



INSTRUCTIONS FOR  
 ASSEMBLY AND INSTALLATION OF  
 SPRENGNETHER SERIES AR SEISMOGRAPH

General:

The following instructions should be read over carefully before attempting to assemble or place the seismograph in operation.

The instrument should be installed in a basement room, as far as possible from any machinery, such as furnace stokers, washing machines, et cetera. The seismograph should be enclosed in a small, dark room with at least sufficient space for servicing the instrument and changing records. If the operator already has a photographic dark room, the problem is easily solved. The operation of the seismometer will not be affected by moisture, however, some recorder parts may rust in time if the air is damp. It is an easy matter to keep the air dry in a small room by means of calcium chloride. If the instrument is properly assembled, it should give continuous service for many years.

Assembly of Seismometer:

Print No. 101 illustrates two views of the complete seismometer assembly. Proceed to assemble in the following manner:

1. Press the upper clamping stud 8 in the top hole of the torsion bracket 15. Tighten 8 in the bracket 15 by riveting the edge of the stud over with a small hammer. Set the clamping stud 8 against a flat iron surface such as an anvil when riveting. Before it is completely tightened, insert Torsion Head 17 and rotate the head so that the axis of the Torsion Head is parallel to the edge of Torsion Bracket 15, then tighten.
2. Attach the lower clamping stud 4 to torsion bracket in the same manner. Square as in 1 before tightening. The cut-away section should be on left side as shown in the figure.
3. Slip the magnet clamp 19 over the torsion bracket 15 and press the damping magnet 13 inside the clamp with edges flush. Lock the magnet near the lower end of the torsion bracket (see figure).
4. Lock set collar 9 on torsion head 17, clamp tension weight 12 to lower clamping stud 4 by means of clamp screw 10 and clamp 11.
5. Screw leveling screws 3 to leveling plate 2.
6. Screw torsion bracket 15 to leveling plate 2 by means of mounting screw 20.
7. Mount leveling base 2 on cast iron base 1, with spring 21 and washer and nut (see figure).
8. Cement round glass to inside of window 14. (Inside surface of window 14 should be painted black.) The glass may best be cemented by touching the inside edge of the tube with clear finger nail polish or lacquer, and setting the glass in position with a tweezer. Do not cement the glass to the outside of the window.
9. The last step is to make up the filament 22 with pendulum mass and mirror. This should not be attempted until the recorder has been assembled and piers are in readiness. The obvious reason for this, of course, is to eliminate the possibility of accidental breakage in handling. An aluminum template is provided on which have been marked the exact position of the pendulum mass 6 and the two terminals to which the filament must be soldered. The terminals and pendulum mass are held in position by means of spring clips. The terminals should be tinned with solder and clamped in line with the two marks on the template. Solder one end

of the filament to the terminal. A small kink or curl in the end of the filament which is soldered will improve the grip of the solder. Pull the filament straight and solder the other end. Adjust the pendulum mass 6 in position. The filament should lay along the line marked on the pendulum mass. Solder the two edges of the mass to the filament. A small pencil type soldering iron should be used. A heavy iron will melt the fine wire. Do not use soldering acid or paste. Use rosin core solder.

10. After solder connections are satisfactorily made, cement the mirror (coated surface up) to the pendulum mass. The relative position of the mirror is shown in the drawing. The mirror is attached to the side opposite the filament. Clear finger nail polish is suitable for cementing the mirror. After cement has hardened, the suspension is ready to mount.

11a. Pick up the suspension by the upper terminal. Drop the lower end through the poles of the magnet. Clamp the upper end in the torsion head 17. Move the tension weight 12 as high as it will go and clamp with clamp screw 10. Set the lower terminal in upper end of tension weight and lock with small screw.

11b. With the thumb and index finger of the right hand, hold the tension weight at the upper end near the small set screw. Unclamp screw (10) and gently lower the weight until most of the slack is out of the filament wire and re-clamp. See that the filament is inside all damping grooves (5), then unclamp and gently lower the torsion weight until the weight is supported freely by the filament and re-clamp (10). **Add one drop of oil in each damping groove (5).**

12. Set the cover tube (16) over the seismometer and if the mirror (7) does not line up with the window, it will be necessary to adjust the position of the suspension by means of set collar (9). If this is necessary, proceed as follows: Hold the torsion weight (12) near the small set screw. Unclamp the clamp screw (10). Move the torsion weight (12) up about half an inch and re-clamp. Move the set collar (9) up or down, as required, and lower the torsion weight as described in 11-b.

