four miles from the power plant, and connected with it through the 6600 volt transmission line and a telephone communication line for the tests. At 11:00 o'clock on the first evening, word was received from the power plant that the load had dropped sufficiently to permit the use of the necessary approximately 300 H.P. required to operate the two pumps.

The pumps were started as shown by the time schedule on Drawing No. 6203-1060-B at 11:04 p.m. By referring to diagram 6203-1060-A, it will become apparent that the starting of the pump at the surface did not immediately produce a flow of water because of the fact that the water level is 463 below the base of the pump. It took just three minutes.

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to lift the water for the total height of 483 ft., the draw-down being immediately established at approximately 18 ft., but at the end of three minutes water was flowing smoothly into the surge tank located about 300 ft. south, and which has a capacity of 50,000 gallons.

Referring again to the statement that the Venturi Meter had not yet been installed, arrangements were made to measure the flow from this Deep Well Turbine by reading the water level as it rose in the tank from the bottom towards the top, the rate of filling having been calculated previously by the measurements of the tank area and having been fixed at 425 gallons per inch of rise in the depth of water within the tank. These inches were measured as shown by reading a wooden rod which had been graduated into inches and tenths of inches. The time scheduled for this first test which was made on Sunday, July 30th, will indicate that the pumping period was divided as nearly as possible into fifteen minute intervals. In this first test there were five such intervals established and as shown in this data sheet, the number of inches measured at the end of each successive fifteen minute intervals was noted, and from the number of inches of water pumped into the tank, at the fixed rate of 425 gallon per inch, the number of gallons pumped is indicated in the third column of the Pump Test. From the gallons pumped the rate per minute is fixed by dividing the gallons pumped by the actual number of minutes of elapsed time. By referring again to the diagram, the head against which this pump operated is fixed by the actual depth of the water level plus the depth of draw-down, plus the additional head created by friction in the length of travel in the 8" pipe leading from the water level to the discharge pipe in the Surge Tank, 40 ft. of this total pumping head was estimated, 490 ft. was actual measured lift, which gave a total head of 530 ft.

To determine the quantity of power, since there are no test measuring instruments available at this Post, the determination was made by observing the number of revolutions, in a fixed number of seconds, of the balance wheel on the electric meter which had been installed as a part of the equipment. This was done because of the fact that the graduations on the dials were spaced too far apart to give a reading sufficiently close. To be sure that the revolutions counted on this balance wheel would be accurate, the instrument was removed and taken to the testing laboratory of the Arizona Edison Co., Bisbee, Arizona, and the actual value in KW was fixed by an examiner in the presence of the local electrician. Through this medium therefore, the fairly uniform KW rate of power consumption was definitely fixed for this test at 63.5, as shown in the sixth column of the test data sheet. This fixed KW rate multiplied by the fractional part of the hour which was consumed between each reading interval gave KWH consumption and is shown in the next column. The equivalent rate of consumption of H.P. was definitely fixed by using the standard relation between these two power units. The actual theoretic H.P. was determined by multiplying gallons per minute by the total lift and by the weight of a gallon of water, this product being divided by the 33,000 foot pound units entering into H.P. determinations. As soon as the theoretic H.P. was determined, a comparison between it and the actual H.P. gave the figures shown as the

Efficiency in percent. The total kilowatt hours used divided by the number of thousands of gallons of water produced gave the consumption per 1,000 gallons. The comparison between factory tests and field test is shown on Chart No. 1060-A. Since the Surge Tank was about filled, it was necessary to take the water pumped into the Surge Tank and deliver it into the pipe line heading towards the Post Reservoir, the first test of this Turbine Pump was stopped at 12:28 a.m. The total length of the pump test was therefore 84 minutes from which 3 minutes are subtracted as the length of time necessary to produce the flow into the Surge Tank, the remaining 81 minutes being actual testing time as indicated by the flow of water, and this 81 minutes is the figure used in all the calculations for both efficiency and power consumption.

