Mobile Whips Are Directional

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You can't work 'em if you can't hear 'em, and you can't hear 'em with the beam in the wrong direction. Don't fall out of your Thunderbirds, mobile hams, but this applies to you, too. For the average mobile installation can work like a beam if one just knows how to turn it.

Most of us who work mobile have had the experience of turning the car while in motion and having the station worked grow much weaker or much stronger in our receiver. This happened to me so often my curiosity overcame me, so I undertook a study and review of the situation to learn just how and why my mobile rig worked directionally.

Here are some findings from 3½ years of tests, reading, study and figuring:

1. The average mobile radio installation is highly directional, regardless of theories about omnidirectional vertical antennas. This is true on most amateur bands.

2. This directivity appears due mainly to an increase in field strength in the air above a metal car body and a decrease in radiated signal intensity at the sides of the car when the antenna is bumper or shoulder-mounted at the rear of the vehicle.

3. The directional effect increases as the car moves in line toward the signal source. This appears due to eddy currents in the car body.

4. Signals sent and received are weakest when the car body is at right angles to the station being worked.

5. While mobile directional characteristics are altered somewhat by such things as surrounding objects and ionospheric variations, the main directive characteristics of the installation will not vary too much under most operating conditions.

I went into this study to learn how to get the most out of my mobile antenna. I hope this article will help you likewise to make the best possible use of yours.

When a vertical antenna is mounted on an automobile, some significant changes take place from the theoretical condition of an omnidirectional quarter-wave vertical antenna over a perfectly conducting ground or an infinite copper sheet. We all know about the effects of such things as antenna loading changes due to whip sway while in motion, trees, buildings, wires and changing ground conditions. But the greatest effect on field intensity usually does not result from any of these causes. It results from the car's metal body.

Field-strength measurements of others have indicated that, *Fig. 1*, in the area above an all-metal car the field strength increases 10 to 30 per cent over that at the antenna, while at the sides of the car there is a decrease in intensity of some 40 per cent. The pattern of variation in strength seems generally independent of frequency.

This distortion of the r-f field can be attributed to induced currents or secondary fields caused by the metallic surfaces of the car.

During QSO's

After observations of the author and other mobile hams confirmed this phenomenon, I decided to measure the directive pattern of mobile antennas on favored amateur bands.

A field pattern is three-dimensional, so it was out of the question—without a balloon—to make measurements in all directions. I debated whether to take measurements at a far distance or in a near field (Fraunhofer pattern or Fresnel pattern). The latter won out.

Early one morning—I was W2VMF then—I got W2VLR to bring along his 10-meter mobile rig and accompany me as I drove to a nearby smooth and open area, clear of trees and other obstructions for at least 15 wavelengths on 20 meters. My 20-meter rig was installed then in a 1947 Dodge club coupe, and the antenna was center-loaded with a capacity hat.

Incidentally, in figuring out the behavior of an antenna with a capacity hat, it's permissible to forget the negligible radiated field produced by horizontal currents flowing in the hat.

We operated my rig on the way out, and it was thoroughly warmed up. We parked my car in the middle of the open area, turned on the

