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12 December 1942 DECLASSIFIED NRL Report No. B-1968

NAVY DEPARTMENT

Report of Test

on

Underwater Electric Log Equipment

Contract NOs-86224

Submitted by

Consolidated Instruments Corporation
Michigan City, Indiana

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D. C.

Number of Pages: Text- 11 Tables-8 Plates-12

Authorization: RDDM, So. Bend, Indiana, Advance Inspection Memo. of 19 August 1942.

Date of Test: September-November 1942.

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APPENDICES

AUTHORIZATION FOR TEST

1. This problem was authorized by reference (a) and other references pertinent to this problem are listed as references (b) to (o) inclusive.

References:
(a) RIMM, S. Bend, Indiana, Advance Inspection Memo. dated 19 August 1942.
(b) Specification SGS (65)-151a of 1 February 1937.
(c) Contract NOs.-86224.
(d) NACA Report on Calibration of a Consolidated Log Rodmeter of February 7, 1942.
(e) NACA Report on Calibration of a Consolidated Log Rodmeter with Revised Form of Tip of August 6, 1942.

Consolidated Plan No.	Title
(f) Plan No. N-4-6	Master-Transmitter
(g) Plan No. N-4-7A	Speed-Repeater
(h) Plan No. N-4-7B	Speed and Distance Repeater
(i) Plan No. N-4-5	Differential Unit
(j) Plan No. N-4-9	Underwater Log Assembly
(k) Plan No. N-4-1	Rodmeter
(l) Plan No. N-2-2	Hull Flange
(m) Plan No. N-2-3	Sea Valve Parts
(n) Plan No. N-2-4	Sea Valve
(o) Plan No. N-4-8	Wiring Diagram

OBJECT OF TEST

2. The object of this test was to determine conformance of the electric log equipment with specification, reference (b), and contract, reference (c).

ABSTRACT OF TEST

3. The log equipment was set up at this Laboratory in conjunction with suitable test apparatus, and its performance was carefully observed for compliance with specification, reference (b), and contract, reference (c). Following an initial accuracy test, tests were conducted to determine the effect of inclination, variation in supply of voltage and frequency, endurance, and shock. An inspection of the sample, to determine compliance in the matter of materials, design, and workmanship, concluded the test.

CONCLUSIONS

(a) This Underwater Log System, manufactured and submitted by the Consolidated Instruments Corporation, failed to comply with specification, reference (b), and contract, reference (c), in the following respects:

(1) As shown by Table 1, Plate 6, the initial accuracy of indicated knots did not comply with the specification. The errors in recorded miles exceeded the specified tolerance and were negative.
(2) Inclining the instruments gave no material changes in the degree of accuracy from that at normal plane. See Tables 2, 3, 4, 5, and Plates 7, 8, 9 and 10.
(3) Test with supply of 108 volts - 55 cycles - produced no significant change in indicated knots. See Table 6, Plate 11. Supply of 122 volts, 65 cycles produced a significant change in its degree of accuracy. See Table 7, Plate 12. However, for either accelerating and decelerating speeds, at times the relays would lock, causing the follow-up motor to swing the pointer up to 40 knots or back to zero, before returning to approximately the speed indicated on the test manometer. Sometimes the follow-up motor would swing the pointer past zero to minus 3 knots.
(4) After the shock test, the Master-Transmitter failed to give an indication of speed below 23 knots. The highest indicated speed was 15.45 knots, for test manometer setting of 40 knots. See Table 8. There was no other observed damage to the Master-Transmitter.

(b) The following comments are the results of an examination of the equipment to determine any defects and to ascertain what changes would be desirable.

MASTER-TRANSMITTER

(1) The chassis has no handles to assist in its removal and replacement or extending dowels to rest it on when it is removed.
(2) There is no jack and plug assembly which would allow removal of the chassis without disconnecting wires.

CONCLUSIONS (Continued)

(3) There are sections of the chassis which are inaccessible for checking, lubricating, or adjusting.
(4) No method is provided to drain and prevent flooding of the master-transmitter case, in the event that the diaphragm chamber should leak or the diaphragm seal fail.
(5) The hydraulic diaphragm chamber was not provided with vents when the equipment was received. Two, one for each side of the chamber, were installed by the manufacturer's engineer, but neither of these enabled the seal part of the chamber to be drained.
(6) Setting the master to a new rodmeter constant required the incorporation of two new cams (accelerating cam and decelerating cam), which were cut on an empirical basis at the Laboratory. It is understood that the use of two cams is necessary, due to certain characteristics of the Neoprene-fabric diaphragm.
(7) The master unit could be greatly simplified by rearrangement of the component parts. For example, a very large girder type member is used to link together two small gear racks and actuate two small limit switches.
(8) The noise produced by operation of the master unit is excessive.

SPEED AND DISTANCE REPEATER

(9) The chassis has no aligning dowels to assist in its replacement in the case or extending dowels to rest it on when it is removed.
(10) The chassis is difficult to remove, due to jumpers between the dial lighting sockets.
(11) Much difficulty was experienced in replacing the bolts which hold the chassis in the case.
(12) The dial lighting did not conform to paragraph E-11b of specification, reference (c). In addition, the dial lighting lamps are supplied with 6.5 volts with 115 volts to primary of the lighting transformer. For longer lamp life, it has been the practice to keep the voltage to 6 volts or less.

CONCLUSIONS (Continued)

SPEED REPEATER

(13) The chassis has no dowels to assist in its replacement in the case or extending dowels to rest it on when it is removed. Difficulty was experienced in replacing the bolts which hold the chassis to the case.

GENERAL

(14) None of the instruments has handles extending from its chassis.
(15) Some indication of rust appears in the Master-Transmitter and the Speed and Distance Repeater.
(16) There are many instances of unsatisfactory electrical practice in the several units. For example, no terminal blocks are provided for the repeater units, radio type connector plugs being used instead. The terminal blocks of the master unit are of a type requiring both incoming and outgoing leads to be soldered to the connector strip.
(17) The equipment fails to meet the usual standards of workmanship in many instances. Examples of this are the failure to provide for proper alignment or engagement of such parts as gears. The noisy operation of the Master-Transmitter is attributed largely to this.
(18) The master unit appears to have been altered at several points, and, as a result, several of the modified parts are not as rugged as they could have been, had they been contemplated in the original design.

RECOMMENDATIONS

(a) In view of the unsatisfactory operation, and of the deficiencies noted under "Conclusions", it is recommended that the subject equipment be NOT approved for Naval use in its present form.

DESCRIPTION OF MATERIAL UNDER TEST

4. The equipment submitted for test was a 40-knot Electric Log consisting of units as follows:

One Master-Transmitter
One Speed and Distance Repeater
One Speed Repeater
One Bleed-off Chamber Assembly

5. The Master Transmitter indicates and transmits ships speed in knots and distance in nautical miles. It is covered by drawings, references (f), (i), (j), and (o), and is shown by photographs, Plates 1, 2, and 3.

6. The Speed and Distance Repeater is equipped with a reflected light type of dial pointer illumination. Type "L" Synchro-motors are used to position the pointer and drive the odometer. This instrument is covered by drawings, references (h), (j), and (o), and Photographs, Plates 1, 2, and 4.

7. The Speed Repeater is equipped with a type "M" synchro-motor to position the pointer. This instrument is covered by drawing, references (g), (j), and (o), and Photographs, Plates 1, 2, and 5.

Principles of Underwater Log System (As described by the manufacturer)

8. The Consolidated N-4 Electric Log System is of the pilot tube, differential diaphragm type, consisting of a rodmeter, hull fitting, master-transmitter, speed and distance repeater, and speed repeater. The resistance of the water to the passage of the rodmeter through it creates a pressure at the forward surface of the rodmeter. The static pressure of the water, due to depth, is measured by two slots in the forward side of the rodmeter. These two pressures or the difference between them are measureable by means of openings in the forward surfaces of the rodmeter, connecting with tubing inside the ship by means of passages in the rodmeter.

9. The sea water is carried through the tubing inside the ship directly to the diaphragm chamber in the master-transmitter. The two different pressures, created by the passage of the rodmeter through the water, are transmitted by means of hydraulic columns (the water in the passages and tubing) directly to the main diaphragm, which divides the diaphragm chamber into two portions.

DESCRIPTION OF MATERIAL UNDER TEST

Principles of the Underwater Log System (Cont'd.)

10. This main diaphragm will be under equal pressure on both sides when the ship is at rest, due to the depth of the master-transmitter in the water. This is the static pressure which will change with different loadings of the ship. This static pressure is also present when the ship is under way and is constantly changing, due to the motion of the ship in waves. But since the static pressure always affects both sides of the main diaphragm, it always cancels out and so has no tendency to move the main diaphragm.

11. When the ship is under way, the pressure, caused by the resistance of the water to the passage of the rodmeter through it, is also transmitted to the pressure side of the main diaphragm. The main diaphragm, when the ship is under way, is therefore subject to two sets of pressure, the static pressures cancel out. The total difference in pressures between the dynamic pressure of the forward opening plus static pressure, and the static pressure of the slot openings, will act upon the diaphragm and create a force, tending to move the diaphragm in the direction of the static pressure. This force, acting on the diaphragm, varies with the speed of the ship and it is the measurement of the variations of this force that is used to indicate the speed and the distance traversed.

12. The spring tension arrangement is adjusted (calibrated) so that the force acting on the main diaphragm will be balanced by the spring tension when the diaphragm has moved an equal distance for each knot increase in speed. Whenever the ship gets under way, the increasing resistance of the water to the passage of the rodmeter through it, will cause the forces acting on the diaphragm to move the pressure arm until the ship reaches a constant speed, at which time the force acting on the diaphragm and the spring tension on the pressure arm will balance each other as described above.

13. The diaphragm is made of neoprene, with inserted fabric, and this material has a slight resistance to any change of shape when the speed is decreasing. A simple adjustment is provided in the mechanism (see service instructions) to compensate for this effect.

14. The pressure arm extends through a flexible watertight seal diaphragm to the outside of the diaphragm chamber, where it is pivoted. One part of the pressure arm outside of the chamber, is connected to the spring tension mechanism and another part of the pressure arm operates two switches which control the linear drive motor through two interlocking relays. The two switches are arranged on opposite sides of the

DESCRIPTION OF MATERIAL UNDER TEST

Principles of the Underwater Log System (Continued)

operating portion of the pressure arm in such a fashion that a very small movement of the pressure arm in either direction will close the contacts of one or the other switches, causing the linear drive motor to rotate in corresponding directions. The housing (or switch box), to which the switches are fastened, is at one end of an arm, independently pivoted on the same shafts as the pressure arm. The other end of the housing arm, held by spring tension against a cam on the shaft, is geared by rack and pinion to the linear drive plate. As the ship picks up speed, the end of the pressure arm moves and closes the contacts on one switch (the lower side), starting the linear drive motor. This motor, through gearing, moves the linear drive plate upward, moving the cam on the driving shaft and the opposite end of the arm (on which the switch is located) with the linear drive plate. This movement continues until the switch has moved downward to line up with the pressure arm, at which point the contacts open and the current is cut off to the linear drive motor. For every change in speed of the ship, this process is repeated or reversed, so that each movement of the pressure arm operates one or the other switch and causes the linear drive motor to move the linear drive plate and to bring the switch arm in alignment with the pressure arm.

15. At the top of the linear drive plate is a rack which engages a gear directly connected to the shaft of the speed indicating generator. An extension of the speed generator shaft extends through the speed dial, carrying a pointer on its outer end. This indicates the speed in knots at the master-transmitter and the generator furnishes power for the indicating motors of the various repeaters.

16. The integrating mechanism is that part of the master-transmitter whose function it is to convert the movements of the linear drive plate into distance traversed. This is accomplished by means of a roller driven by friction discs. Two constant speed synchronous motors are placed in opposing positions with friction drive discs fastened directly to their shafts. A spring is placed between the motors and the friction discs, keeping the discs pressed against the friction driven roller and two idler rollers from opposing sides. The friction driven roller is designed to be moved across the face of the friction discs by the linear drive plate, so that when the ship is at rest, the roller is in the center of the discs and does not rotate. When the ship picks up speed, the roller is moved out away from the center of the discs by the movement of the linear drive plate to rotate faster and faster as it contacts larger circles on the friction discs. When the ship slows down, the roller moves in. The size of the roller is designed to turn 360 revolutions per nautical mile.

