CHAPTER - V

STUDY OF THE RESPONSE OF THE CIRCUIT WITH CHANGE OF THE TAPPING POINT

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5.1 CIRCUIT DIAGRAM :- In order to find the optimum operating conditions, the new active-R circuit is studied again with variations in tapping parameter A. The circuit is redrawn to indicate the tapping parameter A for resistance R_1. The circuit is shown in fig. (5.1).

5.2 CIRCUIT ANALYSIS :- In litrature with the help of single pole model, verious circuts were deigned[1-10]. The circut analysis of new active-R biquadratic filter to study the response with change in tapping point parameter A is same as that of discussed in section (3.3).

With the help of equation (3.1) and tapping point parameter A, the voltage transfer function becomes as follows.

The voltage transfer function for low pass filter.

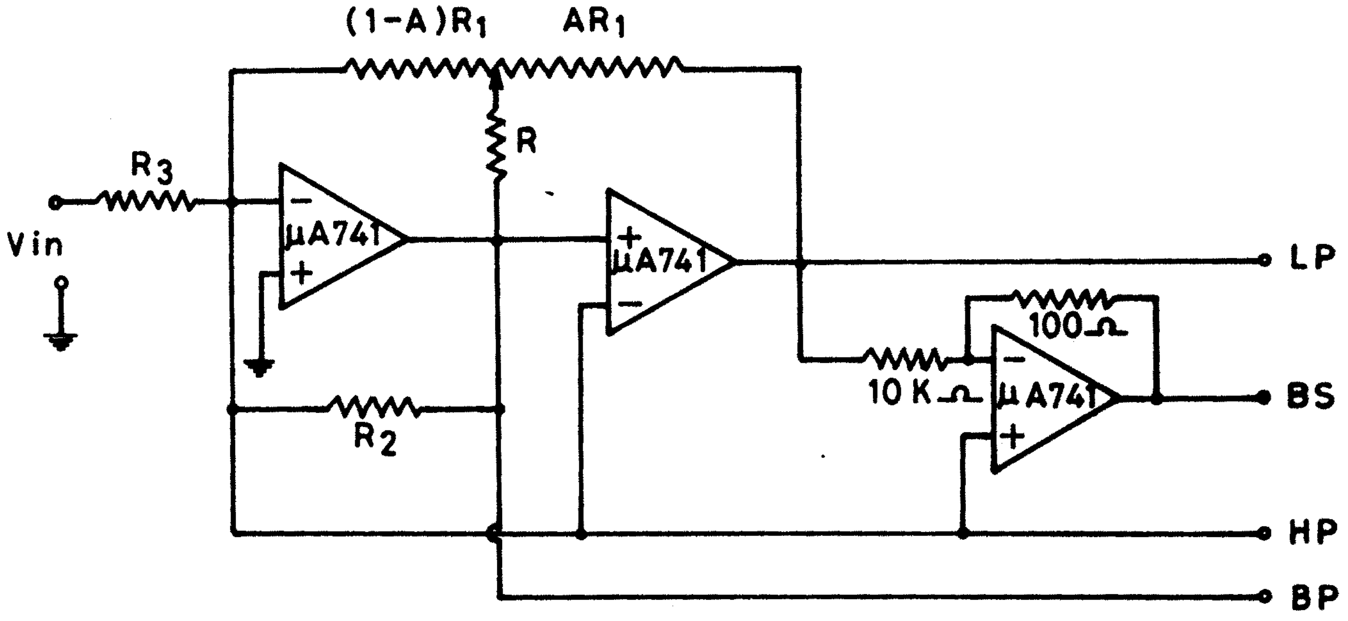

Fig. 5·1 Circuit diagram for new active R biquadratic filter for change in tapping point.

$T_{LP}(S) =$

$$= \frac{-(1/R_3)GB_1 \cdot GB_2}{S^2[\,1/R_A + 1/R_2 + 1/R_3] + S\,[\,GB_1(1/R_2 + \frac{A}{(1-A)AR_1+R}) - GB_2\,(\frac{R}{R_1[(1-A)AR_1 + R\,]})] + GB_1GB_2\,(\frac{R}{R_1[(1-A)AR_1+R]})}$$

.... (5.1)

