

CHAPTER 6 - THE FIRE-FINDER

The fire-finder is the key piece of equipment for the lookout-man, and is essentially a sighting device mounted on a stand in the centre of his lookout building. Two types of fire-finders are used in the Forest Service, the standard B.C.F.S. fire-finder and the Osborne fire-finder, which has almost been phased out.

I. THE BRITISH COLUMBIA FOREST SERVICE FIRE-FINDER

1. Description of the B.C.F.S. Fire-Finder

There are four main parts; the lower plate, the upper plate, the map plate, and the sighting assembly. The drawing in Appendix IV should be used in conjunction with the following description and procedures to ensure familiarity with this instrument.

Lower Plate - The lower plate is approximately 25 inches in diameter. It is the base for the instrument. Original models had the lower plate secured to the top of the wooden stand through four bolt-holes but in later models the plate is secured by four clamps fastened to the top of the stand, permitting easier orienting adjustments. At the lower edge it has a setscrew designed to lock the map plate in position.

Upper Plate - This is a revolving circular part with an inner projecting circle designed to fit outside the circular collar of the lower plate, and bearing on it.

On top are found four bolt-holes through which the sighting assembly is bolted into position. On the opposite side of the rim are two small holes through which is bolted the outer fixture holding the lining tape.

Map Plate - This is the circular plate on which the base map is mounted. Underneath, a $1\frac{1}{2}$ -inch deep collar is designed to fit inside the inner circle of the upper plate, where it is free to revolve until locked into the desired position by the setscrew. A very small aperture is located in the dead centre of the plate to pin-point the lookout station when mounting the base map.

The perimeter of the map plate fits snugly to the inner edge of the upper plate, but permitting free movement. On later models, four rubber studs are positioned on springs attached to the lower plate, to provide tension to the map plate and the sighting assembly.

Sighting Assembly - Mounted on a semi-circular frame, the sighting assembly is bolted to the upper plate. A fixture is centred on the straight edge of the frame, designed to take the inner end of the lining tape.

Sighting Assembly, cont'd. - The sighting unit is a 22-inch arm with a fixed rear peepsight and cross-hair foresight. On the upper surface a spirit level is mounted. Below the arm is a vertical angle scale, graduated to show plus or minus readings when the sighting arm line of sight, controlled by means of the larger knurled nut, is raised or lowered about the horizontal. The smaller knurled nut is used to zero the pointer on the vertical scale when required.

Azimuth (horizontal angle) sightings are taken by swinging the whole assembly to sight on the target, and reading off the bearing at the marker.

Where a line of sight may be obstructed by a window frame or corner, the whole assembly can be moved sideways on the two chrome bars in order to obtain a clear line-of-sight.

The sighting assembly should not be taken apart from the frame. If necessary to change the map on the map plate, the whole sighting assembly should be taken off the upper plate.

The lining tape tension is adjusted by means of the top screw on the outer fixture, secured by the small setscrew.

2. Setting up the B.C.F.S. Fire-Finder

The Stand - The container in which the fire-finder is shipped forms the stand on which it is mounted, positioned according to the stencilled directions. The bottom shelf is removable, permitting the stand to be securely fastened to the floor through the 2" by 2" framing pieces.

Level the stand, using a spirit level, and shim the corners as required, firmly securing the stand when completed. At the start of each season, the stand should be re-checked, and shimmed as necessary.

Securing the Fire-Finder Base - Remove the upper portion of the fire-finder from the lower plate. Centre the lower plate on the stand, and secure it by the four hold-down clamps or the four bolts (depending on model).

Preparation of the Base Map - Before assembling the instrument ensure that the North line has been drawn on the base map from the exact lookout location to the north edge of the map. This step should have been done earlier at the Ranger Station, and involves the following procedure:

- (a) The map location of the lookout site is accurately determined, and a pin-prick made through the map at this point.
- (b) A thin red line is then drawn due north from the pin-prick to the edge of the map. If it is drawn parallel to the nearest meridian line it will give a close approximation

Prepar

Orientin

ro
on
lo
lo
th
in
In
rin
in
sid
sid
Pos
the
the
fir
to

Preparation of the Base Map, cont'd.

(b) cont'd.

to true north at this scale. However, for true accuracy, allowance should be made for convergence of the meridians, i.e., the line should be the same proportionate distance between the two enclosing meridians along its length.

(c) A circle of 10-inch radius (corresponding with the map plate) is drawn on the map with the pin-prick as centre, and the map trimmed accordingly. At this stage, three concentric circles should be drawn on the map at $2\frac{1}{2}$, 5, and $7\frac{1}{2}$ -inch radii to facilitate later measurement of distances.

(d) Positioning the pin-prick on the map with the small hole in the centre of the map plate, the map is glued to the map plate.

