time the pumping plant itself would have run its useful course simultaneously with the tube-well.

12. The authors did not describe the details of the method of carrying out the determination of transmission constants of the water-bearing strata, but mentioned that the tests were carried out in the Irrigation Research Institute. A practical method of testing the suitability of water-bearing strata obtained from bore-holes had been described by S. Hukam Singh. It was very simple and could be carried out in the field by an overseer or even by a works mistri or munshi. It had proved a sound and reliable guide in the selection of water-bearing strata over a long period of years.

The authors had stated that the transmission constant of the soil (by which they mean sand strata) varied considerably from "strata" to "strata" but actually it did more, it varied from inch to inch of each layer or stratum and this was not surprising, bearing in mind that a single stratum might have taken hundreds of years to deposit. The determination of a single transmission coefficient for a stratum 20 or 30 feet thick, therefore, is not accurate in the scientific sense, it merely gave results which might be assumed to be average, though they might not even be that.

Bearing in mind these possibilities of errors in the samples, meticulous refinements in the tests did not appear to be warranted. The method mentioned by the authors might be more accurate but such accuracy was a matter more of academic interest than practical application for tube-well design in the writer's opinion.

Again, the Hydraulic Research Institute might not be conveniently available to many practical engineers, called upon to select samples of water-bearing strata for strainer installations and the writer therefore commended the simple "Kennedy" test for their use, after 20 years' practical experience of it in connection with a very considerable number of tube-wells.

13. In regard to the necessity of "shrouding" round strainers as carried out on the Karol scheme, the writer was not in general favour of this. It frequently meant that the bore-hole had to be kept of larger diameter than may be necessary otherwise and there was no guarantee, with the usual precautions adopted, that the shrouding did, in fact, fill all the space round the strainer, while there could not possibly be any hydraulic advantage (*i.e.* appreciable increase in yield) in shrouding round the plain pipes. Moreover, the arrangements required for boring, might make the tube-well more liable to slip in the ground, than if the methods of construction advocated by him were adopted. It was preferable, in many cases to "develop" the tube-well initially by temporarily pumping under control, by means of air-lift or other system, larger discharges out of the tube-well than the permanent pumping plant to be installed was intended to extract. The object of this development was to pull out the finer particles in the water-bearing sands surrounding

the strainers, thus increasing the porosity and the "transmission constant" of the strata itself. The yield or discharge of the tube-well against unit depression head was usually increased appreciably by this action and sometimes, as already mentioned by Mr. G. Khosla with reference to tube-wells recently completed at Pasrur and Ambala Saddar Bazar, the yield could be increased many times over by this method. Such system of development was useful, not only with unshrouded wells but also with shrouded ones. Of course, with the increase in discharge, a corresponding decrease in depression head and, consequently, in pumping-head, if the discharge was limited by the characteristics of a pump, will result and this in turn reduced the cost of pumping operations. This was a factor which should not be lost sight of, especially for low-lift irrigation pumping work. Careful development on these lines should also ameliorate the trouble experienced at Karol with sand continuing to be pumped with the water. He did not think that it was desirable in any case to allow sand, in appreciable volume, to be pumped with the water for long periods as it might, in time, cause collapse of the tube-well as well as its superstructure. There should, therefore, be careful control over this and development on the lines above indicated would seem to be the most reasonable solution. *After development was completed, there should not be any appreciable quantity of sand in the water.*

14. The third or most recent case of failure referred to by Mr. Isher Dass, who stated that the tube-well, after three days' testing, had sunk down into the ground, might be due to too much sand being drawn into the well in course of test pumping, thereby causing a large cavity behind the strainers; also to failure to hold the well head, and the friction between the tube-well and the ground being inadequate on account of shrouding. In the construction of tube-wells, like all other engineering problems, before success could be achieved, a "technique" or system of working based on practical experience, either of oneself *or of somebody else*, had to be developed to such an advanced stage that undue risks of failure or accident were eliminated. Until this was achieved, the work remained in an experimental stage. It would seem that further development of the "technique" for these tube-wells of the Karol scheme was required.

Mr. A. R. Talwar while replying to the discussion thanked Mr. A. M. R. Montague, who, while initiating the discussion on the paper, had given valuable information regarding the preparation and the design of the Karol scheme. In fact his opening remarks were really adjuncts to the paper without which it would have been incomplete.

Continuing Mr. Talwar said that at the time of writing the paper some of the information had not been available. This had been presented now by Mr. H. L. Vadera, the co-auther in the form of three statements relating to the financial aspect of the project and working of the tube-wells for the last three crops, namely *Rabi* 1939-40, *Kharif* 1940 and *Rabi* 1940-41. The financial aspect as given in the statement presented now was in no case the last word on the subject. The actual annual return would depend upon the development which according to the forecast would be in the 6th year of its working.

The working during the last three crops was very hopeful and was far above the expectations set forth in the forecast regarding the hours of working of pumps, area irrigated, cost of energy consumed, etc.

Sardar Hukam Singh had suggested that in order to find out the coarseness of sand and determine its suitability of water-yielding purposes, Kennedy's tests used in Public Health Circle had been found to give satisfactory results for nearly 600 borings and as such he did not see any necessity of finding out the transmission constant of the soil for which elaborate apparatus and scientists were required. He had pointed out that with the means available at our disposal it was not possible to collect true sample of the soil through a sledger. This was no good reasoning if accuracy at one stage was not possible, there was no reason why it should be sacrificed where it was possible. The method of locating the strainer on the basis of transmission constant of strata was the only scientific method as it confirmed what was actually happening, when sub-soil water was drawn into the strainer at the time of pumping.

S. Hukam Singh did not see any advantage in using tapered strainer and quoted certain experiments carried on by Messrs. Ashford and Leggette in favour of this without giving any facts and figures. Tapered strainer was doubtlessly economical. The comparative cost of using the tapered and uniform strainers had been worked out in the paper. Another advantage of the tapered strainer was to secure a certain minimum velocity in the rising water which prevented the settlement of the finest particles to the bottom of the tube.

He had further suggested the use of "Sea-borne Intercepters" which would obviate the necessity of fitting the pump below spring level and many other constructional difficulties consequent thereon. The Sea-borne Intercepters would, of course, keep the pump self-primed but this was not the only object of fitting pump below the spring level. By this means it was possible to get the required discharge at comparatively less depression head. Also if and when the yield of the tube-well deteriorated the required discharge could be pumped out by increasing the depression-head.

Mr. G. R. Sawhney had suggested that carbonate of soda, bhusa plaster, should be tried for lining instead of expensive brick-lining. In this connection the author would like to point out that certain experiments were carried out using the mixture consisting of:

(1) Earth	.. 75 c.ft.	For % s.ft. plaster.
(2) Sodium Carbonate	.. 15 lbs.	
(3) Molasses	.. 6 mds.	
(4) White Lime	.. 6 mds.	
(5) Washed Sand	.. 75 c.ft.	

This mixture had not been found suitable and had to be discard The plaster suggested by Mr. Sawhney might help in lowering absorption losses to certain extent which would mean a great achie ment in case of canal watercourses as ordinarily the later consist silt banks not infrequently overgrown with weeds and sarkan where absorption losses were to the extent of 40 per cent. and ev more. But tube-well water was far more precious and it was ve necessary to cut down the absorption losses to the minimum by usi the most efficient lining. Also soda, bhusa plaster, would not sta the cattle trespass.

Mr. Sawhney could not imagine how a tube-well operator wou be able to perform the multifarious duties allotted to him. T system was working quite efficiently and there was no difficul experienced as anticipated by Mr. Sawhney.

Messrs. Sethi and Khosla had recommended that developing woul increase the discharge of the tube-well. The authors did not conten the advantages of developing, but it might be remarked that it wa not necessary to resort to developing when a satisfactory discharg had already been obtained. Mr. Khosla had mentioned two tube wells at Pasrur and Ambala where he had been able to improve th yield a great deal through developing. In the case of tube-well a Pasrur the original discharge was 200 gallons per hour whereas in cas of Ambala tube-well it was practically nothing. These were doubt lessly fit cases for developing. In case of the tube-wells at Karol, al of them are yielding 33,000 gallons per hour, with depression head o not more than 12 feet.

Other points raised by Messrs. Hukam Singh, Sethi, Khosla, Handa and Ishar Das in connection with the use of bore-hole pumps in preference to vertical-spindle pumps had been replied to later.

Mr. S. M. Ellahi had taken objection to the remarks on page 225, para 4, regarding the two irrigation tube-wells at Qadian in Gurdaspur District, which had been originally installed by the Agricultural Department and subsequently handed over to the Canal Department. No reflection was meant whatsoever on the Agricultural Department. It was regretted that Mr. Ellahi had taken it in that light. The fact however remained that the tube-wells at Qadian had to be abandoned due to deterioration of the yield.

In connection with the accidents mentioned in para 3, page 229, Mr. Ellahi had found fault with the design and had stated that perforated brass tube less than $\frac{1}{8}$ inch thick could not be expected to take more than 4 tons' load. He had forgotten that during the location of the strainer and pipes these were not called upon to take any superimposed weight. The string of strainers and pipes were always kept suspended.

The authors remarked that any contribution to the discussion by Mr. Howell had a very great value by reason of his long experience in the sinking and operation of tube-wells. But it must not be forgotten that Mr. Howell's tube-wells were for purposes of water supply. The cost of the tube-well installation was but a fraction of that of the whole project. For irrigation the tube-well installation formed by far the greater part of the whole expenditure.

Moreover, the losses resulting from a slight decrease in efficiency of pump or slight increase in the depression-head, were miscroscopic compared with the total pipe losses. Consequently, the addition to the working expenses in a water-supply scheme was too small to be noticeable. In an irrigation scheme, on the other hand, any falling-off of the efficiency in the pump or increase in the depression-head, was directly reflected in the working expenses. Such working expenses usually formed a very large proportion of the receipts and a small percentage rise in working expense might convert a scheme from a profitable project into a losing one.

In para 2 of his contribution, Mr. Howell seemed to imagine that an increase of discharge per square foot of strainer was evidence of technical efficiency. With strainer of fixed slot area, an increase of discharge only means an increase of velocity through the slot. The designers of the Karol Tube-Well project were advised by the Research Institute that clogging was caused by excessive velocity through the slots in appropriate circumstances. Every endeavour had been made to reduce the discharge per square foot of strainer and to this extent there was no doubt that the designers of the Karol project were successful.

It was noticeable that in his table in para 2 Mr. Howell did not quote the normal working depression-head of the wells listed.

The authors emphasized that the reduction of depression-head was a paramount necessity in irrigation work. The gross lift was usually much lower than in water works projects, and, consequently, every additional foot of depression-head added proportionately to the cost of pumping. It was in this respect that shrouding was of value, and nothing that Mr. Howell had put forward, altered their conclusions on this head.

The authors of this paper had not claimed that shrouding or the use of telescopic strainer was new. Of the various techniques studied, the designers of the Karol Tube-Well Irrigation Scheme had selected that which seemed most reasonable and advantageous for their purpose. Of these the telescopic strainer was merely one item. It should be remembered that the sinking of the Karol tube-wells had not been carried out by the Irrigation Branch but by a works section of another department. There was little question but that in any future large project, Irrigation Branch would entertain and train their own well-sinking staff. By such means it should be possible to avoid the unfortunate accidents which occurred during the actual course of construction. To this extent the authors of the paper entirely agreed with Mr. Howell's remark in para 5 emphasizing the necessity for special precaution for sinking this type of strainer.

Mr. Howell was reminded once more that economy of constru was a paramount consideration in the Irrigation Branch and teles strainer was unquestionably justified on this ground alone.

In respect to the selection of the pumping plant, it was obv that a more efficient turbine pump could be designed for a g discharge, when the designer was not severely restricted in respe the over-all diameter. It was a fact that the claims of various ma of bore-hole pumps had been carefully examined with a view determining which type of plant should be installed in the K Irrigation Project. By the time the capital cost and installa charges and working expenses had been reduced, the compara figures proved that the advantages lay with the plant actu adopted. It was necessary to emphasize once more that the efficie of the pumping plant was as important in an irrigation scheme reduction of the depression-head. It was hardly necessary to po out to an engineer of Mr. Howell's experience that, in selecting pumping plant for the Karol project, the cost of the dry well a sinking thereof, together with all other factors, had been carefu studied. The designers of the Karol project had no prejudice favour of any particular type of plant. Indeed, had only convenien of manipulation been the final criterion there is no doubt that t bore-hole pump would have been adopted. Unfortunately, t efficiency figures and final cost in terms of cubic feet of water rais had swayed the balance in favour of the type of plant adopted in uncertain fashion.

In respect to Mr. Howell's remarks in para 9 on the subject the predilections of the United States Engineers, Mr. Howell shou not confuse the "best" with the "cheapest". The mere fact th skilled and semi-skilled labour in the United States was relative so costly, altered the economic aspect of many things.

On the subject of transmission constants, the authors could onl refer Mr. Howell to the Irrigation Research Institute where the deter mination had been carried out. Mr. Howell should remember tha the Karol Tube-Well Irrigation Scheme was largely experimenta The most accurate determinations had been made of the transmissio constant with a view to a subsequent examination. It was intended to correlate, if possible, the mean transmission constant with the output of the tube-well. The designers of the Karol scheme were unhappily as well aware as Mr. Howell of the wide variations from point to point in soil texture and quality.

On the subject of 'developing', there was room for a legitimate difference of opinion. Developing in one class of soil may be useful and dangerous in another. The concensus of opinion available to the designers of the Karol project was that developing was uncertain and expensive, and in the case of wells, which had been adequately shrouded, unnecessary. For these reasons the designers adopted the existing technique of the Karol project.

Lastly, thanks of the authors were due to Messrs. Ajudhia Nath Khosla and Kanwar Sen for their kind appreciation of the paper.

Financial aspect of Karol Project

Capital cost of Karol Project :—

	Rs.
(*a*) Land for watercourses and service roads (land for wells is taken under pump units) ..	23,320
(*b*) Construction of watercourses and service roads ..	83,362
(*c*) Pump units complete	2,18,185
(*d*) Other charges	3,684
Total ..	3,28,551

1. Interest on the above @ $3\frac{1}{2}\%$ = Rs. 11,499.
   Per tube-well per annum Rs. 575.
2. Depreciation on pump units :—
   (*i*) Tube-well including *kiosk* (life 15 years).

	Rs.
(*a*) Constructing and sinking tube-well *kios* ..	23,600
(*b*) Boring and test pumping	46,273
(*c*) Providing strainer and rising pipes	79,575
(*d*) Delivery pipe and carriage	1,960
Total ..	1,51,408

Depreciation charges per tube-well per annuam Rs. 505.