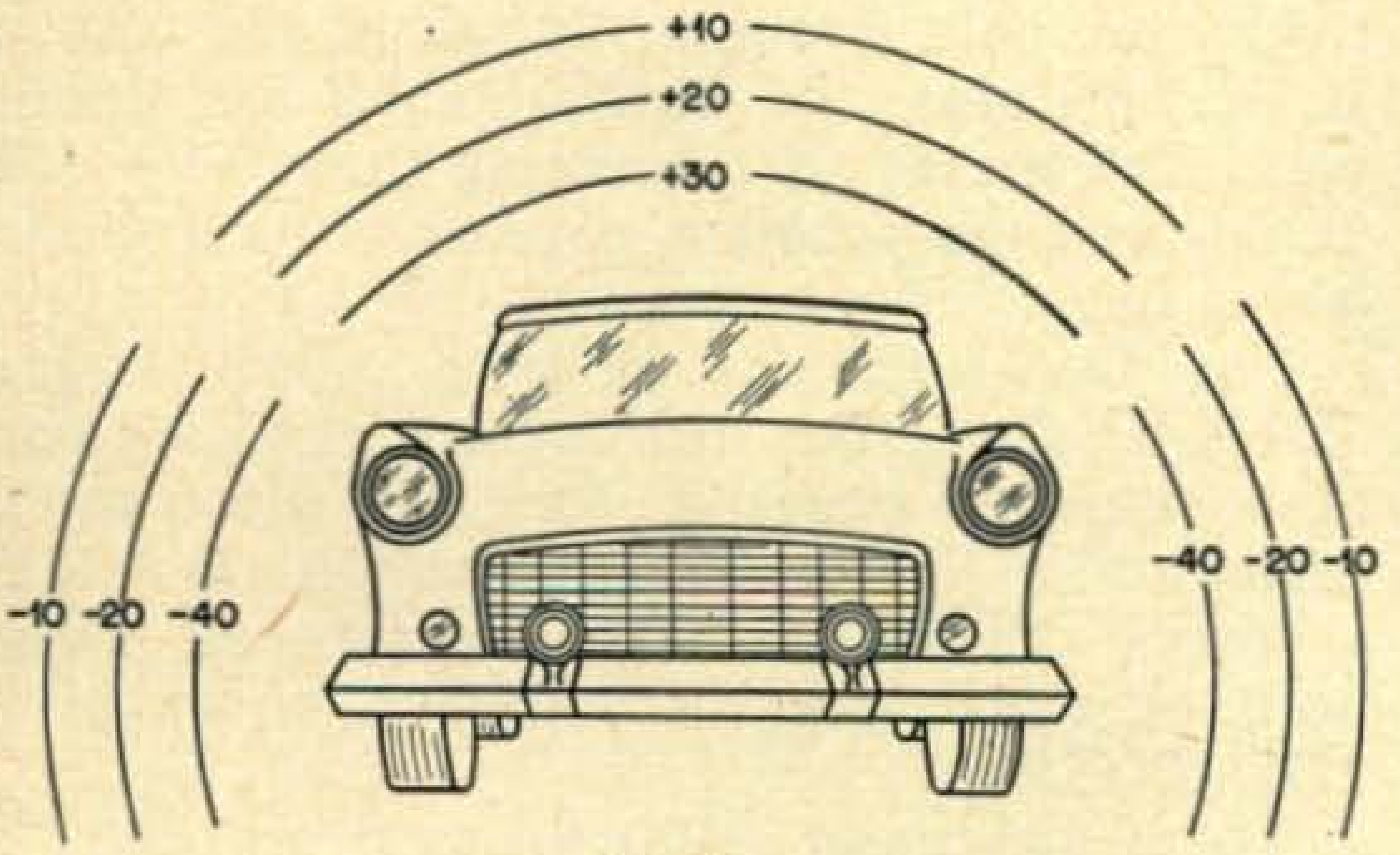

Fig. 1

carrier and took off with a surveyor's tape, a compass and a Model 200 field-strength meter (*Measurements Corporation,* Boonton, N. J.). Thus we plotted the relative strength of the signal from my rig at a distance from the car.

Plots were taken throughout the band, with results as shown by *Fig. 2*. As you can see, radiated strength was greatest in a direction 10° to 20° to the right of that in which the car was headed.

To discount the effect of terrain peculiarities or unknown conditions, the car was turned 90 degrees and other plots made. Results were similar.

Tests were made with the car's broadcast receiving antenna, on its left front, fully extended and then fully collapsed. Directivity on 20 meters was greater with the broadcast antenna collapsed.

Next we made plots of W2VLR's 10-meter mobile signal. Results were even more astonishing than with my 20-meter rig. As shown in *Fig. 3*, we found a highly directional major lobe, again to the right of the car's front center. But on 10 meters, directivity was most pronounced with the car's broadcast receiving antenna fully extended. Apparently it acted as a director.

Later tests were made on 10, 15, 20, 40 and 75 meters. There were similar directive patterns on all bands, but the most astonishing results appeared on 10, 15 and 20.

These findings have been confirmed in actual operation over long paths. One morning I established contact on 20 meters with CN8FL. He watched his S-meter while I reoriented my car, and an S-7 was turned into a 5-db-over-9 report at his location.

Later I contacted HH3DL while driving on a compass heading approximately 45° northeast near Buffalo, N. Y. My major lobe projected at about 65°. HH3DL's QTH is on a magnetic heading of approximtaely 140° from Buffalo. I drove my car into an open area and, with the aid of a compass mounted in easy view, I aimed the car at a heading of approximately 120° to center my major lobe on Haiti.

HH3DL reported a rise of about 20 db in my signal strength!

Other on-the-air checks were made with CN8FR, OX3BI, K6FAL, W5WRN, W4PGZ, VE1MQ, VE6WH, W7LWC/VO4 and many other mobile and fixed stations. It became quite evident that it paid to utilize the strong lobe to the right front of the car.