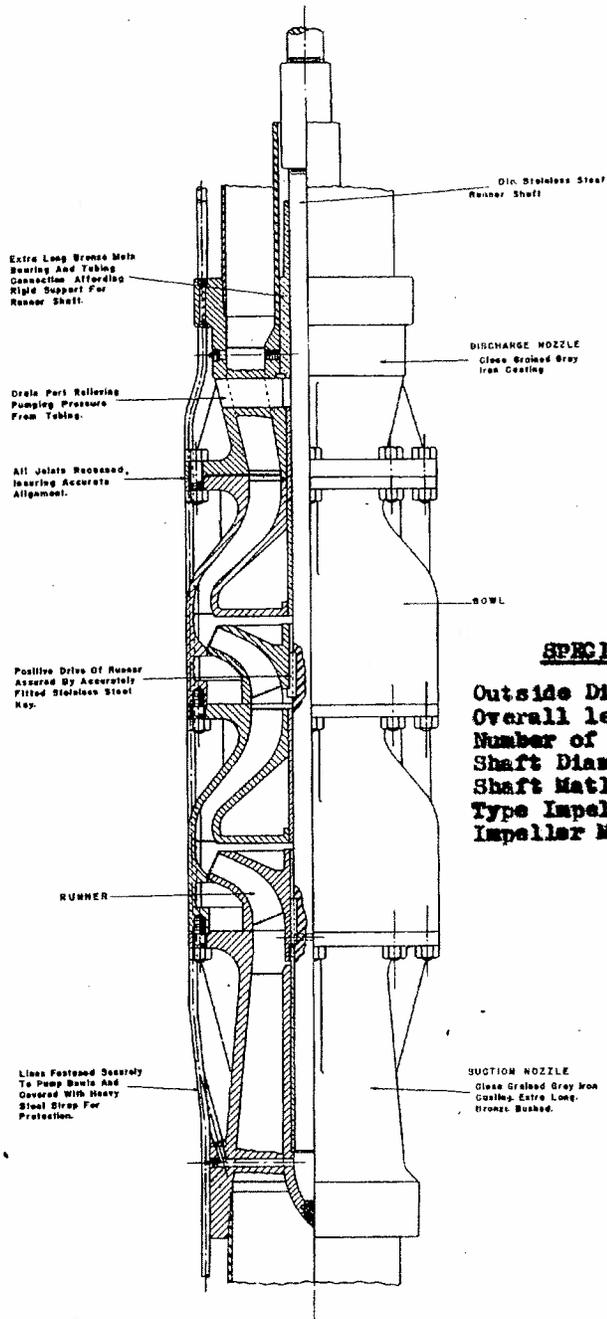
With this quantity of water present in the tank, the Centrifugal Pump, known as the Booster Pump, was put into commission. This pump was started at 12:37 a.m. and operated continuously for 46 minutes, giving the results shown in the test of Sunday, July 30th, on sheet 6203-1060-D. It must be remembered that this pipe line was empty and that the work of this Booster Pump was merely to transfer the 43,000 gallons from the Surge Tank into the pipe line. This is not the duty for which this pump was purchased, but records were kept of this data to be used as a comparison of what might be done under those conditions. By 1:30 that morning, it was necessary to stop using power at the rate which it was being consumed at the pumping plant and as shown on the sheet mentioned. It will be made apparent by the data sheet that both pumps were being operated for the last twenty minutes, this condition being fixed by the fact that in operating practically under no head, the Booster Pump was taking water from the Surge Tank at too rapid a rate to provide any testing data, and, in order to keep the Surge Tank supplied with water, the Deep Well Turbine had been started to provide sufficient water to continue the test. The combined pumps were using about 200 H.P. from the Diesel Plant, and, due to power shortage, this consumption had to be stopped at the time indicated.

