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ELECTROMAGNETIC PROPERTIES OF THE VACUUM CHAMBER

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The latest version of the 6-GeV vacuum chamber is shown in Fig. 1. The existence of the antechamber raises questions as to its effect on the wall impedances in the beam chamber region. The TE and TM modes of the vacuum chamber were investigated using the computer programs Superfish[1] and OSCAR.[2] Most of the calculations presented in this report were run on an earlier version of the vacuum chamber which has slightly different dimensions, however, the conclusions are just as valid although the cutoff frequencies are slightly different.

The pumping slot between the beam chamber and antechamber is 1 cm high. The cutoff frequency of the TE modes of the vacuum chamber are quite low, much lower than they would be with just the beam chamber. However, since TE modes do not interact, either longitudinally or transversely, with the positron beam, their low cutoff frequencies are not important. The electric field lines for the two lowest TE modes are shown in Figs. 2 and 3. The cutoff frequencies are 306.6 MHz and 1029.1 MHz.

In general for TM modes, one would expect the EM fields and the cutoff frequencies of the beam chamber to be very nearly the same as for a simply-closed beam chamber without any slot, because there are no wall currents in the TM mode perpendicular to the direction of the slot. This condition should be true at least up to the cutoff frequency of the first TM mode of the slot itself. The 1-cm slot has a cutoff frequency of 15 GHz. These conclusions are confirmed in the computer results shown in Figs. 4 through 8 where the H-field lines are shown for selected modes from the first

cutoff at 4,146 MHz to one above the cutoff for the slot at 15,914 MHz. At lower frequencies there is hardly any perturbation in the fields due to the slot. At 13,503 MHz, some leakage into the slot is apparent. Above 15 GHz, the slot has a significant effect.

REFERENCES

1. K. Halbach and R. F. Holsinger, Superfish - a Computer Program for Evaluation of RF Cavities with Cylindrical Symmetry, Particle Accelerators, Vol. 7 (1976).

2. Paolo Fernandes and Rinzo Parodi, Computation of Electromagnetic Fields in Multicell Resonant Structures for Particle Acceleration, IEEE Trans. on Magnetics, Vol. Mag-19, No. 6, November 1983.

