EFFECT OF TONE CONTROL ON THE FREQUENCY RANGE IN STRONG AND MODERATE CATEGORY BODY LEVEL HEARING AIDS.

REGESTER NO M9003

AN INDEPENDENT PROJECT WORK SUBMITTED IN PART FULFILMENT FIRST YEAR MASTER OF SCIENCE (SPEECH AND HEARING)

UNIVERSITY OF MYSORE

ALL INDIA INSTITUTE OF SPEECH AND HEARING, MYSORE-570006

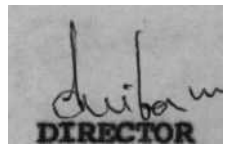
MAY 1991

DEDICATED TO

THE HEARING AID USERS.

CERTIFICATE

This is to certify that the Independent Project entitled " Effect of tone control on the frequency range in Strong and Moderate category body level hearing aids" is the bonafied work in part fulfilment for the Degree of Master of Science (Speech and Hearing) of the student with Register NO.M9003.

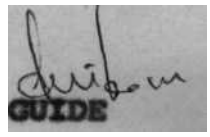


Mysore
May 1991

All India Institute of
Speech and Hearing
Mysore-57006

CERTIFICATE

ThiS iS to certify that the Independent Project entitled " Effect of Tone Control on the frequency range in strong and moderate category body level hearing aids" has been prepared under ay supervision and guidance.



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May 1991

DECLARATION

I hereby declare that this independent Project entitled " Effect of Tone control on the frequency range in Strong and Moderate category body level hearing aid" is the result of my own study under the guidance of Dr.(Ms)S.Nikam, Professor and Head of the Department of Audiology, All India Institute of speech and Hearing, Mysore, and has not been submitted earlier to any univeraity for any other Diploma or Degree.

Mysore

May:1991 Regester:No:M9003

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INTRODUCTION:

The hearing mechanism is one of the sensitive sensory system providing auditory information about far and near, events in an individuals environment.

In lower primates like fish, it is more of a balancing organ, while in higher order animals it helps as a danger sensing mechanism too, thereby enabling the individual for flight or fight.

Hearing plays a very important role in the acquisition of speech and language in humans. Any lesion to this system results in a variety of problem including the deficits in speech and language development, precipitates a number of psychological problems too.

The selection of an appropriate rehabilitation programme for these hearing impaired population falls under the domain of an audiologist apart from mere diagnosis. It includes proper selection of hearing aid, auditory training etc..

The selection of a hearing aid for specific problems is vary challenging and depends upon a number of factors like the degree, and type of hearing loss, age of the patient, etc.

The selection of hearing aid based on gain requirements alone is one of the errors which a student audiologist makes.

However while selecting the hearing aid, the tone control should also be considered equally important as the volume control. The patient should be made aware of its function.

Now comes the question - What is a "TONE CONTROL"?

Most hearing aids have a tone control that adjust the relative strength of the high frequency, low frequency and mid frequency tones that are amplified.

Emphasis on one or another tonal range usually is achieved by a combination of condensors and resistors in the circuits that transmit one range of tone more efficiently than another. The process actually is that of supressing the undesired range while the tones to be emphasises are transmitted relatively more efficiently.

A tone control positioned on 'H' is usually prescribed for the following cases:

- NIHL
- Precipitous high frequency hearing loss
- presbyacuisi
- Ototoxicity
- Congenitally hard of hearing children

Why Tone control on 'H'?

Most environmental sounds have high energy in the low

frequency and leas energy in the high frequency sounds (above 1 KHz). Normal hearing individuals take advantage of high frequency cues of speech to understand in noisy places. But cases with low frequency hearing and high frequency sensori neural hearing loss have more difficulty understanding speech in noisy conditions than those with normal hearing (Skinner).

It is also seen that eliminating low frequency from the hearing aid reduces internal noise, attenuates unwanted back-ground noise, reduces cochlear masking and thus optimally amplifies that part of the speech spectrum which conveys most of the consonant information (Franklin).

Extended high frequency range hearing aids appeared to be of value for persons with precipitous hearing loss of high frequency (Reddell and Calvert, 1966) and also it enhances speech intelligibility in noise (Schwartz et al, 1979).

The low frequency emphasis is not always preferred by case* (John E.Tecca & David P.Goldstein, 1984).

It is also seen that extended high frequency amplification between 4000 Hz and 6500 Hz is especially beneficial for optimum speech intelligibility and the performance on those aids which reduced low frequencies and extend high frequencies is better. These are mostly preferred in noisy conditions especially (Earc R. Harford & Jennifer Fox, 1978).

It should also be noted while prescribing hearing aids to children that the frequency range provided to Children should include sufficient low frequencies for vowel perception and sufficient high frequency for unambiguous /s/ perception and other consonants.(Ross).

The main aim of this study was to know:

- If there is a significant change in the frequency range with a change in tone control position.
- If there is a significant difference in the frequency range provided by different hearing aids.
- If there is a significant difference in the frequency range between the categories of hearing aids.

Need for the study:

- This study enables us to know :
  a) The change in the frequency range with change in tone control position.
  b) If there is real emphasis on high frequencies when the tone control is shifted to 'H' position.
  e) Provides a baseline data for further research.
  d) To see if the hearing aids are satisfying the required standards.

The study helps in bringing an awareness among the audiologists regarding the functioning of the tone control

and also on the frequency range obtained from the hearing aids. It is also helpful while counselling the patient about the use of hearing aid in noisy environments.

METHODOLOGY

A) Selection of hearing aidS

A total of 30 hearing aids were taken up for the study. Of these 15 hearing aids belonged to strong category and 15 hearing aids belonged to moderate category. Hearing aids were classified into moderate and strong (IS:lO775 - 1984) as per the manufacturers claim.

The hearing aids belonged to 6 models and in each model 5 hearing aids were taken. Of the 6 models two models had a provision of N, H1 & H2 tone control position.

B) Test Environment:

The test was carried out in an airconditioned sound treated room, whose ambient noise levels were within permissible limits (IS: 10776-1984).

C) Instrumentation:

The instruments used for the study are as follows:

- Insertion Gain - OptimIser IGO-HAT-1000.
- HAT 500 Test Box
- 1/2" Test Microphone
- A Dummy Microphone
- A 2cc coupler (Type DB 0138)

D) Connections:

Instruments were connected as shown in Appendix A Inside the HAT 500 test box connections were made with the test microphone.

E) Calibration:

After power-up "Testing hearing aid* was selected from the main menu to start the experiment Test-Sate calibration was selected to calibrate.

Procedures for Test-Site calibration:

- HAT speaker push-button on the front of the HAT 500 was depressed.
- The dummy microphone was inserted into the 2cc coupler.
- The receiver of the hearing aid was also inserted into 2cc coupler.
- The test microphone was placed at a distance of 5mm from the hearing aid microphone facing each other. The hearing aid was in "Off" position.
- Placement of dummy microphone, test microphone, and hearing aid are as shown in the Appendix- B
- "Enter" on the operating panel was pressed to calibrate the instrument.

