# INSTRUCTION BOOK
# FOR
# PYRANOGRAPH
# CAT NO 5-3850

## RELATED INSTRUCTION BOOKS

| INSTRUMENT | BOOK NO |
|---|---|
| CHART DRIVE(SPRING-POWERED),PENS AND INKS | 12049 |
| UNIVERSAL CHART DRIVE(BATTERY-POWERED) | 15783 |

OCTOBER 1978

BELFORT INSTRUMENT COMPANY
1600 SOUTH CLINTON STREET
BALTIMORE,MARYLAND 21224

BOOK NO 11900

# I. INTRODUCTION AND DESCRIPTION

1.1 GENERAL: This publication consists of all the necessary information for the installation, operation, and maintenance of the Cat. No. 5-3850 Pyranograph.

1.2 OPERATION: The Pyranograph is a self-contained, self-energized instrument that records solar radiation. The features of compactness, easy portability, and freedom from dependence on power supplies or accessory equipment make it a convenient field exploration instrument.

1.3 The time constant of the instrument is two minutes. Accuracy is within plus or minus five percent, and sensitivity is 0.1 gram calorie per square centimeter per minute for 3/32 inch of chart width. Total instrument range is three gram calories per square centimeter per minute. This provides a comfortable margin over the maximum solar radiation encountered.

1.4 DESCRIPTION: The instrument is mounted on a cast metal base with a hinged cover that can be opened to expose the entire mechanism for service and repair.

1.5 The Pyranograph dome, mounted on the case top, is made of Borosilicate glass. The transmission coefficient for this type of glass is approximately 90% for all wave lengths from 0.36 to 2.0 microns (Very little infrared radiation above 2.2 microns appears in solar radiation reaching the earth.) The coefficient drops to 50% at about 3.3 microns and 20% at 40 microns. Ultraviolet cut off is about 0.28 microns.

1.6 The measuring element of the instrument consists of two identical bimetallic strips, one of which is blackened,while the other is highly polished and covered with a shield. The blackened strip is exposed to both the ambient temperature and the radiant energy of the sun, while the shielded strip is exposed to the ambient temperature but shielded from the radiant energy. The two strips are connected in tandem through a long-thermal-path, convector-fin coupling which minimizes the flow of heat between the two strips. Mounting of the measuring element is such that only the differential temperatures of the strips causes the recording pen to move, while the movement of the strips due to ambient temperature change causes no movement of the pen. Thus the warping of the blackened strip due to temperatures rise from radiant energy alone is recorded on a chart covered drum rotated by a clock movement.

## II INSTALLATION

2.1 Unpack the instrument carefully,and inspect it for any damage that might have occurred in shipment. Remove all shiping ties. It is necessary to mount the chart drive and cylinder in position on the base,as these were packed separately to insure safe shipment.

2.2 Wind the chart drive,install the chart,ink the pen,and set the chart to time. (See instruction book 8566) Your Pyrheliograph is now ready for exposure to the sun in the location selected.

2.3 In order to insure uniformity of measurements,all instruments should be exposed to the sun with the same orientation. It is suggested that the window face South in the Northern Hemisphere and North in the Southern Hemisphere.

2.4 Two holes are provided in the base of the instrument to secure it to a wooden mount if exposed for long periods at one location. Caution should be taken not to tighten the mounting screws too much as warpage of the base and erroneous indications could result.

## III OPERATION

3.1 Total Radiation Measurements. The most acceptable method of measuring the total amount of gram-calories per square centimeter from a chart is to measure the area under the inked record. This area is then multiplied by the Chart Constant, whose dimensions are gram-calories per square centimeter per square centimeter of chart.

3.2 The area under the inked record is measured by means of a Polar Planimeter,Dietzen Series 1800,or equal.

3.3 Calculation of Chart Constants.

3.3.1 Chart #5-1050-AW(Weekly):

Chart length = 14.4",equivalent to 192 hours,
Chart width = 3.1",equivalent to 3.3 g-cal/$cm^2$/min

$$\text{Chart constant} = \frac{(60)(192)(3.3)}{(14.4)(3.1)} \text{ g-cal/cm}^2\text{/in}^2$$

$$= 851.61 \text{ g-cal/cm}^2\text{/in}^2 \text{ or Langleys/in}^2$$

$$= 132.00 \text{ g-cal/cm}^2\text{/cm}^2 \text{ or Langleys/cm}^2$$

3.3.2 Chart #5-1050-AD(Daily):

Chart length = 14.4",equivalent to 24 hours,
Chart width = 3.1",equivalent to 3.3 g-cal/$cm^2$/min

$$\text{Chart constant} = \frac{(60)(24)(3.3)}{(14.4)(3.1)} \text{ g-cal/cm}^2\text{/in}^2$$

$$= 106.45 \text{ g-cal/cm}^2\text{/in}^2 \text{ or Langleys/in}^2$$

$$= 16.50 \text{ g-cal/cm}^2\text{/cm}^2 \text{ or Langleys/cm}^2$$

3.4 To find the total amount of gram-calories per centimeter square for any period,(1) use the planimeter and follow the exact path of the inked record during that period,and (2) complete the loop by returning along the time arcs,if necessary, and the zero-line. (See Fig 1,page 4) It is absolutely necessary that the loop be closed completely. This area multiplied by the chart constant will give the total gram-calories per square centimeter for that period.

## IV MAINTENANCE

4.1 Care of the instrument is simple. The glass dome must be kept clean for accurate results. Wiping the dome with a soft, clean cloth at the time a chart is changed will usually suffice.

4.2 The bimetallic strips should not be touched;however,a supply of the black coating is furnished with the instrument in the event the coating on the strips becomes damaged. This solution should be flowed on freely,using a soft brush. It is not necessary to remove the old coatings unless a heavy layer builds up. The old coatings may be washed off with alcohol. No other blackening agent should be used as this will change the characteristics of the instrument.

4.3 No adjustment of calibration should be required unless the instrument has been damaged or disassembled. From time to time, however,the 'zero' may need resetting. Bring the instrument indoors,and allow it to stand for one hour. Normal room lighting is permissable. Set the pen to zero using the screw located just behind the pen arm pivot bracket in the pen arm assembly. Tap the instrument base lightly to stabilize the pen position. Wait one-half hour;if the pen remains at zero,return the instrument to the outdoors;if the pen has moved,repeat the adjustment and the waiting until a stable zero-setting is attained.

