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Code and Sequencing System for Automatic Weather Stations

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ABSTRACT

Meteorological and oceanographic information is frequently required from critical areas where routine environmental observations are either not made or can be made only at considerable expense and time. As part of a continuing program to develop environmental telemetering equipment for obtaining data from remote or inaccessible regions, a code and sequencing system has been developed.

This system includes an analog-to-digital converter which employs a cyclic Morse-code number system. This number system eliminates all possibility of ambiguity as the output changes from any digit to any other digit. The code and sequencing system consists of a multiplexer, encoder, and parallel-to-serial code converter. The system translates the resistance of transducer elements to Morse code; its output is a contact closure at a rate of 17 words per minute. The information is in the form of three-letter groups. The first letter identifies the information channel. The second and third letters provide the transducer readout which will be one of 196 possible two-character words.

PROBLEM STATUS

This is an interim report on one phase of the problem; work is continuing on this and other phases.

AUTHORIZATION

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CODE AND SEQUENCING SYSTEM FOR AUTOMATIC WEATHER STATIONS

INTRODUCTION

The need for global weather information has continued to increase in importance over the past ten years. This growing need for complete coverage puts a strain on the current manual methods of gathering environmental data. To meet this increased demand for more data economically, with the higher level of accuracy currently required, the Navy has embarked on a program to develop automatic observing systems.

As this program has progressed, a number of approaches to the problem of gathering and making available meteorological and oceanographic information automatically have been pursued. Some of these have been: store the data and physically retrieve the records periodically for review, store the data and collect it via land line on a schedule or on command, collect and transmit data automatically on schedule by radio telemetry, or collect and store data and then transmit by radio telemetry when commanded by a radio signal.

Various scientists have worked in the field previously, but the coding and telemetry system have been of secondary interest to them. Each of the coding and telemetry systems used has been different and was developed only to the degree necessary for the individual experiment. Based on a review of these coding and telemetry systems, the principles used in the telemetry portion of the AN/GMT-1(XG-1) (1,2) offered the most promising concepts. Therefore, they have served as a point of departure for the development of the present device. The Morse-code message format used was chosen because it is reasonably economical of power, has adequate resolution, can be monitored either manually or automatically, and is compatible with existing major communication systems. The equipment described hereafter has been designed and developed to give the scientist a proven device with a high degree of versatility. This will relieve him of the necessity for the engineering of an important portion of the telemetry system.

THE CODE AND SEQUENCING SYSTEM

The code and sequencing system (NRL drawing D3437, Appendix A) consists of two essentially separate electromechanical units (see Fig. 1 and the block diagram, Fig. 2) as follows:

1. The code-generator, call, sequencing, and clock-switch unit (NRL drawing D3441, Appendix B).

2. The code-selector unit (NRL drawing D3703, Appendix C).

These units are presently electrically connected and housed in a common container. There are three connections to the system; two of these make the necessary connections to operate the telemeter, and the third brings out leads for checkout and calibration purposes.

When the clock hour-hand wiper grounds A or B circuit, it closes the clock relay (Fig. 3). This energizes a 30-sec time-delay relay, giving the tubes in the telemeter

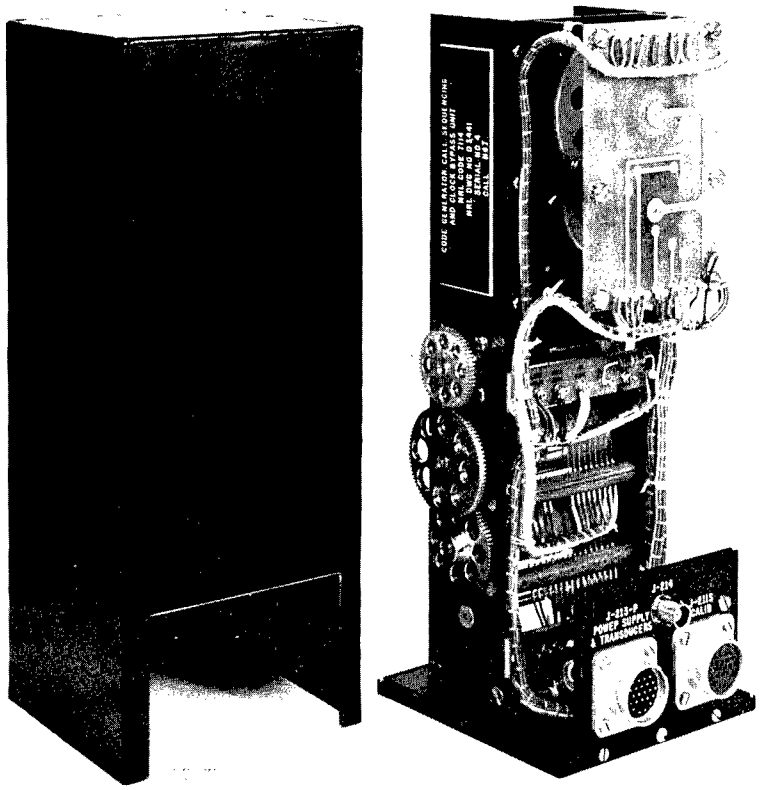

Fig. 1 - Code and sequencing system

time to warm up. At the expiration of this 30 sec, the internal programming system is activated and controls the equipment for the next 71 sec. During this time it generates a specific set of call letters, identifies the channels, samples five variables, and selects the corresponding code for each variable (Fig. 4). It operates the keying relay in the transmitter to communicate this information in Morse code by means of radio. Finally, this system turns off the telemeter and itself so that it is synchronized properly for the next transmission.

The system is designed to accommodate either 0 to 2000 ohm elements or 2500 to 4500 ohm sensing elements. The electrical requirements for these elements are described in the bridge-circuit section of this report. This system will accommodate a variety of transducer elements when the appropriate signal-conditioning equipment is used. A typical response is shown in Fig. 5.

The code-generator, call, sequencing, and clock-switch unit is turned on by the time-delay relay. The motor on this unit turns a call and code drum at 17 rpm for 20 revolutions, a sequencing or multiplexer drum at 0.85 rpm for one revolution, and a clock-switch drum at 0.2125 rpm for 1/4 revolution. A clock-switch vernier is also used and is directly connected to the call and code drum. For the first five revolutions of the call and code drum, the call portion of this drum is connected to the keying relay, and the station transmits its assigned call letters once per revolution as a three-digit Morse-code group. For the last 15 revolutions, the information section of the drum is connected, and the station transmits Morse-code letters which identify a meteorological variable and give its value. The information is given as a three-letter group, formed in

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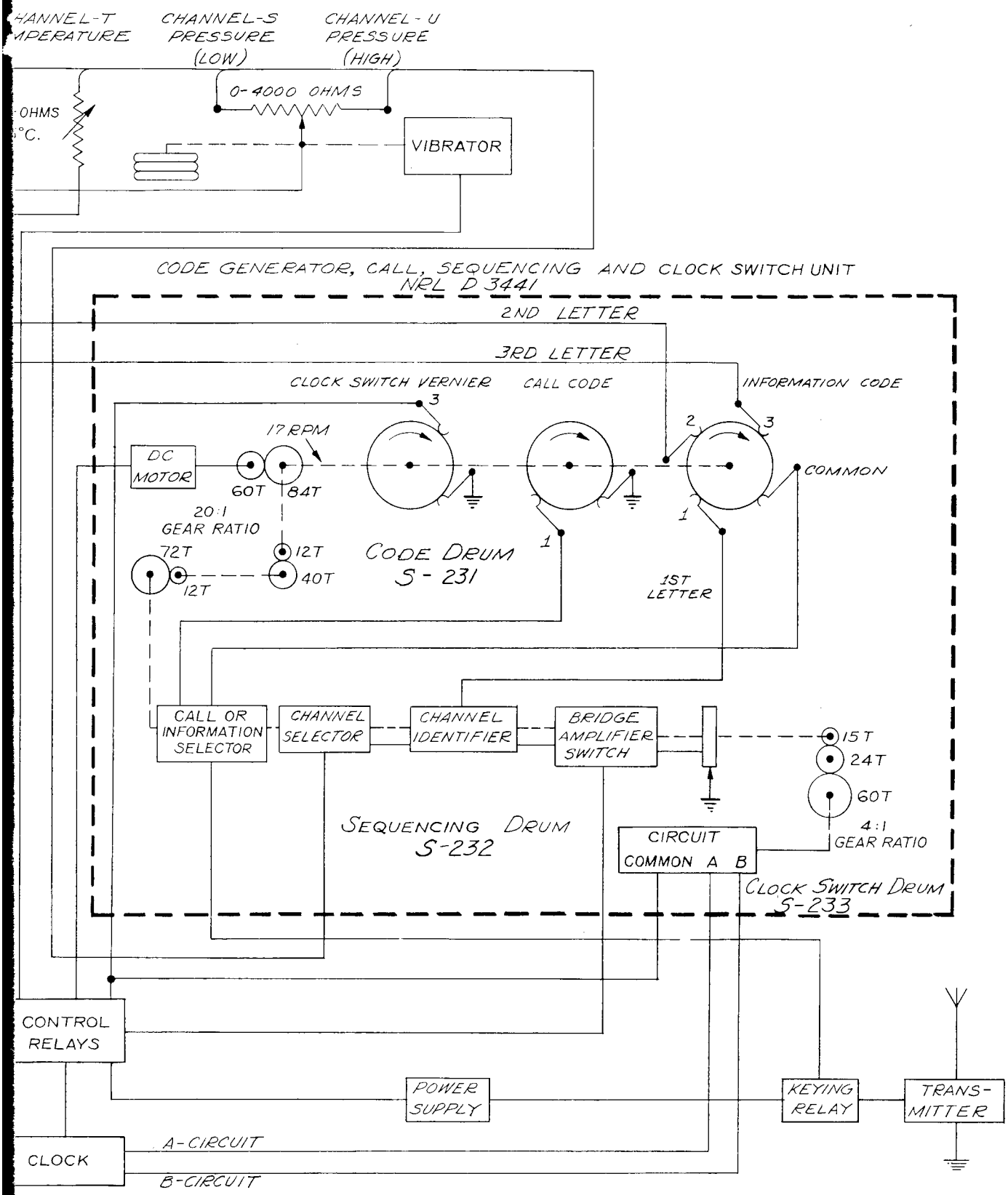

ode and sequencing system

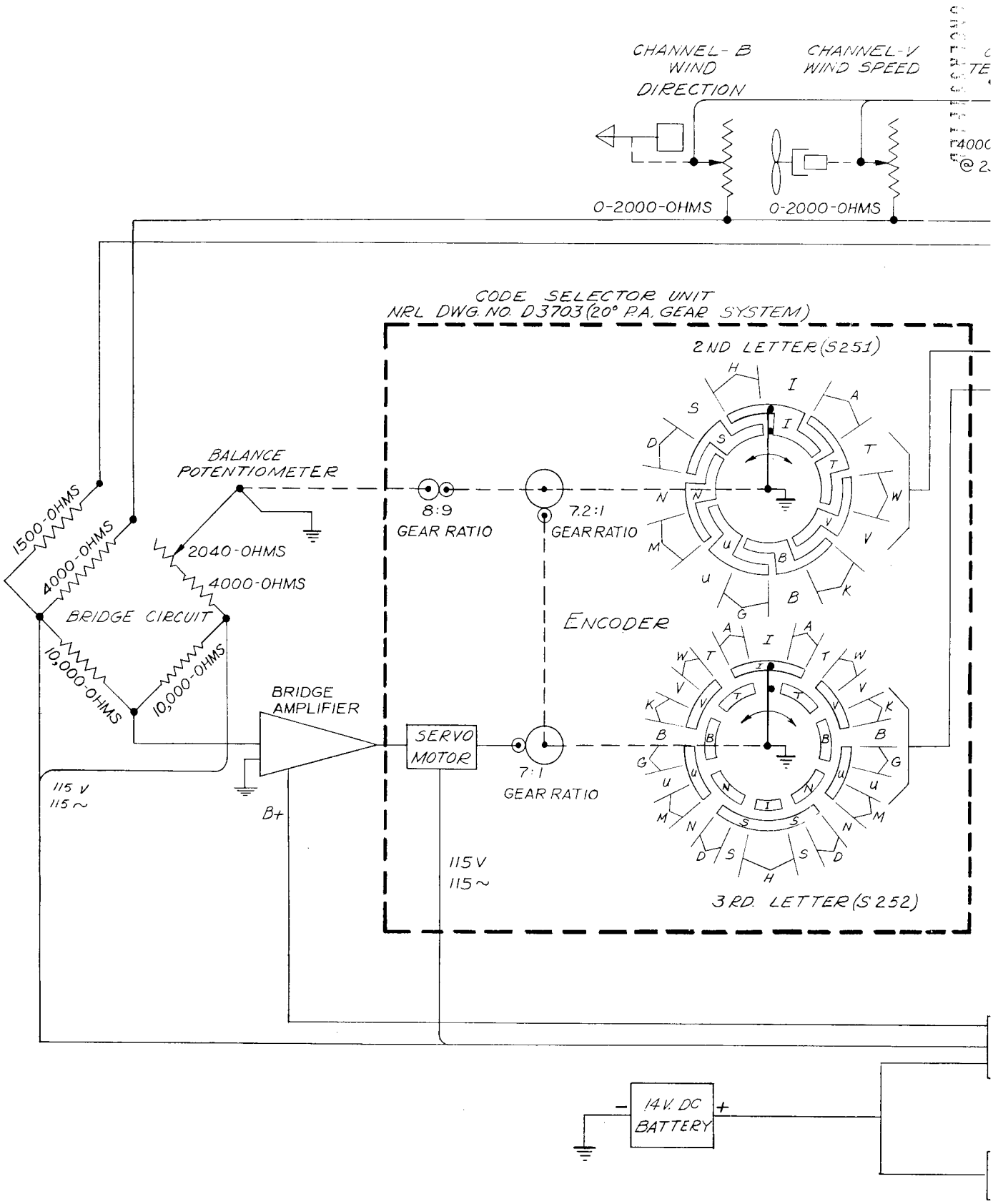

Fig. 2 - Block diagram of c

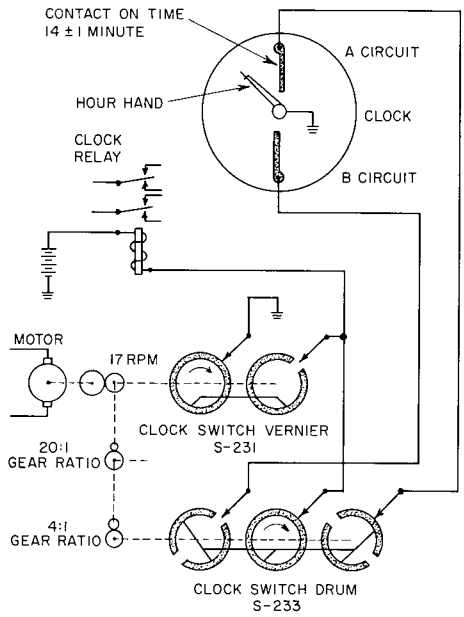

Fig. 3 - Clock-circuit schematic

Transmission Sequence			
Order of Transmission		Times Repeated	Time On in Min.
	Warm-up	1	1/2
1	Call	5	5/17
2	Channel - B	3	3/17
3	Channel - V	3	3/17
4	Channel - T	3	3/17
5	Channel - S	3	3/17
6	Channel - U	3	3/17
Average Time Station On - 1 Min. 40 Sec. Average Time Transmitting - 1 Min. 10 Sec.			

Fig. 4 - Program of system and transmission sequence

one revolution, and each group is repeated three times. This allows the measurement of five different variables.

The transfer from call to information is made by the sequencing drum. This drum also selects the first letter of an information group and so provides an identification of the variable being measured. At the same time it connects the appropriate sensor to the measuring circuit, and turns on the code selector to make the measurement. After four seconds the servo system is turned off, so that no change in value is possible during readout. The preceding action is repeated for each of the five information groups. When

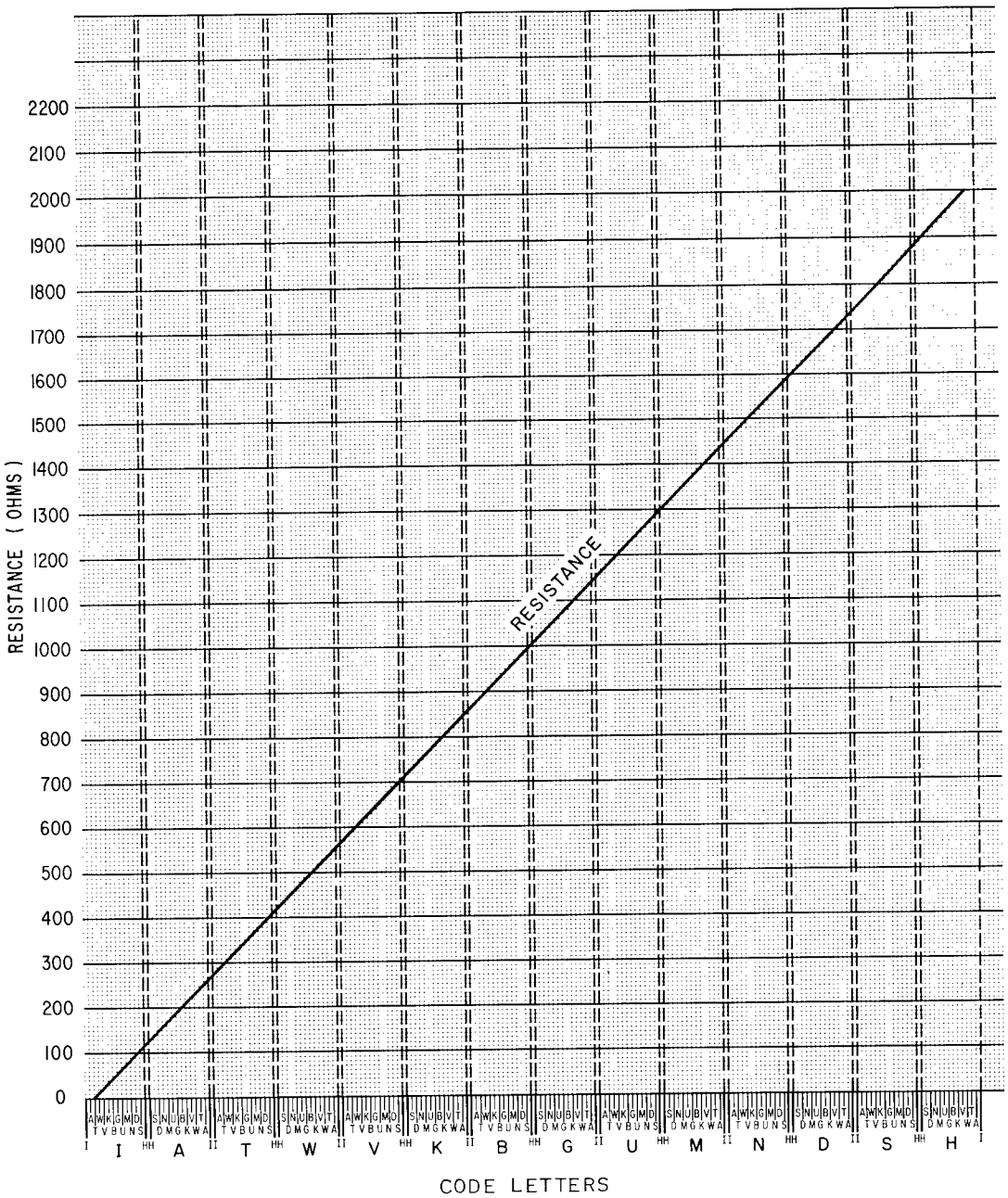

Fig. 5 - Typical response curve, code letters vs resistance

the last information has been transmitted, the station is turned off in a manner that will enable it to respond to a contact made to the alternate clock circuit. This is accomplished by the clock-switch drum and the associated vernier drum.

When the code selector is turned on by the sequence drum, the servo motor drives a balance potentiometer to a position where its resistance equals that of the sensor. The motor shaft is also geared to a shaft-position encoder which selects the second and third letters of the information group. The second letter is the coarse or most significant letter; the third is the fine or least significant letter. Each letter may have 14 values, giving a total of 196 possibilities. No ambiguity is possible at any value, and the mechanical accuracy is one-fifth of a fine letter or better. Balance is accomplished in 1.2 seconds.

THE CODE-GENERATOR, CALL, SEQUENCING, AND CLOCK-SWITCH UNIT

The code-generator, call, sequencing, and clock-switch unit (NRL drawing D3441, Appendix B) has three commutators (Figs. 6, 7): (a) clock-switch vernier, call, and code drum, S-231, (b) sequencing drum, S-232, and (c) clock-switch drum, S-233. These drums are driven through a gear train by a 12-v dc governed motor whose output shaft rotates at 24 rpm. This motor is lubricated for a temperature range of -55°C to +71°C

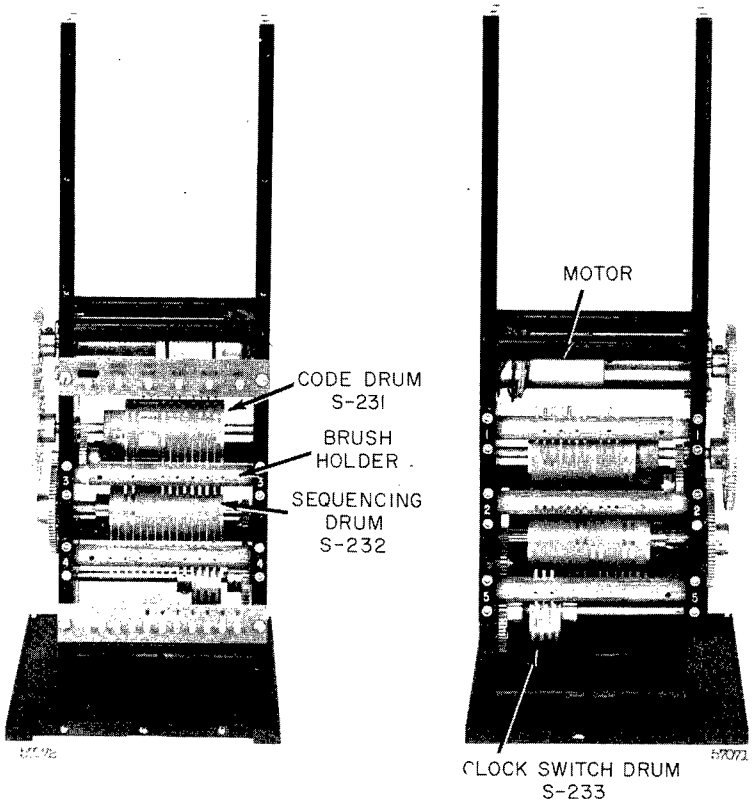

Fig. 6 - Code-generator, call, sequencing, and clock-switch unit

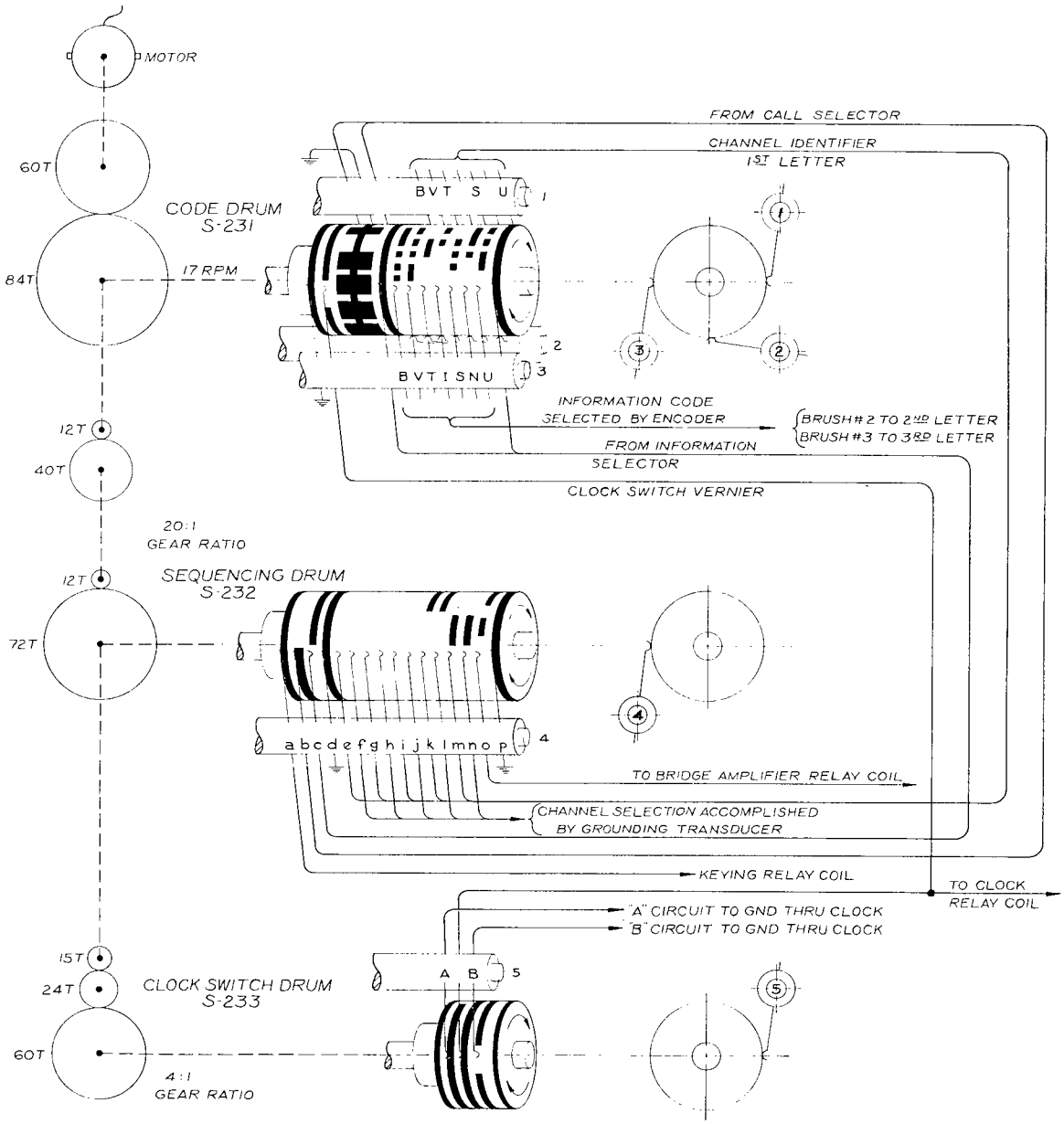

Fig. 7 - Block diagram of code-generator, call, sequencing, and clock-switch unit

and requires less than 280 milliamperes to run. The unit is designed so that the motor can be readily removed without disturbing any associated parts.

The Clock-Switch Vernier, Call, and Code Drum

The clock-switch vernier, call, and code drum has three sections, all insulated from ground (Fig. 8). This drum revolves at a rate of 17 rpm and turns 20 revolutions for one sequence of events. There are three sets of brushes (referred to as 1, 2, and 3) which contact this drum. These are spaced around the circumference of the drum so that there is 90 degrees between sets 1 and 2, 90 degrees between sets 2 and 3, and 180 degrees between sets 3 and 1. This results in a three-letter code group and a one-letter space formed by each revolution of the drum.

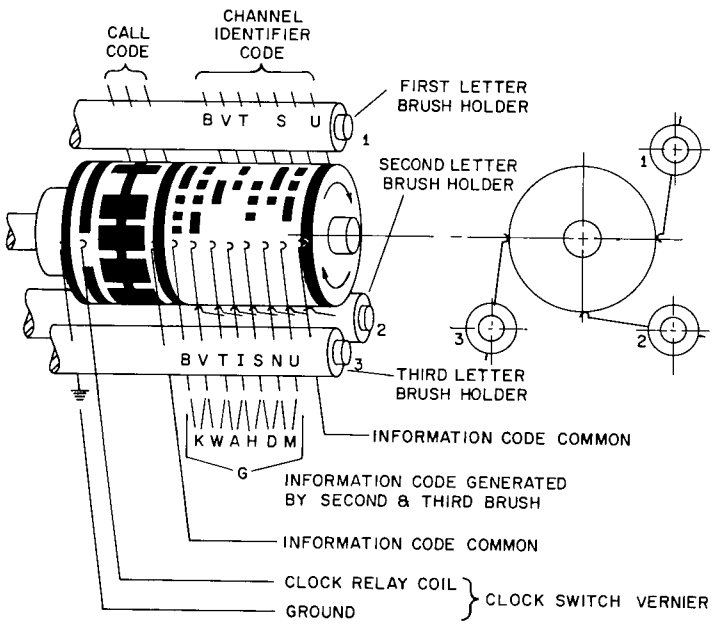

Fig. 8 - Clock-switch vernier, call, and code drum

To make the code, a one-inch-diameter drum is used. All the drums are designed so that they can be made either by machining or by photo-etching processes. To machine the drum, metal is cut away except for the contact areas; then the cut-away area is filled with nonconducting plastic, giving the brushes something to run on between the conducting areas. On the code drum, the bits and spaces are equal; this makes a bit 7 degrees 30 minutes long, a space 7 degrees 30 minutes long, and a dash, which is three bits, 22 degrees 30 minutes long. This results in a convenient set of dimensions to work with on the one-inch-diameter drum; the bits are 0.065 ± 0.002 in. long and the spaces are 0.065 ± 0.002 in. long. This makes it convenient to fabricate with conventional machine tools when the end mill is set up with its center line corresponding to that of the drum.

When the drum is turning at 17 rpm, a bit holds the keying relay down for 73 milliseconds. The key-down time is slightly longer than key-up time, due to the fact that the length of contact on the brush is added to the bit. This comes about because the brush touches the bit on one edge and leaves it on the other (Fig. 9).

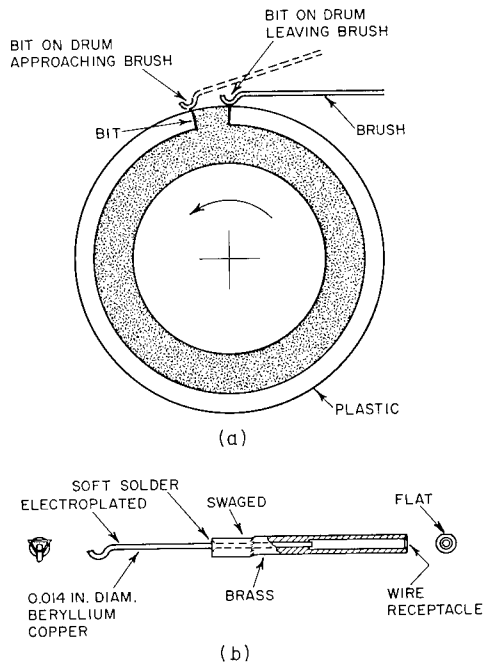

Fig. 9 - Details of code drum and brush

The wear is kept to a minimum by electroplating the brushes with 0.00005 to 0.00010 in. rhodium. The bits will become longer after the system has been in service for a long time. From experience so far, this would be in excess of 60,000 revolutions of the code drum, equal to two years' service of an equipment with five variables transmitting every six hours. The unit will need periodic checking and overhauling. For this reason, the unit is designed so that brush changing is quite simple.

The clock-switch vernier section on this drum is in parallel with the clock-switch drum. It acts as a precise switch to stop the system the following turn of this drum after the clock-switch drum breaks its contact to circuit A or B. This synchronizes the system properly for the next transmission. Its two brushes are located on brush holder 3, with one connected to the clock-relay coil and the other to ground.

The call-code section on this drum generates the call that identifies an individual telemeter. The call, assigned the system by the project engineer, is made by the brushes grounding bits (thereby closing the keying relay) as the drum passes. The call can be selected from a chart (Fig. 10) which shows the 260 calls assigned to the Automatic Systems Section of NRL. As the chart shows, 188 of these can be made by this mechanism. There are three call brushes wiping this drum, and they are located on brush holder 1. The common brush is grounded, and the other two are connected to the call-selector section of the sequence drum. The call is repeated five times during five revolutions of the drum.

The call code is made in three-letter groups, the first being a letter, the second a number, and the third a letter. To design call-code segments, the same geometry is used as for the information-code drum; that is, a dash equals three bits, spaces within letters equal one bit, and spaces between letters equal three bits.

The channel identifier and information code section of this drum has three sets of brushes contacting the drum, as previously described. Since there are three sets of brushes, three letters are made for each revolution of the drum. To send the information, this drum turns 15 revolutions, three revolutions for each channel, resulting in three repeats of the information. The end "common-ring" brushes connect to the keying-relay coil through the sequence drum call or information section. Code is made as the bits on the drum pass a wiper that is grounded by the channel identifier on the sequence drum or the code-selector wipers in the encoder. The first letter identifies the channel with five brushes in brush holder 1, connecting to the sequence drum. These are grounded independently in order to identify the five channels. These letters are B—wind direction, V—wind speed, T—air temperature, S—low pressure, and U—high pressure. The next two letters represent the quantitative information and are the second (coarse letter) and third (fine letter), with seven brushes each connected to the two commutators in the encoder. The encoder has two double-pronged radial displaced wipers. Each of these wipers grounds the appropriate brush lead or pair of brush leads from brush holders 2 or 3 on this drum to make the code selected for a particular variable (Fig. 11).

