INSTRUCTIONS FOR ASSEMBLING THREE COMPONENT RECORDER

SERIES H

The four plated screws which hold the recorder in the crate are the leveling screws. These screws should be replaced in the base of the instrument, with the heads down.

Set the recorder on the four leveling cups and level the base with a spirit level. The leveling screws may be turned with a wrench.

Reverse the pinion gear on its bearing so that the teeth will engage the large gear wheel. (This gear is reversed in shipment to prevent damage). The knurled nut which holds the gear serves as a clutch. When putting paper on the drum, this nut is loosened so that the pinion gear is free to idle. Tightening the gear connects the drum with the motor.

Slip the three cylindrical lenses in their holders. Hold the lenses at the ends and reach over the drum from the open side of the recorder. The convex side of the lens is toward the slit.

Remove the prism relay from one of the lamp tubes and examine the construction so that you will understand the adjustments. The screw at the top of the magnet controls the degree of motion of the prism. The knurled screw between the two binding posts changes the angle of the prism. Rotation of the relay unit in the tube will raise or lower the light ray as required.

Clamp the three light tubes in the yokes below the slits. The adjustable slit on the tube should be directly below the center of the slit diaphragm on the box. Connect the lamp and relay wires. When the tubes are properly in place, the lock screws on the adjustable lamp rods will be on top. The contact block marked "Timer" should be connected with the chronometer. The relays may be tested by short circuiting these terminals.

Connect the outlet cord to a 110 volt A.C. Circuit. There is a built-in power supply for the lamps and relays. Turn on the lamps at the panel and adjust the current to give the desired light intensity. After proper light intensity has been established by test on the photographic paper, the readings of the ammeters should be recorded and kept constant.

Place the galvanometers in position and adjust the light spots. The vertical component galvanometer should be used with the center 6" slit. The long period horizontol components are used with the 10" slits. The galvanometers are placed about one meter from the recorder and a vertical image of the light filaments projected on the white slits. Rotate the lamps so that the filaments are vertical. Adjust the aperture on the lamp tube so that the entire window of the galvanometer is illuminated. The spot is focused on the drum by means of the cylindrical lens adjustment. Have a white paper on the drum when focusing the spot.

Put light oil in the gear box, keeping the level a little below the lowest bearing. The lead screw inside the drum shaft should always be lubricated.

INSTRUCTIONS FOR ASSEMBLY AND ADJUSTMENT

O F

VERTICAL COMPONENT SEISMOMETER

ASSEMBLY

Screw in the three leveling screws. Check the wire connections under the base to be sure that they are not broken. Screw the damping vane to the coil box.

Set the instrument on the three leveling cups. Screw the hinge bar of the boom to the two standards, passing it between the standards from the rear of the instrument. Hook the coil spring to the upper and lower points of suspension. Screw the plate across the top of the yoke near the coil box.

This yoke is drilled for an air jet. A short section of rubber tube is connected with the yoke under the base plate. Later, when checking the system, the long extension of tube is connected to the short section. A gentle puff of air through the tube will move the boom the required amount. When not in use, the short tube is plugged and left under the base.

Unclamp the boom as follows: Tighten the clamp screws on each side of the boom, near the coil box. Next, remove the three thumb screws from the clamp block on the hinge bars, and remove the block. (This block is screwed to the base plate when not in use.) Now, release the two clamp screws near the coil box, and the boom is free to swing. Adjust the tension on the spring until the boom rests parallel to the base.

There is a vertical shaft with a counter-weight on the end of the boom. The purpose of this weight is to make the center of gravity of the boom coincide with its axis of rotation. The position of this weight is set in the factory. If it has been moved, it can be adjusted as follows: Remove the spring and set the seismometer in a vertical position with the coil box down. Unclamp the boom. If the weight is too far up on the shaft, the boom will tilt toward the base plate. If it is too low, the coil box will tilt away from the base plate. Adjust the weight so that the boom is suspended in a vertical plane, when at rest.

ADJUSTMENT

Check the period of the seismometer boom by timing ten oscillations with a stop watch. The position of the upper and lower spring supports determine the period. The period has been adjusted in the factory to match the galvanometer, however, slight changes may be necessary. To lengthen the period, the spring supports are moved forward toward the coil box. For slight changes, it is only necessary to move the top support. To do this, loosen the two side thumb screws at the sides of the standards and rotate the moving arms. The upper spring support should always be made to line up with the spring.

After the correct period has been established, place the magnets in position. The magnets are marked on the bottom near one edge, with the number of the instrument. The numbered edges should always face the name plate side of the base. If the coil magnet is reversed, the seismometer will not function properly. Clamp the magnets to the base by means of the brass bar. Solder the two flexible wires to the boom connections.