F) Procedure:

The dummy microphone and test microphone were inter-changed from their earlier position as shown in Appendix-c

The hearing aid was put on and the volume control was set at full-on position.

On the operating panel 'Menu' was pressed and "Automatic Test Tone" mode was selected and ANSI-1987 standarda were selected.

"Saturated Sound pressure Level 90" and "Full-on-Gain" curve were obtained by pressing "Enter" on the operating panel.

By adjusting the volume control, the "Reference Test Gain" (RTG) position was obtained. So that the measured value met the goal value, the frequency response, and frequency range were displayed. The values of frequency range were recorded. After the recording was done with the tone control at 'N' position, the same procedure was carried out with tone control at 'H' position and the values of frequency range noted.

TABLE-1: Showing the Mean Values of Frequancy Range at various Tone Control positions in various models.

	Number	Frequency range at Tone Control Positions							
		N		H		Hl		H2	
	hearing aids	Lower end of the range	Higher end of the range	Lower end of the range	Higher end of the range	Lower end of the range	Higher end of the range	Lower end of the range	Higher end of the range
1	5	139.2	3486.2	468.8	6822	-	-	-	-
2	5	239	7824	412	7910	-	-	-	-
3	5	158	5600	403	5600	-	-	-	-
4	5	112	6630	161	8000	-	-	-	-
5	5	125	7381	-	-	344	6967	458	7301
6	5	133	6967	-	-	224	7296	387	7730

Showing the Mean value of the frequency range at various Tone Control positions in Strong and Moderate category hearing aids.

Category	Number of hearing aids		Frequency range at various Tone control positions							
			N		H		Hl		H2	
			Lower end of the range	Higher end of the range	Lower end of the range	Higher end of the range	Lower end of the range	Higher end of the range	Lower end of the range	Higher end of the range
Strong	10	Hearing aids with'H' Tone Control posi-tion only	146	4543	436	6211	-		-	
Mode-rate	10		181	7227.1	287	7955	-		-	
Strong	5	Hearing aids with H1 & H, Tone Control posi-tions	125	7381	-	-	344	6967	458	7301
Mode-rate	5		133.6	6967	-	-	224.2	7296	397	7730

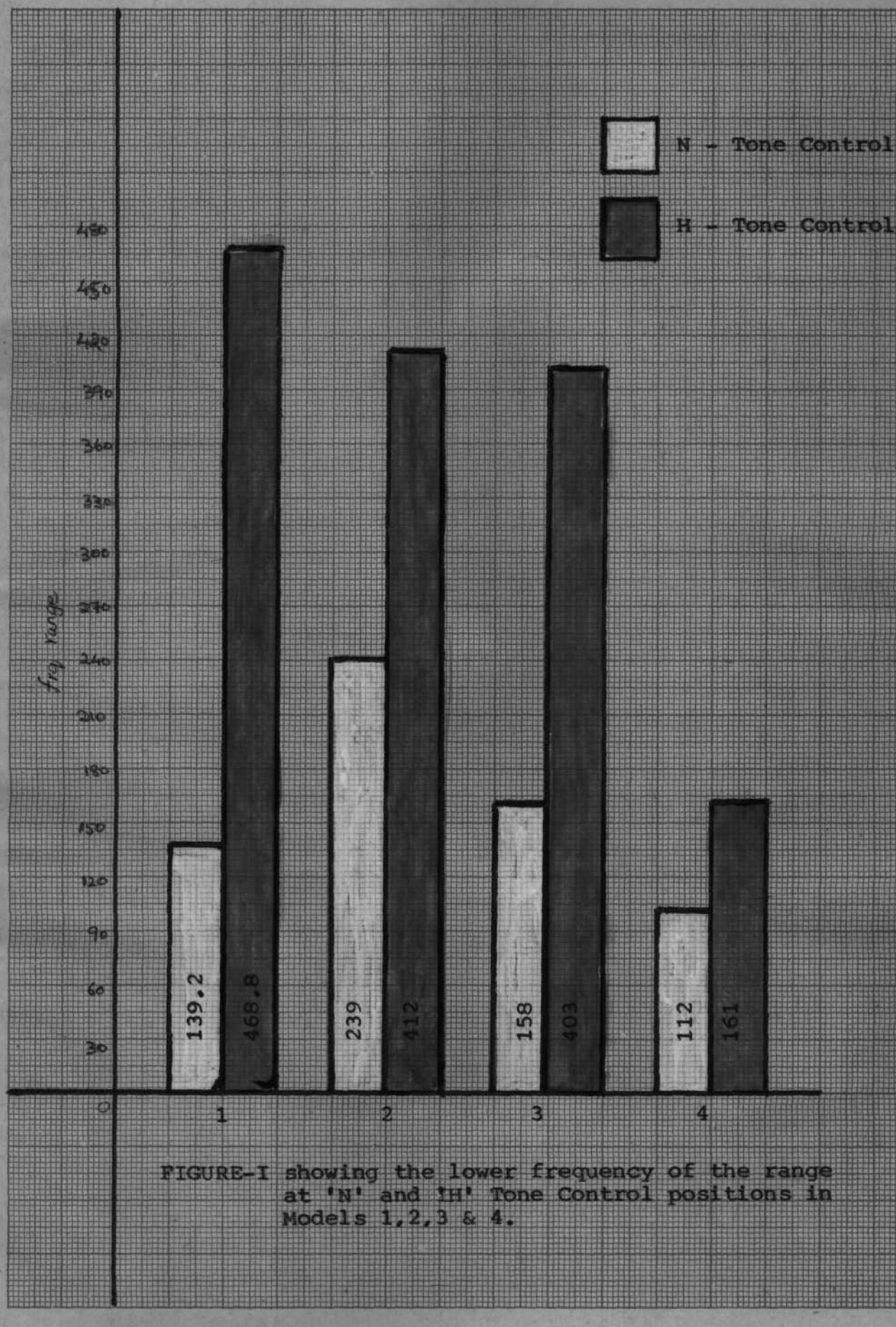


FIGURE-I showing the lower frequency of the range at 'N' and 'H' Tone Control positions in Models 1,2,3 & 4.