#### Period Adjustment.

1. Before attempting to adjust the instrument in the operating position, set it on a solid table facing you as in the front view plate, 101, and practice with the period adjustment. Remove the cover tube (16). Lower the damping magnet (13) to the position shown in the figure. By means of the two side leveling screws (3), tilt the seismometer to the left. The pendulum mass (6) should then swing to the left, and will have a very short period of oscillation. Gradually adjust the torsion bracket (15) to a vertical position. If the pendulum mass swings forward, turn the rear leveling screw to the right until the mass is again parallel to the torsion bracket (15). If the pendulum mass swings backward, turn the rear leveling screw to the left. As the torsion bracket approaches a vertical position, the period of oscillation is increased. The most suitable period for recording local earthquakes is 1.5 seconds. The period is best determined by means of a stop watch. Time 25 oscillations and divide by 25. Start counting at one limit of oscillation. Begin by counting zero, one, two, three....to twenty-five. When measuring the period, be sure there are no air currents affecting the motion of the pendulum. If a stop watch is not available, count 100 oscillations, watching the second-hand of a clock.

#### Damping Adjustment:

1. After the operating period has been established, move the damping magnet upward until the pendulum mass (6) is partly in the field of the magnet.

2. Give the pendulum mass an impulse by blowing gently on it. If the pendulum is under-damped, it will make several oscillations before coming to rest. If it is over-damped, it will require more time than half its period to come to rest. It is critically damped when it returns to its zero position in one-half its period. It is recommended that the pendulum be slightly under-damped for best operation, i.e., when the pendulum is given an impulse it should move away from the zero position, return, and move slightly past the zero position, and then come to rest. The operator should become thoroughly familiar with all of these adjustments before making a final set up.

INSTALLATION: The instruments should be set on two piers built upon the basement floor. The piers should be cast of concrete or built with bricks, or concrete blocks.

Dimensions of Recorder Pier

<u>Height</u>	<u>Width</u>	<u>Length</u>
26-1/2"	14"	18"

Dimensions of Seismometer Piers

<u>Height</u>	<u>Width</u>	<u>Length</u>
24"	9"	9"

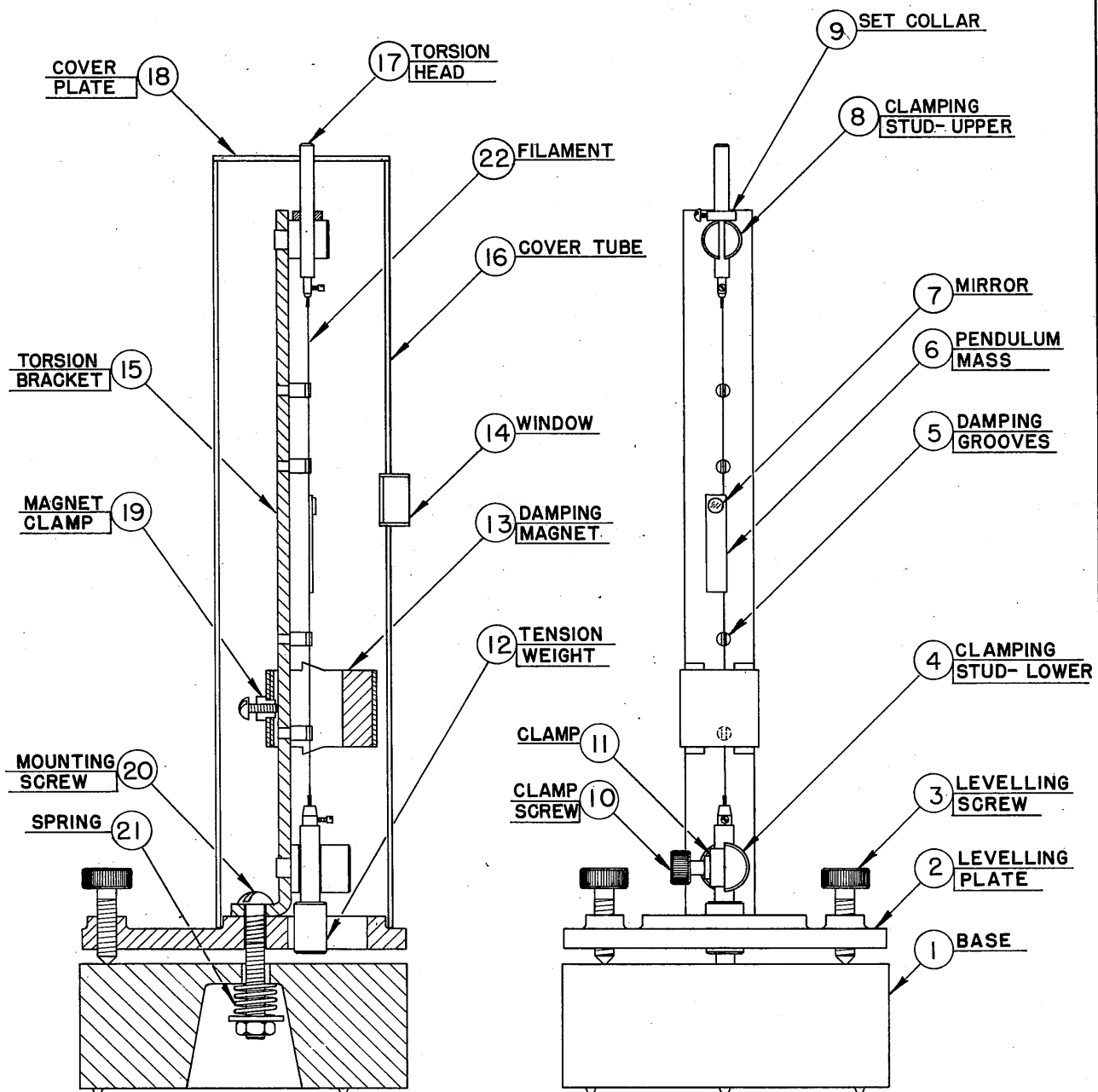
Distance between piers - 32". The piers can be made larger and higher if desired, but should not be made smaller. The recorder pier should be kept approximately 2-1/2" higher than the seismometer pier. If possible, the piers should be placed on true N-S or E-W bearing. The best way to obtain this bearing is from the surveyors plat. If it is impossible to place the instruments in the true meridian, determine, if possible, the angle of departure from the true bearing.

