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INSTRUCTIONS
FOR
BENDIX-FRIEZ
WIND SPEED, WIND DIRECTION,
RAINFALL AND SUNSHINE
REGISTERS
MODELS 441 AND 443

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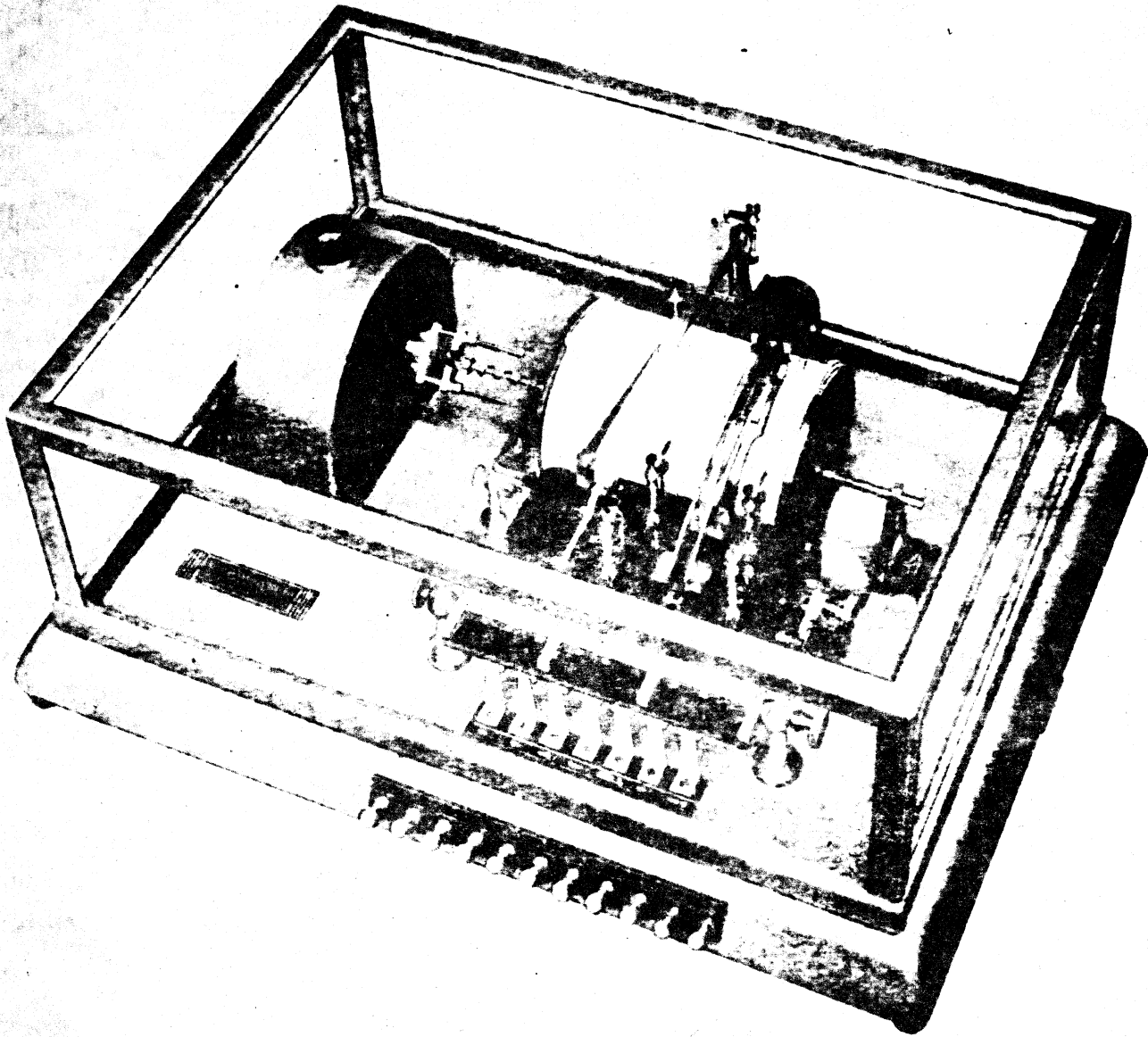
(Should additional copies of this publication,
Bendix-Friez Instruction Book #34, be desired,
please mention Bendix-Friez Part #509535-1).

