A PORTABLE HIGH TOWER TO SUPPORT METEOROLOGICAL AND AIR SAMPLING EQUIPMENT

by

J. A. Armstrong

CHEMICAL CONTROL RESEARCH INSTITUTE

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The drift of a cloud of insecticide droplets, and the distribution of the droplets in the deposit is affected by the meteorological conditions at the time of spray application (Hurtig et al 1953, Yates, Akesson and Coutts 1967, Akesson, Yates and Wilce 1969, Courshee, Coutts and Hays 1969). In an attempt to learn more of the movement of the insecticide cloud and the fate of the airborne droplets, measurements have been made to correlate spray drift and deposit with the meteorological conditions at the time of application Hurtig et al (1953) carried out a basic study of spray deposit on a fir-spruce complex and recorded the insecticide deposit on different areas of a tree, i.e. upwind side vs downwind side and upper, mid, and lower crown regions. They showed that a good general indication of the deposit on the tree crown could be obtained by use of sample cards placed in open areas on the ground, adjacent to the target tree. It was also shown by Hurtig et al (1953) that by making allowance for wind speed and direction it was possible to spray from a height such that under stable (inversion temperature) conditions the spray would be deposited on the target. Yates, Akesson and Coutts (1966) investigated spray deposit and drift in open areas (pasture lands, rice fields) where it was possible to study the uninterrupted movement of the spray cloud, and showed a correlation between the stability of the air mass and the drift of the insecticide cloud. Maybank (1969), in an investigation on the extent of drift of herbicide under conditions of varying wind speeds, also showed that it was possible to predetermine the conditions under which susceptible non-target plants at known distances from the target area would escape damage from the herbicide.

In the aerial application of insecticide every attempt is made to release the material under conditions which will result in the minimum drift and maximum deposit of the insecticide on the target. These conditions are: a wind speed of about 3-5 mph (if higher the wind should be a steady wind and not turbulent), a high relative humidity, a low temperature, and a temperature inversion or if not an inversion at least a stable air mass. Frequently it is not possible to spray under these ideal conditions and the application must be done under conditions which will result in a partial loss of spray formulation either by evaporation or by air currents carrying the insecticide away from the target area. In a large scale scheme such as forest insect control the insecticide cloud will be affected by the air movement through the trees as well as by the meteorological conditions above the trees. With the increased use of ULV (Ultra Low Volume[1]) application techniques in all fields of aerial application, and in forest insect control in particular (Courshee, Coutts and Hays 1969, Randall 1969) it is even more important that full knowledge of insecticide drift and deposit under varying meteorological conditions is made.

The movement of an air mass over a forest area is affected by the type of trees and their density (Geiger 1965). As the wind moves across the tree tops there is a shearing effect which results in the wind tumbling and rolling in this interphase region. There is also a general interference of the smooth air movement above the trees which affects the air mass to varying heights in this region. Thus the drift and deposit of small droplets may not follow the predicted pattern based on weather measurements and air movement studies at a point in an undisturbed air stream above the

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1. Ultra Low Volume. Defined by the United States Department of Agriculture as the application of a spray in less than one half U.S. gallon of liquid per acre (Courshee, Coutts and Hays 1969)

trees, or based on studies carried out in open areas.

In an attempt to learn more of air movement above and within the forest canopy a program involving the measurement of air turbulence and movement, temperature, and relative humidity both above and within the forest canopy was initiated by the Chemical Control Research Institute. Associated with this study air sampling equipment capable of collecting droplets and air borne vapors is used. This equipment, consisting of cards and plates to collect droplets down to 20-40 microns; cascade impactors, for droplets down to approximately 5 microns; and air samplers capable of collecting all air borne particles of insecticide gives an indication of the droplet distribution within the insecticide cloud which can then be correlated with the meteorological conditions and the insect kill.