(e) The 1/8-inch protective plexiglass map cover is positioned on the map plate, and the location of each mounting hole marked on the map. The map plate is then drilled with a 3/16" bit to make drill holes to accommodate the three mounting posts. The plexiglass cover is then positioned and secured with the three Chicago posts supplied. The map plate is then positioned in the fire-finder and revolved to ensure that there is no binding, in which case slight filing of the posts on the undersurface of the map plate may be required.

(f) The 2-Mile = 1 Inch Provincial Topographic Series is the recommended map but as this series is not available yet in all areas, other map series will be used.

Orienting the Map Plate to the Azimuth Ring - To orient the map plate, rotate it until the red north line on the map exactly cuts 180° on the graduated azimuth circle. Secure the map plate to the lower plate in this position, by means of the setscrew in the lower plate. (This apparent 180° anomaly is due to the fact that the azimuth marker is located at the eyepiece end of the sighting assembly, for convenience of direct reading of bearing lines. In order to accommodate this convenience the lower plate azimuth ring itself has to be rotated through 180° before being secured in its fixed position. Therefore, 360° will be at the south side of the instrument, 90° at the west side, 180° at the north side, 270° at the east side.)

Position and bolt the sighting assembly to the frame. Rotate the sighting assembly until the lining tape lies directly over the red north line. The azimuth marker should read 360° , confirming that the map plate is correctly positioned in relation to the graduated azimuth circle.

Levelling the Fire-Finder

- (a) The initial step is the levelling of the fire-finder stand, using shims where necessary, as described earlier.
- (b) The final levelling is done by placing a small spirit level on the base plate and adjusting the levelling studs (applicable on the clamp models). This should be checked at several points on the circumference.

Orienting the Fire-Finder - The fire-finder has now been completely assembled. The final orienting procedure is as follows:

- (a) Loosen the top screw on each of the four clamps so that the *entire fire-finder* can be rotated.
- (b) Select an easily-spotted reference point from one of the lookout photographs.
- (c) Set the azimuth marker on the exact bearing of the reference point.
- (d) Swing the entire fire-finder and using the sight, aim exactly on the reference point chosen.
- (e) Tighten down two opposite clamps.
- (f) Sight on another reference point approximately at right angles to the first. Check that the azimuth marker bearing exactly coincides with that on the lookout photograph. If it does not, repeat the entire procedure.
- (g) When the above tests check out accurately, secure the remaining two clamps.
- (h) Re-check using other reference points in all quadrants and check the sightings against the azimuth marker readings. Also check again with the spirit level around the circumference of the base. If they all check out accurately, the fire-finder is now "oriented" to the surrounding topography.

Checking the Level Bubble - The bubble on the sighting arm must be tested before vertical angles can be checked on the instrument, as follows:

- (a) Select a suitable point on one of the lookout photographs exactly on the zero line of the vertical scale, and readily identifiable from the lookout. Sight exactly on this point.
- (b) Check that the bubble is centred. If not, make the required adjustments with the bubble adjusting screw until the bubble is centred.

Seasonal and Periodic Instrument Checks - The above described instrument checks should be run through each spring, after the lookout cabin has been readied for the season, and adjustments made to the instrument as needed. It cannot be overemphasized that the fire-finder must be "zeroed" in each spring and remain "zeroed" for the remainder of the summer. Periodic checks during the lookout season are necessary, especially after severe wind storms or other causes that result in vibrations to the building.

Sighting Procedures when Instrument Levelling is not Possible - If the fire-finder cannot be levelled because of a springy floor, or for other reasons, special procedures must be used on each individual fire to obtain accurate vertical angles. These are:

- (a) Lay the vertical hair in the foresight through the base of the fire.
- (b) Level the sighting arm by centering the bubble with the larger knurled knob on the side.
- (c) Bring the vertical angle pointer to zero with the small knurled knob under the eyepiece.
- (d) Lay the horizontal hair on the base of the fire, and read the vertical angle.

(Note that this procedure would have to be repeated with each fire.)

II. THE OSBORNE FIRE-FINDER

1. Description of the Osborne Fire-Finder

The Osborne fire-finder differs in some respects from our B.C. F.S. instrument, and is described below.

Base - The instrument sits on a heavy wooden base which is screwed to the top of the stand. Three tubular steel tracks are attached to the base, the instrument riding on two of these. These tracks must be parallel to one side of the room.

Lower Plate - Grooved guides on the lower plate fit on the two steel tracks, and hold the unit in position. Four levelling setscrews, passing through the lower plate, rest directly on the tracks. The instrument may be lifted sideways to fit on any two of the three tracks, or slid along the tracks, to avoid any sighting obstructions such as corners of buildings, etc.