(*ii*) Cost of a pump (age 25 years) Rs. 1,280.

Depreciation charges per tube-well per annum Rs. 51.

(*iii*) Actual cost of a motor (age 10 years), Rs. 642.

Depreciation charges for a motor per annuam Rs. 64

Total depreciation on a pump unit	620

3. Establishment and maintenance charges per tube-well per annuam, excluding energy charges :—

	Rs.
(*a*) Establishment	515
(*b*) Stock, maintenance and repairs	90
Total ..	605

Total Recurring Expenditure for a complete Tube-Well, excluding cost of energy :—

	Rs.
I. Interest on capital outlay	575
II. Depreciation	620
III. Establishment, Maintenance & Repairs ..	605
Total ..	1,800

FINANCIAL ASPECT OF KAROL PROJECT WHEN FULLY DEVELOPED

Tube Well No.	Crop.	Energy charges	Establishment	Maintenance & Stock	Depreciation charges interest, etc.	Total expenditure	Revenue		Profit per year
		Rs.	Rs.	Rs.	Rs.	Rs.	Rs.		Rs.
6	Kharif ..	859	515	90	1,195	3,518	3,032	5,053	1,535
	Rabi ..	859					2,021		
2	Kharif ..	688	515	90	1,195	3,176	2,894	4,823	1,647
	Rabi ..	688					1,929		
5	Kharif ..	680	515	90	1,195	3,160	2,894	4,823	1,663
	Rabi ..	680					1,929		
14	Kharif ..	702	515	90	1,195	3,204	2,874	4,790	1,586
	Rabi ..	702					1,916		
13	Kharif ..	859	515	90	1,195	3,518	3,230	5,383	1,865
	Rabi ..	859					2,153		
10	Kharif ..	716	515	90	1,195	3,232	2,894	4,823	1,591
	Rabi ..	716					1,929		
8	Kharif ..	859	515	90	1,195	3,518	3,269	5,448	1,930
	Rabi ..	859					2,179		
1	Kharif ..	803	515	90	1,195	3,406	3,131	5,218	1,812
	Rabi ..	803					2,087		
							Total ..		13,629

Average annual profit per tube-well ..	1,700
Capital cost per tube well ..	16,400
Annual return ..	10½ %

T OF KAROL PROJECT WHEN FULLY DEVELOPED

Establishment	Maintenance & Stock	Depreciation charges interest, etc.	Total expenditure	Revenue	Profit per year
Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
515	90	1,195	3,518	3,032 2,021 } 5,053	1,535
515	90	1,195	3,176	2,894 1,929 } 4,823	1,647
515	90	1,195	3,160	2,894 1,929 } 4,823	1,663
515	90	1,195	3,204	2,874 1,916 } 4,790	1,586
515	90	1,195	3,518	3,230 2,153 } 5,383	1,865
515	90	1,195	3,232	2,894 1,929 } 4,823	1,591
515	90	1,195	3,518	3,269 2,179 } 5,448	1,930
515	90	1,195	3,406	3,131 2,087 } 5,218	1,812
				Total ..	13,629

Average annual profit per tube-well .. 1,700
Capital cost per tube well .. 16,400
Annual return .. 10½ %

WORKING OF TUBE-WELLS FOR RABI 1939-40, KHA

TUBE WELLS N

Particulars.	6			2			5			14			
	Rabi 1939-40.	Kharif 1940.	Rabi 1940-41.	Rabi 1939-40.	Kharif 1940.	Rabi 1940-41.	Rabi 1939-40	Kharif 1940.	Rabi 1940-41.	Rabi 1939-40.	Kharif 1940.	Rabi 1940-41	Rabi 1939-4
1. Depth of Spring Level below Natural Surface..	13·7	12·9	13·1	13·8	13·4	13·7	10·5	10·2	10·3	12·8	11·9	12·3	12·00
2. Actual hours run ..	1,314	1,468	1,852	1,966	1,699	1,824	970	259	1,000	1,158	188	870	1,633
3. Hours as per forecast ..	100	200	400	100	200	400	100	200	400	100	200	400	100
4. Discharge	1·54	1·53	1·53	1·47	1·47	1·46	1·47	1·45	1·47	1·46	1·43	1·44	1·64
5. Gross Suction Head ..	11·1	12·52	12·52	6·5		6·03	10		12·2	7·95		7·8	11·62
6. Delivery Head ..	17·3		13·50	15·95		15·90	13·2		10·0	16·63		13·5	16·20
7. Total Pumping Head ..	23·4		26·02	22·45		21·93	23·2		22·2	24·58		21·3	27·82
8. Over-All Efficiency—													
(a) Designed Efficiency	63·2			59·4			59·4			59·4			63·2
(b) Actual Efficiency ..	65·7			62·8			61·6			61·87			69·06
9. Water pumped in acre-foot	168·00	186·00	234·00	223·00	203·00	220·00	113·00	31·00	121·00	135·0	22	104	205
10. Gross area	501			660			555			393			587
11. C. C. A.	482			631			543			388			532
12. Area irrigated ..	231	165	249	270	150	241	179	50	170	132	22	139	235
13. Delta neglecting water given from open-wells ..	0·72	1·11	0·94	0·82	1·31	0·91	0·68	0·59	0·71	1·01	0·98	0·75	0·85
14. Cost of energy ..	602/-	658/-	822/-	664/-	670/-	722/-	360/-	120/-	386/-	439/-	95/-	344/-	532/-
15. Energy cost per acre-foot of water pumped ..	3/9/5	3/8/8	3/8/2	2/15/6	3/3/11	3/4/6	3/2/10	3/13/7	3/3/-	3/3/-	4/4/6	3/4/11	2/9/7
16 Energy cost per acre irrigated	2/9/9	3-15/11	3/4/9	2/7/4	4/4/6	3/-/-	2/-/2	2/6/9	2/4/4	3/5/-	4/4/6	2/7/7	2/4/2
17. No. of units consumed ..	7,814	8,795	11,112	9,309	8,249	9,120	4,228	1,205	4,750	5,336	936	4,385	8,654
18. Units used per hour ..	5·95	5·99	6·00	4·74	4·86	4·80	4·35	4·65	4·75	4·61	4·98	4·90	5·26
19. Units per 1,000 c.ft. ..	1·07	1·09	1·09	0·95	0·92	0·91	0·86	0·89	0·90	0·91	0·97	0·97	0·97
													Impeller "O" Type used.

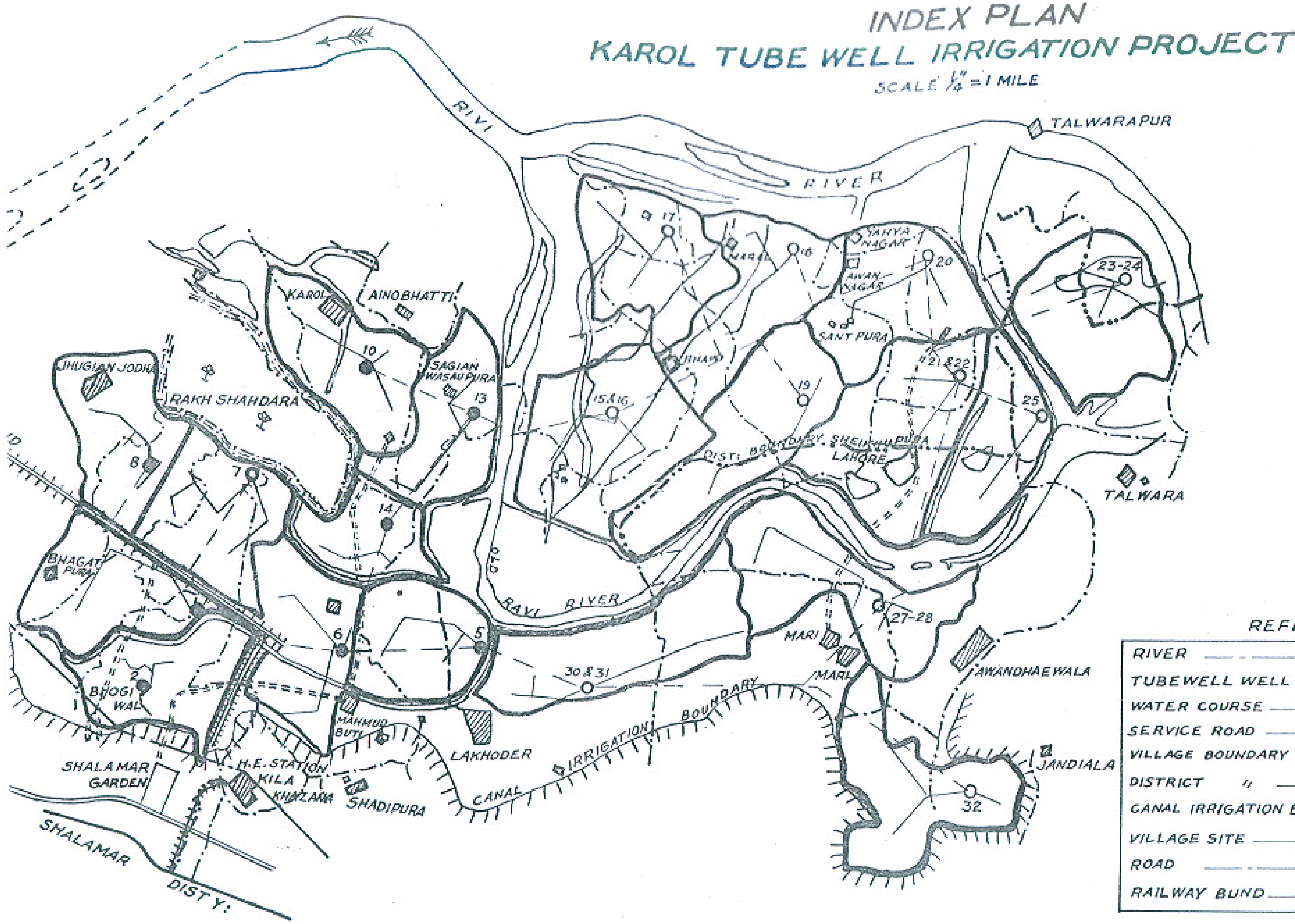
WORKING OF TUBE-WELLS FOR RABI 1939-40, KHARIF 1940, AND RABI 1940-41.

TUBE WELLS NO.

6		2			5			14			13			10			8			1		
arif 40.	Rabi 1940-41.	Rabi 1939-40.	Kharif 1940.	Rabi 1940-41.	Rabi 1939-40	Kharif 1940.	Rabi 1940-41.	Rabi 1939-40.	Kharif 1940.	Rabi 1940-41	Rabi 1939-40.	Kharif 1940.	Rabi 1940-41.	Rabi 1939-40.	Kharif 1940.	Rabi 1940-41.	Rabi 1939-40.	Kharif 1940.	Rabi 1940-41.	Rabi 1939-40.	Kharif 1940.	Rabi 1940-41.
2·9	13·1	13·8	13·4	13·7	10·5	10·2	10·3	12·8	11·9	12·3	12·00	11·4	11·7	12·5	11·7	12·2	16·8	16·2	15·7	14·6	14·6	14·7
·68	1,852	1,966	1,699	1,824	970	259	1,000	1,158	188	870	1,633	312	625	1,084	314	600	681	1,144	715	529	617	925
·00	400	100	200	400	100	200	400	100	200	400	100	200	400	100	200	400	100	200	400	100	200	400
53	1·53	1·47	1·47	1·46	1·47	1·45	1·47	1·46	1·43	1·44	1·64	1·64	1·66	1·47	1·47	1·47	1·66	1·66	1·66	1·59	1·59	1·58
52	12·52	6·5		6·03	10		12·2	7·95		7·8	11·62		11·04	8·43		7·93	6·825	6·58	6·5	8·8	8·6	8·4
	13·50	15·95		15·90	13·2		10·0	16·63		13·5	16·20		10·0	13·91		12·0	18·075	18·3	18·3	16·01	16·0	16·0
	26·02	22·45		21·93	23·2		22·2	24·38		21·3	27·82		21·4	22·34		19 93	24·9	24·88	24·35	24·81	24·6	24·4
		59·4			59·4			59·4			63·2			59·4			63·2			63·2		
		62·8			61·6			61·87			69·06			61·1			57·5			61·1		
00	234·00	223·00	206·00	220·00	113·00	31·00	121·00	135·0	22	104	205	42	86	141	38	73	94	157	98	69	81	120
		660			555			393			537			685			705			669		
		631			543			388			532			644			678			627		
65	249	270	156	241	179	50	170	132	22	139	235	60	131	211	51	91	112	161	110	91	112	120
·11	0·94	0·82	1·31	0·91	0·68	0·59	0·71	1·01	0·98	0·75	0·85	0·69	0·66	0·65	0·73	0·80	0·83	0·97	0·89	0·74	0·72	0·91
8/-	822/-	664/-	670/-	722/-	360/-	120/-	386/-	439/-	95/-	344/-	532/-	187/-	307/-	344/-	155/-	250/-	284/-	504/-	405/-	222/-	277/-	442/-
/8	3/8/2	2/15/6	3/3/11	3/4/6	3/2/10	3/13/7	3/3/-	3/3/-	4/4/6	3/4/11	2/9/7	4/6/9	3/9/3	2/7/1	4/1/3	3/6/10	3/-/4	3/3/5	4/2/1	3/3/9	3/6/9	3/10/8
/11	3/4/9	2/7/4	4/4/6	3/-/-	2/-/2	2/6/9	2/4/4	3/5/-	4/4/6	2/7/7	2/4/2	3/2/-	2/5/7	1/10/1	3/-/9	2/12/1	2/8/7	3/2/1	3/10/10	2/6/11	2/7/8	3/10/8
·95	11,112	9,309	8,249	9,120	4,228	1,205	4,750	5,336	936	4,385	8,654	1,905	3,750	5,645	1,576	3,000	4,105	6,857	4,290	2,981	3,495	5,280
·99	6·00	4·74	4·86	4·80	4·35	4·65	4·75	4·61	4·98	4·90	5·26	6·10	6·0	5·21	5·01	5·0	5·03	5·99	6·0	5·63	5,66	5·60
·09	1·09	0·95	0·92	0·91	0·86	0·89	0·90	0·91	0·97	0·97	0·97	1·03	1·0	0·82	0·95	0·94	1·00	1·00	1·04	1·00	0·99	1·01
											Impeller "O" Type used.			Impeller changed.			Impeller "O" Type used for some time.					

PLATE I
PAPER NO. 248

INDEX PLAN
KAROL TUBE WELL IRRIGATION PROJECT
SCALE 1/4" = 1 MILE



REFERENCES.