First Letter	Second Letter										Third Letter
	ϕ	1	2	3	4	5	6	7	8	9	
N	X	X	X	X	X	X	X	X	X	X	A
N			X	X	X	X	X	X	X		B
N				X	X	X	X	X			C
N		X	X	X	X	X	X	X	X	X	D
N	X	X	X	X	X	X	X	X	X	X	E
N			X	X	X	X	X	X	X		F
N			X	X	X	X	X	X	X		G
N		X	X	X	X	X	X	X	X	X	H
N	X	X	X	X	X	X	X	X	X	X	I
N					X	X	X				J
N			X	X	X	X	X	X	X		K
N			X	X	X	X	X	X	X		L
N		X	X	X	X	X	X	X	X	X	M
N	X	X	X	X	X	X	X	X	X	X	N
N				X	X	X	X	X			O
N				X	X	X	X	X			P
N					X	X	X				Q
N		X	X	X	X	X	X	X	X	X	R
N	X	X	X	X	X	X	X	X	X	X	S
N	X	X	X	X	X	X	X	X	X	X	T
N		X	X	X	X	X	X	X	X	X	U
N			X	X	X	X	X	X	X		V
N			X	X	X	X	X	X	X		W
N				X	X	X	X	X			X
N					X	X	X				Y
N				X	X	X	X	X			Z

Calls that are possible are indicated by $\boxed{X}$. Of the 260 calls that are assigned to NRL by CNO, Code OP943F, the call-letter chart shows the 188 that can be formed by the call-letter section of S-231 drum. Additional calls not assigned to NRL for automatic weather-station use can be formed by changing the first letter, using a letter rather than a number for the second letter, or by interchanging the orders of the characters making up the call.

Fig. 10 - Call-letter chart

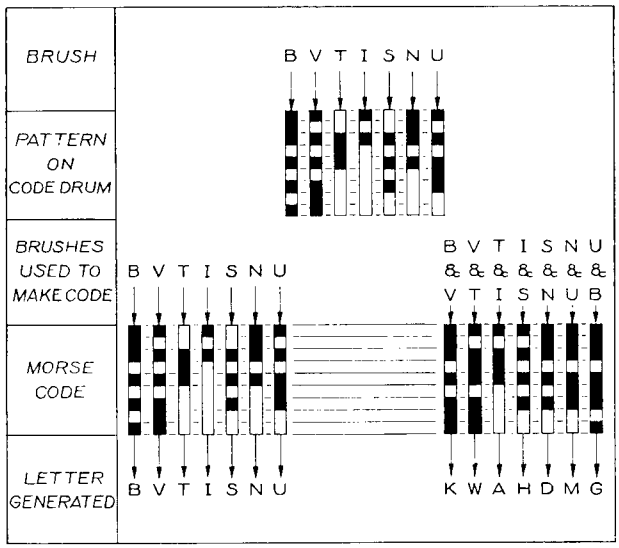

Fig. 11 - Code made by grounding brush leads

The Sequence Drum

The sequencing drum is essentially a multiplexer that performs several functions (Fig. 12). It turns one revolution for a sequence of events while the code drum turns 20 revolutions. The call is connected for 90 degrees, and the information is connected for 270 degrees; this drum switches the lead from the keying relay to accomplish this. In addition, three other operations are performed by this drum: (a) every revolution of the code drum connects to ground the brushes from brush holder 1 on the code drum to identify the channel of weather information being transmitted, (b) it connects the proper weather-transducer resistance element to ground, thereby placing it in the "unknown" leg of the bridge circuit, and (c) it applies voltage to the bridge circuit and bridge amplifier for four seconds as each transducer is connected. The last is accomplished by grounding the bridge-relay coil. The bridge amplifier is not allowed to stay on for the entire ten seconds each channel is connected, because four seconds is adequate time for the servo motor to balance (in fact, this is about twice the time normally needed). This makes it desirable to cut the amplifier and bridge off so that once the transducer has been sampled and its value encoded, slight hunting will not change the characters during readout. Further advantages are that this arrangement saves power and reduces heating in the transducer elements.

Clock-Switch Drum

The clock-switch drum turns one-fourth revolution for one revolution of the sequencing drum (Fig. 13). It has three brushes on one brush holder, with the center brush, common to alternate circuits A and B, connected to the clock-relay coil in parallel with the clock-switching vernier. The other two brushes are connected to the clock printed-circuit contacts A and B respectively, where they are grounded as the clock wiper on the hour hand passes. The drum is insulated from ground and is made so that it alternately connects A and B to the clock-relay coil. The drum is made so that the circuits are connected for a little less than one-fourth of a revolution, thereby allowing the clock-switch vernier to turn off the system. When the drum interrupts one circuit (A, for instance), it has already connected the other circuit (B) in order that the clock may turn

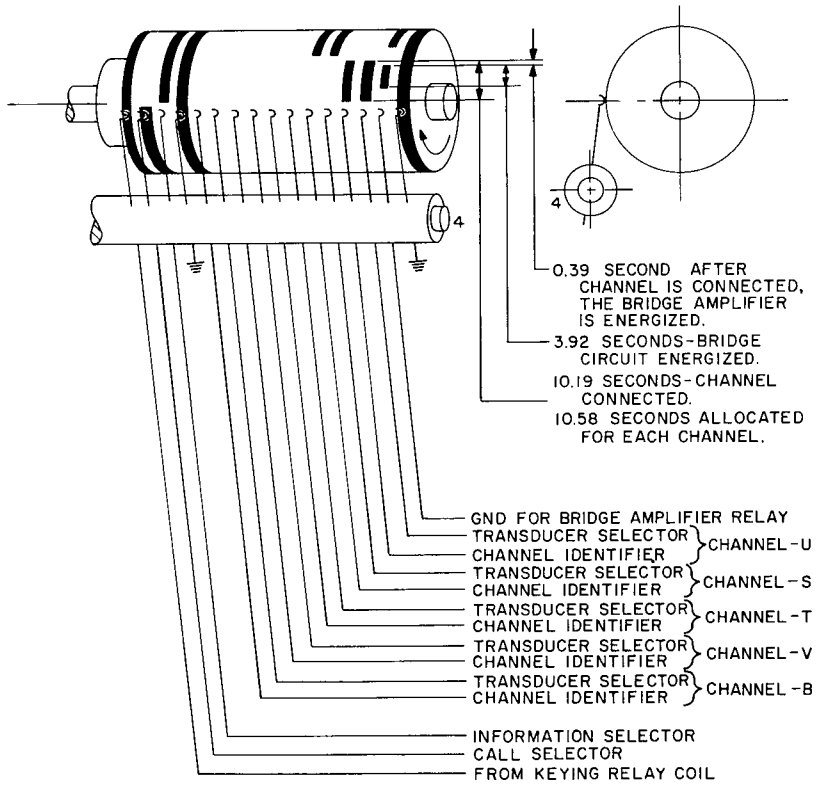

Fig. 12 - Sequencing drum (S-232)

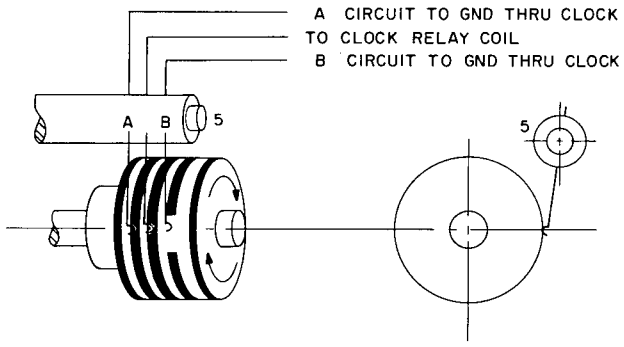

Fig. 13 - Clock-switch drum (S-233)

the system on when the hour-hand wiper grounds the B circuit. The clock hour-hand wiper has to remain connected to ground for a minimum of 100 sec. There is no limit on how long it remains closed, provided it is interrupted before the next circuit is made. A nominal clock hour-hand wiper connection is 14 ± 1 min for the system as it is presently designed; however, when a shorter contact duration is mandatory a latching relay is added to the circuit to accommodate this.

Drum and Brush Design

When manufacturing these drums by the machining process, the procedure required on the clock-switch vernier, call, and code drum should be the same as described earlier; however, the machinery system adapted for the sequence drum and clock-switch drum was to set one edge of the end mill to correspond with the center line of the drum to achieve the accuracy desired and reduce manufacturing cost.

The drums are designed as smooth cylinders to give the highest degree of code accuracy and long life. They are machined from commercial brass and flash nickel plated; then the sections are aligned and the unit potted with ceramic-filled epoxy plastic. After casting, the drums are cured four hours at 50°C, then rough turned and ground to a finish of 16 microinches rms. This is followed by electroplating rhodium on nickel. The nickel plate is 0.00025 to 0.00050 in. thick, and the rhodium plate is 0.00005 to .00010 in. thick. The drums are checked dimensionally, then tested for run-out, finish, and continuity before they are assembled; they remain stable at low temperatures, and have not shown any effect from low-temperature exposure.

The brushes (Fig. 9) have a rating of 200 milliamperes at 12 v dc. They are assembled with 15 to 25 grams contact pressure on the drums. Each drum is wiped with DC5 compound to control the freezing of condensation on the drum's surface. The brushes are each precisely aligned in the brush holders, and the assembly is installed to give the required initial contact pressure. The drums are synchronized with the aid of a testing and synchronizing unit; then the drums and gears are pinned to the shafts.

CODE-SELECTOR UNIT

The code-selector unit described in NRL drawing D3703 (Appendix C) and shown in Fig. 14 contains the shaft-position encoder, balancing (servo-drive) motor, and the balancing potentiometer. This unit makes up part of an integrated code-selection system (Fig. 15) for automatic weather stations. This system is an analog-to-digital converter and employs a cyclic Morse-code number system. It consists of a multiplexer, a bridge circuit, a signal amplifier, a balancing motor with appropriate gearing, and an encoder. To understand fully the operation of this code-selector unit, the system and the associated components in the loop will be described briefly.

This system translates the resistance of five weather transducer elements to Morse code; it has an output of a contact closure at a rate of 17 words per minute in three-letter groups. The encoder contacts have a rating of 200 milliamperes at 14 v dc. The multiplexer connects each transducer in turn to a self-balancing Wheatstone bridge, which is utilized as the resistance-measuring device. The resistance of each transducer is connected in the "unknown" leg of the bridge circuit. The "known" leg of the bridge circuit contains the balancing potentiometer. This potentiometer is driven in the proper direction by the two-phase, servo-type motor through an appropriate gear train until a null occurs in the bridge circuit. At the same time the encoder is positioned; this permits the simultaneous measurement of the "unknown" and the encoding of its value. An amplifier is employed to operate the servo motor from the bridge signal. The potentiometer position at null is linearly proportional to the bridge input resistance.

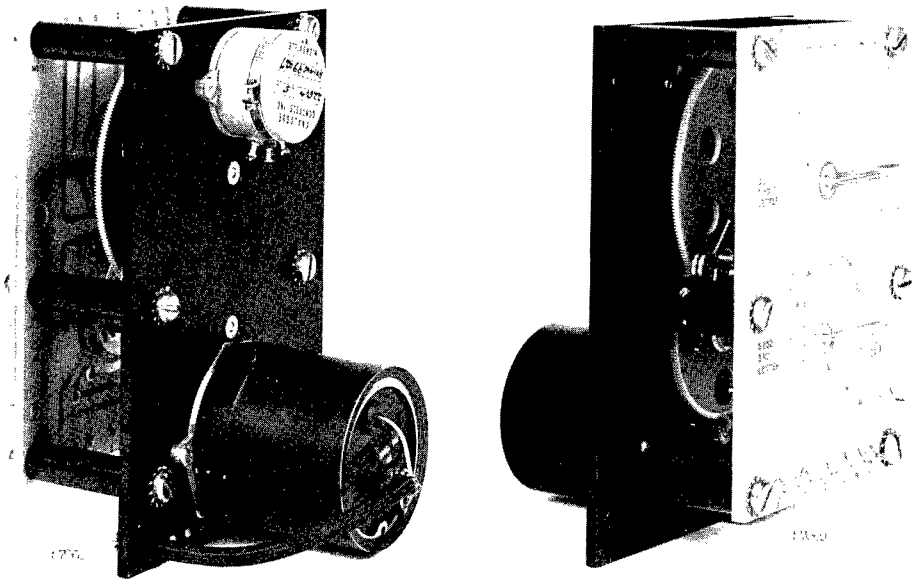

Fig. 14 - Code-selector unit, two views

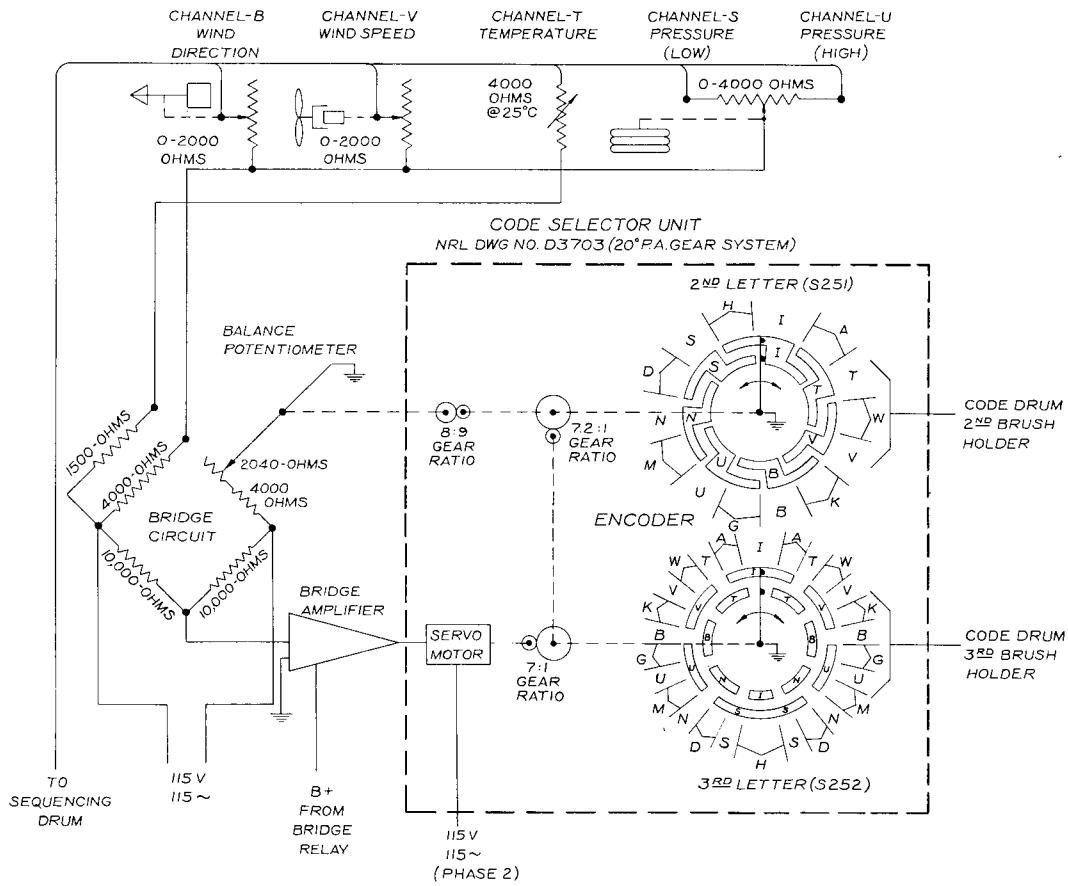

Fig. 15 - Block diagram of code-selector unit and associated components

Code Selection

The encoder shaft position is converted to Morse code by the location of two brushes on each side of the two commutators (Fig. 16). One character is selected by these wipers from each commutator. The brushes rotate with the brush shaft for one commutator connected by gears to that for the other commutator, so that the least significant digit passes through a complete cycle for each value of the most significant digit. Fourteen Morse-code characters are utilized in the system. Successive code is generated by a single contact change to make a new value. Further, the change in value of the most significant character occurs at a time when the least significant character is not changing. With this arrangement no ambiguities are possible. This technique has a distinct advantage, and is believed to be the most advanced in this field of encoding.

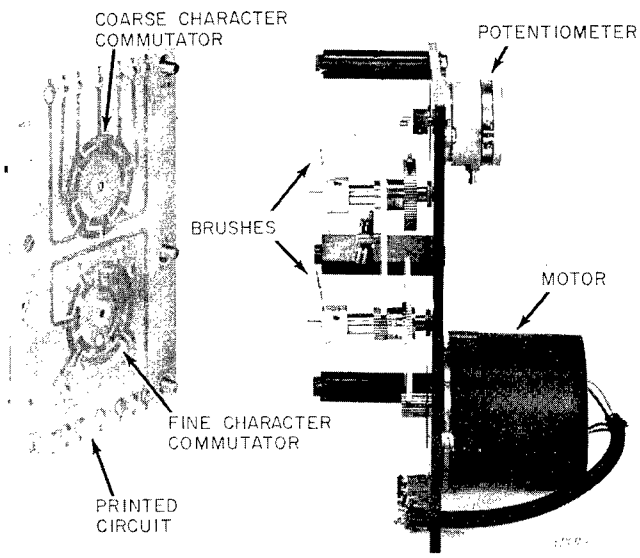

Fig. 16 - Encoder, printed circuits, brush assembly, and gear train

The circuit is arranged so that the grounded commutator segment is utilized as the output. This output is in the form of contact closures between a common ground and 14 output leads. Seven of these leads are used for the least significant digit, and seven for the most significant digit. A digit may be made by a single closure to one of these leads or by closures to two leads. In the latter case, the possible combinations are restricted to seven specific pairs. Each digit then may have 14 values, seven made by connecting one of seven wires to a common and seven made by connecting two consecutive wires to the common. These leads are connected to the code-drum brushes; this allows the keying relay to be actuated as the Morse-code pattern on the drum is rotated past these brushes (Fig. 17).

Code Generation

The code-drum or serial readout (described under the code-generator, call, sequencing and clock-switching unit) converts the output of the encoder to real-time Morse code. It does this by means of seven brushes for each digit. The surface of the drum on

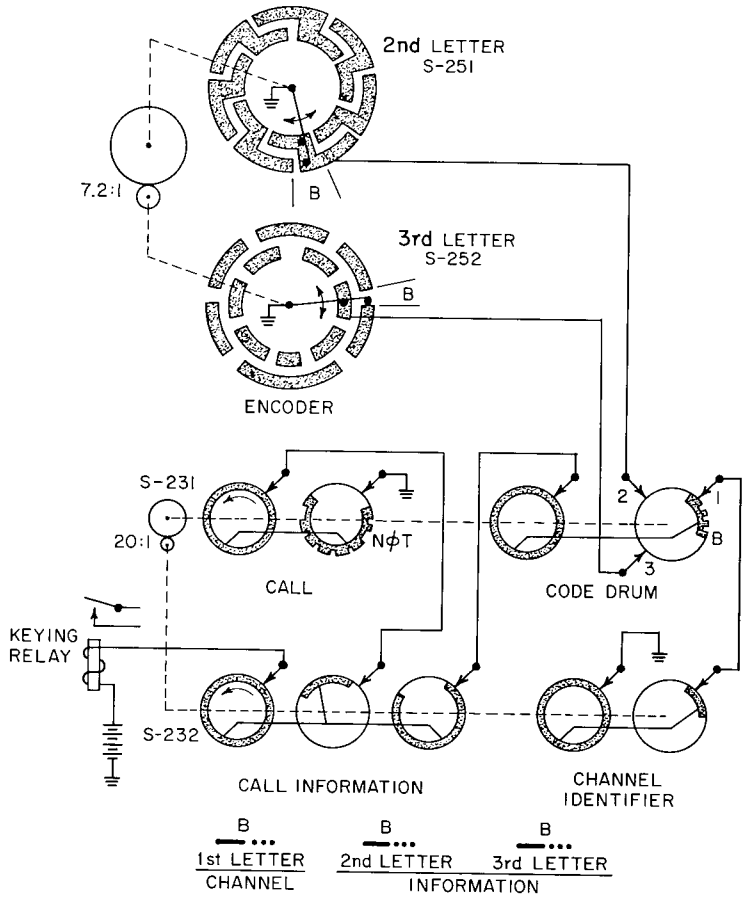

Fig. 17 - Keying circuit for typical transmission

which each brush rides is configured to generate a discrete Morse character when the drum is revolved. This provides seven values for this digit corresponding to the seven outputs of the encoder which are one-wire closures. By properly selecting and phasing two Morse characters on the drum surface, and connecting both simultaneously, a third character may be formed (Fig. 11). It is by this process that the additional seven values are provided corresponding to the two-wire outputs of the encoder.

The digital output from this unit is 14 different Morse characters formed for the least significant digit and the same for the most significant digit, giving a total of 196 two-character pairs (Fig. 18). These two characters make up the second, or coarse, letter and the third, or fine, letter on each channel of the weather information.

Bridge Circuit

The Wheatstone bridge (Fig. 19) is used to measure the resistance of the transducer element. The bridge operates on 115 v, 115 cps, and requires a current of approximately 16 milliamperes. The bridge has an output impedance of about 7500 ohms and generates a signal of not more than 12 volts into an open circuit.

*1st letter channel identification
2nd letter (S-251)
3rd letter (S-252)

	H	I										
Stop												← Change-over point
	I	I	T	I	V	I	B	I	U	I	N	I	S	I
	I	A	T	A	V	A	B	A	U	A	N	A	S	A
	I	T	T	T	V	T	B	T	U	T	N	T	S	T
	I	W	T	W	V	W	B	W	U	W	N	W	S	W
	I	V	T	V	V	V	B	V	U	V	N	V	S	V
	I	K	T	K	V	K	B	K	U	K	N	K	S	K
	I	B	T	B	V	B	B	B	U	B	N	B	S	B
	I	G	T	G	V	G	B	G	U	G	N	G	S	G
	I	U	T	U	V	U	B	U	U	U	N	U	S	U
	I	M	T	M	V	M	B	M	U	M	N	M	S	M
	I	N	T	N	V	N	B	N	U	N	N	N	S	N
	I	D	T	D	V	D	B	D	U	D	N	D	S	D
	I	S	T	S	V	S	B	S	U	S	N	S	S	S
	I	H	T	H	V	H	B	H	U	H	N	H	S	H
														← Change-over point
	A	H	W	H	K	H	G	H	M	H	D	H	H	H
	A	S	W	S	K	S	G	S	M	S	D	S	H	S
	A	D	W	D	K	D	G	D	M	D	D	D	H	D
	A	N	W	N	K	N	G	N	M	N	D	N	H	N
	A	M	W	M	K	M	G	M	M	M	D	M	H	M
	A	U	W	U	K	U	G	U	M	U	D	U	H	U
	A	G	W	G	K	G	G	G	M	G	D	G	H	G
	A	B	W	B	K	B	G	B	M	B	D	B	H	B
	A	K	W	K	K	K	G	K	M	K	D	K	H	K
	A	V	W	V	K	V	G	V	M	V	D	V	H	V
	A	W	W	W	K	W	G	W	M	W	D	W	H	W
	A	T	W	T	K	T	G	T	M	T	D	T	H	T
	A	A	W	A	K	A	G	A	M	A	D	A	H	A
	A	I	W	I	K	I	G	I	M	I	D	I	H	I
														← Change-over point Stop
													I	I

*First letter channel identification is selected by sequencing drum (S-232).

Fig. 18 - Letter combinations made. This code mechanism is capable of selecting for transmission a total of 196 letter combinations.

The bridge circuit consists basically of two fixed legs and two variable legs. The variable legs are composed of fixed resistors in series with variable resistors. The combined resistance of the fixed resistor and the variable resistance of the weather transducer in that leg should be equal to the combined resistance of the fixed resistor and the balancing potentiometer in the adjacent leg.

The fixed resistors in the variable legs have a temperature coefficient of 0.002 percent per degree Centigrade, as do the fixed legs of the bridge. Their values were chosen to limit the current through the transducer element to 14 milliamperes, as well as to accommodate two varieties of transducer elements.

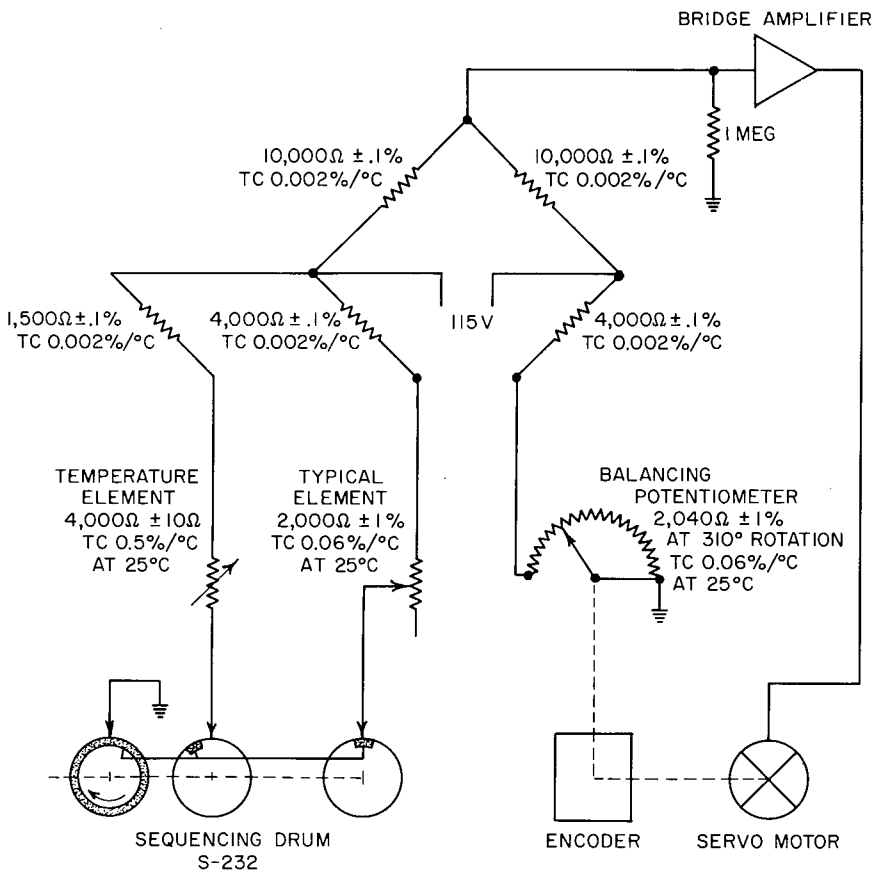

Fig. 19 - Bridge-circuit schematic

The system is designed to accommodate either 0 to 2000 ohm elements or 2500 to 4500 ohm elements, and it may be adapted for use with other inputs by appropriate signal-conditioning equipment. A 4000-ohm ±0.1 percent resistor with a temperature coefficient of 0.002 percent per degree Centigrade is used in series with 0 to 2000 ohm ±1 percent elements, which are usually in the form of a wirewound potentiometer with a temperature coefficient of 0.06 percent per degree Centigrade. With these elements, this leg of the bridge will vary from 4,000 ohms to 6,020 ohms. A 1500-ohm ±0.1 percent resistor with a temperature coefficient of 0.002 percent per degree Centigrade is used in series with a 2500 to 4500 ohm element. This is usually in the form of a resistance element that is sensitive to temperature. A typical value is 4000 ohms ±1/4 percent at 25°C with a temperature coefficient of 0.5 ± 0.005 percent per degree centigrade. With such an element, this leg of the bridge will vary from 4000 ohms to 6020 ohms over a temperature range of -58°F to +124°F.

The variable resistance of each transducer element is connected into the "unknown" leg of the bridge by the sequence drum, or multiplexer, in proper order as the station operates. Where the elements, except for the temperature element, are used in the proximity of the system, the temperature coefficient of the element should be matched to the balancing potentiometer to minimize the temperature correction needed. Where the transducers are used away from the system, a reference temperature element located with the remote transducers should be placed in one channel to provide a reference from which to make the necessary temperature corrections.

The fixed resistor in series with the balancing potentiometer in the other leg of the bridge circuit is 4,000 ohms ±0.1 percent with a temperature coefficient of 0.002 percent per degree Centigrade. This potentiometer is located in the code-selector unit, and is driven by the gear train of the encoder. This is a rotary type potentiometer with synchro type mounting for ease of adjustment. Its resistance is 2040 ohms ±1 percent at 25°C with a temperature coefficient of 0.06 percent per degree Centigrade; this resistance covers 310 degrees rotation of the shaft; the mechanical rotation is unlimited. This potentiometer has a 1-percent linearity, and a resolution of better than one part in one thousand over this region. The life expectancy of the unit is believed to be in excess of 1,000,000 balancing operations. Considering half of them to be in each direction, this corresponds to a continuous operating life of over 100 years in a system of five channels operating four times per day. The resistance of this potentiometer is varied by the gear train to match the resistance of the "unknown" leg of the bridge. This leg of the bridge will vary from 4,000 ohms to at least 6,020 ohms, for the lowest value the balance potentiometer can have, 2020 ohms, and will match the highest value the transducers can have. This combination will match the full range of the transducer to the full range of the encoder, 196 characters. Should both potentiometers vary in the opposite sense to the tolerance limit, the full range of the transducer will be encoded in 188 characters. This gives about ten ohms resistance and about five wire turns on the potentiometer for each of the 196 characters encoded.

When the balance potentiometer is driven to zero to match a low resistance in a transducer element or a shorted transducer element, the encoder gear train may encounter the mechanical stop, and will balance, in most instances, not more than one character from the stop. On the other hand, when the potentiometer is driven to a high value of resistance to match a high-resistance transducer, or an open circuit in a transducer element, the encoder gear train may again encounter the mechanical stop. Formerly, scattered readings of several characters in this region would indicate an open circuit. Now, under these conditions, hunting and pitch-off by the stop (when the amplifier is deenergized) are kept to a minimum by connecting the potentiometer tap located at the high end to the movable arm.

In order to insure that the resistors in the bridge circuit vary in the same direction and magnitude over the temperature operating range of the station, one must adhere to the resistance tolerances and temperature coefficients indicated in Fig. 19.

Bridge Amplifier

The bridge amplifier is one unit of the servomechanism system. Other units are an error detector and servo motor.

The error detector is the Wheatstone bridge circuit, which converts the difference between the input potentiometer and the balance potentiometer to a voltage signal. Its output impedance varies from 7,000 to 8,000 ohms, depending on the value of the variable. Since the functions of this bridge circuit have been described in an earlier paragraph, they will not be repeated here.

The electronic bridge amplifier converts the bridge signal to a form capable of driving the servo motor. This bridge amplifier consists of two resistance-coupled stages (Fig. 20). The first stage employs a 12AU6 pentode voltage amplifier tube whose grid receives the output signal from the bridge circuit. The grid resistor for the 12AU6 is one megohm, and this is substantially the input impedance of the amplifier. This stage amplifies the input signal to the level required to drive the power stage.

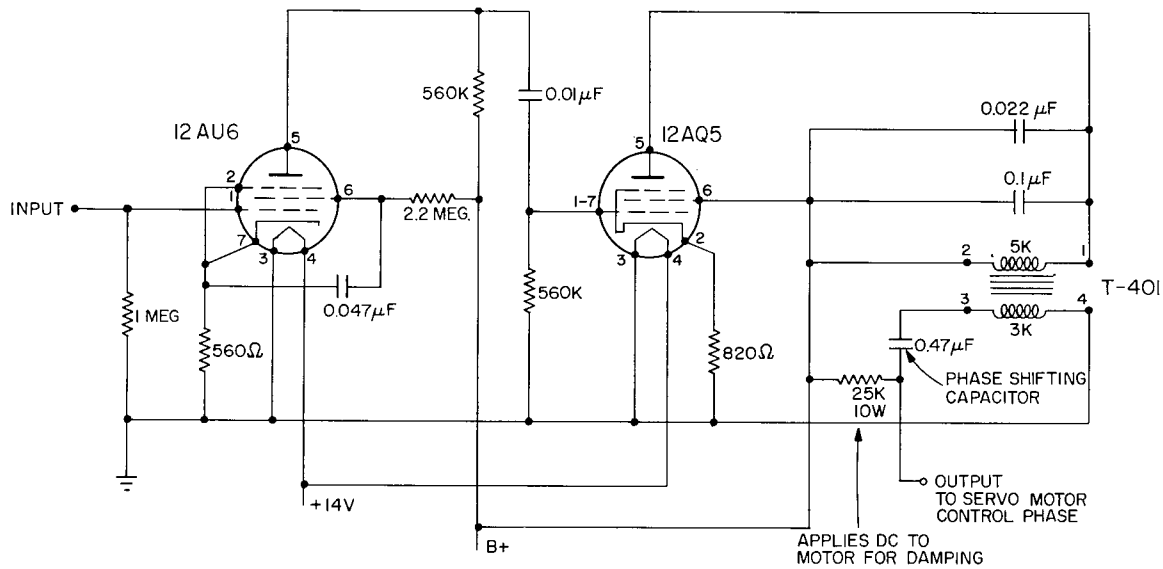

Fig. 20 - Bridge-amplifier schematic

The second, or power, stage employs a 12AQ5 beam-power output tube. The plate of this tube is coupled to the control field of the servo motor through an output transformer. This transformer is used to match the impedance of the 12AQ5 tube to that of the servo motor control field.

The 115 v at 115 cps applied to the bridge circuit, and to one field of the two-phase servo motor, are derived from the same source. Therefore, to operate the two-phase servo motor, the voltage applied to the control field from the output transformer has to have a phase shift of 90 electrical degrees with respect to the applied source. This is accomplished with a phase-shifting 0.47-μf capacitor in series with the output transformer.