DESCRIPTION OF MATERIAL UNDER TEST

Principles of the Underwater Log System (Continued)

17. The driven roller moves along a squared shaft, which rotates with it. The distance transmitting generator is driven by miter gears from this shaft and so furnishes a continuously rotating electrical output of 360 revolutions per knot. The outer end of the roller shaft drives a cross shaft which, in turn, drives a reset counter in the combination repeater, read in hundredths of miles on the right hand figures of the count.

18. The Combination Repeater consists of an indicating motor, with a shaft extension carrying a pointer through the dial, connected with the speed indicating generator. A separate indicating motor, connected to the distance indicating generator, drives the mileage counter through a pair of miter gears. This repeater is furnished with dial illumination from three bulbs. The current for the bulbs comes from a transformer through a rheostat.

19. The Speed Repeater consists of a single indicating motor with a pointer fixed directly to its shaft and a dial fastened to its end housing.

METHOD OF TEST

20. The subject equipment was set up at this Laboratory in conjunction with suitable testing equipment and given a brief preliminary test. As no information was given as to the rodmeter constant used by the manufacturer in designing and calibrating the Master-Transmitter, and the performance was unsatisfactory when the master unit was tested in conjunction with any available manometer scale, the manufacturer was requested to send his engineer to the Laboratory.

21. Following the receipt of test report, reference (e), covering supplementary tests on the rodmeter designed for this equipment, a conference was held between representatives of the manufacturer, the Bureau, and the Laboratory. It was decided to make no attempt to recalibrate the master instrument on the basis of the tow test data, as the rodmeter coefficient was a variable beyond the range of the compensating cams of the instrument. Instead, the master transmitter was calibrated by the manufacturer's engineer against the manometers in the test equipment. These had scales giving equivalent speed in knots for a rodmeter coefficient of 0.957, calculated for fresh water (sp. gr. $\approx$ 1.0). The water manometer (with static head of approximately 2 feet) was used for speeds up to 8 knots. The mercury manometer (with static head of approximately 10 feet) was used for speeds between 9 to 40 knots. The equipment was supplied with power at rated voltage and frequency.

METHOD OF TEST (Continued)

22. In making all accuracy tests, it was necessary to make a complete test accelerating and then a duplicate test decelerating, in order to get consistent readings. The pointer on the master unit would accelerate or decelerate in pulsating stages (usually from .2 to .6 of a knot for each stage), making it difficult to duplicate readings. Speed and distance indications were recorded concurrently.

23. Following this, the equipment was tested for accuracy while inclined 45 degrees in each direction. The accuracy was also checked with the equipment in the normal plane and with the supply varied ± 7 volts and ± 5 cycles. The supply to the synchronous motors was varied in voltage only as the effect of a frequency variation in the supply to a synchronous motor is well known.

24. The instrument received credit for 160 hours of endurance, which was the time required to conduct the accuracy tests.

25. After this endurance test, the equipment was subjected to the specified shock test on a standard Navy type 250-ft. pound shock machine. Each unit was shocked separately and was operating at the time. An accuracy test was taken and it was found that the instrument was damaged to the extent that a 23 knot differential on the manometer was required to cause the Master-Transmitter to show any indication of speed. Therefore, no further tests were conducted.

RESULTS OF TESTS

26. The results of the tests, conducted as described under "Method of Test", follow:

Requirements	Test Values
Supply: Shall be designed to operate from a 115 volt, 60 cycle power source, having operating tolerances of ± 7 volts and ± 5 cycles.	Supplied with power from a 115 volt, 60 cycle controlled-frequency source, except for special tests.
Power requirement of equipment: (Not specified).	Watts-121 Amps. -2.32 P.F. -0.45 For Steady Speed Watts-143 Amps. -3.68 P.F. -0.34 For changing speed.

RESULTS OF TEST (Continued)

Requirements	Test Values
Accuracy: Errors in indicated speed or recorded miles shall never exceed the following: 6 percent at 4 knots 4 percent at 6 knots 3 percent at 9 knots 2 percent at 16 knots 1 percent at 20 knots or over	
(a) At start of test	*Knots and miles unsatisfactory. See Table 1 and Plate 6.
(b) Inclined 45° Forward	*Knots and miles unsatisfactory. See Plate 2 and Plate 7.
(c) Inclined 45° Backward	*Knots and miles unsatisfactory. See Table 3 and Plate 8.
(d) Inclined 45° Right	*Knots and miles unsatisfactory. See Table 4 and Plate 9.
(e) Inclined 45° Left	*Knots and miles unsatisfactory. See Table 5 and Plate 10.
(f) With Supply 108 volts- 55 cycles	*Knots and miles unsatisfactory. See Table 6 and Plate 11.
(g) With supply 122 volts- 65 cycles	*Knots and miles unsatisfactory. See Table 7 and Plate 12.
(h) Accuracy following shock	*Knots unsatisfactory. See Table 8.
Dielectric and insulation tests: An alternating potential of 1500 volts, 60 cycles shall be applied between each terminal and ground for 1 minute. Following this, the insulation resistance at 500 volts shall be not less than 10 megohms.	Complied. Greater than 100 megohms. (500 volts, 60 cycles used for dielectric test on 6 volt lighting circuit.

RESULTS OF TEST (Continued)

Requirements	Test Values
Weight-Dimensions: Shall not exceed the following: Master-Transmitter-Height-90", Width-18", Depth-12".	Height-27", Width-17", Depth-9¼". Weight-150¼ lbs. (Not specified)
Speed and Distance Repeater Height-12", Width-12", Depth-8".	Height-11 3/4", Width-11 3/4", *Depth-9½". Weight-38¼". (Not specified)
Speed Repeater Height-12", Width-12", Depth-8".	Height-10½", Width-10", *Depth-8¼". Weight - 24 3/4 lbs. (Not specified)

*Denotes non-compliance with the specification.

CONCLUSIONS

27. This Underwater Log System, manufactured and submitted by the Consolidated Instruments Corporation, failed to comply with specification, reference (b), and contract, reference (c), in the following respects:

(1) As shown by Table 1, Plate 6, the initial accuracy of indicated knots did not comply with the specification. The errors in recorded miles exceeded the specified tolerance and were negative.
(2) Inclining the instruments gave no material changes in the degree of accuracy from that at normal plane. See Tables 2, 3, 4, 5, and Plates 7, 8, 9, and 10.
(3) Test with supply of 103 volts -- 55 cycles - produced no significant change in indicated knots. See Table 6, Plate 11. Supply of 122 volts, 65 cycles produced a significant change in its degree of accuracy. See Table 7, Plate 12. However, for either accelerating and decelerating speeds, at times the relays would lock, causing the follow-up motor to swing the pointer up to 40 knots or back to zero, before returning to approximately the speed indicated on the test manometer. Sometimes the follow-up motor would swing the pointer past zero to minus 3 knots.
(4) After the shock test, the Master-Transmitter failed to give an indication of speed below 23 knots. The highest indicated speed was 15.45 knots, for test manometer setting of 40 knots. See Table 8. There was no other observed damage to the Master-Transmitter.

28. The following comments are the results of an examination of the equipment to determine any defects and to ascertain what changes would be desirable.

MASTER TRANSMITTER

(1) The chassis has no handles to assist in its removal and replacement or extending dowels to rest it on when it is removed.
(2) There is no jack and plug assembly which would allow removal of the chassis without disconnecting wires.

CONCLUSIONS (Continued)

(3) There are sections of the chassis which are inaccessible for checking, lubricating, or adjusting.
(4) No method is provided to drain and prevent flooding of the master-transmitter case, in the event that the diaphragm chamber should leak or the diaphragm seal fail.
(5) The hydraulic diaphragm chamber was not provided with vents when the equipment was received. Two, one for each side of the chamber, were installed by the manufacturer's engineer, but neither of these enabled the seal part of the chamber to be drained.
(6) Setting the master to a new rodmeter constant required the incorporation of two new cams (accelerating cam and decelerating cam), which were cut on an empirical basis at the Laboratory. It is understood that the use of two cams is necessary, due to certain characteristics of the Neoprene-fabric diaphragm.
(7) The master unit could be greatly simplified by rearrangement of the component parts. For example, a very large girder type member is used to link together two small gear racks and actuate two small limit switches.
(8) The noise produced by operation of the master unit is excessive.

SPEED AND DISTANCE REPEATER

(9) The chassis has no aligning dowels to assist in its replacement in the case or extending dowels to rest it on when it is removed.
(10) The chassis is difficult to remove, due to jumpers between the dial lighting sockets.
(11) Much difficulty was experienced in replacing the bolts which hold the chassis in the case.
(12) The dial lighting did not conform to paragraph E-11b of specification, reference (c). In addition, the dial lighting lamps are supplied with 6.5 volts with 115 volts to primary of the lighting transformer. For longer lamp life, it has been the practice to keep the voltage to 6 volts or less.

CONCLUSIONS

SPEED REPEATER

(13) The chassis has no dowels to assist in its replacement in the case or extending dowels to rest it on when it is removed. Difficulty was experienced in replacing the bolts which hold the chassis to the case.

GENERAL

(14) None of the instruments has handles extending from its chassis.
(15) Some indication of rust appears in the Master-Transmitter and the Speed and Distance Repeater.
(16) There are many instances of unsatisfactory electrical practice in the several units. For example, no terminal blocks are provided for the repeater units, radio type connector plugs being used instead. The terminal blocks of the master unit are of a type requiring both incoming and outgoing leads to be soldered to the connector strip.
(17) The equipment fails to meet the usual standards of workmanship in many instances. Examples of this are the failure to provide for proper alignment or engagement of such parts as gears. The noisy operation of the Master-Transmitter is attributed largely to this.
(18) The master unit appears to have been altered at several points, and, as a result, several of the modified parts are not as rugged as they could have been, had they been contemplated in the original design.

TABLE 1

ACCURACY TEST OF UNDERWATER LOG

CONDUCTED BEFORE ALL OTHER TESTS

Supply 115 volts, 60 cycles
(Accelerating)

Manometer	Master Transmitter		Speed and Distance Repeater		Speed Repeater		Master Transmitter
Simulated	Indicated	Percent	Indicated	Percent	Indicated	Percent	Percent Error
Knots	Knots	Error	Knots	Error	Knots	Error	in Counted Miles.
0	0		0		0		
1	0	-100.0	0	-100.0	0	-100.0	-
2	0	-100.0	0	-100.0	0	-100.0	-
3	2.20	- 26.66	2.20	- 26.6	2.21	- 26.3	-29.63
4	3.59	- 10.25	3.60	- 10.0	3.60	- 10.0	- 8.55
5	4.55	- 9.0	4.59	- 8.2	4.60	- 8.0	- 6.61
6	5.03	- 16.16	5.02	- 16.33	5.08	-15.33	-15.33
8	7.22	- 9.75	7.22	- 9.75	7.27	- 9.12	- 7.94
9	8.57	- 4.77	8.55	- 5.0	8.60	- 4.4	- 3.77
16	15.80	- 1.25	15.80	- 1.25	15.80	- 1.25	- 0.5
20	20.02	+ 0.10	20.03	+ 0.15	20.13	+ 0.65	+ 1.05
25	24.77	- 0.92	24.77	- 0.92	24.79	- 0.84	- 0.31
30	29.70	- 1.0	29.69	- 1.03	29.63	- 1.23	- 0.88
35	35.00	0	35.00	0	35.01	+ 0.02	- 0.22
39	38.80	- 0.51	38.80	- 0.51	38.82	- 0.46	- 0.86
40	39.50	- 1.25	39.45	- 1.37	39.43	- 1.42	- 1.75

TABLE 1 (Continued)

ACCURACY TEST OF UNDERWATER LOG

CONDUCTED BEFORE ALL OTHER TESTS

Supply 115 volts, 60 cycles
(Decelerating)