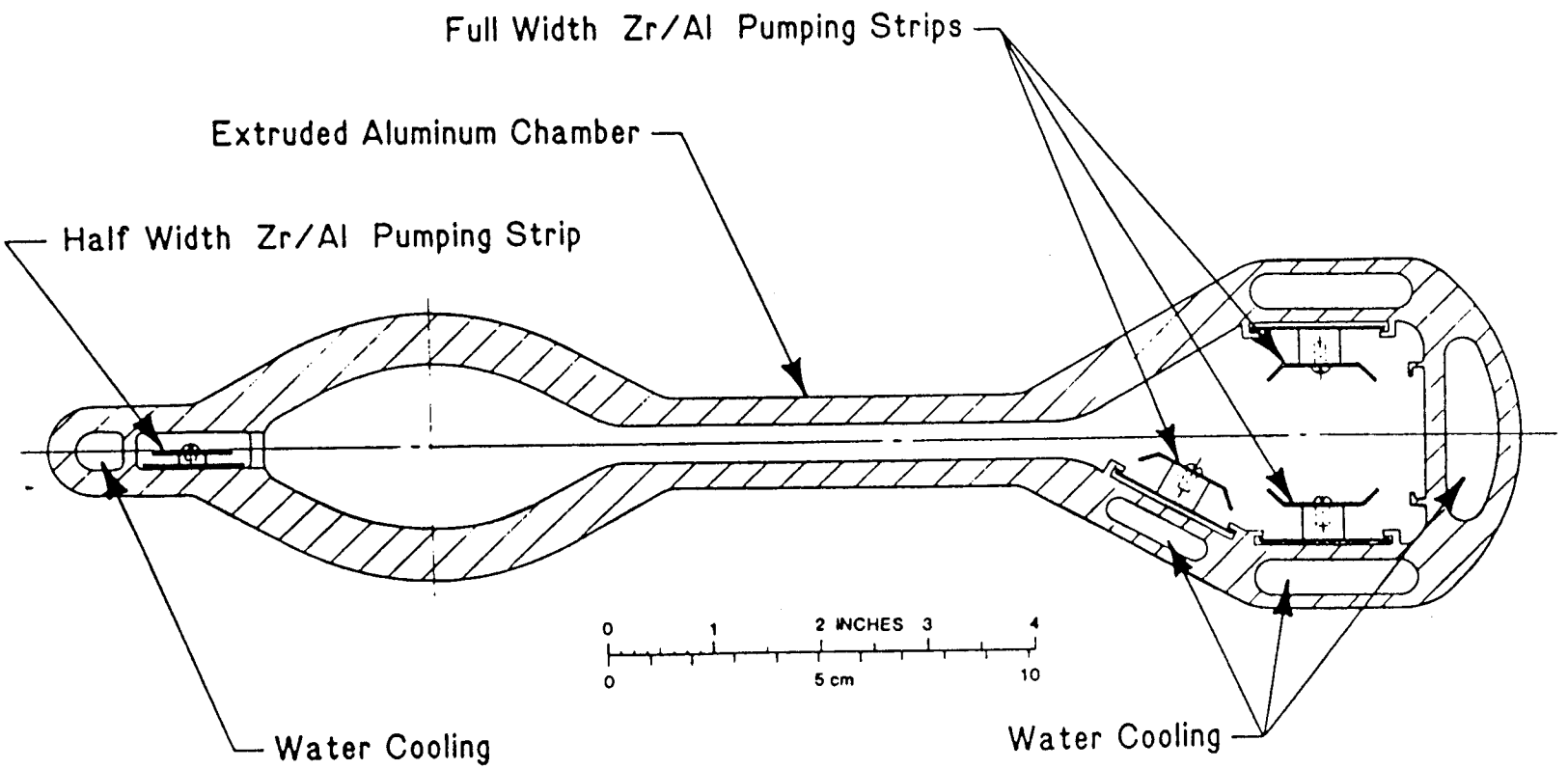


Figure 1. Vacuum chamber for the 6-GeV storage ring.

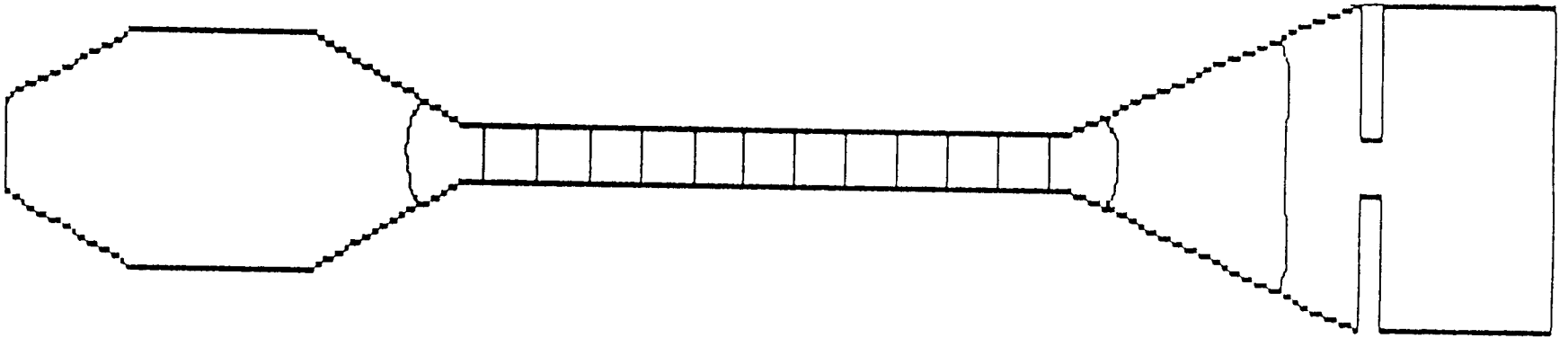


Figure 2. Electric field lines for the dominant TE modes.