Upper Plate - This plate is secured to the lower plate by setscrews, after being oriented. The graduated azimuth circle is located on the upper plate.

Map Plate - This plate is fastened to a raised central part of the upper plate by means of flat-headed screws. The map is positioned by loosening the screws and turning the plate to coincide the red north/south line with 180° , then retightening the screws.

Sighting Ring - This revolves on the upper plate, and has the front and back sights attached to it, with a steel lining tape held rigidly between the two sights.

The front sight has a long vertical hair line and two short horizontal cross-hairs, one above the other. The rear sight has a vertical slot with a sliding peepsight for reading vertical angles.

A vernier marker on the azimuth circle is used for reading horizontal angles.

2. Setting up the Osborne Fire-Finder

The principles are the same as with the B.C.F.S. fire-finder. With the top of the stand level, the base is screwed on and the unit placed on the tracks. The unit is then levelled with the setscrew bolts, then tightened in position with the lock nuts. Map positioning and orientation of the fire-finder are the same as described previously, with an additional check that the long vertical hair in the foresight is plumb.

The basic difference from the B.C.F.S. fire-finder is in the taking of vertical angle sightings. Vertical sightings *below the horizontal* use the lower horizontal hair on the foresight and the right-hand (minus) scale beside the vertical slot in the rear sight. Sightings *above the horizontal* use the upper horizontal hair and the left-hand (plus) scale.

Using

1. Re
fu
wit

2. Pla

CHAPTER 7 - LOCATING FIRES

We use two chief means of locating fires: the fire-finder and the lookout photographs. Each complements or supports the other, providing a check against each, and both should be used. In addition, knowledge of the surrounding country and ability in reading topographic maps are supplementary skills to be developed as part of the fire location process.

The fire-finder is the principal means used in fire location, and the techniques are described in some detail in this chapter. The lookout photographs can be described much more briefly, and will therefore be dealt with first.

I. LOCATING FIRES BY LOOKOUT PHOTOGRAPHS

Lookout photographs are taken with a special camera mounted on a surveying transit base, oriented to astronomic north, and accurately levelled. Eight photographs are taken around the azimuth, centred on the cardinal directions, with a five degree overlap on the ends of each photograph. "Azimuth" is the horizontal angle measured clockwise from North; e.g., due East is 90° , South is 180° , West is 270° , and North is 360° or zero. A "reference point" within each photograph is lined up in the transit sight and an accurate bearing recorded. This reference point in each photograph will be a readily-discernable feature, such as a sharp mountain peak. Later, in the photographic printing process, the white horizontal and vertical angle grid is superimposed on the photograph.

After printing, the actual numerical values for the horizontal scale are then tied in and entered on each photograph. The eight photographs are bound in a booklet, and a transparent plastic grid overlay supplied for reading the angles in the central part of the photographs.

Both the Ranger and the lookout are supplied with exact copies of the lookout photograph booklet, which is a very useful tool for the following reasons:

- (a) To help a new man learn the country.
- (b) To orient the fire-finder.
- (c) To discuss a fire over the radio with the Ranger staff, each man referring to the same photograph.

Using the Photographs to Locate a Fire

1. Relate the appropriate photograph to the actual topography, and carefully mark the fire location or base of the smoke on the photograph with a soft pencil.
2. Place the transparent grid overlay accurately on the photograph. The white lines of the five-degree vertical and horizontal angles on the

photograph should be completely blocked out by the corresponding black lines on the plastic overlay.

3. Measure the horizontal angle, working to the right, or clockwise from the nearest lowest five-degree line on the photograph, and write it down in degrees and minutes. (Remember there are 60 minutes in one degree.)
4. Measure the vertical angle, plus or minus (above or below the 0° horizon line). Again, write it down in degrees and minutes.
5. Do not trust your figures to memory -- write them down, and re-check, before sending the fire report. Remember, an error of 2° in the bearing line reported from a lookout would result in a ground location error of $1/2$ mile at a distance of 15 miles from the lookout.

II. LOCATING FIRES BY THE FIRE-FINDER

Once oriented and levelled, the basic operation of the fire-finder consists of sighting at the base of the fire, and recording the horizontal angle and the vertical angle.

Take time at the outset to become thoroughly familiar with the instrument and its operation. Periodically check azimuth readings on various reference points against those from the lookout photograph bearings.

Always check and compare your fire-finder readings against the lookout photographs before passing any fire location information to the Ranger.

1. Sighting with the Fire-Finder

General steps in sighting are as follows:

- (a) Swing the instrument until the sighting arm is in line with the target.
- (b) Sighting along the top of the sighting arm, use the large knurled nut to depress (or raise) the sighting arm to line up the target approximately.
- (c) Look through the peepsight and make an accurate sighting. Line up the vertical wire of the front sight through the centre of the smoke, and the horizontal wire on the base of the smoke.