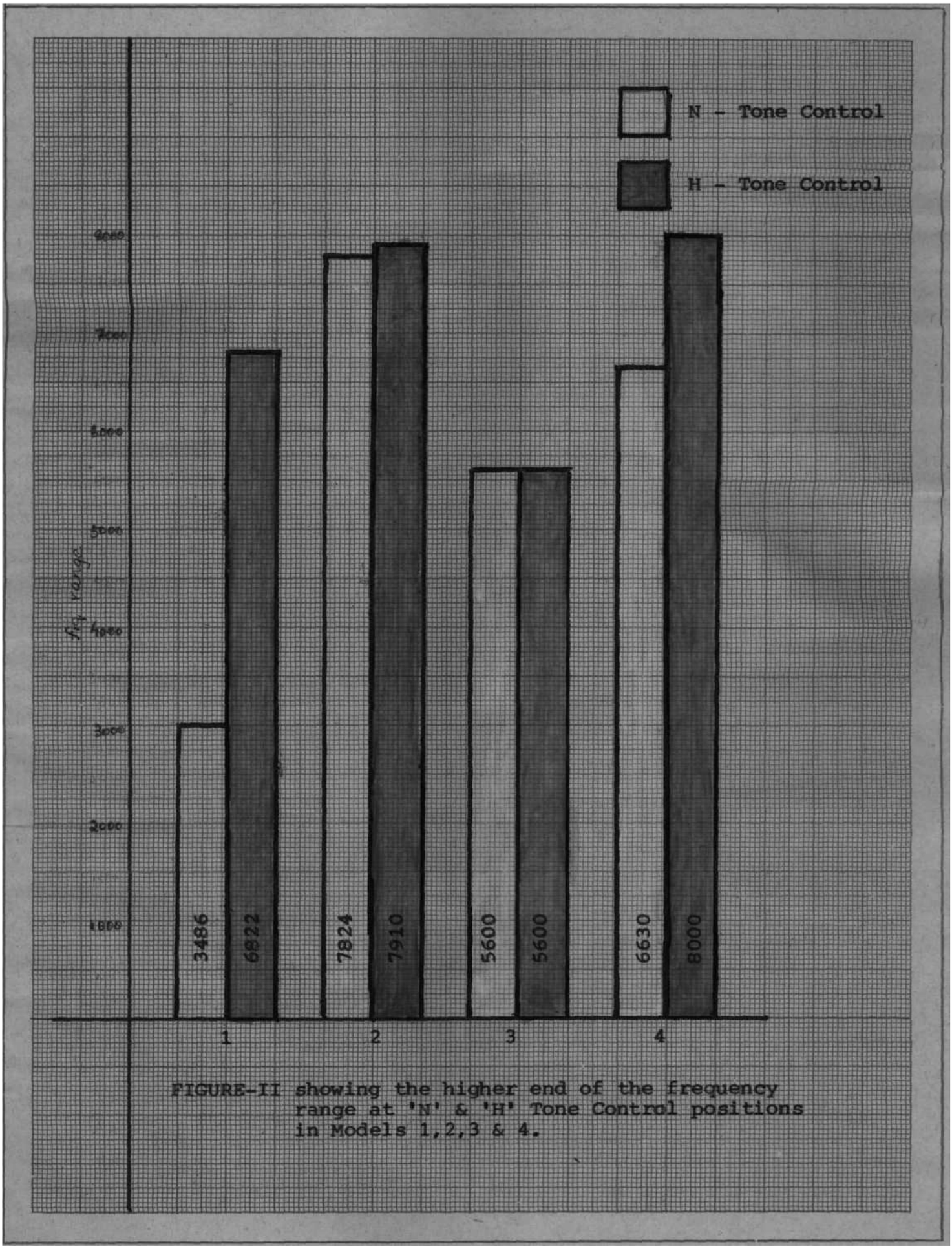


FIGURE-II showing the higher end of the frequency range at 'N' & 'H' Tone Control positions in Models 1,2,3 & 4.

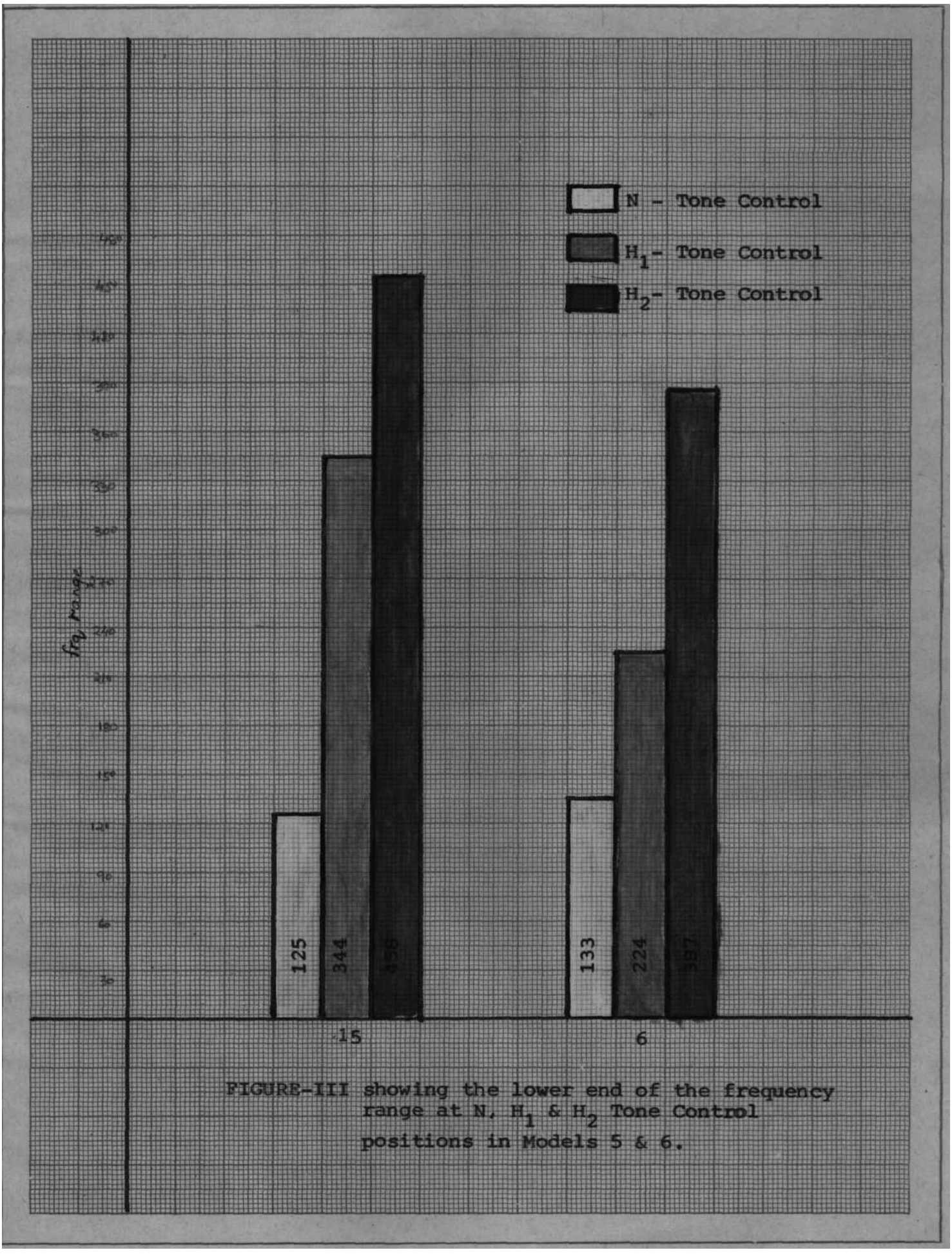


FIGURE-III showing the lower end of the frequency range at N, H_1 & H_2 Tone Control positions in Models 5 & 6.