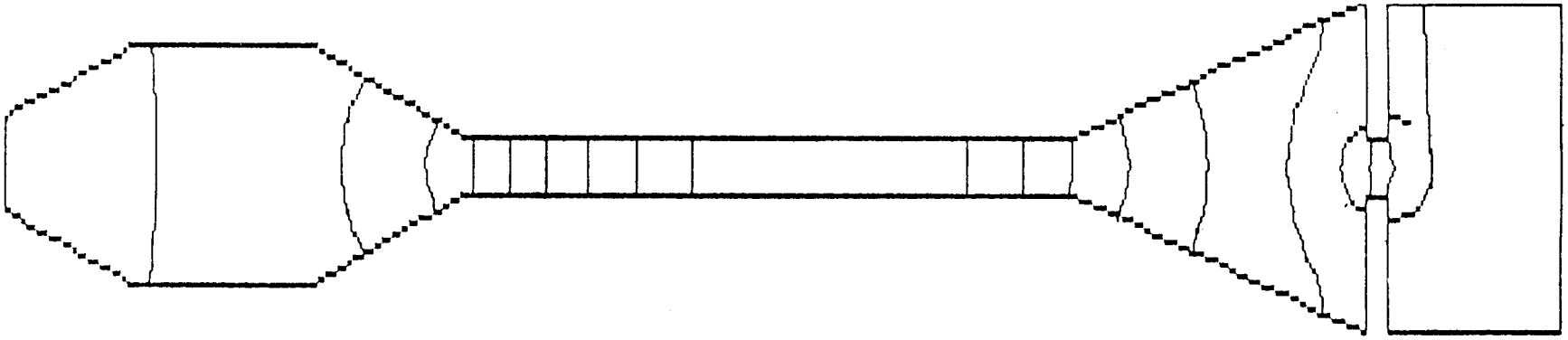
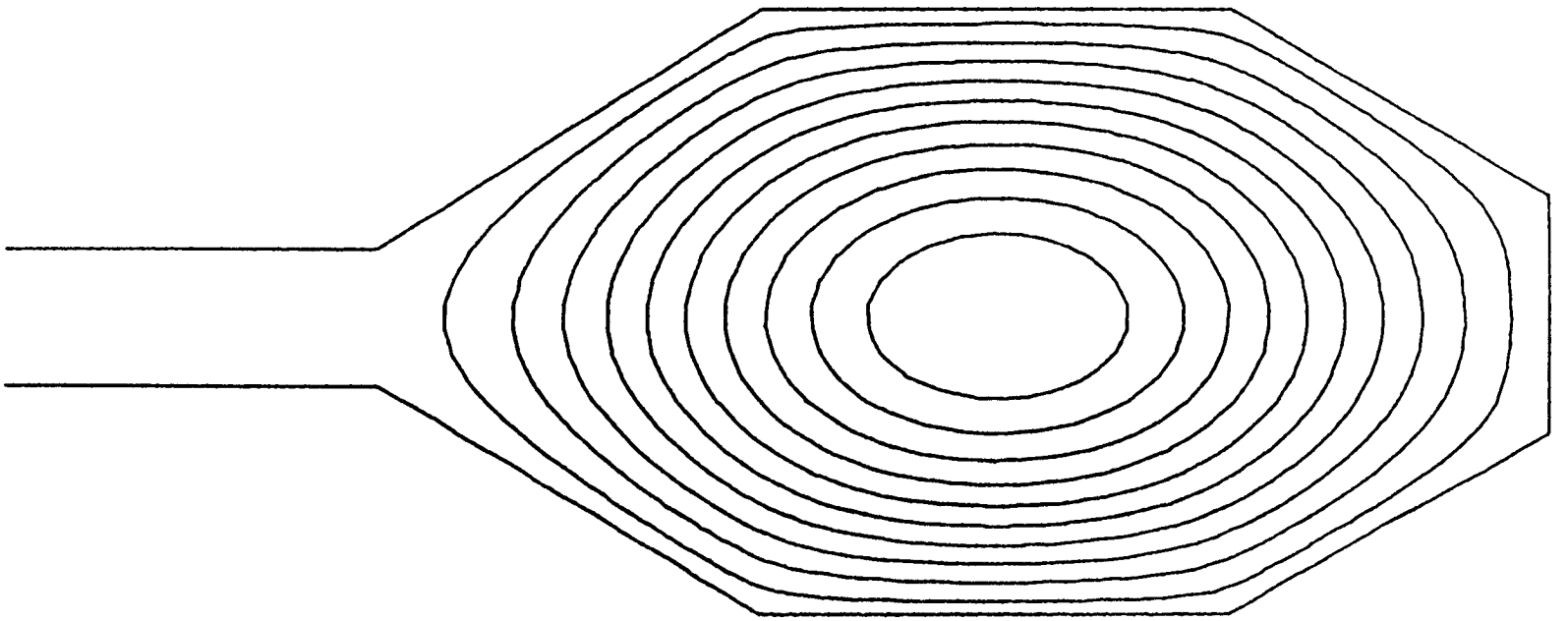