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10.9

DIRECTION, SPEED, RAINFALL AND SUNSHINE REGISTER
MODEL #441

Figure 1

DIRECTION, SPEED, RAINFALL AND SUNSHINE REGISTER

Models #441 and #443

A. DESCRIPTION

1. General. -

(a) The Model 441 register (Figure 1) is designed to give a simultaneous continuous record of wind direction, wind speed, rainfall and sunshine duration on parallel sections of a strip chart wrapped on a drum. These records are made when the wired circuits are closed by switches in the outdoor transmitters, as direction and speed from the anemometer and sunshine duration from the sunshine transmitter, and provided the circuits are completed within the register itself by the chart drive mechanism. The rainfall transmitter has a separate circuit which does not pass through the contacts of the chart drive mechanism. The register consists of a cylinder drive mechanism, a chart drum assembly, a direction and mile recording unit, a 1/60 mile audible indicating unit, and a sunshine-rainfall recording unit, all mounted on a base with a hinged, glass panelled, cover.

(b) The Model 443 register is similar to the Model 441 except that it does not have the sunshine-rainfall unit attached.

(c) The Model 441 register provides a simultaneous, continuous record of wind speed, wind direction, rainfall and duration of sunshine; however, a simultaneous record of rainfall and duration of sunshine is not to be expected. The Model 443 provides for record only of wind speed and wind direction. Both registers may be used with Bendix-Friez Anemometers, Models 343, 347, 349, 349-A, 349-K and 349-N; Bendix-Friez Contacting Wind Vanes, Models 363-B, 363-D, 371, 373 and 376. Model 441 only may be used with Bendix-Friez Tipping Bucket Rain Gauges Models 405, 405-1, 415 and 415-1 and the Bendix-Friez Sunshine Transmitter Model 380.

2. Chart Mechanism and Drum: -

The spring-wound chart drive mechanism serves a two-fold purpose. One of its functions is to turn the shaft of a chart drum, causing the drum to make a complete revolution every six hours. Its second function is to complete two separate circuits for a short period of time once every minute by means of a common revolving contact. One of these minute contacts is wired in series with the sunshine circuit and the other in series with the direction magnet circuits. In the Model 443, the sunshine contact is omitted.

The charts are designed to cover a 24-hour period from noon to noon with four revolutions of the drum. During each revolution the drum is shifted endwise approximately one-half inch by means of a worm on the drum shaft. The endwise movement of the drum causes the record to be placed on the chart in a spiral as it appears with the chart in place on the drum. There is provision for an overrun of six-hours on the chart providing space for the record if the chart is not changed at the end of the regular 24-hour period.

3. Direction Unit. -

The direction unit registers the wind direction indications by means of printing points located at the end of inking lever arms which are actuated by the magnets in the direction circuit. One of these lever arms is attached to the armature of each of the four direction magnets. As one of the magnets is energized once each minute and the armature is moved, the lever printing point is pulled down across the ink pad making a mark on the chart. The direction unit is wired with one of the minute contacts in the chart drive mechanism, so that the wind direction is indicated once every minute as the circuit is closed. When the external wind vane is within $\pm 22\frac{1}{2}$ degrees of a cardinal direction, and wired with a completed circuit to the direction unit, only that respective direction magnet is energized. When the indicated direction is within $\pm 22\frac{1}{2}$ degrees of an inter-cardinal direction, the magnets for the two cardinal positions are energized simultaneously. In this way, the four magnets furnish eight possible direction indications.

The wind direction indication may be obtained at any time, by pressing the push button located in the left end of the register base. This closes the direction circuit by short circuiting the drive mechanism contact and the instantaneous wind direction will be registered on the chart.

4. Speed Unit. -

The speed unit registers wind movement indications by means of a pen actuated by a magnet. The pen arm is mounted on a pen arm holder attached to the armature of the magnet. As the magnet is energized and the armature is moved, the pen arm is displaced from its normal position and makes a jog in the normally straight speed line on the chart. The magnet is energized whenever a contact is made by one mile of wind passing the cups of the external anemometer wired with the speed unit.

Wind speed may also be indicated by means of a buzzer which is

controlled by a toggle switch located in the right or drum end of the register base. The buzzer, located on the under side of the register base, will signal every time 1/60 mile of wind passes the cups of the external anemometer with which it is wired. Therefore, by counting the number of buzzes per minute, the speed in miles per hour may be obtained.

5. Sunshine-Rainfall Unit (Model 441 only). -

The sunshine-rainfall unit registers both the sunshine duration and the rainfall by means of a single pen which produces a pyramid step-type record, the regular steps representing sunshine and the irregular steps, rainfall. When sunshine closes the contact in the external sunshine duration transmitter, wired with one of the minute contacts and the sunshine-rainfall unit, a sunshine indication will be made once every minute. The rainfall circuit is not connected to the drive mechanism contacts but is directly wired from the sunshine-rainfall unit to the tipping bucket rain gauge. The magnet is energized momentarily for every .01" or .2 millimeter of rainfall, depending upon which rainfall transmitter is used.

