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NAVY DEPARTMENT

Report of Test

on

Engine Order Telegraph System

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for

Bureau of Ships

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D. C.

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Authorization: BuShips Ltr. S65-5(350) of 28 August 1942.

Date of Test: June 1943.

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AUTHORIZATION FOR TEST

1. This problem was authorized by reference (a), and other references pertinent to this problem is listed as references (b) and (c).

Reference: (a) BuShips Ltr. S65-5(350) of 28 August 1942.
(b) Specification SGS(65)-42a dated 15 February 1937 and Amendment 1 of 1 March 1942.
(c) NRL Test No. 382, file S65-5/L5(486)N140s-2676A of 20 May 1943.

OBJECT OF TEST

2. The object of this test was for information and specification development in order to determine suitability for Naval use.

ABSTRACT OF TEST

3. The subject equipment was partially reconditioned and was then set up at this Laboratory in suitable test circuits where its performance was carefully observed. An inspection to determine the design and the materials utilized, concluded the test.

CONCLUSIONS

(a) The subject Engine Order Telegraph System, of foreign manufacture, contains no features that are worthy of further development, except that it has the basic principles of the equipment tested and reported by reference (c).

(b) The only possible feature of merit is the continuous ringing feature of the bell alarm. However, the great number of additional parts required for its operation makes its adaption inadvisable.

RECOMMENDATIONS

(a) That the results of this test be considered as having demonstrated that there are no features in the subject system that merit development for Naval use.

DESCRIPTION OF MATERIAL

4. The Engine Order Telegraph System submitted for test consisted of the following:

- 1 - Pedestal mounted double engine order telegraph unit with two (2) bells, removed from Pilot House and damaged by heat and water.
- 1 - Engine order telegraph unit removed from Engine Room and damaged by water.

5. The units selected for test are identical except that the direction of operation is reversed, one being clockwise, designated "ER" and the other counter-clockwise, designated "PH". Unit "PH" being one unit of the double engine order unit. Each unit is of the transmitter-indicator type, lever operated with single dial, for pedestal mounting. All equipment is designed for 115 volt D.C. operation.

6. The transmitter-indicator units each consist of a watertight case containing a transmitter unit, an indicator unit, a dial and pointer, a set of contacts and relay for bell alarm, lamps for dial illumination with switch and a terminal block for electrical connections. The operating handle is so mounted that it can be positioned on the periphery of the case in any one of 10 locations within an arc of 202.5 degrees.

7. Each case is approximately 18 inches in diameter by 8 inches in depth. A watertight window is provided in the front of the case for viewing the dial. The dial covers the entire front of the case and is approximately 15-1/2 inches in diameter. No dials were furnished with this equipment and no indication can be given as to the type or markings used. It is assumed that they were of the back-lighted translucent type with pointers silhouetted on an illuminated field.

8. The operating lever is of cast aluminum and is shaped to fit across the back and side of the case from the operating shaft extending through the back of the case at the center, to the operating handle at the front edge. A transmitter pointer is attached to an extension of the operating handle. Counter-weights are provided to balance the lever and handle.

9. The operating shaft extending through the back of the case at the center is provided with a sleeve type bearing and a water-tight packing gland. A detent wheel is mounted on the operating shaft and provides the means for holding the operating lever in position. The detent wheel has a total of eleven notches spaced evenly 22-1/2 degrees apart. Normal operation of the lever is confined to nine positions around the upper half of the dial by stops on the sides of the case. A button operated latch in the operating handle permits the handle to pass the stop on one side to obtain a tenth position. A collector ring assembly for the bell alarm circuit is also mounted on the operating shaft as well as a gear which, by means of a 1:1 ratio gear train, drives the brush contact assembly of the transmitter unit.

10. The transmitter unit consists of a contact block and a brush contact assembly with the necessary resistors and inter-connections. The contact block has 32 contacts arranged in a circle and 2 collector rings, one inside and one outside the contact circle, all mounted on an insulated block which comprises the main portion of the chassis of the unit. The brush contact

DESCRIPTION OF MATERIAL (Cont'd)

assembly is mounted on the central shaft of the unit and has two pairs of brush contacts which provide the connection between the contacts and the collector rings. A gear on the projection of the central shaft at the back of the unit engages the gear on the operating shaft and the movement of the brush contact assembly therefore is controlled by the operating handle. The contacts are grouped in pairs and are connected in combination with the resistors in back of the contact block. When line voltage is applied to the terminals of the connections, voltages of different value and/or polarity are obtained from each pair on contacts. The brush contacts are arranged so that the proper group of contacts is connected to supply the two circuits of the indicator unit for each setting of the operating handle.

11. The indicator unit is comprised of a bi-polar field structure and a central housing containing the rotor. The windings of the field consist of three coils, one at each end of the yoke and one at the center. The three coils are connected in series, across the line, to provide a constant field and a center tap is brought out of the center coil. The rotor has two concentrated windings spaced at 90 degrees with leads brought outside the housing by means of slip rings and brushes. One lead of each of the rotor windings is connected together as a common and in turn is connected to the center tap of the field winding. The other leads of the rotor windings are each connected to a collector ring in the transmitter unit of the other transmitter-indicator. A dial pointer is mounted on the extended shaft of the rotor.

12. The quantity and direction of current flow in the two coils of the indicator rotor is regulated by the voltage and polarity of the group of contacts selected in the transmitter unit. The independent fields of the rotor windings combine to form a resultant field which always aligns itself with the stronger main field and supplies the torque necessary to turn the rotor.

13. The bell alarm system is comprised of two parts. First, a set of contacts operated by the detent wheel which initially energize the bell circuit, but only while passing from notch to notch on the wheel. Second, a set of contacts operating in conjunction with a relay which continuously energize the bell circuit until the signal is acknowledged by proper positioning of the transmitter handle at the receiving instrument. The second part consists of a pair of collector rings mounted on an insulating plate with the detent wheel and a pair of roller contacts mounted on the indicator rotor shaft at the end opposite the pointer. The roller contacts are connected in the coil circuit of an auxiliary relay. The relay contacts are normally open and are connected in the bell circuit. When the operating handles and the indicator pointers of both telegraph units are coincident, one of the rollers of each set of contacts is disengaged from its collector ring by a fibre block inlay, and both bell circuits are deenergized. When one of the operating handles is displaced, the fibre block is moved from beneath the roller and a bell circuit is energized. At the same time, the response of the indicator rotor in the other unit moves the roller off the fibre block and energizes a bell circuit. When the signal is acknowledged and both operating handles and indicator pointers are again coincident, the bell circuits are deenergized. It could not be established whether or not the bell circuits were cross connected or were for parallel operation.