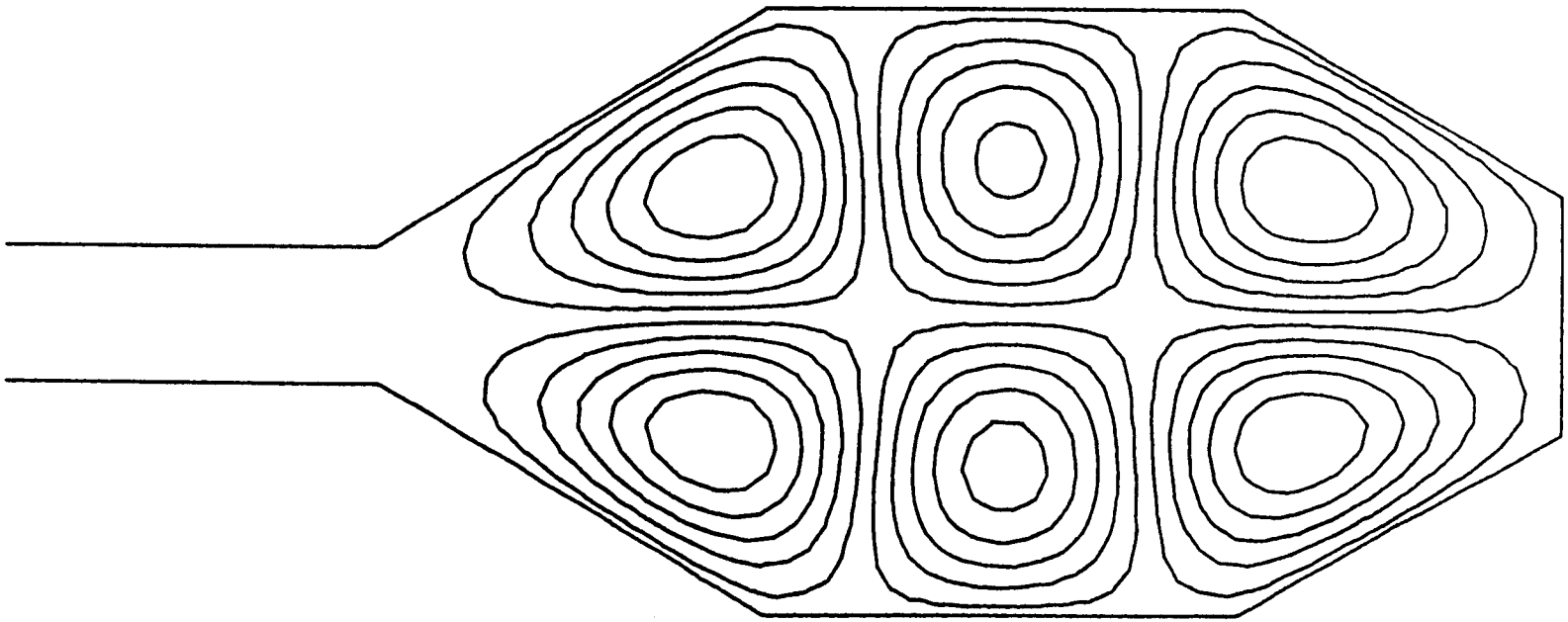