Voltage transfer function for high pass filter $T_{HP}(S) =$

$$= \frac{(\,1/\,R_3)\,S^2}{S^2\,[\,\frac{1}{R_A} + \frac{1}{R_2} + \frac{1}{R_3}] + S\,[GB_1(\frac{1}{R_2} + \frac{A}{(1\,-A)AR_1+\,R}) - GB_2\,(\frac{R}{R_1[(1-A)AR_1+R]})]\,+GB_1 . GB_2(\frac{R}{R_1[(1-A)AR_1+R]})}$$

.... (5.2)

Voltage transfer function for band pass filter $T_{BP}(S)$ =

$$= \frac{-(1/R_3).\, GB_1\, .S}{S^2\left[\frac{1}{R_A}+\frac{1}{R_2}+\frac{1}{R_3}\right]+S\left[GB_1\left(\frac{1}{R_2}+\frac{A}{(1-A)AR_1+R}\right)-GB_2\left(\frac{R}{R_1[(1-A)AR_1+R]}\right)\right]+GB_1.GB_2\left(\frac{R}{R_1[(1-A)AR_1+R]}\right)} \qquad \ldots\ldots\ldots (5.3)$$

where a small term is appearing in the numerator has been neglected as GB >> S.

The value of R_A is given by

$$\frac{1}{R_A} = \frac{1}{(1-A)R_1} - \frac{AR}{(1-A)R_1[(1-A)AR_1+R]} \qquad \ldots\ldots\ldots (5.4)$$

5.3 DESIGN CONSIDERATION :-

The general second order transfer function is given by

$$T(S) = \frac{\alpha_2\, S^2 + \alpha_1 S + \alpha_o}{S^2 + (W_O/Q)\, S + W_O^{\,2}} \qquad \ldots\ldots\ldots (5.5)$$

comparing equation (5.1), (5.2) and (5.3) with this equation, we get

$$\frac{W_0}{Q} = GB_1\left(\frac{1}{R_2} + \frac{A}{(1-A)AR_1 + R}\right) - GB_2\left(\frac{R}{R_1[(1-A)AR_1+R]}\right) \quad \text{.............(5.6)}$$

$$W_0^2 = GB_1 GB_2\left(\frac{R}{R_1[(1-A)AR_1+R]}\right) \quad \text{.........(5.7)}$$

$$1 = \frac{1}{R_A} + \frac{1}{R_2} + \frac{1}{R_3} \quad \text{.............(5.8)}$$

By using these equations, we can get the values of R_1, R_2, R_3 with variation of tappin point parameter A for center frequency F_0 = 10 kHz and Q = .2.For more practical values of these resistances, multiply by impedance scale factor 100.

5.4 EXPERIMENTAL STUDY WITH VARIATION IN TAPPING POINT PARAMETER :-

The performance of circuit was studied for different tapping point parameter A = 0.1 ,0.3,0.5,0,7,0.9. The output response for low pass , high pass ,band pass and band stop filters were taken at four different output terminals and the frequency responses are plotted as shown in fig.[5.2],[5.3],[5.4] and [5.5]. The theoretical curve for A = 0.5, Q = 0.2 and F_0 = 10 kHz is shown by (——·——).

5.5 RESULT AND DISCUSSION :-

A) LOW PASS RESPONSE :-

The low pass response is shown in fig. (5.2). The theoretical and exprimental results are in good agreement with the theoretical observation. The responses were plotted for A = 0.1. 0.3, 0.5, 0.7 and 0.9. The observed center frequency is also in good agreement with designed value. Below 10 Khz the response shows slight variation in gain with respect to tapping point. However, above 10 Khz all curves marge and level off after 500 KHz. It is observed that, highest gain for low pass response was found for tap point A = 0.5. The gain decreases as tapping point moves towards either extremities. The gain roll off at high frequency region is 35 db/decade.

B) HIGH - PASS RESPONSE :- The high pass response is shown in fig (5.3). Result shows close agreement between the designed and experimental values. The satisfactory response is observed from 1 Khz onwards. The designed value of f_o agreed well with observed values. The gain roll- off was found to be excellent when tapping point is at the extreme points. However, the gain - roll of is decreases as tapping point moves towards center point.