FOCUSING THE LIGHT SPOT:

After the period and damping adjustments have been approximated on the pier, focus the light on the mirror and search for the reflected spot. If the spot is too high, move the light tube (47) up. If the spot is too low, move the light tube down. The focal length of the mirror is approximately one meter. The image of the light filament should be focused on the aperture strips (48). It may be necessary to move the instruments closer or further apart. Rotate the light socket (46) until the image of the filament is vertical. After a sharp image has been obtained on the aperture strips, adjust the period and damping of the seismometers to proper values. Remove the light shield (45) and focus the spot on the drum by means of the focusing screw (49). While making the focusing adjustments have the lamp turned on to full intensity. When ready to record, reduce the light intensity to about two-thirds maximum. The light spot should be centered on the aperture. Replace the light shield (45).

The seismograph is now ready for operation. Proceed as follows: Place a shield over the light tube to block out the light. (A small piece of cardboard will do). Disengage the motor gear from the shaft gear. Clamp one end of photo-paper to the drum (be sure sensitive surface is outside). Rotate the drum, wrapping the paper around to the plastic clamp. Hold the two edges in place. Remove the clamp and replace to hold both ends of the paper. The transparent plastic clamp has a hook bent on one end and is held on the other by means of a spring clip. Lift the drum shaft off the spacing roller (54) and move the drum to the motor end of the cabinet. Swing the motor bracket up to engage the motor gear and shaft gear. Watching the second hand of a clock, remove the light shield and record the exact time of removal. The instrument is now in operation and should not be disturbed for 24 hours. If the instruments are set on new piers, the light spot is apt to drift, in time, from its zero position. It should be re-centered by means of one of the side leveling screws on the seismometer. Put a pencil mark on the aperture strips so that the spot can always be centered at exactly the same place.

After the record has been exposed for 24 hours, cover the light, disengage the gears, remove the paper. Check the zero position of the light spot, cover the light, disengage the gears, replace the paper and record the exact time the new record is started. If the developed record shows that the light intensity was too strong or too weak, make an adjustment in the proper direction. Other information on the proper procedure of operation will be found in the text book supplied with the seismograph. You are now in operation. May your interest grow and may you derive much pleasure and satisfaction from your new and fascinating hobby.