The following night, Monday, July 1st, the saving of power was developed in the Post consumption to an extent which permitted the start of the Turbine Deep Well pump at 10:03. This pump was kept in operation for 75 minutes, as shown in the second set of figures on Drawing 1060-B, and indicates that the figures obtained in the first test were practically duplicated in the second set, some adjustments having been made on all recording instruments except the balance wheel of electric meter referred to in a previous paragraph. The actual time required to bring the water from the well to the surface was again three minutes and this subtracted from the 75 operating minutes gives the 72 minutes which was used in the computations. With this quantity of water on hand in the Surge Tank, the Booster Pump was again started and operated from 11:21 to 12:06, at which time it was again necessary to start the Deep Well Turbine in order to provide sufficient water to keep the Booster operating. The

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pressure in the pipe line between the Booster Pump and the Reservoir had risen from that of 187 ft., the head as resulting from the first day's test up to 715 ft. of head, which indicated that water was now flowing into the reservoir within the Post located some four miles distant. The length of operating time on the Booster from this second test of 84 minutes indicates that 60,000 gallons of water was pumped, the rate varying from 1,100 gals. of the first test under no head up to 612 gallons per minute under the full head of pressure. Again the power consumption had to be stopped and the test was discontinued until 9:55, August 1st, at which time the Turbine Pump was again started and delivered water into the Surge Tank at approximately the same rate as shown on the first day's test. A slight decrease was noticeable being due to the fact that the draw down had been increased from 18 ft. to 20 ft., however, the difference is small and has no appreciable effect on the final results obtained. At 11:19, with the tank practically filled, the Booster pump was again started and operated for 75 minutes. For some reason water had flowed out of the four mile delivery pipe in quantity sufficient to reduce the total pumping head from 715 down to 592; therefore, the first two periods of 15 minutes each were required to refill the delivery pipe so that the total pumping head was again 715 ft. From that time, that is, 11:49 until 12:34, the Booster Pump was operating against the full head and doing the work for which it was purchased. To make an actual determination of the quantity of power used per 1,000 gallons of water pumped against that full head, only the last four items as shown on this set have been used to fix the amount of power per 1,000 gallons, and that is shown to be 3.05. The conditions under which this pump is operating is indicated on Drawing 6203-1060-C, which gives, in addition to the data furnished by the United Iron Works, that determined by the Field Test, the figures having been plotted on the chart and which indicates that the efficiency of the pump was slightly less than that guaranteed by the United Iron Works, but which, if reduced to the pumping head fixed by the specifications and, compared to the actual head determined by pressure gauge, would probably place the Field Test slightly above the efficiency shown in the factory test. Likewise the amount of H.P. used is slightly above that shown on the factory test curve. But if this quantity of H.P. was corrected from 715 ft. down to 680 ft., it also would probably be very close to the factory test line. All of this information was obtained by testing the pumps on the three days mentioned, and under conditions which gave us use of power for a limited time only. The actual measurements taken by the measuring rod in the Surge Tank are probably more accurate than those that might be obtained through the readings from the Venturi Meter. However, the Venturi Meter is now installed and the purchase of the Diesel engine is also being made. As soon as the Diesel engine is installed and when it is expected that all work on the Venturi Meter will be completed, it is the intent to obtain from the Eighth Corps Area standard measuring instruments both for current, voltage, and power, which instruments will be borrowed for a sufficient length of time to permit both of these pumps to be operated for a testing period of sufficient length to more fully determine every characteristic of each of the pumps. This will probably be done in the first half of the next year.