RIVER	
TUBEWELL WELL NUMBER	○ 20
WATER COURSE	
SERVICE ROAD	
VILLAGE BOUNDARY	
DISTRICT "	
CANAL IRRIGATION BOUNDARY	
VILLAGE SITE	
ROAD	
RAILWAY BUND	

PUNJAB ENGINEERING CONGRESS

PLATE 2
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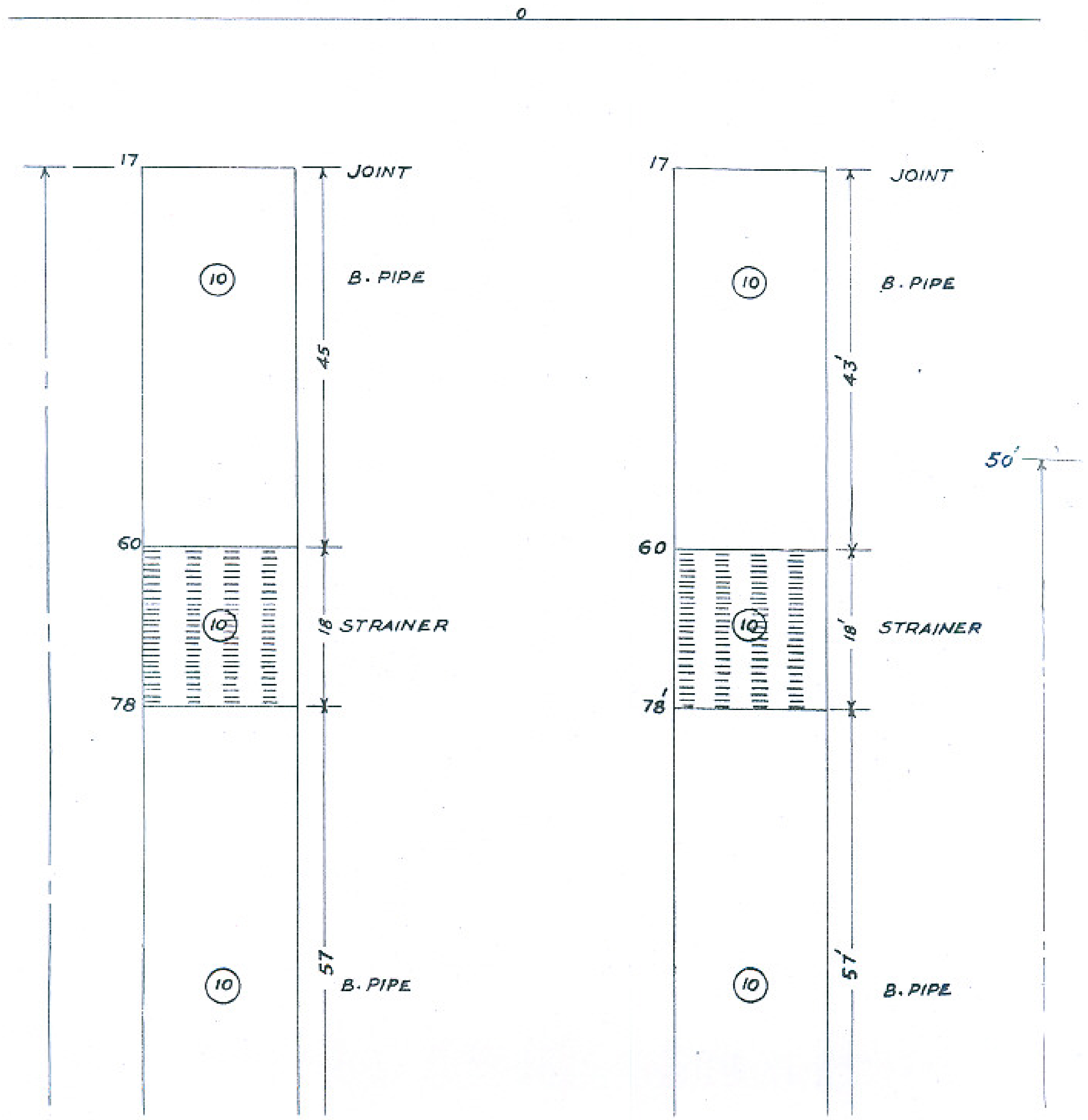
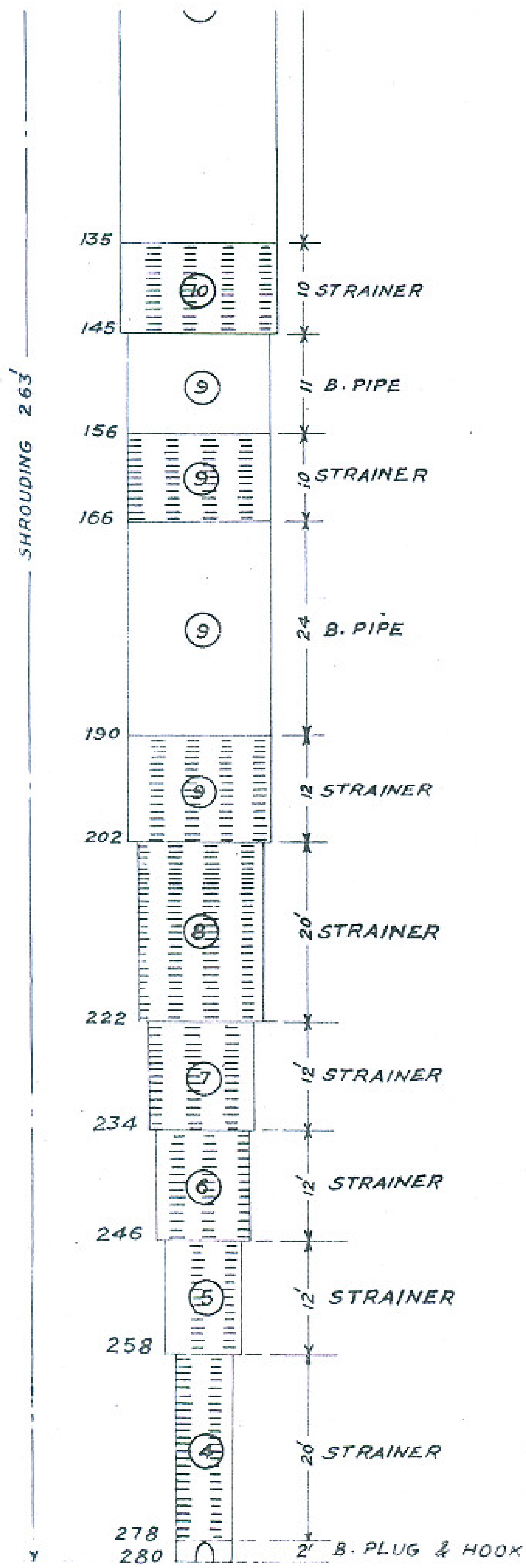
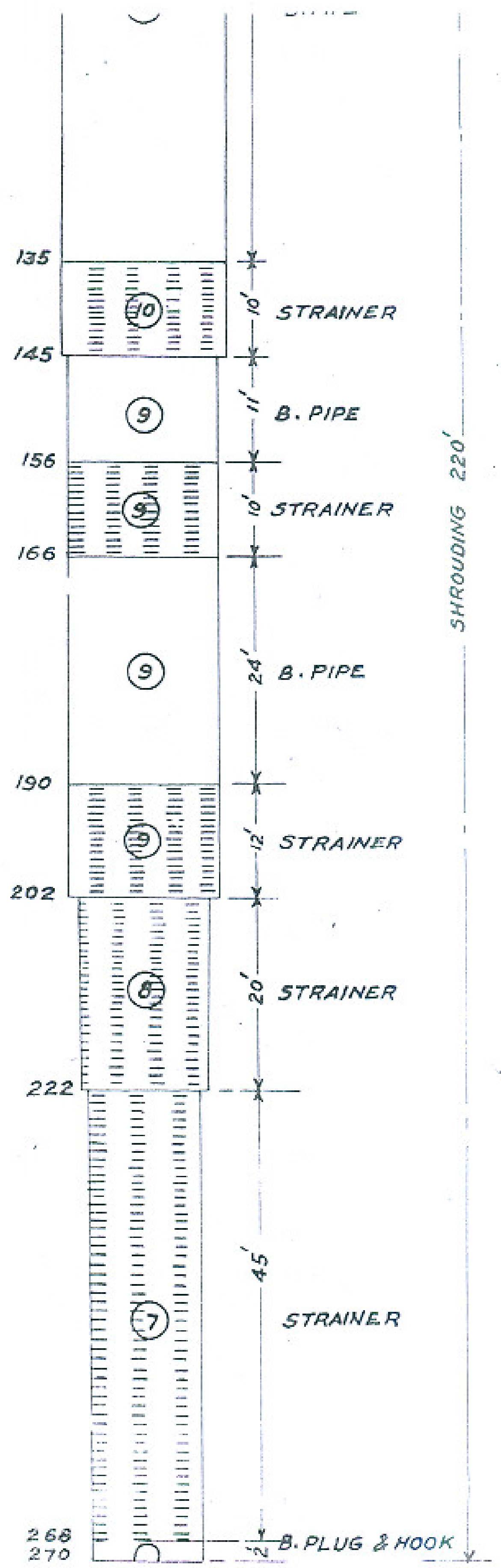
LOCATION CHART OF STRAINER & B. PIPE TYPE DESIGN

SCALES { HORI: = 1/10, VERT: = 1/200 }





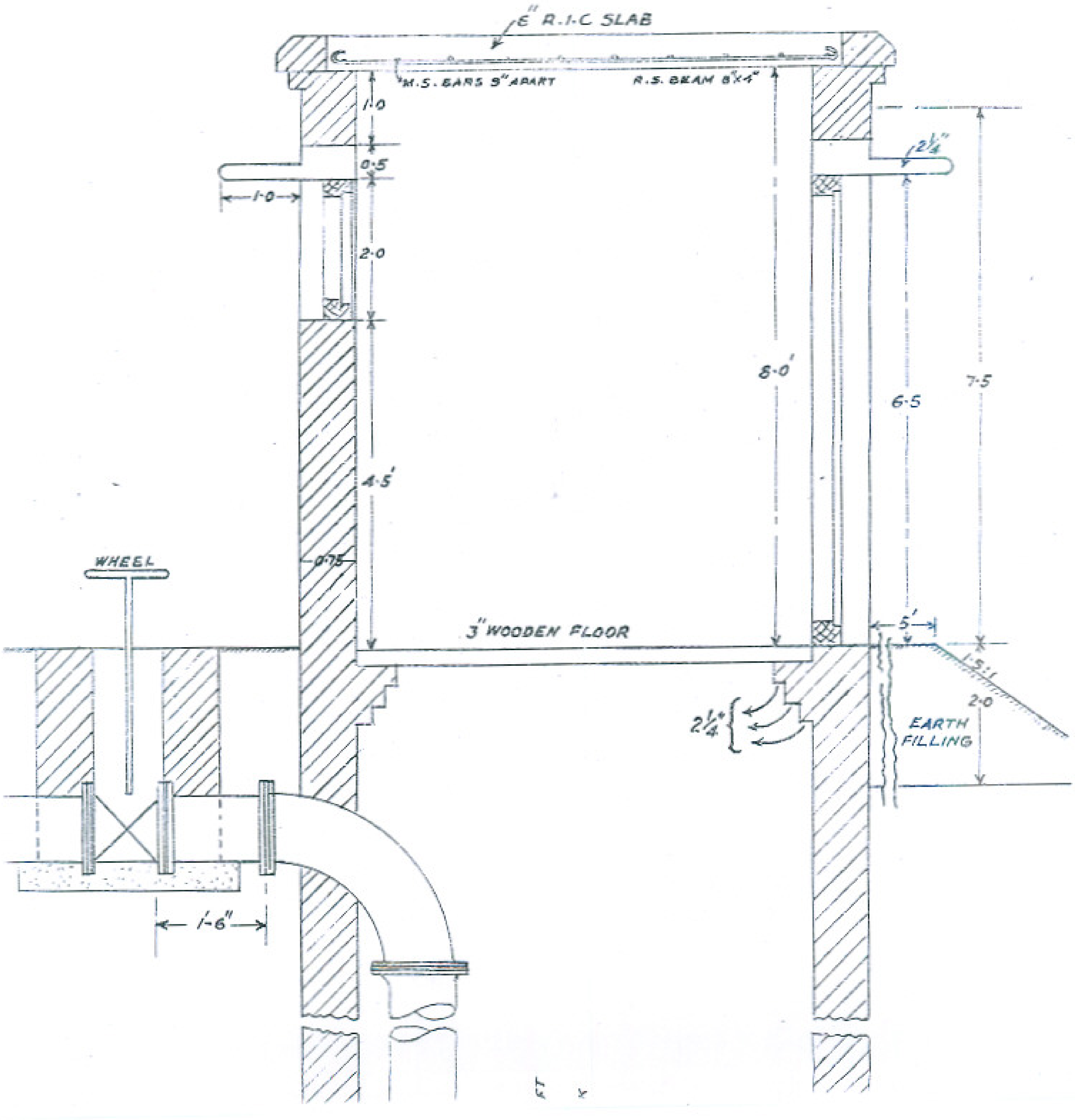
TOTAL LENGTH OF STRAINER = 126'