SIDE CUT-AWAY VIEW

FRONT VIEW WITH COVER REMOVED

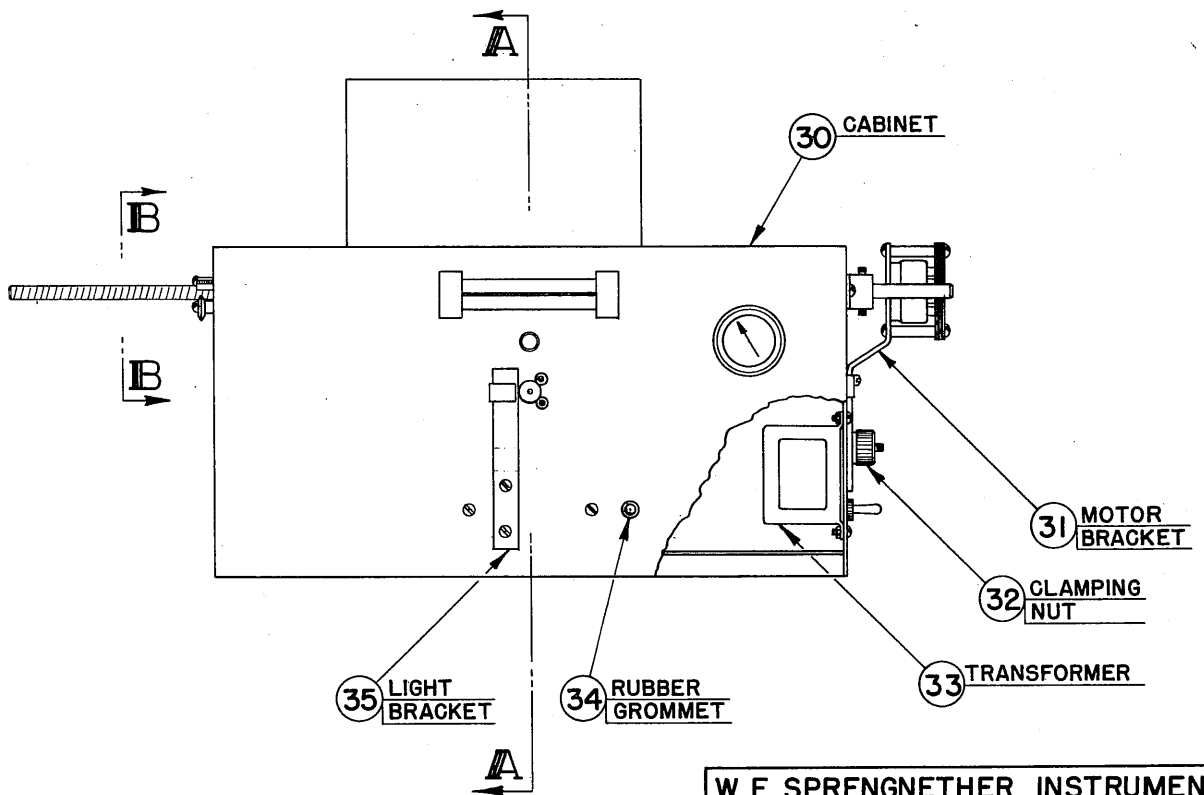
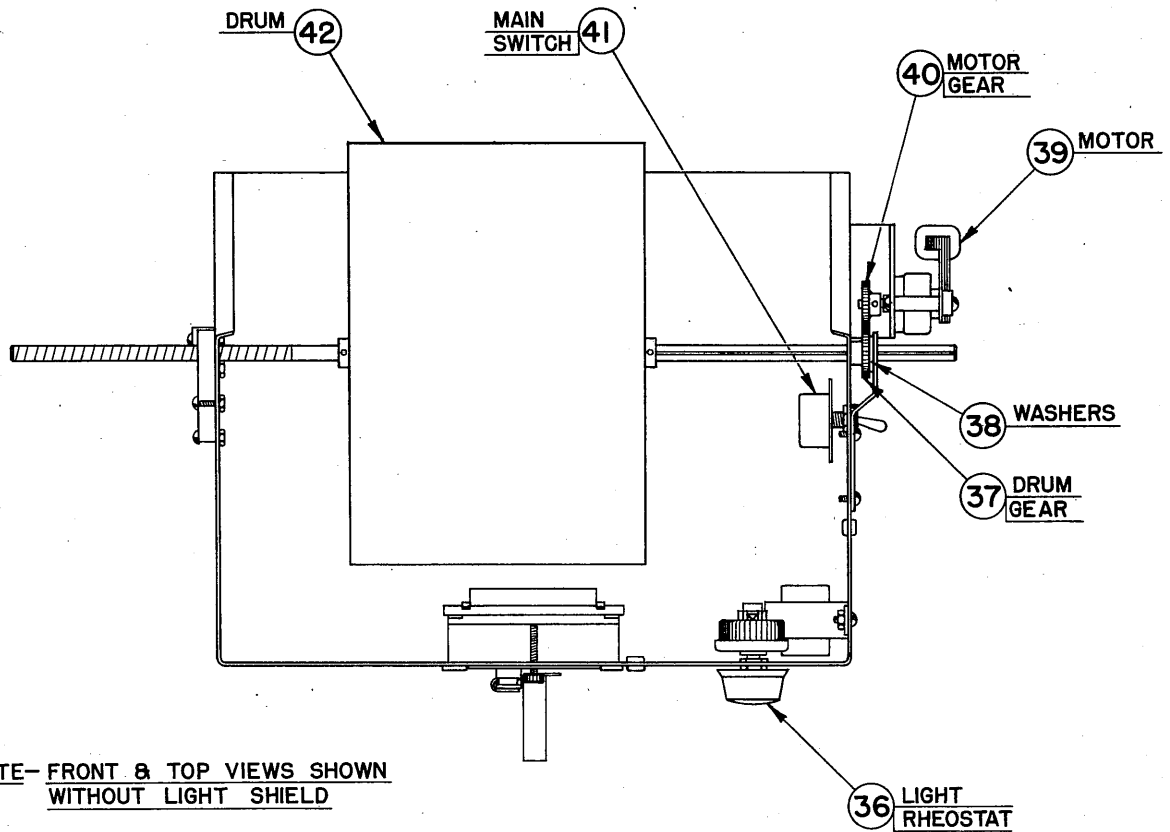
W. F. SPRENGNETHER INSTRUMENT CO.  
ST. LOUIS, MISSOURI, U.S.A.