B. INSTALLATION AND OPERATION

1. Installation. -

The register is designed for mounting on a firm, horizontal surface at any desired indoor location. External wires are connected to the appropriate marked binding posts on the base of the register. A ten-conductor cable of #16 or #18 insulated copper wire is suggested for the external wiring. It should be run in the most direct way possible, while being protected from the wind, weather, and abrasion. The ordinary care generally required in wiring procedures should be observed.

2. Operation. -

There are three general methods of operating the registers. The system should be wired according to the wiring diagram for that particular method of operation.

Where 110 volt, 60 cycle A.C. is available, it is recommended that the register be connected to this current through a 110 volt A.C. /6 volt D.C. rectifier transformer, (Bendix-Friez Part No. ~~58703-2~~). In order that only a minimum current will be used in energizing the magnets, an adjustable 20 ohm 10 watt resistor (I.R.C. Type ABA or equal) must be introduced into each circuit, as shown in the wiring

diagram, Figure 3. These resistors may be introduced into their respective circuits outside the register itself. Each resistor should be adjusted so that the magnet in that circuit draws only the minimum current necessary to move the pen arm. Newer models of the register have these resistors already assembled and wired in their respective circuits.

By inserting resistors in the same way as for the rectified current, a standard storage battery may be used to operate the register. The storage battery should be connected to a battery charger having a low charging current rate so that it can be re-charging continually during actual operation. For wiring a system using a storage battery, see Figures 3 and 4.

At certain locations the registers can be advantageously operated from a group of 9 primary cells, such as the Schoenmehl #3 copper oxide element battery. This battery (Bendix-Friez Part No. AS-500053-1) needs little attention, gives a constant and uniform current during its comparatively long life, and is unaffected by considerable variations of temperature. Each circuit will require a certain number of these cells connected in series - the wind speed unit, 2 cells; the wind direction unit, 4 cells; and the sunshine-rainfall unit, 3 cells. See wiring diagram, Figure 5.

3. Evaluation of Record. -

The top section of the chart is devoted to the wind direction. The position of the cardinal directions on the chart is indicated by the corresponding letter - N, E, S, W. The wind direction (within $\pm 22\frac{1}{2}$ degrees) at any time is determined by the position on the chart of the direction point for that particular time. On the sample chart shown in Figure 2, the wind direction at 8:30 P.M. was east, while at 5:00 A.M. it was north. Simultaneous indications on two direction points are indicative of an inter-cardinal direction (within $\pm 22\frac{1}{2}$ degrees), such as the southeast indications at 9:30 P.M. and 5:25 A.M.

The sunshine and rainfall record is made by one unit and hence on the same line in the lower section of the chart. It is easy to differentiate between the two conditions because of the difference in appearance. The sunshine record is a regular one while that of the rainfall is very irregular. It can be seen by examining the sample record that there was rain from 8:15 P.M. until 9:25 P.M., while the sun was shining from noon until 1:04 P.M. The straight line connecting these periods of rain and sunshine would indicate either cloudiness or darkness.

The speed record is made below the time line on the lower section of the chart. An indentation is made by the pen every time the speed circuit is closed by the mile contact in the anemometer, except that the contact is held closed between the ninth and tenth miles, making a longer indentation. The average speed can be determined by counting the indentations made during a given period of time and dividing this by the number of hours covered. For example, between 8:00 P.M. and 10:00 P.M. there were 22 jogs on the chart or an average wind speed of 22 miles per hour, while between 7:00 A.M. and 7:30 A.M. there were 10 jogs or a speed of 20 miles per hour.

G. ADJUSTMENT AND MAINTENANCE.

1. Chart Drive:-

The chart drive mechanism of the register should be wound at weekly intervals. The key is held in place by a bushing in the base at one end of the case. Two holes are provided in the front of the case for winding each spring of the spring drive mechanism. A small window in the top of the case makes it possible to see whether the drive mechanism is operating. The drive mechanism may be exposed for further inspection by removing the case.

When prepared for shipment the electrical contacts, controlled by the drum drive mechanism, were properly adjusted. However, handling may have thrown these parts out of adjustment. These contacts and their adjusting screws are mounted on the drive mechanism under the drive mechanism cover. If necessary, they should be adjusted so that the circuit is closed only for an instant. Longer contact periods will cause excessive wear on the contacts. The contacts are made by an arm of the mechanism making one revolution each minute.