While living in Buffalo and driving to work

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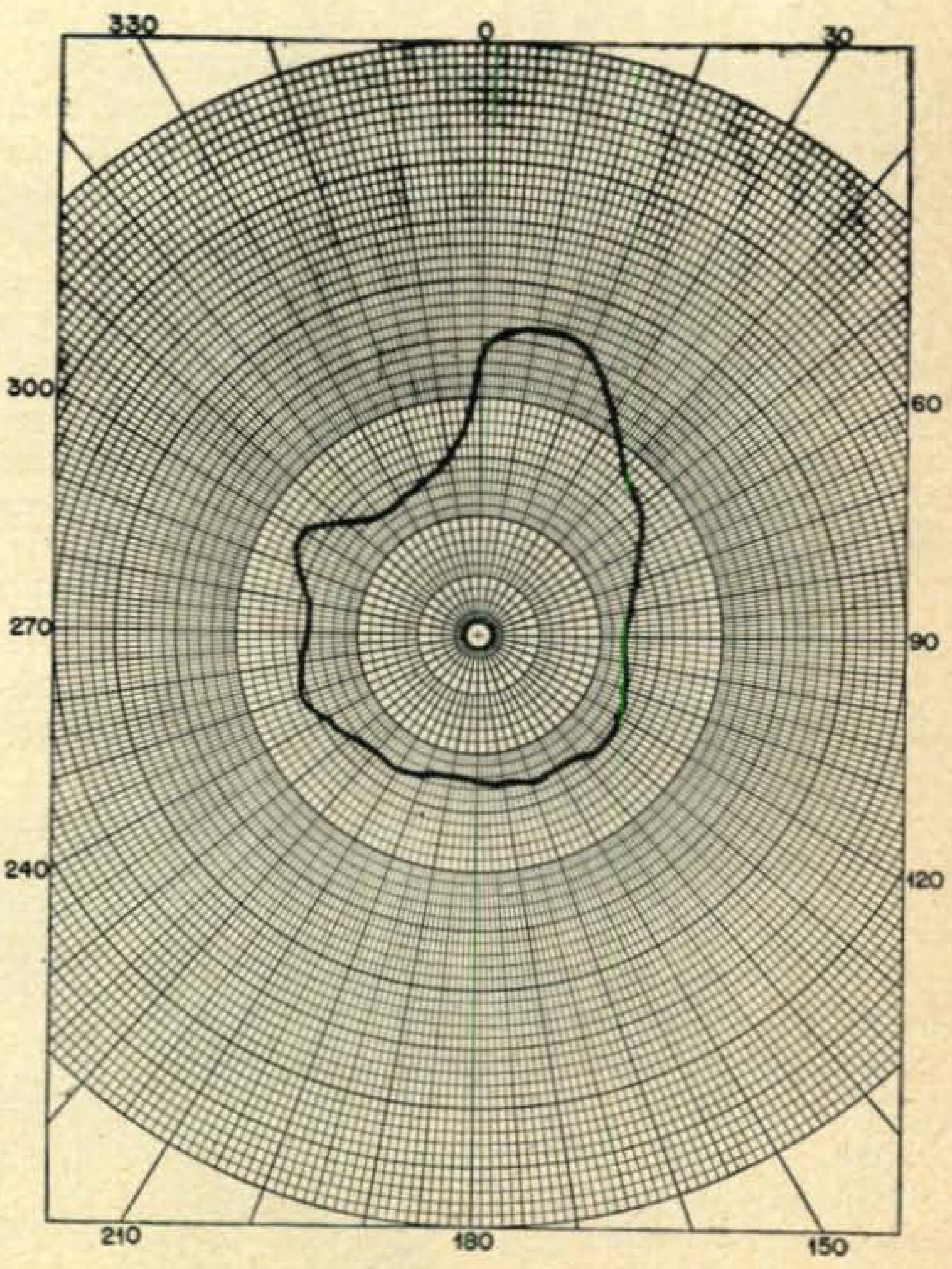

Fig. 2

DIRECTIONAL WHIPS

[*from page 45*]

in Niagara Falls and back, I had an almost perfect 20-mile north-south route. My best contacts were to the north-northeast and south-southwest.

To other mobileers, I recommend using front and rear lobes, particularly on the higher-frequency bands of 10, 15 and 20. If possible, head your car in the general direction of the station being worked. A compass mounted in the car will be a great help.