Figure 3. Electric field lines for the second order TE mode.



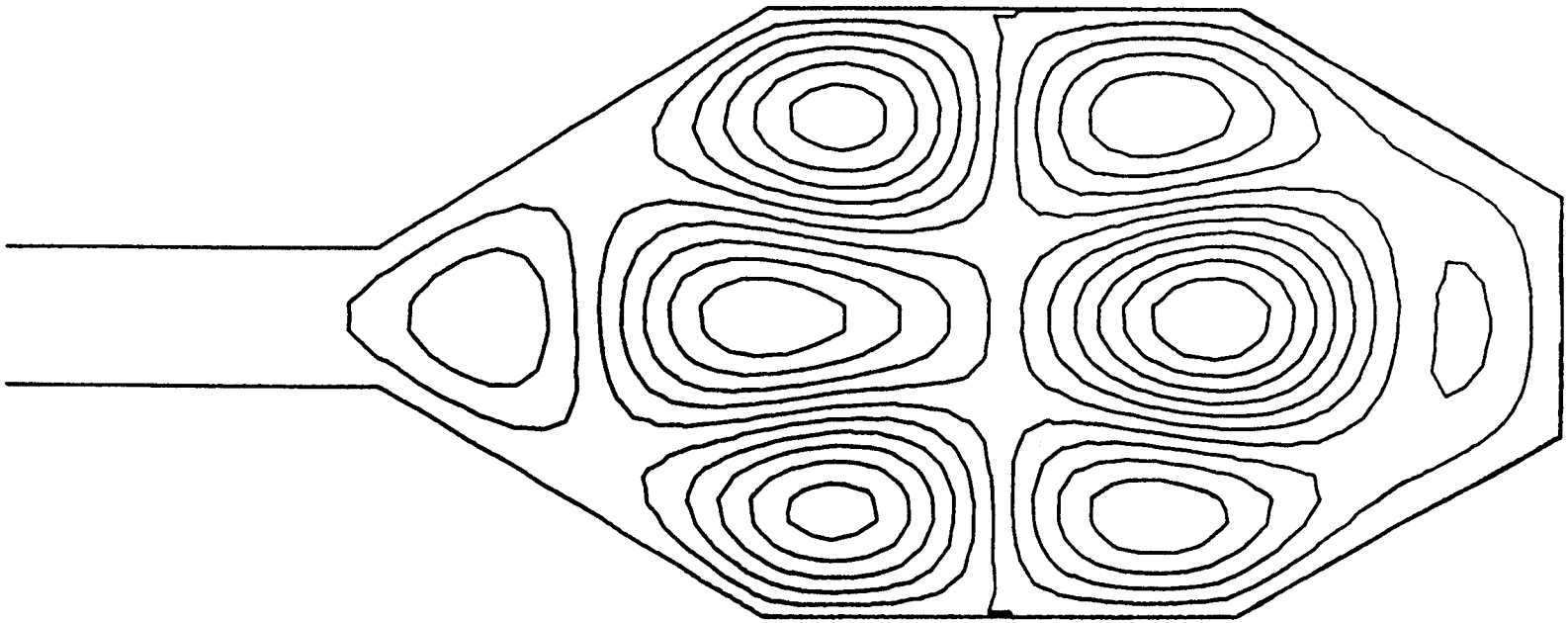
4,146 MHz

Figure 4. Plot of H-field lines at the cutoff frequency for the first TM mode - 4,146 MHz.