2. Adjustment of Charts:-

Access to the drum for replacing the chart is attained by swinging the direction recording pens up and away from the drum about a supporting shaft. The pen arms for speed and sunshine-rainfall units may be lifted a very little above the drum and turned horizontally away from the drum. These arms are supported by a type of swivel joint. The chart is retained on the drum by a metal band and spring at each end which are removed to release the chart. When placing a new chart on the drum, the top must be at the end of the drum farthest from the drive mechanism and with the tabulation end underneath the other end.

To set the chart and drum to the correct time position, proceed as follows. Loosen the thumb set screw in the universal joint at the end of the worm on the drum shaft. Then hold the drum and turn the knurled end of the drum hub, projecting at the end nearest the spring drive mechanism, causing the drum to move farther from, or closer to, the drive mechanism. By varying the amount of rotation of the knurled end of the hub and the drum itself, the position of the direction letters on the chart may be brought directly under the direction pens. During this locating process, the pens should be brought to the chart for the briefest time possible for location, as the pens in operation may make a record on the chart which may be false. Having positioned the direction letters of the chart correctly with the direction pens, the chart, drum and hub may be rotated forward or backward until the correct time location between the hour marks on the chart has been reached. At this stage of operation, tighten the thumb set screw in the universal joint at the end of the worm on the drum shaft. In setting the pens to the time between the hour lines, it will be observed that the spaces between the closest chart lines parallel to the drum axis represent five minutes of time. When rotating the drum backwards, be careful that the chart end does not foul the pens.

After adjusting the chart to the direction point pens, the pen arms for speed and sunshine-rainfall units may also be brought to their proper positions over the chart (refer to the sample chart, Figure 2). Place the direction pens in position for recording on the chart.

3. Direction Printing Points. -

(a) Cleaning. The printing points should be cleaned occasionally with a stiff brush or a damp cloth to remove the accumulation of dust, dried ink, fibers from the felt pad, etc. This cleaning can be done after turning back the direction unit and removing the ink pad.

(b) Renewal. The wind direction printing points may become corroded or pitted due to accumulation of atmospheric moisture with the ink, necessitating a renewal of the points. The lever arms should first be removed from the armatures. The points may then be driven out by tapping the tapered end protruding through the top of the pen arms from above, and providing they have not been soldered in place. In previous renewals, the holes in the pen arms may have been reamed too large and soldering used to hold the printing point. If the points are soldered in the arms, the ends of the arms must be heated enough to soften the solder so the points can be removed. If, after removing the soldered points, the holes in the ends of the pen arms are too small, due to solder in them, they may be enlarged by the use of a reamer. Care should be taken not to ream the holes larger than .045". Over-

size printing points (Bendix-Friez part No. 506431) may be used which will eliminate the soldering.

(c) Ink pads. The ink pad should be inked with #40 black ink (Bendix-Friez Part No. 504974-13). This should be done carefully so as to avoid smearing ink on the adjacent parts of the instrument. Sufficient ink should be applied for making a 24-hour record but not enough to cause blurs. The pad should be removed from the instrument by withdrawing the pin holding it in place. The ink should be applied lightly to both the top and bottom of the pad by a small stick or flattened wire and worked into the felt so that the record will be of uniform strength:

When the felt becomes worn, the small metal plate holding and covering the pad should be removed. The felt can then be lowered and the worn part cut off.

4. Speed and Sunshine-Rainfall Pens. -

(a) Ink and pens. The wind speed and sunshine-rainfall pens should be inked whenever the chart is changed. For the wind speed pen, use #10 purple ink (Bendix-Friez Part No. 504974-4). For the sunshine-rainfall pen, use #10 red ink (Bendix-Friez Part No. 504974-2). Introduce a drop of ink, such as normally sticks to the end of a small wire or the applicator in the ink bottle, into the space between the nibs of the pen. The flow of ink may be started by carefully drawing a piece of smooth lint-free writing paper between the points so as to wet the inside faces. Care should be taken that the points are not bent or deformed by the operation, and that no particles of the paper are caught between the points. Any ink on the outer surface of the pen or pen arm should be removed, as it tends to collect dust and dirt and produce a broad record line.

The pens should be adjusted so that they exert no more pressure than is necessary against the drum. If too much pressure is exerted by a pen, the record line will be broad and the pen soon will become clogged with paper particles.