C) BAND PASS RESPONSE :- The bandpass response is shown in fig(5.4). In this case also good agreement was observed between

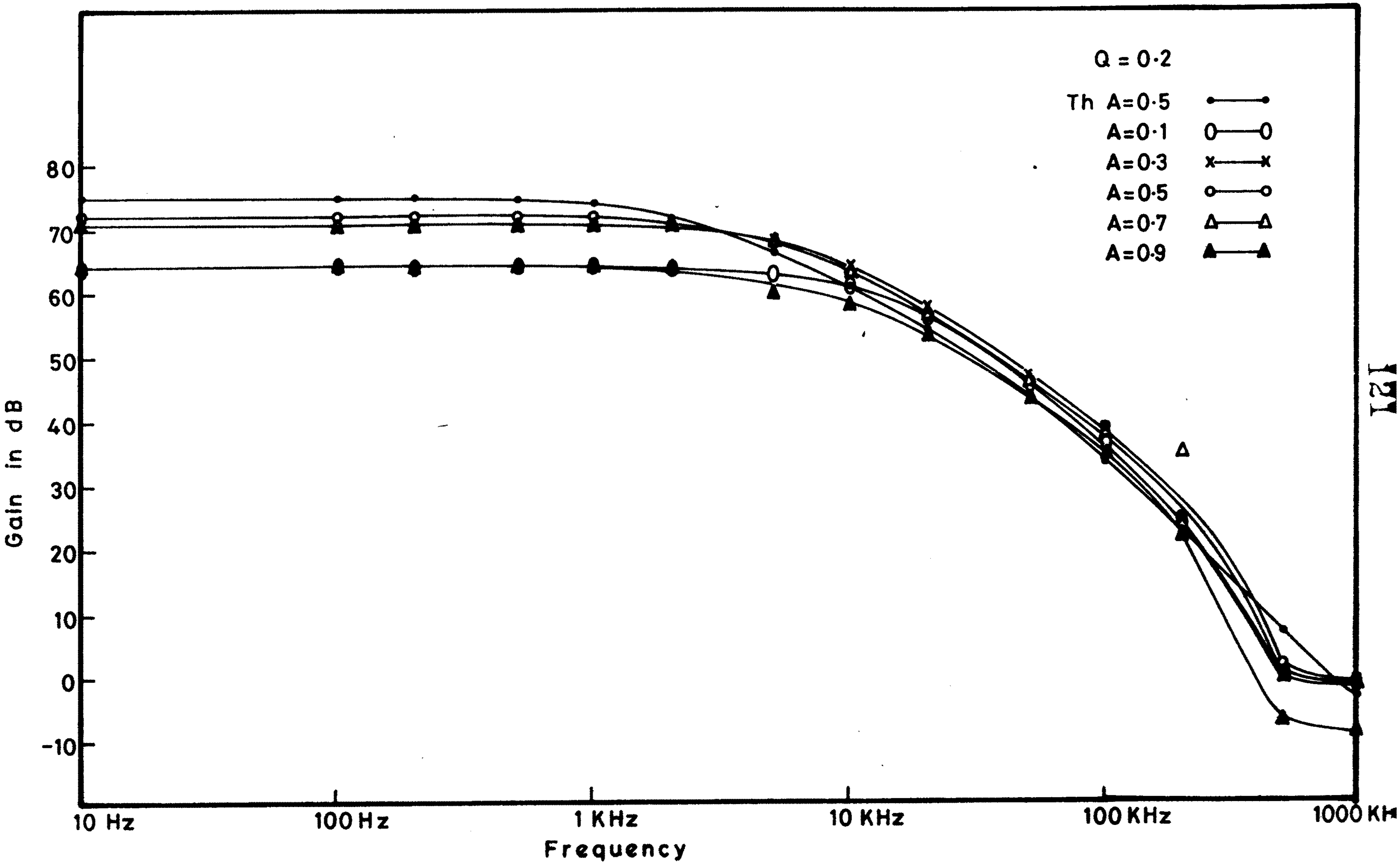

Fig. 5.2 Low pass responce for fo = 10 KHz, Q=0·02 and variation in tapping point.