Manometer	Master Transmitter		Speed and Distance Repeater		Speed Repeater		Master Transmitter
Simulated	Indicated	Percent	Indicated	Percent	Indicated	Percent	Percent Error
Knots	Knots	Error	Knots	Error	Knots	Error	in Counted Miles.
0	0		0		0		
1	0	-100.0	0	-100.0	0	-100.0	
2	0.90	- 55.0	0.99	- 50.5	1.01	- 49.5	-100.69
3	1.59	- 47.0	1.60	- 46.6	1.71	- 43.0	- 80.75
4	1.88	- 53.0	1.90	- 52.5	2.0	- 50.0	-101.5
5	2.21	- 55.8	2.28	- 54.4	2.40	- 52.0	-115.65
6	2.90	- 51.66	2.99	- 50.1	3.0	- 50.0	-101.83
8	5.70	- 28.75	5.72	- 28.5	5.79	- 27.6	- 37.69
9	7.75	- 13.88	7.80	- 13.3	7.90	- 12.2	- 14.41
16	14.68	- 8.25	14.76	- 7.75	14.80	- 7.5	- 8.16
20	19.20	- 4.0	19.20	- 4.0	19.28	- 3.6	- 3.5
25	24.12	- 3.52	24.20	- 3.2	24.20	- 3.2	- 3.11
30	29.12	- 2.93	29.20	- 2.66	29.23	- 2.56	- 2.97
35	34.22	- 2.23	34.38	- 1.77	34.40	- 1.71	- 2.38
39	38.70	- 0.77	38.78	- 0.56	38.80	- 0.51	- 1.14
40	40.10	+ 0.25	40.05	+ 0.12	40.15	+ 0.37	- 0.14

TABLE 2

ACCURACY TEST OF UNDERWATER LOG

CONDUCTED WITH ALL EQUIPMENT INCLINED 45° FORWARD

Supply-115 volts, 60 cycles
(Accelerating)

Manometer	Master Transmitter		Speed and Distance Repeater		Speed Repeater		Master Transmitter
Simulated	Indicated	Percent	Indicated	Percent	Indicated	Percent	Percent Error
Knots	Knots	Error	Knots	Error	Knots	Error	in Counted Miles.
0	0		0		0.20		
1	0	-100.0	0	-100.0	0.20	-80.0	
2	0	-100.0	0	-100.0	0.20	-90.0	
3	2.05	- 31.6	2.02	- 32.6	2.10	-30.0	-34.66
4	3.92	- 2.0	3.90	- 2.5	3.97	- 0.75	+ 2.69
5	4.50	- 10.0	4.53	- 9.4	4.60	- 8.0	- 5.88
6	5.40	- 10.0	5.41	- 9.83	5.47	- 8.83	- 6.56
8	7.80	- 2.50	7.82	- 2.25	7.90	- 1.25	+ 1.03
9	8.61	- 4.33	8.59	- 4.55	8.55	- 5.0	+ 1.68
16	15.83	- 1.06	15.70	- 1.87	15.60	- 2.5	+ 0.22
20	20.02	+ 0.10	19.99	- 0.05	19.90	- 0.50	+ 1.38
25	24.80	- 0.80	24.80	- 0.80	24.80	- 0.80	0
30	29.80	- 0.66	29.79	- 0.70	29.70	- 1.0	- 0.25
35	35.18	+ 0.51	35.10	+ 0.28	35.00	0	+ 0.47
39	38.87	- 0.33	38.90	- 0.25	38.98	- 0.05	- 0.44
40	39.52	- 1.20	39.50	- 1.25	39.53	- 1.17	- 1.4

TABLE 2 (Continued)

ACCURACY TEST OF UNDERWATER LOG

CONDUCTED WITH ALL EQUIPMENT INCLINED 45° FORWARD

Supply-115 volts, 60 cycles
(Decelerating)

Manometer	Master Transmitter		Speed and Distance Repeater		Speed Repeater		Master Transmitter
Simulated Knots	Indicated Knots	Percent Error	Indicated Knots	Percent Error	Indicated Knots	Percent Error	Percent Error in Counted Miles
0	- 0.15		- 0.18		-0.15		
1	- 0.15	-115.0	- 0.18	-118.0	-0.15	-115.0	
2	0.53	- 73.5	0.60	- 70.0	0.78	- 61.0	-191.4
3	1.99	- 33.66	2.02	- 32.6	2.20	-26.6	-42.27
4	2.30	- 42.50	2.40	-40.0	2.55	-36.2	-92.3
5	3.00	- 40.0	3.11	-37.8	3.21	-35.8	-61.11
6	3.20	- 46.66	3.30	-45.0	3.42	-43.0	-80.55
8	5.70	- 28.75	5.75	-28.1	5.80	-27.5	-36.5
9	7.90	- 12.2	7.97	-11.4	8.0	-11.1	-10.5
16	14.85	- 7.18	14.85	- 7.18	14.92	- 6.75	- 6.19
20	19.25	- 3.75	19.20	- 4.0	19.22	-3.90	- 2.83
25	24.20	- 3.2	24.25	- 3.0	24.40	- 2.4	- 2.61
30	29.01	- 3.3	29.00	- 3.33	29.01	- 3.3	- 3.08
35	34.08	- 2.62	34.13	- 2.48	34.17	- 2.37	- 2.61
39	38.42	- 1.48	38.42	- 1.48	38.42	- 1.48	- 1.58
40	39.95	- 0.13	39.93	- 0.17	40.0	0	- 0.55

TABLE 3

ACCURACY TEST OF UNDERWATER LOG

CONDUCTED WITH ALL EQUIPMENT INCLINED 45° BACKWARD

Supply-115 volts, 60 cycles

(Accelerating)

Manometer	Master Transmitter		Speed and Distance Repeater		Speed Repeater		Master Transmitter
Simulated	Indicated	Percent	Indicated	Percent	Indicated	Percent	Percent Error
Knots	Knots	Error	Knots	Error	Knots	Error	in Counted Miles.
0	0		0.07		0.17		
1	0	-100.0	0.07	-93.0	0.17	-83.0	
2	0	-100.0	0.07	-96.5	0.17	-91.5	
3	2.21	- 26.33	2.20	-26.6	2.20	-26.6	-31.33
4	3.60	- 10.0	3.60	-10.0	3.60	-10.0	- 9.72
5	4.45	- 11.0	4.42	-11.6	4.42	-11.6	- 9.97
6	5.38	- 10.33	5.38	-10.3	5.38	-10.3	-10.47
8	7.40	- 7.50	7.40	- 7.5	7.40	- 7.5	- 6.61
9	9.12	+ 1.33	9.05	+ 0.55	9.10	+ 1.11	+ 2.30
16	16.02	+ 0.12	15.99	- 0.06	15.99	- 0.06	+ 0.72
20	20.23	+ 1.15	20.20	+ 1.0	20.20	+ 1.0	+ 1.88
25	25.01	+ 0.04	25.00	0	25.00	0	+ 0.77
30	30.03	+ 0.10	30.07	+ 0.23	30.05	+ 0.16	+ 0.27
35	35.30	+ 0.85	35.27	+ 0.77	35.22	+ 0.62	+ 0.44
39	38.98	- 0.05	38.98	- 0.05	38.97	- 0.07	- 0.47
40	39.68	- 0.80	39.65	- 0.87	39.68	- 0.80	- 1.38

TABLE 3 (Continued)

ACCURACY TEST OF UNDERWATER LOG

CONDUCTED WITH ALL EQUIPMENT INCLINED 45° BACKWARD

Supply-115 volts, 60 cycles
(Decelerating)

Manometer	Master Transmitter		Speed and Distance Repeater		Speed Repeater		Master Transmitter
Simulated	Indicated	Percent	Indicated	Percent	Indicated	Percent	Percent Error
Knots	Knots	Error	Knots	Error	Knots	Error	in Counted Miles
0	0.01		0.15		0.20		
1	0.07	-93.0	0.15	-85.0	0.20	-80.0	
2	0.75	-62.50	0.80	-60.0	0.81	-59.5	-164.16
3	2.22	-26.0	2.28	-24.0	2.40	-20.0	- 33.05
4	2.60	-35.0	2.62	-34.5	2.72	-32.0	- 54.11
5	2.90	-42.0	2.95	-41.0	3.00	-40.0	- 73.61
6	3.62	-39.66	3.70	-38.3	3.80	-36.6	- 63.41
8	6.27	-21.62	6.39	-20.1	6.42	-19.7	- 26.48
9	7.60	-15.55	7.72	-14.2	7.80	-13.3	- 17.02
16	14.78	- 7.62	14.80	- 7.50	14.88	- 7.0	- 7.77
20	19.22	- 3.90	19.22	- 3.90	19.38	- 3.1	- 3.44
25	23.82	- 4.72	23.85	- 4.6	23.90	- 4.4	- 4.38
30	29.35	- 2.16	29.40	- 2.0	29.42	- 1.93	- 2.11
35	34.20	- 2.28	34.32	- 1.94	34.39	- 1.74	- 2.66
39	38.70	- 0.76	38.79	- 0.53	38.80	- 0.51	- 1.25
40	40.05	+ 0.12	40.05	+ 0.12	40.12	+ 0.3	- 0.38

TABLE 4

ACCURACY TEST OF UNDERWATER LOG

CONDUCTED WITH ALL EQUIPMENT INCLINED 45° RIGHT

Supply 115 volts, 60 cycles
(Accelerating)

Manometer	Master Transmitter		Speed and Distance Repeater		Speed Repeater		Master Transmitter
Simulated	Indicated	Percent	Indicated	Percent	Indicated	Percent	Percent Error
Knots	Knots	Error	Knots	Error	Knots	Error	in Counted Miles
0	0		0.02		0.18		
1	0	-100.0	0.02	-98.0	0.18	-82.0	
2	0	-100.0	0.02	-99.0	0.18	-91.0	
3	2.19	- 27.0	2.10	-30.0	2.07	-31.0	-34.72
4	3.88	- 3.0	3.82	- 4.5	3.82	- 4.5	- 0.31
5	4.60	- 8.0	4.60	- 8.0	4.68	- 6.4	- 6.08
6	5.35	- 10.83	5.39	-10.16	5.40	-10.0	-10.13
8	7.38	- 7.75	7.40	- 7.5	7.40	- 7.5	- 6.80
9	8.80	- 2.22	8.79	- 2.33	8.78	- 2.44	- 1.08
16	16.08	+ 0.50	16.01	+ 0.06	16.01	+ 0.06	+ 1.16
20	20.0	0	19.98	- 0.10	19.98	- 0.10	+ 0.72
25	24.80	- 0.80	24.80	- 0.80	24.79	- 0.84	- 0.02
30	30.03	+ 0.10	30.08	+ 0.26	30.07	+ 0.23	+ 0.41
35	34.90	- 0.28	34.98	- 0.05	35.00	0	- 0.16
39	38.90	- 0.25	38.85	- 0.38	38.81	- 0.48	- 0.63
40	39.45	- 1.37	39.40	- 1.50	39.40	- 1.50	- 1.80

TABLE 4 (Continued)

ACCURACY TEST OF UNDERWATER LOG

CONDUCTED WITH ALL EQUIPMENT INCLINED 45° RIGHT

Supply 115 volts, 60 cycles
(Decelerating)

Manometer	Master Transmitter		Speed and Distance Repeater		Speed Repeater		Master Transmitter
Simulated Knots	Indicated Knots	Percent Error	Indicated Knots	Percent Error	Indicated Knots	Percent Error	Percent Error in Counted Miles
0	0		0.05		0.17		
1	0	-100.0	0.05	-95.0	0.17	-83.0	
2	0.73	- 63.5	0.75	-62.5	0.79	-60.5	-149.63
3	2.10	- 30.0	2.13	-29.0	2.20	-26.6	- 38.27
4	2.53	- 36.7	2.58	-35.5	2.60	-35.0	- 56.16
5	2.70	- 46.0	2.80	-44.0	2.92	-41.6	- 81.55
6	3.62	- 39.66	3.73	-37.83	3.80	-36.66	- 62.13
8	5.80	- 27.5	5.85	-26.9	5.99	-25.1	- 35.72
9	7.40	- 17.7	7.50	-16.6	7.60	-15.5	- 19.69
16	14.30	- 10.6	14.39	-10.06	14.41	- 9.93	- 11.22
20	18.80	- 6.0	18.80	- 6.0	18.87	- 5.65	- 6.05
25	24.20	- 3.2	24.27	- 2.92	24.33	- 2.48	- 2.5
30	29.35	- 2.16	29.41	- 1.96	29.47	- 1.76	- 1.97
35	34.20	- 2.28	34.20	- 2.28	34.21	- 2.26	- 2.69
39	38.43	- 1.46	38.47	- 1.35	38.50	- 1.28	- 1.66
40	39.90	- 0.25	39.97	- 0.07	40.00	0	- 0.55

TABLE 5

ACCURACY TEST OF UNDERWATER LOG

CONDUCTED WITH ALL EQUIPMENT INCLINED 45° LEFT

Supply 115 volts, 60 cycles
(Accelerating)