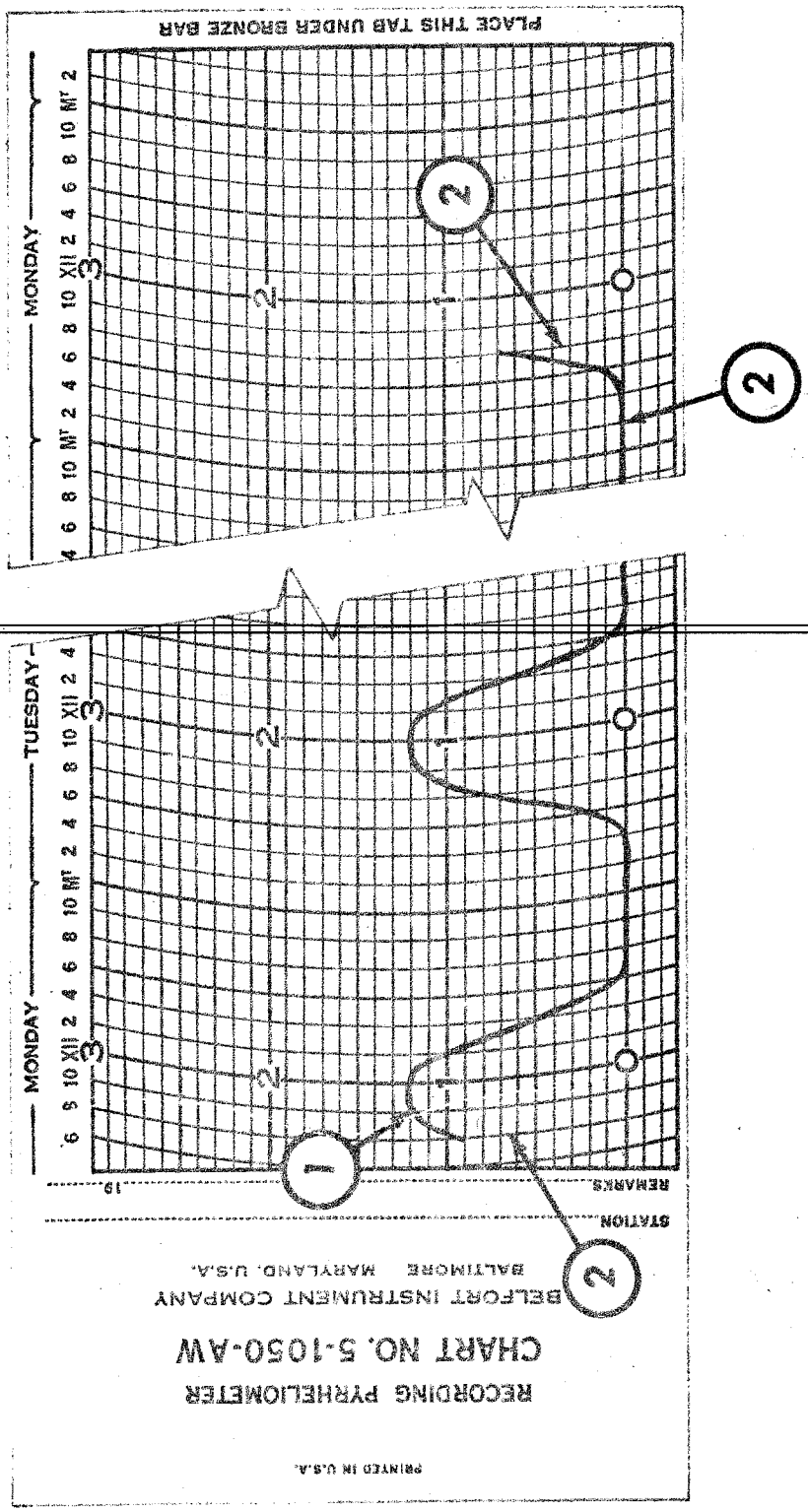


Fig 1 Sample Chart

## V. REPLACEMENT PARTS

| FIG./ITEM | PT. NO. | DESCRIPTION | QTY. |
|---|---|---|---|
| 2-1 | 3039 | Dome | 1 |
| -1 | 9806 | Replacement kit, dome | 1 |
| -2 | 3196 | Window | 1 |
| -3 | 3214 | Case | 1 |
| -4 | 9160 | Pivot; case hinge | 2 |
| -5 | 1016 | Gasket; Base | 1 |
| 2-6 | 3187 | Stud | 1 |
| 3-1 | 3186 | Latch | 1 |
| -2 | 5-1050AD | Chart (Daily 24 Hr.) | 100 (Pkg.) |
| -2 | 5-1050AW | Chart (Weekly-192 Hr.) | 100 (Pkg.) |
| -3 | 8171, Gp.6 | Chart drive assy. | 1 |
| -4 | 11852 | Thermoelement assy. | 1 |
| -5 | 2299-P | Shield, thermoelement | 1 |
| -6 | 2292-S | Thermoelement | 1 |
| -7 | 2295-A | Mounting strip-upper | 1 |
| -7 | 2295-B | Mounting strip-lower | 1 |
| -7 | 2296-A | Mounting strip-upper | 3 |
| -7 | 2296-B | Mounting strip-lower | 1 |
| -8 | 2292-L | Thermoelement | 1 |
| -9 | 2290 | Lever, calibrating | 1 |
| -9 | 16255 | Nut/Counterweight, calibration | 1 |
| -9 | 2286 | Pen arm shaft assy. | 1 |

| FIG./ITEM | PT. NO. | DESCRIPTION | QTY. |
|---|---|---|---|
| 3-10 | 2281-N | Bracket | 1 |
| -11 | 3042 | Base | 1 |
| -12 | 16256 | Pen Assy, recording | 1 |
| -13 | 3040 | Rod, pen shifting | 1 |
| -13 | 3184 | Latch | 1 |
| -13 | 1707-MB | Screw, pen shaft | 1 |
| -14 | 196 | #1-BT Recording pen | 1 |
| -15 | 2298 | Link assy. | 1 |

## CONSUMABLE SUPPLIES

| | | |
|---|---|---|
| 5592,Pt.$\frac{1}{4}$ | Ink, #10-Purple | $\frac{1}{4}$ Oz. |
| 8516 | Coating, Sensing Element | 4 Oz. |