If one of the pens fails to make a fine, clear line, it should be removed from the pen arm and cleaned. This is accomplished by holding the pen arm with one hand and pulling the pen away horizontally with the other hand. It should be thoroughly soaked in a small amount of #10 ink, and then washed in warm water. As mentioned before, care must be taken that neither the pen nor the pen arm is damaged in this operation and the writing points of the pen must fit tightly together. If the pen still does not give a satisfactory record line after being washed, it is probably worn and should be replaced.

(b) Adjustment of length of speed pen stroke. The length of the stroke made by the speed pen is controlled by the lever stop screw. This screw is adjusted by means of the pin wrench located in a hole in the end of the base plate of the speed and direction units. This wrench is also used to tighten the various lock nuts to prevent shake in the direction unit.

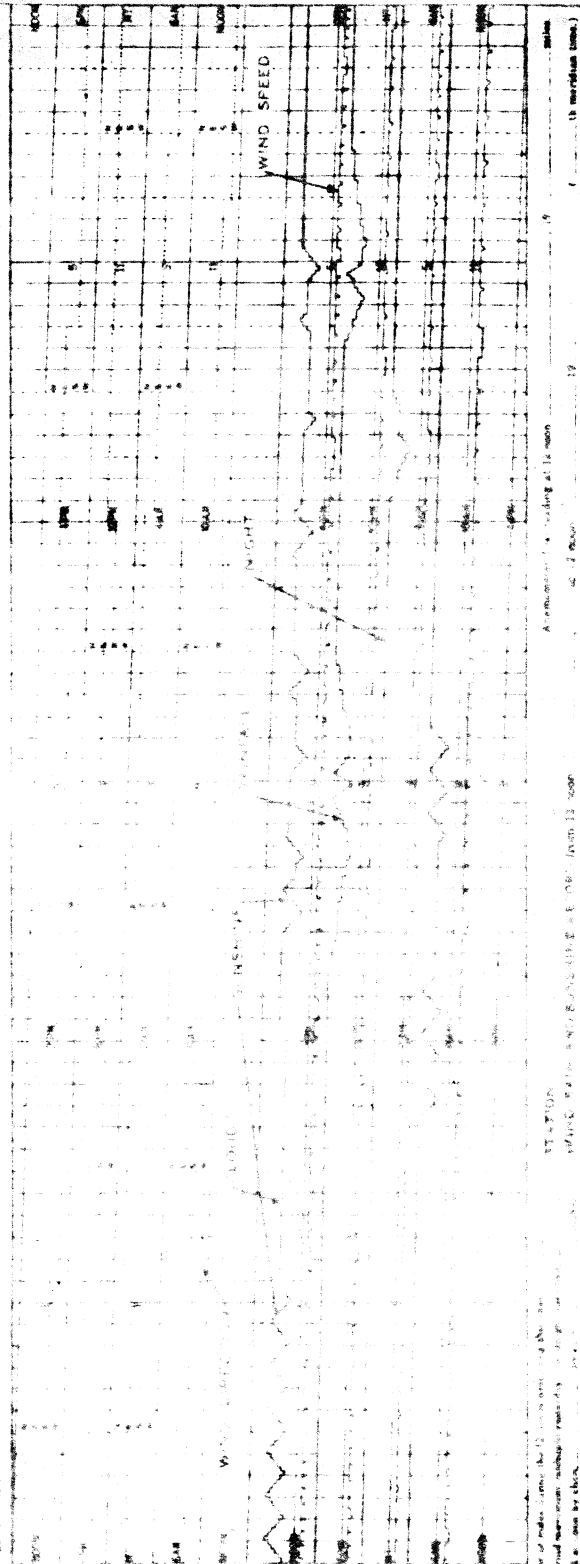
5. Adjustment of Magnets. -

The stroke of the magnet and the tension of the magnet restraining spring should be at the minimum so that the least possible current is necessary for satisfactory operation. If the resistors described in Section B are included in the register circuit, they should be adjusted so as to draw the minimum current.

There are three reasons why this adjustment should be made. It will prevent excessive drain on the battery; it will prevent the burning of the contacts; and it will prevent spattering of the ink, which is caused by the pen being moved with unnecessary force.

STATION NAME AND LOCATION
STATION NO. AND DATE

CHART No 1017 COMBINED - WIND DIRECTION - VELOCITY - SUNSHINE - RAIN FALL - RECORDER.