Adjust the boom for critical damping. This adjustment is made before connecting the galvanometer. The boom, when moved, should return to its starting position without passing it. If the boom is overdamped, it will require more than half the period to return. If it is underdamped, it will go past the starting position and then return. The damping adjustment has been approximated in the factory. The damping force of the magnet is changed by moving the adjustable shunt on the magnet. To increase the damping, move the sliding shunt into the field of the magnet.

The recorder should be set up (See Instructions for Assembling Recorder) and the light spots adjusted. Level the galvanometer carefully. Give large deflections and see that the mirror and coil do not stick, jerk, or bump, but swing freely. (To produce deflections, remove the binding post caps and touch the terminals with moistened fingers.) Check the period and see if it is within 0.2 second of rated value. When properly leveled, connect to seismometer. The boom must be clamped by means of the two side screws only.

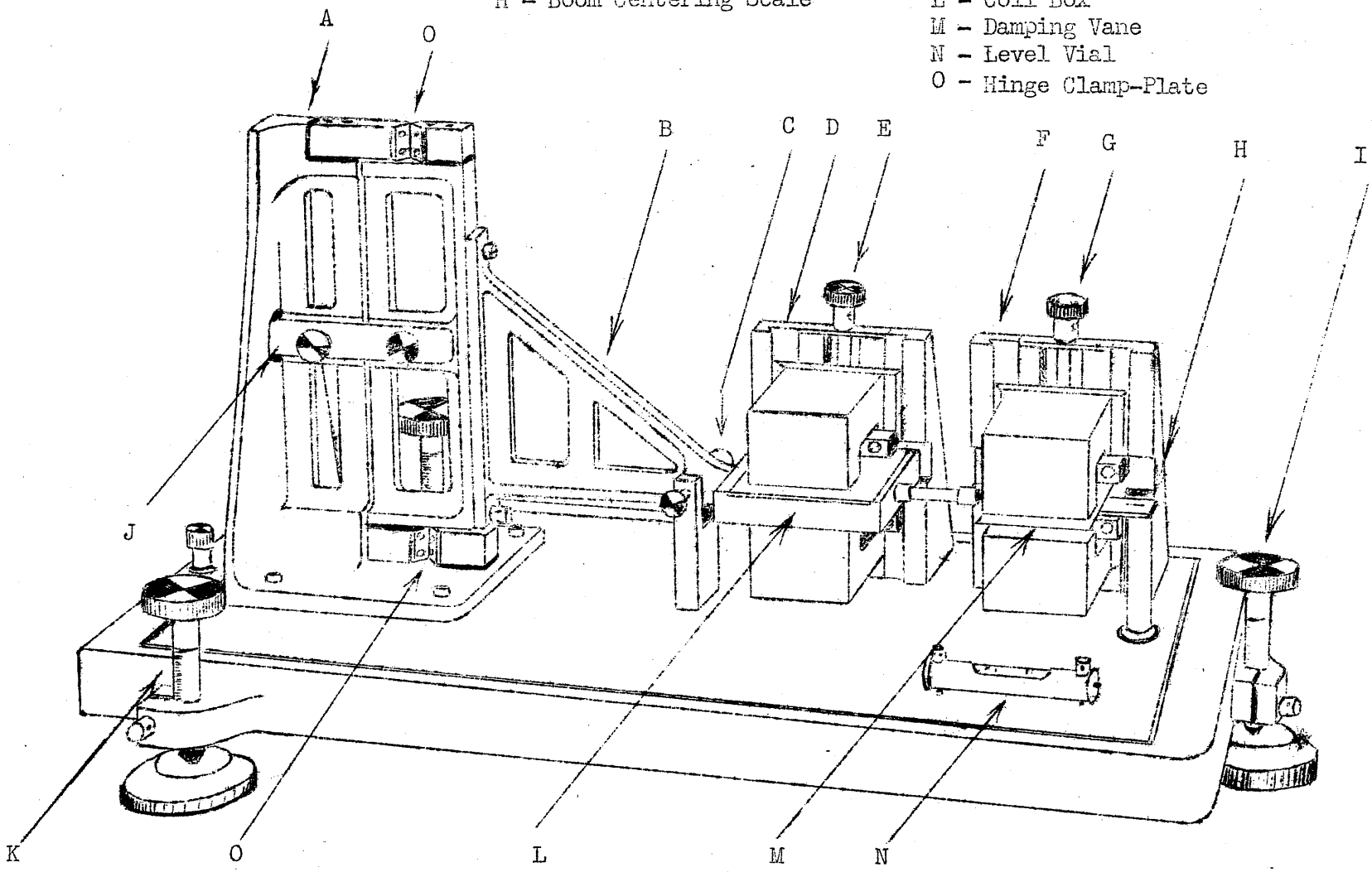
The galvanometer must be critically damped, as well as the boom. The galvanometer damping is controlled by the external resistance in the circuit. The external resistance here is the resistance of the seismometer coil. The resistance of this coil is made equal to the CDRX (critical damping resistance)

of the galvanometer, therefore, the galvanometer should be critically damped without further adjustment. To check, clamp the boom, and give deflections to the galvanometer. (To produce deflections of the galvanometer for making damping tests with the seismometer boom locked, hold a flashlight battery between the thumb and first finger and touch the seismometer binding posts with the extremeties of the thumb and finger.) The light spot should return to its starting point without passing through.