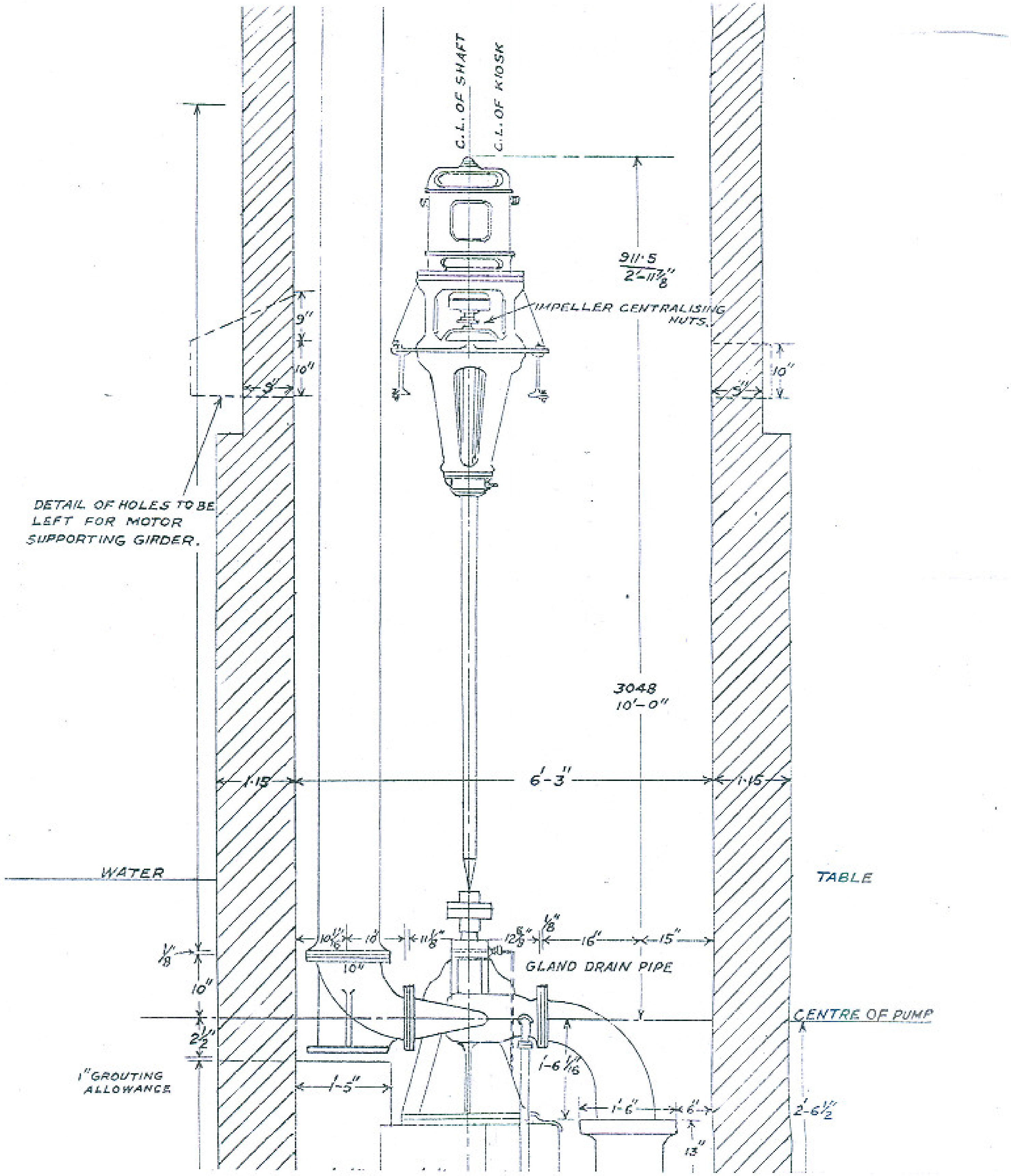


TOTAL LENGTH OF STRAINER = 116'

SECTION THROUGH TUBE WELL

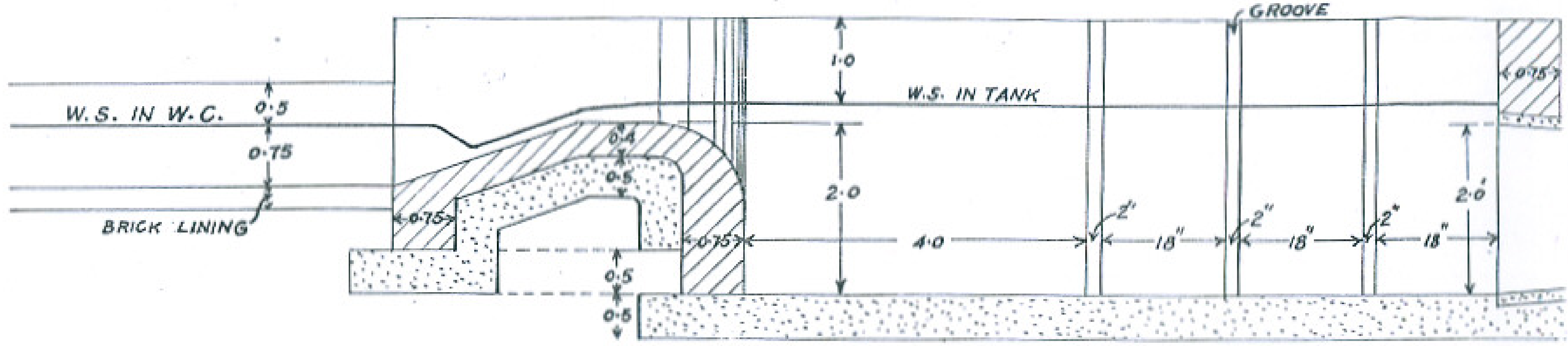
SCALE ½" = 1 FT



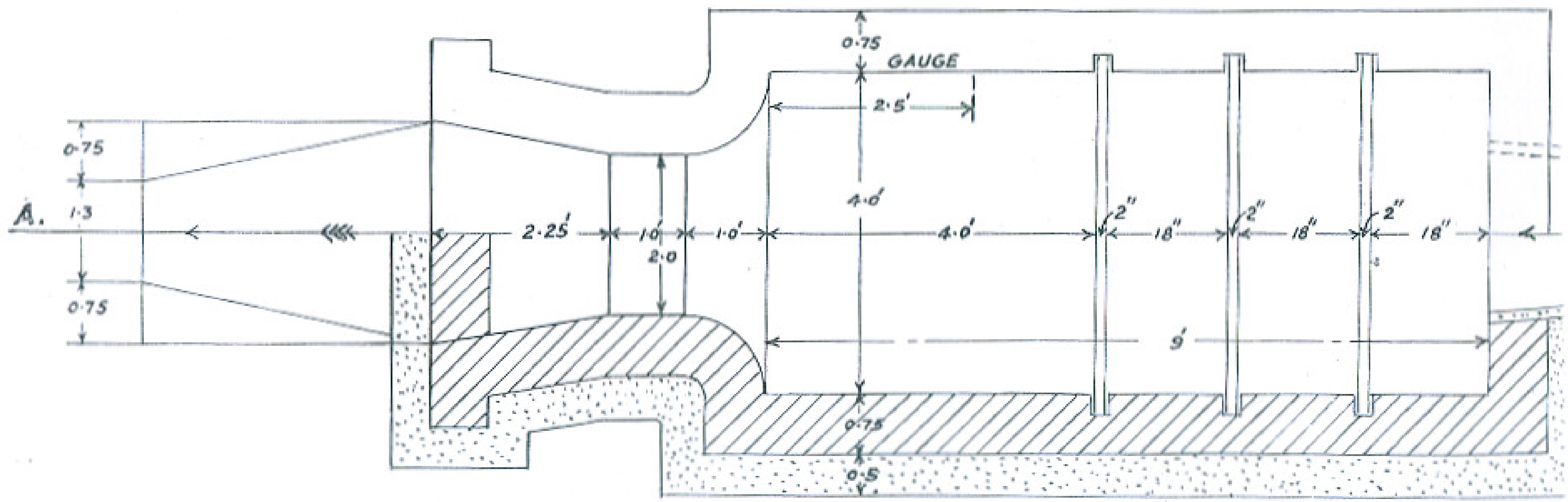

C.L. OF SHAFT
C.L. OF KIOSK
911·5
2'-11⅞"
IMPELLER CENTRALISING NUTS.
9"
10"
5"
10"
5"
DETAIL OF HOLES TO BE LEFT FOR MOTOR SUPPORTING GIRDER.
3048
10'-0"
1·15
6'-3"
1·15
WATER
TABLE
10 1/16
10"
11⅛"
12⅝"
⅛"
16"
15"
⅛"
10"
GLAND DRAIN PIPE
10"
2½"
CENTRE OF PUMP
1" GROUTING ALLOWANCE
1'-5"
1'-6 1/16
1'-6"
6"
2'-6½"
13"

PLAN OF MEASURING DEVICE FOR 1·5 CUSEC DISC

SCALE = 1/25



SECTION ON A.B.



PLAN

PLATE 4
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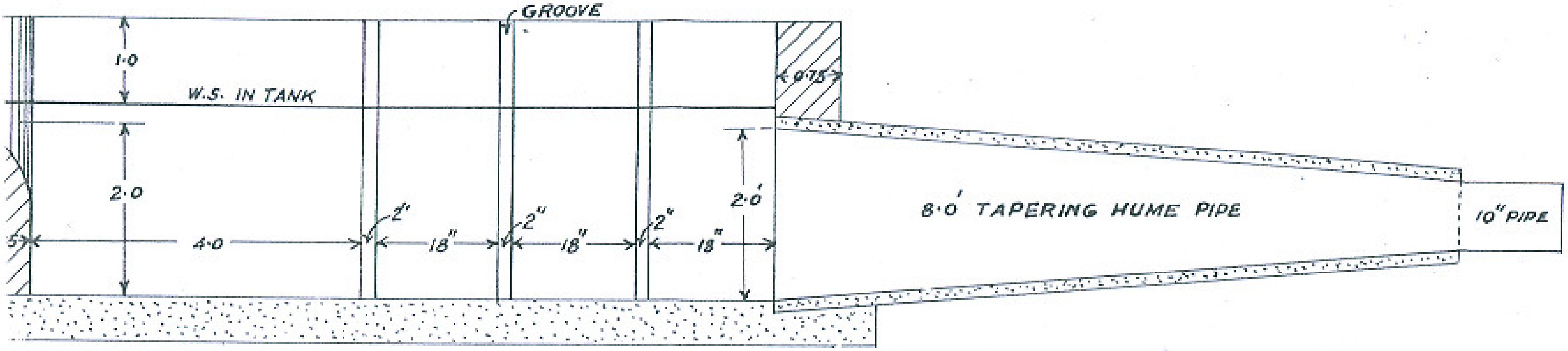
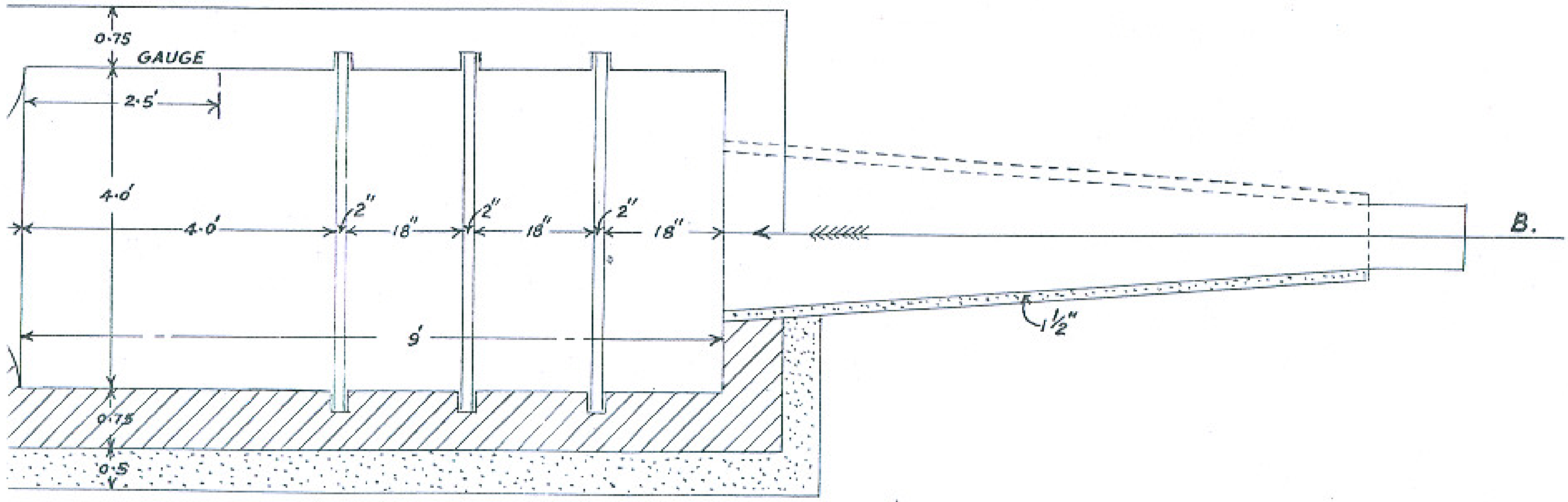
MEASURING DEVICE FOR 1·5 CUSEC DISCHARGE

SCALE = 1/25



SECTION ON A.B.