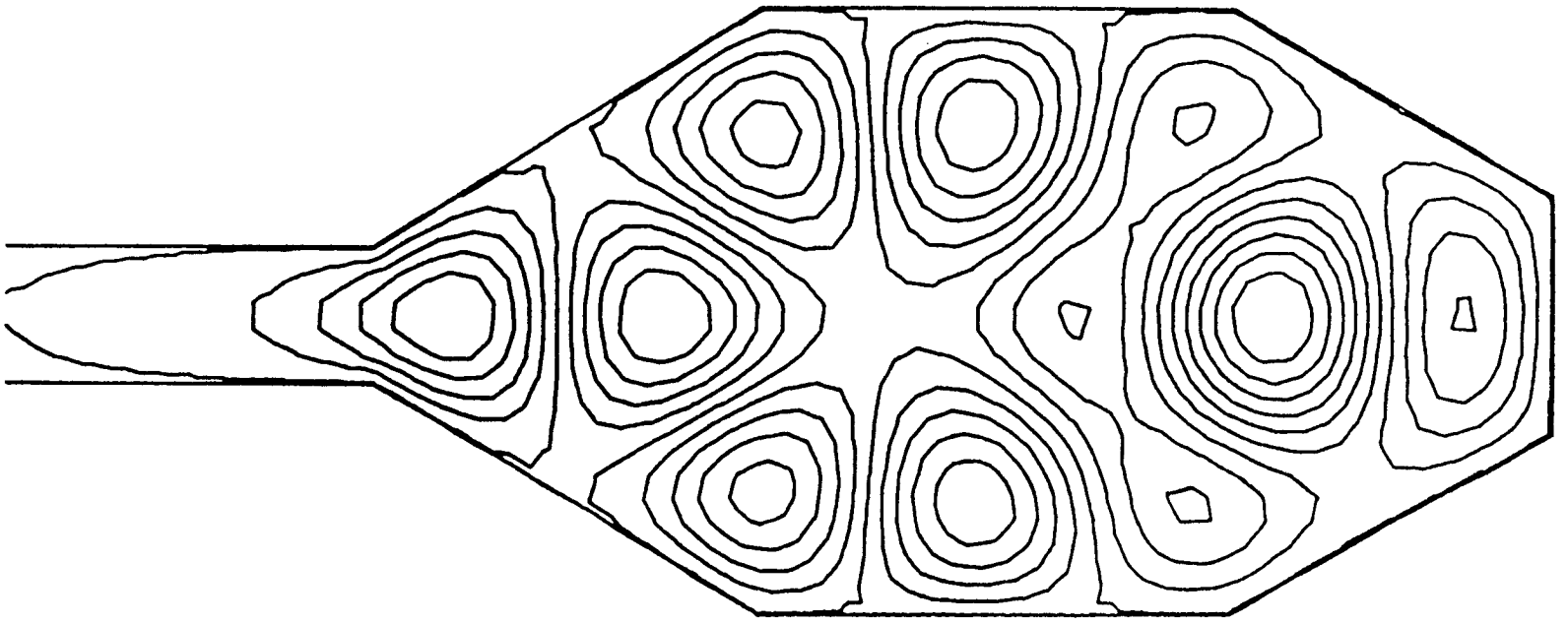
10,387 MHz

Figure 5. H-field lines for a mode with a cutoff frequency at 10,387 MHz.



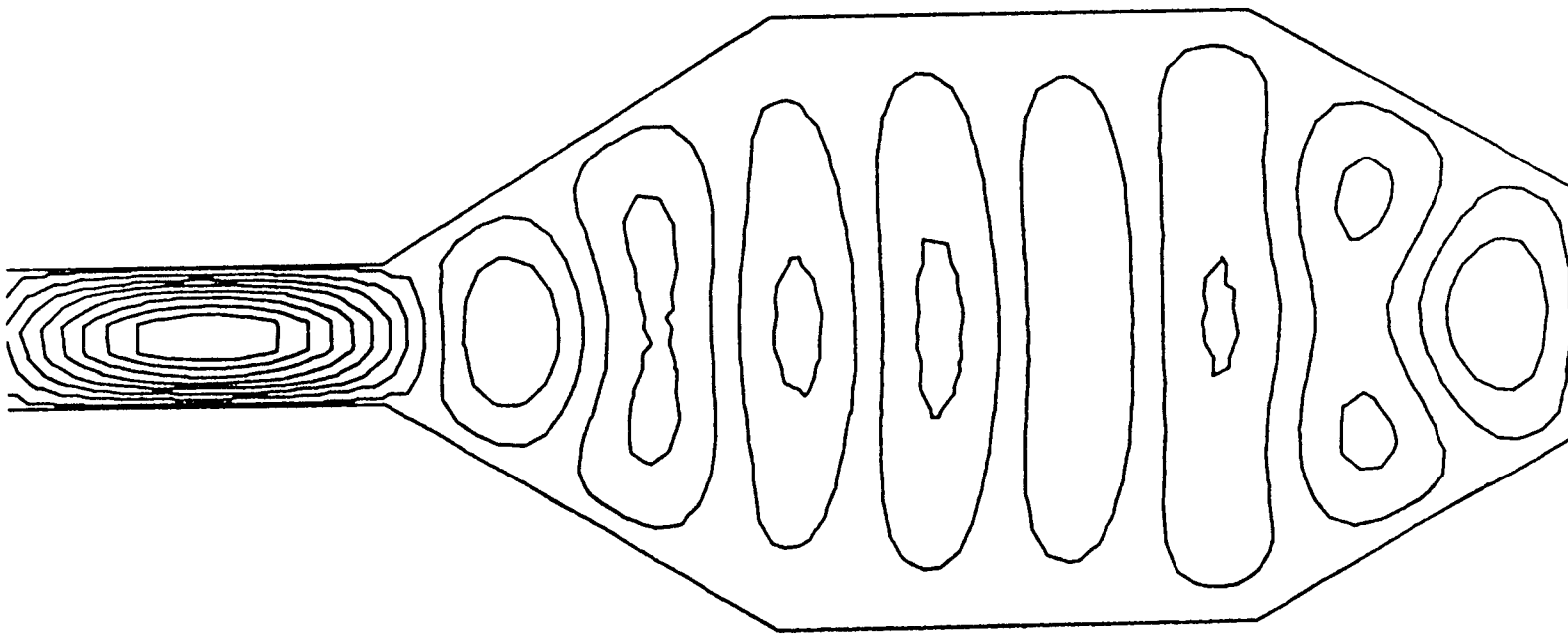
11,969 MHz

Figure 6. H-field lines for a mode with a cutoff frequency of 11,969 MHz



13,503 MHz

Figure 7. H-field lines for a mode with a cutoff frequency of 13,503 MHz.



15,914 MHz

Figure 8. H-field lines for a mode with a cutoff frequency of 15,914 MHz.