SEISMOMETER - SERIES A-R  
HORIZONTAL COMPONENT

Drawn: 10/30/50

Approved: *[Signature]*

101



NOTE- SEE DRAWING 103 FOR END VIEW & VIEWS A-A & B-B

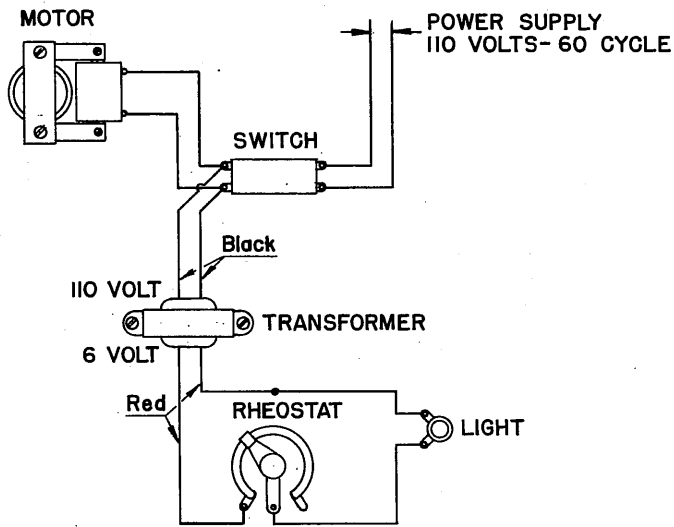
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SEISMOGRAPH RECORDER  
SERIES A-R

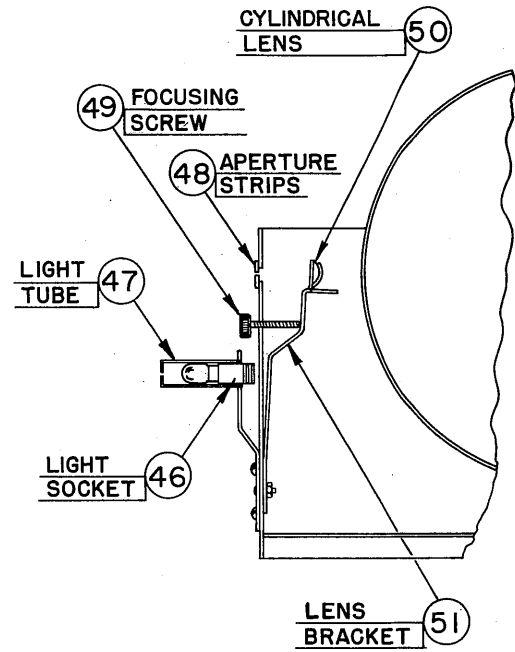
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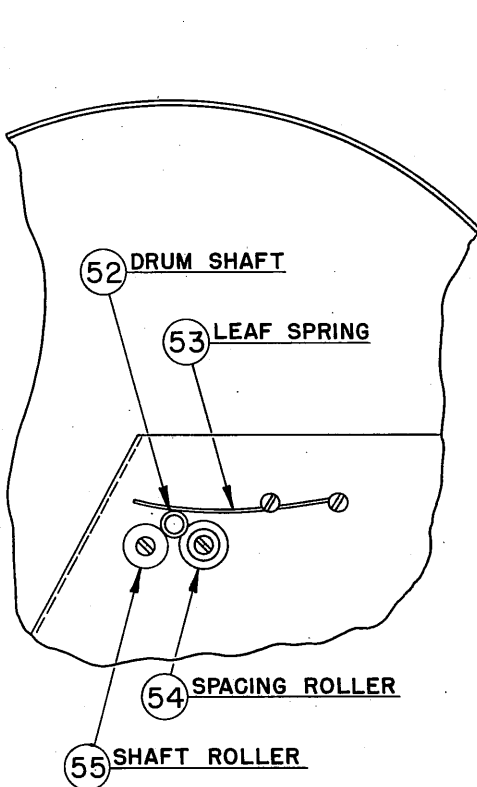
102