If the wind is obviously blowing the smoke to right or left and obscuring the base of the smoke, line up the vertical wire on the windward side (that from which the wind is blowing), and give this advice when passing the bearing to the Ranger.

If the base of the smoke is obscured by a hill or other obstruction, centre the cross hairs where the smoke is first seen to rise -- but again it is essential that the circumstances be

(c) cont'd.

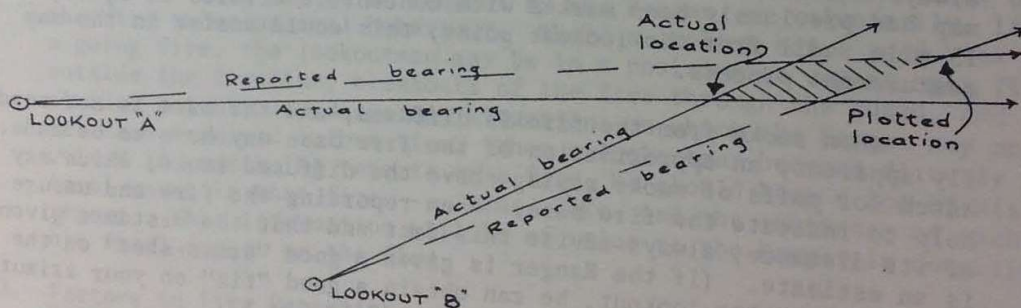
given to the Ranger when reporting the vertical angle. (This has an important influence in determining the distance from the lookout, as will be discussed below.)

2. Taking the Azimuth (Horizontal) Bearing

When sighting has been completed on the fire, look down to the pointer on the azimuth scale, then go back to the nearest lower even five or ten degree marker, and count up from it. Count out loud, and double check. Suppose that the bearing is $213^{\circ} 15'$; say aloud -- "two one three degrees, one five minutes," and write it down.

Again, the importance of an accurate bearing line is emphasized. (As noted, at a range of 15 miles from the lookout an error of 2° will result in an error on the ground of 1/2 mile, left or right.) It will be appreciated that a ground location error of 1/2 mile in rugged topography could offer real problems to a field crew looking for a fire.

A further consideration is the plotting of a "fix" from the reported bearing lines from two lookouts reporting the same smoke. Where these bearing lines converge at a fairly "shallow" angle, an error in the reported bearing from one or both lookouts could result in a considerable potential error in ground location when plotted at the Ranger Station, as illustrated in the following sketch:



Showing potential error in plotting map "fix" from inaccurate bearing lines reported from two lookouts

3. Taking the Vertical Angle

Read the vertical angle scale carefully, particularly when the pointer lies between whole degree lines. For example, a reading of $-4^{\circ} 30'$, with the pointer lying midway between the -4° and -5° lines, could be misread as $-5^{\circ} 30'$ if read the wrong way in relation to the -5° line.

Remember, an error in the vertical angle scale could result in a much greater ground error than a similar azimuth bearing error, particularly where relatively level or rolling country is involved.

Again, say the angle out loud -- "Minus four degrees, three zero minutes," and write it down. Be sure to read and record whether the angle is plus or minus (above or below the horizontal line). Most vertical angle reports will be minus.

4. Determining Distance

The distance of a fire from the lookout is an important factor, yet it is the most difficult information to get accurately. Smoke may be diffused and blowing towards the lookout, making it difficult to relate to the base of the fire.

Where the smoke column is readily visible from the lookout, relate its base to some nearby topographic feature which can be located on your base map. Using a ruler of suitable length, measure the distance on the base map, and convert to miles. Most fire-finder base maps will be at a scale of two miles to one inch, but this is not always the case. *Make sure of the scale of your map.* If your base map had previously been marked with concentric circles of 5, 10, and 15-mile radii from the lookout point, this could assist in the map measurement process.

When smoke from the fire is diffused, and the base is not readily apparent, an approximation of the fire base may have to be made. Watch for puffs of smoke rising above the diffused smoke, which may help to indicate the fire base. When reporting the fire and unsure of its distance, always advise this fact and that the distance given is an estimate. (If the Ranger is given a good "cross-shot" on the fire from another lookout, he can obtain a good "fix" on your azimuth bearing line, and locate the fire fairly closely.)

REMEMBER, a fire report to the Ranger must supply:

- (a) Horizontal angle (azimuth bearing).
- (b) Vertical angle.
- (c) Estimate of distance from the lookout.
- (d) Other pertinent information as required by the Ranger.

singl
Range
requi

1. I

ti
su
ti
ma
fe
pl

to
ro
sh
app
sm

2. Fo

sup
vid
the
the
a g
out.
sim
yet
volv
inve
repc
his

3. Fact

incl

Smoke

Smoke