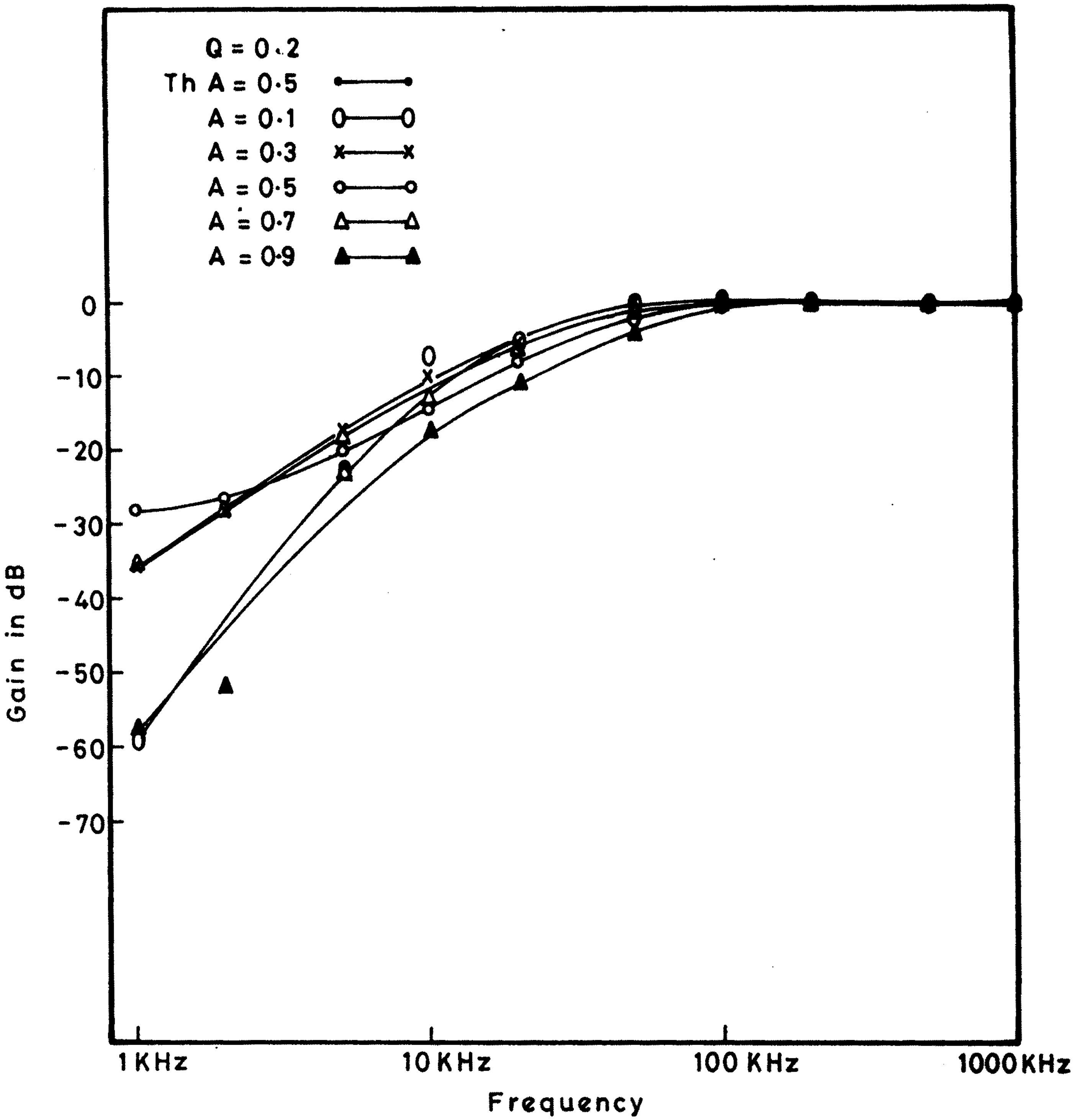

Fig.5·3 High pass response for fo = 10 KHz, Q=0·2 and variation in tapping point .