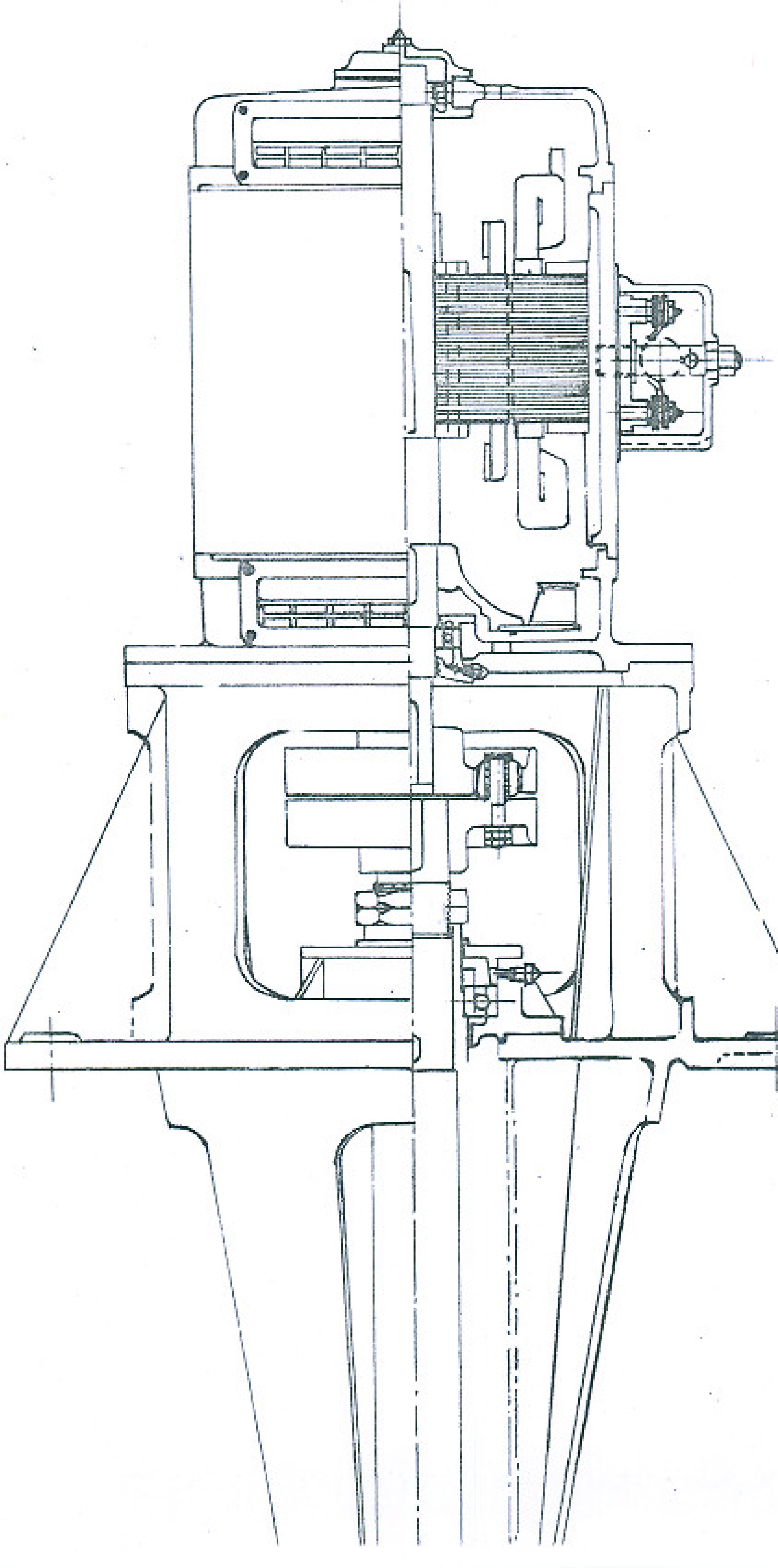


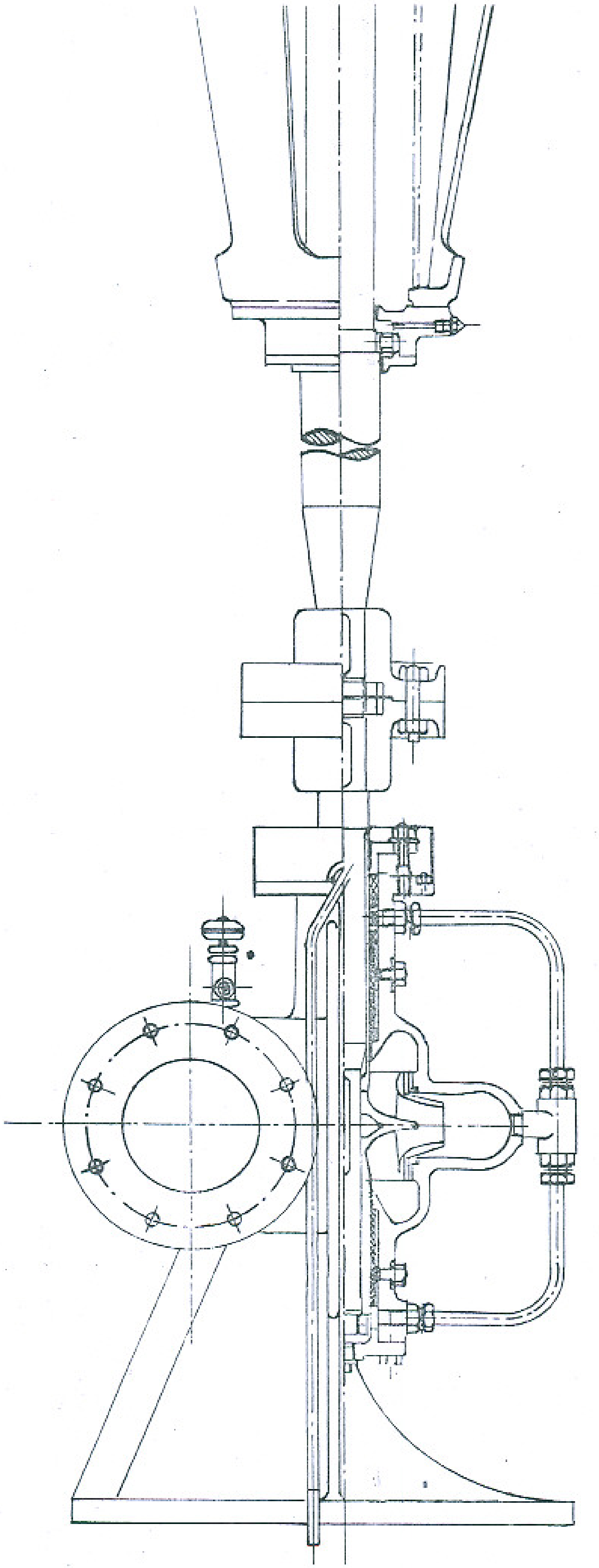
PLAN

PLATE 5
PAPER NO.248

HARLAND VERTICAL "SPIROGLIDE" PUMPING UNIT.

S.D.A. 6/6 PUMPING AND S. 70 MOTOR.





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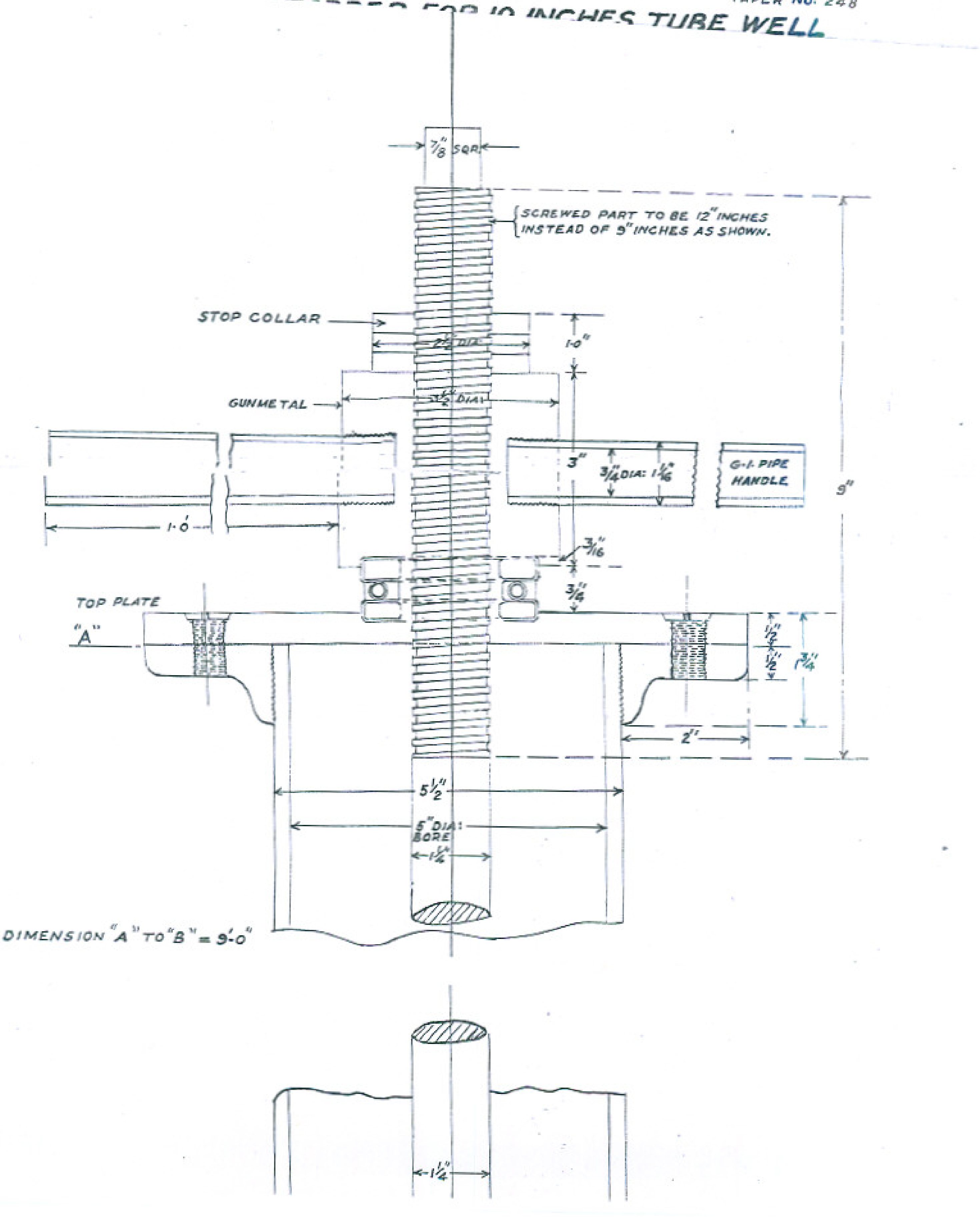
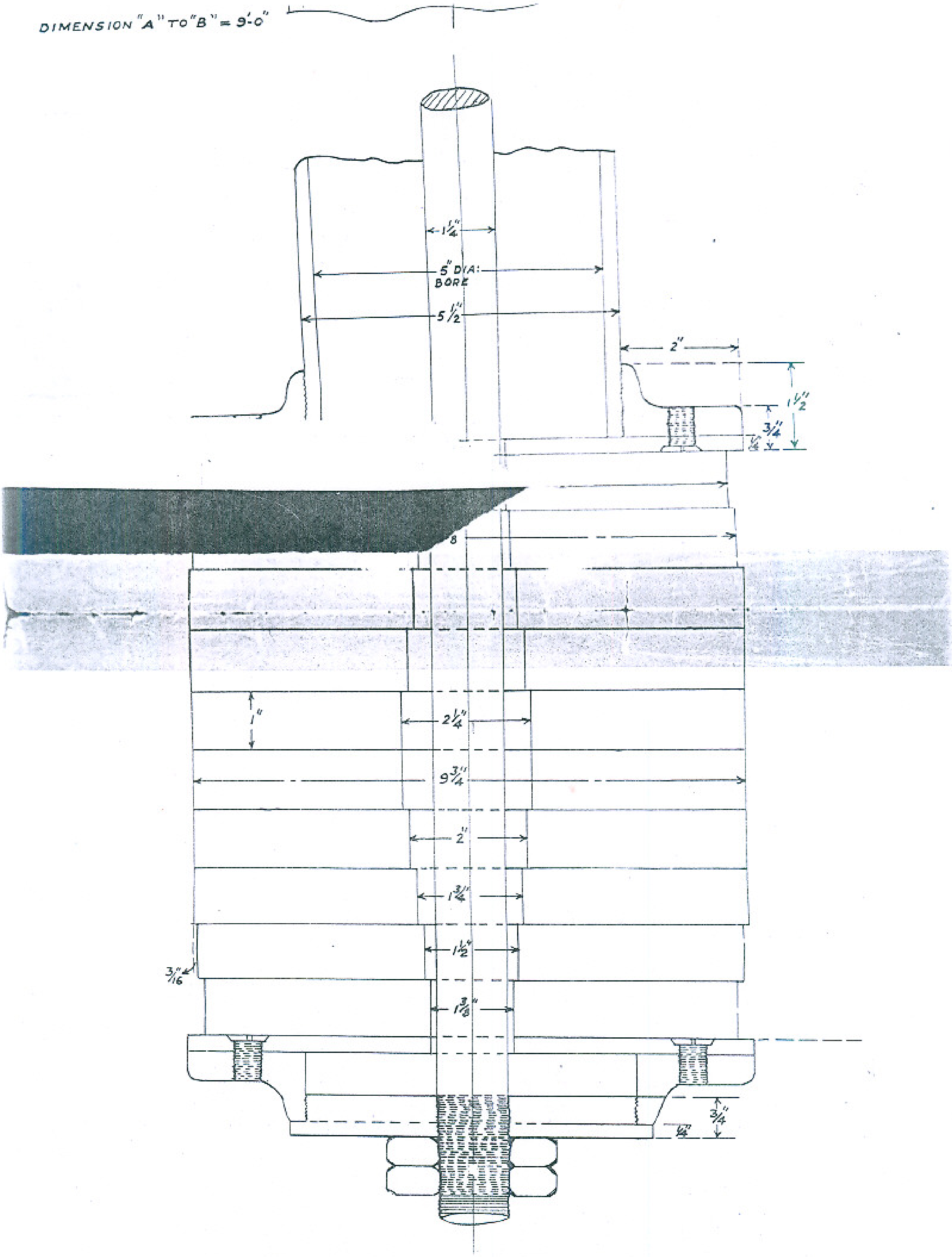
1941.

PLATE 6

PAPER NO. 248



DIMENSION "A" TO "B" = 9'-0"