Disconnect the galvanometer so that the boom may be unclamped, then, when the boom is at rest, reconnect the galvanometer. Give a slight impulse to the boom by means of the air jet. If the boom and galvanometer are properly damped, the light spot will move several inches. It will not stop when it returns to its zero position, but will make a secondary swing to the other side of the zero, and then return. The ratio of the primary to the secondary swing should be within the limits 2.14 to 2.44. The secondary swing is caused by the current which is generated by the return of the seismometer boom.

If it is necessary to replace the hinges, proceed as follows: Lock the boom with the clamp bar. Loosen all screws in the hinge clamp plates. Slip four hinges in place and tighten all screws, being sure that none are overlooked.

A – Retaining Standard
B – Boom
C – Boom Clamp and Air Jet
D – Coil Magnet Support
E – Magnification Adjusting Screw
F – Damping Magnet Support
G – Damping Adjustment Screw
H – Boom Centering Scale
I – Leveling Screw For Period Adjustment
J – Boom Clamp Bar
K – Leveling Screws For Centering Boom
L – Coil Box
M – Damping Vane
N – Level Vial
O – Hinge Clamp-Plate



INSTRUCTIONS FOR ASSEMBLY AND ADJUSTMENT

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HORIZONTAL COMPONENT SEISMOMETER, SERIES H

To Setup Magnets

Remove the magnet supports from the base of the seismometer, and clamp the four magnets in position. Each magnet is marked on one face with the number of the instrument and a letter from A to D. The supports are also marked on the plates to which the magnets are to be clamped. The marked face of the magnet is clamped against the plate having the corresponding letter. The pole face of each magnet should be level with the edge of the plate to which it is clamped. The bottoms of the magnet supports are marked C and D respectively. These marks identify the Coil and Damping units. They are not interchangeable. The coil magnet is stronger than the damping magnet. Do not secure the magnet supports to the base until the period of the Boom has been adjusted.

To Mount Hinges

To mount the hinges, first have the clamp bar in position and release the coil box clamp screws. Have all of the hinge clamp-plate screws loose. Do not remove them. Slip the four hinge blades in place, clamping them one at a time. Begin with the plates on the Retaining Standard. When tightening the screws on the boom, do not push on the screws hard enough to move the boom out of line. Be sure that all of the hinges blades are at right angles to the edge of the blocks. The hinges are supplied longer than necessary so that they may be easily aligned. The hinges must be placed so that they lay under the taper projections of the clamp plates. There are 16 screws. Be sure that all are tightened before unclamping the boom. Cut away the ends of the hinge blades, leaving 1/8" projections.

To Unclamp Boom

To unclamp the boom, draw up the coil box clamp screws until they are LIGHTLY in contact with the boom. These screws will steady the boom while the clamp bar is being removed. Unclamp the boom as follows: Remove the two screws from the clamp bar and carefully withdraw the bar. Always pull the bar straight back. Do not attempt to force it out sideways. After removing the clamp bar, back away the two coil box clamp screws. The boom is now free to swing. (The clamp bar should be screwed to the base plate when not in use.)

Period Adjustment

Adjust the two side leveling screws until the boom is centered by the Centering Scale on the Damping Vane. Set the period of the boom to correspond to the period of the galvanometer. This must be accomplished with the magnet supports removed from the base. The period is controlled by means of the leveling screw at the end of the base. To increase the period, raise the end of the plate. To shorten the period, lower the end of the plate. The period should be adjusted with the cover box in place to prevent air currents from disturbing the boom. After obtaining the desired period, set the level vial so that it is centered. This level will then assist in resetting the period in case the instrument is moved about.

Reclamp the boom by means of the coil box clamp screws only. Screw the magnet supports to the seismometer base plate. Adjust the coil magnet so that there is about a 1/8" gap between the pole face and the coil box.

To Adjust Damping of Seismometer Boom

Unclamp the boom and recenter if necessary. Adjust the damping by varying the gap between the damping magnets so that the boom will return to its initial starting point after being displaced. Use the centering scale for making this adjustment. For more accuracy, use the mirror which is mounted at the top of the hinge block.