The present publication is a description of a high (122 feet) tower used to support the sampling and meteorological equipment. Yule and Cole (1969) have described an air sampling system which is used on the tower. Cascade impactors, Kromekote cards and glass plates are standard sampling systems and have been described by many authors (Hurtig et al 1953, Armstrong and Randall 1969, Maybank 1969). Subsequent publications will describe the meteorological equipment, modifications to the air sampling equipment, and a remote sensing relative humidity-temperature unit which has been designed and constructed by this Institute.

The High Tower

The high tower was purchased from Carleton Equipment Limited[1]. It is a trailer mounted unit with a total weight of 1590 pounds and is easily pulled by a 1/2 ton pickup truck or similar sized vehicle. Fig. 1

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1. Carleton Equipment Limited, 46 Elgin Street, Ottawa 4, Ontario.

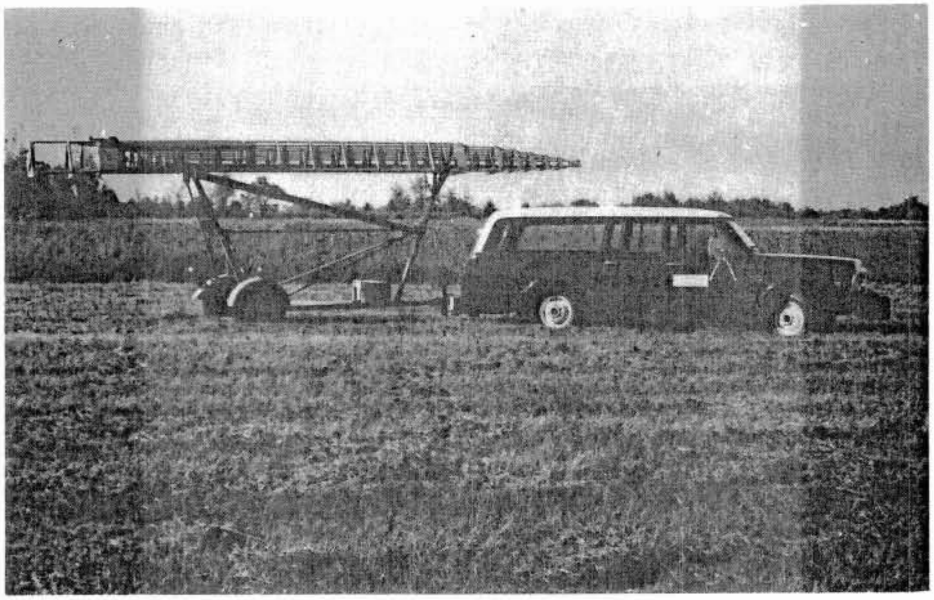

Figure 1.