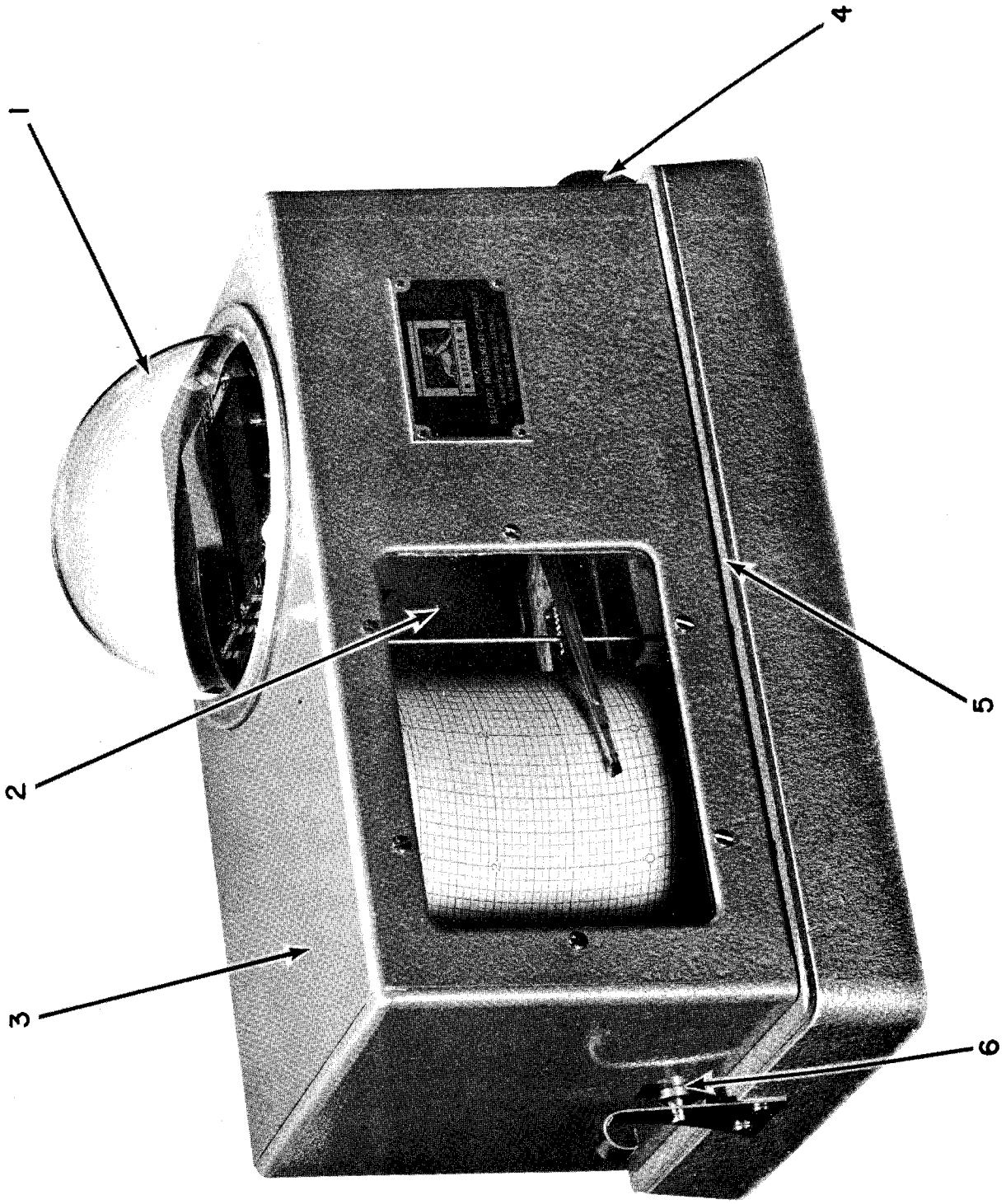


FIGURE 2 PYRHELIOGRAPH

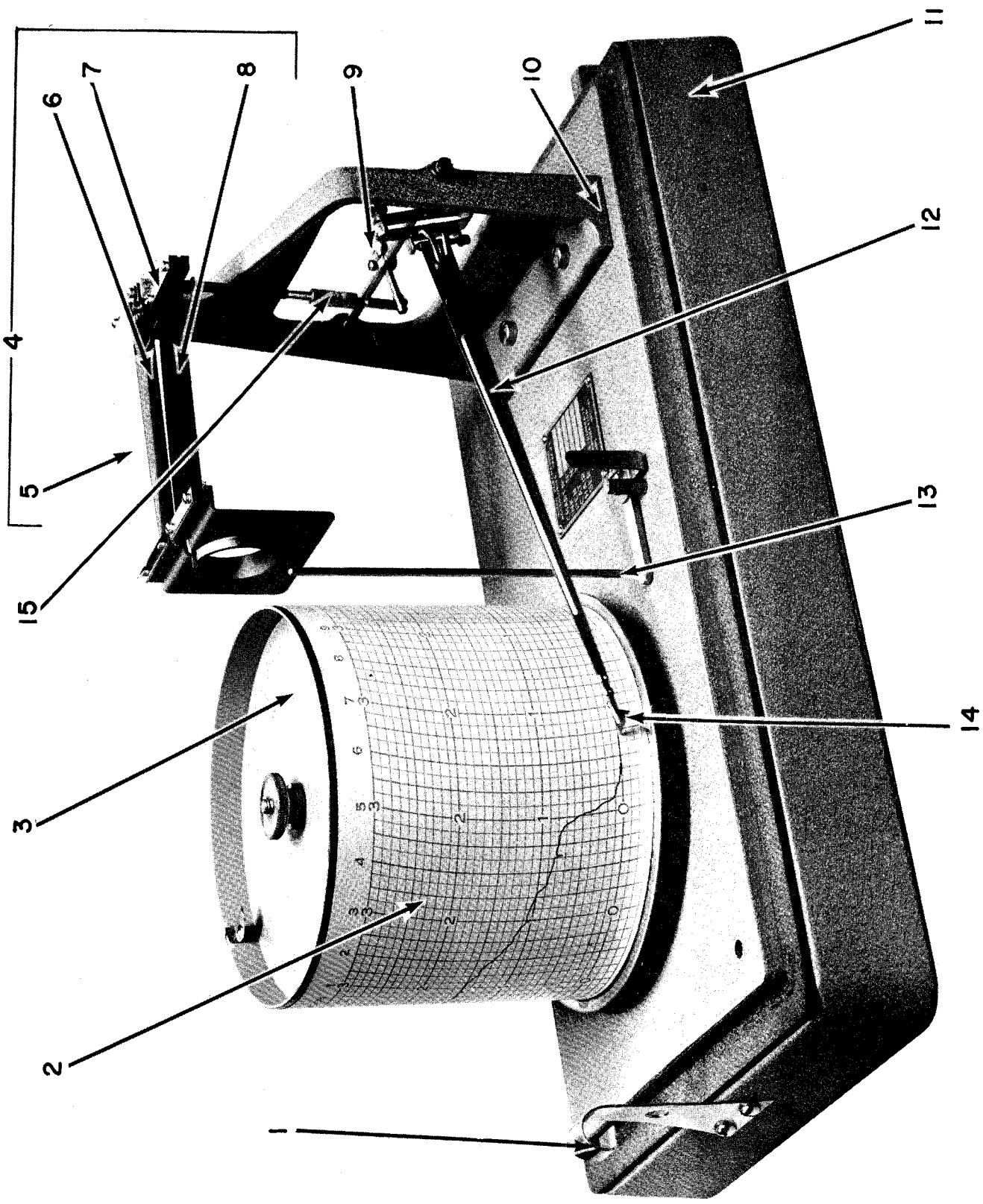


FIGURE 3 PYRHELIOGRAPH-OPEN

# INSTRUCTIONS FOR
# CHART DRIVE ASSEMBLIES
# AND
# LOW-CAPACITY PENS AND INKS

SEPTEMBER 1978

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BOOK NO 12049

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LIST OF ILLUSTRATIONS

## I INTRODUCTION & DESCRIPTION

1-1. DESCRIPTION. The Belfort Instrument Company chart drive mechanism is spring wound and employs a jewelled escapement clock movement to rotate a vertical cylinder on a fixed spindle attached to the upper movement plate. This arrangement minimizes the danger of damaging the movement during shipment and routine service operations. The cylinder carries a rectangular chart wrapped around the outer surface and held in place by a spring clip. The mechanism drives the cylinder through an external gear and pinion. The mechanism is wound by means of a ratchet winding lever.

1-2. CHART CYLINDER. The chart cylinder has a hollow central support that forms the bearing on which it rotates. The drive gear is friction fitted to the lower end of this tube. When the mechanism is to be wound or the chart changed, the cylinder is removed from the mechanism spindle by lifting it straight up.

1-3. A knurled thumbnut at the top of the mechanism spindle is provided to retain the cylinder in place. This thumbnut must be removed before the cylinder can be separated from the mechanism proper.

1-4. A special chart drive design (Fig.2) is provided for applications where it is necessary to make records under conditions such as those encountered on ships at sea. The cylinder of these chart drives are mounted on a rotating central spindle. The cylinder driving gears remain in mesh when the cylinder is removed. A key is provided to prevent any slip in the drive.

1-5. When the chart cylinder is replaced, lower it gently straight down. On all mechanisms except the one mentioned in the previous paragraph, the drive gears must be meshed as the cylinder is lowered into operating position. Never drop the cylinder or try to force it into place. Simply rotate the cylinder slightly as the gears make contact and they will slide into mesh easily.

## II MOUNTING

2-1. Two basic methods are used to secure the chart drive mechanism to the base of the recorder with which it is associated.

2-2. The method most often used is to mount the mechanism by means of a threaded stud extending from the lower side of the movement opposite the cylinder spindle.

2-3. Where access to the bottom of the instrument base is possible, the machine is mounted to the base by passing the stud through a plain hole in the base and securing the mechanism with a wing nut.