To keep hunting to a minimum, some direct current (in the order of 14 milliamperes) is allowed to flow through the control winding of the servo motor, providing a degree of magnetic damping. This current flows from the B+ to the control field of the servo motor, after the phase-shifting capacitor, through a 25,000-ohm, 10-watt resistor.

The bridge voltage, servo-motor voltage, and the B+ voltage to the amplifier are applied by the bridge relay. The heaters of the tubes are energized when the station is turned on, and remain energized as long as the station is on. This bridge relay, controlled by the sequence drum, energizes these circuits for 3.9 sec for each variable. This is adequate time for the bridge to balance. The circuit on time is limited to 3.9 sec to keep the encoder from possibly varying characters during transmission, to conserve power, and to minimize heating of the transducers.

A signal of 20 millivolts is required to drive the servo motor. A change of two ohms in the variable leg is sufficient unbalance in the bridge circuit to cause the motor to move. The motor rotates the balance potentiometer through a gear train in the proper direction to balance the bridge circuit, thus reducing the voltage applied to the grid of the 12AU6 tube to near zero. The servo motor simultaneously encodes the weather variable.

Encoder

The encoder converts the position of the balance potentiometer shaft to Morse code. The fine-character-brush shaft is driven by the servo motor through a gear ratio of about 7 to 1. In turn, this shaft drives the coarse-character-brush shaft through a 7.2 to 1 gear ratio. Finally, the balancing potentiometer is driven through an 8 to 9 gear ratio by the coarse-character shaft (Fig. 21).

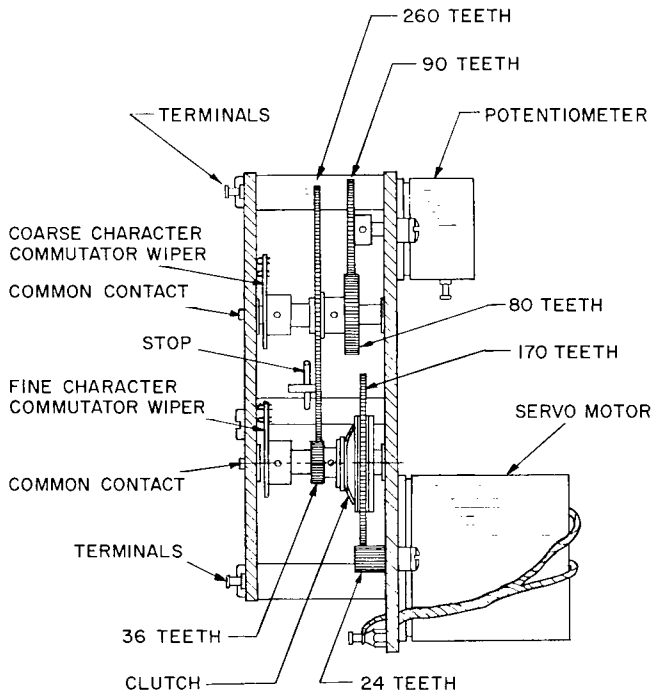

Fig. 21 - Encoder gear train

The potentiometer position is converted to cyclic Morse code from the locations of the two brushes on the commutators. The digital output of this encoder is 196 two-character words (Fig. 18).

The encoder has two commutator patterns on one side of a piece of flat, etched circuit material. Epoxy-glass plastic double printed circuit material is used for the basic encoder (Fig. 16). The contacts are flush pressed, and the surfaces are rhodium plated to give a smooth, oxide-free surface. Each commutator pattern has two radially displaced segment tracks with connecting links to a row of terminals. During manufacture, the wiped edges of the commutators are controlled to ±15 min to assure accurate, reproducible code.

The second, or coarse-letter, pattern contains seven segments of equal length; space has been allowed for the stop. The brush on this commutator turns nearly one revolution, and in the process forms 14 characters with a code progression of I, A, T, W, V, K, B, G, U, M, N, D, S, and H. The third, or fine-letter, pattern contains 28 equal spaces, occupied by one or two of 13 segments. The brush on this commutator turns seven revolutions, and in the process forms 14 characters for each half revolution. The cyclic feature of the number system is formed by this brush; its code progression is I, A, T, W, V, K, B, G, U, M, N, D, S, H, H, S, D, N, M, U, G, B, K, V, W, T, A, I.

A basic problem in obtaining precise readout from all shaft-position encoders is that of ambiguity at the change between successive values. The problem is particularly acute if two digits are required to change value simultaneously. The object of the cyclic feature of this system is to eliminate all possibility of ambiguity at the coarse-character changeover points (Fig. 22). The design of the commutator and the gear train is such that the coarse character changes value when the fine letter is in the middle of the double-width letters I or H. Thus, as the coarse-letter brush approaches a change point, the fine letter encoded will be an I (or H) for 107 min of arc before the change point, and will remain I (or H) for 107 min of arc after the change point. Thereby, the change in the coarse letter is associated with an unvarying fine letter for two quanta. This results in unambiguous code. Manufacturing tolerances limit the maximum error to 1/5 of one least count when the coarse letter changes value. When the fine letter changes value, the error is less than 1/50 of one least count.

The gear on the coarse-letter shaft has a pin (parallel to the shaft) riveted into it. This pin engages a spring-wire stop that is attached to the frame. The spring-wire stop is adjustable and must be locked in place after the unit is synchronized. Should the pin be inadvertently forced past the stop, the fine-letter and coarse-letter shafts will be out of synchronism. They may be resynchronized by reversing the procedure, but the alignment and calibration should be rechecked.

The sliding wipers are made of round wire 0.020 in. diameter, resulting in an appreciable wear in the contact area when the brushes are new. During life testing this

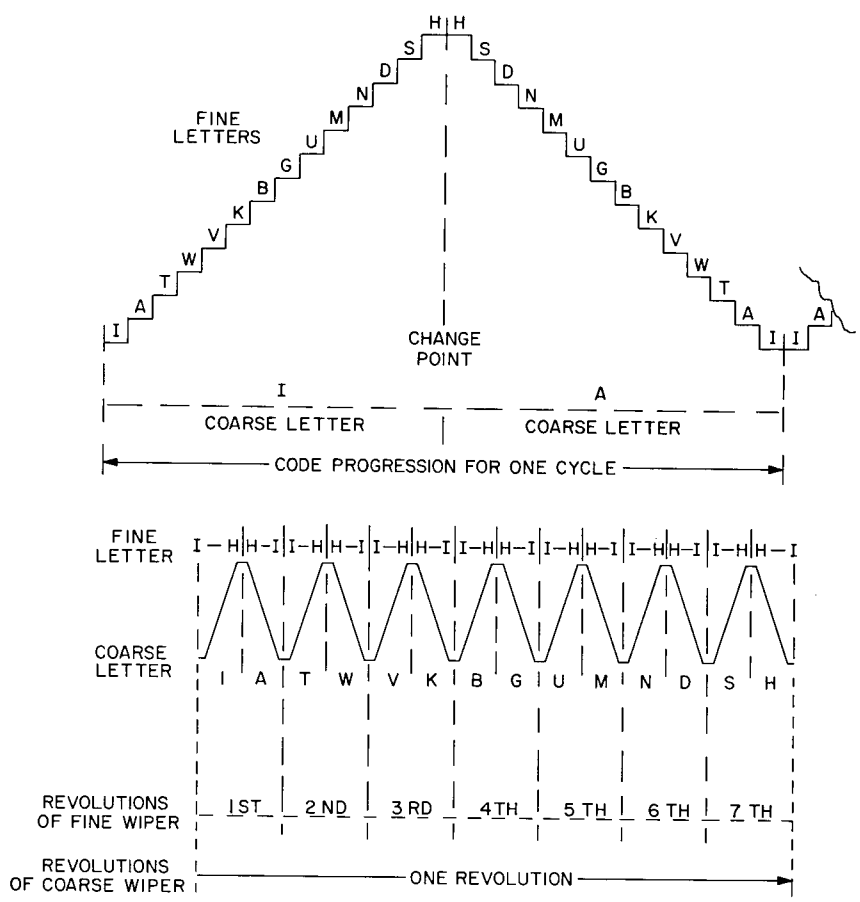

Fig. 22 - Cyclic code-progression chart

wear is stabilized after 2,000 balances; this is equal to 2,000 revolutions on the coarse letter and 14,000 revolutions on the fine letter shafts. To make sure the encoder would perform with the highest degree of accuracy, provisions were made to cope with this wear. To do this, the edges of segments of the commutators where characters are changed were set back 0.005 in. to allow for the average flat worn on the sliding wipers during their life. To make sure all the wipers have flats, each unit is run-in for 15 min in each direction (stop removed), equal to 2000 balances (normally 400 transmissions of five variables), before adjustments are made. This also assures running-in of the gears and bushings. For motor connections, see the section on the motor in a later paragraph.

Each commutator is wiped by a grounded brush that has two radially positioned sliding contacts. These contacts are rhodium plated to assure a low-resistance, long-wearing, oxide-free wiper. The geometry of the brush design combined with the selection of a suitable material and appropriate contact pressure contribute to the accurate encoding and long life of the unit (Fig. 23). When the two wipers of one brush contact only one segment of the code pattern, a character is generated which corresponds to this segment; when these two wipers contact separate segments on each track of the code pattern, each generates a letter simultaneously. This results in a third character generated from the overlapping of the two letters corresponding to the two segments (Fig. 11). With this arrangement of bridging segments, 14 Morse-code characters can be made with seven fundamental characters.

To utilize the output from this encoder, the segments of the coarse-letter code pattern are wired to the code-generator brush holder 2, and the segments of the fine-letter code pattern are wired to the code-generator brush holder 3.

When the sliding wiper grounds segments of either track on the commutator, the 12-v dc keying relay coil (with suitable contact protection) is connected to ground through the code drum. This keys the transmitter, sending out the characters encoded (Fig. 17).

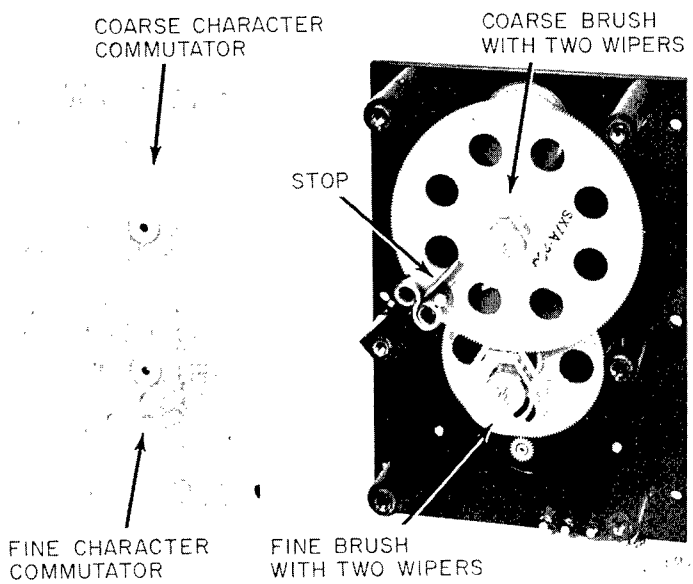

Fig. 23 - Encoder brush and stop assembly

UNCLASSIFIED

Other factors entering into the accuracy of the encoded characters are the gears and bearings in the gear train. To a great degree the accuracy of the gears determines the accuracy of the code as much as the encoder itself. For this reason, aluminum and stainless steel precision gears are used throughout the unit. The use of aluminum for the large gears also helps to reduce the inertia of the system. The supporting shafts are made of stainless steel and run in oilite bearings, purged in low-temperature instrument oil.

The response of the converter is 1.2 sec, or 6 millisec per character, with a slight increase at lower temperatures and lower voltages. The mechanical accuracy of the shaft-positioning encoder is better than 0.1 percent. This much error can occur only at 14 values; at all the other values the accuracy is considerably better. The accuracy of the gear train and potentiometer are compatible with the above accuracy.

Servo Motor

The servo motor is located in the encoder. It is a size 18 induction type motor with an impedance of 3200 ohms on each phase. The resistance of each phase is 2160 ohms. The motor is rated 3450 rpm (no load) at 115 v, 60 cps; the speed is increased when it is used on 115 cps. The motor used is made by Kollsman Motor Corporation as part No. 951-0161. This motor is furnished with the drive gear and is lubricated for low-temperature use. The motor is modified to have a servo mounting ring so it will be simple to install and service.

The unit is run in 15 min in each direction by connecting this motor to 115 v ac at 60 cps (Fig. 24). To do this, the stop is removed and a small amount of lubricant is applied to the printed-circuit commutator in the path of the wipers. After run-in the unit is cleaned, inspected, and prepared for service. Just prior to placing the covers on the unit and sealing it, a thin coat of DC-5 compound is wiped on the printed circuit in the path of the wipers to control the freezing of condensation in this area.

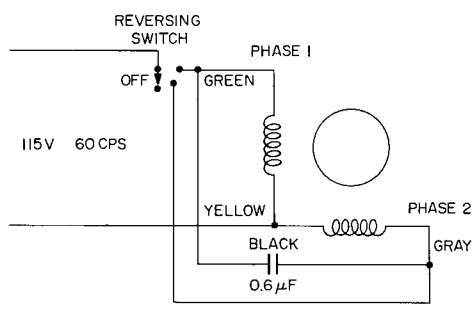

Fig. 24 - Servo motor run-in schematic

SERVICE EXPERIENCE

A number of these units have been manufactured and tested in the Laboratory and in the field in telemetering equipment with satisfactory results.

Ten units of the present design have been manufactured in accordance with the engineering drawings and quality-control procedures in Appendixes A, B, and C. The allocation of the units has been as follows:

Unit (Serial No.)	Current Status
0	Used in laboratory evaluation.
1	In Navy Environmental Telemeter (NET) 101, in use in Antarctica since December 1962.
2	In Navy Environmental Telemeter (NET) 102, in use in Antarctica since October 1963.
3	In Navy Environmental Telemeter (NET) 103, retained at NRL as prototype model.
4	To be used in converting AN/GMT-1(XG-1) NAFI serial no. 1 to NET configuration.
5	To be used in converting AN/GMT-1(XG-1) NAFI serial no. 6 to NET configuration.
100	For use in a new telemeter now in the preliminary development stage.
101	For use in a new telemeter now in the preliminary development stage.
200	Used to adapt one AN/SMT-1(XN-2) for oceanographic studies.
201	Used to adapt one AN/SMT-1(XN-2) for oceanographic studies.

Technical reports from the field commands on the operation of this unit in the Navy Environmental Telemeters have been published (3,4).

CONCLUSIONS

As part of a continuing program to develop means for obtaining data from remote or inaccessible regions, a code and sequencing system has been developed to use with environmental telemetering equipments. This system has been designed to give the scientist or engineer a unit that will accommodate a resistance input of either 0 to 2000 ohms or 2500 to 4500 ohms, and provide an output in the form of Morse code in three-letter groups. The first letter identifies one of the five channels of information, and the second and third letters make one of 196 possible letter combinations which provide the information. The output of 196 available combinations has proved adequate to match the resolution of the most critical environmental transducers.

The most important design considerations of the system were as follows:

1. Weight
2. Compactness
3. Low power consumption
4. Fast response
5. Wide range of operating temperatures
6. All essential parts accessible for inspection or adjustment
7. Components located for convenient wiring and cabling
8. Maximum unattended service life.

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An extensive study and test program has resulted in a system designed for ease of fabrication, quality control, and alignment, as well as for reliable trouble-free service.

The system will accommodate a variety of transducer elements as it is now designed and may be adapted to other elements when a special range with higher resolution or more accuracy is desired. If the system is used in a manner other than as described in the text of this report, the new use should be backed up with appropriate study and testing of the instrument under the new conditions.

There is no equipment known to the authors that will perform the functions of this system in an environmental telemeter with all possibility of ambiguity in the output, at the change between successive values eliminated. During test and evaluation, the output code sent from the system has remained very distinct and uniform. To date there has not been a single component failure or part alignment requiring adjustment. It seems certain that this system or portions of this system will be used by research groups and engineers in meteorological and oceanological telemetering equipment.

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1. Heritage, D.P., "Development of a Parachute-type Expendable Automatic Weather Station," Navy Electronics Laboratory Report 229, Mar. 9, 1951

2. Marshall, T.E. III, "Automatic Weather Station (Grasshopper) Part 1 - Design and Modifications 1955-1961," NRL Report 5966, Aug. 13, 1963

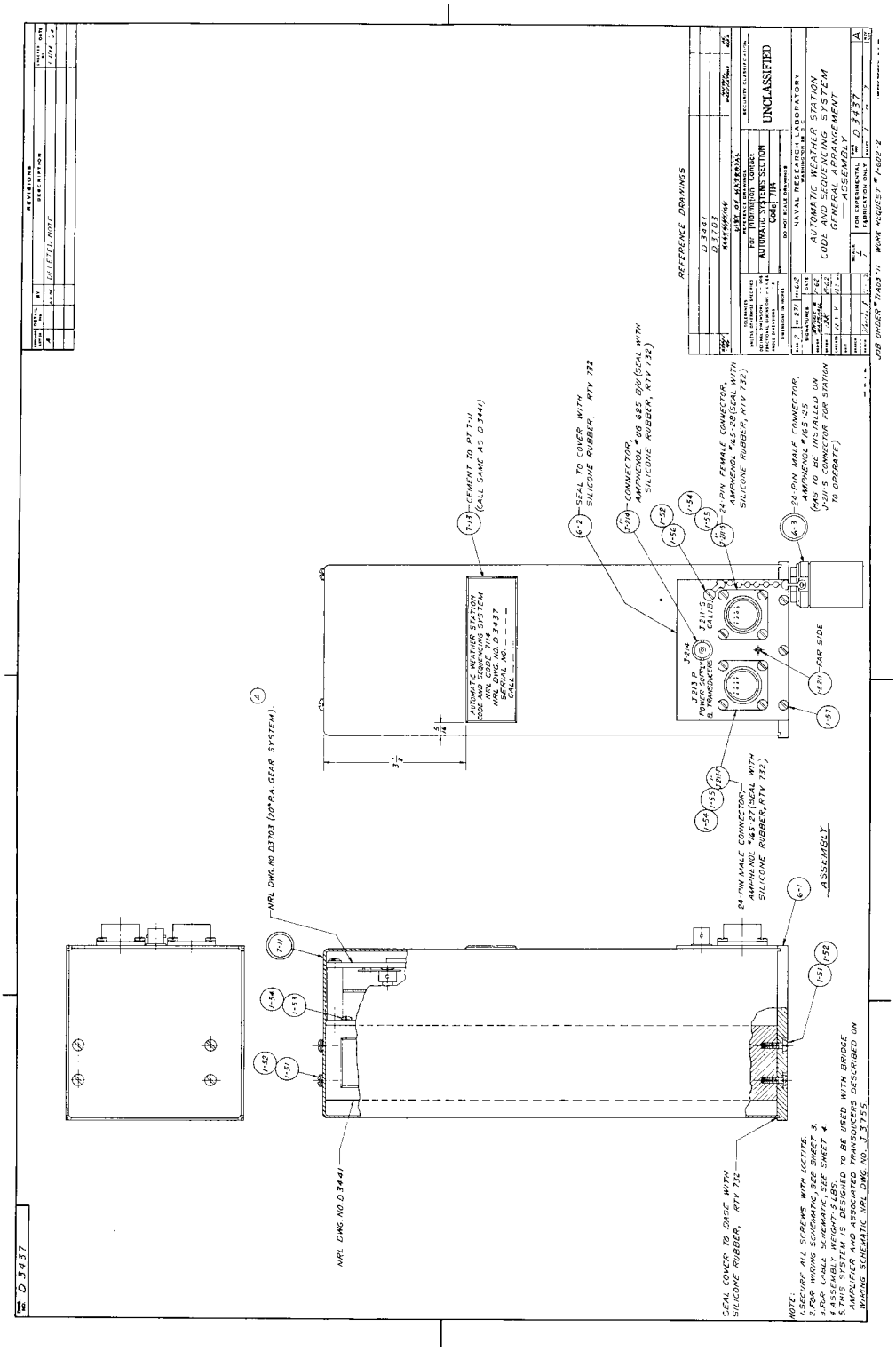
3. Sawyer, T.W., "Operational History and Technical Evaluation of the Automatic Weather Stations, Operation Deepfreeze - Antarctica, September 1962 through February 1963," NRL Miscellaneous Paper 763

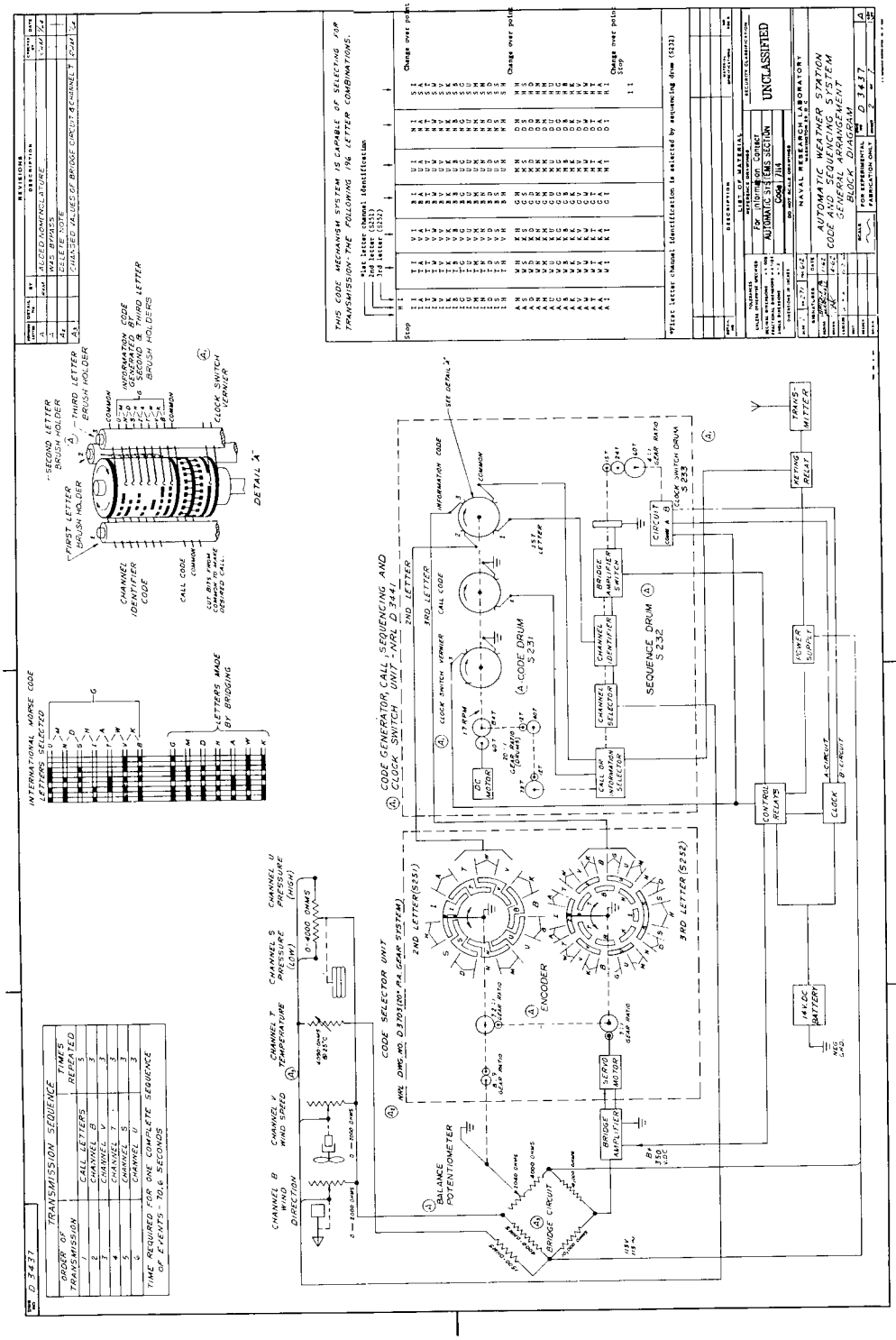
4. McClary, A.H., "Operational History and Technical Evaluation of the Automatic Weather Stations, Operation Deepfreeze - Antarctica, September 1962 through September 1963," NRL Test and Evaluation Report No. 22

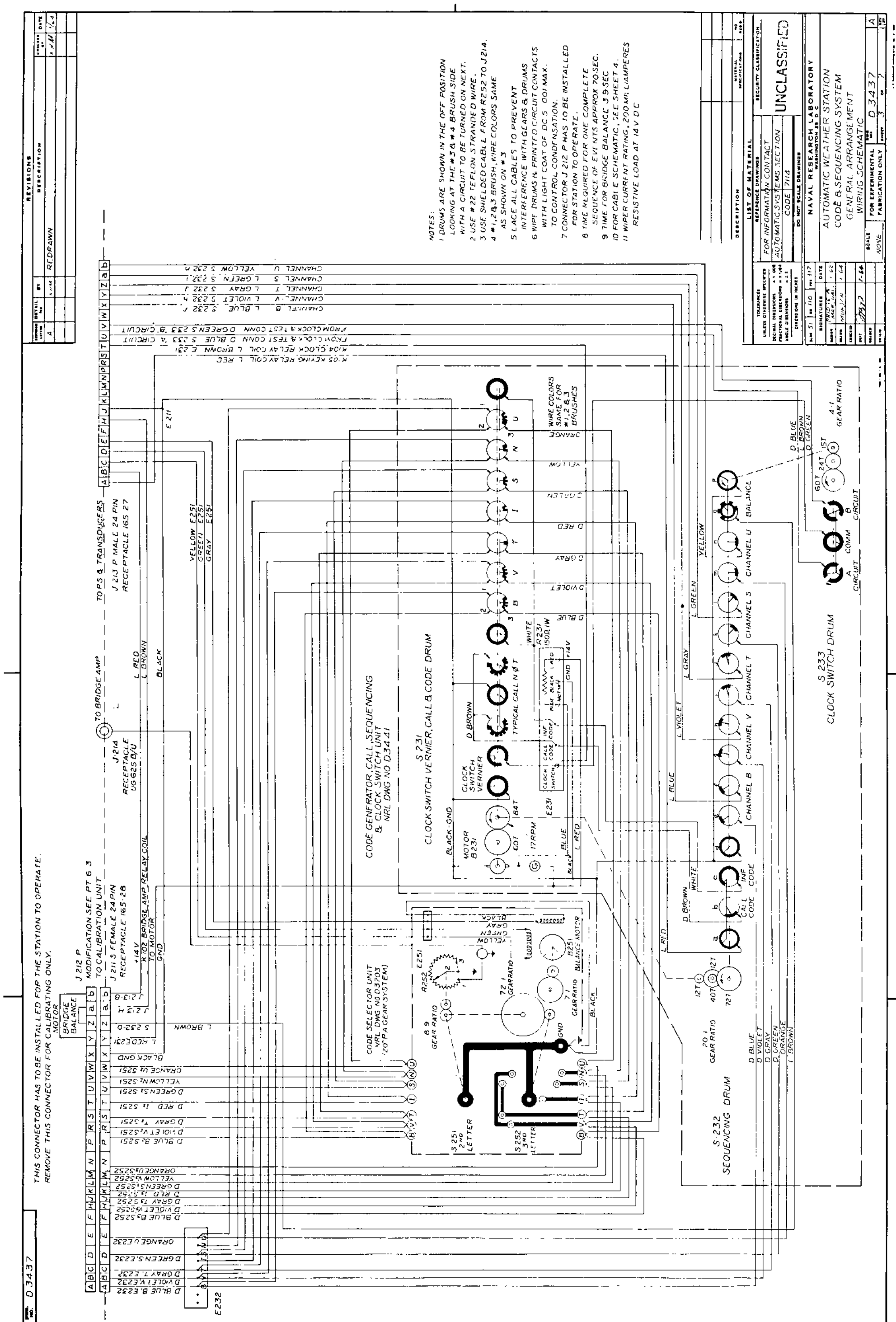
APPENDIX A

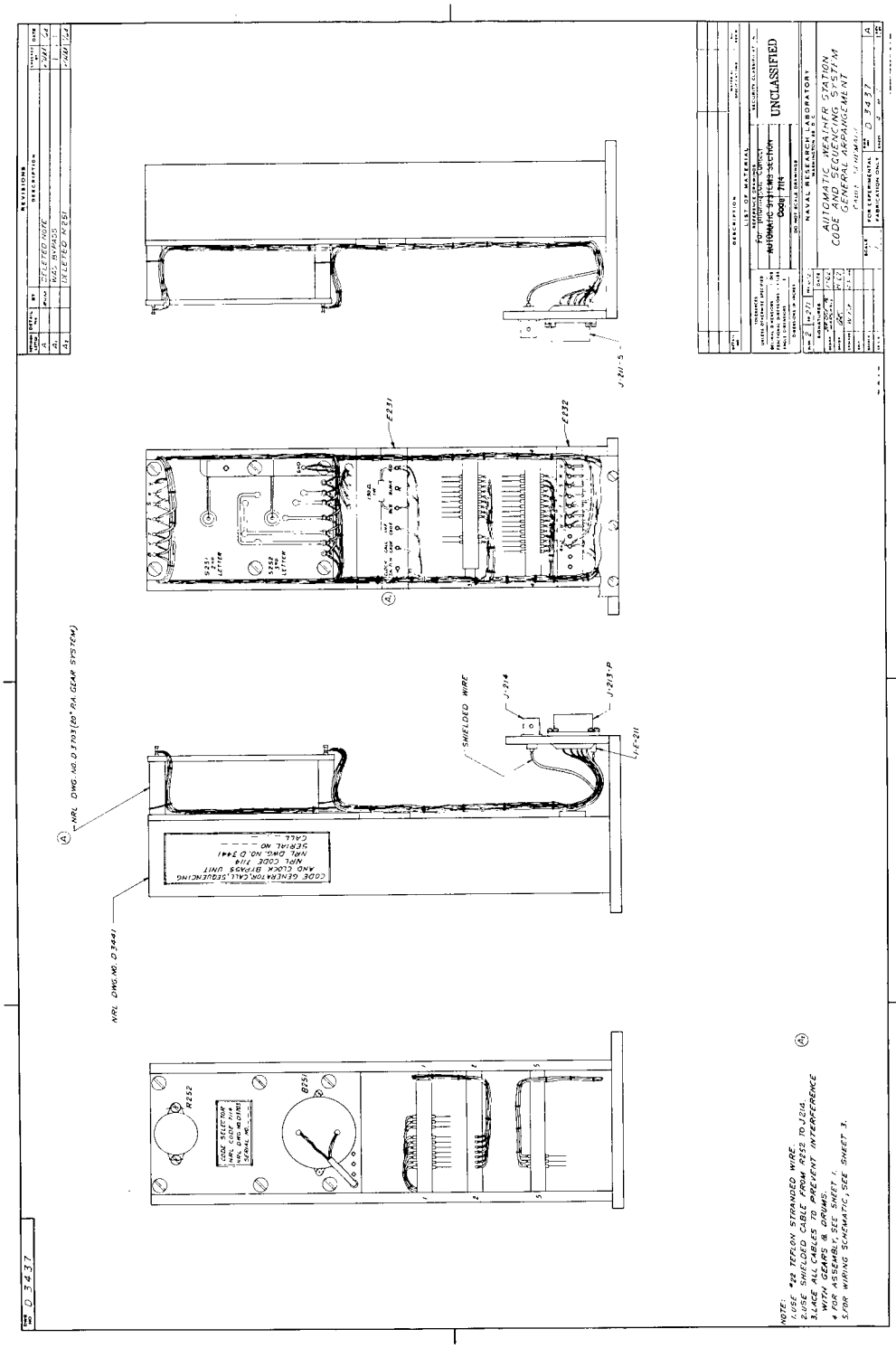
CODE AND SEQUENCING SYSTEM FOR AUTOMATIC WEATHER STATIONS

NRL DRAWING D3437, REVISION A (7 SHEETS)


REVISIONS
DELETED NOTE
REFERENCE DRAWINGS
D 3441
D 3703
LIST OF MATERIAL
UNCLASSIFIED
AUTOMATIC WEATHER STATION
CODE AND SEQUENCING SYSTEM
GENERAL ARRANGEMENT
ASSEMBLY
NRL DWG. NO. D3703 (20" P.A. GEAR SYSTEM).
NRL DWG. NO. D3441
SEAL COVER TO BASE WITH SILICONE RUBBER, RTV 732
24 PIN MALE CONNECTOR AMPHENOL #165-27 (SEAL WITH SILICONE RUBBER, RTV 732)
J-313-P POWER SUPPLY & TRANSDUCERS
J-311-S CALIBR
J-314
FAR SIDE
24 PIN FEMALE CONNECTOR AMPHENOL #165-25 (SEAL WITH SILICONE RUBBER, RTV 732)
CONNECTOR, AMPHENOL #MS 625 B/P (SEAL WITH SILICONE RUBBER, RTV 732)
SEAL TO COVER WITH SILICONE RUBBER, RTV 732
CEMENT TO PT 711 (CALL SAME AS D 3441)
24 PIN MALE CONNECTOR, AMPHENOL #165-25 (HAS TO BE INSTALLED ON J-311-S CONNECTOR FOR STATION TO OPERATE)
AUTOMATIC WEATHER STATION
CODE AND SEQUENCING SYSTEM
NRL CODE 7114
WORK UNIT NO. D 3437
SERIAL NO.
CALL
NOTE:
1. SECURE ALL SCREWS WITH LOCTITE.
2. FOR WIRING SCHEMATIC, SEE SHEET 3.
3. FOR CABLE SCHEMATIC, SEE SHEET 4.
4. ASSEMBLY WEIGHTS LBS:
5. THE SYSTEM IS DESIGNED TO BE USED WITH BRIDGE AMPLIFIER AND ASSOCIATED TRANSDUCERS DESCRIBED ON WIRING SCHEMATIC NRL DWG. NO. J 3755.
JOB ORDER #7A03-11 WORK REQUEST #7-602-2
D 3437