The high tower collapsed to the towing position

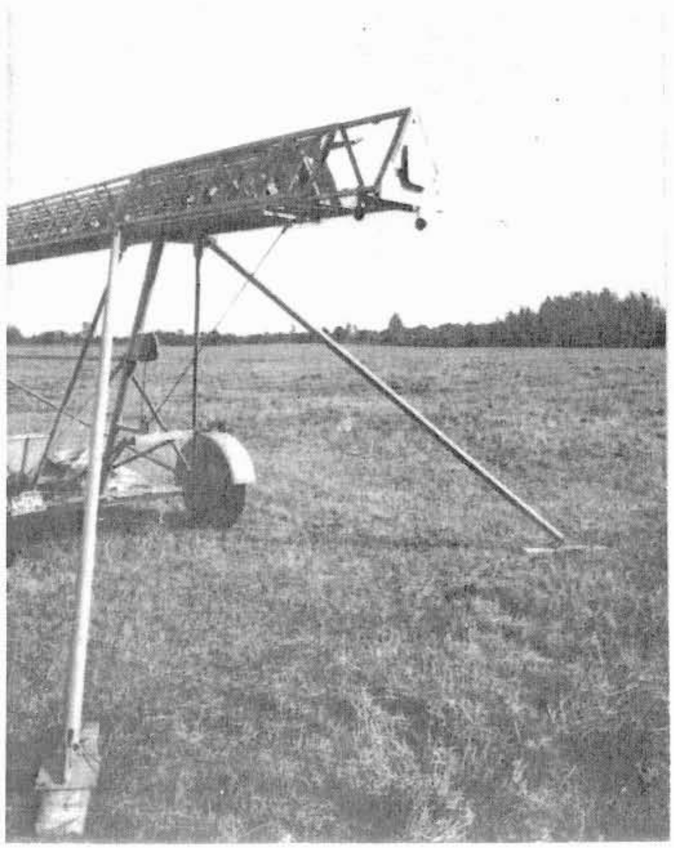

Figure 2.

Trailer parked in position, support legs extended shows the tower collapsed to the towing position and hitched to a panel van. The tower trailer comes fitted with brake lights and turn indicators for highway travel.

1. Erection of the tower

The tower is parked in the desired position and the two support legs are extended (Fig. 2). A two foot carpenters level has been found to be useful to ensure that the trailer is level. Major adjustments to level are made by jacking and blocking the trailer wheels; minor corrections are made by adjustments to the legs or to the crank at the trailer hitch.

With the trailer level and before the tower is swung to the vertical position, all equipment is fastened to the tower head, this can be facilitated by backing the truck under the tower head and standing on the truck. All conductor and electrical supply cables are run through the centre of the tower. This prevents excess movement of the cables in a wind, and also keeps the weight of the cables centered in the tower. The guying cables, bearing identification tags to indicate their position of attachment, may be fastened to the appropriate tower sections at this time, or they may be fastened when the tower is swung to the vertical position. The tower is then cranked to the vertical position (Fig. 3) and a final check is made to ensure that the tower does stand vertical. At this time the guy cables can be brought out to their approximate position and when the tower is found to be standing vertically the bottom set of guy cables is extended and fastened to the ground anchors. The ground anchors (Fig. 4) are purchased from C. Frensch[1]. Most efficient use of the ground anchor is obtained when the anchor is set vertically in to the ground to its maximum depth, i.e. until the hook is just clear of the ground.

According to directions the topmost section is first extended,

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1. C. Frensch. P.O. Box 67 Grimsby Ontario

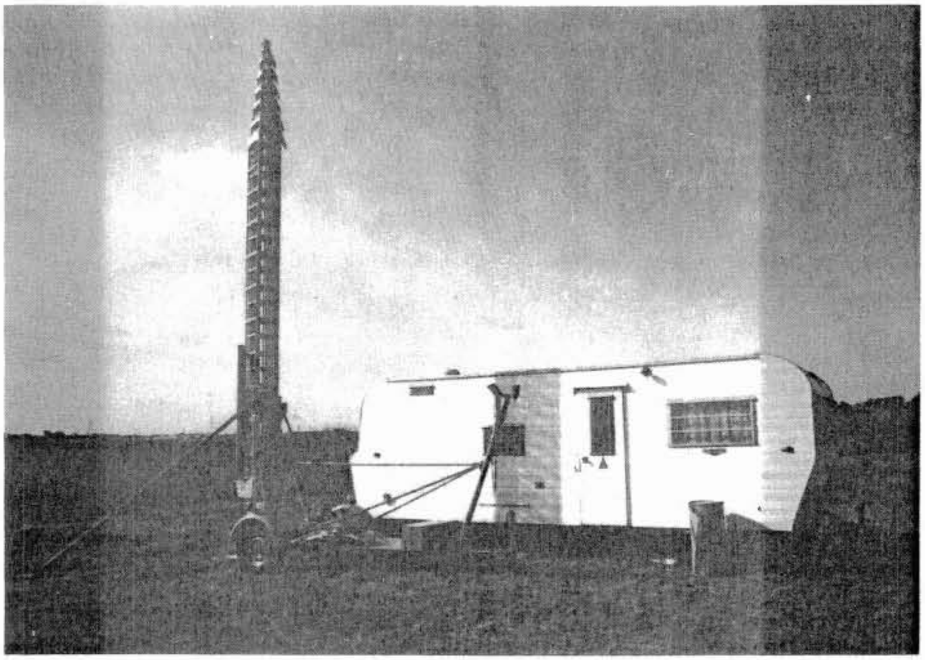

Figure 3.