Signal Intensities

Note received signal intensities when turning your car. You should transmit well in the directions from which you hear strong signals.

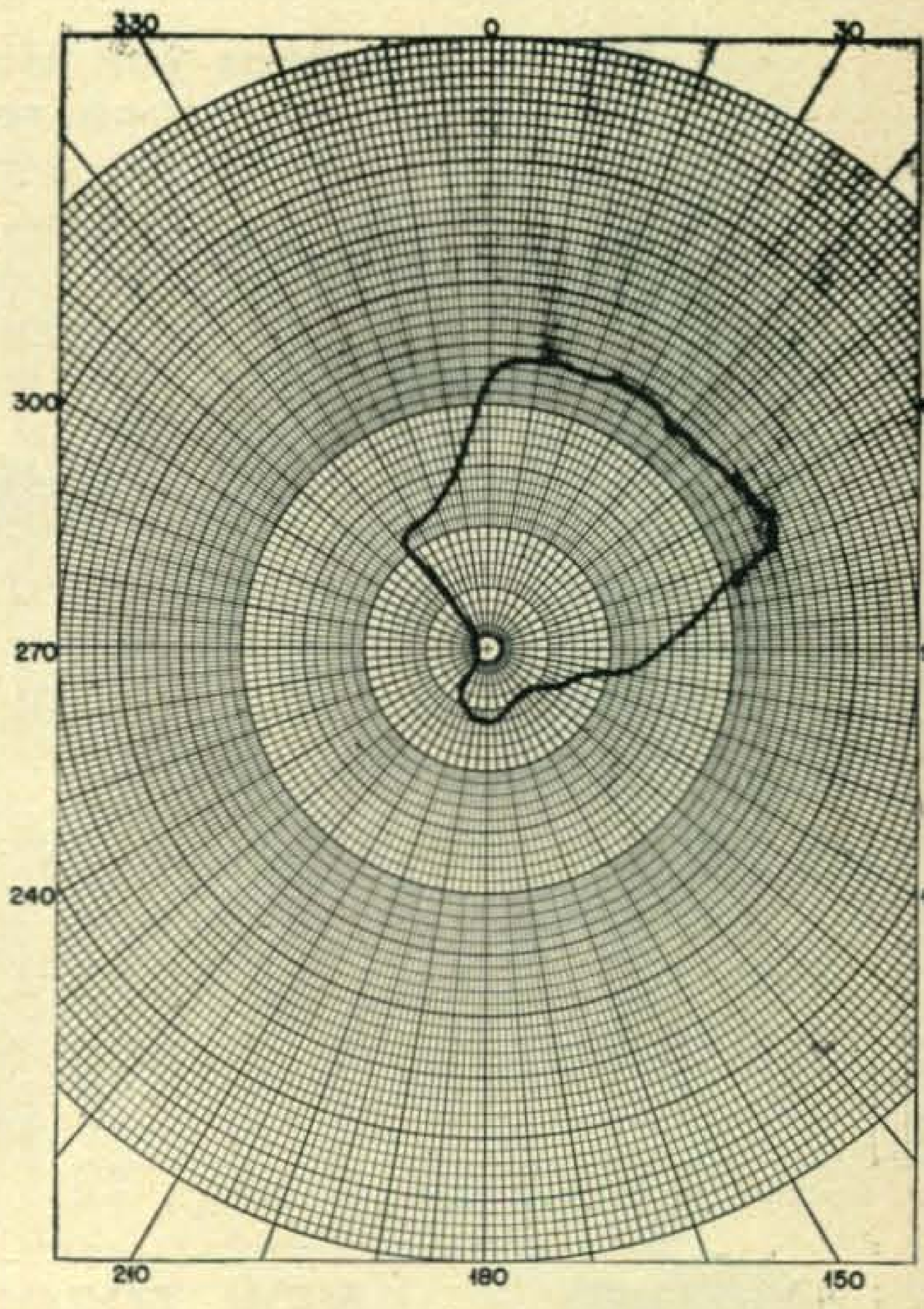

Fig. 3

Avoid bumper mounting of your mobile whip if you can. Side mounting also is discouraged. Both bumper and side mountings are situated badly in respect to noise fields. Shoulder mounting is efficient and is recommended. Top mounting is fine, but it presents some problems, especially in areas of many overhead traffic lights.

In any case, more fun to you from your mobile beam! ■

Reference Jan. 39. Proceedings of the I.R.E.