J. L. Brooks
 J. L. BROOKS,
 Major, U. S. Army,
 Constructing Quartermaster.



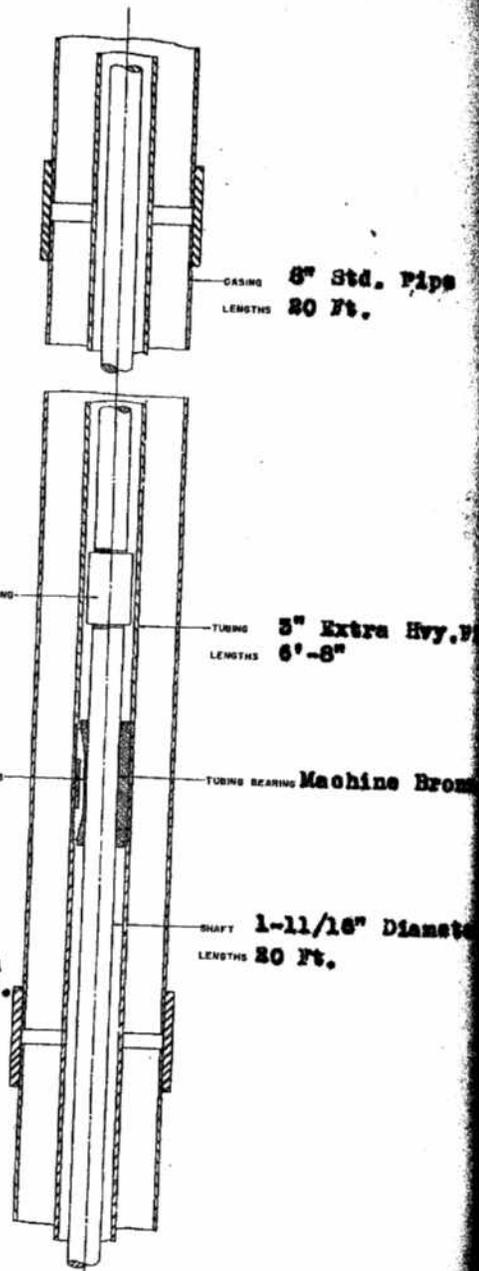
SPECIFICATIONS

Outside Diameter--11-5/16"
Overall length---20' 6-3/4"
Number of stages--21
Shaft Diameter--1-11/16"
Shaft Matl.--Stainless Steel
Type Impeller--END-SEAL
Impeller Matl.--Bronze

Wintroath Pump No. 2491

U.S. War Department, Fort Huachuca, Arizona

TYPICAL PUMP BOWL CONSTRUCTION FEATURES	
WINTROATH PUMPS INC. ALABAMA, CALIF.	ORCA. INC. OKLA. OK. XR-96



Structural Details covering all column sections except Nos. 6-12-18 & 23 as outlined on Drg. XM-8.

Total column length 520'-4"

Wintroath Pump No. 2491
 U. S. War Department, Fort Huachuca,
 Arizona.

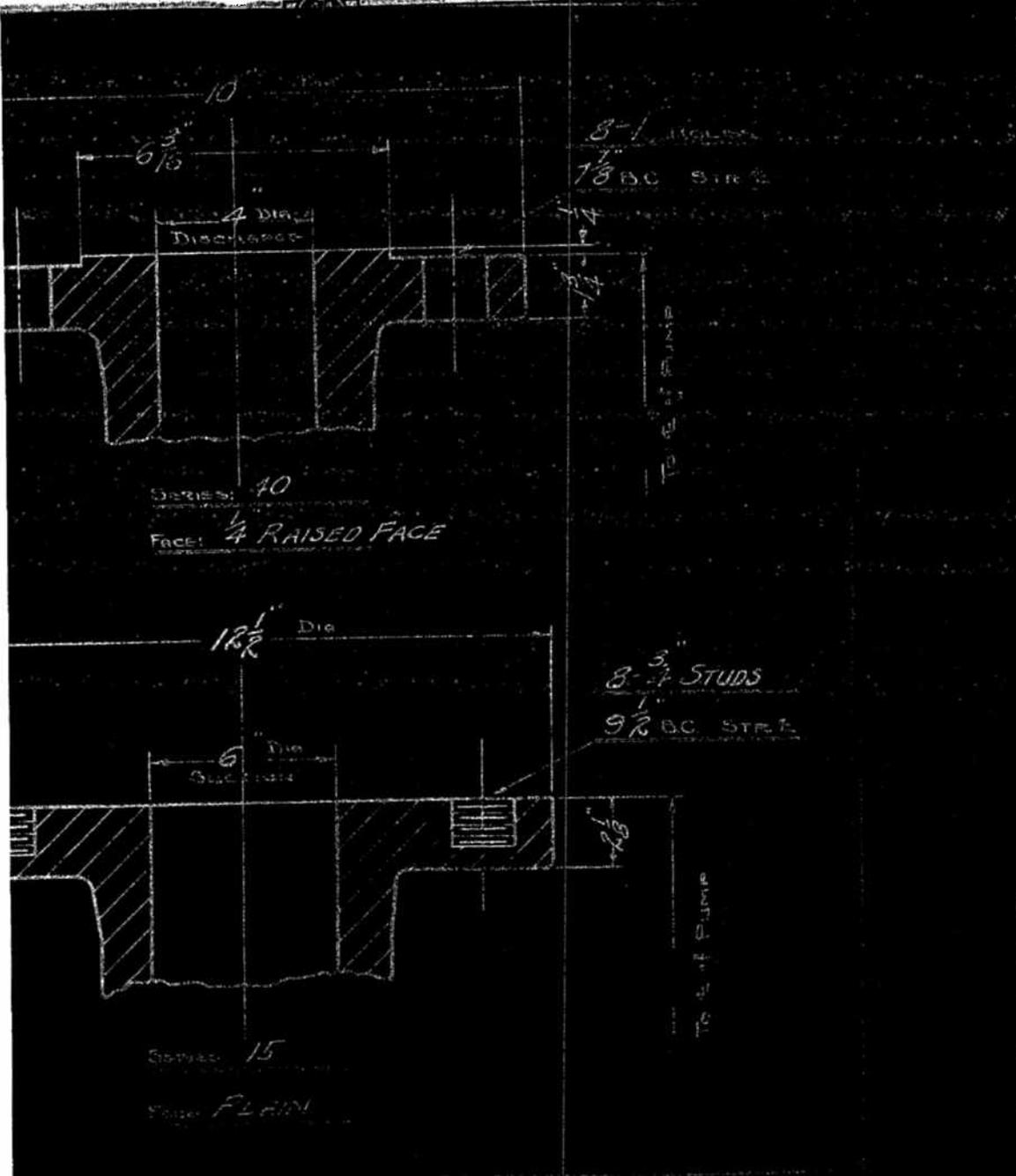
SCREWED COLUMN	DATE
WINTROATH PUMPS INC.	NO.
ALHAMBRA, CALIF.	CHICAGO, ILL.
XM-8	