AUTOMATIC WEATHER STATION
CODE AND SEQUENCING SYSTEM
GENERAL ARRANGEMENT
BLOCK DIAGRAM
NAVAL RESEARCH LABORATORY
UNCLASSIFIED
D 3437
TRANSMISSION SEQUENCE
ORDER OF TRANSMISSION
TIMES REPEATED
CALL LETTERS
CHANNEL B
CHANNEL V
CHANNEL T
CHANNEL S
CHANNEL U
TIME REQUIRED FOR ONE COMPLETE SEQUENCE OF EVENTS - 70.6 SECONDS
THIS CODE MECHANISM SYSTEM IS CAPABLE OF SELECTING FOR TRANSMISSION THE FOLLOWING 196 LETTER COMBINATIONS.
CODE GENERATOR, CALL, SEQUENCING AND CLOCK SWITCH UNIT - NRL D 3441
CODE SELECTOR UNIT
SEQUENCE DRUM S 232
CODE DRUM S 231
CLOCK SWITCH DRUM S 233
CHANNEL IDENTIFIER CODE
CALL CODE
INTERNATIONAL MORSE CODE
LETTERS SELECTED
LETTERS MADE BY BRIDGING
DETAIL "A"
CHANNEL B WIND DIRECTION
CHANNEL V WIND SPEED
CHANNEL T TEMPERATURE
CHANNEL S PRESSURE (LOW)
CHANNEL U PRESSURE (HIGH)
BALANCE POTENTIOMETER
BRIDGE CIRCUIT
ENCODER
CONTROL RELAYS
CLOCK
TRANSMITTER
RETIMING RELAY
POWER SUPPLY
14 V. DC BATTERY


UNCLASSIFIED
AUTOMATIC WEATHER STATION
CODE & SEQUENCING SYSTEM
GENERAL ARRANGEMENT
WIRING SCHEMATIC
D 3437


REVISIONS
DESCRIPTION
NOTE:
1. USE #22 TEFLON STRANDED WIRE
2. USE SHIELDED CABLE FROM J-214 TO J-214
3. USE SHIELDED CABLES TO PREVENT INTERFERENCE WITH GEARS & DRUMS.
4. FOR ASSEMBLY, SEE SHEET 1.
5. FOR WIRING SCHEMATIC, SEE SHEET 3.
NRL DWG. NO. D 3437 (25" RA. GEAR SYSTEM)
NRL DWG. NO. D 3441
SHIELDED WIRE
J-214
J-213-P
J-E-211
J-211-S
E231
E232
R251
R252
B251
CODE GENERATOR, CALL, SEQUENCING AND CLOCK BYPASS UNIT
NRL CODE 7114
NRL DWG. NO. D 3441
SERIAL NO.
CALL
CODE SELECTOR
NRL CODE 7114
NRL DWG. NO. D 3441
SERIAL NO.
LIST OF MATERIAL
UNCLASSIFIED
AUTOMATIC SYSTEMS SECTION
Code 7114
NAVAL RESEARCH LABORATORY
AUTOMATIC WEATHER STATION
CODE AND SEQUENCING SYSTEM
GENERAL ARRANGEMENT
D 3437

DRAW NO. D 3437

DETAIL NO.	DESCRIPTION	MATERIAL SPECIFICATIONS	NO. REQD.
6-1	$\frac{1}{8}$ X $4\frac{5}{8}$ X $4\frac{5}{8}$ ALUM. ALLOY	6061-T6	1
6-2	$\frac{3}{16}$ X $2\frac{3}{4}$ X $3\frac{1}{2}$ ALUM. ALLOY	6061-T6	1
6-3	SUBASSEMBLY		1
7-11	WELDMENT		1
7-12	.051 THICK X 16 X 17 ALUM. ALLOY	6061-T6	1
7-13	$\frac{1}{16}$ X $1\frac{1}{4}$ X $3\frac{5}{8}$ PHENOLIC RESIN, LAMINATED	BLACK COVER W/WHITE CORE	1
1-51	BIND. HD. SCR. #6-32NC-2 X $\frac{3}{8}$ STAINLESS STEEL	COMM.	8
1-52	SPLIT LOCK WASHER #6 " "	"	9
1-53	BIND. HD. SCR. #4-40NC-2 X $\frac{1}{2}$ " "	"	6
1-54	SPLIT LOCK WASHER #4 " "	"	14
1-55	BIND. HD. SCR. #4-40NC-2 X $\frac{5}{16}$ " "	"	8
1-56	BIND. HD. SCR. #6-32NC-2 X $\frac{3}{4}$ " "	"	1
1-57	FLAT HD. SCR #4-40NC-2 X $\frac{1}{2}$ " "	"	3

DETAIL NO.	DESCRIPTION	MATERIAL SPECIFICATIONS	NO. REQD.
3-21-5	MINIATURE "AN" TYPE CONNECTOR, 165 SERIES, FEMALE, 24-PIN, AMPHENOL #165-28, CAT. B6, P.28	COMM.	1
3-21-6	MINIATURE "AN" TYPE CONNECTOR, 165 SERIES, MALE, 24-PIN, AMPHENOL #165-28, CAT. B6, P.28 MODIFICATION - SEE SHEET 4.	COMM.	1
3-21-8	MINIATURE "AN" TYPE CONNECTOR, 165 SERIES, MALE, 24-PIN, AMPHENOL #165-27, CAT. B6, P.28,	COMM.	1
1-3214	COAXIAL CABLE CONNECTOR, RF SERIES, AMPHENOL #UG/625 B/U	COMM.	1
14-211	STANDOFF, LERCO #6108 OR EQUAL	COMM.	1
6-230	BEAD CHAIN, 6" LENGTH PT NO LOAD TYPE A, STD BEAD CHAIN MFG CO BRIDGEPORT CONN OR EQUAL	COMM.	1 (A)
6-231	COTTER PIN, $\frac{1}{16}$ X $\frac{3}{4}$ STAINLESS STEEL	COMM.	1

REVISIONS

REVISION LETTER	DETAIL NO.	BY	DESCRIPTION	CHECKED BY	DATE
A	6-230	PAM	WAS: 6-FT. 7A-17-43		

DETAIL NO.	DESCRIPTION	MATERIAL SPECIFICATIONS	NO. REQ'D.

LIST OF MATERIAL

TOLERANCES UNLESS OTHERWISE SPECIFIED: DECIMAL DIMENSIONS ± .005; FRACTIONAL DIMENSIONS ± 1/64; ANGLE DIMENSIONS ±2°

DIMENSIONS IN INCHES — DO NOT SCALE DRAWINGS

REFERENCE DRAWINGS: For Information Contact AUTOMATIC SYSTEMS SECTION, Code 7114

SECURITY CLASSIFICATION: UNCLASSIFIED

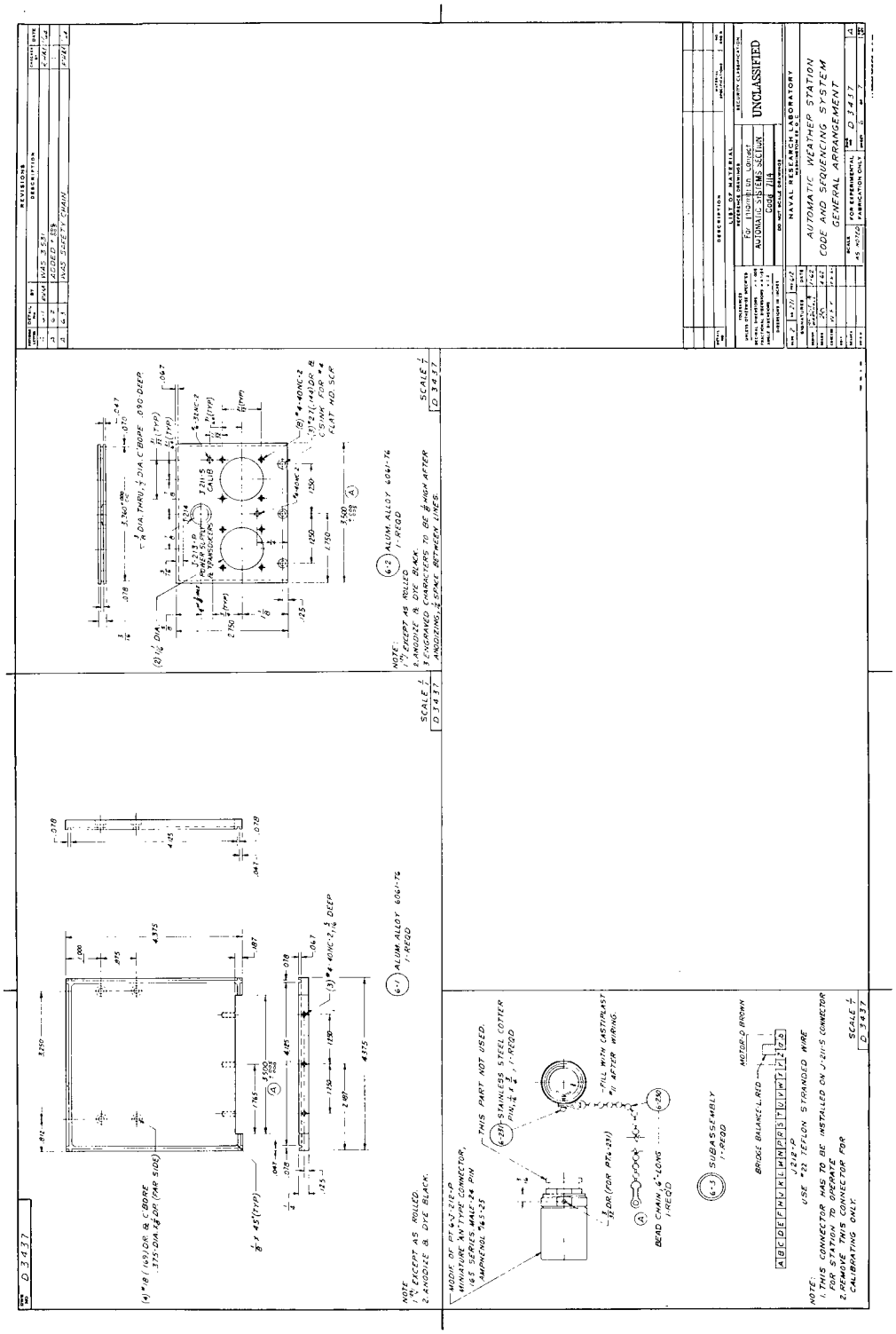
DRN. Z	CK. 271	DATE 6/12	
DESIGN.	SIGNATURES: FROST & MACPHERSON	DATE 1-62	
DRAFT.	BAK	8-62	
CHECKED.			
APP.			
DESIGN'D.			
CK. D.			

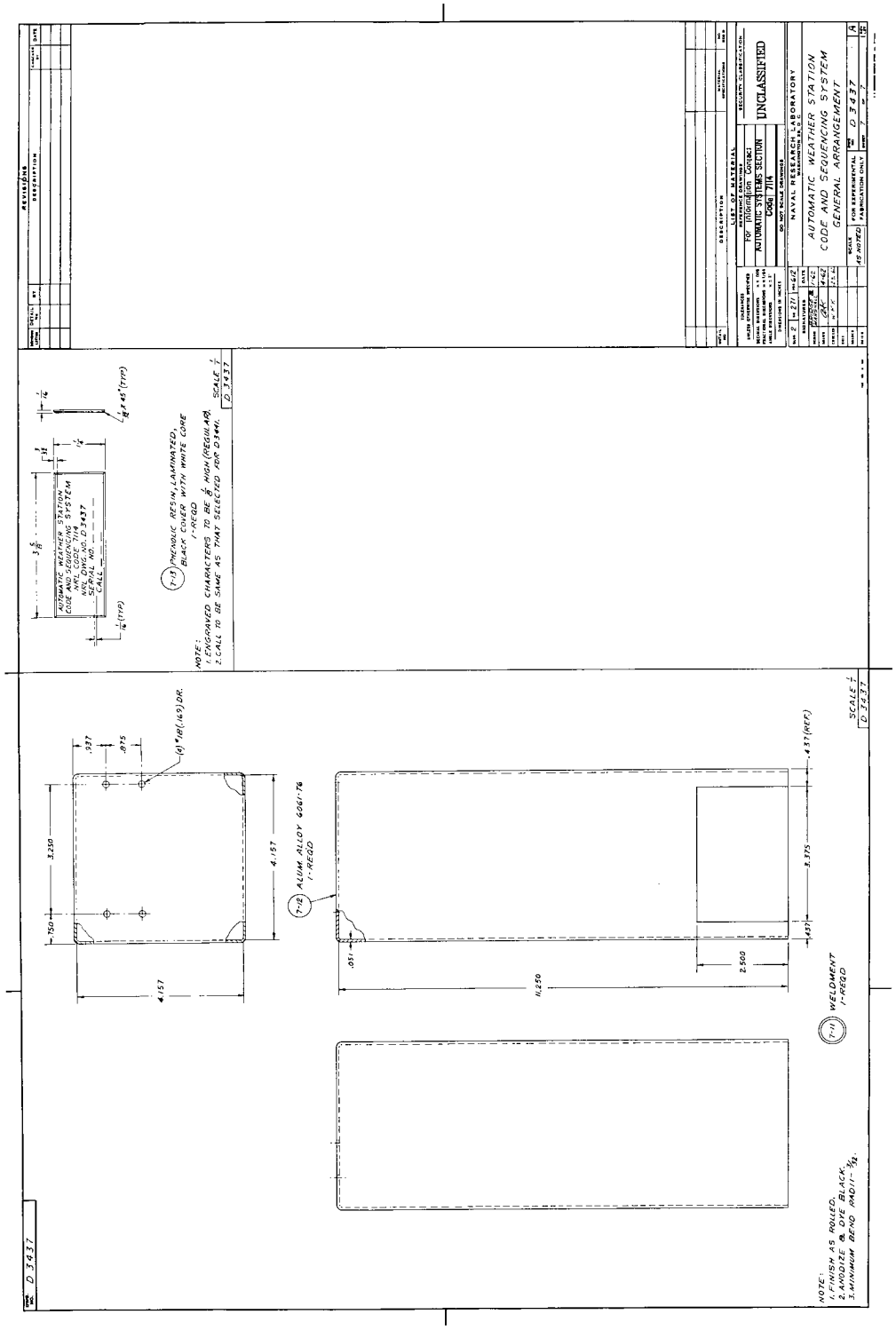
NAVAL RESEARCH LABORATORY
WASHINGTON 25, D. C.

AUTOMATIC WEATHER STATION
CODE AND SEQUENCING SYSTEM
GENERAL ARRANGEMENT
—LIST OF MATERIAL—

SCALE — FOR EXPERIMENTAL FABRICATION ONLY — DRAW NO. D 3437 — SHEET 5 OF 7 — REV. A

UNCLASSIFIED

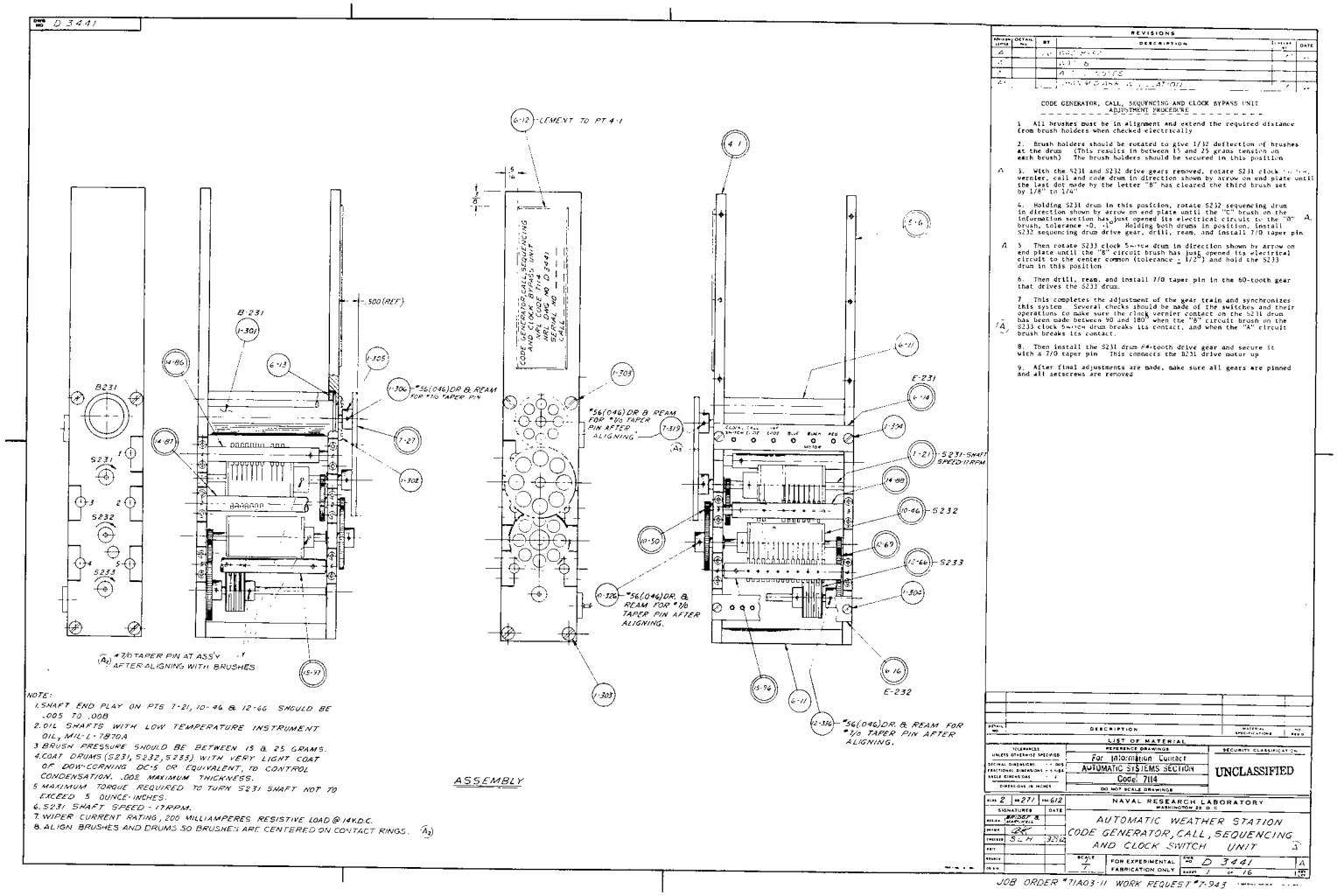

REVISIONS
DESCRIPTION
PRINTED NAME
PXM MAR 7 '67
AUTOMATIC SYSTEMS SECTION
Code 7114
UNCLASSIFIED
NAVAL RESEARCH LABORATORY
AUTOMATIC WEATHER STATION
CODE AND SEQUENCING SYSTEM
GENERAL ARRANGEMENT
D 3437
ALUM. ALLOY 6061-T6
1-REQD
SCALE 1/1
THIS PART NOT USED.
STAINLESS STEEL COTTER
FILL WITH CASTIRLAST
BEAD CHAIN, 6" LONG
SUBASSEMBLY
BRIDGE BALANCE L-RED
USE #23 TEFLON STRANDED WIRE
J212-P
THIS CONNECTOR HAS TO BE INSTALLED ON J-211-S CONNECTOR
FOR STATION TO OPERATE
REMOVE THIS CONNECTOR FOR
CALIBRATING ONLY.


REVISIONS
DESCRIPTION
LIST OF MATERIAL
PRIMARY CONTRACTOR
FOR INFORMATION CONTACT
AUTOMATIC SYSTEMS SECTION
CODE 7114
DO NOT SCALE DRAWINGS
SECURITY CLASSIFICATION
UNCLASSIFIED
NAVAL RESEARCH LABORATORY
WASHINGTON, D.C.
AUTOMATIC WEATHER STATION
CODE AND SEQUENCING SYSTEM
GENERAL ARRANGEMENT
D 3437
FOR REFERENCE ONLY
FABRICATION ONLY
AS NOTED
SCALE
SHEET 7 OF 7
AUTOMATIC WEATHER STATION
CODE AND SEQUENCING SYSTEM
NRL CODE 7114
WEIGHT 15 LBS
SERIAL NO. D 3437
CALL
3 5/8
1/4
1/8
1/16 (TYP)
1/16 (TYP)
1/4
1/8
1/8
1/8 x 45° (TYP)
(7-13) PHENOLIC RESIN, LAMINATED, BLACK, 1-REQD WITH WHITE CORE
NOTE:
1. ENGRAVED CHARACTERS TO BE 3/8" HIGH (REGULAR)
2. CALL TO BE SAME AS THAT SELECTED FOR D 3441.
SCALE 1/1
D 3437
.937
.875
(4) #12 (.165) DR.
3.250
.750
4.157
4.157
(7-8) ALUM ALLOY 6061-T6 1-REQD
.051
11.250
2.500
.437
5.375
.437 (REF)
(7-11) WELDMENT 1-REQD
NOTE:
1. FINISH AS ROLLED.
2. ANODIZE ONE BLACK.
3. MINIMUM BEND RADII - 3/32.
SCALE 1/1
D 3437
D 3437

APPENDIX B

CODE GENERATOR, CALL, SEQUENCING, AND CLOCK-SWITCH UNIT FOR AUTOMATIC WEATHER STATIONS

NRL DRAWING D3441, REVISION A (16 SHEETS)



NOTE:
1. SHAFT END PLAY ON PTS 7-21, 10-46 & 12-66 SHOULD BE .005 TO .008
2. OIL SHAFTS WITH LOW TEMPERATURE INSTRUMENT OIL, MIL-L-7870A
3. BRUSH PRESSURE SHOULD BE BETWEEN 15 & 25 GRAMS.
4. COAT DRUMS (S231, S232, S233) WITH VERY LIGHT COAT OF DOW-CORNING DC-5 OR EQUIVALENT, TO CONTROL CONDENSATION. .002 MAXIMUM THICKNESS.
5. MAXIMUM TORQUE REQUIRED TO TURN S231 SHAFT NOT TO EXCEED 5 OUNCE-INCHES.
6. S231 SHAFT SPEED - 1 RPM.
7. WIPER CURRENT RATING, 200 MILLIAMPERES RESISTIVE LOAD @ 14 V.D.C.
8. ALIGN BRUSHES AND DRUMS SO BRUSHES ARE CENTERED ON CONTACT RINGS. (A2)

REVISIONS

REVISION LETTER	DETAIL NO.	BY	DESCRIPTION	CHECKED BY	DATE
A			[illegible]		
B			[illegible]		
C			[illegible]		
D			[illegible]		

CODE GENERATOR, CALL, SEQUENCING AND CLOCK BYPASS UNIT
ADJUSTMENT PROCEDURE

1. All brushes must be in alignment and extend the required distance from brush holders when checked electrically

2. Brush holders should be rotated to give 1/32 deflection of brushes at the drum (This results in between 15 and 25 grams tension on each brush) The brush holders should be secured in this position

A 3. With the S231 and S232 drive gears removed, rotate S231 clock switch, vernier, call and code drum in direction shown by arrow on end plate until the last dot made by the letter "B" has cleared the third brush set by 1/8" to 1/4"

4. Holding S231 drum in this position, rotate S232 sequencing drum in direction shown by arrow on end plate until the "C" brush on the information section has just opened its electrical circuit to the "D" brush, tolerance -0, +1" Holding both drums in position, install S232 sequencing drum drive gear, drill, ream, and install 7/0 taper pin A

A 5. Then rotate S233 clock switch drum in direction shown by arrow on end plate until the "B" circuit brush has just opened its electrical circuit to the center common (tolerance ± 1/32") and hold the S233 drum in this position

6. Then drill, ream, and install 7/0 taper pin in the 60-tooth gear that drives the S233 drum.

7. This completes the adjustment of the gear train and synchronizes this system Several checks should be made of the switches and their operations to make sure the clock vernier contact on the S231 drum has been made between 90 and 180° when the "B" circuit brush on the S233 clock switch drum breaks its contact, and when the "A" circuit brush breaks its contact. (A)

8. Then install the S231 drum 84-tooth drive gear and secure it with a 7/0 taper pin This connects the B231 drive motor up

9. After final adjustments are made, make sure all gears are pinned and all setscrews are removed

DETAIL NO	DESCRIPTION	MATERIAL SPECIFICATIONS	NO REQ'D

LIST OF MATERIAL

TOLERANCES UNLESS OTHERWISE SPECIFIED	REFERENCE DRAWINGS	SECURITY CLASSIFICATION
DECIMAL DIMENSIONS ± .005 FRACTIONAL DIMENSIONS ± 1/64 ANGLE DIMENSIONS ± 1	For Information Contact AUTOMATIC SYSTEMS SECTION Code 7114	UNCLASSIFIED
DIMENSIONS IN INCHES	DO NOT SCALE DRAWINGS	

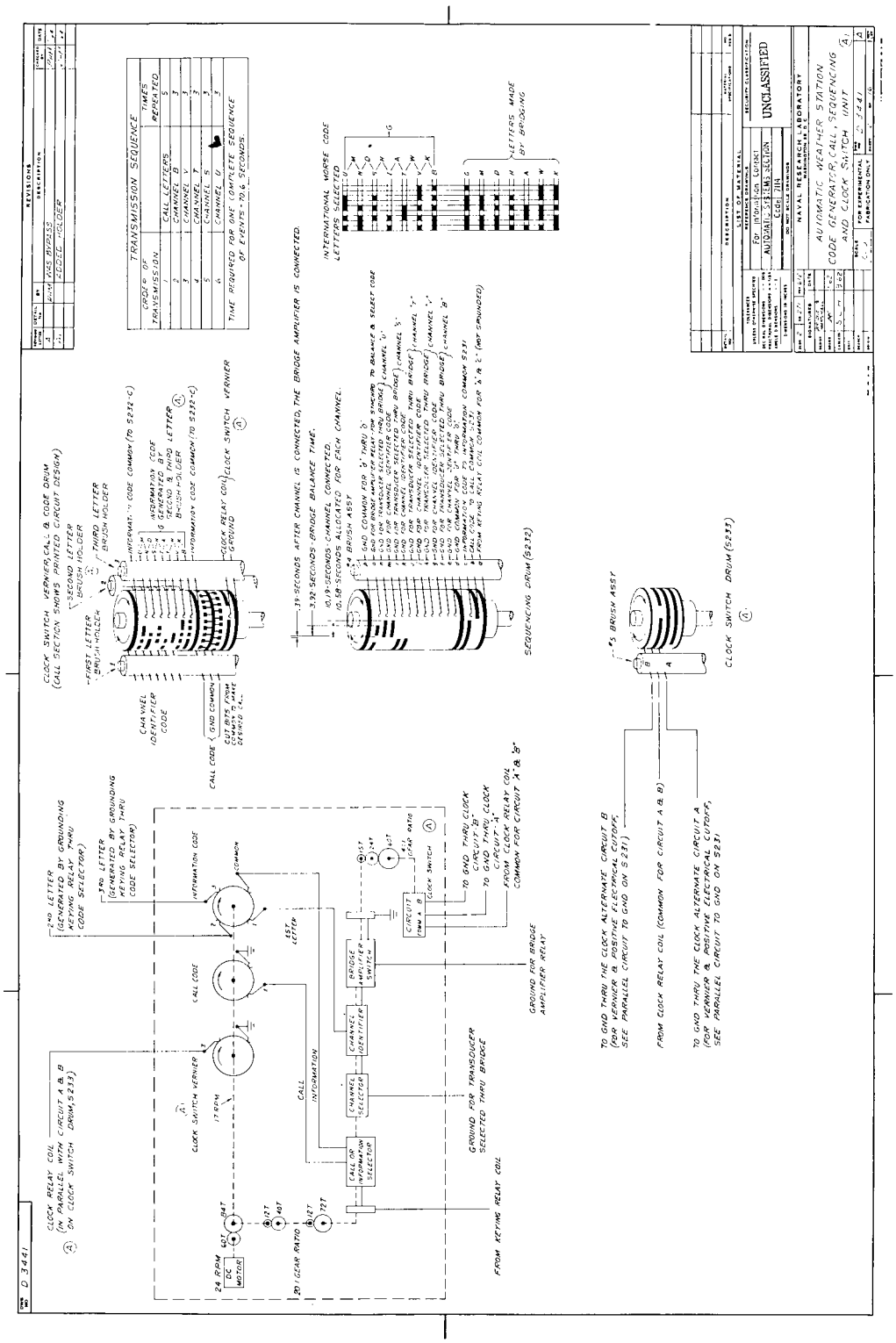
SIGNATURES	DATE
DESIGN	
DRAWN	5-24-61
ENGINEER	5-24-61
EDIT	
BRANCH	
CHAIRMAN	

NAVAL RESEARCH LABORATORY
WASHINGTON 20 D. C.