Before connecting the galvanometer to the seismometer, the galvanometer should be set up in the operating position and the light spots should be focused on the drum. (See instructions for recorder).

Connect the long rubber tube to the short section under the seismometer. Slight impulses are imparted to the boom by means of this air jet. CAUTION: Never make adjustments on the seismometer boom unless the galvanometer is disconnected. If the boom should be accidentally touched, the galvanometer suspension could be broken.

Galvanometer Tests

If not familiar with the L & N Galvanometer furnished with the seismometer, read the instruction book which is supplied with it. Following are additional hints for setting it up.

1.) Leveling Galvanometer.

   a) Give a large deflection (90°) and see that the mirror and coil do not stick, jerk, or bump, but swing freely. (To produce deflections, remove the Binding Post caps and touch the terminals with moistened fingers).

   b) Check period and see if it is within 0.2 second of rated value.

2.) Choice of Resistance. - The amount of resistance which is to be connected in series with the seismometer should be determined by means of a decade resistance box. After this value is known, the resistance box should be replaced with the small adjustable resistance supplied with the seismometer. This resistance should be set to the value of the decade box by means of a Wheatstone Bridge. (The value of the resistance will be between 1000 ohms and 5000 ohms, depending upon the number of turns selected in the seismometer coil).

3.) To produce deflections of the galvanometer for making damping tests with the seismometer boom locked, hold a flashlight battery between the

thumb and first finger and touch the seismometer binding posts with the extremeties of the thumb and finger. Moisten fingers if necessary. Do not short terminals with battery alone.

The resistance of the seismometer circuit should always be equal to the CDRX of the galvanometer. When you are sure you have the proper ratio, unclamp the seismometer boom and check galvanometer deflections and if the deflection ratio is still not within the proper limits (2.139 to 2.449) change the damping of the seismometer boom until within this range. The seismograph is now ready for an operation test. If the seismometer circuit has less resistance than the CDRX of the galvanometer, the system will be over-damped, and vice versa.

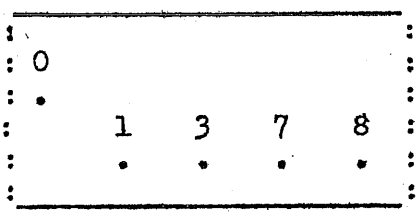
Damping Adjustment Of Galvanometer

Now connect the seismometer to the galvanometer, putting a variable resistance in series with the circuit. Give the seismometer boom a slight impulse, using the air jet, and watch the galvanometer deflection. Check the ratio of the deflections on each side of the zero position of the spot. This ratio should be within limits of 2.139 and 2.449. If the ratio is not proper, clamp the boom by means of the coil box clamp screws so that it cannot move. Give the galvanometer a deflection. (Put fingers across the resistance or use a flashlight battery as explained under GALVANOMETER TESTS). The galvanometer should be critically damped. If not, vary the resistance until critical damping is obtained. Repeat until you get consistent series of readings.

To Adjust Magnification

Make a 24-hour record. If the seismograph records microseisms with double amplitudes much greater than 2 mm., the magnification is too high. In this case, open the coil magnets a few millimeters, using the reference scale, and make another record.

If the proper degree of magnification cannot be obtained by adjusting the coil magnets, clamp the boom and remove the coil magnet support from the base plate. Open the coil box and connect the coil terminals to give you more or less turns of wire as required. Inside the coil box is a terminal strip as shown in the sketch below. The terminals are numbered from 0 to 8. By changing the connections you can get windings in steps of 1000 from 1 to 8.



0 - 1	1,000	Turns	8 - 3	5,000	Turns
3 - 1	2,000	"	7 - 1	6,000	"
0 - 3	3,000	"	0 - 7	7,000	"
7 - 3	4,000	"	0 - 8	8,000	"

If the coil winding is changed, it will be necessary to re-adjust the damping of the system.

This instrument is designed to operate at periods between 6 and 24 seconds. The six-second period is used for recording microseisms caused by storms over the sea. Longer periods between 14 and 24 seconds are used for recording distant earthquakes.

The seismometer is extremely sensitive at the longer period range, and it often requires several weeks of operation to accomplish a stable adjustment.

Remove the tape from the cover boxes. (If gum from the tape adheres to the box, it may be removed with turpentine or benzine). After all final adjustments have been made, put a small amount of petroleum jelly in the marginal groove of the base plate. This will seal the instrument against moisture, dust, and insects.

The boom clamp bar should only be used if the seismometer is being moved about, or if it is necessary to replace the hinges. Always have a film of oil on the clamp bar when in use. It is convenient to have a knife switch in one side of the galvanometer line.