Manometer	Master Transmitter		Speed and Distance Repeater		Speed Repeater		Master Transmitter
Simulated Knots	Indicated Knots	Percent Error	Indicated Knots	Percent Error	Indicated Knots	Percent Error	Percent Error in Counted Miles
0	-0.08		0		0.01		
1	-0.08	-108.0	0	-100.0	0.01	-99.0	
2	-0.08	-104.0	0	-100.0	0.01	-99.5	
3	2.39	- 20.33	2.40	- 20.0	2.40	-20.0	-20.52
4	4.13	+ 3.25	4.05	+ 1.25	4.10	+ 2.50	+ 5.77
5	5.15	+ 3.0	5.12	+ 2.40	5.12	+ 2.40	+ 4.80
6	5.99	- 0.16	5.99	- 0.16	5.99	- 0.16	+ 1.52
8	8.05	+ 0.62	8.02	+ 0.25	8.05	+ 0.62	+ 2.47
9	9.25	+ 2.77	9.20	+ 2.22	9.20	+ 2.22	+ 4.5
16	16.30	+ 1.87	16.21	+ 1.31	16.20	+ 1.25	+ 2.58
20	20.21	+ 1.05	20.20	+ 1.0	20.19	+ 0.95	+ 2.11
25	25.00	0	25.00	0	24.99	- 0.04	+ 0.8
30	30.00	0	30.0	0	30.0	0.	0
35	35.20	+ 0.57	35.20	+ 0.57	35.20	+ 0.57	+ 0.25
39	38.95	- 0.12	38.93	- 0.17	38.90	- 0.25	- 0.47
40	39.59	- 1.02	39.59	- 1.02	39.59	- 1.02	- 1.63

TABLE 5 (Continued)

ACCURACY TEST OF UNDERWATER LOG

CONDUCTED WITH ALL EQUIPMENT INCLINED 45° LEFT

Supply 115 volts, 60 cycles
(Decelerating)

Manometer	Master Transmitter		Speed and Distance Repeater		Speed Repeater		Master Transmitter
Simulated Knots	Indicated Knots	Percent Error	Indicated Knots	Percent Error	Indicated Knots	Percent Error	Percent Error in Counted Miles
0	0		0		+0.10		
1	0	-100.0	0	-100.0	+0.10	-90.0	
2	1.05	- 47.5	1.13	- 43.5	1.20	-40.0	-71.5
3	2.18	- 27.3	2.20	- 26.6	2.20	-26.6	-33.75
4	2.60	- 35.0	2.68	- 33.0	2.80	-30.0	-49.02
5	3.0	- 40.0	3.10	- 38.0	3.20	-36.0	-62.22
6	4.00	- 33.3	4.05	- 32.5	4.20	-30.0	-45.69
8	6.37	- 20.37	6.40	- 20.0	6.50	-18.75	-24.05
9	8.00	- 11.1	8.05	- 10.5	8.19	- 9.0	-10.86
16	14.81	- 7.43	14.90	- 6.87	15.00	- 6.25	- 6.94
20	19.22	- 3.90	19.22	- 3.9	19.30	- 3.5	- 3.05
25	24.10	- 3.60	24.20	- 3.20	24.20	- 3.20	- 2.94
30	29.19	- 2.70	29.27	- 2.43	29.39	- 2.03	- 2.63
35	34.19	- 2.31	34.25	- 2.14	34.39	- 1.74	- 2.8
39	38.55	- 1.15	38.60	- 1.02	38.60	- 1.02	- 1.61
40	40.0	0	40.0	0	40.0	0	- 0.52

TABLE 6

ACCURACY TEST OF UNDERWATER LOG

CONDUCTED WITH SUPPLY OF 108 VOLTS, 55 CYCLES .

(Supply to synchronous motors–
108 volts, 60 cycles.)
(Accelerating)

Manometer	Master Transmitter		Speed and Distance Repeater		Speed Repeater		Master Transmitter
Simulated Knots	Indicated Knots	Percent Error	Indicated Knots	Percent Error	Indicated Knots	Percent Error	Percent Error in Counted Miles
0	0		0		0		
1	0	-100.0	0	-100.0	0	-100.0	
2	0	-100.0	0	-100.0	0	-100.0	
3	2.30	- 23.3	2.33	- 22.3	2.23	- 25.6	-24.83
4	3.62	- 9.5	3.65	- 8.75	3.60	- 10.0	- 7.36
5	4.65	- 7.0	4.70	- 6.0	4.62	- 7.6	- 4.44
6	5.55	- 7.50	5.59	- 6.83	5.50	- 8.33	- 6.05
8	7.45	- 6.87	7.52	- 6.0	7.45	- 6.87	- 4.86
9	8.80	- 2.22	8.81	- 2.11	8.80	- 2.22	- 0.88
16	15.80	- 1.25	15.80	- 1.25	15.80	- 1.25	- 0.5
20	20.0	0	20.0	0	20.0	0	+ 0.97
25	25.08	+ 0.32	25.05	+ 0.20	25.00	0	+ 1.0
30	29.80	- 0.66	29.80	- 0.66	29.70	- 1.0	- 0.41
35	35.20	+ 0.57	35.20	+ 0.57	35.19	+ 0.54	+ 0.25
39	38.90	- 0.25	38.90	- 0.25	38.79	- 0.53	- 0.55
40	39.59	- 1.02	39.60	- 1.0	39.50	- 1.25	- 1.5

TABLE 7
ACCURACY TEST OF UNDERWATER LOG

CONDUCTED WITH SUPPLY OF 122 VOLTS, 65 CYCLES

(Supply to synchronous motors-
122 volts, 60 cycles.)
(Accelerating)

Manometer	Master Transmitter		Speed and Distance Repeater		Speed Repeater		Master Transmitter
Simulated Knots	Indicated Knots	Percent Error	Indicated Knots	Percent Error	Indicated Knots	Percent Error	Percent Error in Counted Miles
0	0		0		0		
1	0	-100.0	0	-100.0	0	-100.0	
2	0	-100.0	0	-100.0	0	-100.0	
3	0	-100.0	0	-100.0	0	-100.0	
4	0.25	- 93.75	0.30	- 92.50	0.20	- 95.0	
5	4.85	- 3.0	4.90	- 2.0	4.80	- 4.0	+1.19
6	5.79	- 3.5	5.80	- 3.33	5.78	- 3.66	-0.02
8	7.68	- 4.0	7.78	- 2.75	7.70	- 3.75	-0.83
9	8.79	- 2.33	8.80	- 2.22	8.68	- 3.55	-0.38
16	15.90	- 0.62	15.90	- 0.62	15.80	- 1.25	+0.55
20	19.90	- 0.50	19.85	- 0.75	19.80	- 1.0	+0.63
25	24.90	- 0.40	24.85	- 0.60	24.80	- 0.80	+0.47
30	29.80	- 0.66	29.80	- 0.66	29.75	- 0.83	-0.38
35	34.77	- 0.65	34.80	- 0.57	34.70	- 0.85	-0.69
39	38.60	- 1.02	38.60	- 1.02	38.42	- 1.48	-1.22
40	39.32	- 1.70	39.30	- 1.75	39.20	- 2.0	-1.88

TABLE 7 (Continued)

ACCURACY TEST OF UNDERWATER LOG

CONDUCTED WITH SUPPLY OF 122 VOLTS, 65 CYCLES

(Supply to synchronous motors–
122 volts, 60 cycles)
(Decelerating)

Manometer	Master Transmitter		Speed and Distance Repeater		Speed Repeater		Master Transmitter
Simulated Knots	Indicated Knots	Percent Error	Indicated Knots	Percent Error	Indicated Knots	Percent Error	Percent Error in Counted Miles
0	0		0		0		
1	0	-100.0	0	-100.0	0	-100.0	
2	0	-100.0	0	-100.0	0	-100.0	
3	0.25	- 91.6	0.30	- 90.0	0.25	- 91.6	-553.3
4	0.53	- 85.5	0.60	- 85.0	0.55	- 86.25	-427.2
5	0.85	- 83.0	0.90	- 82.0	0.80	- 84.0	-382.5
6	1.0	- 83.3	1.0	- 83.3	1.0	- 83.3	-414.3
8	2.10	- 73.75	2.18	- 72.75	2.08	- 74.0	-250.4
9	3.70	- 58.8	3.80	- 57.7	3.80	- 57.7	-130.3
16	12.25	- 23.43	12.40	- 22.50	12.39	- 22.56	- 27.91
20	16.72	- 16.40	16.72	- 16.40	16.65	- 16.75	- 18.22
25	22.00	- 12.0	22.00	- 12.0	22.00	- 12.00	- 12.47
30	27.00	- 10.0	27.01	- 9.96	27.00	- 10.0	- 10.47
35	31.30	- 9.14	31.95	- 8.71	31.90	- 8.85	- 9.86
39	35.30	- 9.48	35.40	- 9.23	35.35	- 9.36	- 10.58
40	39.52	- 1.20	39.60	- 1.0	39.60	- 1.0	- 1.38

TABLE 8

ACCURACY TEST OF UNDERWATER LOG

FOLLOWING SHOCK

(Supply - 115 Volts, 60 Cycles)

Manometer	Master Transmitter		Speed and Distance Repeater		Speed Repeater	
Simulated Knots	Indicated Knots	Percent Error	Indicated Knots	Percent Error	Indicated Knots	Percent Error
20A	-0.2		-0.05		-0.10	
25A	1.70	-93.20	1.80	-92.80	1.80	-92.80
30A	6.50	-78.33	6.60	-78.0	6.55	-78.16
35A	11.45	-67.28	11.60	-66.85	11.60	-66.85
39A	14.90	-61.79	15.0	-61.54	15.0	-61.54
40A	15.45	-61.37	15.55	-61.12	15.60	-61.0
25D	-0.2		0		0	
30D	3.20	-89.33	3.40	-88.66	3.45	-88.5
35D	7.85	-77.57	8.05	-77.0	8.10	-76.85
39D	11.65	-70.12	11.90	-69.48	11.90	-69.48
40D	12.75	-68.12	12.90	-67.75	12.85	-67.87