DESCRIPTION OF MATERIAL (Cont'd)

14. Dial illumination is provided by two 25-watt, 115 volt lamps, connected for either series or parallel operation. Lamp control is by means of a rotary switch, the handle of which extends through the side of the case. Access to the lamps is by means of screw cover ports on the sides of the case, permitting relamping without the necessity of removing the front cover and dial.

METHOD OF TEST

15. Due to the condition of the equipment when received it was first necessary to disassemble and clean all parts of the two units to be tested. New wiring was added where necessary when reassembling.

16. All electrical circuits were then checked for continuity and the general operation studied. The system was adjusted until the best possible operation was obtained.

17. It was not deemed advisable to perform shock and vibration tests.

18. Since the equipment had been subjected to water and heat, no insulation resistance, dielectric or temperature rise tests were performed.

19. A temporary dial was mounted on each unit and accuracy tests conducted by the dial and pointer method.

20. Torque measurements were made to determine the maximum torque at each position of the operating handle. The torque gradient for a 10 degree interval in increments of 1 degree on both sides of zero was also determined.

21. A determination of the power consumption of each unit concluded the test.

COMMENTS ON RESULTS OF TEST

22. This particular equipment can be considered an elementary form of the Type ADC Transmitter-Generator and the Type MDC Indicator-Motor which was previously tested and reported by reference (c). The operation of the subject transmitter unit and indicator need not necessarily be confined to a portion of a revolution. If notches were added on the detent wheel for the balance of the circumference it would be possible to obtain continuous rotation, although the operation of the indicator would be in steps of 22-1/2 degrees. Similarly, by adding more contacts, with corresponding resistor and inter-connection combinations, in the transmitter unit and by adding an equal number of notches to the detent wheel, a continuous rotation can be obtained with smaller increments of indicator movement. Thus, as the number of contacts are increased, the design of the transmitter unit will approach that of the drum-wound resistor unit employed in the Type ADC Transmitter-Generator.

23. From Table 1, it will be noted that the accuracy of Unit "ER" was fairly good (within 3 degrees) while the accuracy of Unit "PH" was very poor. Since the pointer position is fixed by the resultant field in the rotor, any unbalance in the resistors of the transmitter will produce a resultant field not at the proper angle for the given position. The values of the resistors in the two transmitter units are not the same and apparently the original position of

COMMENTS ON RESULTS OF TEST

balance was obtained by the "cut and try" method. Since it was believed that sufficient information had been obtained from Unit "ER", no attempt was made to substitute resistors in Unit "PH" to improve its operation.

24. In view of the fact that the current in the component fields of the indicator rotor is varied and is not the same for all positions, the resultant field therefore will not be a constant for all positions. This effect is reflected in the torque measurements, see Table 2.

25. The power consumption for the two units combined, determined for each position of the indicator, had a maximum value of 37.7 watts and a minimum value of 35.5 watts. Due to interconnection in and between the two units, the power consumption of an individual unit or any portion of same was not determined.

CONCLUSIONS

26. The subject Engine Order Telegraph System, of foreign manufacture, contains no features that are worthy of further development, except that it has the basic principles of the equipment tested and reported by reference (c).

27. The only possible feature of merit is the continuous ringing feature of the bell alarm. However, the great number of additional parts required for its operation makes its adaption inadvisable.

TABLE 1

Analysis of Results of Accuracy Test

Lever Position	Lever Position Degrees	Indicator Unit "PH" Transmitter Unit "ER" Degrees	Indicator Unit "ER" Transmitter Unit "PH" Degrees
1	0	0.0	0.0
2	22-1/2	-2.0	-2.5
3	45	+16.0	-2.5
4	67-1/2	+10.5	-2.0
5	90	-1.0	-3.0
6	112-1/2	-7.5	-0.5
7	135	+8.0	-0.5
8	157-1/2	+4.5	+0.5
9	180	-4.0	+0.5
10	202-1/2	-6.5	-1.5
9	180	-4.0	+0.5
8	157-1/2	+4.5	+0.5
7	135	+7.5	-0.5
6	112-1/2	-8.0	-0.5
5	90	-1.5	-3.0
4	67-1/2	+10.5	-2.5
3	45	+15.5	-3.0
2	22-1/2	-2.5	-3.0
1	0	0.0	0.0

Note: Requirement for Type M and N Self-Synchronous Indicator Motors

Accuracy \pm 1 geometrical degree, specification, reference (b).

TABLE 2

Results of Torque Tests

Lever Position	Lever Position Degrees	Maximum Torque	
		Indicator Unit "PH" Transmitter Unit "ER" IN-OZS.	Indicator Unit "ER" Transmitter Unit "PH" IN-OZS.
1	0	3.99	5.12
2	22-1/2	3.58	4.91
3	45	4.16	3.89
4	67-1/2	5.06	3.58
5	90	5.16	3.99
6	112-1/2	4.50	3.88
7	135	3.88	3.69
8	157-1/2	4.29	3.98
9	180	3.96	4.91
10	202-1/2	3.60	4.64
Torque gradient per degree —		0.063	0.086

Note: Requirements for Type "N" Self-Synchronous Indicator Motor

Maximum Torque — Not less than 4 inch-ounces.

Torque Gradient — Not less than 0.05 inch-ounces.

Specification, reference (b).