Tower in the vertical position ready for extension

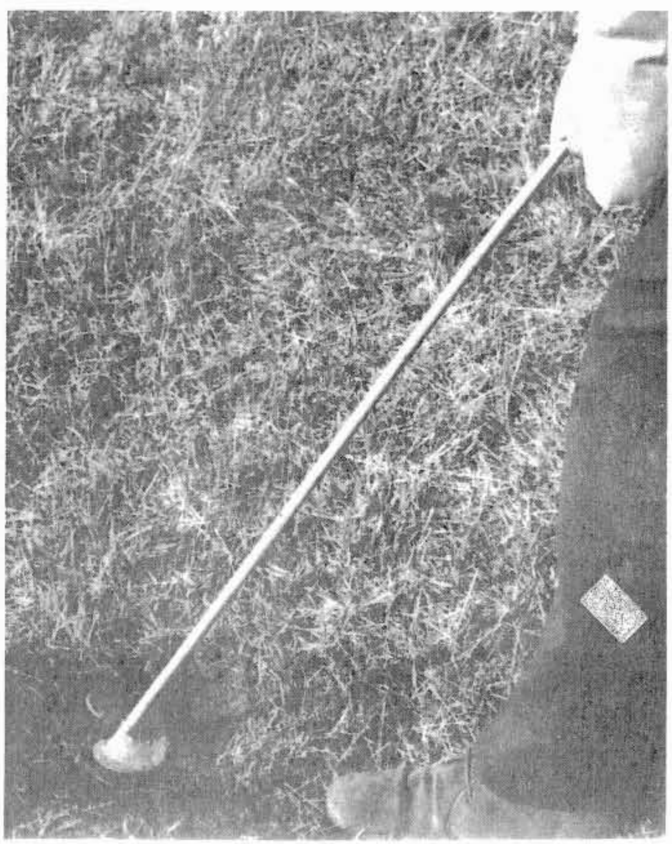

Figure 4.

Ground anchor

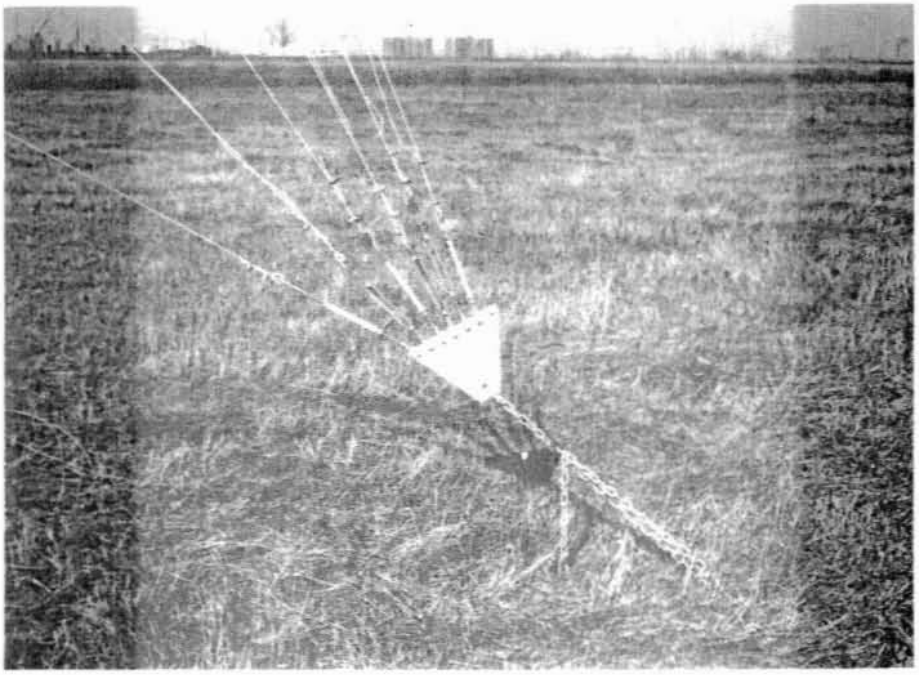

Figure 5.