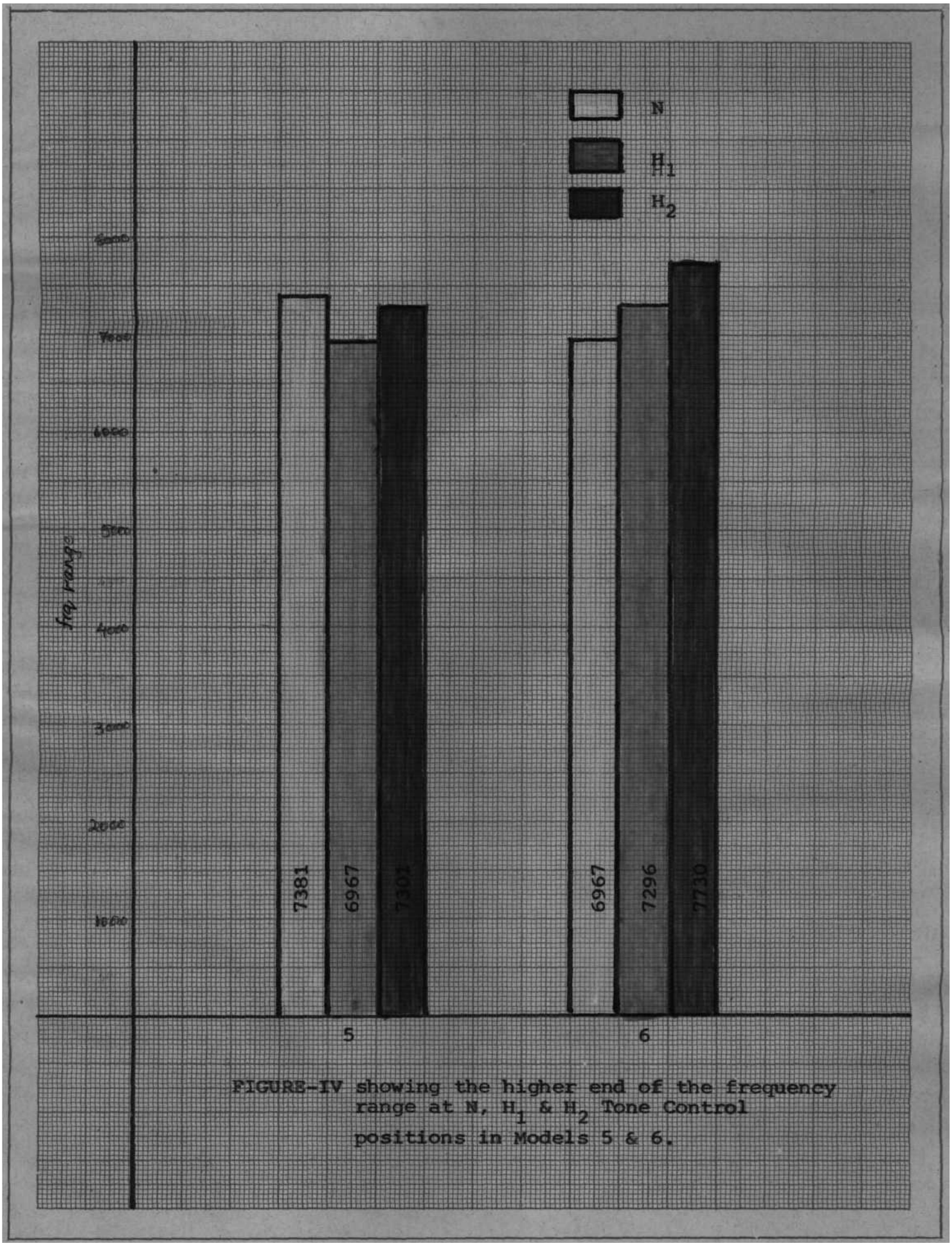
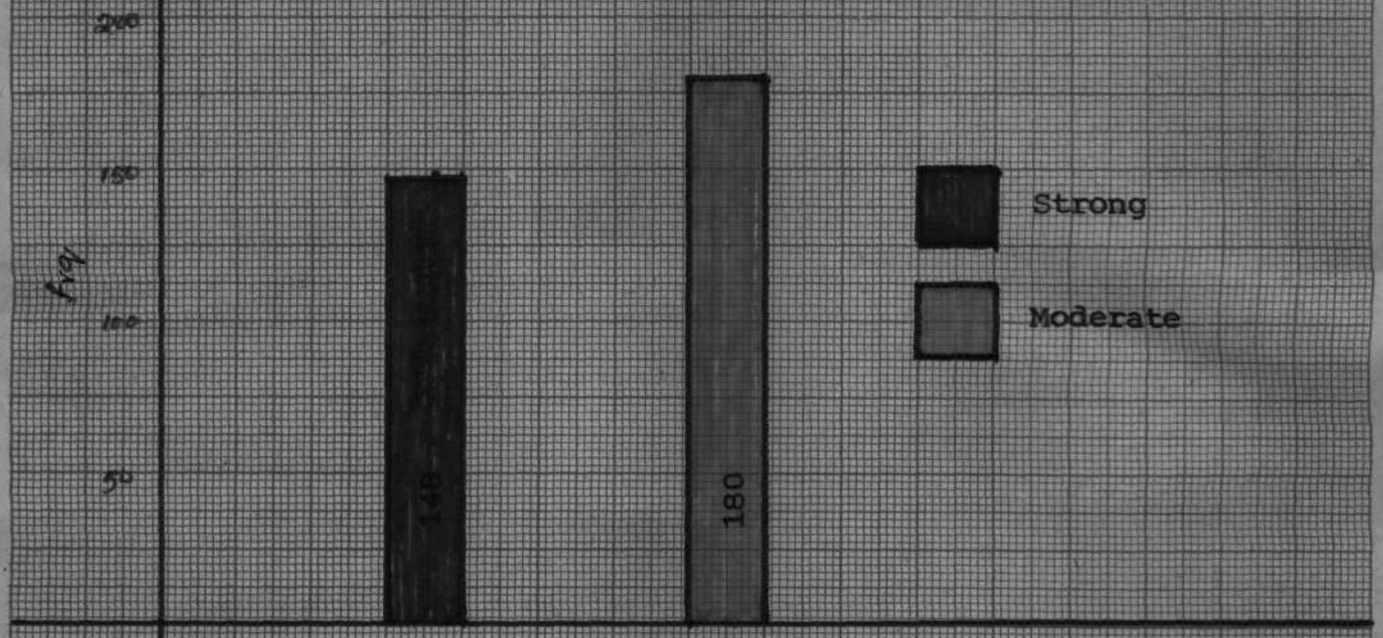


FIGURE-IV showing the higher end of the frequency range at N, H_1 & H_2 Tone Control positions in Models 5 & 6.