Note: A-Accelerating
D-Decelerating

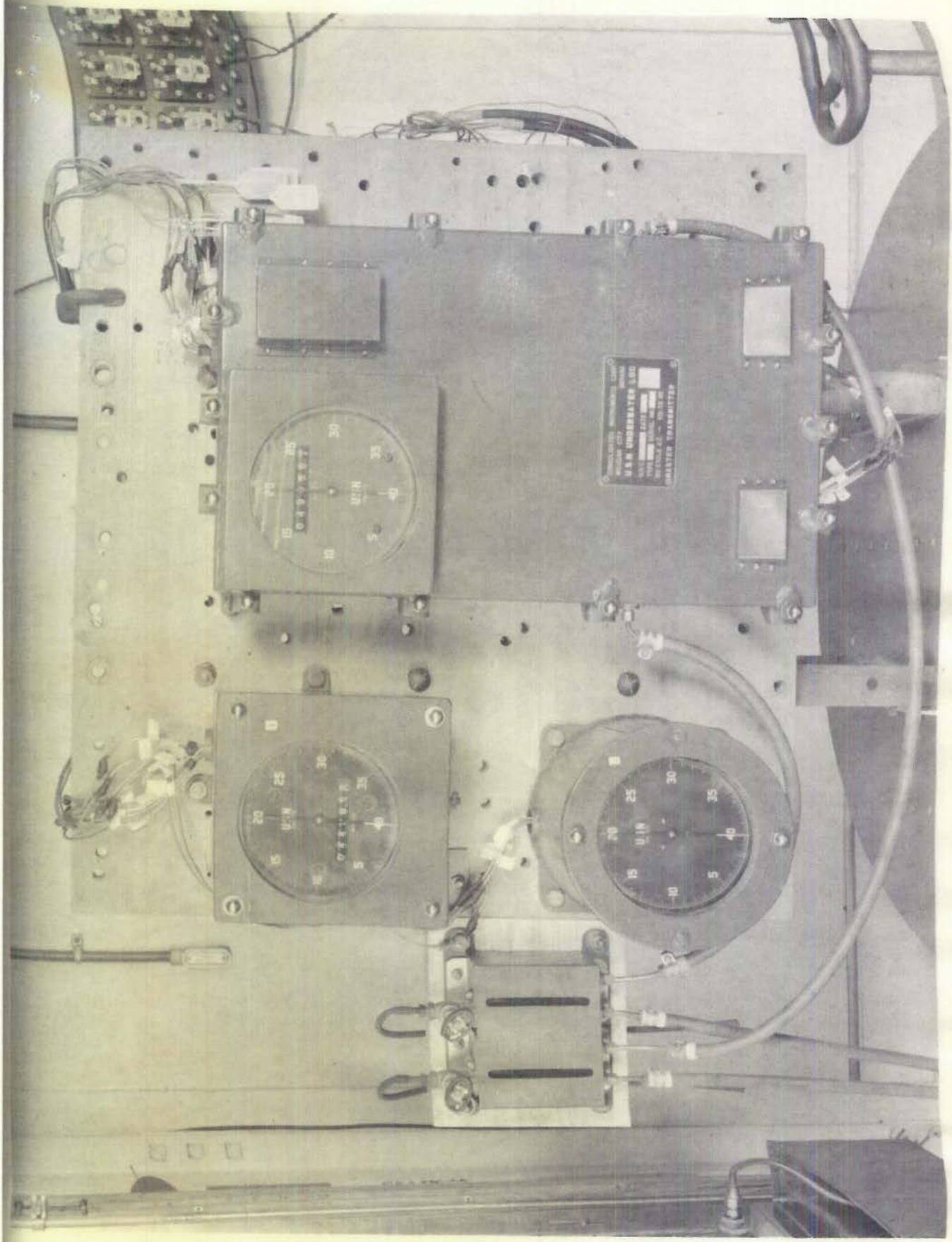


PLATE I

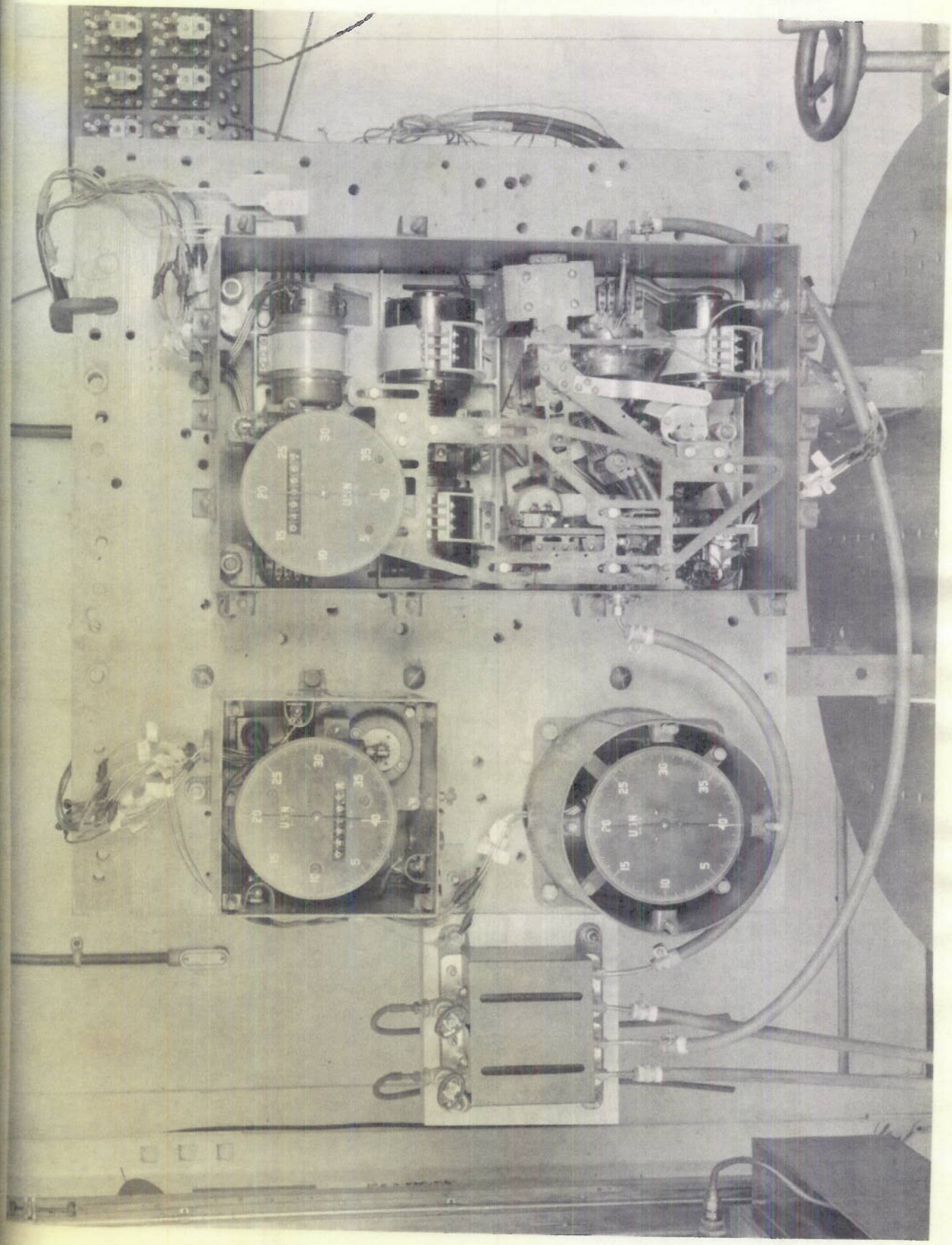
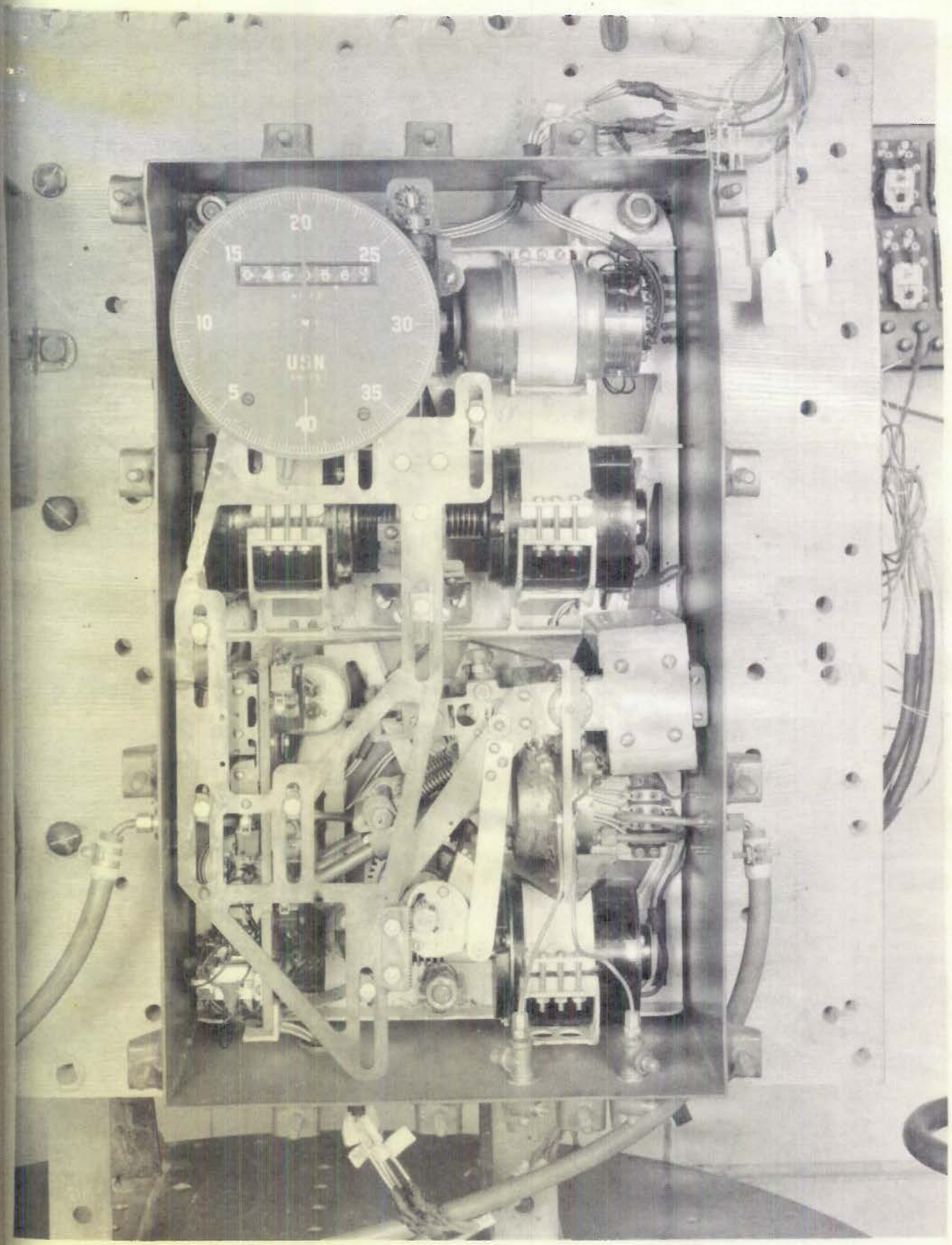


PLATE 2



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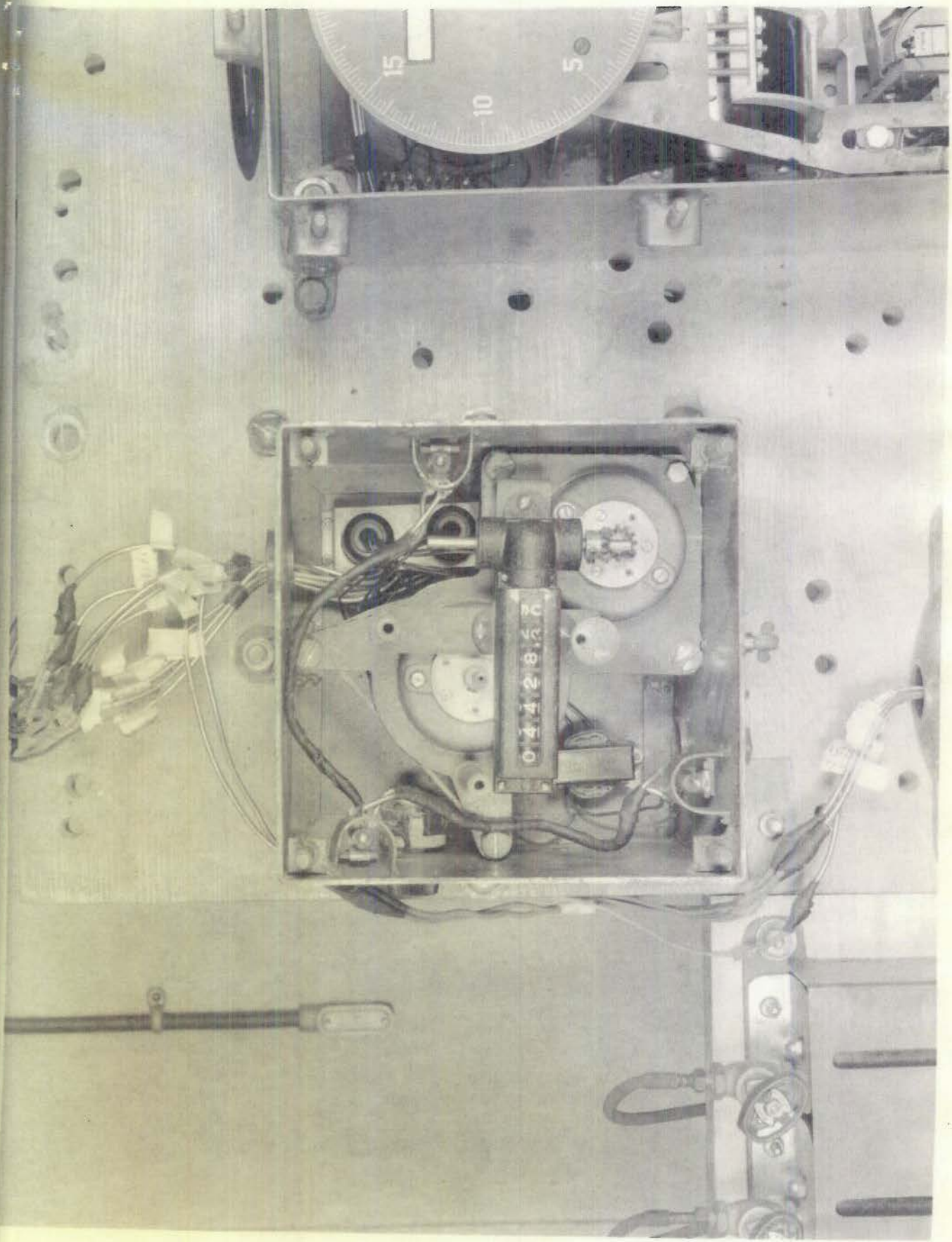