Anchor plate with guy wires attached

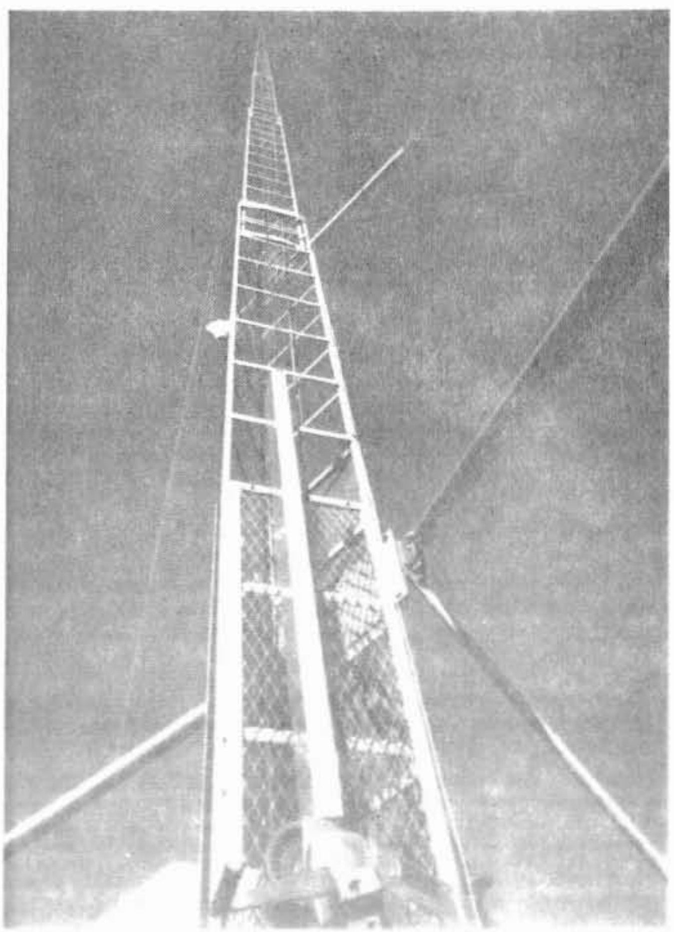

Figure [illegible].

Tower extended

tower extension is then continued starting with the bottom section. The particular model of tower that we have has an automatic locking device, as each section is extended dogs lock in position to support the weight of that particular section. The dogs must first be released to permit extension of the section, this is done by pulling straight down on the appropriate guy cable, when the section is extended the dog locks into position and takes the weight off the lift cable. As soon as a section is released and has risen sufficiently to clear the dog the guy cable can be fastened to the ground anchor. This procedure is continued until the tower is extended to its full height, or until only the required number of sections are required to give the desired height. Fig. 5 shows the anchor support with the guy wires attached; Fig. 6 shows the tower fully extended.

Letting the tower down

To run the tower down the erection procedure is reversed. The top section is first run down; to do this the guy cable which controls the dog locking the section into position is released and the dog is tripped. This entails releasing the guy wire from the anchor and pulling straight down on the dog, frequently it is necessary to raise the tower slightly to take the weight off the dog, before it will release. To assist in releasing the guy wire from the ground anchor a "come along" 's used to take the strain off the guy wire (see Fig. 7). When the top section is down the section second from the top is next released and run down and this procedure is continued until the tower is collapsed. When collapsing the tower care must be taken to ensure that the electrical cables do not become entangled and damaged.