PLATE I

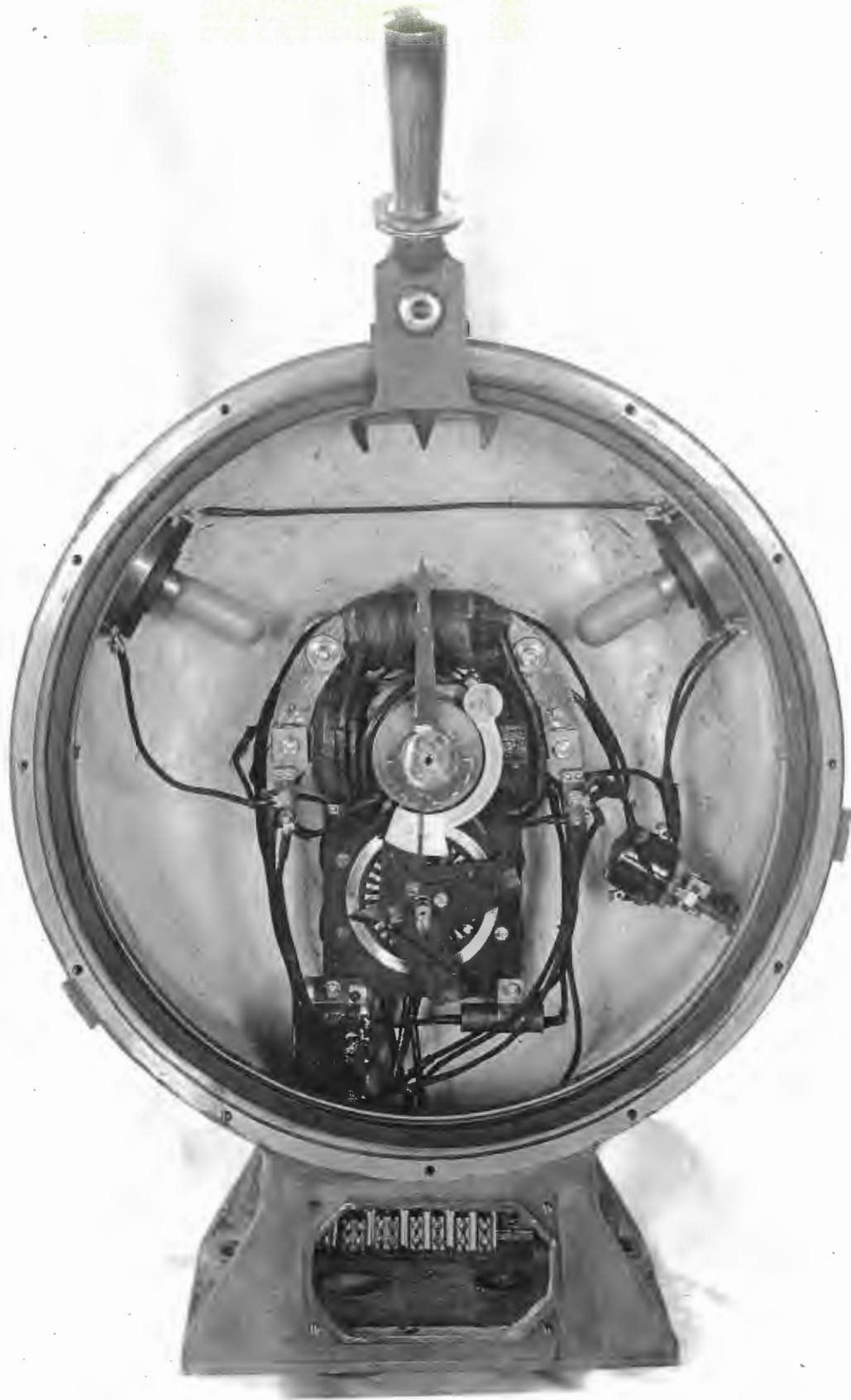


PLATE 2