FIGURE-Va shows the lower end of the frequency range at 'N' Tone Control position in Strong and Moderate class hearing aids.



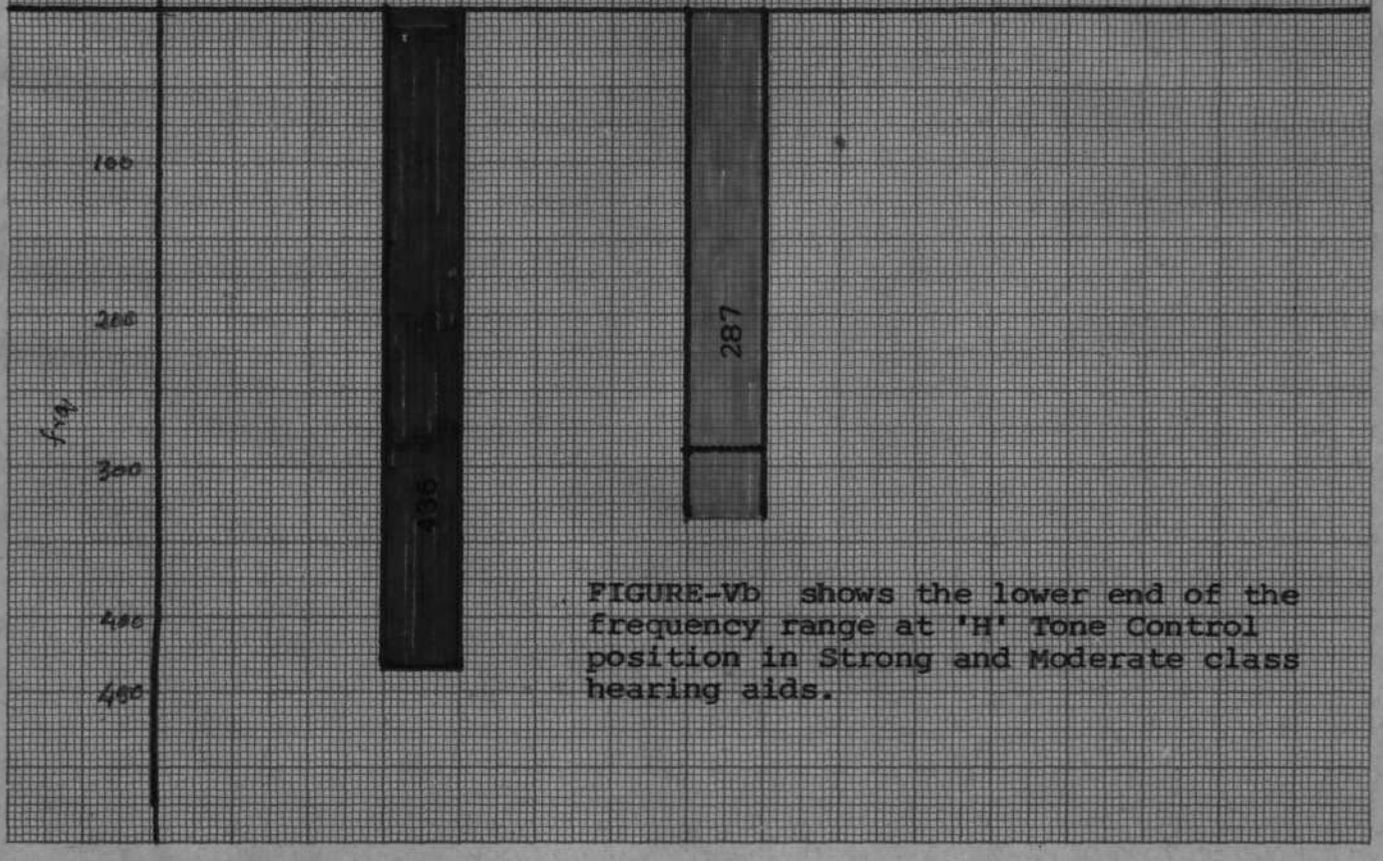


FIGURE-Vb shows the lower end of the frequency range at 'H' Tone Control position in Strong and Moderate class hearing aids.

FIGURE-VIa showing the higher end of the frequency range at 'N' Tone Control position in Strong and Moderate class hearing aids.