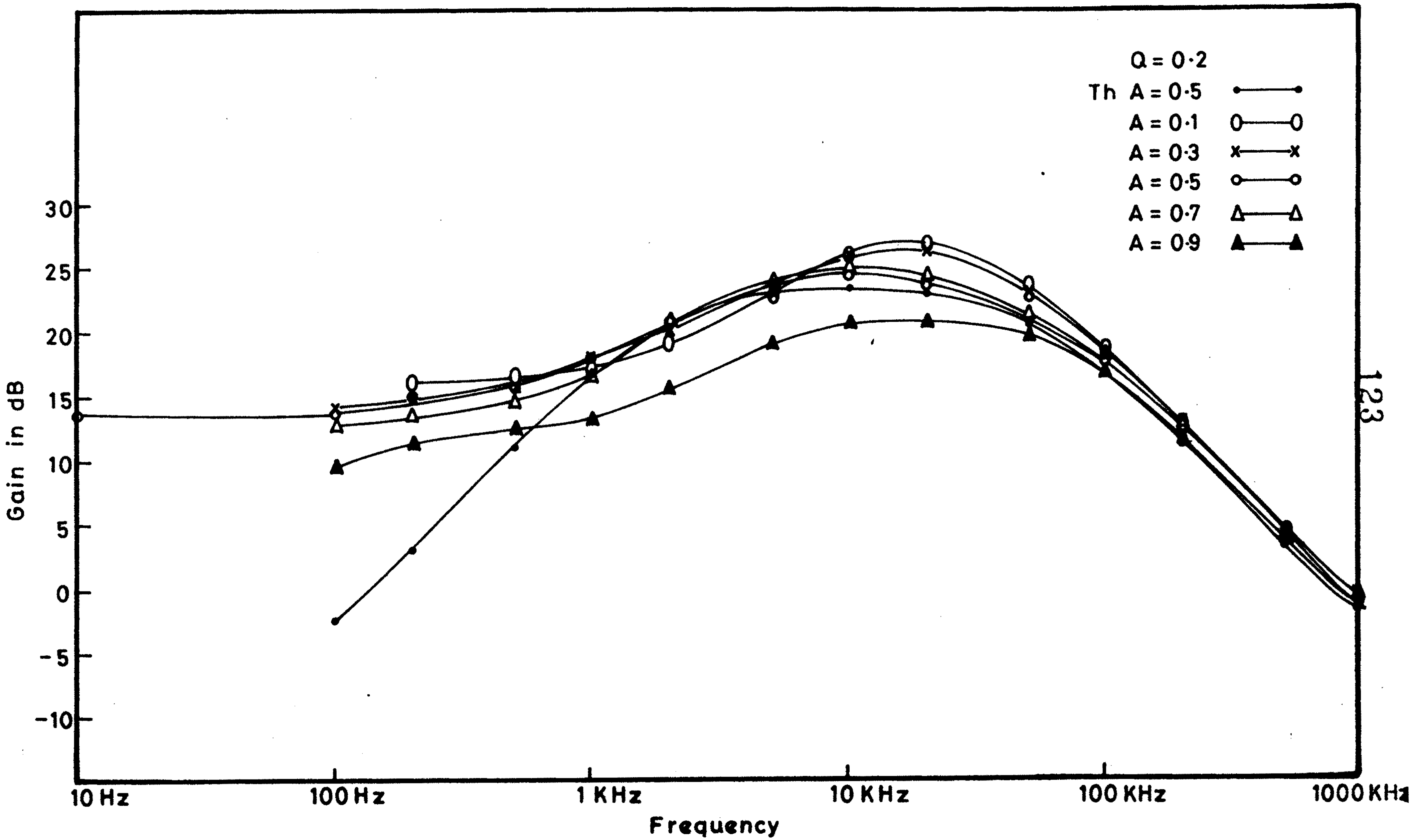

Fig. 5.4 Band pass response for fo = 10 KHz, Q=0·2 and variation in tapping point.

theoratical and observed results. On very low frequency side, there is degradation. Above 100 Khz, all curves marge together. The center frequency is almost equal to the designed value of f_o = 10Khz .The response becomes peaked as tapping point moves towards extreme points.

1] BAND STOP RESPONSE :- The bandstop response is shown in fig(5.5). It is seen that by moving the tap point towards extreme points, the gain decreases. Below 2 Khz the response is almost flat and sharply decreases up to 100 Khz and above 100 Khz the response increases up to 0 dB, then becomes flat. We are getting sharp rejection point with very good deep. The center frequency does not match with the designed value.

The Table (5.1) summarizes overall behavior of the circuit for different tapping point parameter A. In this table the designed value of F_o, Q, gain bandwidth product and low pass gain is compared with observed values