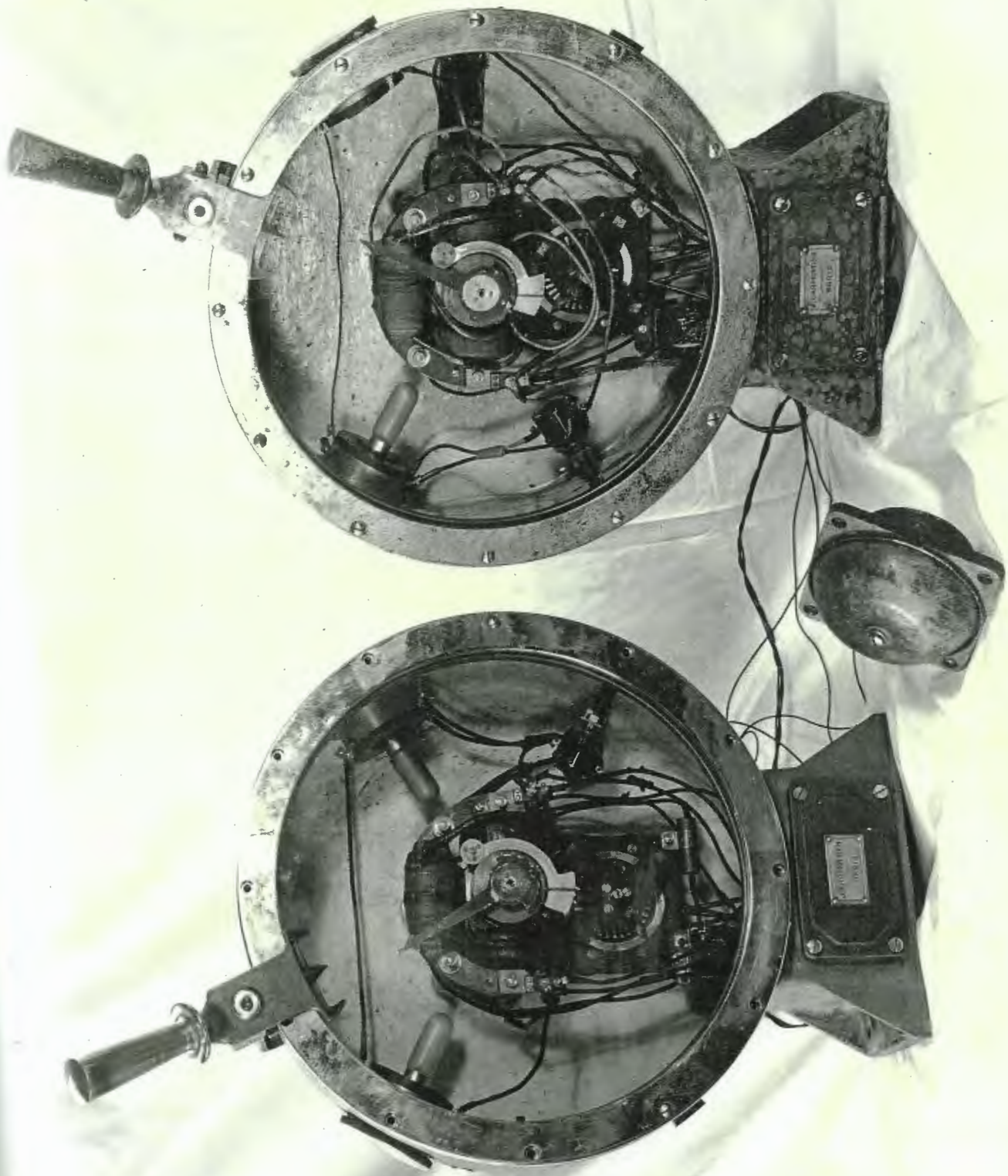
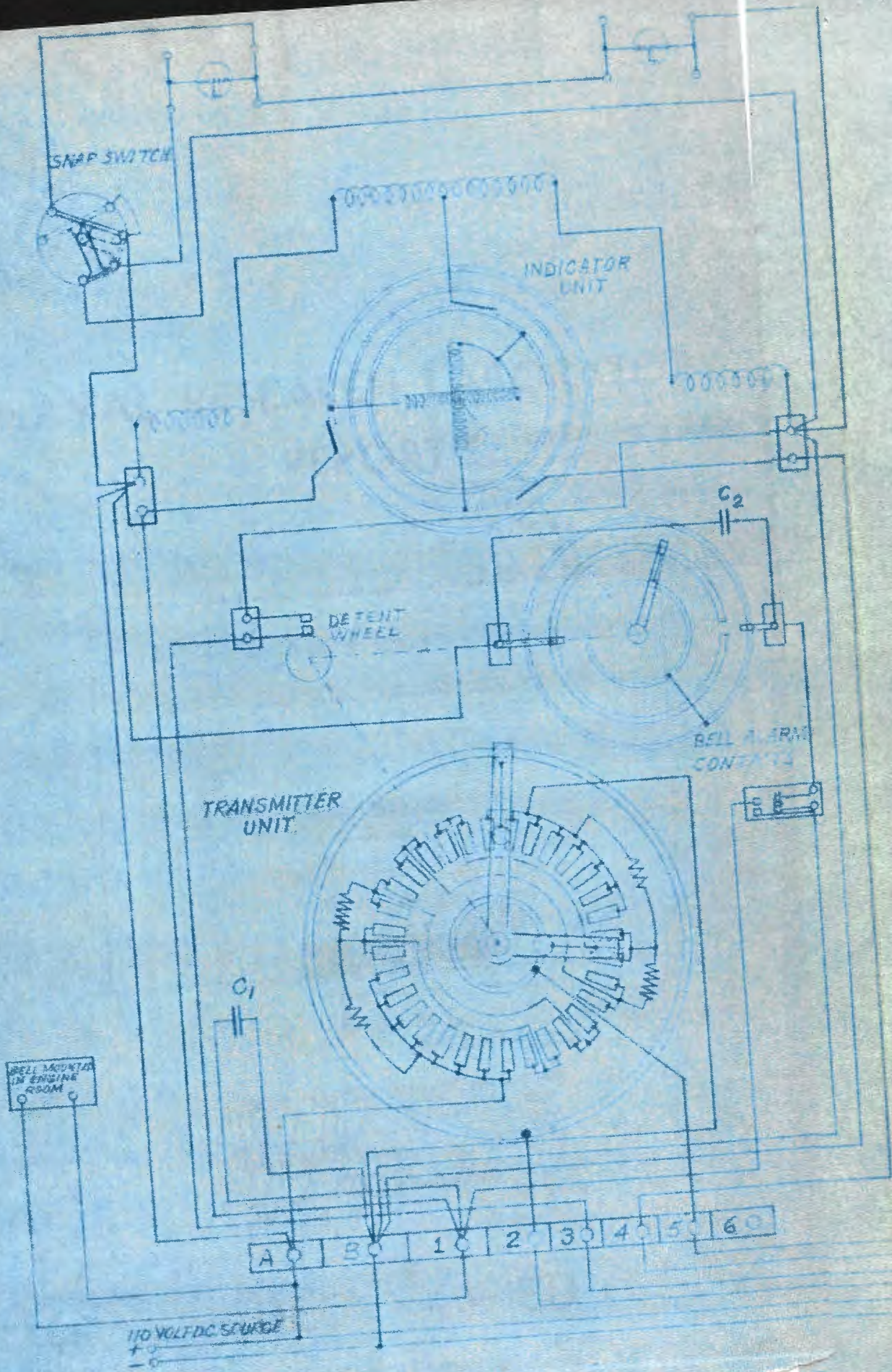