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GEA-1966

GEA-1368

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UNITED TOOL WORKS
MILWAUKEE CALIF.

PUMP LANGES
6-8-39 EBR 3A719

GEA-1368

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TEST ——— DEEP-WELL TURBINE PUMP ———
 WATER SUPPLY PROJECT ——— FORT HUACHUCA, ARIZ. ———

July 30th 1939. Surge Tank calibration, One inch = 425 gallons

GALS PUMPED	RATE per MINUTE	HEAD in FEET	KW RATE	KWH	EQUIV HP RATE	THEORETIC HP	EFF. %	KWH Per 1000 G		DRAW DOWN ft
0			63.5	3.16	85.1					8
4.250	5.40	530	"	8.45	"					"
7.980	5.31	"	"	15.85	"					"
7.980	5.31	"	"	15.85	"	71.8	84.3	1.99		"
7.980	5.21	"	"	15.85	"					"
7.950	5.30	"	"	15.85	"					"
6.890	5.30	"	"	13.70	"					"
				88.71						* Gross
43.030	5.32			85.95						* Net

July 31st 1939. $532 \times 530 \times 8.35 \div 33,000 = 71.8$ $85.95 \div 43.03 = 1.99$

0.0			67.0	3.35						20
7.860	5.25	530	67.0	16.75						"
7.860	"	"	"	16.75						"
7.860	"	"	"	16.75	89.7	70.5	78.9	2.13		"
7.860	"	"	"	16.75						"
6.330	"	"	"	13.30						"
				83.85						* Gross
37.770				80.30						* Net

AUG. 1st 1939. $525 \times 530 \times 8.35 \div 33,000 = 70.5$ $80.3 \div 37.77 = 2.13$

7.700	5.12	530	67.0	16.75						20
7.730	5.14	"	"	16.75						"
7.730	5.14	"	"	16.75						"
7.730	5.14	"	"	16.75	89.7	68.6	76.4	2.18		"
7.700	5.12	"	"	16.75						"
2.000	5.02	"	"	4.47						"
				91.97						"
40.590				88.22						"