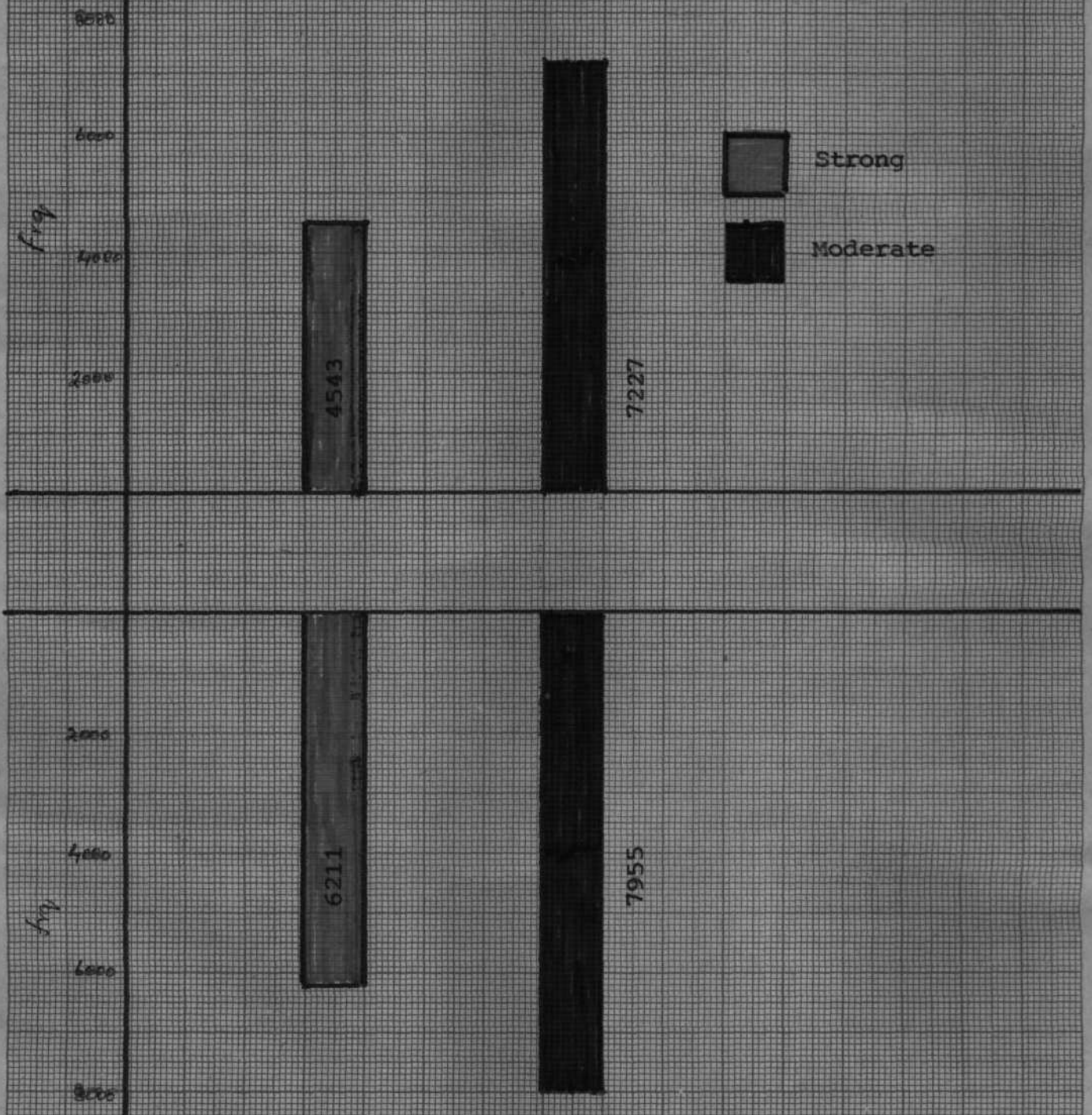
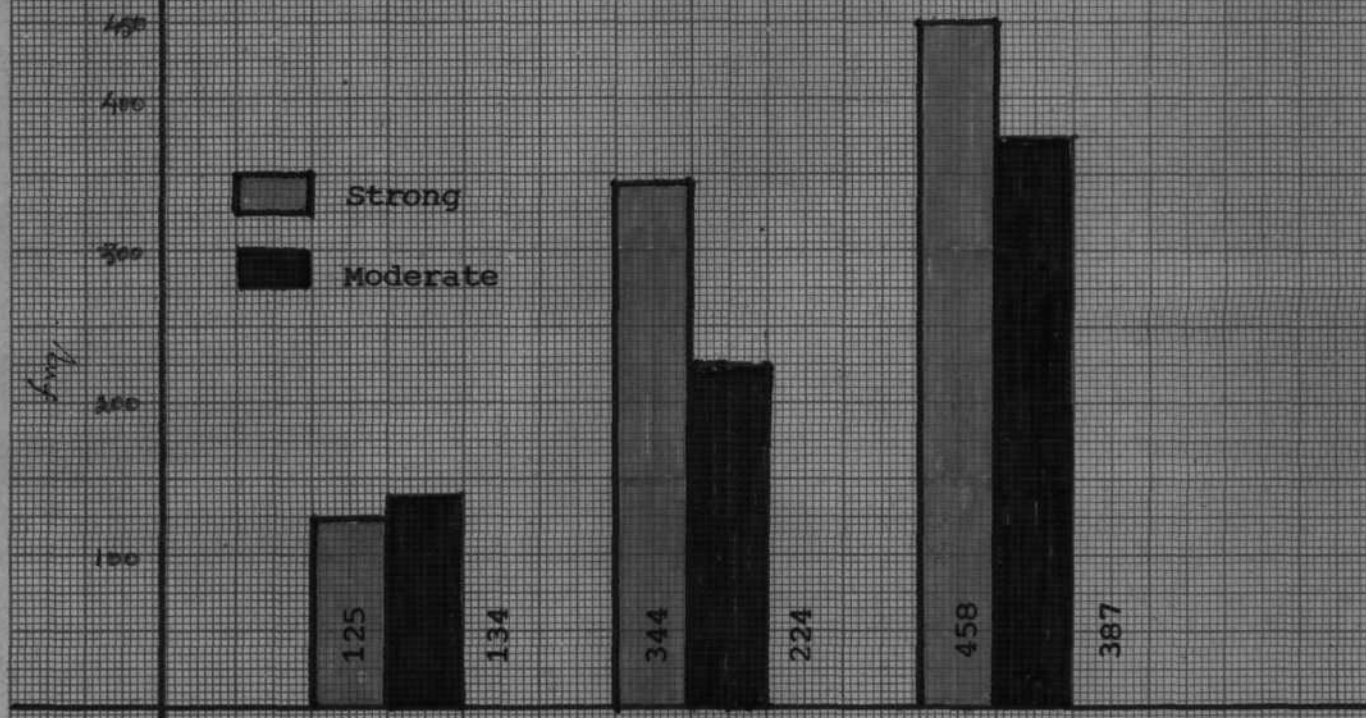


FIGURE-VIb showing the higher end of the frequency range at 'H' Tone Control position in Strongaand Moderate class hearing aids.

FIGURE VIIa showing the lower end of the frequency range at N, H_1 & H_2 in Strong and Moderate class hearing aids.