PLATE 3



SNAP SWITCH

INDICATOR UNIT

DEFENT WHEEL

TRANSMITTER UNIT

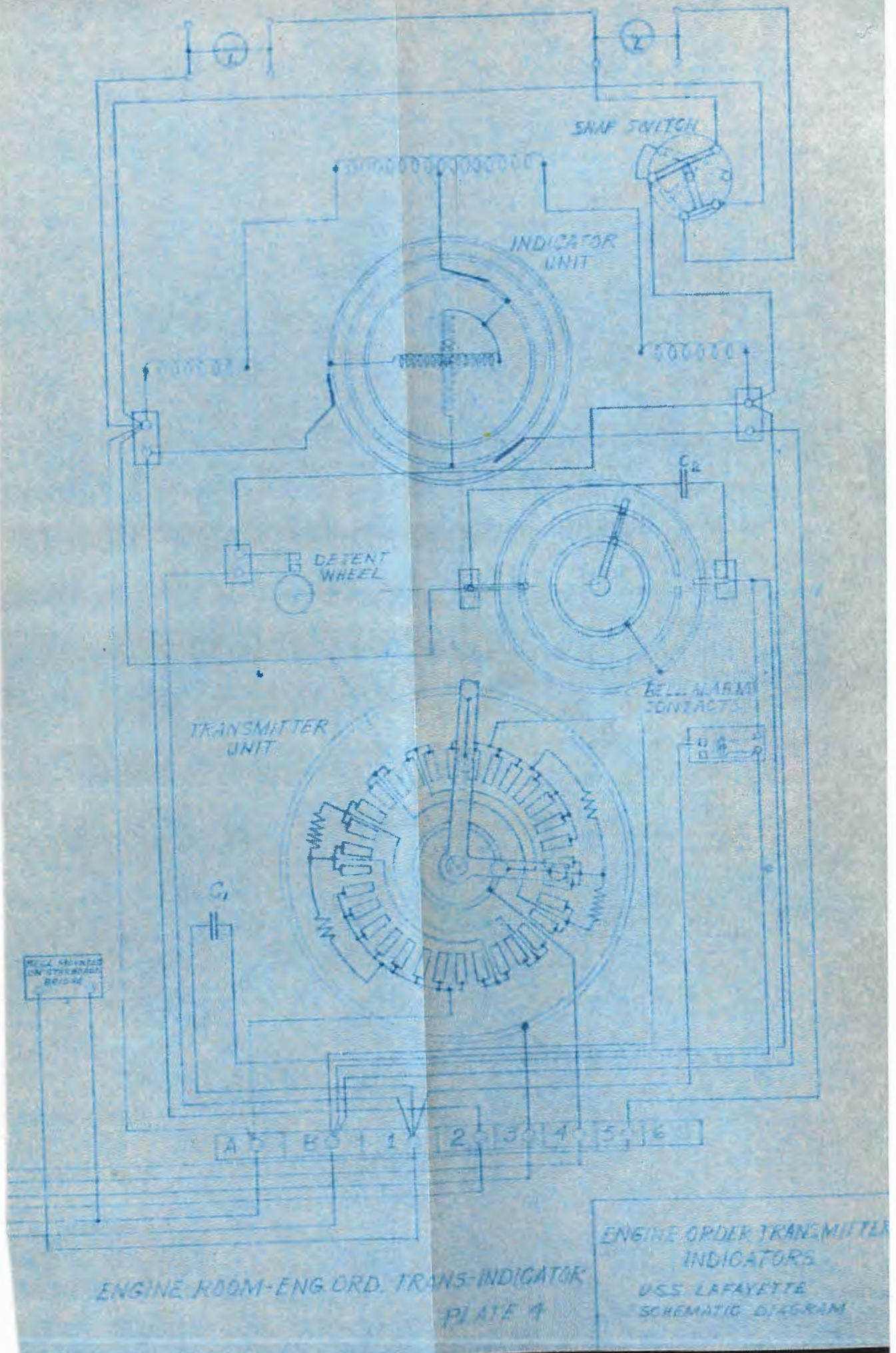
BELL ALARM CONTACT

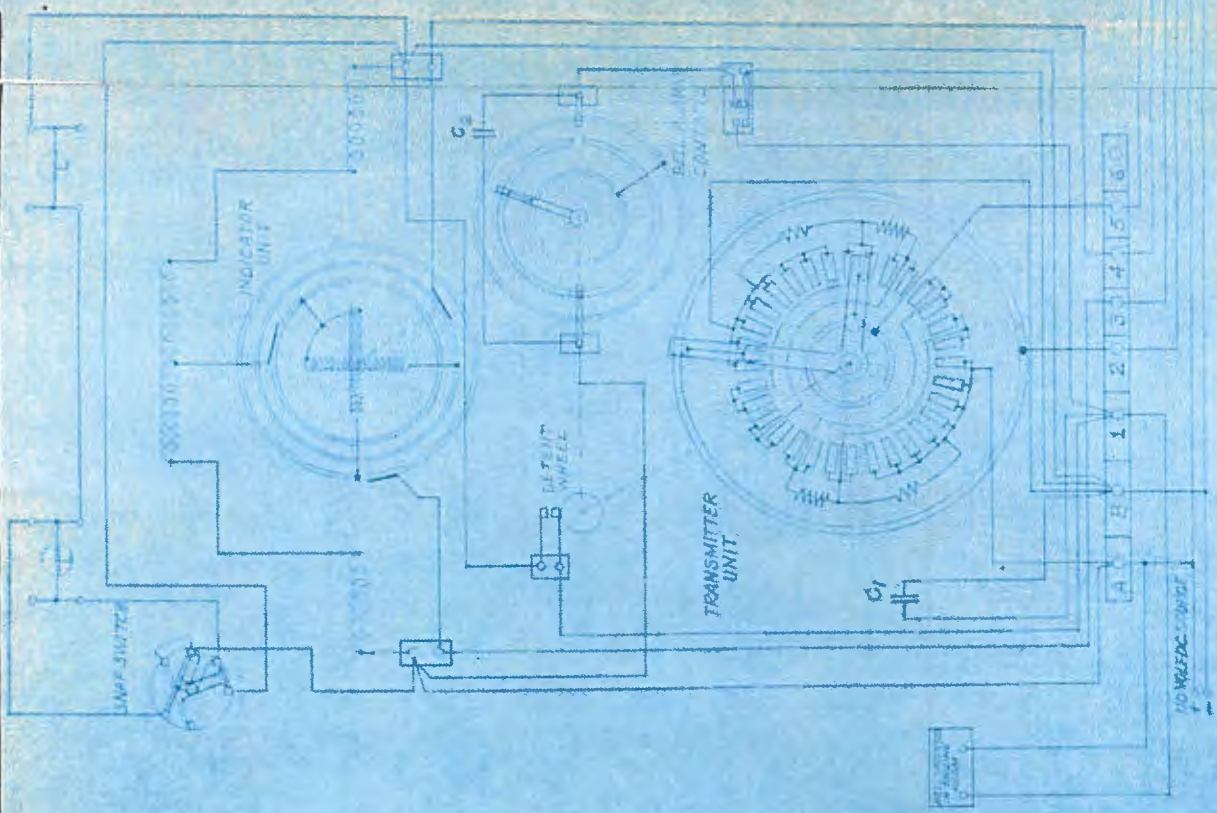
BELL MOUNTED IN ENGINE ROOM

110 VOLT D.C. SOURCE
+
0