AUTOMATIC WEATHER STATION
CODE GENERATOR, CALL, SEQUENCING AND CLOCK SWITCH UNIT

SCALE 2/1 — FOR EXPERIMENTAL FABRICATION ONLY — DWG NO D 3441 — SHEET 1 OF 16 — REV A

JOB ORDER *71A03-11 WORK REQUEST *7-943


TRANSMISSION SEQUENCE
CODE OF TRANSMISSION
CALL LETTERS
TIMES REPEATED
CHANNEL B
CHANNEL V
CHANNEL T
CHANNEL S
CHANNEL U
TIME REQUIRED FOR ONE COMPLETE SEQUENCE OF EVENTS - 10.6 SECONDS
INTERNATIONAL MORSE CODE LETTERS SELECTED
LETTERS MADE BY BRUSHING
CLOCK SWITCH VERNIER CALL & CODE DRUM (CALL SECTION SHOWS PRINTED CIRCUIT DESIGN)
SEQUENCING DRUM (S232)
CLOCK SWITCH DRUM (S233)
CLOCK RELAY COIL (IN PARALLEL WITH CIRCUIT A & B ON CLOCK SWITCH DRUM, S233)
2ND LETTER (GENERATED BY GROUNDING KEYING RELAY THRU CODE SELECTOR)
3RD LETTER (GENERATED BY GROUNDING KEYING RELAY THRU CODE SELECTOR)
CLOCK SWITCH VERNIER
17 RPM
24 RPM DC MOTOR
20:1 GEAR RATIO
CALL CODE
INFORMATION CODE
CALL OR INFORMATION SELECTOR
CHANNEL SELECTOR
CHANNEL IDENTIFIER
BRIDGE AMPLIFIER SWITCH
CIRCUIT PARA A & B
CLOCK SWITCH
GEAR RATIO
FROM KEYING RELAY COIL
GROUND FOR TRANSDUCER SELECTED THRU BRIDGE
GROUND FOR BRIDGE AMPLIFIER RELAY
TO GND THRU CLOCK CIRCUIT "B"
TO GND THRU CLOCK CIRCUIT "A"
FROM CLOCK RELAY COIL COMMON FOR CIRCUIT "A" & "B"
TO GND THRU THE CLOCK ALTERNATE CIRCUIT B (FOR VERNIER & POSITIVE ELECTRICAL CUTOFF, SEE PARALLEL CIRCUIT TO GND ON S231)
FROM CLOCK RELAY COIL (COMMON FOR CIRCUIT A & B)
TO GND THRU THE CLOCK ALTERNATE CIRCUIT A (FOR VERNIER & POSITIVE ELECTRICAL CUTOFF, SEE PARALLEL CIRCUIT TO GND ON S231)
UNCLASSIFIED
NAVAL RESEARCH LABORATORY
AUTOMATIC WEATHER STATION
CODE GENERATOR, CALL SEQUENCING AND CLOCK SWITCH UNIT
D 3441

DWG NO. D 3441

DETAIL NO.	DESCRIPTION	MATERIAL SPECIFICATIONS	NO. REQD
4-1	SUBASSEMBLY		1
4-2	.250 X 1.875 X 11.125 ALUM. ALLOY	6061-T6	1
4-3	.250 X 3/2 X .842 " "	" "	5
5-6	SUBASSEMBLY		1
5-7	.250 X 1.875 X 11.125 ALUM. ALLOY	6061-T6	1
5-8	.250 X .312 X .842 " "	" "	5
6-11	3/8 DIA. X 3.218 ALUM. ALLOY	6061-T6	4
6-12	1/4 X 1/4 X 4 PHENOLIC RESIN, LAMINATED	MIL-P-15035 W/WHITE CORE	1
6-13	1.375-DIA. X 3/8 ALUM. ALLOY	6061-T6	1
6-14	SUBASSEMBLY (TERMINAL E231)		1
6-15	1/8 X 1/2 X 3 1/2 PHENOLIC RESIN, LAMINATED	TYPE FBE	1
6-16	SUBASSEMBLY (TERMINAL E232)		1
6-17	1/8 X 3/4 X 3 1/2 PHENOLIC RESIN, LAMINATED	TYPE FBE	1
7-21	SUBASSEMBLY		1
7-23	SUBASSEMBLY		1
7-24	.250-DIA. X 3/8 BRASS	COMM.	1
7-25	.484-DIA. X 1/4 OILITE BRONZE		2
7-26	.484 DIA. X 1/4 " "	"	4
7-27	SUBASSEMBLY		1
7-28	.250-DIA. X 1/8 BRASS	COMM.	1
7-29	5/8 DIA. X .067 STAINLESS STEEL	TYPE 304	1
8-36	1 3/16 DIA. X 1.063 BRASS	COMM.	1
8-37	.750-DIA. X 2.063 PHENOLIC RESIN, LAMINATED	TYPE FBE	1
8-38	SUBASSEMBLY		1
8-39	1 7/16 DIA. X .187 BRASS	COMM.	1
8-40	1.062-DIA. X .312 "	"	1
10-46	SUBASSEMBLY		1
10-47	.250-DIA. X 1 3/8 STAINLESS STEEL	TYPE 304	1
10-48	SUBASSEMBLY		1
10-49	.250-DIA. X 3/8 BRASS	COMM.	1
10-50	SUBASSEMBLY		1
10-51	SUBASSEMBLY		1
10-52	1/8 DIA. X 3/16 BRASS	COMM.	1
10-54	.359-DIA. X .171 OILITE BRONZE	COMM.	1
10-55	.359-DIA. X .171 " "	"	1
11-61	1 1/8 DIA. X 2.187 BRASS	COMM.	1
11-62	1 5/16 DIA. X .375 "	"	1
11-63	SUBASSEMBLY		1
11-66	SUBASSEMBLY		1
11-67	1/4 DIA. X 3 3/16 STAINLESS STEEL	TYPE 304	1
11-69	SUBASSEMBLY		1
11-70	1/2 DIA. X .484 STAINLESS STEEL	TYPE 304	1
11-71	SUBASSEMBLY		1
11-72	5/8 DIA. X .156 OILITE BRONZE	COMM.	1
11-73	1/4 DIA. X .031 STAINLESS STEEL	TYPE 304	1

DETAIL NO.	DESCRIPTION	MATERIAL SPECIFICATIONS	NO. REQD
11-76	SUBASSEMBLY		1
11-77	5/8 DIA. X 1/4 BRASS	COMM.	1
11-78	1 1/8 DIA. X .312 "	"	1
11-79	1/2 DIA. X .437 NYLON	"	1
11-80	1 1/8 DIA. X .031 BRASS	"	1
14-86	SUBASSEMBLY		1
14-87	SUBASSEMBLY		1
14-88	SUBASSEMBLY		1
14-89	.375-DIA. X 3.500 PHENOLIC RESIN, LAMINATED	TYPE FBE	2
14-90	.375-DIA. X 3.500 " " "	" "	1
15-96	SUBASSEMBLY		1
15-97	SUBASSEMBLY		1
15-98	.375-DIA. X 3.500 PHENOLIC RESIN, LAMINATED	TYPE FBE	1
15-99	.375-DIA. X 3.500 " " "	" "	1
16-106	SUBASSEMBLY		47
16-108	.042-DIA. X (LENGTH AS REQD) BERYLLIUM COPPER WIRE	COMM.	47
16-109	.062-DIA. X .562 BRASS	"	47
B231	MOTOR, GLOBE TYPE 55, PLANETARY GEAR REDUCED (RATIO 192:1), GOVERNED D.C. MOTOR, TEST CONDUCTED AT 13 1/2 V.DC. SPEED: MIN. 23 RPM AT 10 V.D.C. MAX. 25 RPM AT 14 V.D.C. TO BE LUBRICATED FOR TEMPERATURE RANGE OF -55°C TO +71°C. GLOBE PART NO. 43A126-13	COMM.	1
1-302	BINDING HD SCR. #6-32NC-2 X 3/4 STAINLESS STEEL	COMM.	4
1-303	FLAT HD SCR. #8-32NC-2 X 1/2 " "	"	8
1-304	BINDING HD SCR #4-40NC-2 X 3/4 " "	"	4
1-305	CUP PT SET SCR #6-32NC-2 X 1/8 " "	"	1
1-306	TAPER PIN #3/0 X 1/2 " "	"	1

DETAIL NO.	DESCRIPTION	MATERIAL SPECIFICATIONS	NO. REQD
1-309	HEX SOC HD SCR #4-40NC-2 X 3/16 STAINLESS STEEL	COMM.	10
1-310	SPLIT LOCKWASHER #4 " "	"	10
5-3.1	HEX SOC HD SCR #4-40NC-2 X 3/16 STAINLESS STEEL	COMM.	10
5-3.4	SPLIT LOCKWASHER #4 " "	"	10
6-317	SOLDER TERMINAL #A2027-D CAMBRIDGE THERMIONIC CORP	COMM.	17
7-319	TAPER PIN #3/0 X 1/2 STAINLESS STEEL	COMM.	1
7-320	TAPER PIN #3/0 X 3/16 " "	"	1
7-321	CUP PT SET SCR #6-32NC-2 X 1/8 " "	"	2
7-322	MODIFICATION-STEEL PINION WIRE, BOSTON #GS-29, 12-TEETH, 48 PITCH, 14 1/2° PA, CAT #57, P.65	"	1
7-323	MODIFICATION-BRASS SPUR GEAR, BOSTON #G147 84-TEETH, 48 PITCH, 14 1/2° PA, CAT #57, P.14	COMM.	1
7-324	MODIFICATION-BRASS SPUR GEAR, BOSTON #G144 60-TEETH, 48 PITCH, 14 1/2° PA, CAT #57, P.14	COMM.	1
8-316	TAPER PIN #3/0 X 1/2 STAINLESS STEEL	COMM.	2
8-317	CUP PT SET SCR #6-32NC-2 X 1/8 " "	"	2
8-128	BRASS SPUR GEAR, BOSTON #G131 15 TEETH, 48 PITCH, 14 1/2° PA, CAT #57, P.14	"	1
8-319	MODIFICATION-BRASS SPUR GEAR, BOSTON #G146 12 TEETH, 48 PITCH, 14 1/2° PA, CAT #57, P.14	COMM.	1
8-330	TAPER PIN #3/0 X 3/8 STAINLESS STEEL	COMM.	1
8-331	CUP PT SET SCR #2-56NC-2 X 1/8 " "	"	1
8-332	MODIFICATION-BRASS SPUR GEAR, BOSTON #G140 40-TEETH, 48 PITCH, 14 1/2° PA, CAT #57, P.14	"	1
8-333	MODIFICATION-STEEL PINION WIRE, BOSTON #S29 12-TEETH, 48 PITCH, 14 1/2° PA, CAT #57, P.65	COMM.	1
8-336	TAPER PIN #3/0 X 1/2 STAINLESS STEEL	COMM.	2
8-337	CUP PT SET SCR #6-32NC-2 X 1/8 " "	"	2
8-338	MODIFICATION-BRASS SPUR GEAR, BOSTON #G144 60-TEETH, 48 PITCH, 14 1/2° PA, CAT #57, P.14	"	1
8-339	CAT RETAINING RING, TRUARC #5100-12-W	COMM.	1
8-340	BRASS SPUR GEAR, BOSTON #G136 24-TEETH, 48 PITCH, 14 1/2° PA, CAT #57, P.14	"	1
14-145	CUP PT SET SCR #2-56NC-2 X 3/16 STAINLESS STEEL	COMM.	28
15-146	CUP PT SET SCR #2-56NC-2 X 3/16 STAINLESS STEEL	COMM.	19

REVISIONS

SYMBOL LETTER	DETAIL NO.	BY	DESCRIPTION	CHECKED BY	DATE
A			ADD: 1-301		
A			ADD: 3-1.1.2		

DETAIL NO.	DESCRIPTION	MATERIAL SPECIFICATIONS	NO. REQD

LIST OF MATERIAL

REFERENCE DRAWINGS: For information Contact AUTOMATIC SYSTEMS SECTION Code 7114

TOLERANCES UNLESS OTHERWISE SPECIFIED: DECIMAL DIMENSIONS ± .005; FRACTIONAL DIMENSIONS ± 1/64; ANGLE DIMENSIONS ± 1°; DIMENSIONS IN INCHES

DO NOT SCALE DRAWINGS

SECURITY CLASSIFICATION: UNCLASSIFIED

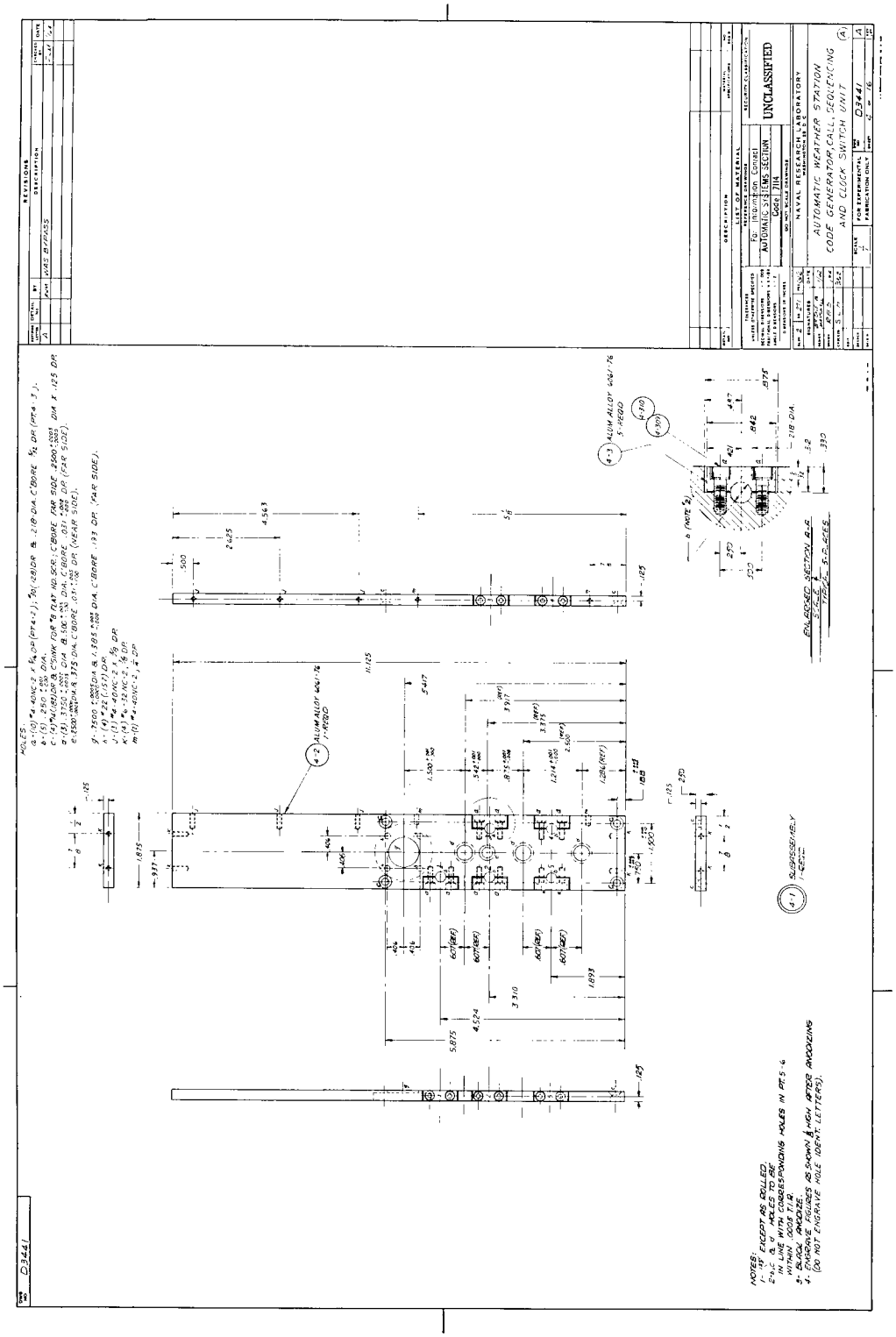
	SIGNATURE	DATE
DRAWN	BRYANT W. MARSHALL	
DESIGN	SAK	5/62
CHECKED	S.C.H.	9/62
APPR		

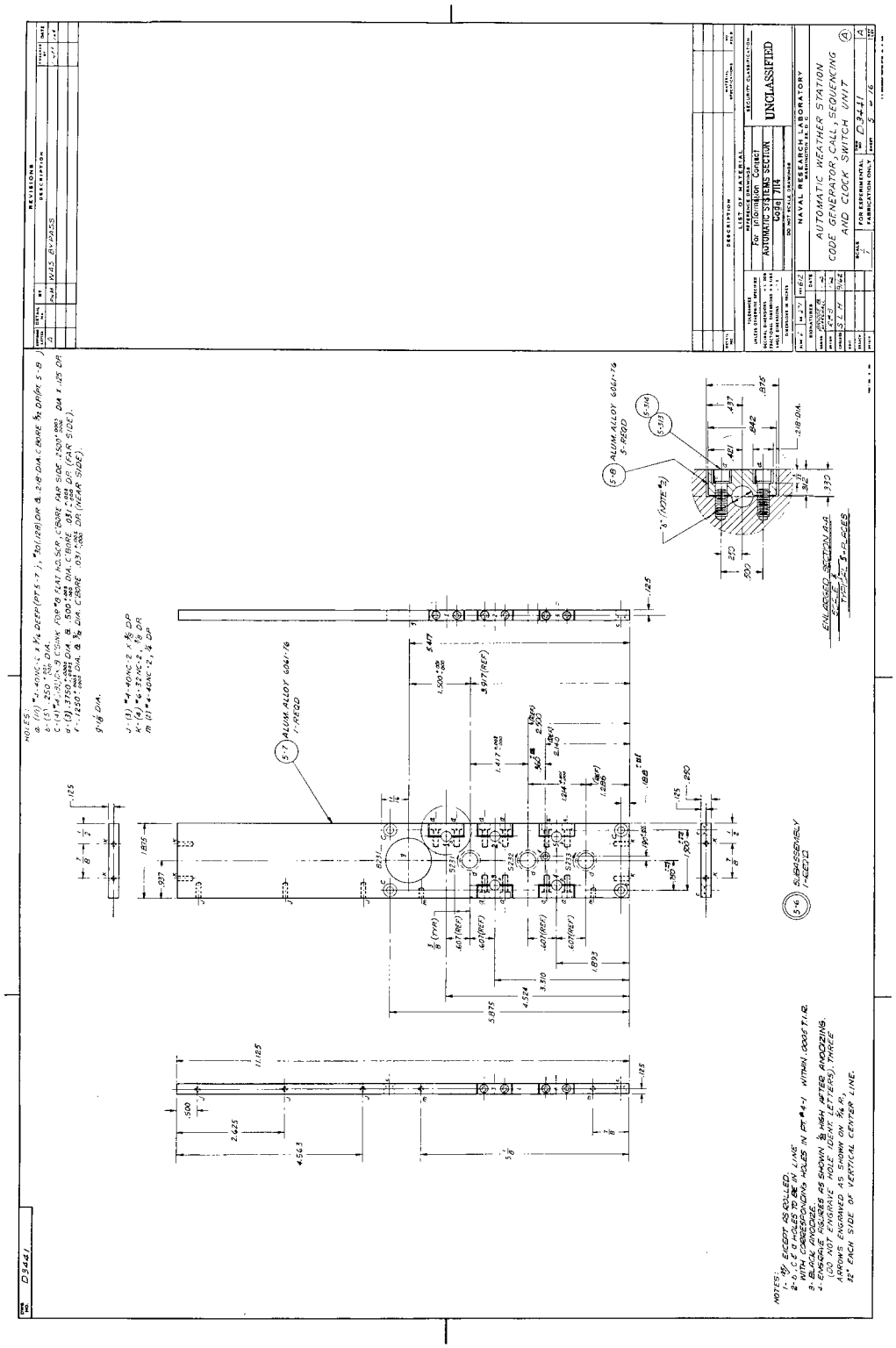
NAVAL RESEARCH LABORATORY
WASHINGTON 25 D.C.

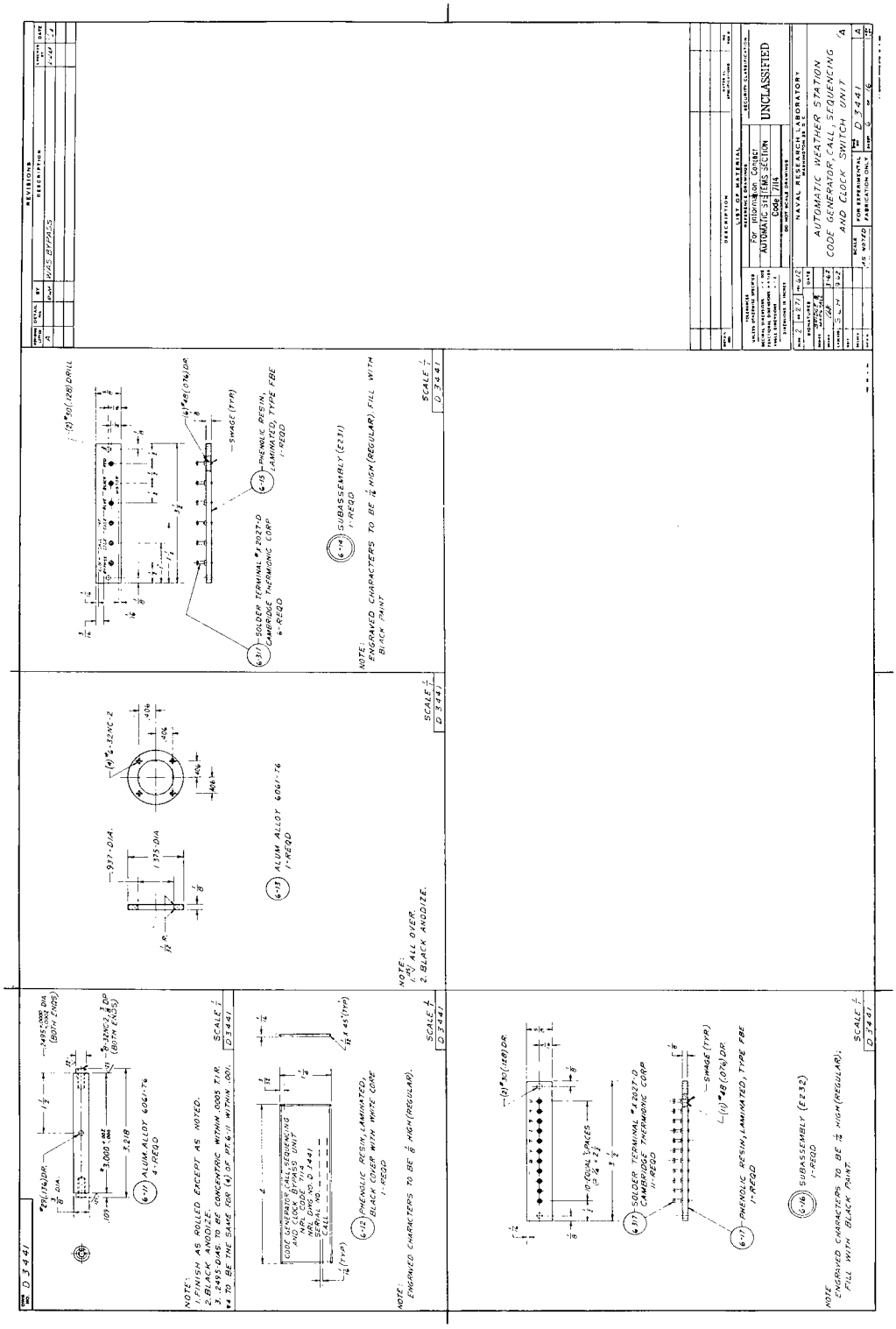
AUTOMATIC WEATHER STATION
CODE GENERATOR, CALL, SEQUENCING
AND CLOCK SWITCH UNIT

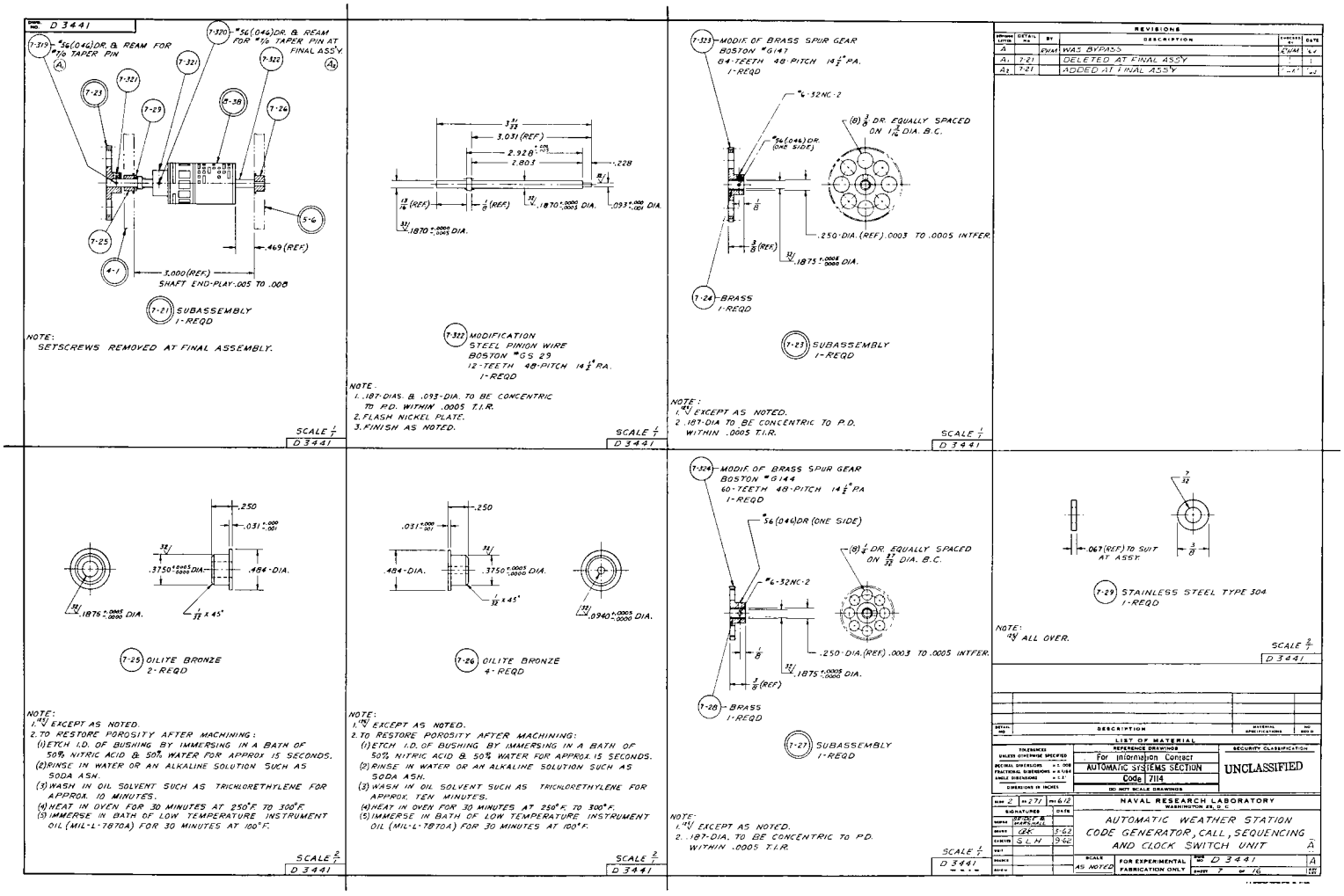
SCALE — FOR EXPERIMENTAL FABRICATION ONLY — DWG NO. D 3441 — SHEET 3 OF 16 — A

UNCLASSIFIED

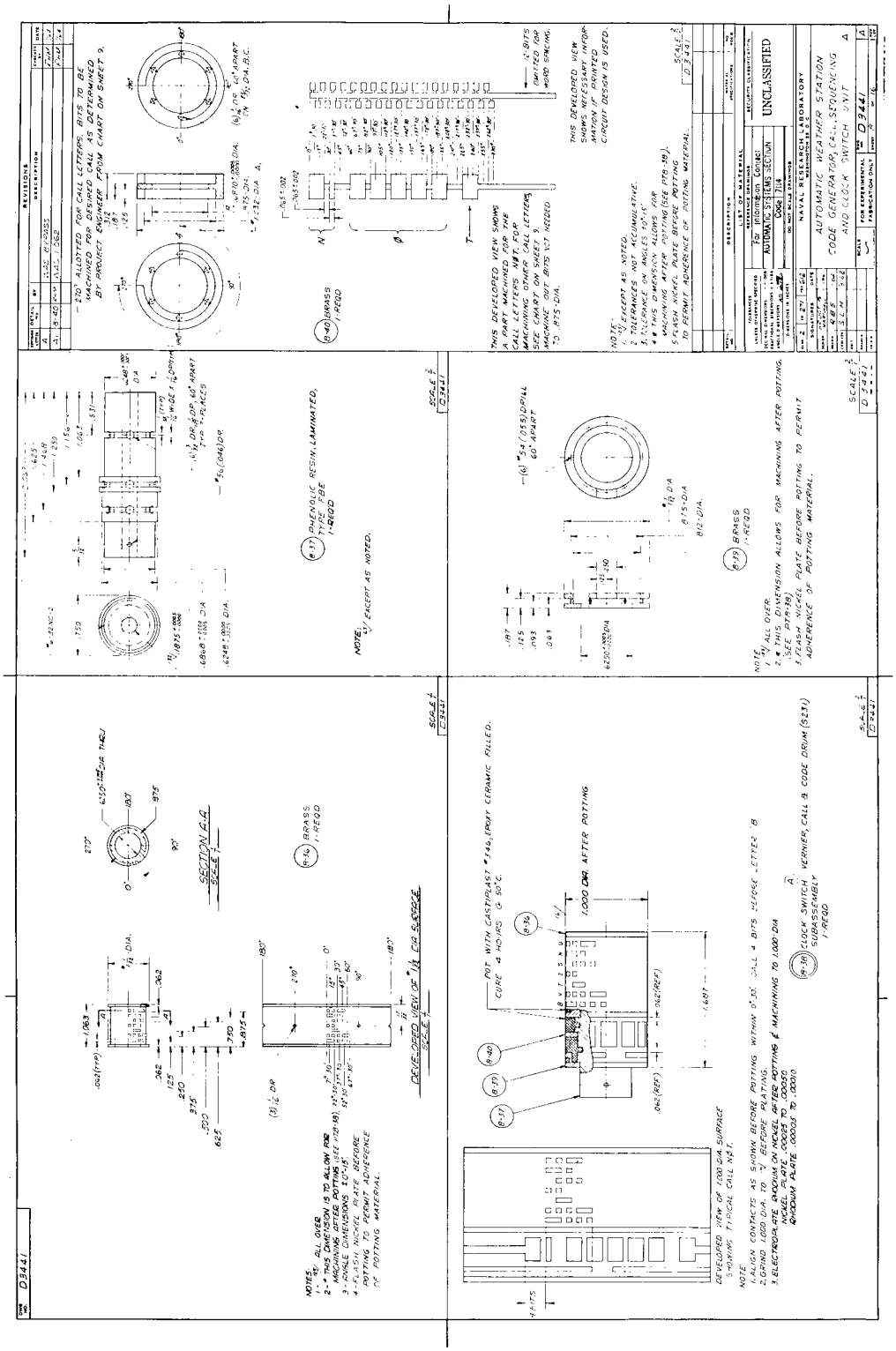

UNCLASSIFIED
NAVAL RESEARCH LABORATORY
AUTOMATIC WEATHER STATION
CODE GENERATOR, CALL SEQUENCING
AND CLOCK SWITCH UNIT
D3441
ALUM ALLOY WQ-76 T-REQD
ALUM ALLOY WQ-76 S-REQD
SUPERSEDED BY
NOTES:
1. 'A' EXCEPT AS NOTED.
2. ALL HOLES TO BE
3. BLACK ANODIZE.
4. ENGRAVE FIGURES AS SHOWN & HIGH AFTER ANODIZING
(DO NOT ENGRAVE HOLE IDENT. LETTERS).


UNCLASSIFIED
For information Contact
AUTOMATIC SYSTEMS SECTION
6098 / 7114
NAVAL RESEARCH LABORATORY
AUTOMATIC WEATHER STATION
CODE GENERATOR, CALL, SEQUENCING
AND CLOCK SWITCH UNIT
D3441
ALUM ALLOY 6061-T6
T-ROD
ALUM ALLOY 6061-T6
S-ROD
ENLARGED SECTION A-A
SUBASSEMBLY
(-6E12)


D 3441
REVISIONS
DESCRIPTION
WAS BYPASS
NOTE:
1. FINISH AS ROLLED EXCEPT AS NOTED.
2. BLACK ANODIZE
3. .2493 DIA. TO BE CONCENTRIC WITHIN .0005 T.I.R.
* TO BE THE SAME FOR (*) OF PT. 6-11 WITHIN .001
SCALE 1/1
D 3441
(6-11) ALUM ALLOY 6061-T6
4-REQD
(6-12) PHENOLIC RESIN, LAMINATED,
BLACK COVER WITH WHITE CORE
1-REQD
CODE GENERATOR, CALL, SEQUENCING
AND CLOCK SWITCH UNIT
NRL CODE 7114
NRL DWG NO. D 3441
SER. NO.
CALL
NOTE:
ENGRAVED CHARACTERS TO BE 1/8" HIGH (REGULAR).
(6-13) ALUM ALLOY 6061-T6
1-REQD
NOTE:
1. ALL OVER.
2. BLACK ANODIZE.
(6-14) SUBASSEMBLY (E231)
1-REQD
NOTE:
ENGRAVED CHARACTERS TO BE 1/16 HIGH (REGULAR). FILL WITH
BLACK PAINT
(6-15) PHENOLIC RESIN,
LAMINATED, TYPE FBE
1-REQD
(6-16) SOLDER TERMINAL #2027-D
CAMBRIDGE THERMONIC CORP.
4-REQD
SWAGE (TYP)
(6-17) SOLDER TERMINAL #2027-D
CAMBRIDGE THERMONIC CORP
11-REQD
(6-17) PHENOLIC RESIN, LAMINATED, TYPE FBE
1-REQD
(6-18) SUBASSEMBLY (E232)
1-REQD
NOTE
ENGRAVED CHARACTERS TO BE 1/16 HIGH (REGULAR);
FILL WITH BLACK PAINT.
SCALE 1/1
D 3441
UNCLASSIFIED
NAVAL RESEARCH LABORATORY
WASHINGTON, D. C.
AUTOMATIC WEATHER STATION
CODE GENERATOR, CALL, SEQUENCING
AND CLOCK SWITCH UNIT
D 3441
FOR EXPERIMENTAL FABRICATION ONLY



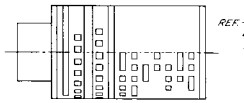
UNCLASSIFIED


NAVAL RESEARCH LABORATORY
AUTOMATIC WEATHER STATION
CODE GENERATOR, CALL SEQUENCING
AND CLOCK SWITCH UNIT
UNCLASSIFIED
AUTOMATIC SYSTEMS SECTION
D3441
SECTION A-A
DEVELOPED VIEW OF 1/4 DIA SURFACE
(8-40) BRASS 1-REQD
(8-17) PHENOLIC RESIN, LAMINATED, TYPE FBE 1-REQD
(8-39) BRASS 1-REQD
(8-16) BRASS 1-REQD
(8-36)
(8-37)
(8-31)
(8-18) CLOCK SWITCH VERNIER, CALL & CODE DRUM (S23) SUBASSEMBLY 1-REQD
POT WITH CASTIPLAST #346, EPOXY CERAMIC FILLED.
CURE 4 HOURS @ 90°C.
1.000 DIA AFTER POTTING
DEVELOPED VIEW OF 1.000 DIA SURFACE
SHOWING TYPICAL CALL NO.
NOTE
1. ALIGN CONTACTS AS SHOWN BEFORE POTTING WITHIN 0°30'. CALL 4 BITS HEDGE LETTER 18
2. GRIND 1.000 DIA. TO ±1 BEFORE PLATING.
3. ELECTROPLATE ANODIUM ON NICKEL AFTER POTTING & MACHINING TO 1.000 DIA
NICKEL PLATE .0002 TO .0005
ANODIUM PLATE .0002 TO .0010
NOTES
1. ALL OVER
2. THIS DIMENSION IS TO ALLOW FOR MACHINING AFTER POTTING (SEE PTS-18)
3. FINALE DIMENSIONS ±0°15'
4. FLASH NICKEL PLATE BEFORE POTTING TO PERMIT ADHERENCE OF POTTING MATERIAL
THIS DEVELOPED VIEW SHOWS NECESSARY MODIFICATION OF PRINTED CIRCUIT DESIGN IS USED.
A PART MACHINED FOR THE CALL LETTERS NOT FOR MACHINING OTHER CALL LETTERS SEE PART ON SHEET 3. MACHINE OUT BTS 1-7 NEEDED TO .875 DIA.
NOTE
1. ALL EXCEPT AS NOTED
2. TOLERANCE NOT ACCUMULATIVE
3. TOLERANCE ON ANGLES ±0°15'
4. THIS DIMENSION ALLOWS FOR MACHINING AFTER POTTING (SEE PTS-18).
5. FLASH NICKEL PLATE BEFORE POTTING TO PERMIT ADHERENCE OF POTTING MATERIAL
NOTE
1. ALL EXCEPT AS NOTED
2. THIS DIMENSION ALLOWS FOR MACHINING AFTER POTTING. SEE PTS-18
3. FLASH NICKEL PLATE BEFORE POTTING TO PERMIT ADHERENCE OF POTTING MATERIAL.
REVISIONS
LIST OF MATERIAL
SCALE 1/2

DRAWING NO. D 3441

(A)

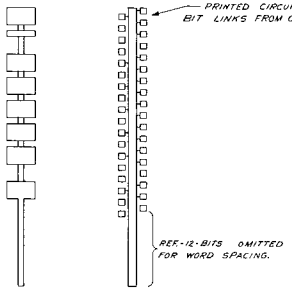
CLOCK SWITCH VERNIER, CALL & CODE DRUM (S231)
SUGGESTED CALL LETTER FORMING.
FOR DESIRED CALL, SEE CALL LETTER CHART.
CALL LETTER SECTION SHOWS PRINTED CIRCUIT DESIGN.