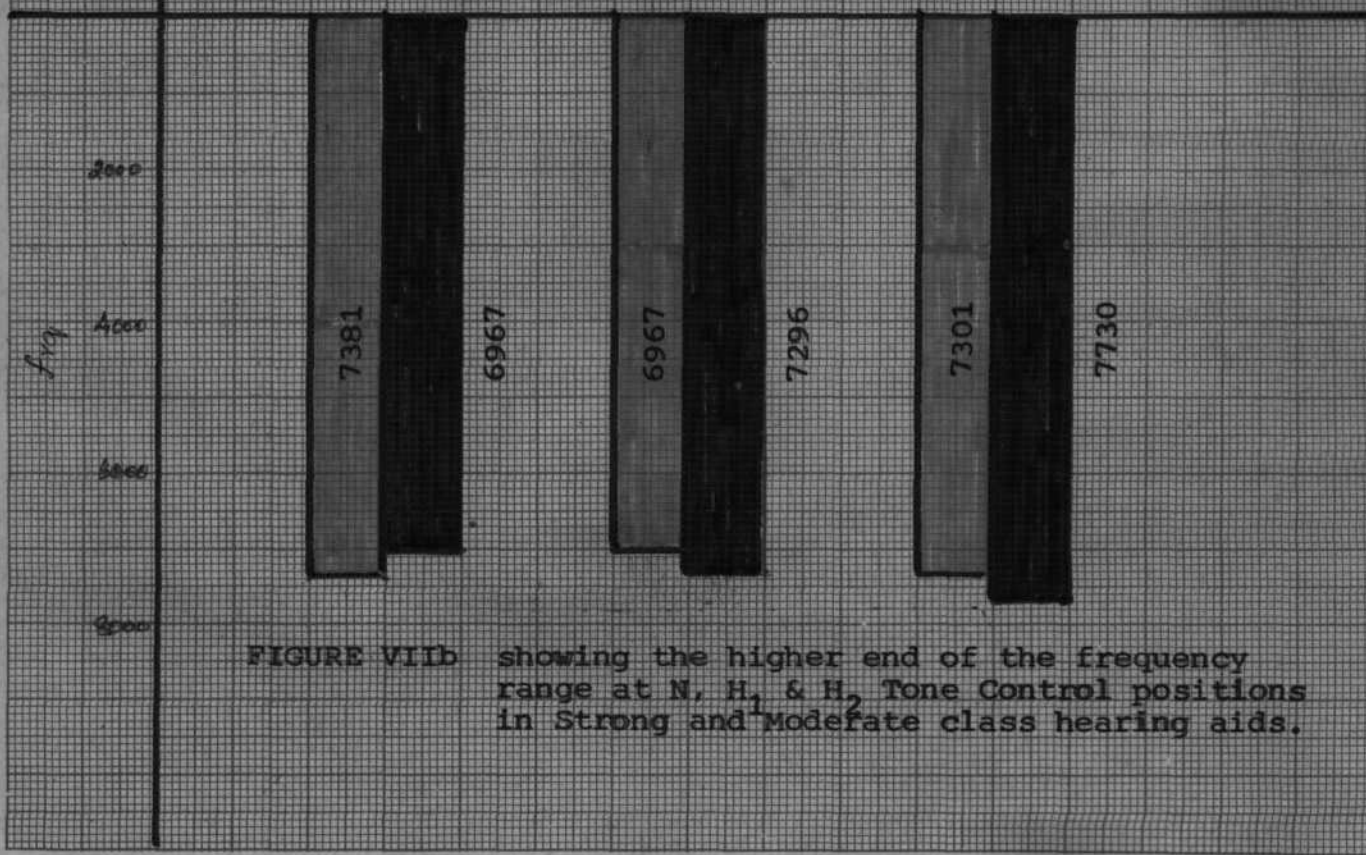


FIGURE VIIb showing the higher end of the frequency range at N, H_1 & H_2 Tone Control positions in Strong and Moderate class hearing aids.

RESULTS AND DISCUSSION

The data obtained has been analysed so as to find if there is any significant difference in the frequency range when the tone control is shifted from 'N' to 'H' positions.

The means of the frequency range at 'N' and 'H' positions were subjected to 't' test to determine any significant difference. Comparison has been done at 0.05 levels of significance.

The comparison has been done as follows:

I. Within the Models
II. Between the Models
III. Between Strong and Moderate categories

I. Within the Models;

Model-1 Showed a significant difference in the frequency range with change in tone control while Model-2 did not show any difference. However in Models 3 & 4 difference is seen only in the lower end of the frequency range. Models 4 & 5 had 3 tone controls N, H1 & H2 . So comparison has been done between (i) N and H1 , (ii) N and H2 (iii) H1 and H2 . The frequency range changed significantly in Model-4 between N and HL, but there was a change only in the lower end of the range when the tone control was

changed from N to H- and between H1 and H2 Model-6 : Comparison of the frequency ranges at N and H- showed a significant difference in the lower end of the frequency range only, but in N and H2 and H1 and H2 tone control positions there was a significant difference in the lower and higher ends of the frequency range.

II. Between the Models;

Significant difference in the frequency range at 'N' tone control position was seen between the following models; 1&2, 1&4, 1&5, 2&3, 2&5, 2&6, 3&5.

The Models 264 and 364 showed a significant difference only in the lower end of the frequency range at 'N' tone control position.

Significant difference in the highest end of the frequency range at 'N' was seen between the following Models: 1&3, 1&6, 3&6, 4&5, 4&6, 5&6.

At 'H' tone control position significant difference in the frequency range was seen between the following Models: 1&4, 3&4, 3&6, 4&5, 4&6.

Between the following Models significant difference was seen only in the lower end of the frequency range at 'H' tone control position: 1&2, 1&6, 2&4, 3&5, 5&6.

Significant difference in the higher and of the frequency range was seen between the following Models at 'H' tone control positions : 1&3, 2&3, and 2&5.

In the Models 1&5 and 2&6 there was no significant difference in the frequency range.

III. Comparison of the frequency range between Strong and Moderate categories:

a) Models with 'H' tone control only.

There was a significant difference only in the higher end of the range at 'N' tone control position but at 'H' position there was a significant difference in the whole range.

b) Models with H1 and H2 tone control.

Significant difference was seen only in the higher end of the frequency range at N, H1 and H2 position.

From the above findings it is evident that in most of the hearing aids there is a low frequency cut-off at 'H' tone control position, rather than an emphasis of the high frequencies.

Comparison between the hearing aid models reveal that there was a significant difference in the low frequency region when tone control is shifted to the 'H' position. However,

a Change in higher frequency was seen in some hearing aids.

In hearing aids with H1 and H2 tone controls the H2 tone control seems to be effective in emphasising the high frequencies.

At 'H' tone control position,significant difference in the frequency range was seen between the following models: 1&4, 3&4, 3&6, 4&5, 4&6.

Between the following models, significant difference was seen only in the lower end of the frequency range at 'H' tone control position :

i. 1 & 2
ii. 1 & 6
iii. 2 & 4
IV. 3 & 5
v. 5 & 6

Significant difference in the higher and of the frequency range was seen between the following models at 'H' tone control position:

i. 1 & 3
ii. 2 6 3
iil. 2 & 5

SUMMARY

A total of 30 hearing aids which consisted of six models with five hearing aids in each model were taken for the study.

All the hearing aids were subjected to electro acoustic performance on a standard instrument to obtain the frequency range at 'N' and 'H' tone control position. (TWO models out of the six had HL1and H2 tone control positions).

a) There was only a cut-off of the lower frequencies of the range when the tone control was shifted from 'N' to 'H' with in each models.

b) A comparison between the models showed heterogeneous results. However the lower frequency cut off was seen when the tone control position was shifted. Some models really showed a difference in the range when the tone control was shifted from 'N' to 'H'.

c) The comparison between strong and moderate class hearing aids showed a significant difference in the higher frequency of the range.

Clinical Implication:

The present study has the following clinical implications:

The variation of the tone control from 'N' to H1 and H2 does make a difference in the frequency range and the clinicians, parents and the hearing aid users should be aware of this fact and make use of this information. However that provision of H1 and H2 is not seen in all models.

It ia also seen that the low frequencies are cut off so 'H' tone control position can be used in places where there is low frequency noise.

The strong category hearing aids provide greater high frequency emphasis than the moderate category hearing aids apart from the gain.

The hearing aid user may vary the tone control and report which tone control position provides better information. They should be encouraged to use different tone control position according to their needs.

Recommendation:

- To study the same parameters on a large sample and compare the results and on other models of body level and ear level hearing aids.
- To study the effect of 'L' tone control position on the frequency range.
- Subjective reports from patient's may be Obtained.