2-4. Where access to the bottom of the base is difficult, the stud is screwed into a threaded hole in the base by rotation the entire mechanism. The stud itself is clamped to the bottom of the mechanism. If the winding lever falls into an inconvenient location when the mechanism stud is properly tightened into the threaded hole in the base, remove the mechanism, loosen the clamp screws in the stud flange and rotate the stud to put the winding lever in the desired position. Tighten the stud flange screws before replacing the mechanism.

2-5. The second means of mounting employs a flange at the base of the mechanism. This flange is secured to the instrument base by machine screws.

2-6. WINDING. The chart drive mechanism is wound by operating the winding lever back and forth. In order to gain access to the lever the chart cylinder must be removed. DO NOT OVERWIND - STOP WINDING AS SOON AS THE SOLID RESISTANCE OF THE MAINSPRING IS FELT. The spring can be fully wound with twenty-four ninety-degree strokes of the winding lever. After the winding operating is complete, push the free end of the lever back toward the center spindle of the mechanism as far as it will go. This locks the lever in a position that prevents any interference with the chart cylinder.

2-7. Note that these mechanisms are "eight-day" and will run a full week on one winding. The use of "daily" charts does not alter the winding schedule.

208. MOUNTING THE CHART. To apply a chart to the chart drum, wrap the chart around the cylinder so that time reads from left to right and make sure that the lower edge of the chart rests squarely on the flange at the bottom of the cylinder. While holding the chart snugly in place, slide the metal chart retainer into the slot in the chart drum flange, and into the recess in the upper rim. Be sure to start the wrap so that the beginning of the chart is at the right hand side of the flange slot and the chart will then overlap the identification tab, and end with the narrow right hand margin immediately under the clip.

2-9. SETTING THE TIME. To set the recorder to time rotate the chart cylinder clockwise by hand until the desired time line is a little to the left of the pen, then counterclockwise to the proper time setting. Always make the final time setting by turning the cylinder counterclockwise as this removes the effect of any backlash in the drive gearing.

2-10. MAINTENANCE. The maintenance required by the chart drive assembly depends mainly on environment. The chart drive of a recorder used in a clean, sheltered location requires no more attention than a clock used for timekeeping. On the other hand many recorder chart drives are subjected to extreme environments and will require complete annual overhaul.

2-11. The chart drive should always be given a casual inspection each time it is wound so that incipient trouble can be taken care of before it becomes serious. The appearance of rust, accumulations of gummy dirt, or a growing tendency toward unusual stiffness in winding, weak sound, and erratic behavior are all indications that the mechanism requires a more thorough inspection and possible overhaul.