REF.-FIRST CALL BIT ALIGNED
4-BITS BEFORE LEADING
DASH MADE BY "B."

MACHINE DESIGN; MACHINE OUT BITS
NOT NEEDED TO MAKE CALL DESIRED.

PRINTED CIRCUIT DESIGN; CUT
BIT LINKS FROM COMMON TO MAKE CALL DESIRED.



REF-12-BITS OMITTED
FOR WORD SPACING.

DEVELOPED VIEWS OF CALL LETTER SECTION
OF S231 DRUM. SAMPLE CALL SHOWN IS NØT.
(FOR DETAILS, SEE SHEET 8).

ALLOTTED AREA ON DRUM OF DOTS, DASHES & SPACES
TO FORM INTERNATIONAL MORSE CODE. 36 BITS AVAILABLE
FOR ANY 3-LETTER CALL.

DOT = 1-BIT
DASH = 3-BITS
SPACE BETWEEN DOT & DASH = 1-BIT
SPACE BETWEEN LETTERS = 3-BITS
SPACE BETWEEN WORDS = 12-BITS

OF THE 260 CALL LETTERS THAT ARE ASSIGNED TO NRL
BY CNO CODE OP943F, CALL LETTER CHART SHOWS
THE 180 THAT CAN BE FORMED BY THE CALL LETTER
SECTION OF S231 DRUM.

CALL LETTER CHART

FIRST LETTER	SECOND LETTER Ø	1	2	3	4	5	6	7	8	9	THIRD LETTER
N	X	X	X	X	X	X	X	X	X	X	A
N			X	X	X	X	X	X	X		B
N				X	X	X	X	X			C
N		X	X	X	X	X	X	X	X	X	D
N	X	X	X	X	X	X	X	X	X	X	E
N			X	X	X	X	X	X			F
N			X	X	X	X	X	X			G
N		X	X	X	X	X	X	X	X	X	H
N	X	X	X	X	X	X	X	X	X	X	I
N					X	X	X				J
N			X	X	X	X	X	X	X		K
N				X	X	X	X	X			L
N		X	X	X	X	X	X	X	X	X	M
N	X	X	X	X	X	X	X	X	X	X	N
N				X	X	X	X	X			O
N				X	X	X	X	X			P
N					X	X	X				Q
N		X	X	X	X	X	X	X	X	X	R
N	X	X	X	X	X	X	X	X	X	X	S
N	X	X	X	X	X	X	X	X	X	X	T
N			X	X	X	X	X	X	X	X	U
N				X	X	X	X	X	X		V
N				X	X	X	X	X	X		W
N					X	X	X	X			X
N					X	X	X	X			Y
N				X	X	X	X	X			Z

SECOND CALL LETTERS THAT ARE POSSIBLE
ARE INDICATED BY [X]

NOTE:
ADDITIONAL CALLS NOT ASSIGNED TO NRL FOR AUTOMATIC
WEATHER STATION USE CAN BE FORMED BY CHANGING
THE FIRST LETTER, USING A LETTER RATHER THAN
A NUMBER FOR THE SECOND LETTER, OR BY
INTERCHANGING THE ORDERS OF THE CHARACTERS
MAKING UP THE CALL.

REVISIONS

REVISION LETTER	DETAIL NO.	BY	DESCRIPTION	CHECKED BY	DATE
A		RWH	WAS BYPASS	RWH	[illegible]

INTERNATIONAL MORSE CODE

A	• —	N	— •
B	— • • •	O	— — —
C	— • — •	P	• — — •
D	— • •	Q	— — • —
E	•	R	• — •
F	• • — •	S	• • •
G	— — •	T	—
H	• • • •	U	• • —
I	• •	V	• • • —
J	• — — —	W	• — —
K	— • —	X	— • • —
L	• — • •	Y	— • — —
M	— —	Z	— — • •
1	• — — — —	6	— • • • •
2	• • — — —	7	— — • • •
3	• • • — —	8	— — — • •
4	• • • • —	9	— — — — •
5	• • • • •	Ø	— — — — —

MATERIAL NO.	DESCRIPTION	MATERIAL SPECIFICATIONS	NO. PER U

LIST OF MATERIAL

TOLERANCES (UNLESS OTHERWISE SPECIFIED): DECIMAL DIMENSIONS ± .005; FRACTIONAL DIMENSIONS ± 1/64; ANGLE DIMENSIONS ± 1°; DIMENSIONS IN INCHES

REFERENCE DRAWINGS: For information Contact AUTOMATIC SYSTEMS SECTION Code 7114

DO NOT SCALE DRAWINGS

SECURITY CLASSIFICATION: UNCLASSIFIED

SIZE 2 | NR 271 | PN 612

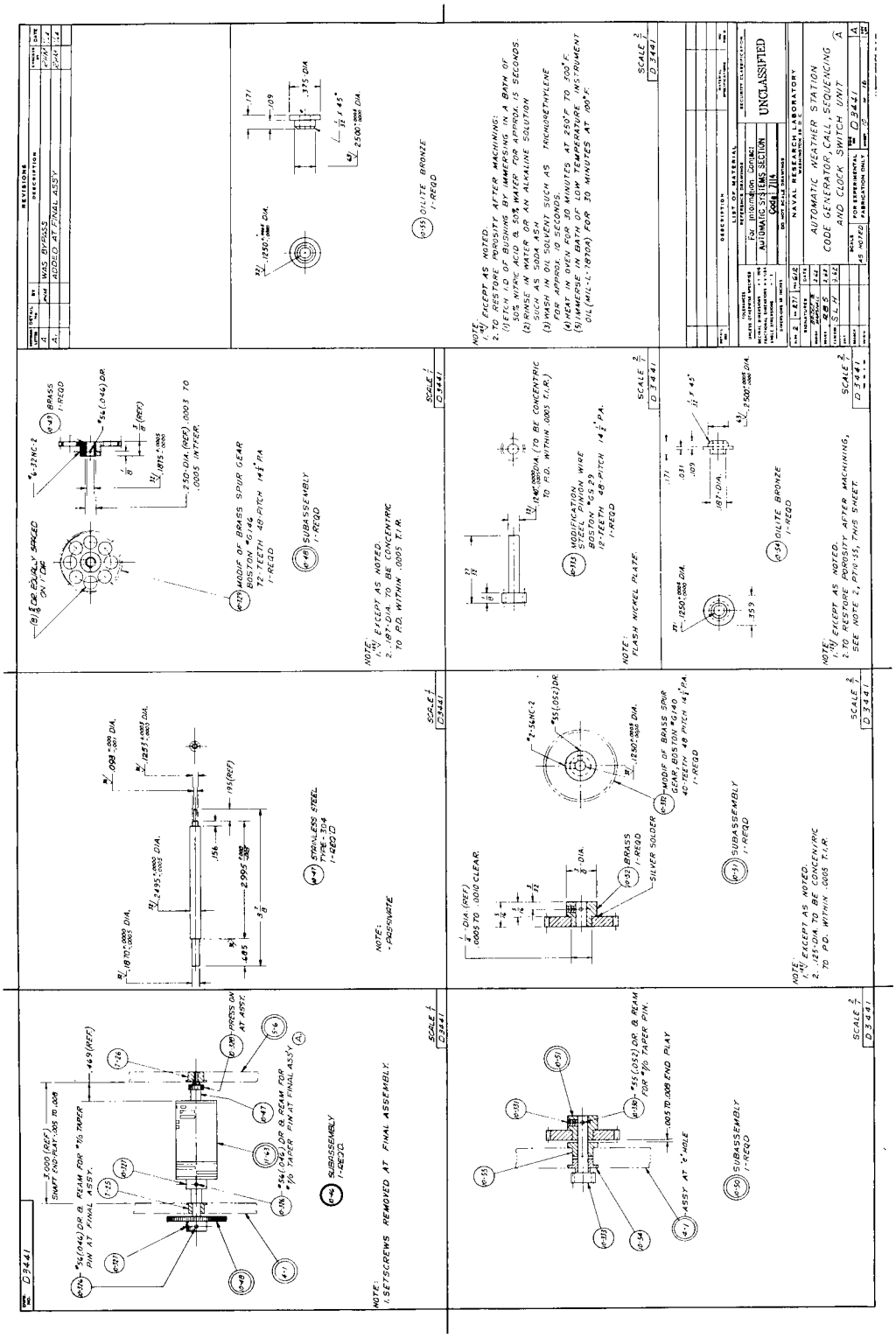
SIGNATURES		DATE
DESIGN	JAMES & HARTWELL	
DRAWN	CAF	5-62
CHECKED	S.L.M.	5-62
EXIT		
SEARCH		
SEAL IN		

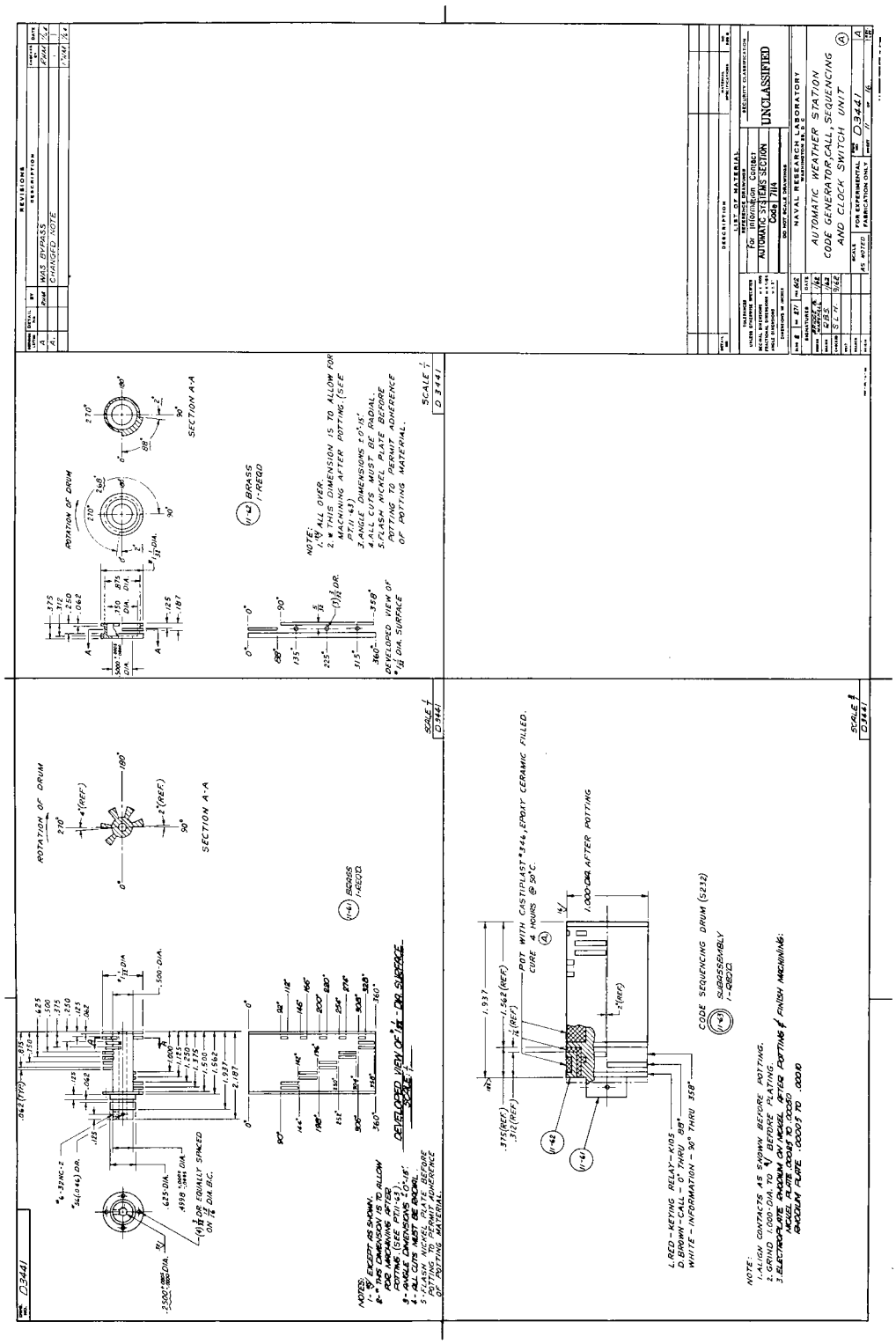
NAVAL RESEARCH LABORATORY
WASHINGTON 25, D. C.

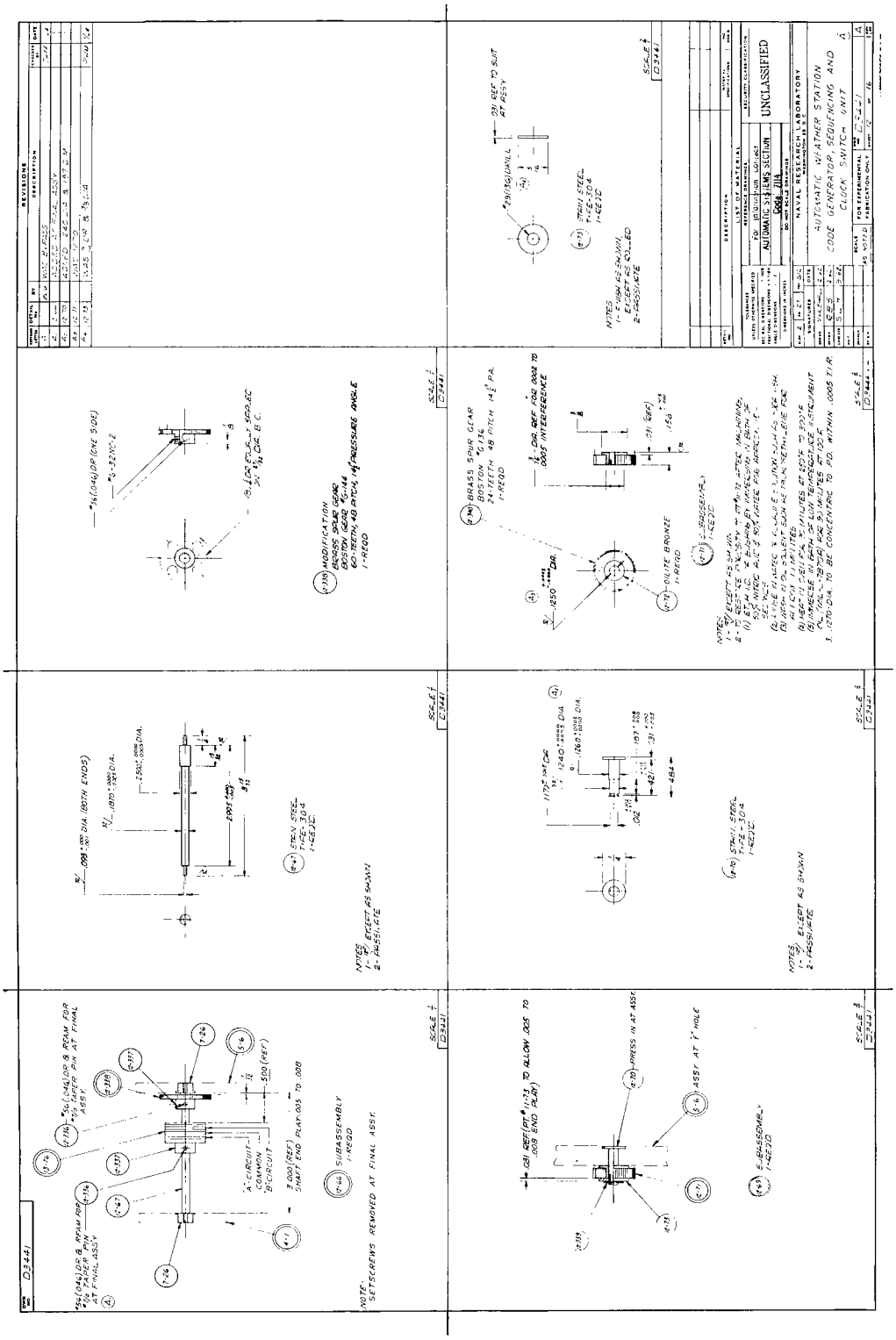
AUTOMATIC WEATHER STATION
CODE GENERATOR, CALL, SEQUENCING
AND CLOCK SWITCH UNIT (A)

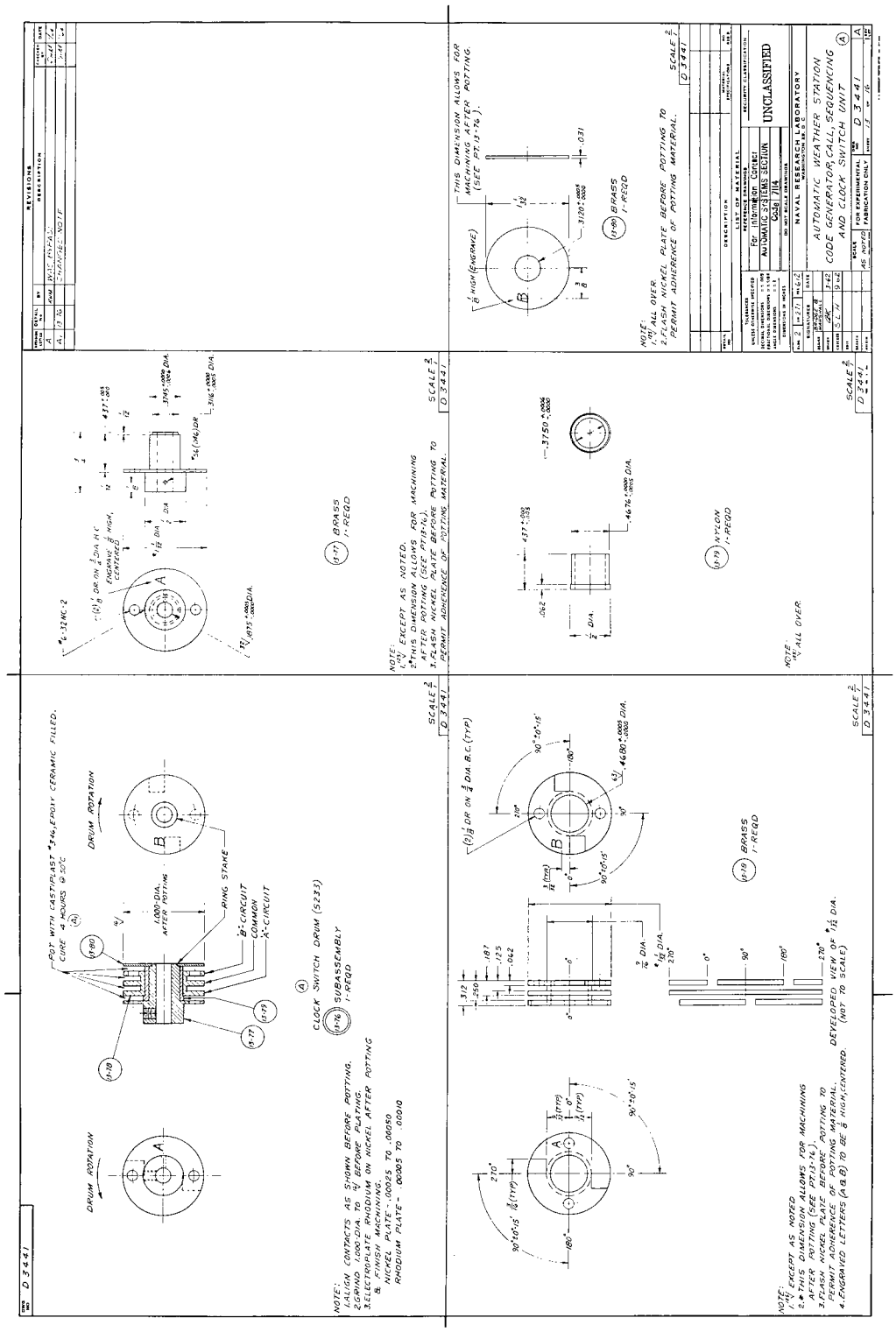
SCALE CAP | FOR EXPERIMENTAL FABRICATION ONLY | DWG NO. D 3441 | SHEET 9 OF 16 | REV A

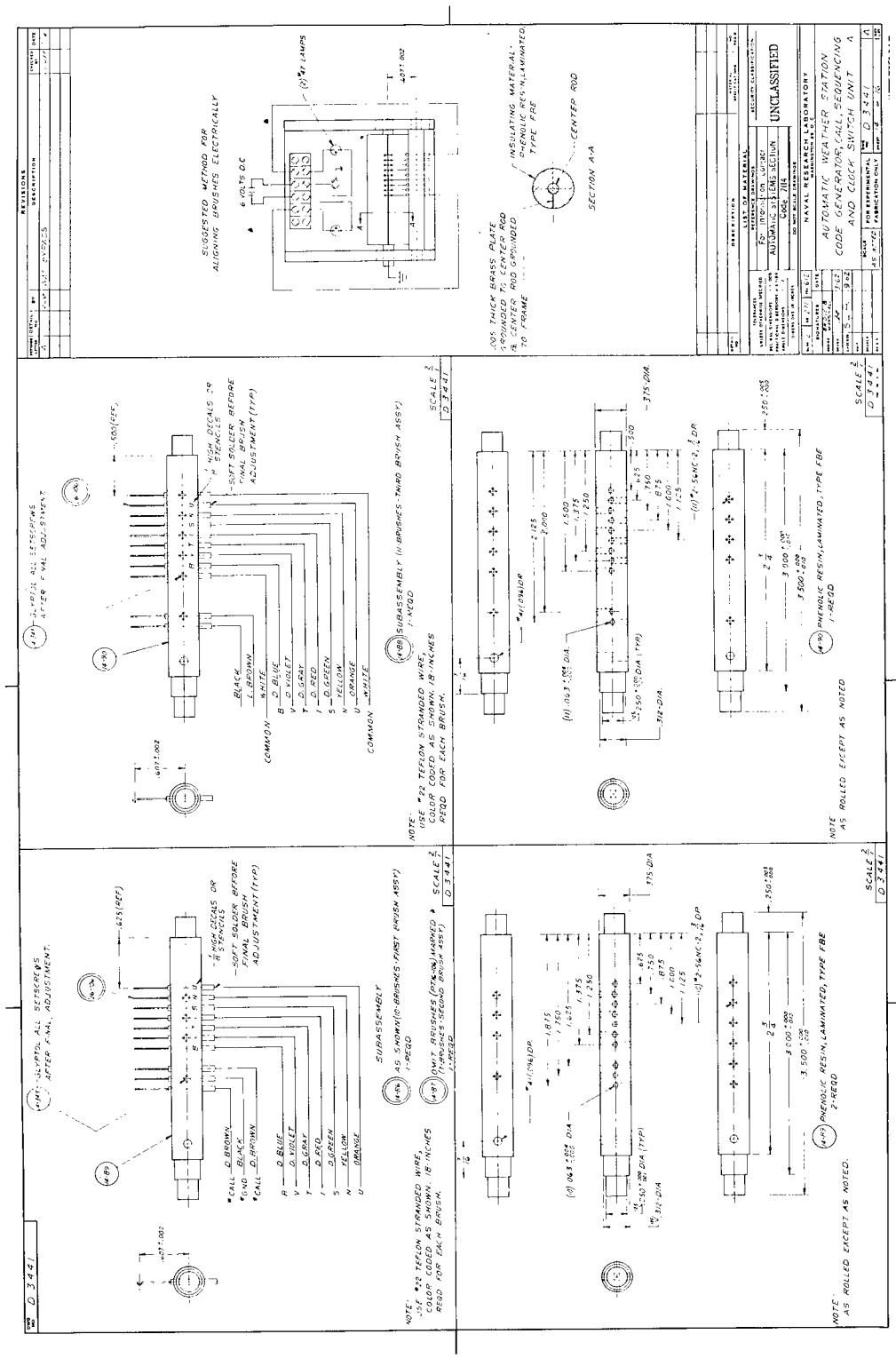
UNCLASSIFIED

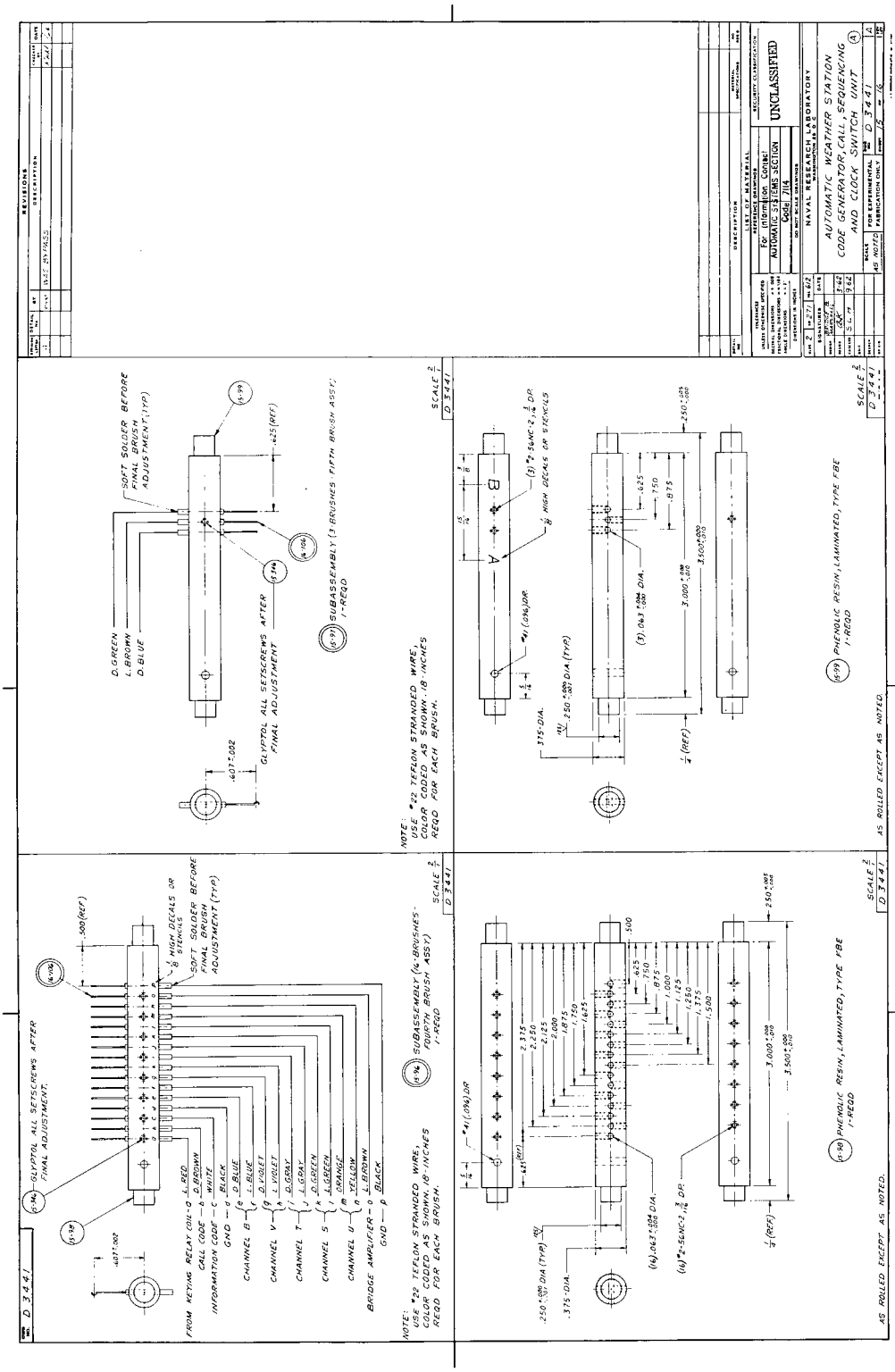

D 3441
REVISIONS
WAS BYPASS
ADDED AT FINAL ASSY
SUBASSEMBLY 1-REQD
SUBASSEMBLY 1-REQD
SUBASSEMBLY 1-REQD
SUBASSEMBLY 1-REQD
SUBASSEMBLY 1-REQD
SUBASSEMBLY 1-REQD
STAINLESS STEEL TYPE-304 1-REQD
MODIFICATION STEEL PINION WIRE BOSTON #6.29 12-TEETH 48-PITCH 1-REQD
MODIFICATION OF BRASS SPUR GEAR BOSTON #6.46 72-TEETH 48-PITCH 1-REQD
OILITE BRONZE 1-REQD
OILITE BRONZE 1-REQD
BRASS 1-REQD
BRASS 1-REQD
SILVER SOLDER
FLASH NICKEL PLATE
NOTE: 1. SETSCREWS REMOVED AT FINAL ASSEMBLY.
NOTE: 1. PASSIVATE
NOTE: 1. EXCEPT AS NOTED. 2. .187-DIA. TO BE CONCENTRIC TO P.D. WITHIN .0005 T.I.R.
NOTE: 1. EXCEPT AS NOTED. 2. TO RESTORE POROSITY AFTER MACHINING, SEE NOTE 2, PTD-35, THIS SHEET.
NOTE: 1. EXCEPT AS NOTED. 2. .125-DIA TO BE CONCENTRIC TO P.D. WITHIN .0005 T.I.R.
NOTE: 1. EXCEPT AS NOTED. 2. TO RESTORE POROSITY AFTER MACHINING: (1) ETCH I.D. OF BUSHING BY IMMERSING IN A BATH OF 50% NITRIC ACID & 50% WATER FOR APPROX. 15 SECONDS. (2) RINSE IN WATER OR AN ALKALINE SOLUTION SUCH AS SODA ASH. (3) WASH IN OIL SOLVENT SUCH AS TRICHLORETHYLENE FOR APPROX. 10 SECONDS. (4) HEAT IN OVEN FOR 30 MINUTES AT 250°F TO 300°F. (5) IMMERSE IN BATH OF LOW TEMPERATURE INSTRUMENT OIL (MIL-L 16204) FOR 30 MINUTES AT 100°F.
LIST OF MATERIAL
REFERENCE DRAWINGS
DESCRIPTION
UNCLASSIFIED
For Information Contact
AUTOMATIC SYSTEMS SECTION
NAVAL RESEARCH LABORATORY
WASHINGTON, D.C.
AUTOMATIC WEATHER STATION
CODE GENERATOR, CALL, SEQUENCING AND CLOCK SWITCH UNIT
D 3441
FOR EXPERIMENTAL FABRICATION ONLY
AS NOTED

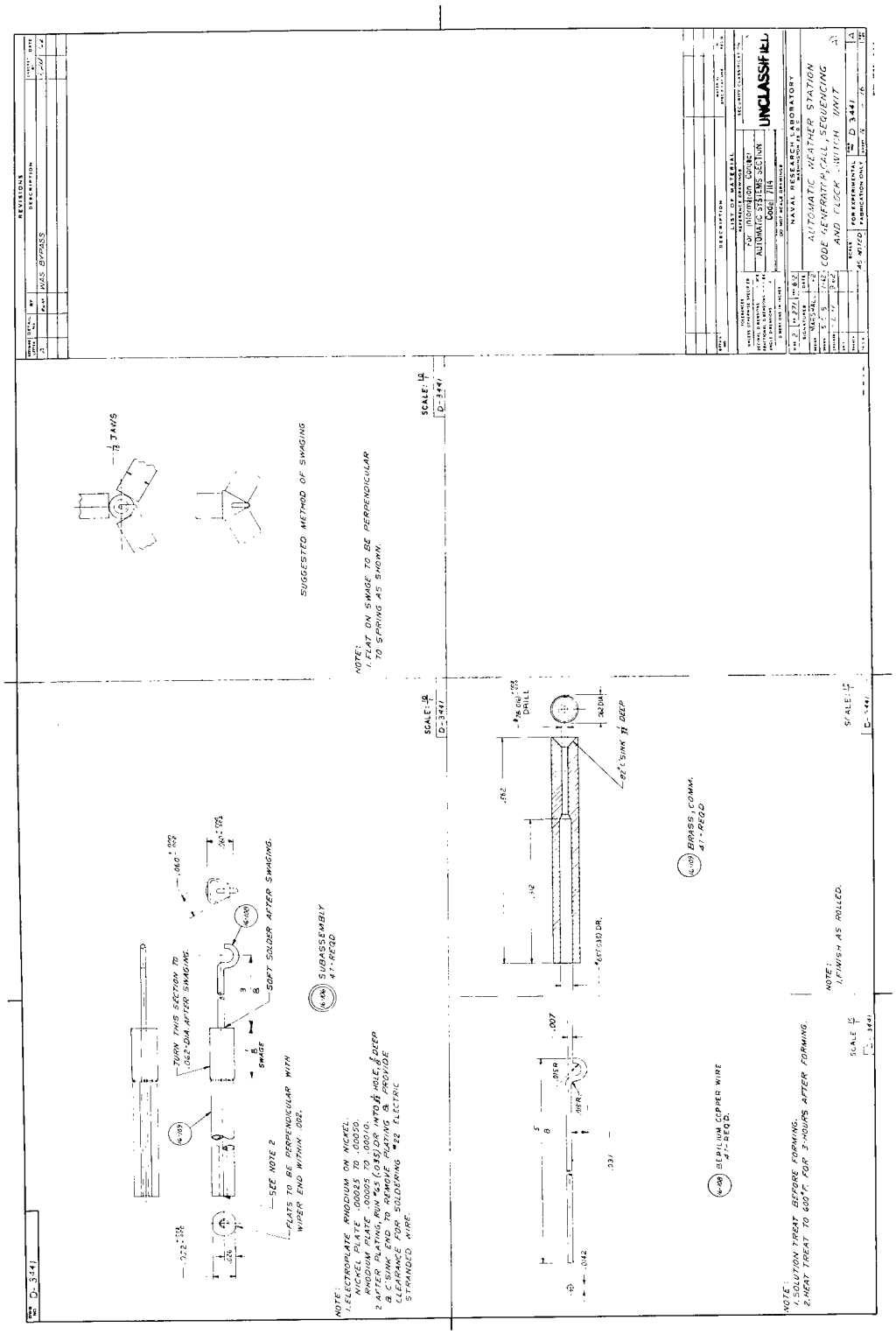

REVISIONS
WIRE BYPASS
CHANGED NOTE
ROTATION OF DRUM
SECTION A-A
BRASS 1-REQD
NOTE:
1. ALL OVER.
2. THIS DIMENSION IS TO ALLOW FOR MACHINING AFTER POTTING. (SEE FIG. 4)
3. ANGLE DIMENSIONS ±0°15'.
4. ALL CUTS MUST BE RADIAL.
5. FLASH NICKEL PLATE BEFORE POTTING TO PERMIT ADHERENCE OF POTTING MATERIAL.
DEVELOPED VIEW OF 1/16" DIA. SURFACE
SCALE 1/1
D3441
NOTES:
1. EXCEPT AS SHOWN.
2. THIS DIMENSION IS TO ALLOW FOR MACHINING AFTER POTTING.
3. ANGLE DIMENSIONS ±0°15'.
4. ALL CUTS MUST BE RADIAL.
5. FLASH NICKEL PLATE BEFORE POTTING TO PERMIT ADHERENCE OF POTTING MATERIAL.
DEVELOPED VIEW OF 1/16" DIA. SURFACE
POT WITH CASTIMAST #346, EPOXY CERAMIC FILLED.
CURE 4 HOURS @ 50°C.
1.000 DIA AFTER POTTING
CODE SEQUENCING DRUM (S212)
SUBASSEMBLY 1-REQD
L. RED - NETWIG RELAY - K105
D. BROWN - ALL 1-7 THRU 1.88"
WHITE - INFORMATION - 90° THRU 358°
NOTE:
1. ALIGN CONTACTS AS SHOWN BEFORE POTTING.
2. GRIND 1.000" DIA. TO 1/16" DIA. BEFORE PLATING.
3. ELECTROPLATE BRASS PARTS WITH NICKEL BEFORE POTTING & FINISH MACHINING:
NICKEL PLATE .0002 TO .0005
RHODIUM PLATE .00005 TO .0010
SCALE 1/1
D3441
LIST OF MATERIAL
UNCLASSIFIED
AUTOMATIC WEATHER STATION
CODE GENERATOR CALL SEQUENCING
AND CLOCK SWITCH UNIT
NAVAL RESEARCH LABORATORY
D3441


REVISIONS
DESCRIPTION
UNCLASSIFIED
NAVAL RESEARCH LABORATORY
AUTOMATIC WEATHER STATION
CODE GENERATOR, SEQUENCING AND
CLOCK SWITCH UNIT
D-3441
SCALE 1/1
NOTES
1-REQD
2-PASSIVATE
STAIN STEEL
1-CE-304
1-CE1C
BRASS SPUR GEAR
24-TEETH 48 PITCH
1-REQD
BRONZE
1-REQD
SUBASSEMBLY
1-REQD
ASSY AT 1/2" HOLE
NOTE
SET-SCREWS REMOVED AT FINAL ASSY.