-

A B 1 2 3 4 5 6

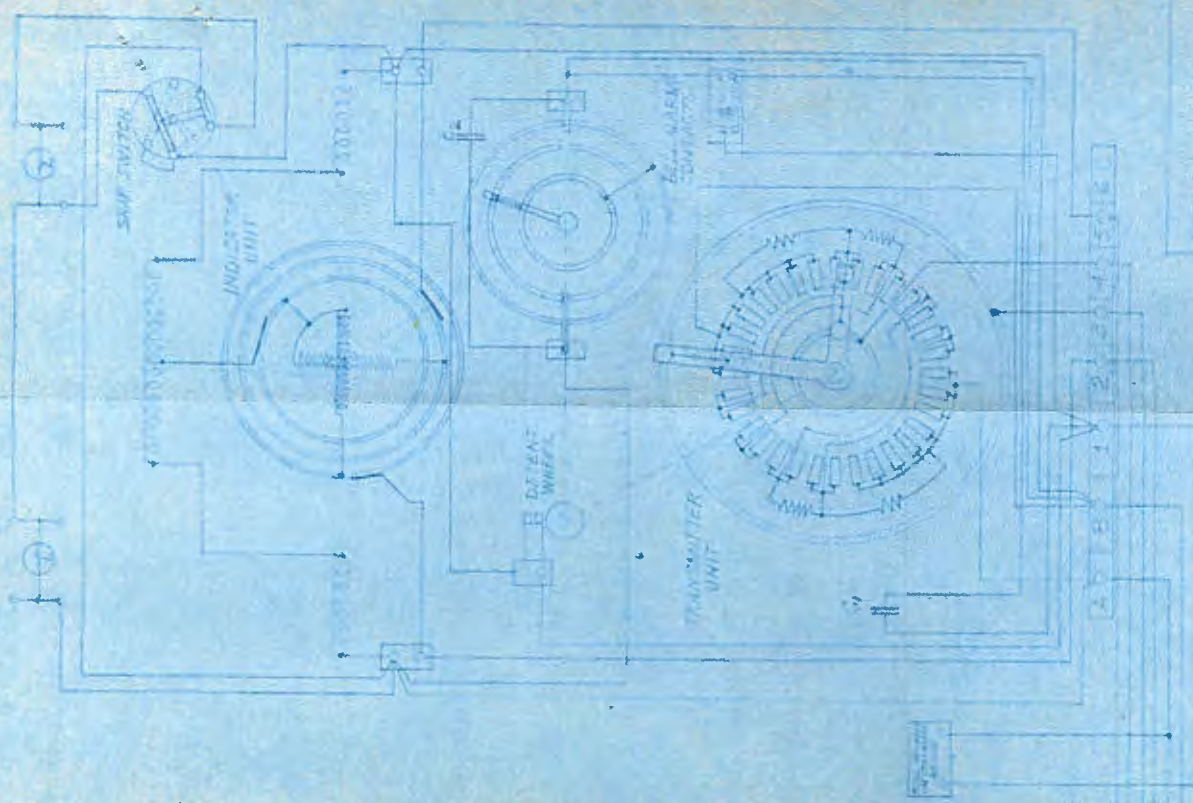
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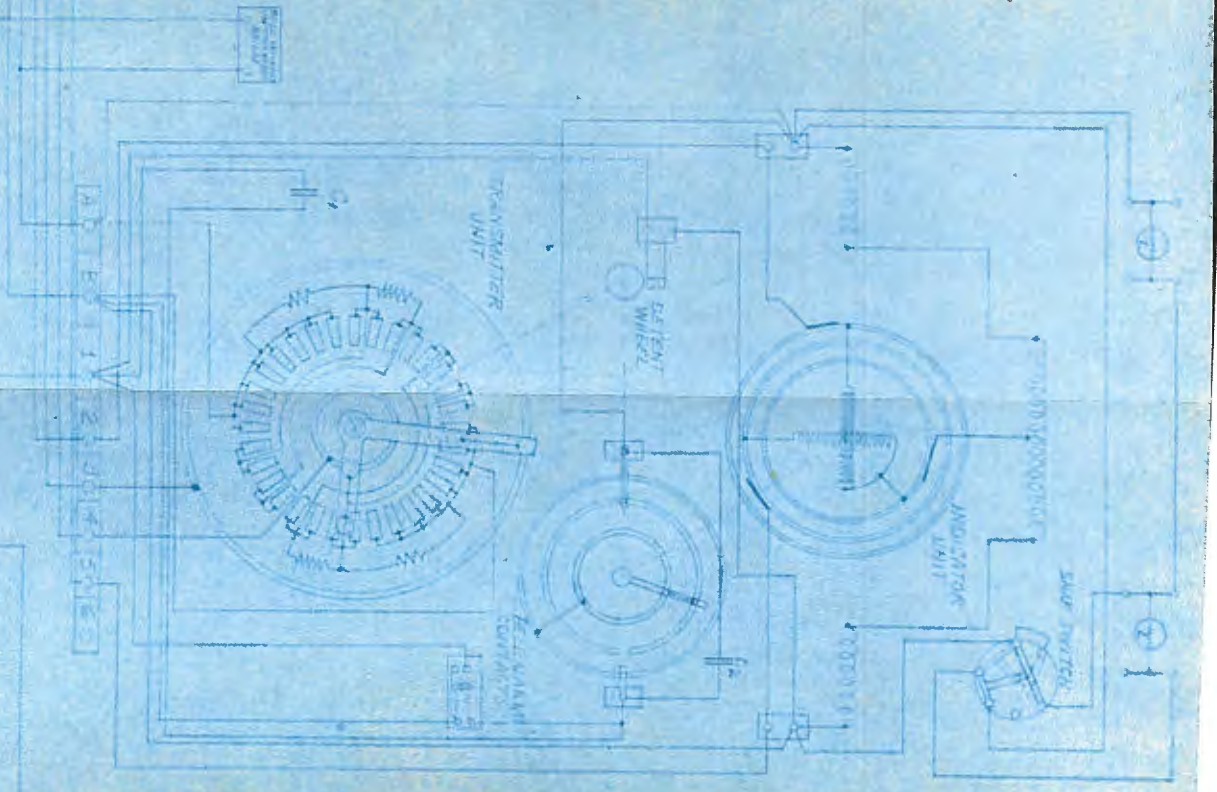
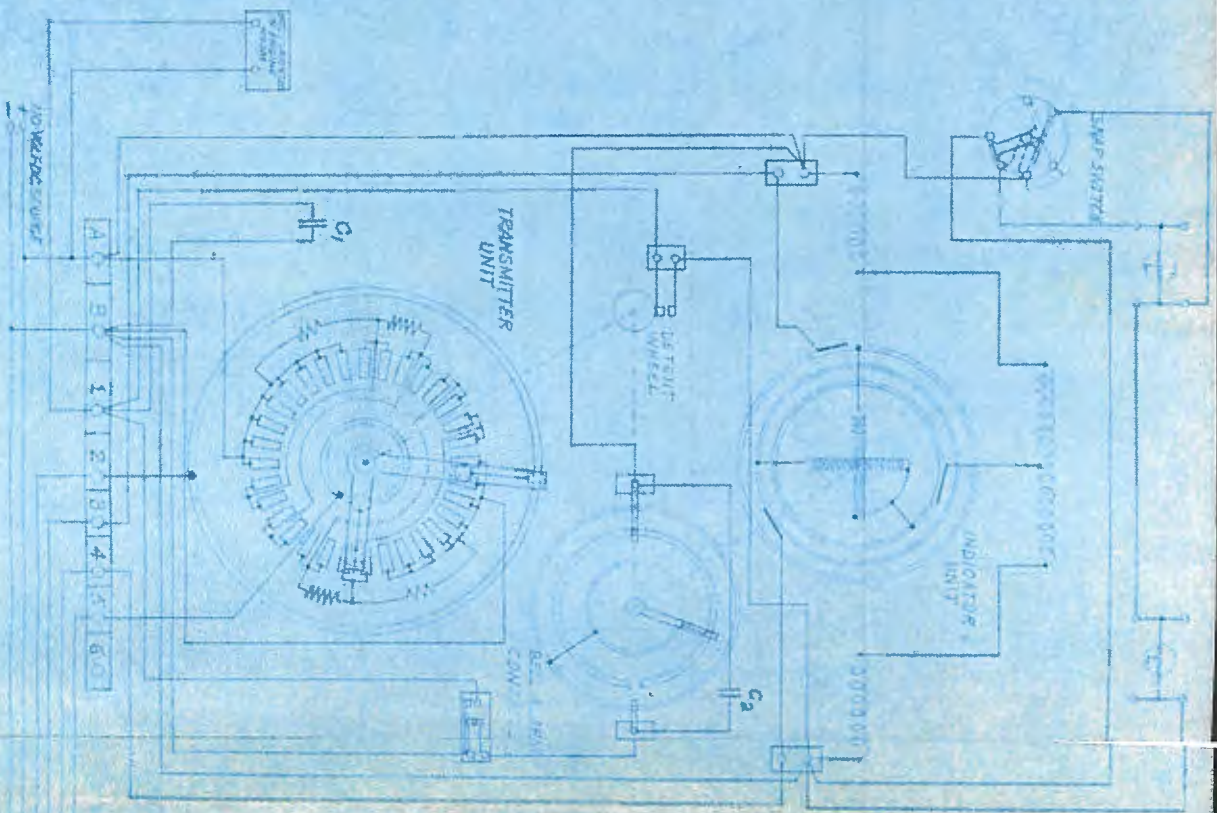
ENGINE INDICATOR WITH LAMP SWITCH