PLATE 4

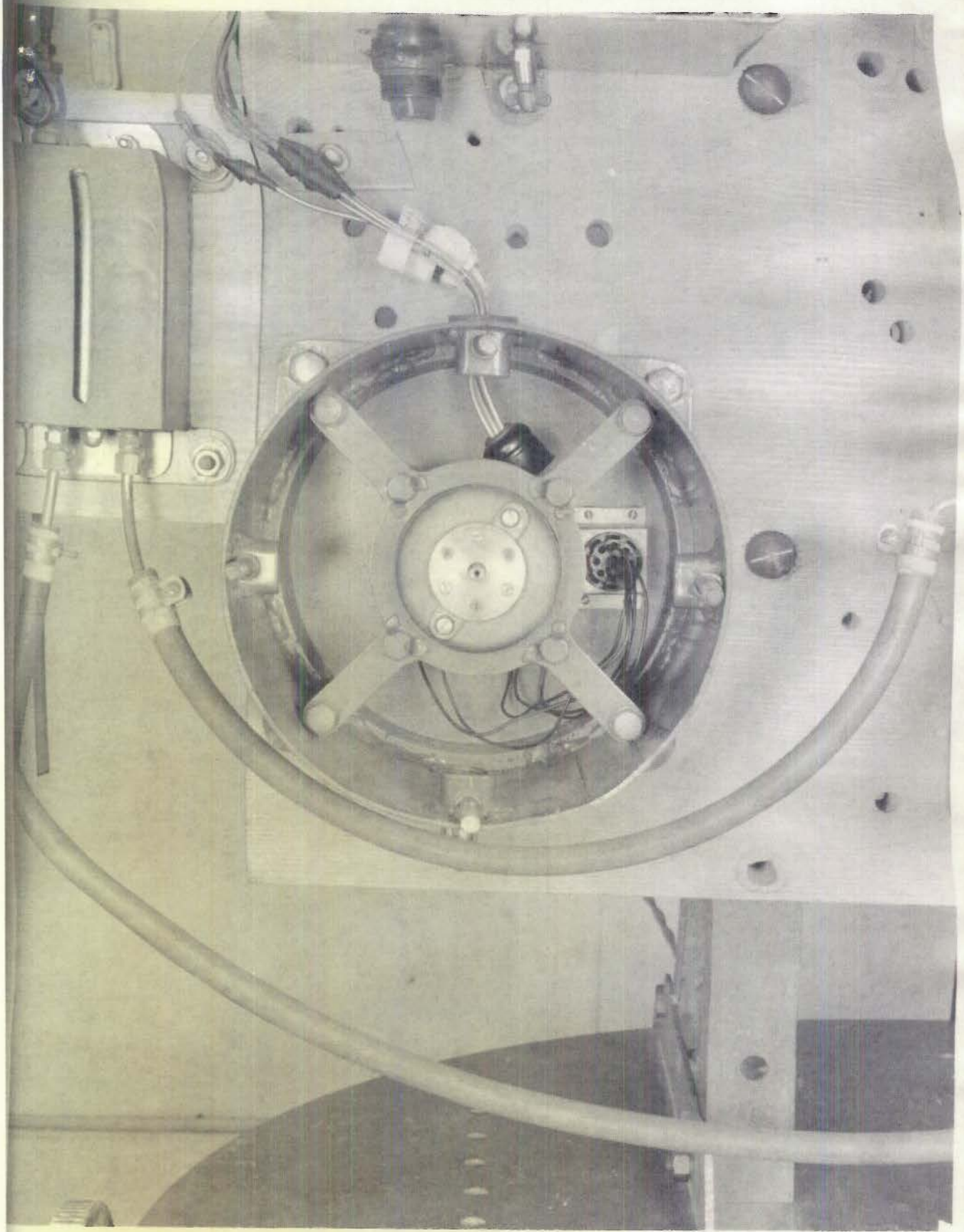


PLATE 5

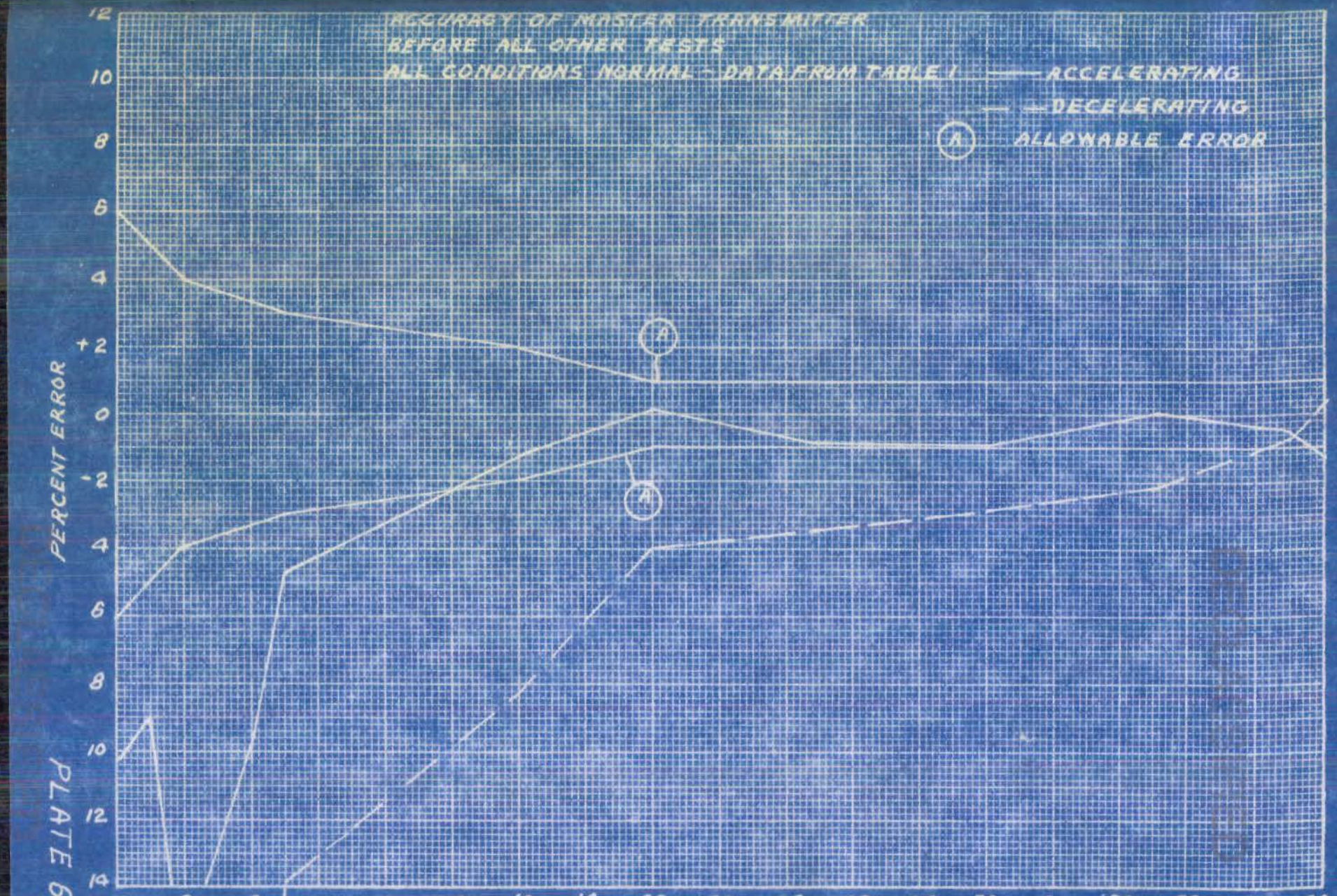
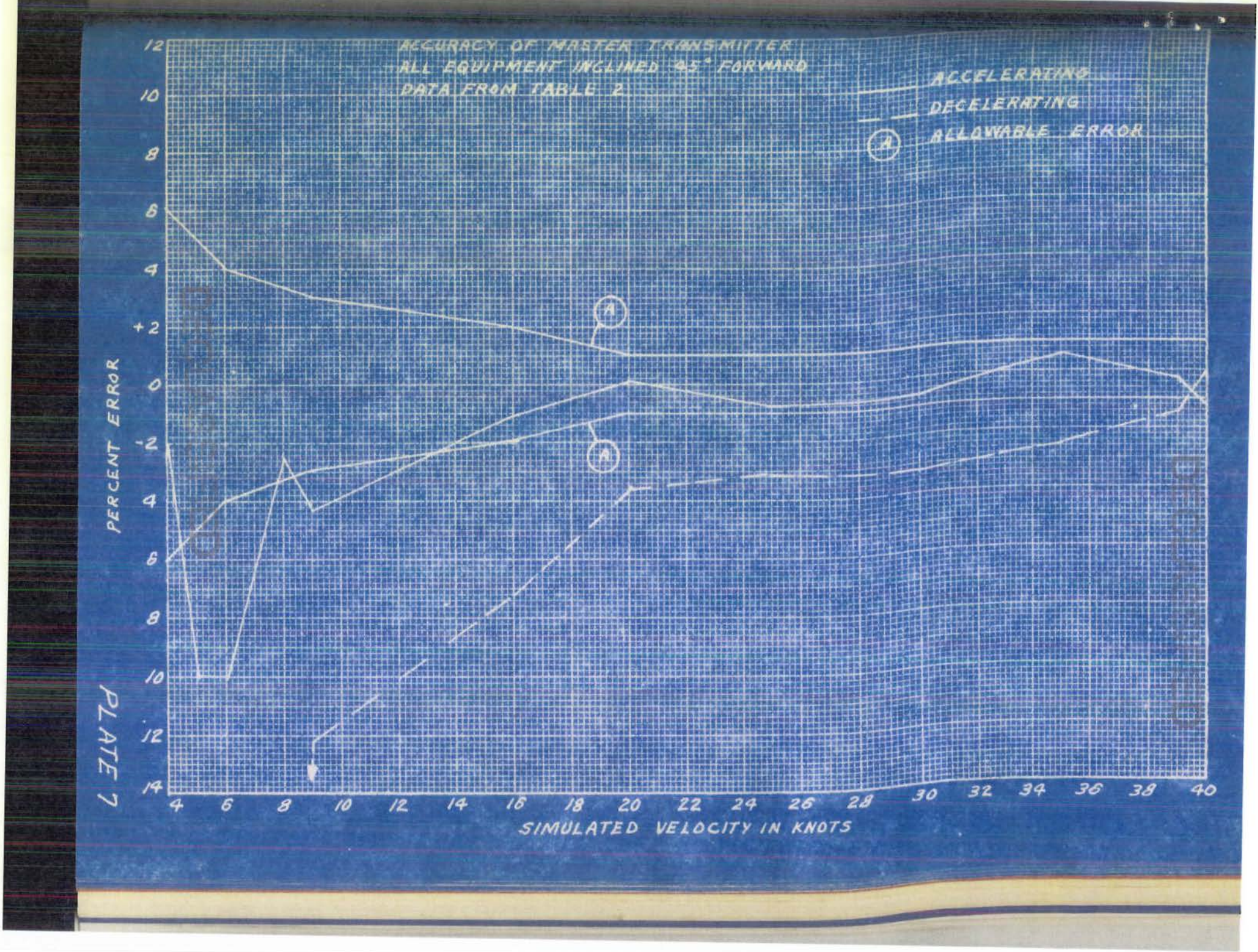
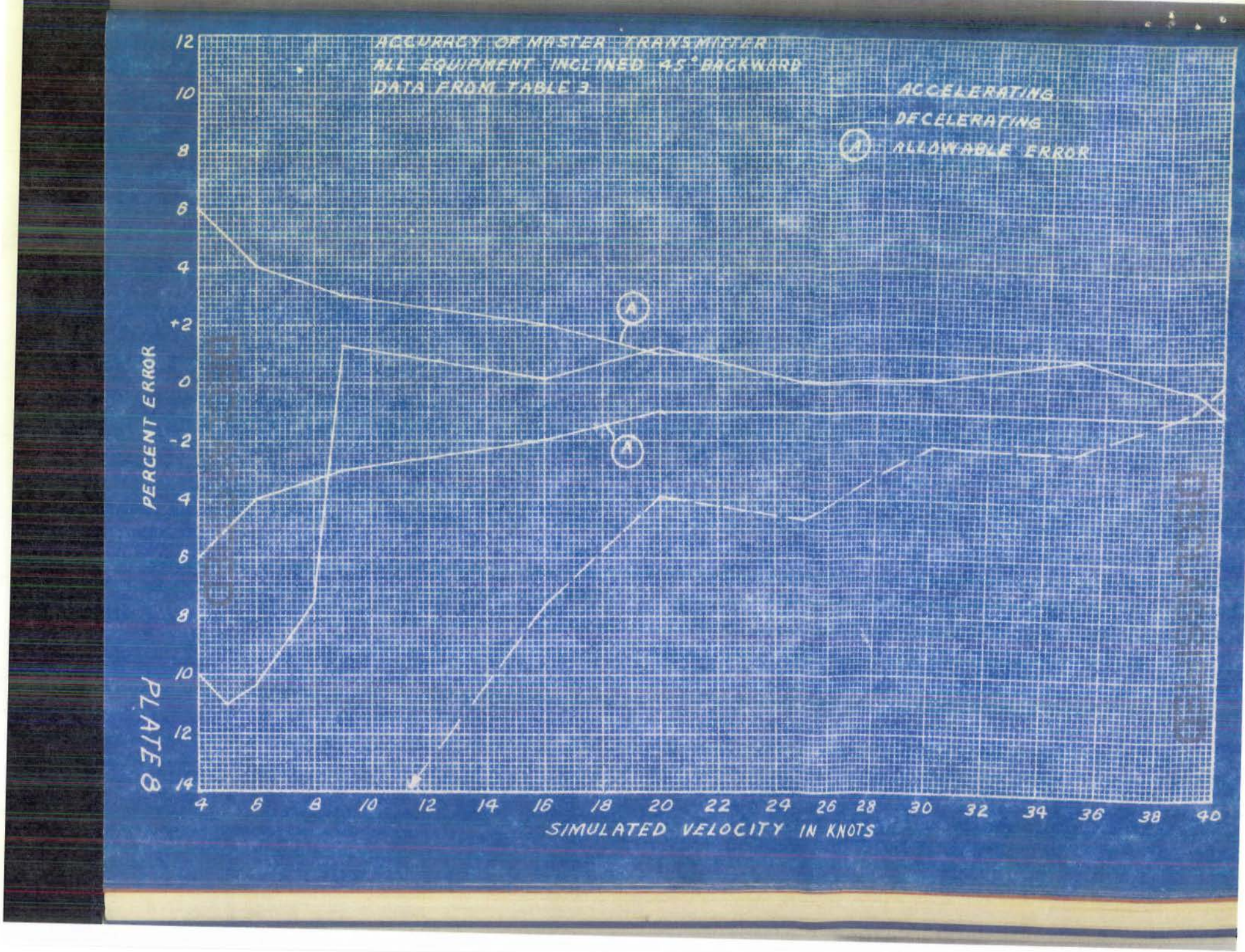
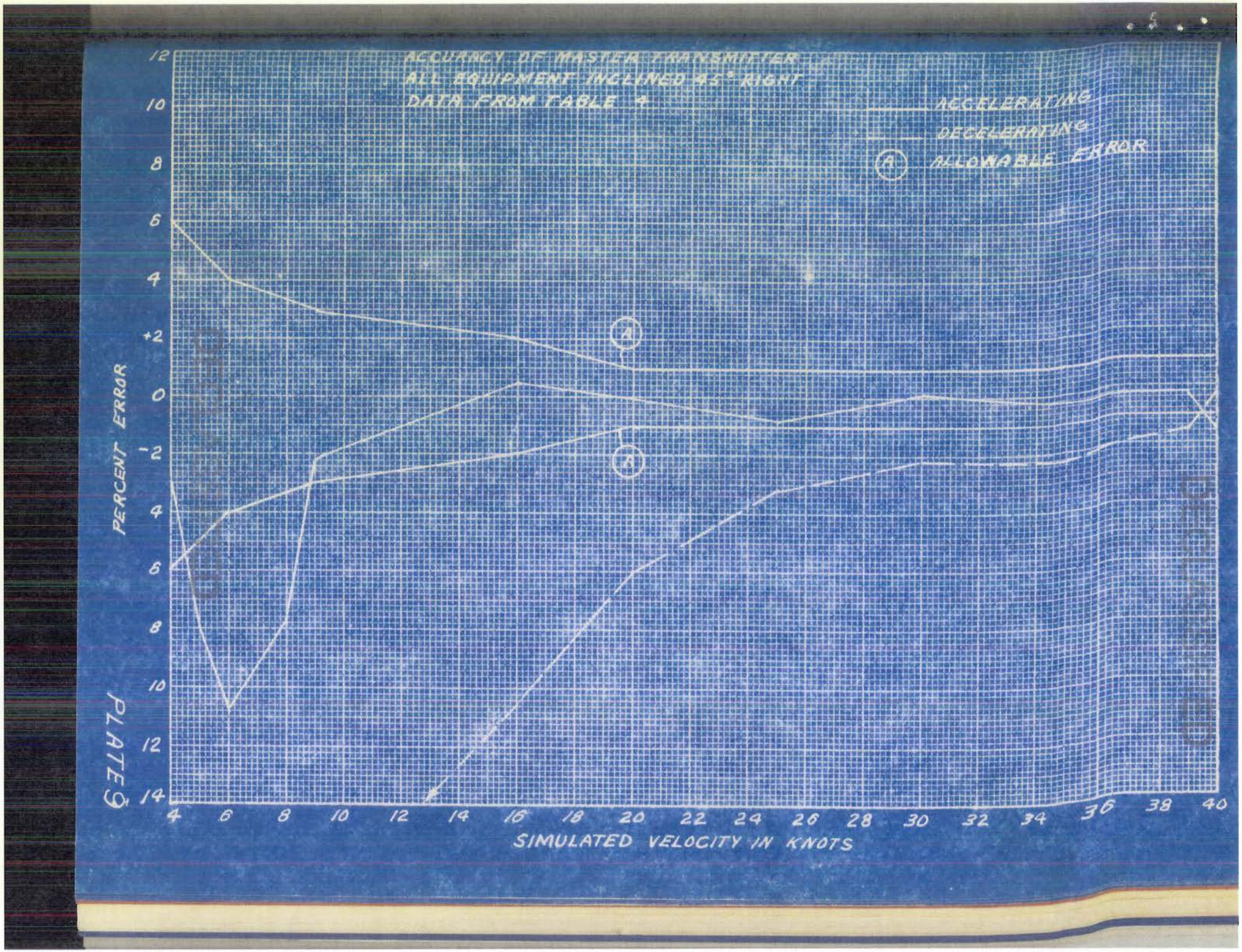