WIND DIRECTION	
Frequency and Time	
Midnight previous to midnight this chart	
From	To
N	0
NE	45
E	90
SE	135
S	180
SW	225
W	270
NW	315
N	360
Time	

WIND VELOCITY	
Rate	
Rate	From
0-5	
6-10	
11-15	
16-20	
21-25	
26-30	
31-35	
36-40	
41-45	
46-50	
51-55	
56-60	

TOTAL	
PERIOD	
Midnight previous to midnight this chart	
Hour	Minutes

Number of observations during the 24 hours ending this hour
Total wind observations, including gusts
Remarks to be used by clerk.

STATION
DATE: 11-10-1917

WIND DIRECTION - VELOCITY - SUNSHINE - RAIN FALL - RECORDER

Wind Speed

Wind Direction

Sunshine

Rain Fall

Temperature

Humidity

Barometer

Sea Level

Pressure

Altitude

Latitude

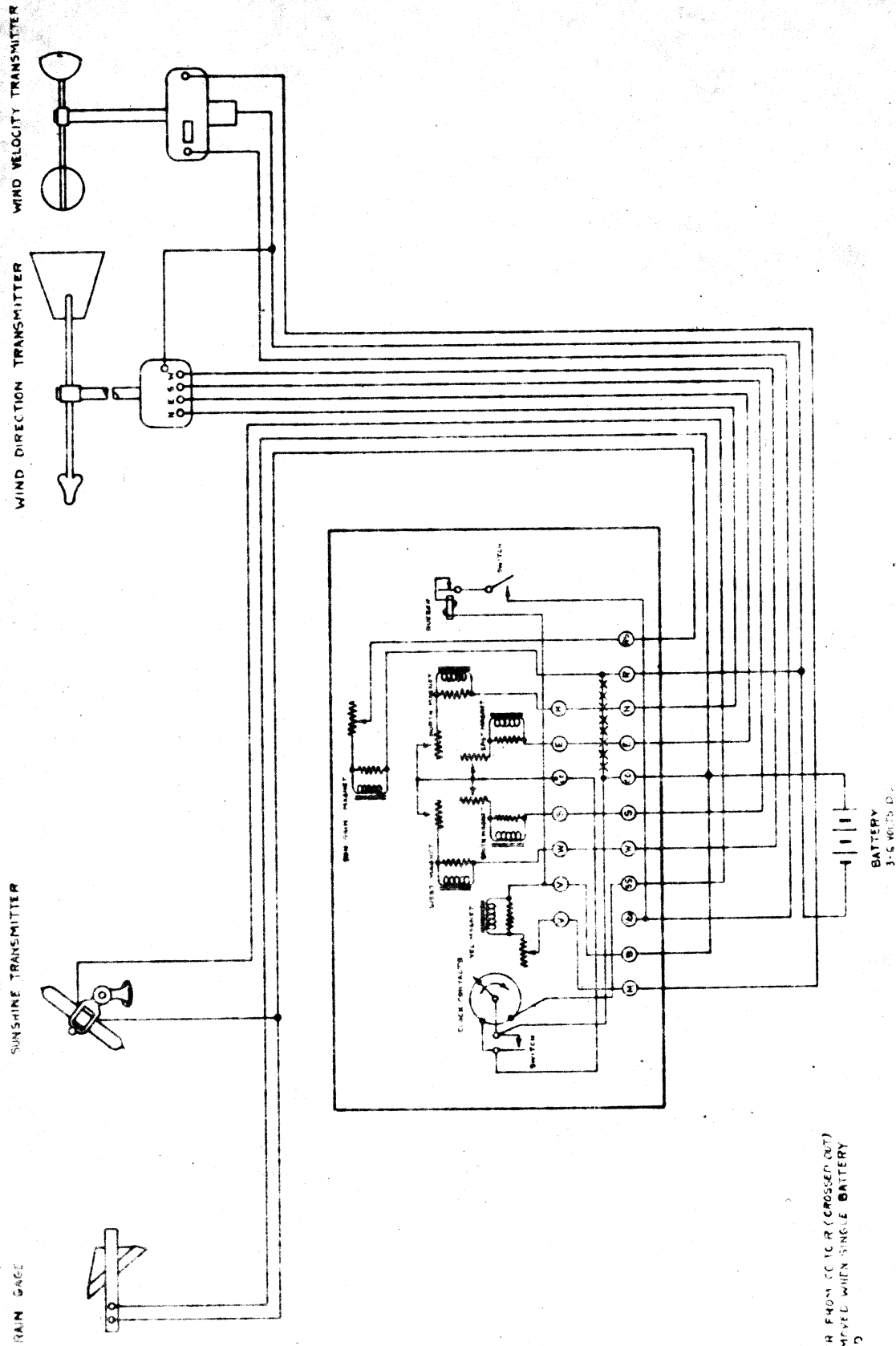
Longitude

Observer

Remarks

SAMPLE REGISTER CHART

FIGURE 2



1- JUMPER FROM CC TO R (CROSSED OUT)
IS REMOVED WHEN SINGLE BATTERY
IS USED
NOTES

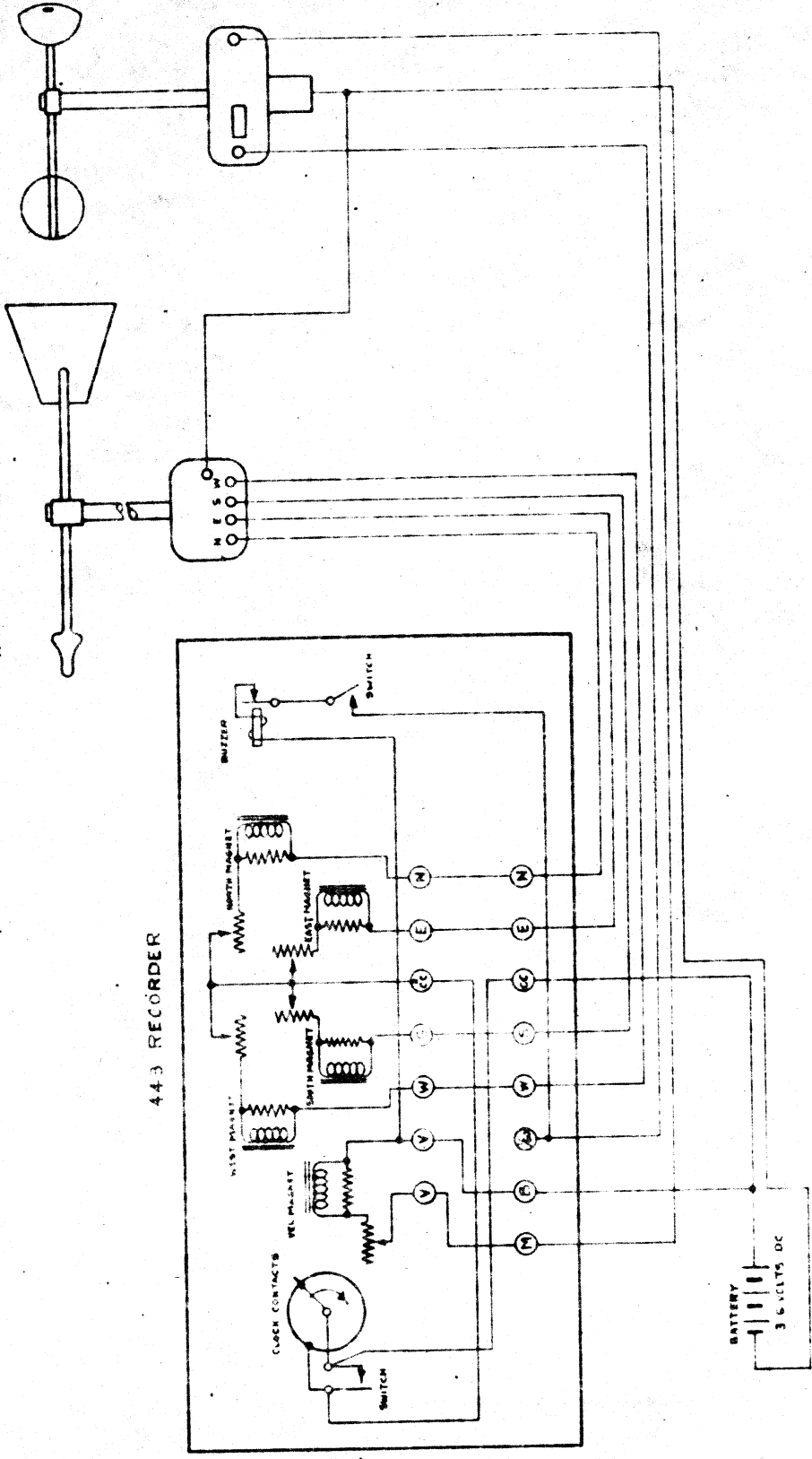
WIRING DIAGRAM FOR REGISTER #441
Using 6 volts D C