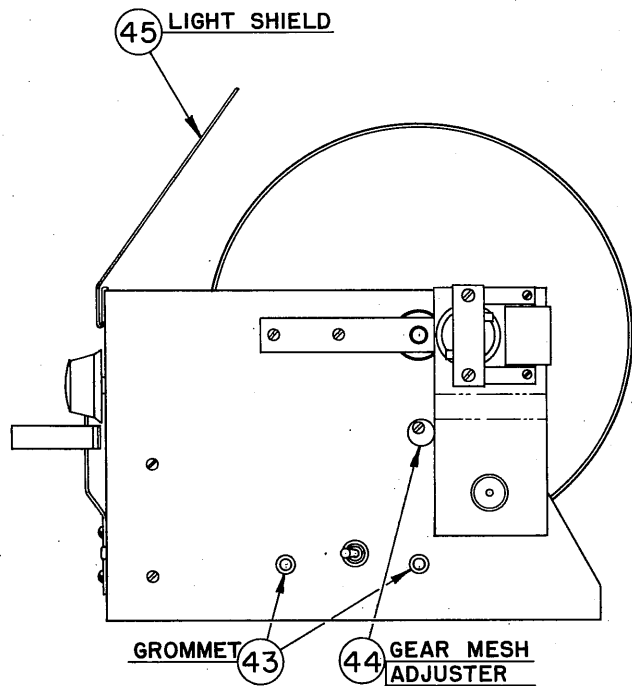
WIRING DIAGRAM



SECTION A-A



VIEW B-B



END VIEW

W. F. SPRENGNETHER INSTRUMENT CO.  
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SEISMOGRAPH RECORDER—SERIES  
A-R, AUXILIARY VIEWS

Drawn: 10/30-50

Approved: *[Signature]*

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PARTS FOR SERIES AR SPRENGNETHER SEISMOMETER

No. 1	Iron base	No. 17	Torsion head
2	Leveling plate	18	Cover plate
3 (3)	Leveling screws	19	Magnet clamp bracket
4	Lower clamping stud	20 (1) 3/4"	1/4-20 mounting screw
4-A	Clamp	20-A	1/4-20 nut
4-B	Clamp screw	20-B (2) 1/4"	washers
5	Damping grooves	21	mounting spring
6	Pendulum mass	22	6 1/2" suspension material
7	Concave mirror	23 (3)	clips
8	Upper clamping stud	23-A	suspension solder bracket
9	Locking collar	24 (1) 3/48	1/4" screw
12	Torsion weight	25 (2)	1-72 screws
13	Magnet	26 (1) 1/2"	8-32 screw
14	Glass window	27 (2)	suspension tips
15	Torsion bracket		
16	Cover tube		

PARTS FOR SERIES AR SPRENGNETHER RECORDER

No. 30	steel recorder housing	No. 47	light tube
31	motor bracket	48	two aperture strips
32	motor bracket clamping nut	49	focusing screw
33	stancor 6-volt transformer	50	one cylindrical lens
35	light tube bracket	51	lens holder
36	Ohmite rheostat with knob	52	steel drum shaft
37	Drum gear	53	leaf spring
38	spacing washers	54	spacing roller
39	Telechron 2 RPH syn. motor	55	shaft roller
40	motor gear	56	light bulb
42	galvanized drum	57	one set paper holders
44	gear mesh stop	78	light shield
46	light tube socket	79	drum gear retainer

SCREWS, et cetera, FOR RECORDER

No. 34 (1)	1/4" grommet	No. 67 (2)	1/4" - 8-32 round head screws
43 (2)	5/16" grommets	68 (4)	1/8" - 6-32 round head screws
58	14" length, 6-volt wire	69 (2)	3/4" - 6-32 round head screws
59	7' length, 110 volt wire	70 (1)	1/4" - 6-32 round head screws
60 (1)	male, 110 volt plug	71 (2)	10-32 locking nuts
61	1-1/2" length electricians tape	72 (4)	8-32 locking nuts
62 (2)	Sprengnether decals	73 (4)	6-32 nuts
63 (2)	1/4" - 10-32 round head screws	74 (2)	#10 washers
64 (1)	3/4" - 10-32 fillister head screw	75	parts list
65 (1)	1/2" - 8-32 fillister head screw	76	instruction book
66 (1)	5/8" - 8-32 fillister head screw	77	Text book



INSTRUCTIONS FOR  
ASSEMBLING

SEISMOGRAPH RECORDER, Series A-R

General:

Detail drawings for the assembly of the recorder are provided in prints Nos. 102 & 103. An effort was made to supply as much detailed information as possible in these drawings, in order to reduce the amount of descriptive information to a minimum. No machine work is necessary and all necessary parts and fasteners are supplied. Any order of procedure may be followed in assembling the parts, however, we suggest the following method:

1. Referring to plate No. 102, mount transformer 33 and rheostat 36 in position.
2. The main switch No. 41 is not a necessary item and is not supplied with the instrument. It can be added to the recorder, if desired.
3. Set the drum (42) in the cabinet (30) and push the drum shaft (52) through the cabinet and drum. The spline end of the shaft (52) should be on the same side of the cabinet as the transformer. Lock the drum to the shaft by means of the set screw. The edge of the drum should be 7-1/2" from the threaded end of the drum shaft.
4. Place the drum gear (37) on the drum shaft. This gear has a screw which fits the spline in the shaft. There is an angular bracket for holding this gear in position. This is secured to the box with two 6-32 screws.
5. Mount the spacing roller (54) and the shaft roller (55) to the side of the cabinet (30) (See view BB, print 103). The rollers are held by means of two 8-32 screws with lock nuts on the inside surface of the box. The screws should be adjusted so that they roll freely with a minimum of play. Next, fit the leaf spring (53) in place.
6. Screw a nut on each of the 6-32 screws. Push them through the two holes in the box and put nuts on the other ends. Adjust the screw projections to the width of the spring and lock tight.
7. Mount the motor (39) to motor bracket (31) by removing two screws opposite the motor magnet and replacing them through the two holes in the motor bracket. Lock the motor gear (40) to the motor shaft. The bracket is held on the box by means of a 10-32 screw and clamping nut (32). Have a washer between the nut (32) and the bracket (31). Adjust the gears so that they are in the same plane.
8. Screw the eccentric washer (44) (gear mesh adjuster) to the cabinet with a 6-32 screw. Adjust the position of the washer so that the gears are properly in mesh when the bracket (31) is against the washer.
9. Assemble the lens bracket (51) and light tube (47). All details are clearly illustrated in Section AA, print 103. The aperture strips are held in place by means of plastic tape. Leave an opening between them about 1/32" wide.
10. Wire the electrical circuit according to the diagram on print 103.
11. All moving parts on the recorder should be oiled. The instrument should be tested for free running of all parts. The drum will make one rev./30 minutes so that its motion will be scarcely noticeable.



SUPPLEMENTARY INFORMATION FOR OPERATION  
AND MAINTENANCE OF SPRENGNETHER SEISMOGRAPH

Photographic Paper Requirements: The size of the record paper is 2.5 ft. x 6". The paper may be purchased most economically by ordering it in 200 ft. rolls, and cutting it to the required lengths. One roll of 200 ft. paper will last 80 days and will cost approximately \$6.00. On this basis, paper costs will be about \$25.00 per year. The paper may be purchased from several sources. A photo paper comparable to "Linagraph Ortho Paper A", made by Eastman Kodak Company should be used. The paper should be spooled with coated surface out. Mention this when ordering.

Development of Record: Most papers may be developed with a D-72 Developer. Follow directions supplied with the developer.

Paper Storage: It is not advisable to purchase more than a six-month stock of paper in advance. After cutting the paper to proper lengths, store in a light-tight container and keep in a dry cool place. Have a separate cylindrical container for holding a small supply of paper from which to operate. This method will not only be more convenient, but will prevent a great loss of paper if the cover is accidentally left off the container. A cylindrical container will keep the paper curled, and make it easier to fit around the recorder drum. It will also eliminate the necessity of deciding which side is sensitized if the paper is properly stored in the container.

Time Marks: It is desirable to have time reference marks at one minute intervals on the seismogram. This will not be necessary if the operator only wishes to record earthquakes and determine their distance from the P - S time difference which may be scaled (25 mm = 1 minute). The simplest method of producing time marks is to use a good 8-day or electric clock with a sweep-second hand which can be made to interrupt the light beam as it leaves the light source. Mount an opaque strip 1/2" wide on the sweep-second shaft. The clock is set in front and to one side of the light source. As the strip rotates, it will interrupt the light once each minute.

Note on drift of light spot: Drifting of the light spot is caused by slight tilting of the earth under the seismometer. The spot may be recentered by means of one of the side leveling screws. Keep a record of tilt in your log.

Note on Seismograph Room: The ideal arrangement is to have a special room for the seismograph, with a separate section for developing and storing records. If it is necessary to enter the room during the day, a double door arrangement should be provided so that the room may be entered without admitting light. If the records can be changed at night, the double door should not be necessary. If it is not possible to have a full room for the seismograph, a small rectangular box made of fiber board can be built over the instruments. The lid can be hinged for access to the instruments. Records must be changed at night.