ACCURACY OF MASTER TRANSMITTER
BEFORE ALL OTHER TESTS
ALL CONDITIONS NORMAL - DATA FROM TABLE I
ACCELERATING
DECELERATING
A ALLOWABLE ERROR
PERCENT ERROR
12
10
8
6
4
+2
0
-2
4
6
8
10
12
14
4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
SIMULATED VELOCITY IN KNOTS

PLATE 6


ACCURACY OF MASTER TRANSMITTER
ALL EQUIPMENT INCLINED 45° FORWARD
DATA FROM TABLE 2
ACCELERATING
DECELERATING
(A) ALLOWABLE ERROR
PERCENT ERROR
12
10
8
6
4
+2
0
-2
4
6
8
10
12
14
4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
SIMULATED VELOCITY IN KNOTS
PLATE 7


ACCURACY OF MASTER TRANSMITTER
ALL EQUIPMENT INCLINED 45° BACKWARD
DATA FROM TABLE 3
ACCELERATING
DECELERATING
A ALLOWABLE ERROR
PERCENT ERROR
12
10
8
6
4
+2
0
-2
4
6
8
10
12
14
A
A
4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
SIMULATED VELOCITY IN KNOTS
PLATE 8


ACCURACY OF MASTER TRANSMITTER
ALL EQUIPMENT INCLINED 45° RIGHT
DATA FROM TABLE 4
ACCELERATING
DECELERATING
A ALLOWABLE ERROR
PERCENT ERROR
12
10
8
6
4
+2
0
2
4
6
8
10
12
14
4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
SIMULATED VELOCITY IN KNOTS
PLATE 9

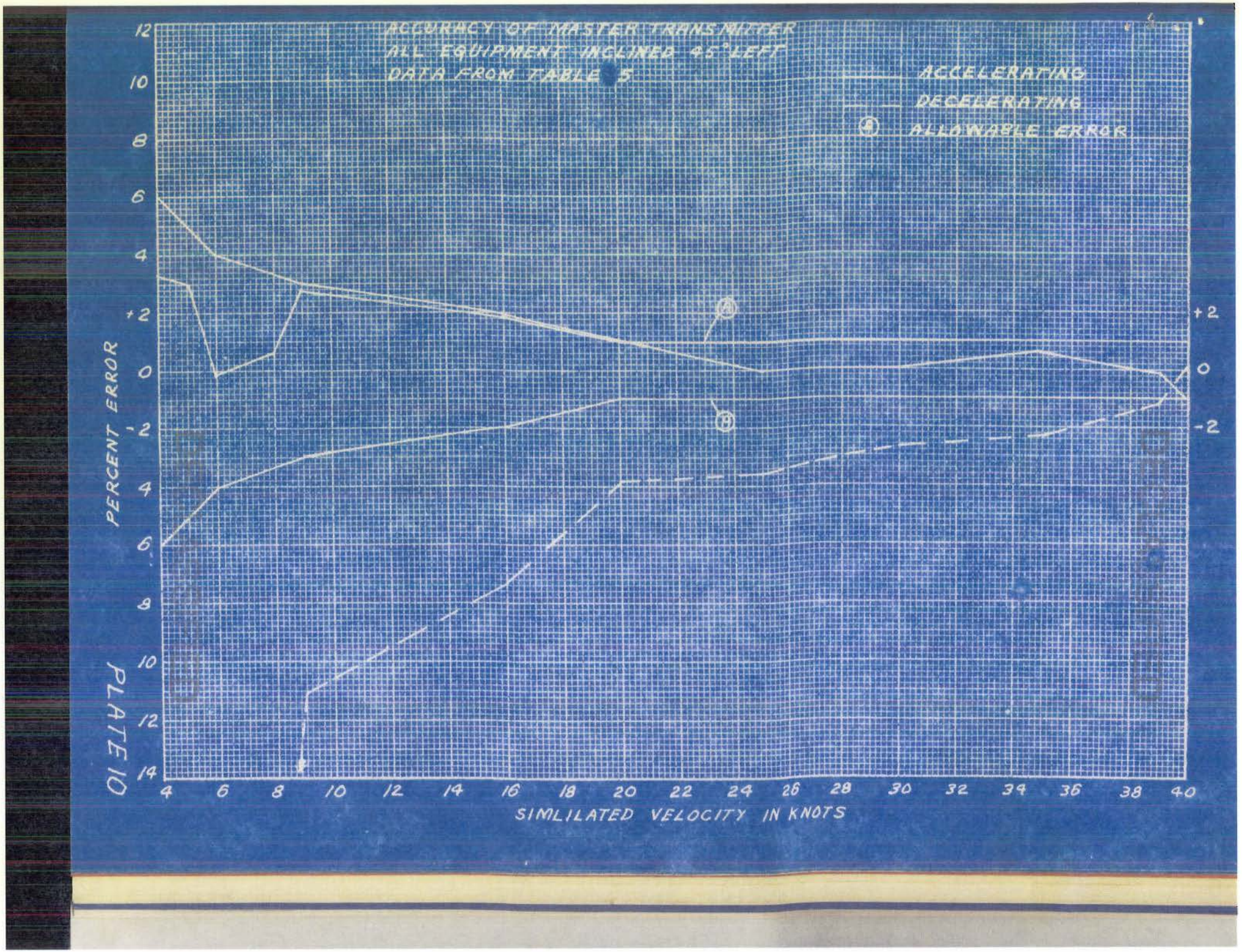
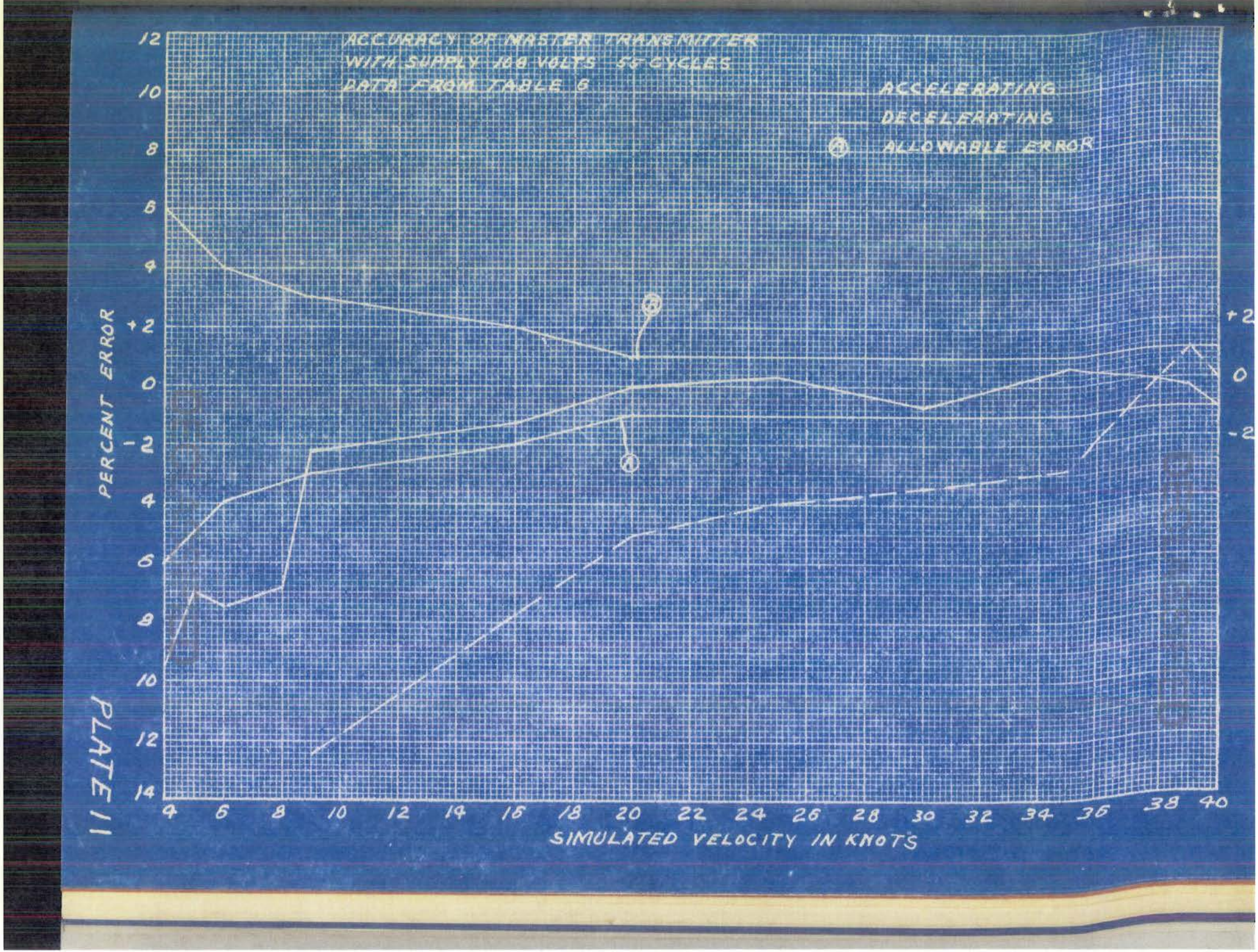