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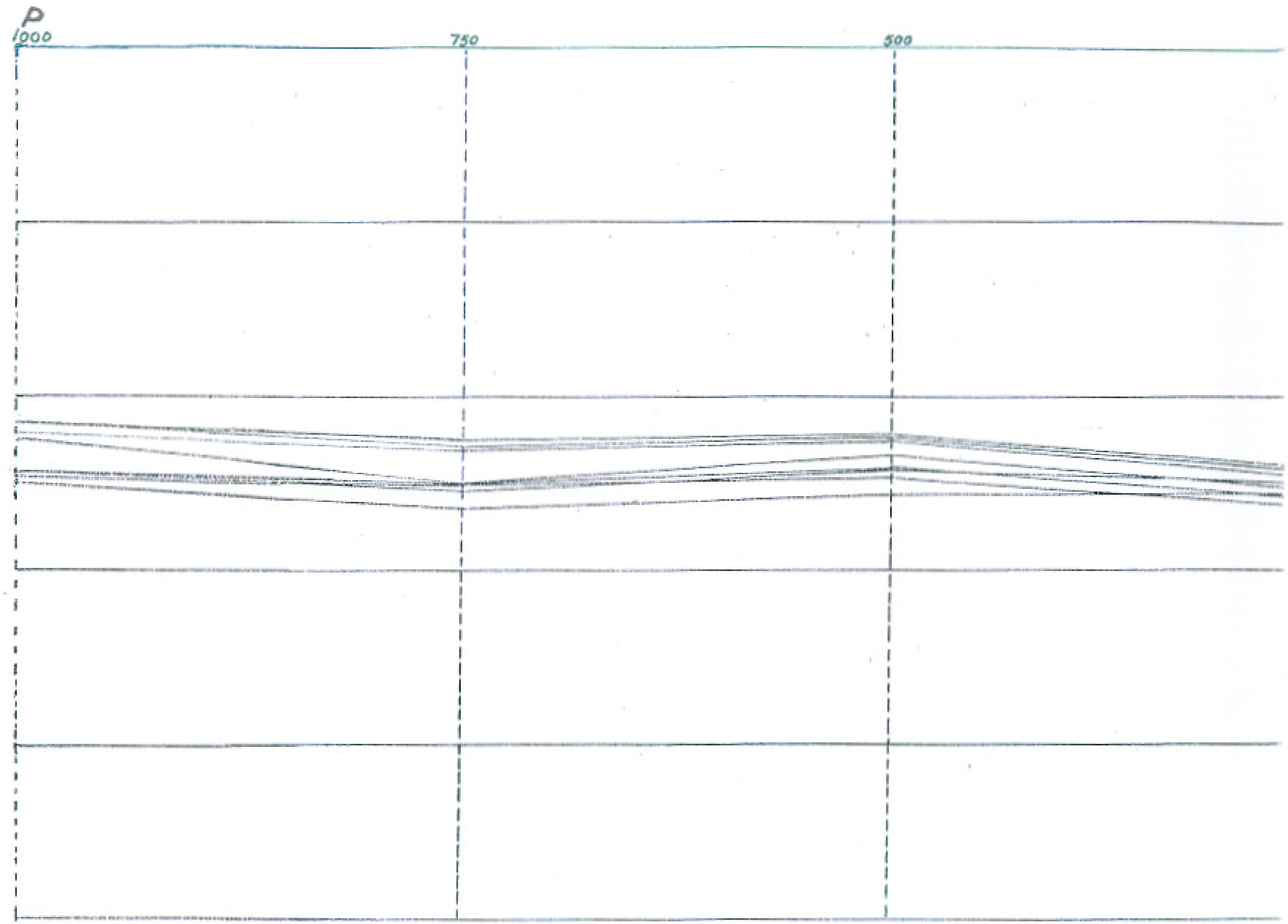
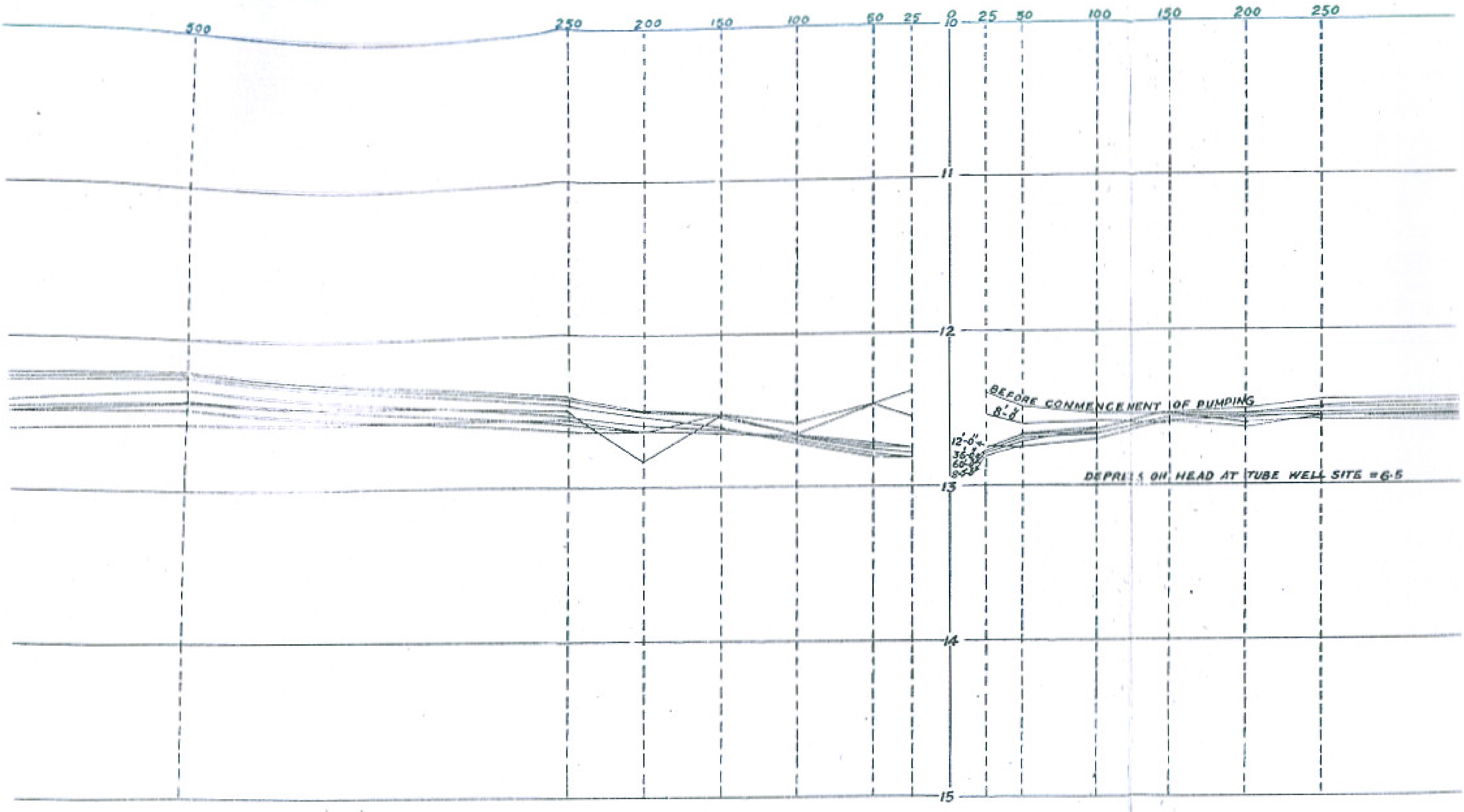

P
1000
750
500

DEPLETION CURVE OF TUBE WELL NUMBER 2

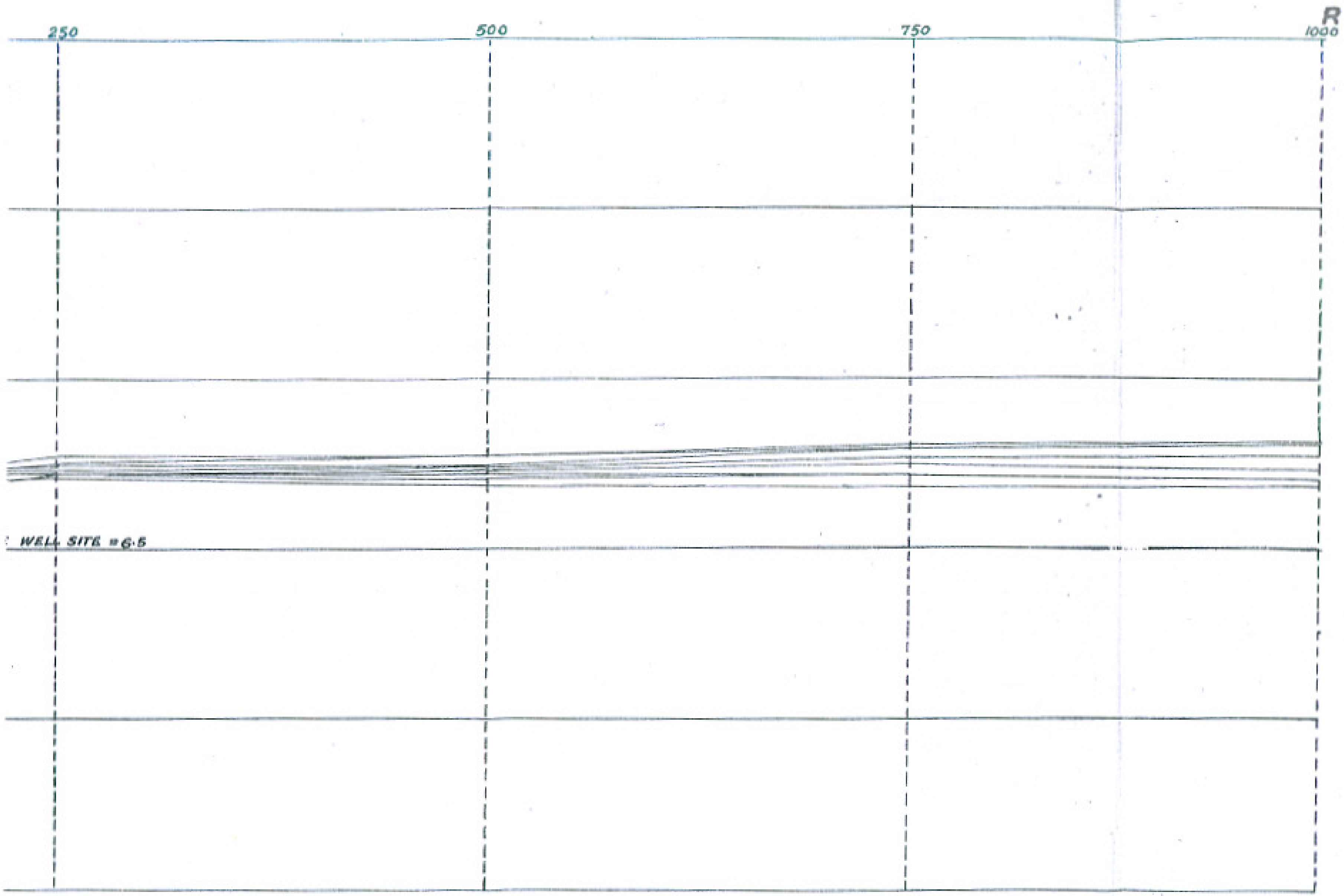
SCALES { HOR: = 1/1000, VER: = 1/10 }



ɜER 2

PLATE 7

PAPER NO. 248



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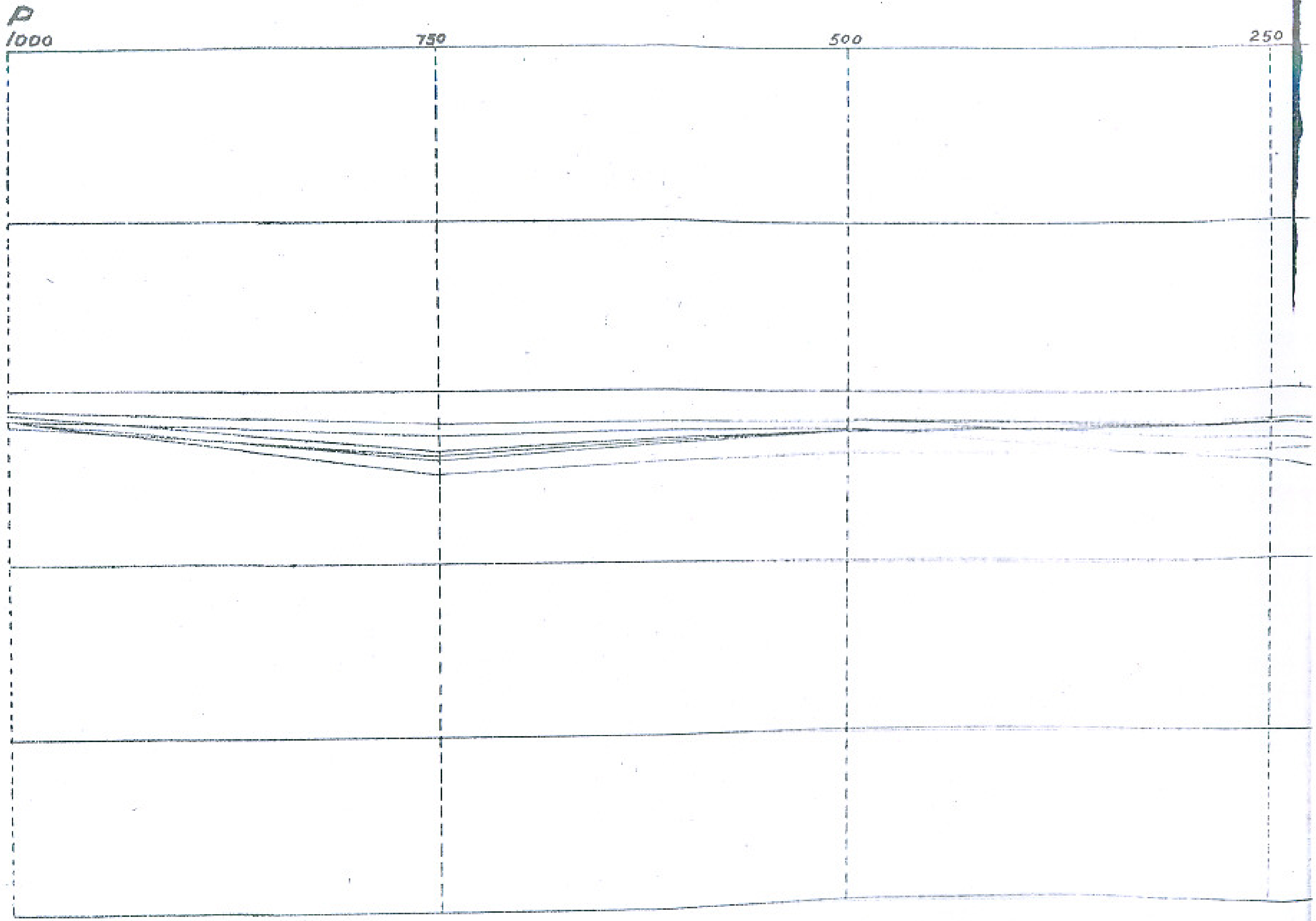
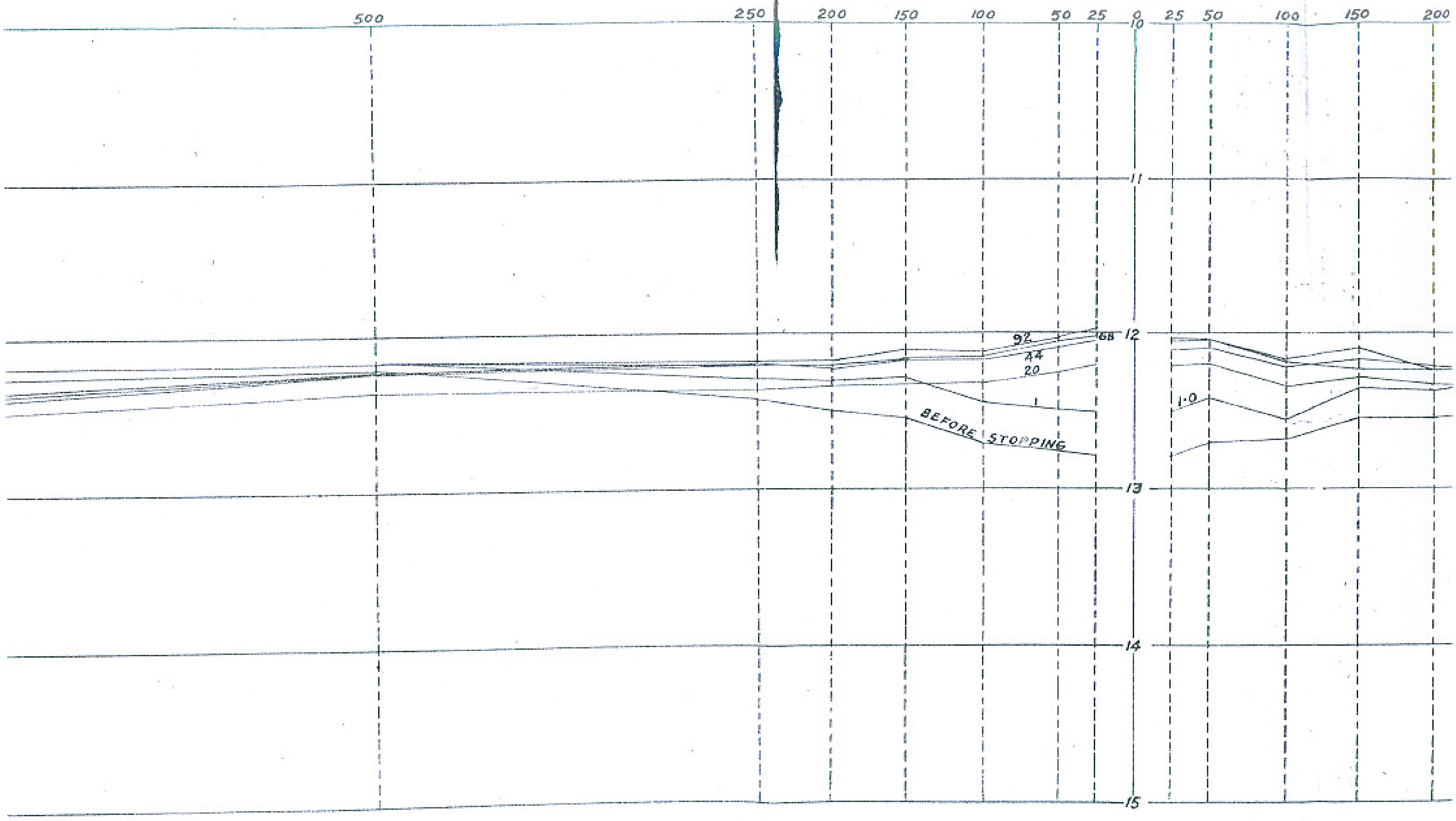