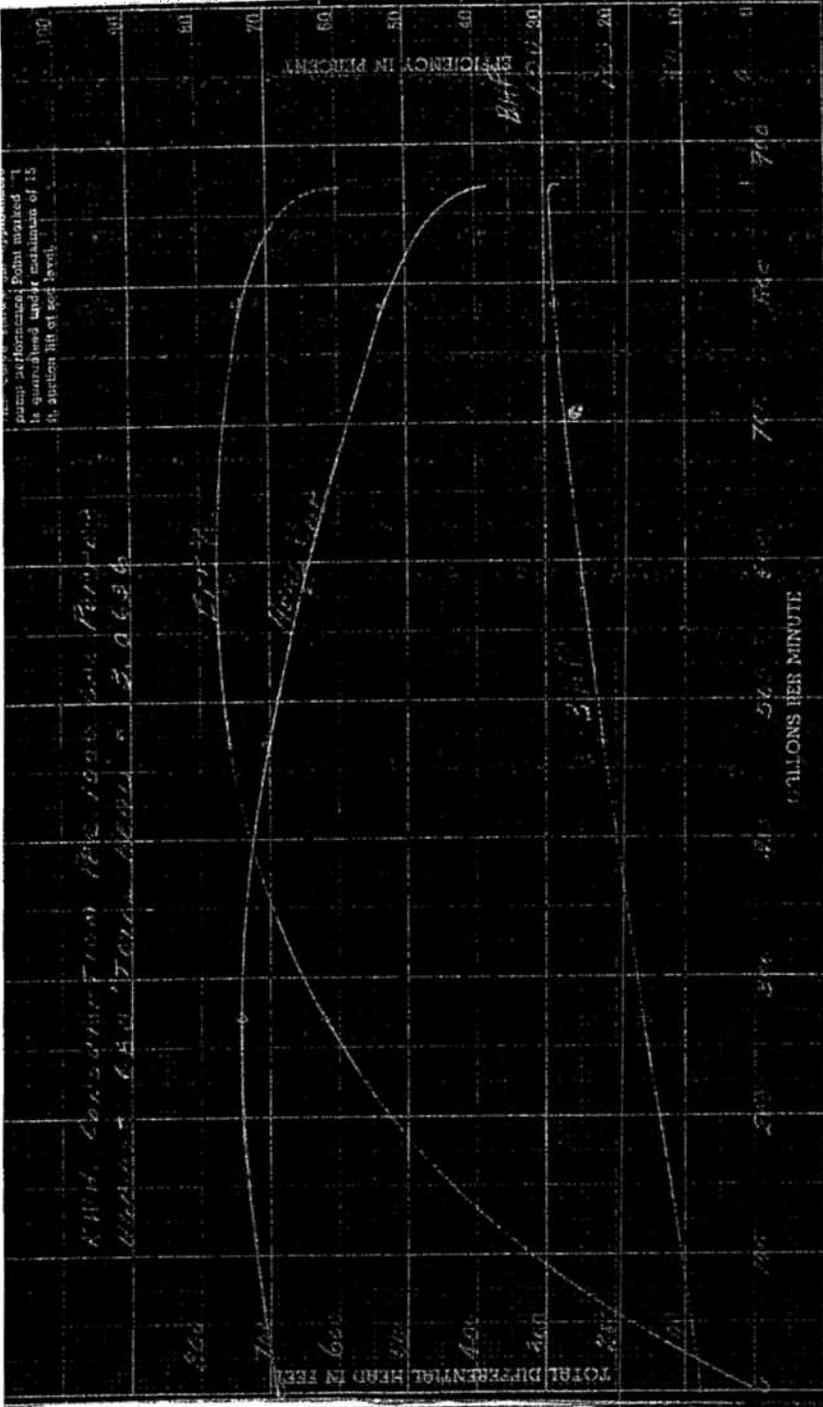
$512 \times 530 \times 8.35 \div 33,000 = 68.6$ $88.22 \div 40.59 = 2.18$

Dwg. No. 6203-1060-B.

UNITED IRON WORKS

GEA-1368

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Point marked
is
at
the
station
lift
of
feet.

Flow
Head

ENGINEERING DEPARTMENT
UNITED IRON WORKS

DESIGN NO. _____
DATE _____
BY _____
CHECKED BY _____

SCALE: _____

REVISIONS:

NO.	DESCRIPTION	DATE
1		
2		
3		
4		
5		

GEA-1368

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