D 3441
POT WITH CASTIPLAST #746, EPOXY CERAMIC FILLED. CURE 4 HOURS @ 50°C
DRUM ROTATION
RING STAKE
1.000 DIA. AFTER POTTING
B-CIRCUIT
COMMON
A-CIRCUIT
CLOCK SWITCH DRUM (5233)
SUBASSEMBLY 1-REQD
NOTE:
1. ALIGN CONTACTS AS SHOWN BEFORE POTTING.
2. GRIND 1.000 DIA. TO ψ BEFORE PLATING.
3. ELECTROPLATE RHODIUM ON NICKEL AFTER POTTING & FINISH MACHINING.
NICKEL PLATE - .00025 TO .00050
RHODIUM PLATE - .00005 TO .00010
SCALE 2/1
D 3441
BRASS 1-REQD
NOTE:
1. (a) EXCEPT AS NOTED.
2. *THIS DIMENSION ALLOWS FOR MACHINING AFTER POTTING (SEE PT.13-14).
3. FLASH NICKEL PLATE BEFORE POTTING TO PERMIT ADHERENCE OF POTTING MATERIAL.
SCALE 2/1
D 3441
BRASS 1-REQD
DEVELOPED VIEW OF ψ 1 1/2 DIA. (NOT TO SCALE)
NOTE:
1. (a) EXCEPT AS NOTED
2. *THIS DIMENSION ALLOWS FOR MACHINING AFTER POTTING (SEE PT.13-14).
3. FLASH NICKEL PLATE BEFORE POTTING TO PERMIT ADHERENCE OF POTTING MATERIAL.
4. ENGRAVED LETTERS (A & B) TO BE 1/8" HIGH, CONTENED.
SCALE 2/1
D 3441
BRASS 1-REQD
THIS DIMENSION ALLOWS FOR MACHINING AFTER POTTING (SEE PT.13-14).
NOTE:
1. (a) ALL OVER.
2. FLASH NICKEL PLATE BEFORE POTTING TO PERMIT ADHERENCE OF POTTING MATERIAL.
SCALE 2/1
D 3441
NYLON 1-REQD
NOTE:
1. (a) ALL OVER.
SCALE 2/1
D 3441
REVISIONS
DESCRIPTION
LIST OF MATERIAL
UNCLASSIFIED
AUTOMATIC SYSTEMS SECTION
Code 7114
NAVAL RESEARCH LABORATORY
AUTOMATIC WEATHER STATION
CODE GENERATOR, CALL SEQUENCING
AND CLOCK SWITCH UNIT
D 3441


SUGGESTED METHOD FOR ALIGNING BRUSHES ELECTRICALLY
6 VOLTS DC
INSULATING MATERIAL PHENOLIC RESIN, LAMINATED TYPE FBE
CENTER ROD
SECTION A-A
.105 THICK BRASS PLATE GROUNDED TO CENTER ROD
CENTER ROD GROUNDED TO FRAME
UNCLASSIFIED
AUTOMATIC WEATHER STATION CODE GENERATOR, CALL, SEQUENCING AND CLOCK SWITCH UNIT
NAVAL RESEARCH LABORATORY
SUBASSEMBLY (11 BRUSHES - THIRD BRUSH ASSY)
NOTE: USE #22 TEFLON STRANDED WIRE, COLOR CODED AS SHOWN, 18" INCHES REQD FOR EACH BRUSH.
PHENOLIC RESIN, LAMINATED, TYPE FBE
NOTE: AS ROLLED EXCEPT AS NOTED
SUBASSEMBLY
NOTE: USE #22 TEFLON STRANDED WIRE, COLOR CODED AS SHOWN, 18" INCHES REQD FOR EACH BRUSH.
PHENOLIC RESIN, LAMINATED, TYPE FBE
NOTE: AS ROLLED EXCEPT AS NOTED.


REVISIONS
LIST OF MATERIAL
UNCLASSIFIED
AUTOMATIC WEATHER STATION
CODE GENERATOR, CALL, SEQUENCING
AND CLOCK SWITCH UNIT
NAVAL RESEARCH LABORATORY
D 3441
SOFT SOLDER BEFORE FINAL BRUSH ADJUSTMENT (TYP)
GLYPTOL ALL SETSCREWS AFTER FINAL ADJUSTMENT
SUBASSEMBLY (3 BRUSHES, FIFTH BRUSH ASSY)
1-REQD
D.GREEN
L.BROWN
D.BLUE
NOTE: USE #22 TEFLON STRANDED WIRE, COLOR CODED AS SHOWN, 18 INCHES REQD FOR EACH BRUSH.
PHENOLIC RESIN, LAMINATED, TYPE FBE
1-REQD
AS ROLLED EXCEPT AS NOTED.
HIGH DECALS OR STENCILS
FROM KEYING RELAY COIL — a L.RED
CALL CODE — b D.BROWN
INFORMATION CODE — c WHITE
GND — d BLACK
CHANNEL B — e D.BLUE
CHANNEL V — f L.BLUE
CHANNEL T — g D.VIOLET
CHANNEL S — h L.VIOLET
CHANNEL U — i D.GRAY
BRIDGE AMPLIFIER — j L.GRAY
GND — k D.GREEN
l L.GREEN
m ORANGE
n YELLOW
o L.BROWN
p BLACK
SUBASSEMBLY (4 BRUSHES - FOURTH BRUSH ASSY)
1-REQD
SCALE 2/1

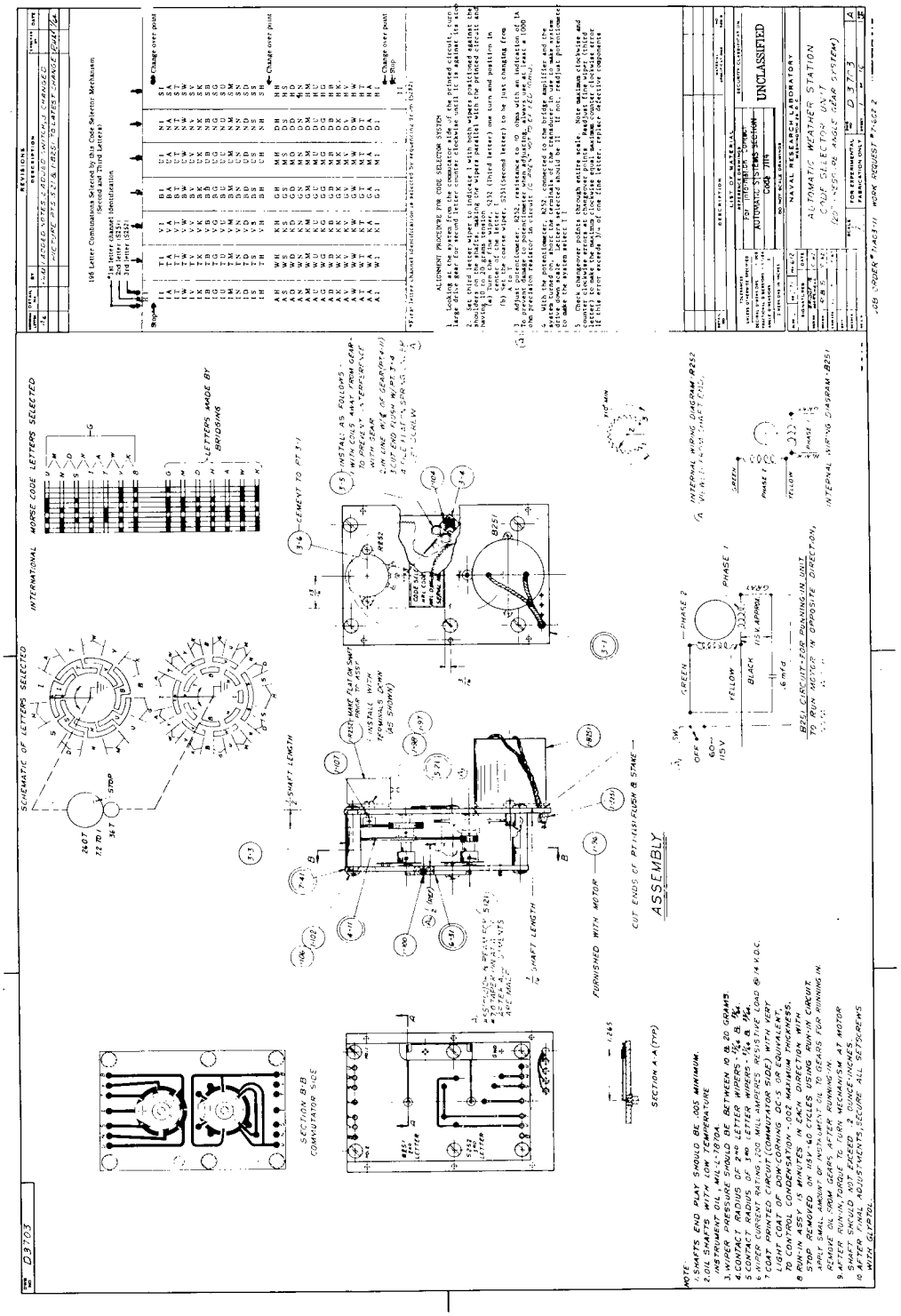

REVISIONS
DESCRIPTION
WAS BYPASS
1/2 TAPS
SUGGESTED METHOD OF SWAGING
NOTE:
1. FLAT ON SWAGE TO BE PERPENDICULAR TO SPRING AS SHOWN.
SCALE: 1/2
D-3441
TURN THIS SECTION TO .062" DIA. AFTER SWAGING.
SOFT SOLDER AFTER SWAGING.
SUBASSEMBLY 41-REQD
SEE NOTE 2
FLATS TO BE PERPENDICULAR WITH WIPER END WITHIN .002.
NOTE:
1. ELECTROPLATE RHODIUM ON NICKEL.
NICKEL PLATE .00025 TO .00035.
RHODIUM PLATE .0005 TO .0010.
2. AFTER PLATING RUN #23 (.023) DR INTO 3/8 HOLE, 1/4 DEEP & C'SINK END TO REMOVE PLATING & PROVIDE CLEARANCE FOR SOLDERING #22 ELECTRIC STRANDED WIRE.
#26 (.016) DRILL
82° C'SINK 1/8 DEEP
.062 DIA.
.142
.262
#57 (.043) DR.
BRASS, COMM. 41-REQD
BERYLLIUM COPPER WIRE 41-REQD.
NOTE:
1. SOLUTION TREAT BEFORE FORMING.
2. HEAT TREAT TO 600°F. FOR 3-HOURS AFTER FORMING.
NOTE:
1. FINISH AS ROLLED.
SCALE: 1/1
D-3441
NAVAL RESEARCH LABORATORY
WASHINGTON 25, D.C.
AUTOMATIC WEATHER STATION
CODE GENERATING, SEQUENCING AND FLOOR SWITCH UNIT
UNCLASSIFIED
AUTOMATIC SYSTEMS SECTION
Code 7114
D-3441

UNCLASSIFIED

APPENDIX C

CODE-SELECTOR DRAWINGS
FOR AUTOMATIC WEATHER STATIONS

NRL DRAWING D3703, REVISION A (10 SHEETS)


SCHEMATIC OF LETTERS SELECTED
INTERNATIONAL MORSE CODE LETTERS SELECTED
LETTERS MADE BY BRIDGING
ASSEMBLY
SECTION B-B COMMUTATOR SIDE
SECTION A-A (TYP)
FURNISHED WITH MOTOR
CUT ENDS OF PT-1 FLASH & STAKE
INTERNAL WIRING DIAGRAM-R252
INTERNAL WIRING DIAGRAM-B251
B251 CIRCUIT-FOR RUNNING IN UNIT TO RUN MOTOR IN OPPOSITE DIRECTION
UNCLASSIFIED
NAVAL RESEARCH LABORATORY
AUTOMATIC WEATHER STATION
CODE SELECTOR UNIT
D3703

DWG NO. D 3703

DETAIL NO.	DESCRIPTION	MATERIAL SPECIFICATIONS	NO. REQD.
3-1	SUBASSEMBLY		1
3-2	1/8 X 3.500 X 5.063 ALUM. ALLOY	6061-T6	1
3-3	3/8 DIA. X 1 1/2	" "	5
3-4	3/8 SQUARE STOCK X 1 1/2 " "	" "	1
3-5	.063-DIA. X LENGTH AS REQD "WILSTABRITE" STAINLESS WIRE	THE MALIN & CO.	1
3-6	1/16 X 7/8 X 1 5/8 PHENOLIC RESIN, LAMINATED, BLACK COVER WITH WHITE CORE	COMM	1
4-11	SUBASSEMBLY		1
4-12	1/4-DIA. X 1 9/16 STAINLESS STEEL	TYPE 304	2
4-13	SUBASSEMBLY		1
4-14	1/8 DIA. X 3/8 BRASS	COMM.	1
5-21	SUBASSEMBLY		1
5-22	~~SUBASSEMBLY~~		1
5-23	.312-DIA. X .140 OILITE BRONZE	COMM	4
6-31	SUBASSEMBLY		1
6-32	3/32 X 3/8 X 1.625 BRASS	COMM.	1
6-33	.020-DIA. X LENGTH AS REQD BERYLLIUM COPPER	COMM.	2
7-41	SUBASSEMBLY		1
8-46	1/8 X 2.768 X 4.500 PRINTED CIRCUIT .0013 COPPER - BOTH SIDES	EPOXY GLASS FF-91	1
10-51	SUBASSEMBLY		2
10-52	.438-DIA. X .281 BRASS	COMM.	2

DETAIL NO.	DESCRIPTION	MATERIAL SPECIFICATIONS	NO. REQD.
10-53	.010 X .906 X 1.093 BERYLLIUM COPPER	COMM	2
10-54	.020-DIA X LENGTH AS REQD BERYLLIUM COPPER	"	4
10-55	4.0 DIA · .030 BRASS	"	2
10-56	.093 DIA · .020 BRASS	"	2
	A1		
1-B251	MOTOR & GEAR ASSY. (MODIFY SEE SHEET 4)	COMM.	1
A1	MOTOR-KOLLSMAN TYPE #951-0161, .1245-DIA		
	SHAFT; BEARINGS TO BE LUBRICATED FOR		
	OPERATING TEMP. -65°F. TO 130°F.		
	SHAFT LENGTH - 7/16 FROM MOUNTING FACE.		
	SPUR GEAR (PT. 1-96) ASSEMBLED FLUSH		
	WITH END OF SHAFT BY KOLLSMAN.		
1-96	SPUR GEAR, PREC 1, 96-PITCH, .125-BORE,	SUPPLIED & INSTALLED BY KOLLSMAN	1
	5/16 FACE, .2500-PD, .2708-O.D., 24-TEETH, 20° PA.,		
	STAINLESS STEEL, TYPE 303		
1-E251	STANDOFF, "MTST-W" WINCHESTER ELECTRONICS, INC.	COMM.	4
	NPL # TL 17-T-28250-1760		
1-R252	POTENTIOMETER, ROTARY TYPE SIMILAR TO	COMM.	1
(A3)	GIANNINI CONTROLS CORP MODEL 1062, OR ANALOGUE		
	CONTROLS INC. MOD. FL 1101 VG5.)		
	MECH ROTATION CONTINUOUS 360°, TORQUE (MAX.) 0.4 IN OZ		
	RESISTANCE 2040 Ω ±1% AT 310° CW VIEWED FROM		
	SHAFT END AND MEASURED @ 25°C.		
	ELECTRICAL OVERTRAVEL PERMISSIBLE TO 320°±4°.		
	RESOLUTION 1000 TURNS MIN., LINEARITY ±.5% CURRENT CAP.		
	.020 AMPERES @ 40°C TEMP COEFF .0006 TO .0008 OHMS/OHMS/°C		
	TEMP OPERATING RANGE -55°C TO +85°C.		
	TERMINALS #1 CCW ENDS (VIEWED FROM SHAFT END)		
	#2 BRUSH		
	#3 CW END 2040 Ω (VIEWED FROM SHAFT END)		
1-S251	SPECIAL SWITCH, CODE SELECTOR 2ND LETTER		
	(SEE SHEETS 7 & 9)		
1-S252	SPECIAL SWITCH, CODE SELECTOR 3RD LETTER		
	(SEE SHEETS 7 & 9)		A2
1-97	SYNCHRO MTG. CLAMP, #C17, STERLING CAT. 70, P. 279	COMM.	4
1-98	RD. HD. SCR. #4-40NC-2 X 1/4 STAIN. STEEL	"	4
1-99	LOCKWASHER #4 STEEL	"	4
			A1

DETAIL NO.	DESCRIPTION	MATERIAL SPECIFICATIONS	NO. REQD.
1-100	FLAT HD. SCR. #4-40NC-2 X 1/4 STAIN. STEEL	COMM.	1
~~1-101~~	~~HEX. SOC. SCR. #6-32NC-2 X 3/8~~	"	3
1-102	BIND HD. SCR. #8-32NC-2 X 1/4 " "	"	12
1-104	CUP POINT SET SCR. #4-40NC-2 X 1/8 STAIN. STEEL	COMM.	1
1-105	SHAKEPROOF LOCK WASHER #6 " "	"	3
1-106	SHAKEPROOF LOCK WASHER #8 " "	"	12
1-107	PIN TYPE SPUR GEAR, PREC 1, 96-PITCH,	ALUMINUM 24ST CHROMIC ACID ANODIZED	1
	.1250-BORE, 1/16 FACE, .9375-PD, .9583-O.D.,		
	90-TEETH, 20° PA, STERLING #BTA-90, CAT 70, P. 49		
4-110	CUP POINT SET SCR. #4-40NC-2 X 1/8 STAIN. STEEL	COMM.	2
4-111	TAPER PIN #7/0 X 3/8 " "	"	1
4-112	HUBLESS SPUR GEAR, PREC. 1, 96 PITCH, .3750-	ALUMINUM 24ST CHROMIC ACID ANODIZED	1
	BORE, 1/16 FACE, 2.7083-P.D., 2.7292-O.D., 260-TEETH,		
	20° PA., STERLING #5X7A-260, CAT 70, P. 98,		
	MODIF-SHEET 4. ASSY ON 4-113		
4-113	STYLE 1 CLUSTER GEAR & HUB, PREC 1,	STAINLESS STEEL #303 - CLEAR PASSIVATE	1
	96-PITCH, .1875-BORE, 5/32 FACE, .8333-P.D.,		
	.8542-O.D., 80-TEETH, 20° PA.,		
	STERLING #CLB-20, CAT 70, P. 261. ASSY WITH 4-112		
5-120	CUP POINT SET SCR. #4-40NC-2 X 1/8 STAIN. STEEL	COMM.	2
5-121	TAPER PIN #7/0 X 3/8 STAIN. STEEL	COMM.	1
5-122	~~HUBLESS SPUR GEAR, PREC. 1, 96-PITCH,~~	~~ALUMINUM 24ST CHROMIC ACID ANODIZED~~	~~1~~ (A4)
	~~.3750-BORE, 1/16 FACE, 1.7708-P.D., 1.7917-O.D.,~~		
	~~170-TEETH, 20° PA., STERLING #5X7-170,~~		
	~~CAT. 70, P. 98, MODIF. SHEET 5 ASSY ON 5-123~~		
5-123	~~SPECIAL STYLE 1 CLUSTER GEAR & HUB,~~	~~STAINLESS STEEL #303 - CLEAR PASSIVATE~~	~~1~~ (A4)
	~~PREC. 1, 96-PITCH, .1875-BORE, 5/32 FACE,~~		
	~~.3750-P.D., .396-O.D., 36-TEETH, 20° P.A.~~		
	~~STERLING CAT 70, P. 261 ASSY WITH 5-122~~		
5-124	SPECIAL CLUSTER GEAR ASSY WITH SLIP	STAINLESS STEEL #303 CLEAR PASSIVATE	1 (A5)
	CLUTCH STERLING PT NO 0067GB INCLUDES		
	SPECIAL CLUSTER GEAR & HUB PREC 1 96 PITCH		
	20° PA, 36 TEETH, .1875 BORE 1/8 FACE, .3750 P.D.		
	.3960 D. AND HUBLESS SPUR GEAR, PREC 1		
	96 PITCH, 20° PA, 170 TEETH 1/8 FACE 1.7708 P.D.		
	.7917 O.D. TORQUE LIMITS TO SLIP CLUTCH 4 TO 9 IN OZ.		
7-131	TERMINAL # X 15580, CTC CAT 500 PG P 110	COMM	15
7-132	EYELET # LE46 3/16 LG GOLD PLATED, CIRCON CO	COMM	7

REVISIONS

REVISION LETTER	DETAIL NO.	BY	DESCRIPTION	CHECKED BY	DATE
A	[illegible]	[illegible]	[illegible]		
A1	[illegible]		[illegible]	P.M.L.	[illegible]
A2	[illegible]		[illegible]		
A3	[illegible]		[illegible] DELETED		
A4	[illegible]		[illegible]		
A5	[illegible]		[illegible]	P.M.L.	[illegible]

DETAIL NO.	DESCRIPTION	MATERIAL SPECIFICATIONS	NO. REQD.

LIST OF MATERIAL

TOLERANCES UNLESS OTHERWISE SPECIFIED: DECIMAL DIMENSIONS ±.005; FRACTIONAL DIMENSIONS ±1/64; ANGLE DIMENSIONS ±1/2°. DIMENSIONS IN INCHES

REFERENCE DRAWINGS: For information Contact AUTOMATIC SYSTEMS SECTION Code 7114

DO NOT SCALE DRAWINGS

SECURITY CLASSIFICATION: UNCLASSIFIED

FILE 2 · 271 · 612

SIGNATURES		DATE
DRAWN	BRIDGE & MARSHALL	10-62
DESIGN	[illegible]	10-62
CHECKED	[illegible]	1-8-63
SUPT		
SUBMIT		
APPROVED		

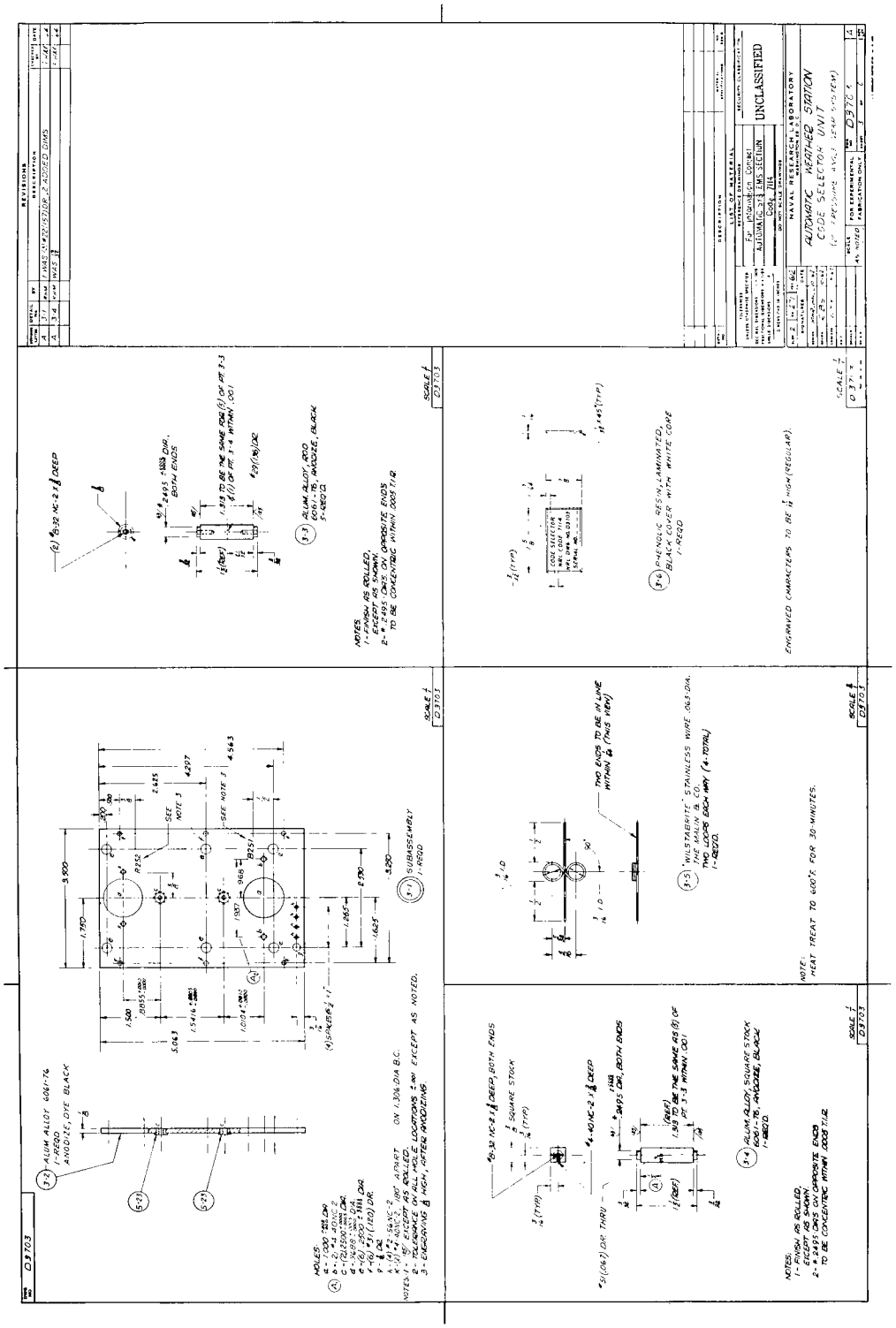
NAVAL RESEARCH LABORATORY
WASHINGTON 25 D.C.