Figure 3

WIND VELOCITY TRANSMITTER

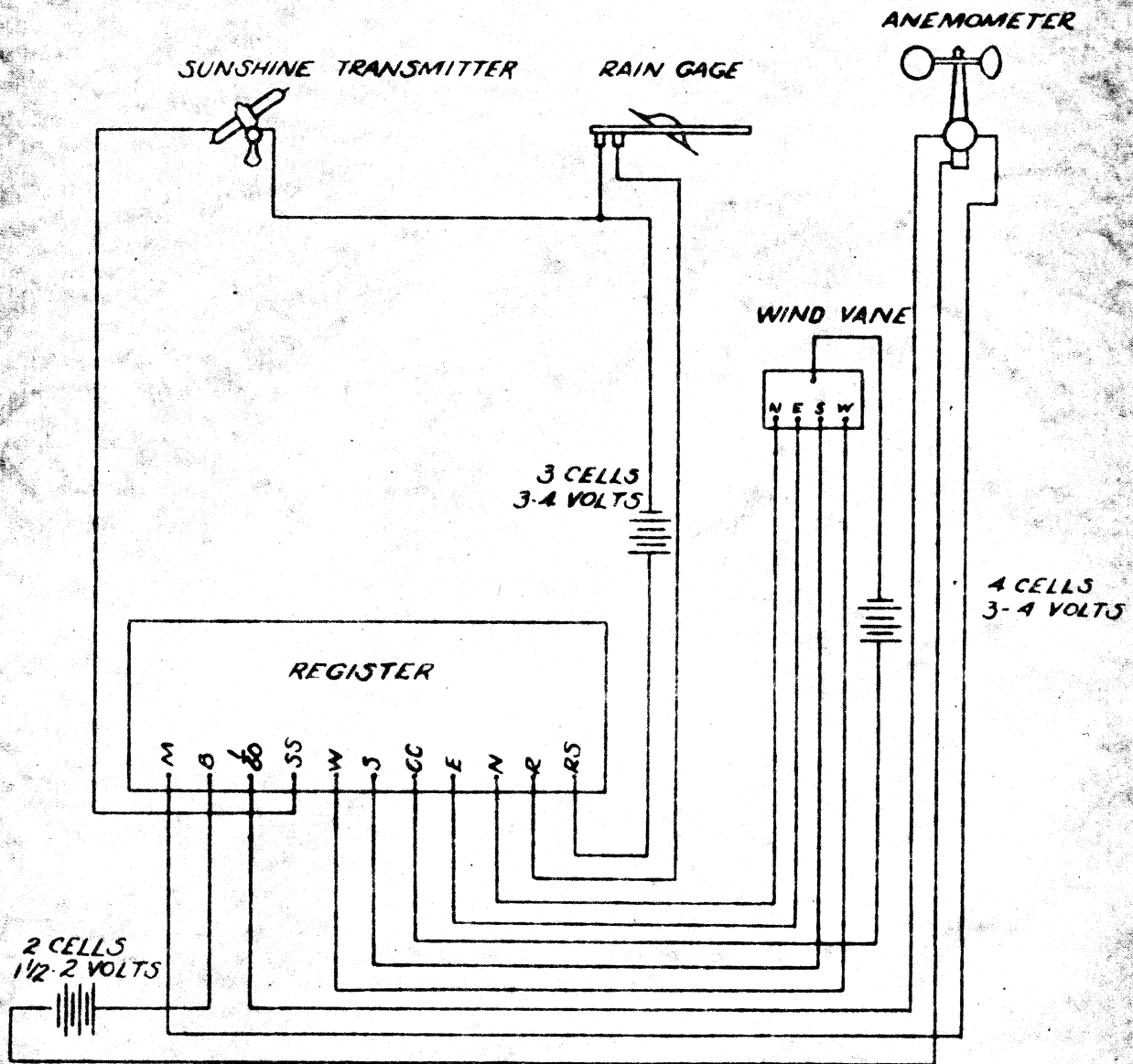
WIND DIRECTION TRANSMITTER

443 RECORDER



WIRING DIAGRAM FOR REGISTER #443
Using 3-6 volts D C

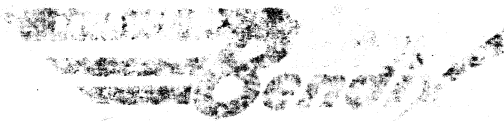
Figure 4



WIRING DIAGRAM FOR REGISTERS #441 AND #443
Using Schoenmehl #3 Cells

(The wiring for #443 is the same as shown above for #441 except the Sunshine-Rainfall Transmitter and associated wiring and battery are omitted; also the #443 Register does not have circuit binding posts designated 'SS', 'R' and 'RS'.)

Figure 5



AVIATION CORPORATION