ENGINE INDICATOR
 P.S. 1275722
 SCHEMATIC DRAWING



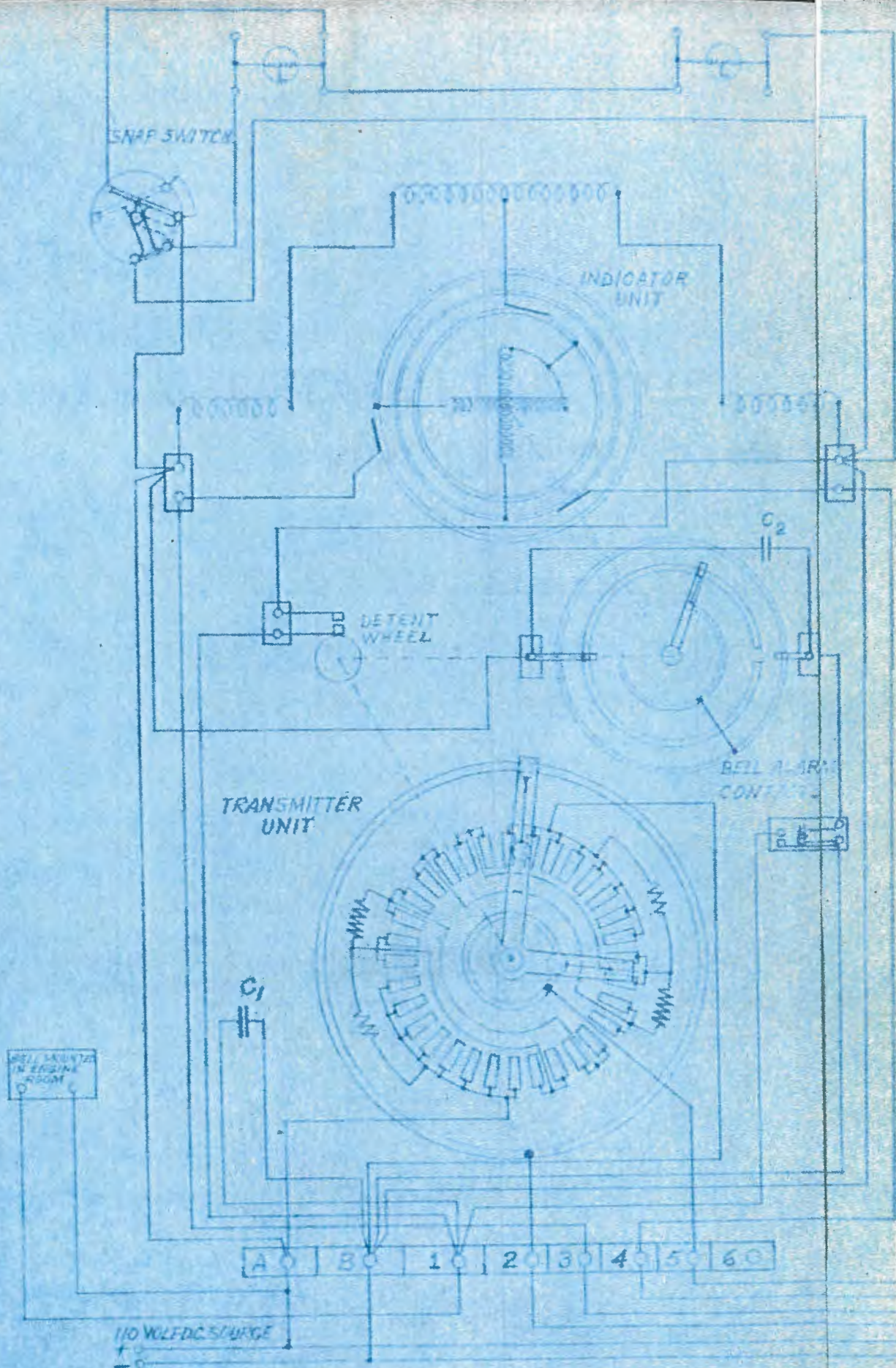
ENGINE INDICATOR WITH LAMP SWITCH

ENGINE INDICATOR
 P.S. 1275722
 SCHEMATIC DRAWING



ENGINE POINT-ENS GBD TRIMS INDICATOR

ENGINE OPER TRANSMITTER INDICATORS USE ALTERNATE



SNAP SWITCH

INDICATOR UNIT

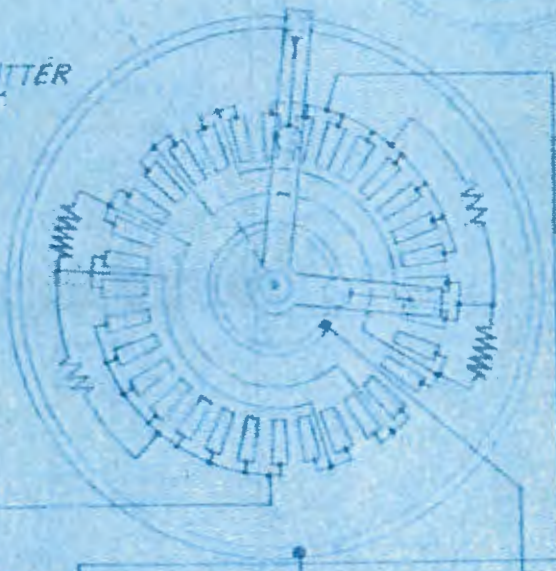


DETTENT WHEEL



BELL ALARM CONT.