2-12. Do not attempt to oil the chart drive in a random fashion. Too much oil will cause gumming that can finally stop the mechanism. A very thin film of light oil or vaseline on the center spindle if wiped and replaced occasionally helps to keep this member clean and rust-free. Sparse lubrication on the face of the boss in which the spindle is set is desirable.

2-13. When the mechanism requires a complete overhaul, the work should be intrusted to a competent clock or watch repairman that thoroughly understands lever escapements. In mild climates, Belfort Instrument Co. #5660 oil is satisfactory, and customary clock lubrication practice is acceptable for normal use. Where the chart drive is to be run in quite low temperatures (zero and below), special lubrication is required. The oil should be removed from the mainspring barrel, and it should be relubricated with fine, powered graphite or molybdenum di-sulphide (molykote). The mechanism gear train must be lubricated with Belfort Instrument Co. #5586 Oil, this oil will not congeal at low temperatures but will attack paints and lacquers, however, and must be used sparingly and never allowed to come in contact with paint or lacquered surfaces.

2-14. TIMING. The mechanisms are timed before shipment but if regulation is required, access to the regulator may be had by removing the mechanism from the instrument base and then removing the screw plug in the mechanism base. The regulator is marked in the usual fashion. If the movement is timed by machine, the escapement must be timed 9 seconds per hour (45 beats per hour) fast; this is necessary to accomodate the various time scales.

2-15. TIME-SCALE GEARS. As explained above, the chart cylinder is driven through a pair of gears external to the mechanism train proper. There are two shaft entensions above the upper plate. These are plainly marked. Gears are available for any of the advertised rotation rates.

2-16. When the cylinder rotation is to be changed the gears in place are removed. Pull the gear off the cylinder support tube. This is purposely made a tight fit compared to the driving pinion. Before the pinion can be removed, the .020" X 3/8" lg. phosphor bronze wire and the washer in the end of the shaft are first removed. After the wire and washer are removed, the pinion can be pulled off the shaft. The replacement gears are pushed on in their appropriate locations and the wire and washer in the pinion shaft replaced. CAUTION: In pressing the gear on the cylinder support tube the bearing must be supported so that no pressure is extended on the edge of the cylinder wall. The cental gear should fit tight enough so that it will not slip. The friction at the pinion hub must be enough to drive the chart drive cylinder but not so great that the mechanism is hard to set to time; this friction between the pinion and its shaft is the setting friction.

2-17. Time scale gears are marked with the number of hours per revolution of the cylinder followed by the letter "S". As there have been many styles of movements used in the past, this "S" designation is important in specifying gearing for this style movement.

2-18. The mechanism shaft extensions are plainly marked on the movement case to designate the proper location of the gear that will product the desired time scale.

2-19 Available Time-Scale Gearing.

| Recording Period Hrs/Rev | Mechanism Pinion | | | Cylinder Gear | | |
|---|---|---|---|---|---|---|
| | Part No | Marked | No of Teeth | Part No | Marked | No of Teeth |
| Fig 1 Chart Drive Assy - Stationary Service | | | | | | |
| 6 | 5573-6 | 6S | 56 | 5572-6 | 6S | 49 |
| 8 | -8 | 8S | 44 | -8 | 8S | 51 |
| 12 | -12 | 12S | 40 | -12 | 12S | 70 |
| 24 | -24 | 24S | 20 | -24 | 24S | 70 |
| 29 | -29 | 29S | 20 | -29 | 29S | 85 |
| 48 | 5574-48 | 48S | 52 | -48 | 48S | 56 |
| 96 | -96 | 96S | 26 | -96 | 96S | 56 |
| 108 | -108 | 108S | 33 | -108 | 108S | 80 |
| 144 | -144 | 144S | 23 | -144 | 144S | 74 |
| 176 | -176 | 176S | 24 | -176 | 176S | 95 |
| 192 | -192 | 192S | 20 | -192 | 192S | 86 |
| 195 | -195 | 195S | 19 | -195 | 195S | 83 |
| Fig 2 Chart Drive Assy - Non-stationary Service | | | | | | |
| 12 | 5573-12 | 12S | 40 | 6848-12 | 12S | 70 |
| 24 | -24 | 24S | 20 | -24 | 24S | 70 |
| 29 | -29 | 29S | 20 | -29 | 29S | 85 |
| 96 | 5574-96 | 96S | 26 | -96 | 96S | 56 |
| 108 | -108 | 108S | 33 | -108 | 108S | 80 |
| 144 | -144 | 144S | 23 | -144 | 144S | 74 |
| 176 | -176 | 176S | 24 | -176 | 176S | 95 |
| 192 | -192 | 192S | 20 | -192 | 192S | 86 |
| 195 | -195 | 195S | 19 | -195 | 195S | 83 |

2-20. There are many styles of charts available for our instruments. The proper chart for any one instrument is listed on the instrument nameplate. Please apply to the factory for information regarding alternate or special charts.

2-21. REPLACEMENT PARTS

| ILLUS. | DESCRIPTION | SERIAL NO. PLAIN | SERIAL NO. "B" PREFIX |
|---|---|---|---|
| Fig. 1 | Chart Drive Assembly; stationary service (with time scale gears; please specify period desired) | 8171 | 14252 |
| -1 | Chart Drive Mechanism; stud mounted (without time scale pinion) | 5418 | 14235,GP.1 |
| -2 | Chart cylinder with clip stationary service (without time scale gear) | 8584 (see Note 1) | 8584 (see Note 1) |
| -3 | Key Assembly | 8581 | 8581 |
| -4 | Chart Drive Movement (includes spindle and thumbnut but no time scale pinion) | SPECIFY SERIAL NO. | |
| -5 | Cover | 5731,Pt.1 | 5731,Pt.1 |
| -6 | Bottom plate with stud | 5406 | 5406 |
| -7 | Wing nut | 2199 | 2199 |
| -8 | Plug regulator access | 5386 | 5386 |
| -9 | Thumbnut | 2088 | 2088 |
| -10 | Chart cylinder (3.658 OD) | 8569 (see Note 1) | 8569 (see Note 1) |
| -10 | Chart cylinder (4.575 OD) | 2969 (see Note 1) | 2969 (see Note 1) |
| -11 | Chart clip | 8570 (see Note 1) | 8570 (see Note 1) |
| -12 | Time scale gears | 5572 (see Note 2) | 5572 (see Note 2) |
| -13 | Time scale pinion, low range | 5573 (see Note 2) | 5573 (see Note 2) |
| -14 | Time scale pinion, high range | 5574 (see Note 2) | 5574 (see Note 2) |
| -15 | Flat washer | 6907 | 6907 |
| -15 | .025" dia. x 3/8" lg. soft copper wire | ---- | ---- |