Meteorological Equipment on the Tower

The meteorological equipment is a bi-vane sensor from Meteorological

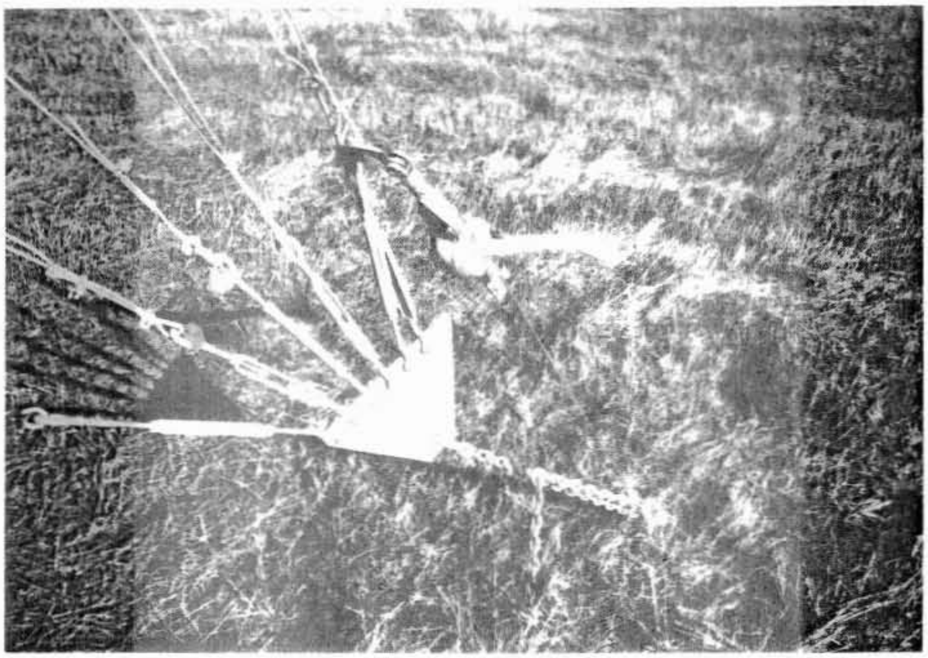

Figure 7.

A "come along" used to take up slack in the guy wires and permit the guy wire to be disconnected.

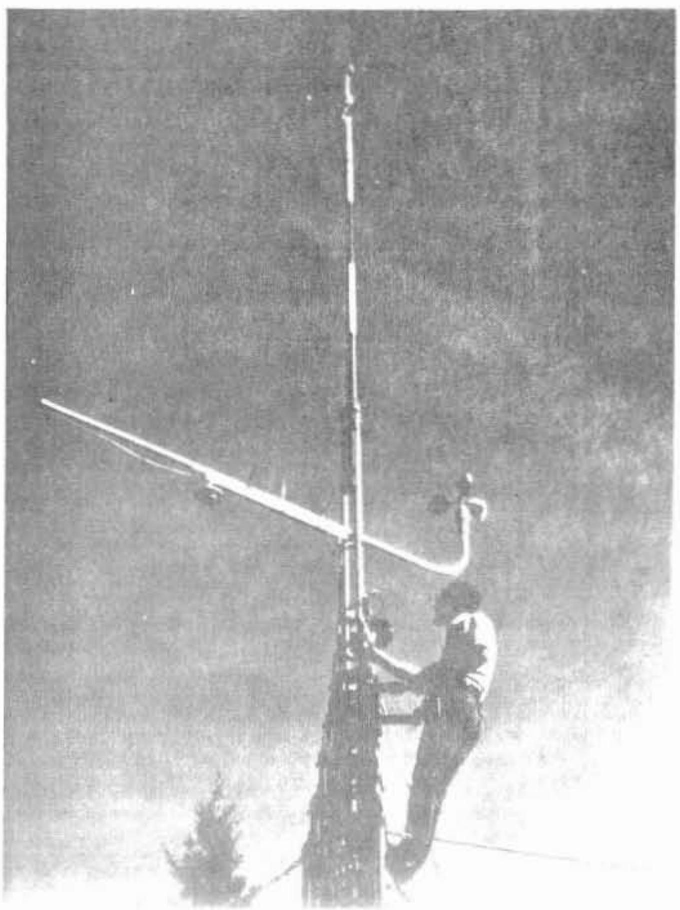

Figure 8.