ACCURACY OF MASTER TRANSMITTER
ALL EQUIPMENT INCLINED 45° LEFT
DATA FROM TABLE 5
ACCELERATING
DECELERATING
ALLOWABLE ERROR
PERCENT ERROR
SIMLILATED VELOCITY IN KNOTS
12
10
8
6
4
+2
0
2
4
6
8
10
12
14
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
+2
0
-2

PLATE 10


ACCURACY OF MASTER TRANSMITTER
WITH SUPPLY 108 VOLTS 55 CYCLES
DATA FROM TABLE 6
ACCELERATING
DECELERATING
ALLOWABLE ERROR
PERCENT ERROR
12
10
8
6
4
+2
0
2
4
6
8
10
12
14
+2
0
-2
4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
SIMULATED VELOCITY IN KNOTS
PLATE 11

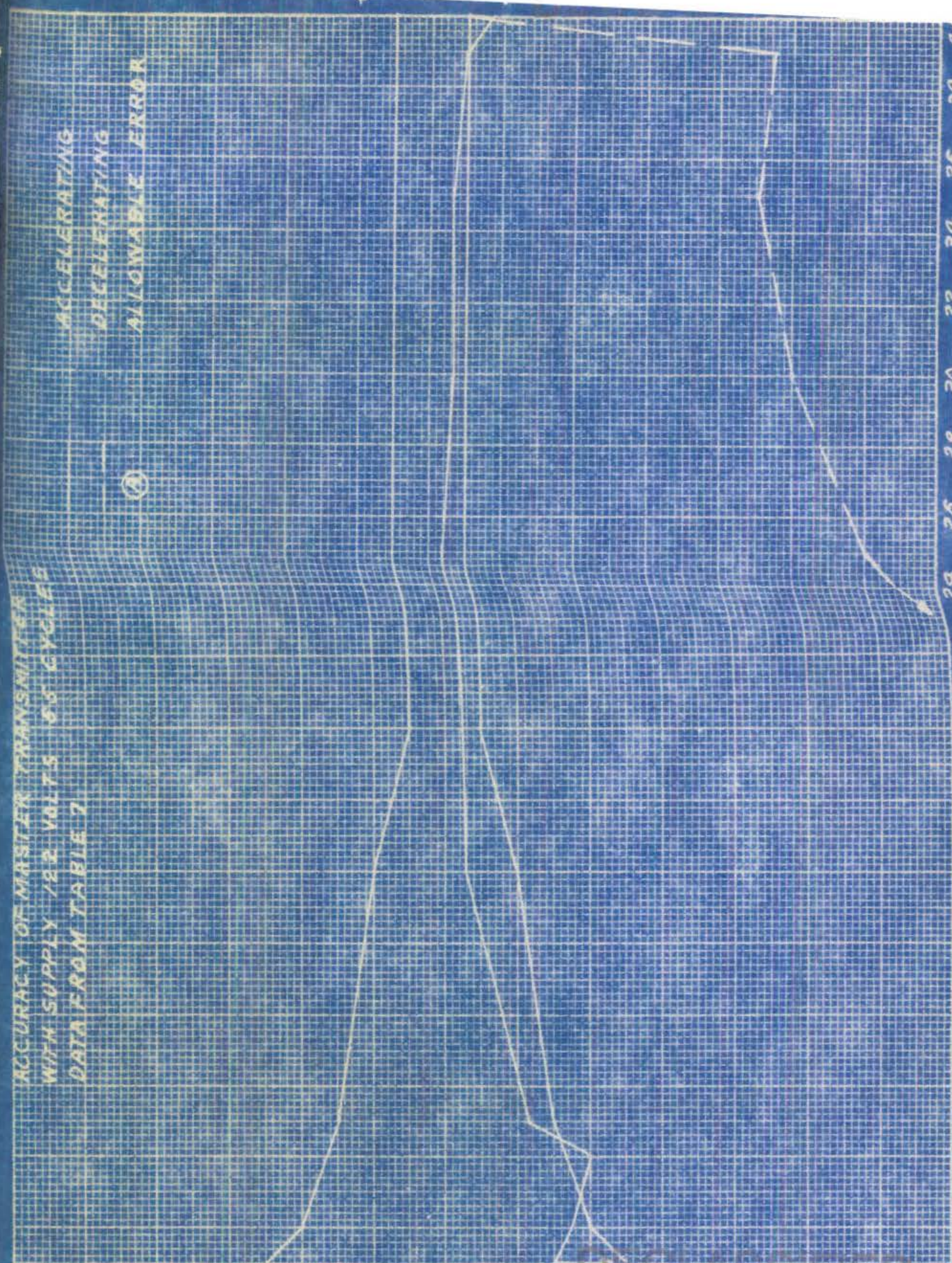

ACCURACY OF MASTER TRANSMITTER
WITH SUPPLY 122 VOLTS 65 CYCLES
DATA FROM TABLE 7
ACCELERATING
DECELERATING
ALLOWABLE ERROR
SIMULATED VELOCITY IN KNOTS
PERCENT ERROR
12
10
8
6
4
+2
0
-2
4
6
8
10
12
14
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
DECLASSIFIED

PLATE 12

U. S. NAVAL RESEARCH LABORATORY
BELLEVUE, D. C.

DATE

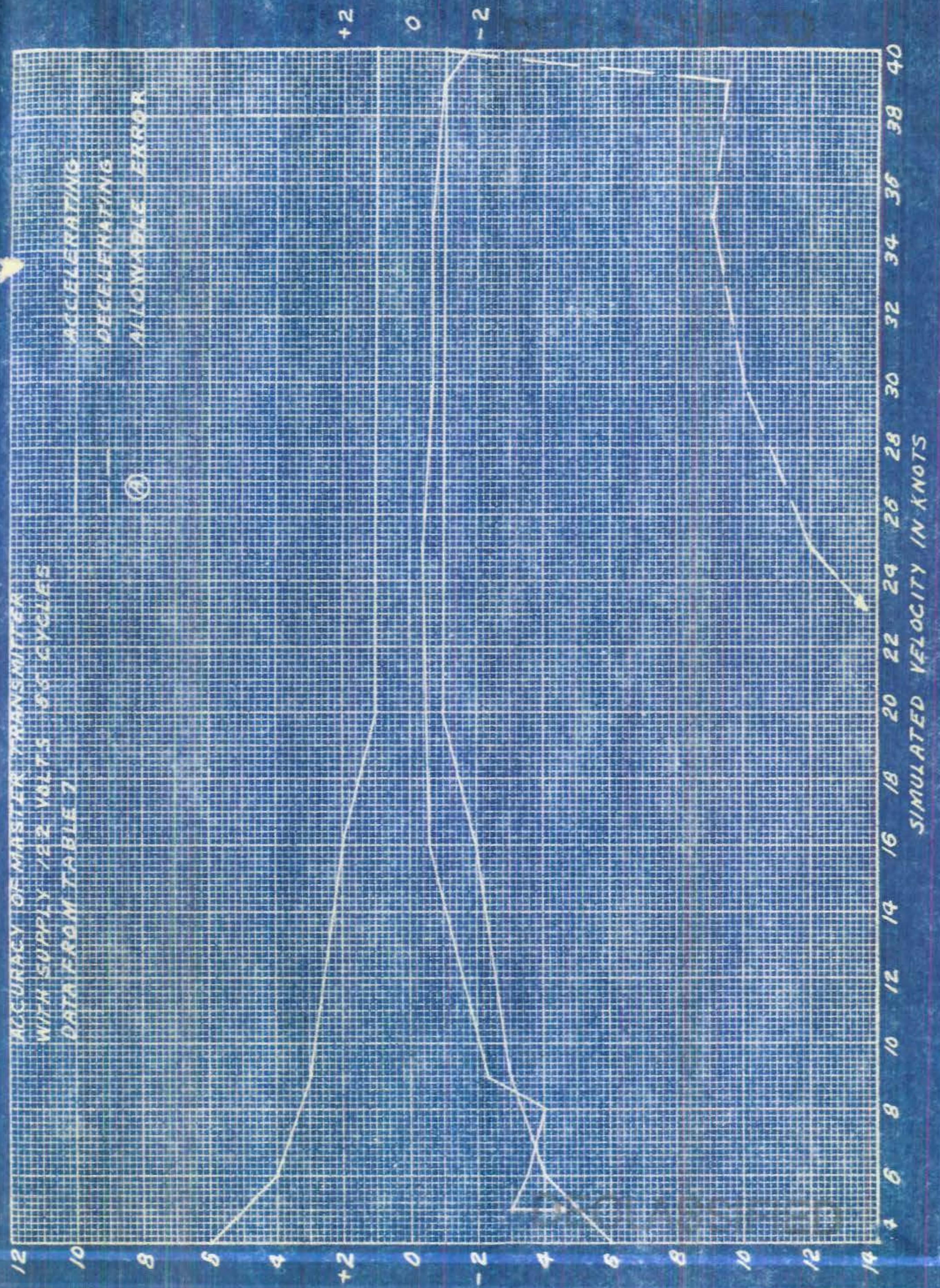


PLATE 12