| ILLUS. | DESCRIPTION | SERIAL NO. PLAIN | SERIAL NO. "B" PREFIX |
|---|---|---|---|
| --- | Escapement | SPECIFY MOVEMENT SERIAL NO. | |
| --- | Spring barrel assembly | SPECIFY MOVEMENT SERIAL NO. | |
| Fig. 2 | Chart drive assembly; non-stationary service (with time scale gears: please specify period desired) | 8952 | 14400 |
| -1 | Chart drive mechanism; flange mounted (without time scale pinion) | 6905 | 11435 GP.2 |
| -2 | Chart cylinder with clip; non-stationary service | 6045 (see Note 1) | 6045 (see Note 1) |
| -3 | Key assembly | 8581 | 8581 |
| -4 | Chart drive movement (includes spindle but no thumbnut, time scale pinion, or gear assembly) | SPECIFY SERIAL NO. | |
| -5 | Cover | 5731,PT.2 | 5731,PT.2 |
| -6 | Bottom plate | 8855 | 8855 |
| -7 | Mounting plate | 6835 | 6835 |
| -8 | Plug, regulator access | 5386 | 5386 |
| -9 | Thumbnut | 6273 | 6273 |
| -10 | Chart cylinder | 7013 (see Note 1) | 7013 (see Note 1) |
| -11 | Chart Clip | 8570 (see Note 1) | 8570 (see Note 1) |
| -12 | Retaining ring | 6047,PT.5 | 6047,PT.5 |
| -13 | Anti-backlash gear assembly | 6848 (see Note 2) | 6848 (see Note 2) |

| ILLUS. | DESCRIPTION | SERIAL NO. PLAIN | SERIAL NO. "B" PREFIX |
|---|---|---|---|
| -14 | Time scale pinion; low range | 5573 (see Note 2) | 5573 (see Note 2) |
| -15 | Time scale pinion; high range | 5574 | 5574 |
| -16 | Flat washer | 6907 | 6907 |
| -16 | .025" dia. x 3/8" lg. soft copper wire | ---- | ---- |
| --- | Escapement | SPECIFY MOVEMENT SERIAL NO. | |
| --- | Spring barrel assembly | SPECIFY MOVEMENT SERIAL NO. | |

SPARES

| | | | |
|---|---|---|---|
| --- | Lubricating oil; general purpose (2 oz.) | 5600,PT.2 | 5600,PT.2 |
| --- | Lubricating oil; special purpose (2 oz.) | 5586,PT.2 | 5586,PT.2 |

NOTES:

1- This item is manufactured in various sizes, which are identified by a Pt. or Gp. number appended to the basic number shown; see the Instruction Book of the corresponding instrument for complete Part No.

2- This item is manufactured in various sizes to give different recording periods; these sizes are identified by a Pt. number appended to the basic number shown, see table in Par. 2-19. for c omplete Part No.