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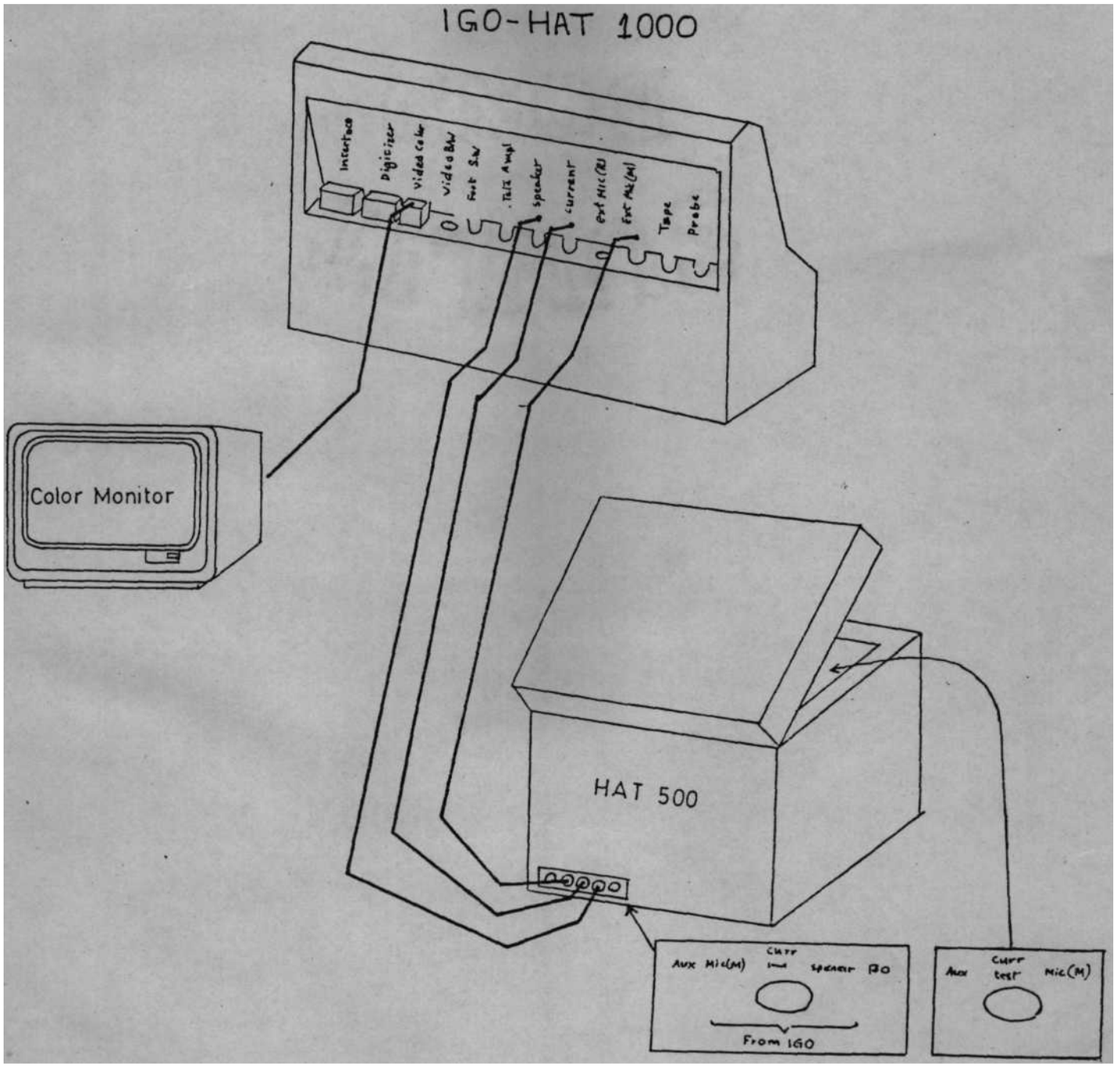
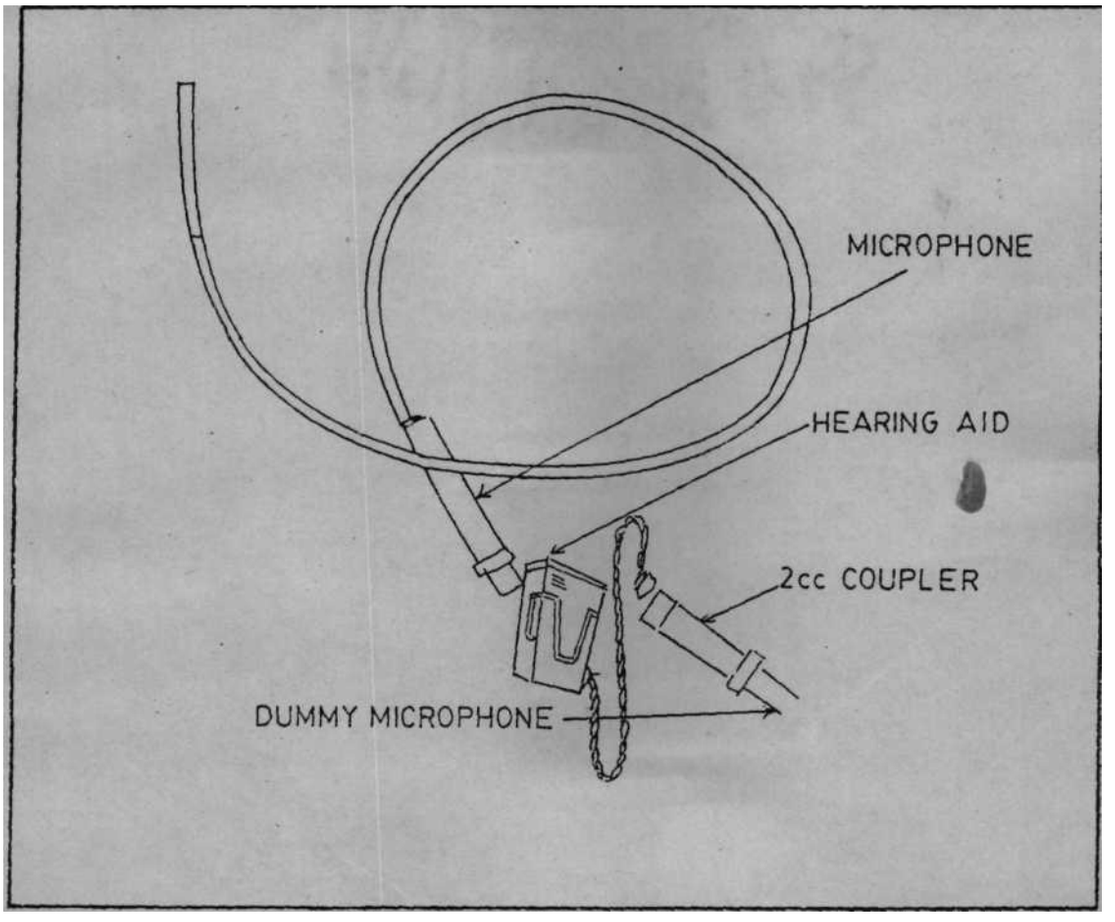
APPENDIX-A

Schematic representation of the connections made between the instruments ased for the study,



APPENDIX-B

Shows the position of dummy microphone, test microphone, hearing-aid and 2cc coupler inside the test box during calibration.



APPENDIX- C

Shows the position of dummy mic; test mic, hearing aid and 2cc coupler inside the test box during testing situation