P
1000
750
500
250

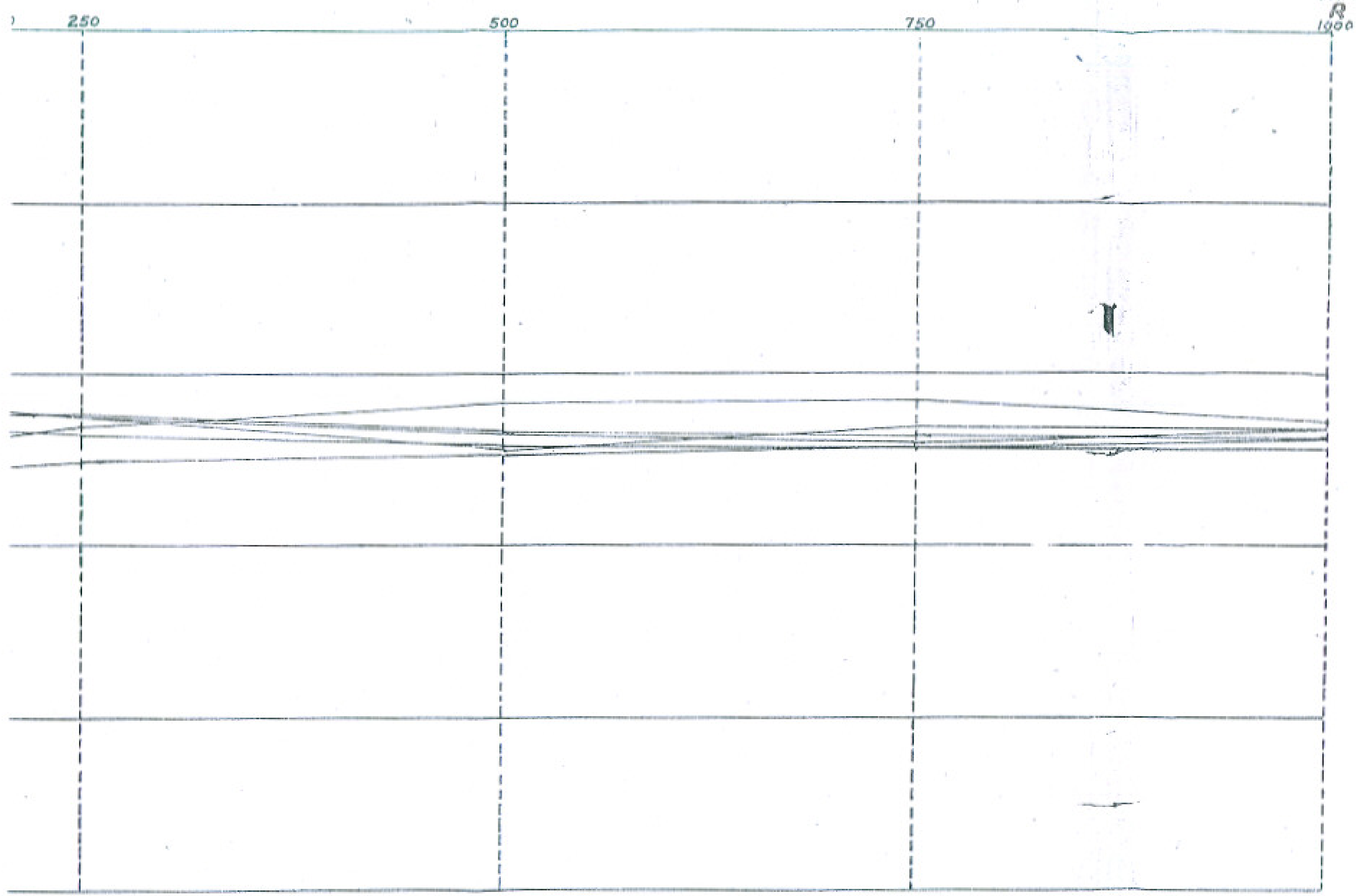
RECUPERATION CURVE OF TUBE WE... NUM

SCALES {HORI: = 1/1000, VERT: = 1/10}



BER 2.

PLATE
PAPER NO. 248.



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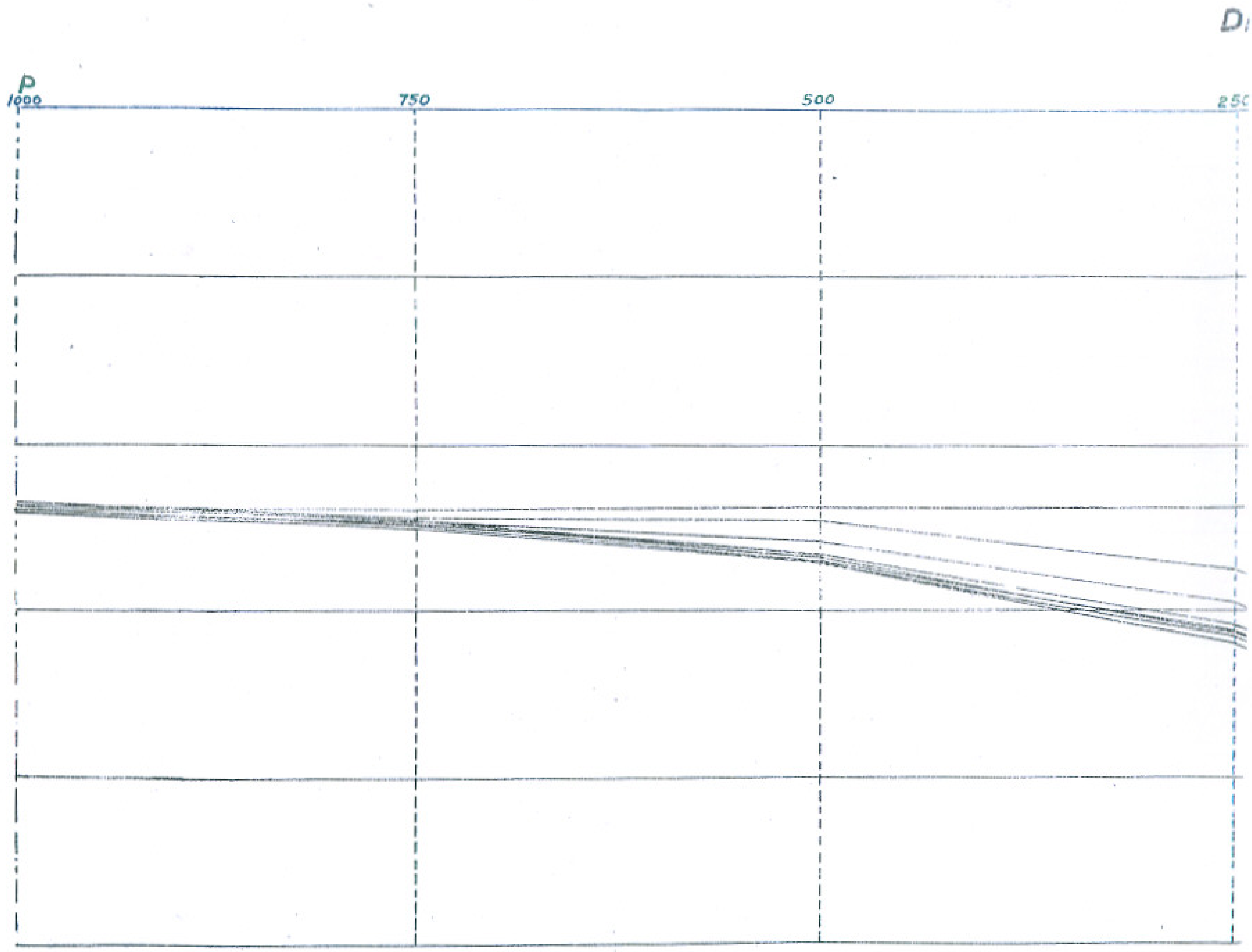
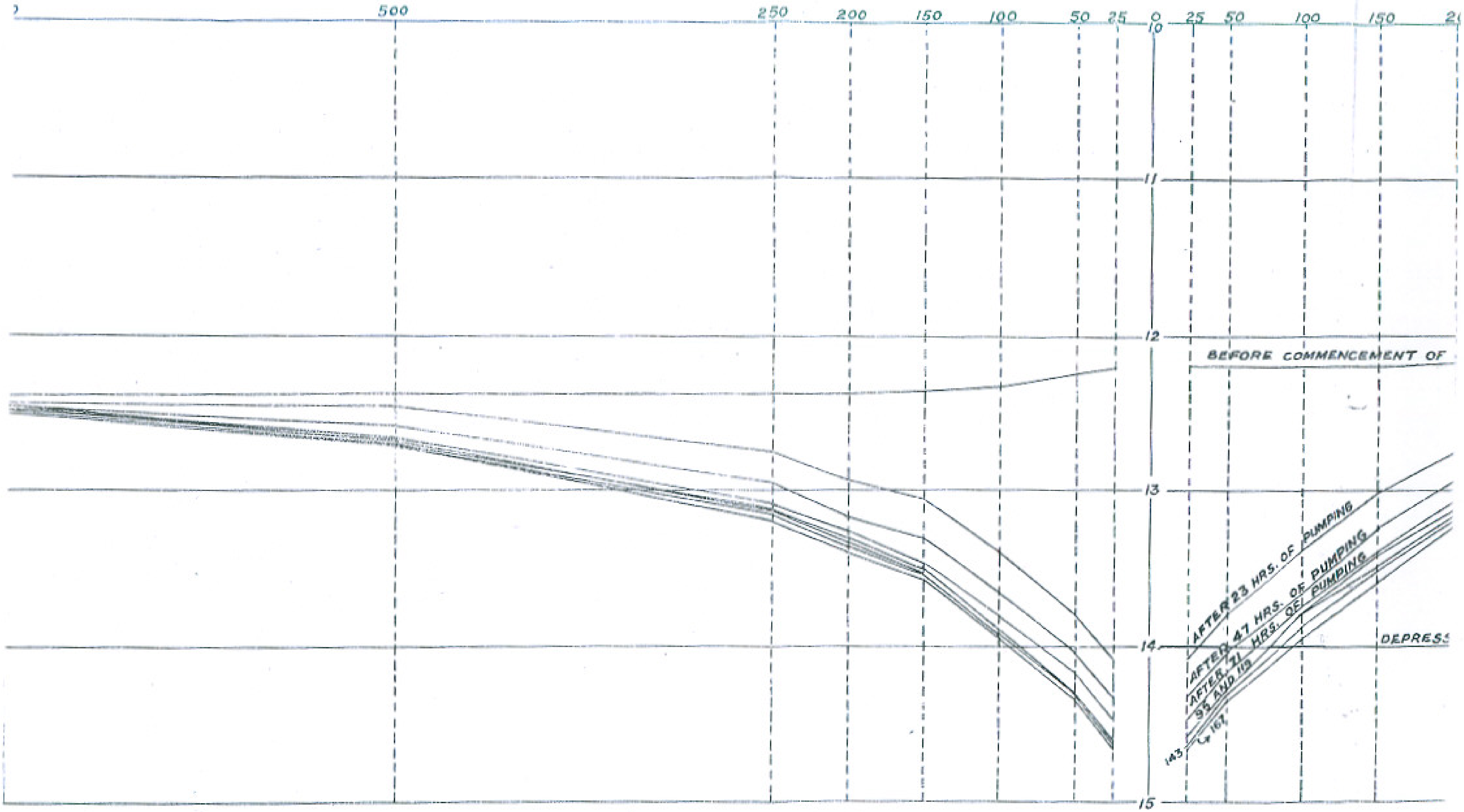