TRANSMITTER UNIT



C1

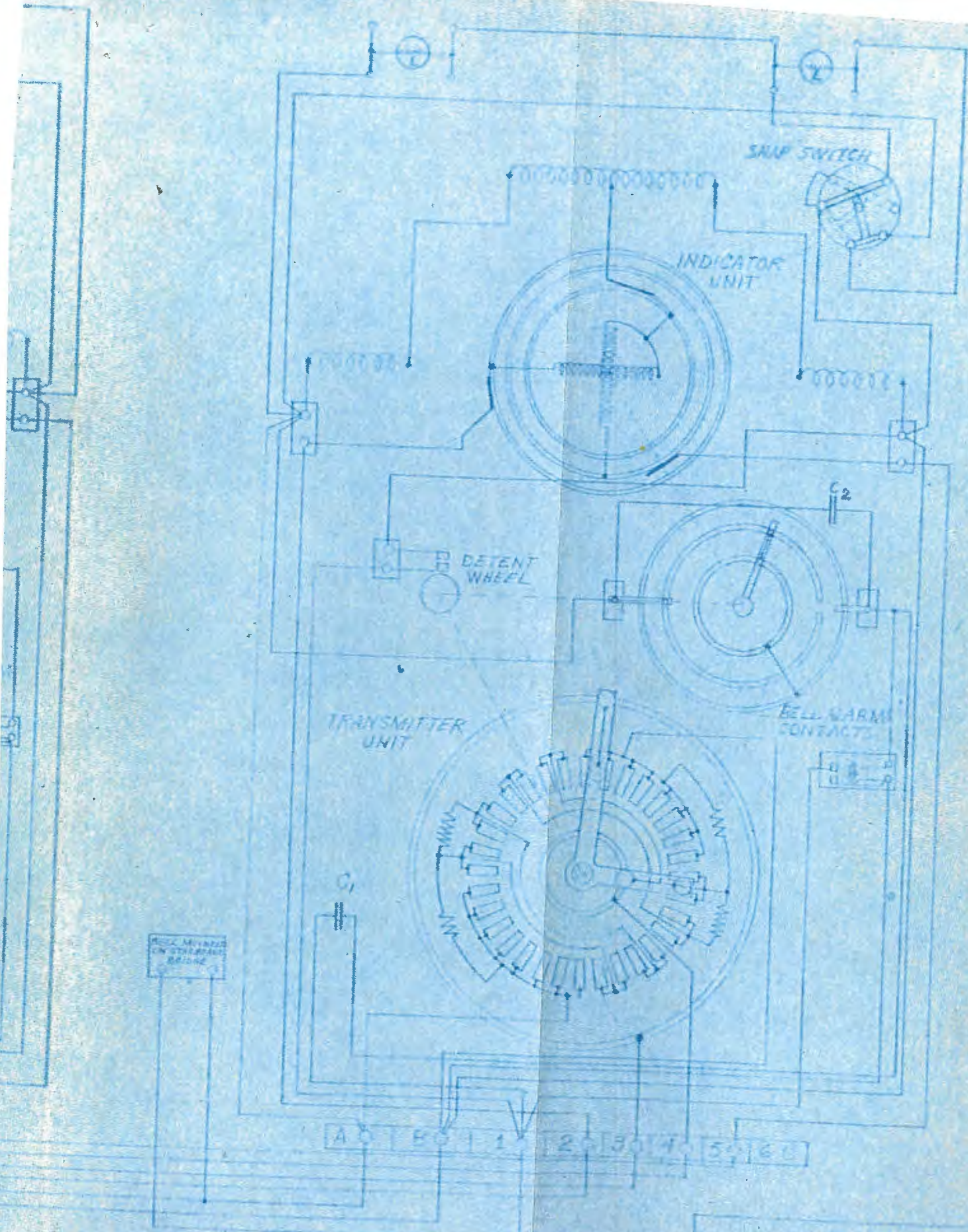
C2

BELL ALARM IN ENGINE ROOM

A B 1 2 3 4 5 6

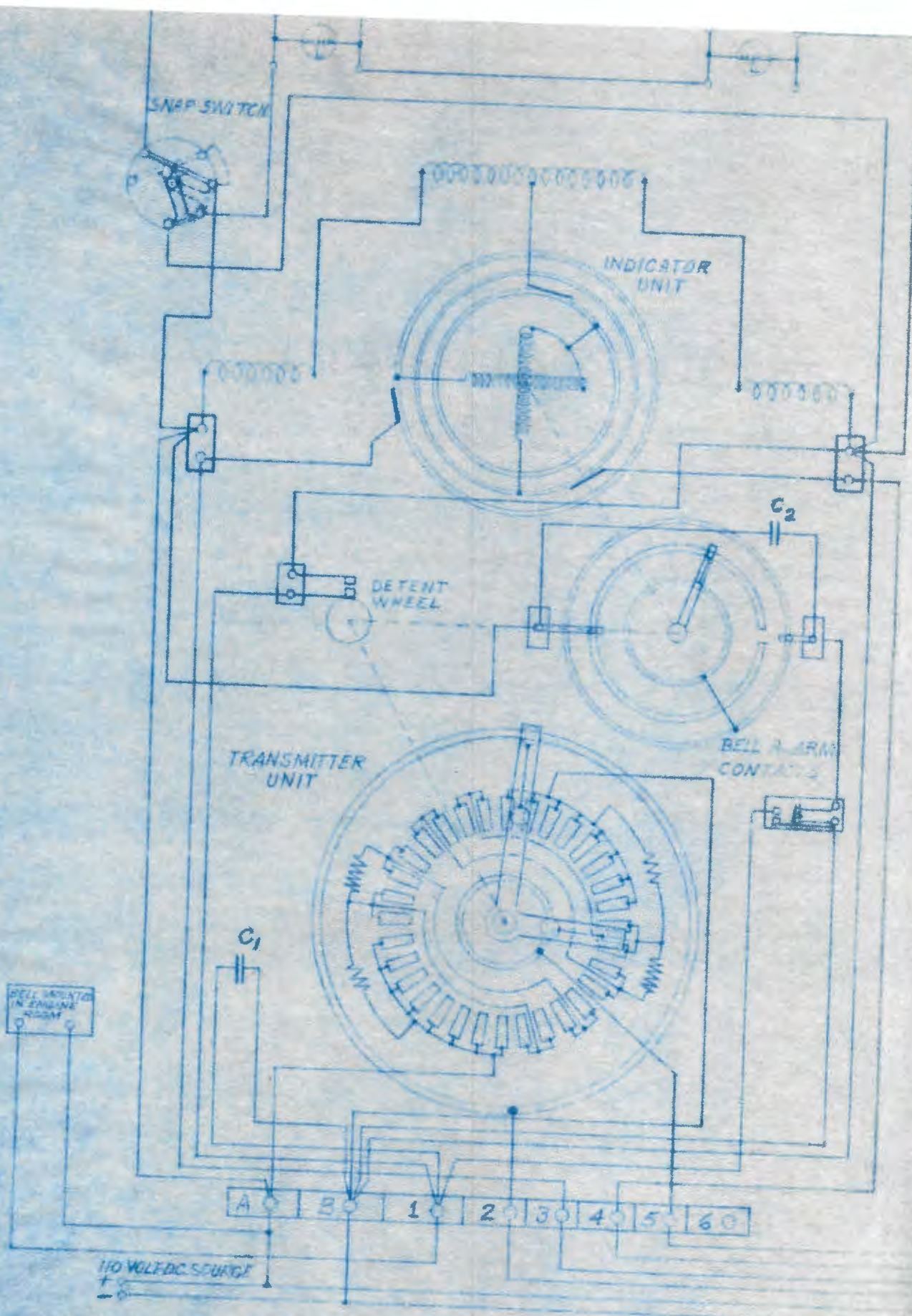
110 VOLT D.C. SOURCE

RR



ENGINE ROOM-ENG ORD. TRANS-INDICATOR
 PLATE 1

ENGINE ORDER TRANSMITTER
 INDICATORS
 USS LAFAYETTE
 SCHEMATIC DIAGRAM



STARBOARD BRIDGE-ENG. G.P.D. TRANS-INDICATOR