16878

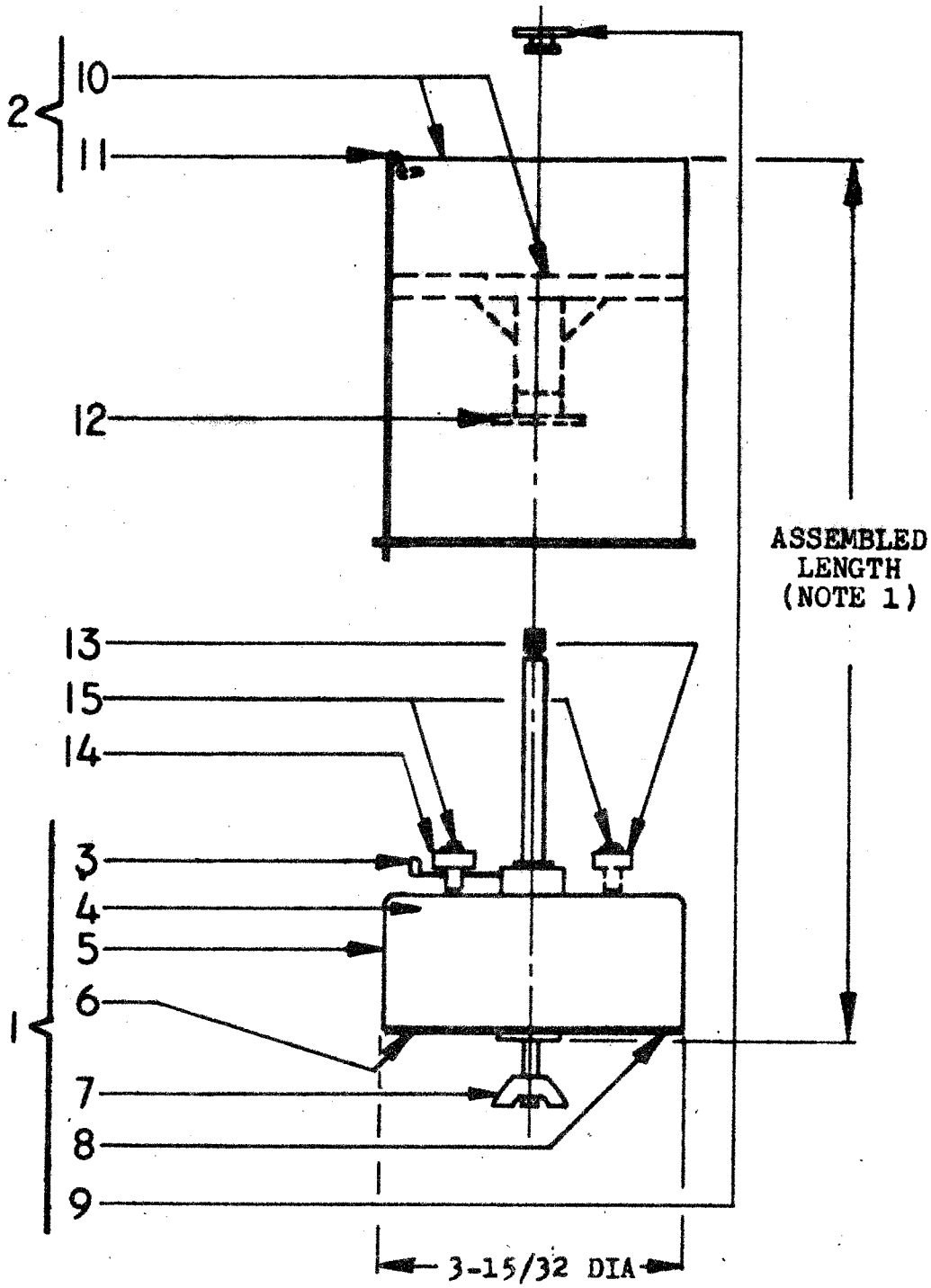


Fig 1 Chart Drive Assembly - Stationary Service

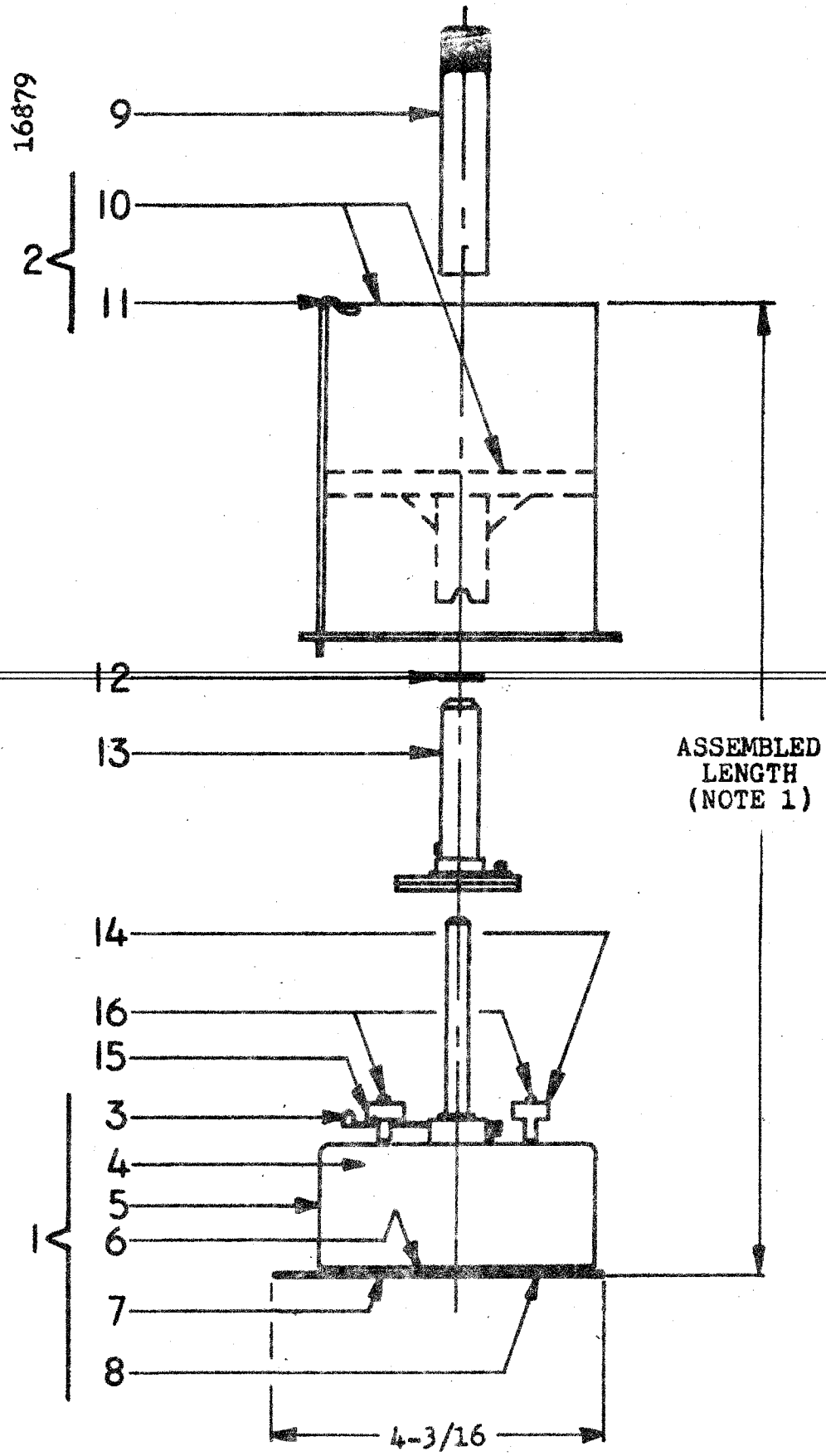


Fig 2 Chart Drive Assembly - Non-stationary Service

## III PENS AND INKS

3-1. DESCRIPTION. All of Belfort Instrument Company Recorders except those requiring heavy ink supplies, use low capacity pens that consist of two parallel nibs supplied by a small cylindrical reservoir. There are three types: 196 (#1-BT), 298 (#5-2RG), and 559 (#3-LS). These are friction fitted to the end of the pen arm of the instrument proper.

3-2. These pens are capable of drawing a fine, neat trace and perform well if given moderate care. Like all pens, cleanliness and proper inking procedure are the keys to sucessful operation.

3-3. There are three types of ink for use in these pens: No.5592 (#10) No.5593 (#20) and No.5595 (#50). No. 5592 is recommended for general use, where ambient temperatures are above $0^{o}F$; No. 5593 should be used for colder temperatures, down to $-60^{o}F$; and No. 5595 for extremely cold temperatures, down to $-80^{o}F$. Nos. 5593 and 5595 will not serve as well as No. 5592 at elevated temperatures. No. 5592 is available in purple, red, green, and black colors; No. 5593 and No. 5595 are available in purple color only. Ink is furnished in glass bottles, 1/2, 1, 4, 8 and 16 fluid ounce capacity.

3-4. INKING THE PEN. The 1/2 oz. bottle is furnished with an applicator fixed in the stopper. When the stopper is removed from the bottle a charge of ink clings to the applicator. The stopper should be withdrawn smartly. If it is withdrawn slowly, the ink on the applicator will drain away into the body of ink in the bottle. The 1 ounce bottle is furnished with an eye dropper; no applicator is furnished with the larger size bottles.