Spare Parts: The only essential spare parts which should be kept on hand are the light bulbs. These may be purchased in any radio store. Any other parts may be ordered by number from the parts list. Chart II should be mounted on a stiff board so that it can be hung on a wall.

It is difficult to anticipate the special problems which may arise for the beginner in seismology. Therefore, it is our plan to supply additional suggestions and information as the amateur program expands. Questions pertaining to special problems sent to Sprengnether Instrument Company should be accompanied by self-addressed, stamped envelope.

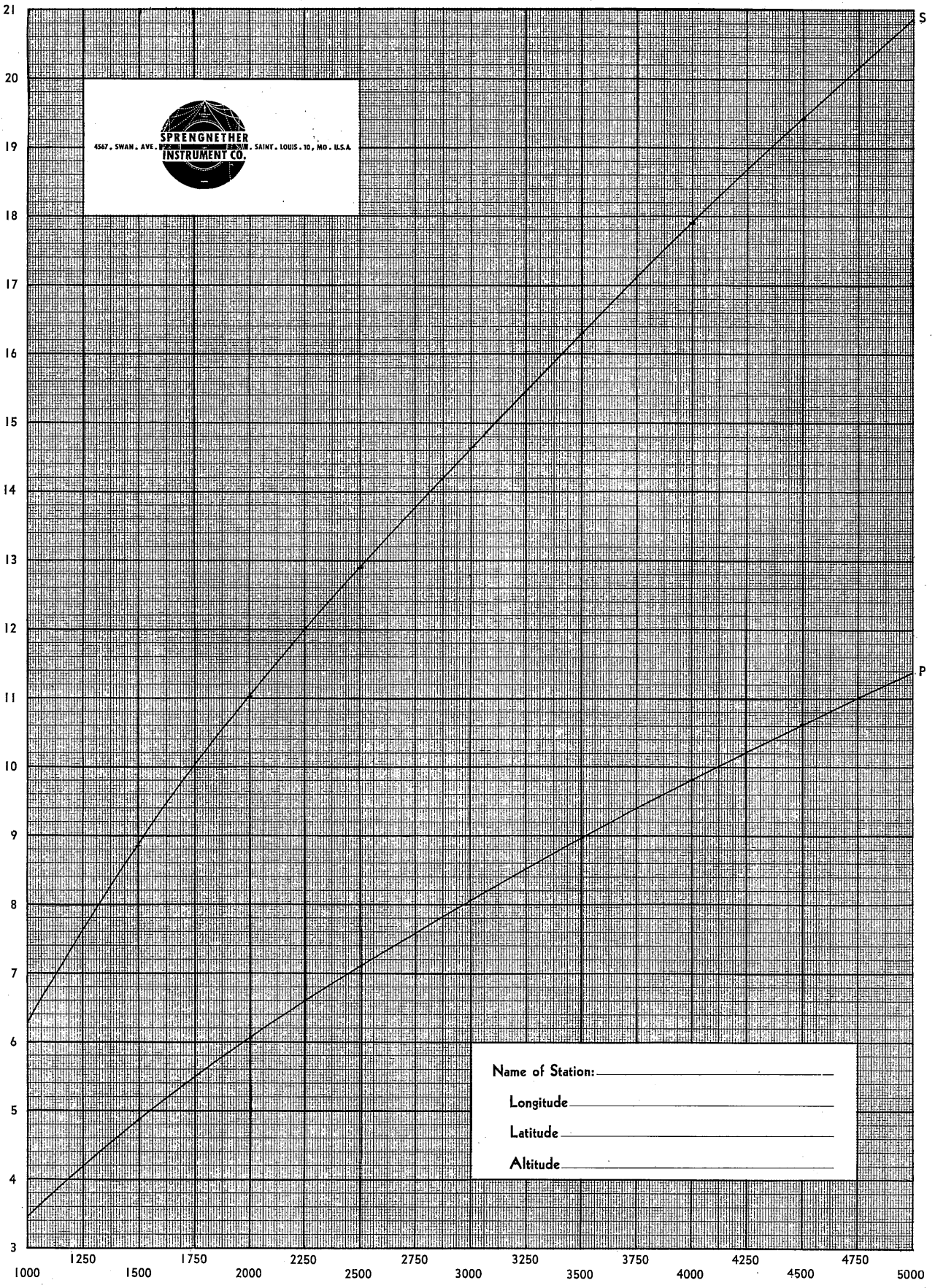


CHART 1. Travel times for normal P and S waves for epicentral distances between 1000 and 5000 Miles.  
 Plotted for Sprengnether Series A-R Siemograph.