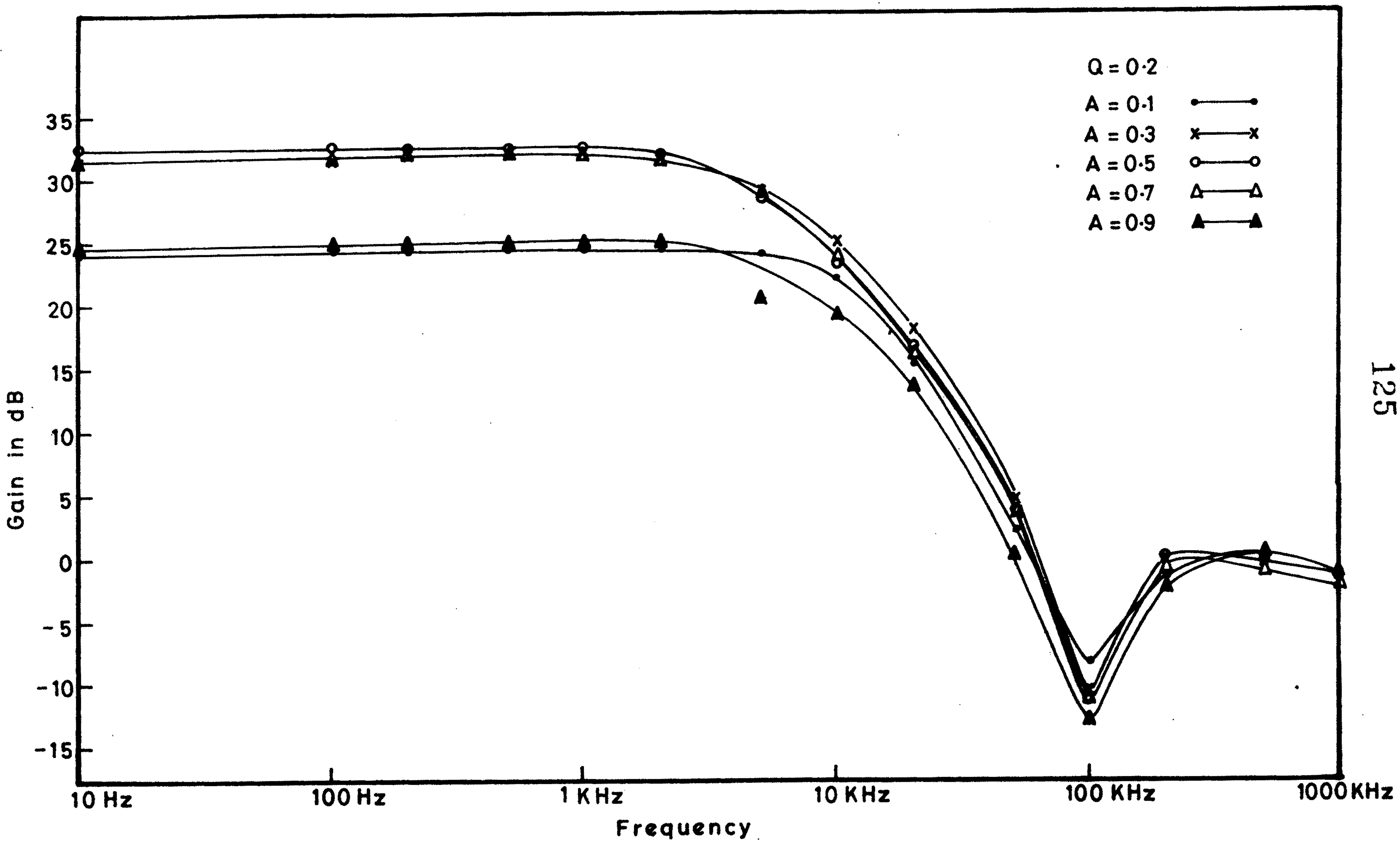

Fig. 5.5 Band stop response for fo 10 KHz, Q=0·2 and variation in tapping point.

TABLE (5.1) EXPERIMENTAL AND DESIGN VALUE COMPAIRISION

Tapping point parameter A	Q		F_0 kHz.		GB Product $2\Pi.10^5$		Low pass gain in dB
	DE.	Exp.	DE.	Exp.	DE.	Exp.	
0.1	0.2	0.4	10	15	7.8	9.00	64.29
0.3	0.2	0.3	10	15	7.8	9.00	71.82
0.5	0.2	0.2	10	10	7.8	7.67	72.36
0.7	0.2	0.2	10	10	7.8	8.05	71.93
0.9	0.2	0.2	10	10	7.8	8.62	64.71

(where DE. = Design value, Exp. = Experimental Value)

5.6 CONCLUDING REMARK :- The new active R filter discussed here for the variation in tapping parameter A shows excellent agreement with Theoretical results. For low pass response, gain decreases when tapping point moves towards extreme points. However, for band pass, the response becomes peaked as tapping point moves towards extreme points. For band pass response some degradation is observed at very low frequencies. The center frequency was not distrubed with change in tapping point parameter.

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