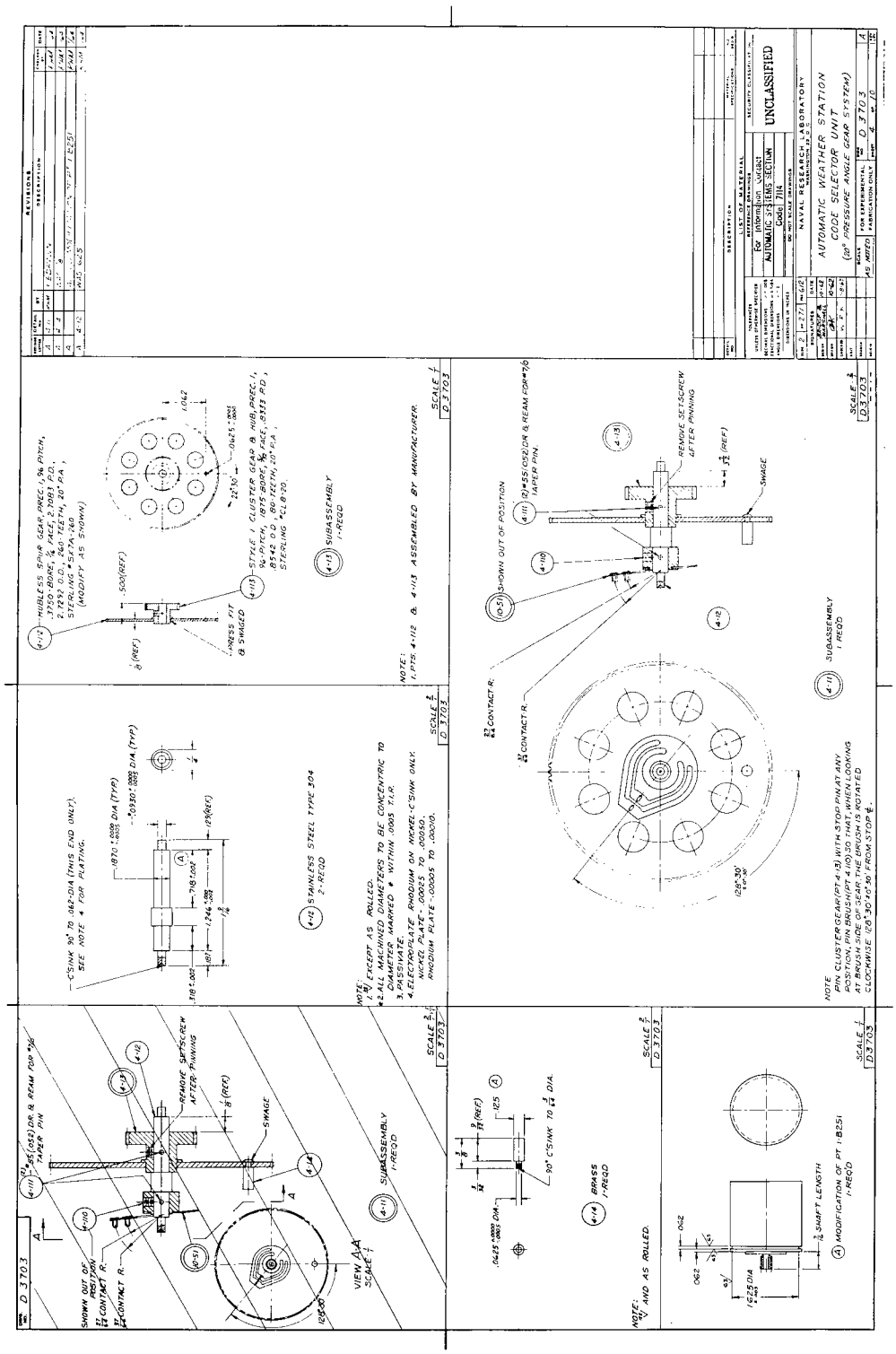
AUTOMATIC WEATHER STATION
CODE SELECTOR UNIT
(20° PRESSURE ANGLE GEAR SYSTEM)

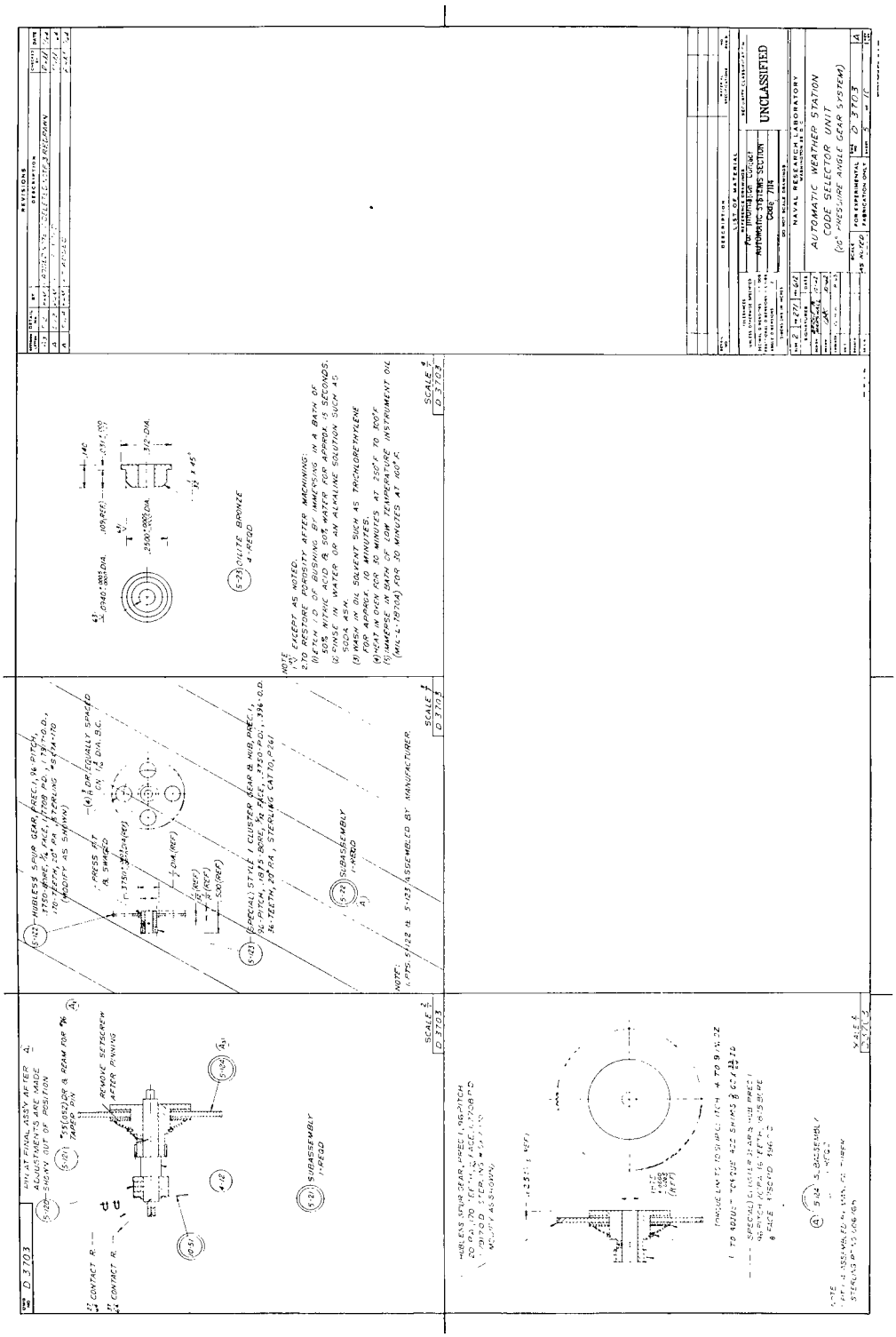
SCALE — FOR EXPERIMENTAL FABRICATION ONLY

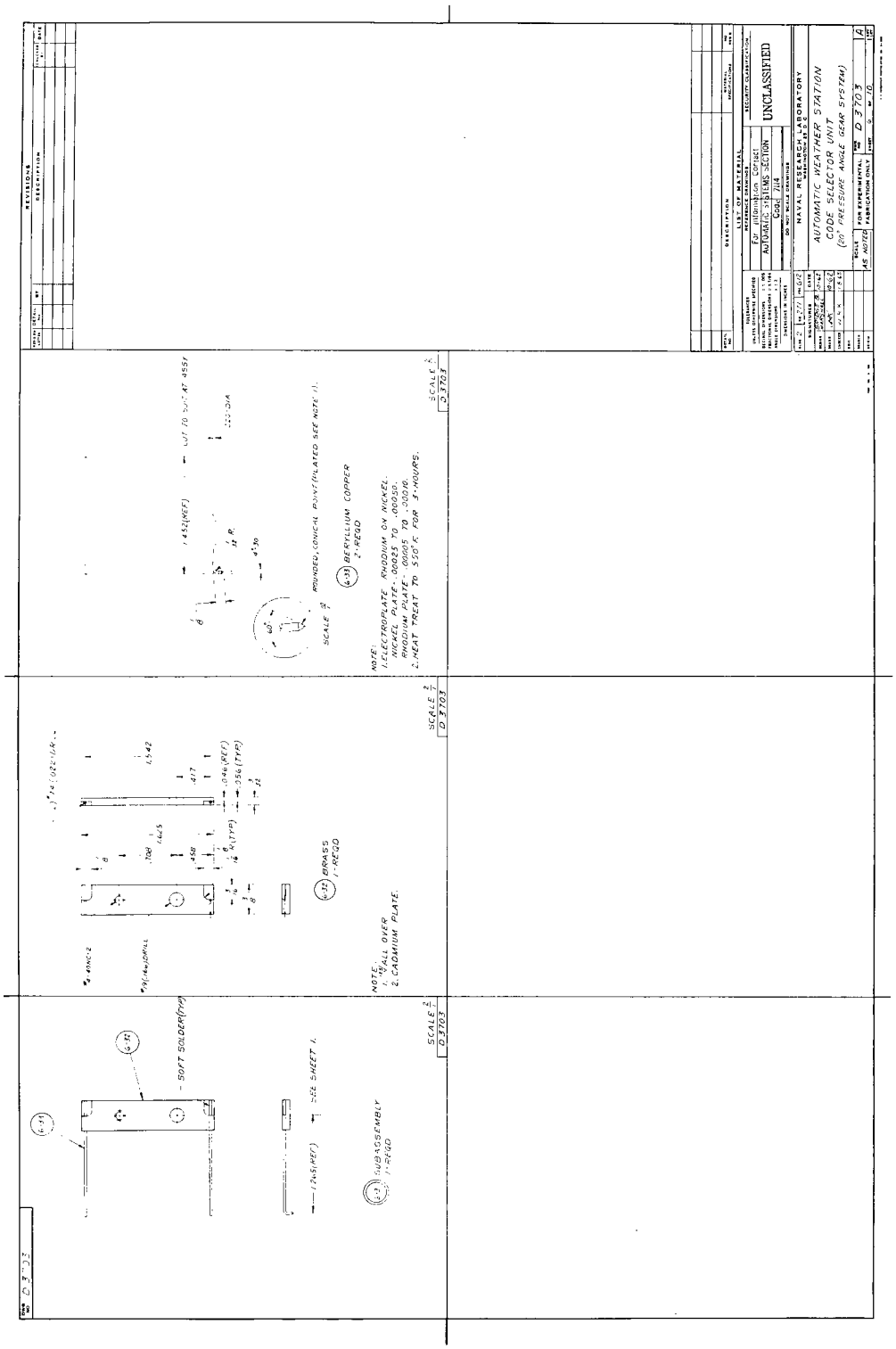
DWG NO. D 3703 — REV LET A — SHEET 2 OF 10

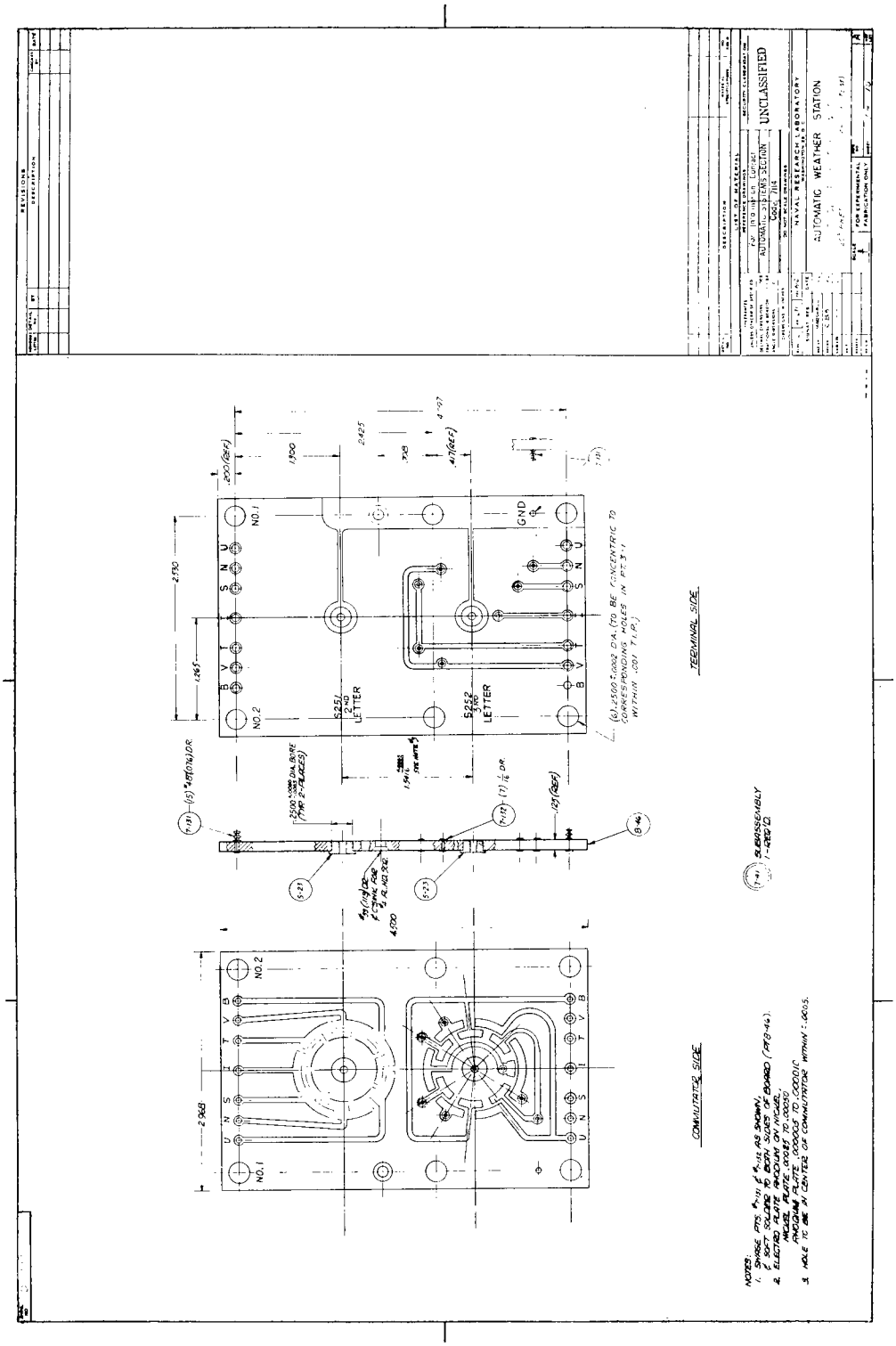
UNCLASSIFIED

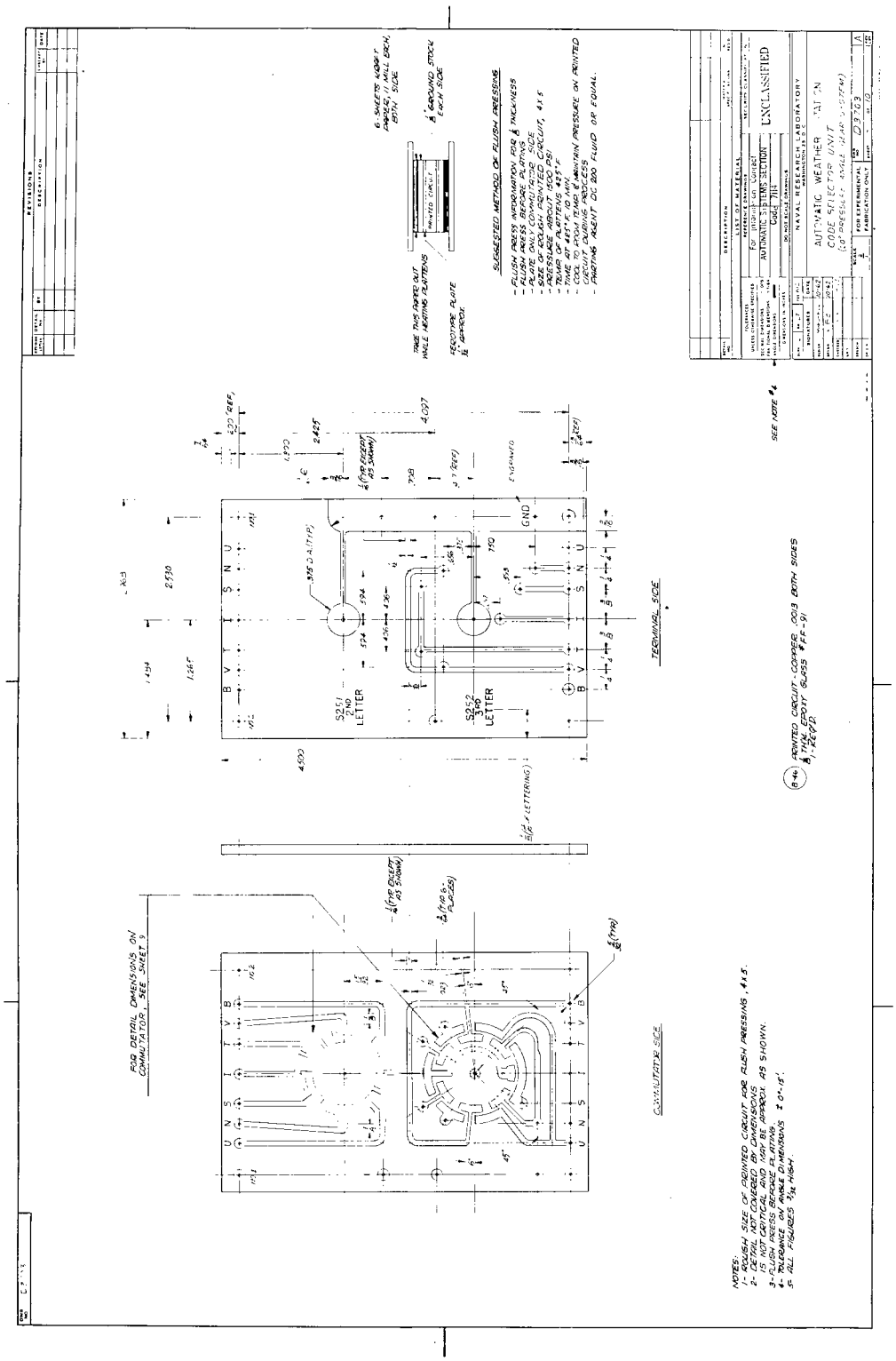

UNCLASSIFIED
NAVAL RESEARCH LABORATORY
AUTOMATIC REMOTE STATION
CODE SELECTOR UNIT
(12 PRESSURE VACUUM SYSTEM)
D3703
SCALE 1/1
D3703
SCALE 1/1
D3703
SCALE 1/1
D3703
SCALE 1/1
D3703
SCALE 1/1
D3703
NOTES
1 - FINISH AS ROLLED.
2 - EXCEPT AS SHOWN.
3 - TOLERANCE ON ALL HOLE LOCATIONS ±.001 EXCEPT AS NOTED.
4 - EXCEPTING 1/8 HIGH, AFTER ANODIZING.
ALUM ALLOY 6061-T6 ANODIZED, DYE BLACK
1-REQD
(3-2)
(3-3) ALUM ALLOY ROD 6061-T6, ANODIZE, BLACK 5-REQD
(3-4) ALUM ALLOY SQUARE STOCK 6061-T6, ANODIZE, BLACK 1-REQD
(3-5) WILSTABRITE STAINLESS WIRE .063-DIA. THE MAIN & CO. TWO LOOP EACH WAY (4-TOTAL) 1-REQD.
(3-6) PHENOLIC RESIN LAMINATED BLACK COVER WITH WHITE CORE 1-REQD
(3-7) SUBASSEMBLY 1-REQD
ENGRAVED CHARACTERS TO BE 1/8" HIGH (REGULAR).
NOTE: HEAT TREAT TO 600°F. FOR 30 MINUTES.
THE ENDS TO BE IN LINE WITHIN 1/64 (THIS VIEW)
CODE SELECTOR
FOR INTERNAL USE ONLY
AUTOMATIC SYS EMS SECTION
CODE TITLE
UNCLASSIFIED
REVISIONS
DESCRIPTION
LIST OF MATERIAL
DESCRIPTION
FOR EXPERIMENTAL FABRICATION ONLY
AS NOTED
SCALE
D3703

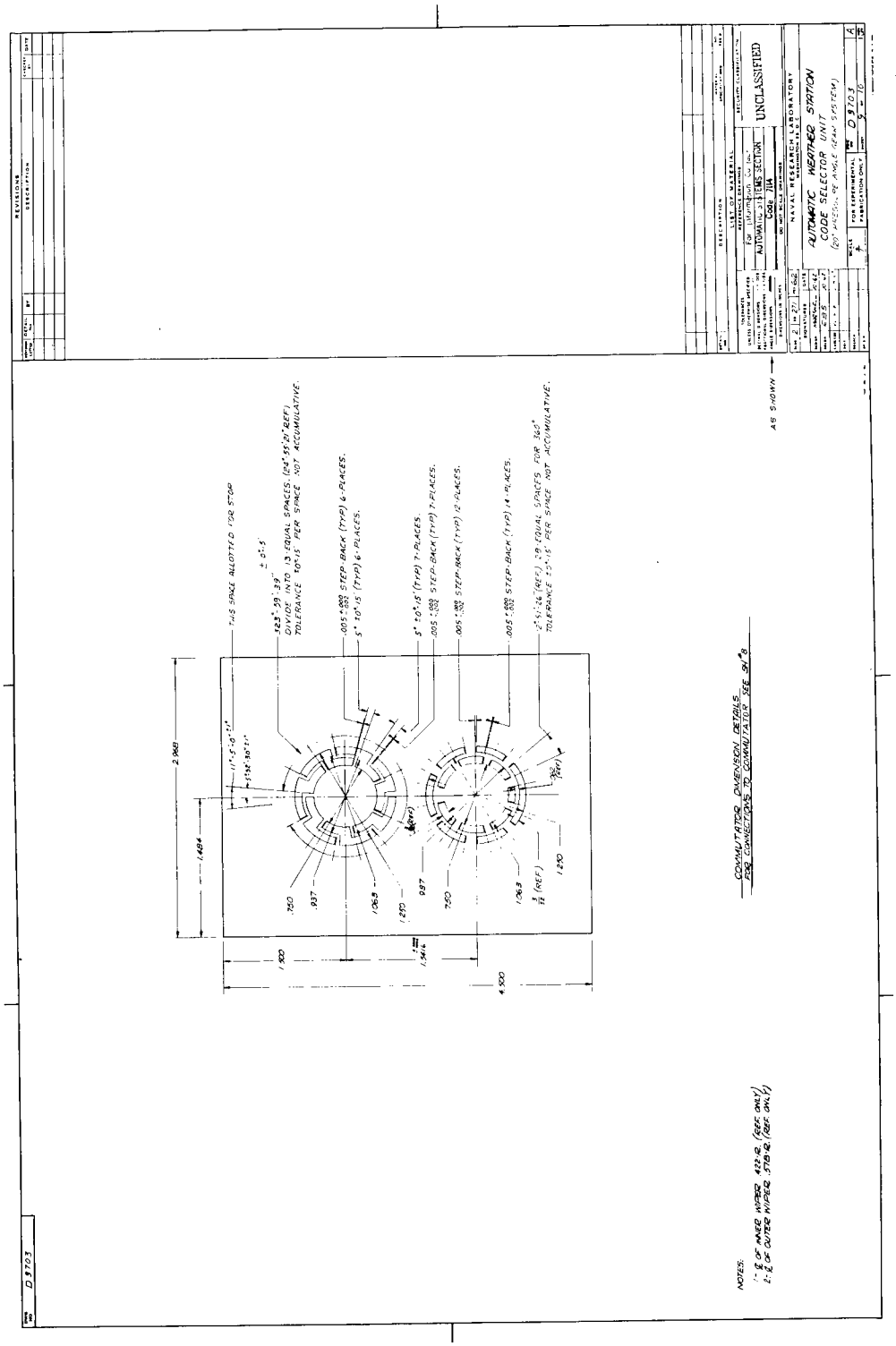

REVISIONS
LIST OF MATERIAL
UNCLASSIFIED
For information only
AUTOMATIC 3-3 TEMS SECTION
Code 7114
NAVAL RESEARCH LABORATORY
AUTOMATIC WEATHER STATION
CODE SELECTOR UNIT
(20° PRESSURE ANGLE GEAR SYSTEM)
D 3703
HUBLESS SPUR GEAR, PREC 1, 96 PITCH, .3750 BORE, 3/4 FACE, 2.1083 P.D., 2.1899 O.D., 240 TEETH, 20° P.A., STERLING SFA-140 (MODIFY AS SHOWN)
STYLE 1 CLUSTER GEAR (& HUB), PREC. 1, 96 PITCH, .875 BORE, 3/8 FACE, .8333 P.D., .8542 O.D., 80 TEETH, 20° P.A., STERLING CLE-80.
SUBASSEMBLY 1-REQD
STAINLESS STEEL TYPE 304 2-REQD
NOTE: 1. PTS 4-112 & 4-113 ASSEMBLED BY MANUFACTURER.
NOTE: 1. 1/8 EXCEPT AS ROLLED. 2. ALL MACHINED DIAMETERS TO BE CONCENTRIC TO DIAMETER MARKED * WITHIN .0005 T.I.R. 3. PASSIVATE. 4. ELECTROPLATE RHODIUM ON NICKEL-C'SINK ONLY. NICKEL PLATE .00005 TO .00010. RHODIUM PLATE .00005 TO .00010.
SHOWN OUT OF POSITION
CONTACT R.
REMOVE SETSCREW AFTER PINNING
SWAGE
SUBASSEMBLY 1-REQD
VIEW A-A
BRASS 1-REQD
NOTE: 1/2 AND AS ROLLED.
MODIFICATION OF PT 1-8251 1-REQD
SHAFT LENGTH
NOTE PIN CLUSTER GEAR (PT 4-13) WITH STOP PIN AT ANY POSITION. SWAGE PT 4-10 THAT WILL CONTACT AT BRUSH SIDE OF GEAR THE BRUSH IS ROTATED CLOCKWISE 128°30'±0°30' FROM STOP 1/4.

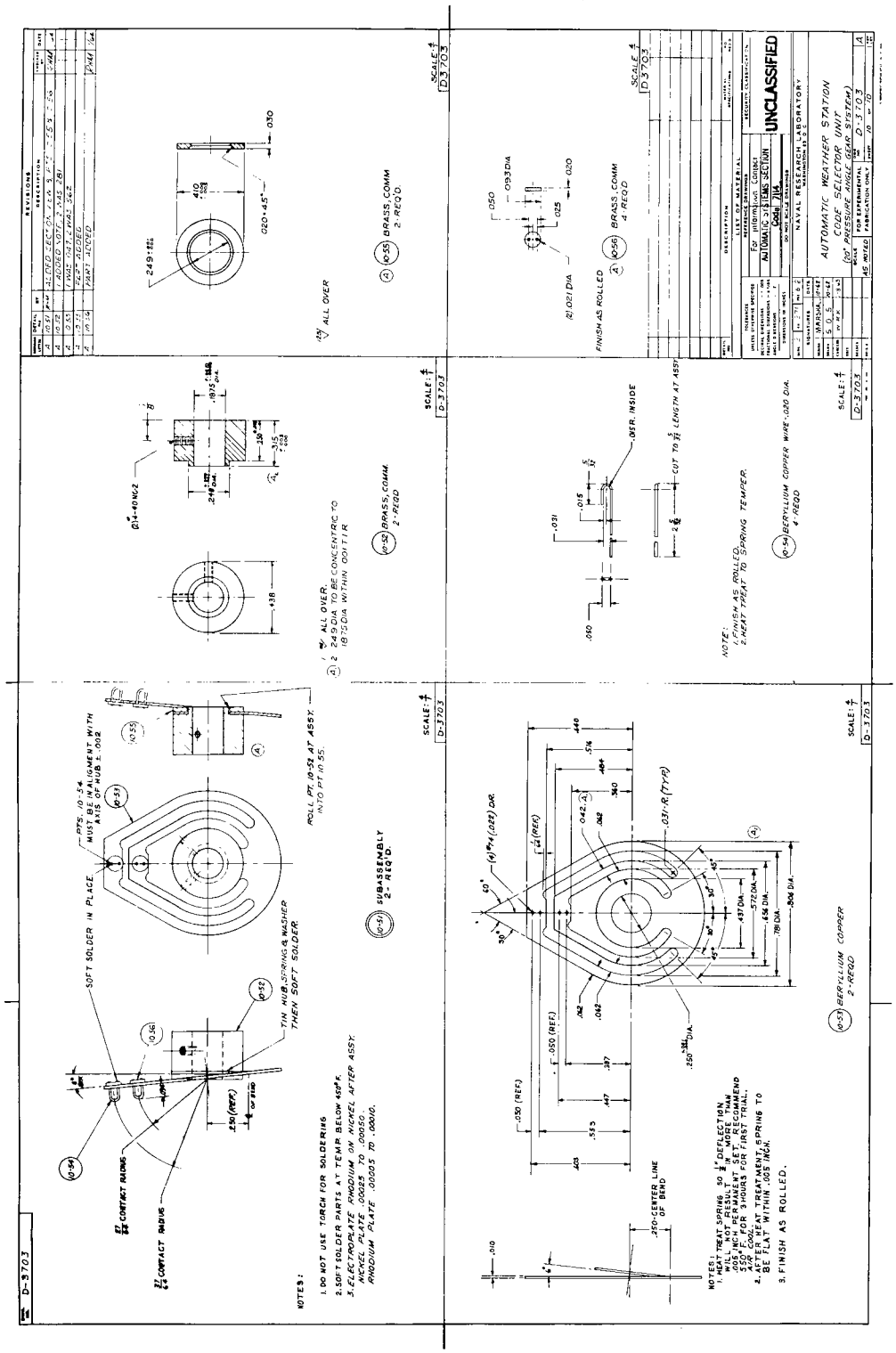

REVISIONS
UNCLASSIFIED
NAVAL RESEARCH LABORATORY
AUTOMATIC WEATHER STATION
CODE SELECTOR UNIT
(10" PRESSURE ANGLE GEAR SYSTEM)
D 3703
SCALE 1/1
D 3703
SCALE 1/1
D 3703
SCALE 1/1
D 3703
SCALE 1/1


REVISIONS
DESCRIPTION
LIST OF MATERIAL
DESCRIPTION
SECURITY CLASSIFICATION
UNCLASSIFIED
For Information Contact
AUTOMATIC SYSTEMS SECTION
Code 7114
DO NOT SCALE DRAWINGS
NAVAL RESEARCH LABORATORY
WASHINGTON, D.C.
AUTOMATIC WEATHER STATION
CODE SELECTOR UNIT
(90° PRESSURE ANGLE GEAR SYSTEM)
D 3703
SCALE 2/1
D 3703
NOTE:
1. ELECTROPLATE RHODIUM ON NICKEL.
NICKEL PLATE .00025 TO .00050.
RHODIUM PLATE .00005 TO .00010.
2. HEAT TREAT TO 570°F FOR 3 HOURS.
(6.33) BERYLLIUM COPPER
2-REQD
ROUNDED, CONICAL POINT (PLATED SEE NOTE 1).
SCALE 2/1
D 3703
NOTE:
1. SHALL OVER
2. CADMIUM PLATE.
(6.32) BRASS
1-REQD
SCALE 2/1
D 3703
(6.31)
SOFT SOLDER (TYP)
SEE SHEET 1.
(6.2) SUBASSEMBLY
1-REQD
SCALE 2/1
D 3703


UNCLASSIFIED
AUTOMATIC WEATHER STATION
NAVAL RESEARCH LABORATORY
TERMINAL SIDE
COMMUTATOR SIDE
NO. 1
NO. 2
GND
S251 LETTER
S252 LETTER
SUBASSEMBLY
NOTES:


SUGGESTED METHOD OF FLUSH PRESSING
- FLUSH PRESS INFORMATION FOR 1/8 THICKNESS
- FLUSH PRESS BEFORE PLATING
- PLATE ONLY CONNECTED SIDE
- SIZE OF FOLDED PRINTED CIRCUIT, 4 x 5
- PRESSURE ABOUT 1500 PSI
- TEMP OF PLATENS 145°F
- TIME OF PRESS 60 MINUTES
- COOL TO 100M TEMP & MAINTAIN PRESSURE ON PRINTED CIRCUIT DURING PROCESS
- PARTING AGENT DC 200 FLUID OR EQUAL.
TERMINAL SIDE
COMMUTATOR SIDE
NOTES:
1- FLUSH SIZE OF PRINTED CIRCUIT FOR FLUSH PRESSING, 4 x 5.
2- DETAIL NOT COVERED BY DIMENSIONS IS NOT CRITICAL AND MAY BE APPROX. AS SHOWN.
3- FLUSH PRESS BEFORE PLATING.
4- TOLERANCE ON WHOLE DIMENSIONS ± 0.01.
5- ALL FILLETS 1/32 MAX.
UNCLASSIFIED
AUTOMATIC WEATHER
CODE SYSTEM (UWT)
NAVAL RESEARCH LABORATORY


REVISIONS
DESCRIPTION
LIST OF MATERIAL
UNCLASSIFIED
AS SHOWN
NAVAL RESEARCH LABORATORY
AUTOMATIC WEATHER STATION
CODE SELECTOR UNIT
D3703
THIS SPACE ALLOTTED FOR STOP
DIVIDE INTO 13 EQUAL SPACES (24°51'12" REF)
TOLERANCE ±0'15" PER SPACE NOT ACCUMULATIVE.
.005 STEP-BACK (TYP) 6-PLACES.
.005 STEP-BACK (TYP) 7-PLACES.
.005 STEP-BACK (TYP) 2-PLACES.
.005 STEP-BACK (TYP) 4-PLACES.
TOLERANCE ±1'15" PER SPACE NOT ACCUMULATIVE.
COMMUTATOR DIMENSION DETAILS
FOR CONNECTIONS TO COMMUTATOR SEE SH. 8
NOTES:
1. ℄ OF INNER WIPER 422-2 (REF ONLY)
2. ℄ OF OUTER WIPER 578-2 (REF ONLY)


D-3703
REVISIONS
SCALE: 4/1
BRASS, COMM 2-REQ'D
BRASS, COMM 4-REQ'D
FINISH AS ROLLED
ALL OVER
BRASS, COMM 2-REQ'D
OVER INSIDE
CUT TO 3/32 LENGTH AT ASSY
NOTE:
1. FINISH AS ROLLED.
2. HEAT TREAT TO SPRING TEMPER.
BERYLLIUM COPPER WIRE .020 DIA. 4-REQ'D
SOFT SOLDER IN PLACE
CONTACT RADIUS
TIN HUB, SPRING & WASHER THEN SOFT SOLDER
SUBASSEMBLY 2-REQ'D
ROLL PT. D-52 AT ASSY. INTO PT D-55
NOTES:
1. DO NOT USE TORCH FOR SOLDERING
2. SOFT SOLDER PARTS AT TEMP. BELOW 450°F.
3. ELECTROPLATE RHODIUM ON NICKEL AFTER ASSY.
NICKEL PLATE .00025 TO .00050.
RHODIUM PLATE .00005 TO .00010.
BERYLLIUM COPPER 2-REQ'D
NOTES:
1. HEAT TREAT SPRING SO 1/4" DEFLECTION WILL RESULT IN .005 INCH PERMANENT SET. RECOMMEND 550°F. FOR 3 HOURS FOR FIRST TRIAL.
2. AFTER HEAT TREATMENT, SPRING TO BE FLAT WITHIN .005 INCH.
3. FINISH AS ROLLED.
NAVAL RESEARCH LABORATORY
WASHINGTON 25, D.C.
AUTOMATIC WEATHER STATION
CODE SELECTOR UNIT
(90° PRESSURE ANGLE GEAR SYSTEM)
UNCLASSIFIED
AUTOMATIC SYSTEMS SECTION
D-3703