Tower [illegible] in position

Research Incorporated[1]. This equipment measures wind speed, wind direction, and the vertical components of air movement, and is sensitive to a wind speed as low as 0.5 to 0.75 mph. Also mounted on the tower are temperature sensing devices which are paired and connected electrically such that a temperature differential is recorded, and relative humidity measuring units. At a study site in the field two sets of units are normally used, one at the top of the tower to give a measure of meteorology conditions in the undisturbed air mass above the forest canopy, the other at the tree canopy height, or just below it to show the pattern of air movement at this position. Fig. 8 shows the head of the tower with one of the meteorology sensing units in position.

Air Sampling Equipment on the Tower

Air samplers as described by Yule and Cole (1969) and cascade impactors are suspended on the tower. A more detailed description of this equipment will be given in a subsequent publication.

Comments

The tower system has been found to be a most useful piece of equipment. It is convenient in that the design permits any number of segments to be run up, and the design of the locking dogs takes the weight of the tower off the hoist cable once the segments are extended. With only one section extended no guy wires are needed, this gives a height of approximately 40 feet. With two sections extended a set of guy wires to the lower section is required, and with more sections up to the full compliment of guy wires is necessary.

In our work with the tower we were concerned for the safety of persons working around the base of the tower. People cranking the sections

1. Meteorological Research Incorporated, 464 Woodbury Rd., Altadena, California.

up, tended to hold on to the base frame; this is potentially dangerous in that there is a minimum clearance between the tower sections and if the cable should break and the tower collapse when a person was holding on to the base a very serious injury would result. With the tower in the erect, collapsed position a ladder was used in order to climb the tower to check equipment. With the tower extended it was very easy to climb and to prevent this a protective metal screen was fastened around the base of the tower to a height of about 7 feet (see Fig. 6), this screening and the metal cover enclosing the hoist cable will also protect a person from a loose end of the cable should it break.

Since the full tower extends to a height of 122 feet we have been informed by the Department of Transport that it must be considered a potential hazard to low flying aircraft and that an obstacle notification must be registered with the Department of Transport to indicate the position of the tower and the length of time it will remain in the position. To make the tower more readily visible the top pipe section was painted with wide red and white bands and a red warning light was affixed to the tower. Power was supplied to the warning light from a car battery. To switch the light on at sunset and off at sunrise when the tower was unattended a photocell was connected to the circuit. With this system a fully charged car battery provided power for 36 hours illumination.

The high tower and equipment has been used in several localities and in areas with a great variation in vegetation and soil type. If there is a dense undergrowth, ie. heavy willow growth or many small trees and shrubs with a densely interwoven root system a ground anchor with a 4 inch screw disc will hold. This is generally true irrespective of the soil type. If, however, the tower is erected in a more open situation, such as a field, where it is exposed to the full sweep of the wind and where the only ground cover is grass a larger (8" diameter disc) ground anchor is required. It was also found that in an open situation exposed to the wind, a continuous wind causing a slight swaying of the tower, puts a strain on the ground anchor which results in it moving over a period of several days. This weakness is accentuated if the ground is soaked by heavy rain.

When setting the trailer and tower into position it is advisable to check the direction of the prevailing wind and orient the trailer so that the strain from the wind is distributed over two guy anchors rather than one. We have also found that if the tower is going to be set in one site for several weeks a very solid ground anchor system is required and if it is contemplated to leave the tower in one site for a considerable length of time it is advisable to use cast cement blocks such as those recommended by the suppliers of the tower.

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