D
P
1000
750
500
250

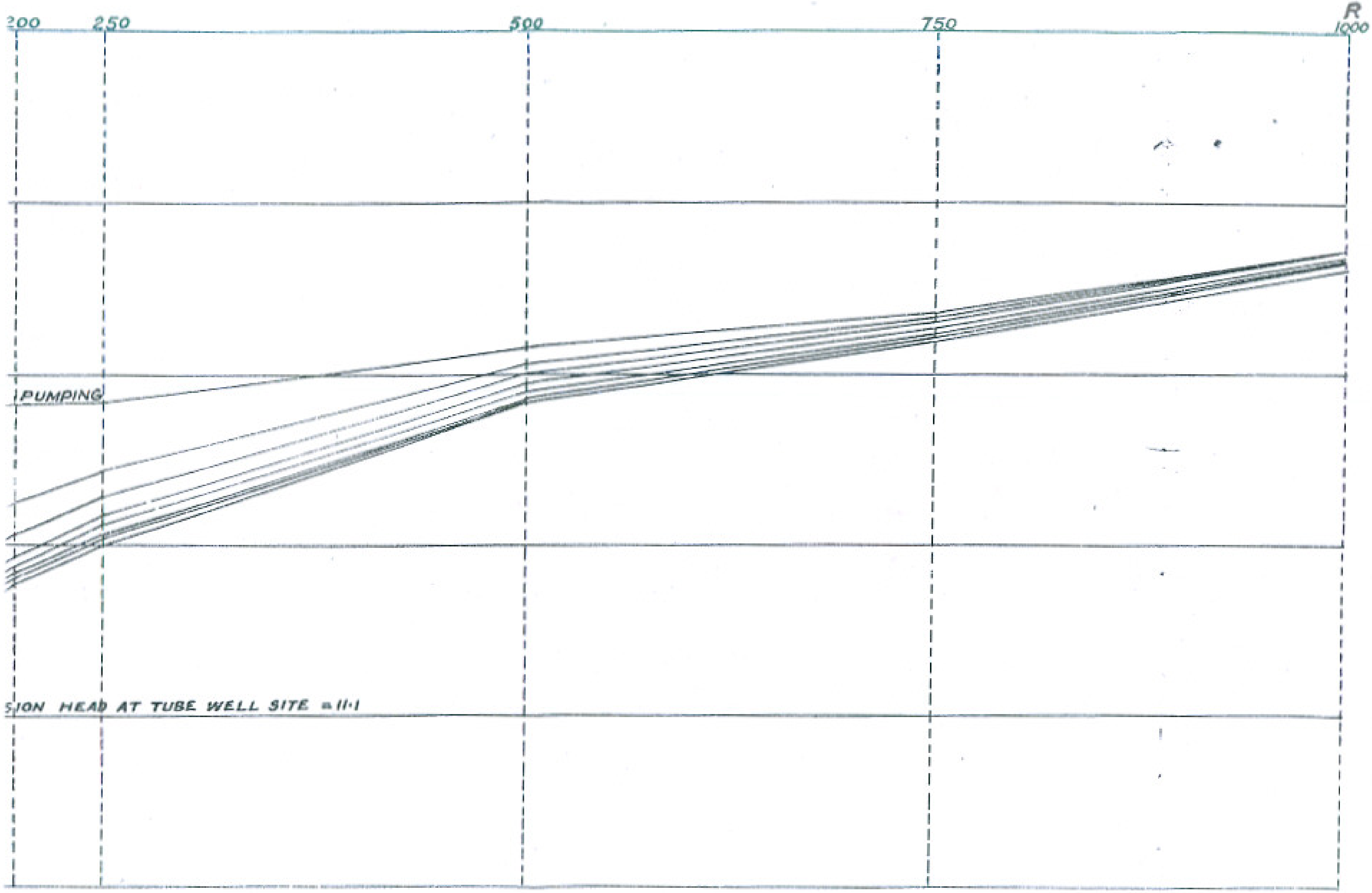
DEPLETION CURVE OF TUBE WELL NUMB.

SCALES {HOR: = 1/1000 VER: = 1/10}



ɜER 6

PLATE
PAPER NO. 248



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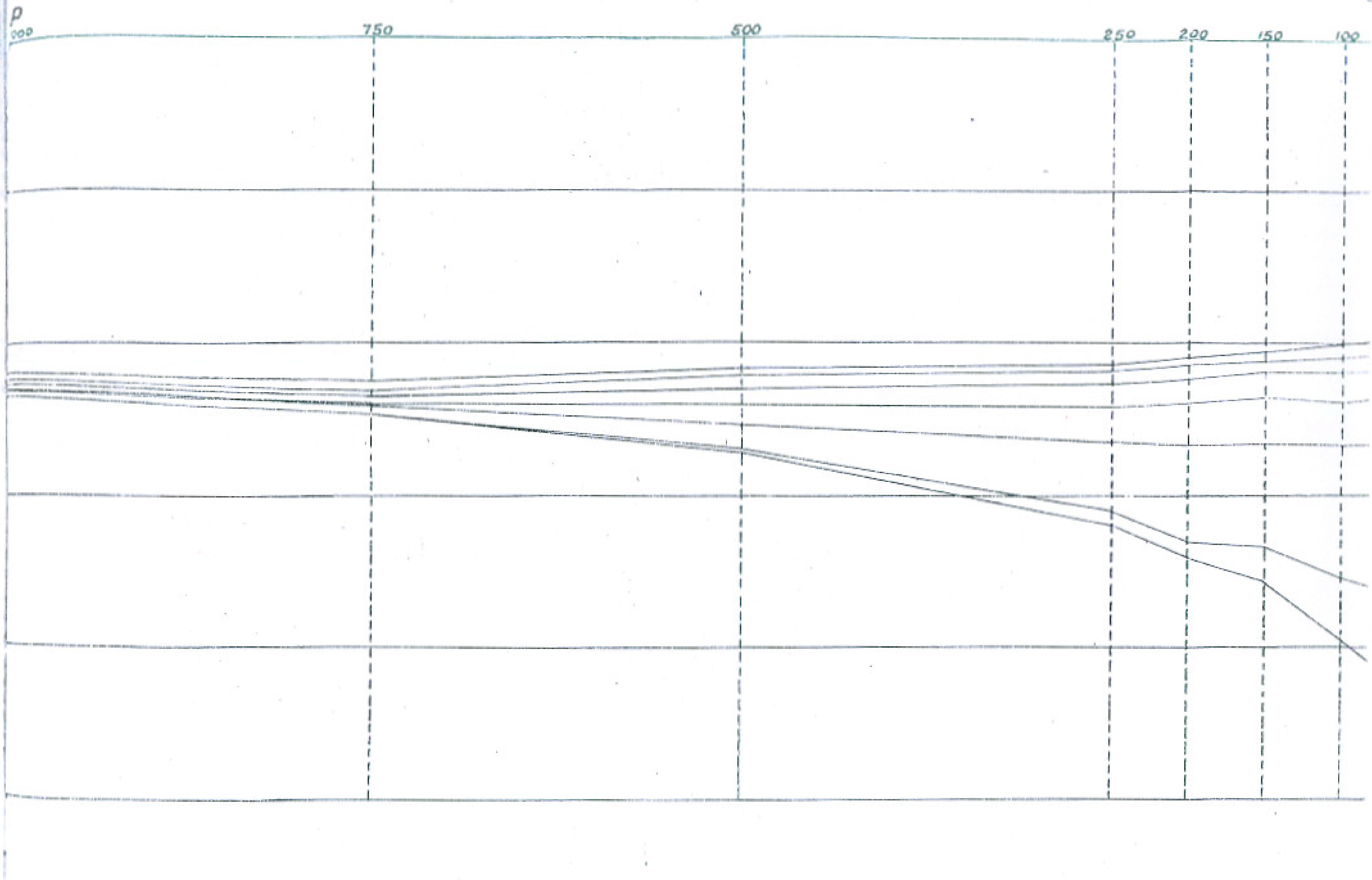
RECUPERATION CURV



RECUPERATION CURVE OF TUBE WELL NUMBER 6

SCALES {HOR: = 1/1000, VER: = 1/10}

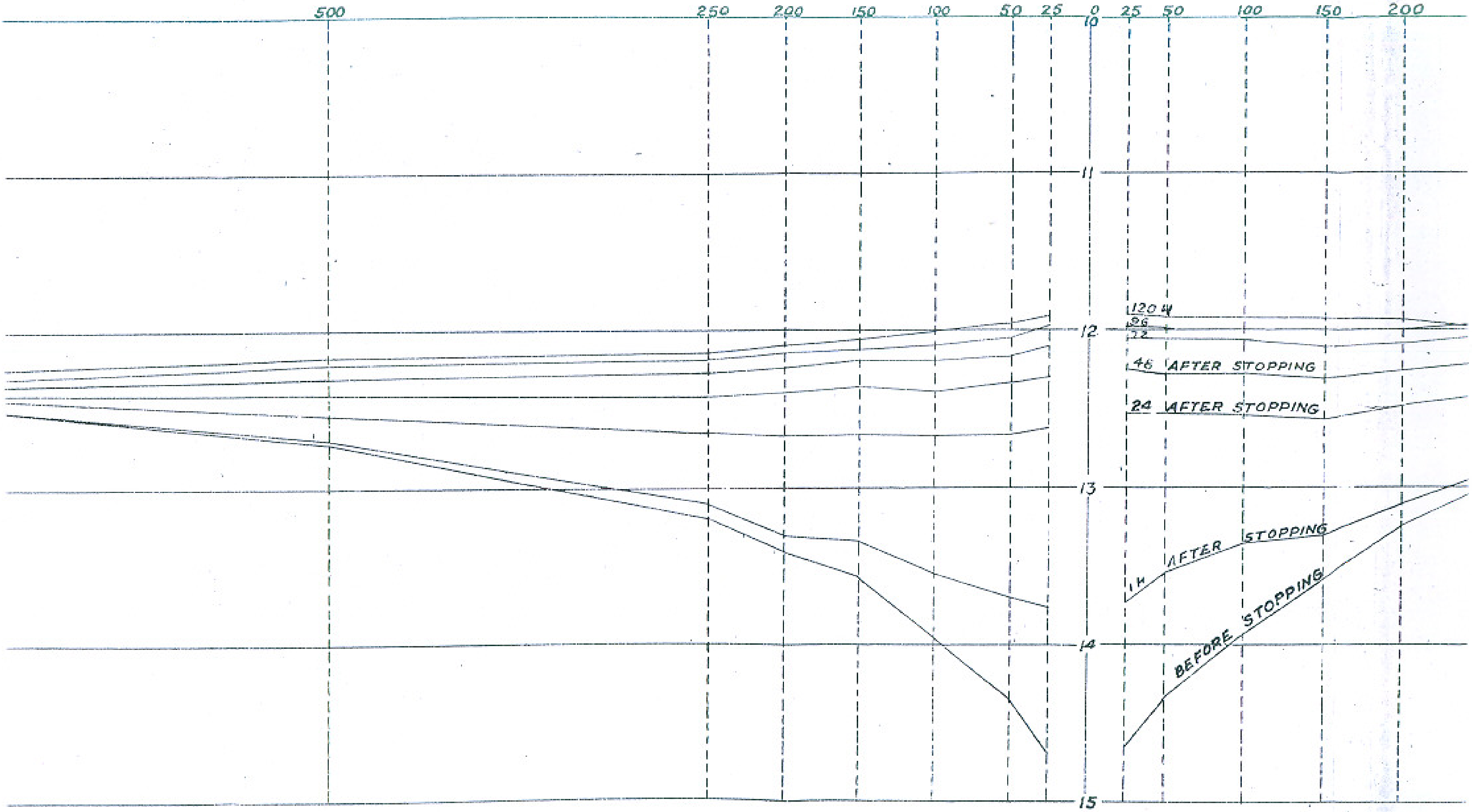
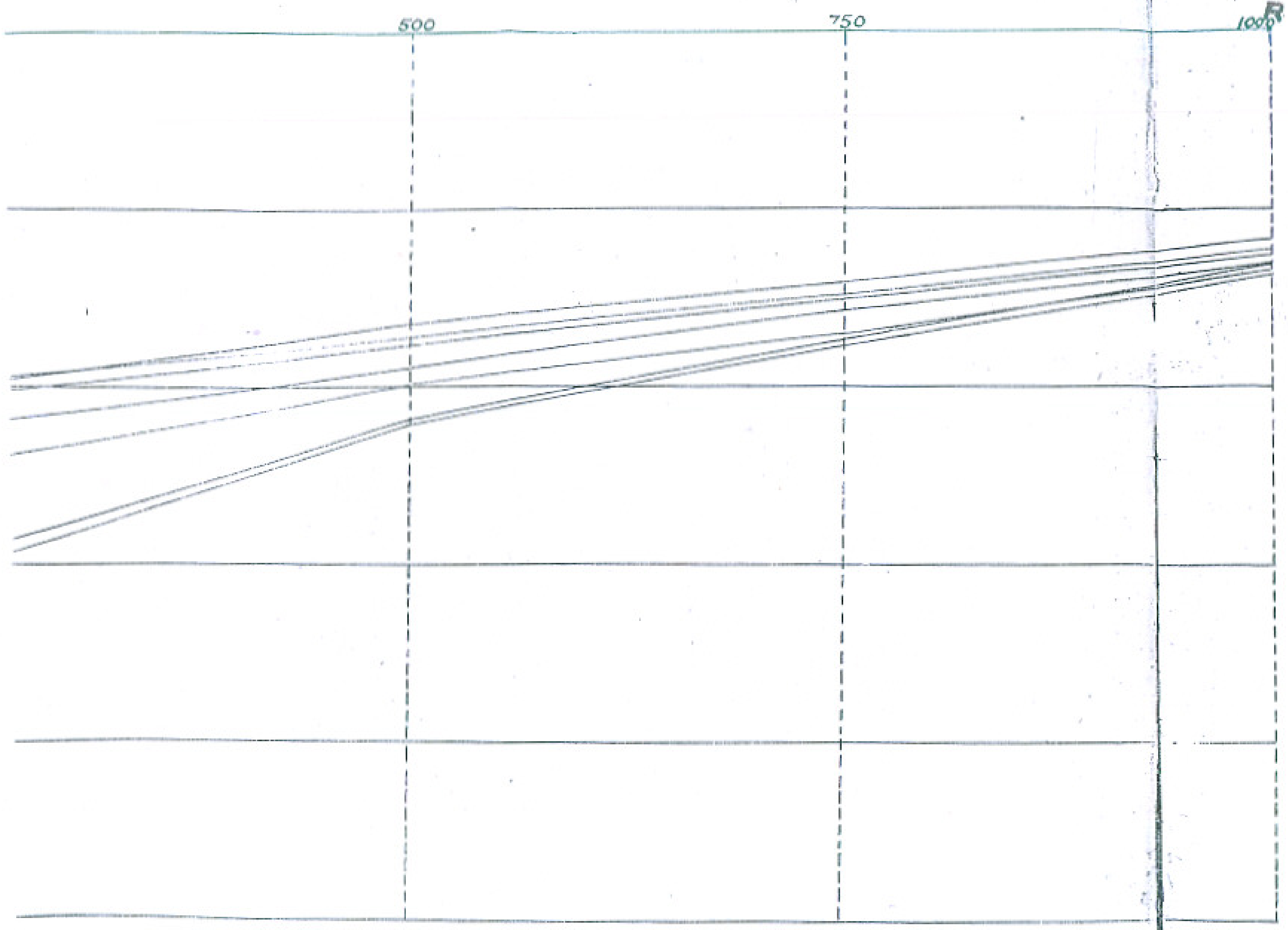


PLATE 10

PAPER NO. 248



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