3-5. Normally all that is required to ink a pen is to touch the loaded applicator to open end of the barrel of the pen at the point where the nibs leave the barrel.

3-6. The ink dries slowly and only a drop or two is required for quite long periods of operation. The time between fillings depends on environment. The ink is hygroscopic and where high humidity is encountered, often seems to increase in quantity and an overfilled pen may overflow. Dilution of this sort can finally cause a faint trace; in such a case the old ink in the pen should be removed with a piece of blotting paper, and replaced with fresh ink. Under dry conditions, the pen carries sufficient ink to outlast the periods between the times the clock must be rewound.

3-7. With a new pen; it may be necessary to coax ink into the interior of the barrel until it becomes wetted. In addition, it is usually necessary to draw a piece of paper down between the nibs to start the pen writing for the first time. Use a piece of bond paper with cut edges. A fiber of paper caught between the nibs will make a blurred line.

3-8. When inking our pens avoid getting ink into the space between the pen arm and pen. Such misplaced ink finally dries and besides being unsightly, causes the pen to be bound to the pen arm tip which makes it difficult to remove if the pen ever needs to be washed.

3-9. When a pen is in constant use and is carefully inked, very little attention is required. If the pen becomes clogged for any reason, it should be removed from the pen arm and washed in warm water. Remove the pen by pulling it straight off the pen arm. The pen is replaced by pushing it straight on after cleaning. Use care to avoid distorting the pen or pen arm during this operation. Do not bend the pen nibs or force them open during the cleaning procedures. The bond paper strip, mentioned above pulled down between the nibs will draw the water into this space and wipe out old ink or dye.

## IV OPERATION METHODS

4-1. When pens are being inked or charts changed and set to time, the pen arm shifter on the instrument should always be put in the position that holds the pen away from the chart. This prevents possible damage to the pen by hooking the chart cylinder flange as the cylinder is removed or replaced, and also prevents unwanted marks on the chart.

4-2. After the chart cylinder is set to the desired time, lower the pen to the chart surface by pushing the pen arm shifter in as far as it will go.

4-3. When the charts are replaced it is normally found that the very latest portion of the record has not had time to dry out. The cylinder should be removed carefully and the chart handled in such a manner as to avoid smearing this portion of the record.

JULY 1978

# INSTRUCTIONS FOR UNIVERSAL CHART DRIVE

## (BATTERY POWERED)

## BELFORT PL-15605

DESCRIPTION - The Belfort universal chart drive is battery operated, and provides cylinder rotations ranging from 6 hours per revolution to 861 hours (35.9 days) per revolution. A quartz crystal controlled oscillator is incorporated in a circuit driving a stepper motor at a precise rate. Chart drives equipped with this crystal controlled movement start with Serial No. E2000. An appropriate gear train containing 3 output shafts, permits the customer to choose 14 different chart speeds, covering the complete range of meteorological drum charts.

CHART CYLINDER - The chart cylinder is removed from the drive mechanism by first removing the knurled thumbnut and raising the cylinder straight up. The chart is wrapped around the outer surface of the cylinder and held in place with a spring clip.

POWER REQUIREMENTS - The chart drive is designed to operate from two 1½ volt Zinc-Carbon, or Alkaline-Manganese Dioxide C size cells. The following table will shown how the type of cell and temperature will effect the service life of the cell. The service life shown in the table is very conservative. Factory fresh cells should give double the life shown in the table.

Service Life in Months

| Temperature | -40°F | +40°F to 100°F | 125°F |
|---|---|---|---|
| Zinc-Carbon | Do not use | 4 months | Do not use |
| Alkaline-Manganese dioxide * | 3 months | 6 months | 3 months |

MOUNTING - The mechanism is mounted to the base of the instruments by means of the threaded stud extending from the lower side of the movement opposite the cylinder spindle. The washer supplied (#10) is placed under the wing nut.

STARTING - The chart drive will start upon insertion of the cells. A window has been provided in the mechanism cover. With care, the gears can be observed through this window, stepping along, indicating to the operator that the chart drive is operating.

* Available as Mallory "Duracel" or Eveready "Alkaline Energizer".

REPLACING CHART CYLINDER - When the chart cylinder is replaced lower it gently, straight down. The drive gears must be meshed as the cylinder is lowered into operating position. Never drop the cylinder or try to force it into place. Simply rotate the cylinder slightly as the gears make contact and they will slide into mesh easily.

SETTING THE TIME - To set the recorder to time rotate the chart cylinder clockwise by hand until the desired time line is a little to the left of the pen, then counterclockwise to the proper time setting. Always make the final time setting by turning the cylinder counterclockwise as this removes the effect of any backlash in the drive gearing.

TIME SCALE GEARS - The chart cylinder is driven through a pair of gears external to the mechanism train proper. There are three shaft extensions above the upper plate. Each of the shafts indicate the number of the gear which it will accept. The number of the gear indicates the number of hours required for the cylinder to make one revolution.

The following table indicates the time scale gears available for the electric chart drive.

| Recording Period Hours | Pinion in Mechanism | | | Gear in Cylinder | | |
|---|---|---|---|---|---|---|
| | Part No. | Marked | No. of teeth | Part No. | Marked | No. of teeth |
| 6 | 5573-6 | 6S | 56 | 5572-6 | 6S | 49 |
| 8 | -8 | 8S | 44 | -8 | 8S | 51 |
| 12 | -12 | 12S | 40 | -12 | 12S | 70 |
| 24 | -24 | 24S | 20 | -24 | 24S | 70 |
| 29 | -29 | 29S | 20 | -29 | 29S | 85 |
| 48 | 5574-48 | 48S | 52 | -48 | 48S | 56 |
| 96 | -96 | 96S | 26 | -96 | 96S | 56 |
| 108 | -108 | 108S | 33 | -108 | 108S | 80 |
| 144 | -144 | 144S | 23 | -144 | 144S | 74 |
| 168 | 7004-168 | 168 | 18 | 7005-168 | 168S | 68 |
| 176 | 5574-176 | 176S | 24 | -176 | 176S | 95 |
| 192 | -192 | 192S | 20 | 5572-192 | 192S | 86 |
| 195 | -195 | 195S | 19 | -195 | 195S | 83 |
| 861 | -861 | 861S | 24 | -861 | 861S | 95 |