HAZELTINE RESEARCH, INC.

(A SUBSIDIARY OF HAZELTINE CORPORATION)

OFFICE AND LABORATORY
325 West Huron Street
Chicago 10, Ill.
DElaware 7-3055

Report No. 8015

A FOUR-STAGE 40 MC IF AMPLIFIER

March 23, 1953

AFFILIATED LABORATORIES

HAZELTINE ELECTRONICS CORPORATION
58-25 Little Neck Parkway
Little Neck, L. I., N. Y.
FLushing 7-8700

HAZELTINE CORPORATION
58-25 Little Neck Parkway
Little Neck, L. I., N. Y.
FLushing 7-8700

HAZELTINE RESEARCH, INC. OF CALIFORNIA
(A Corporation of Delaware)
3320 West Burbank Blvd.
Burbank, Cal.
ROckwell 9-2658

Printed in U. S. A.

H A Z E L T I N E R E S E A R C H , I N C .

Report No. 8015

A FOUR-STAGE 40 MC IF AMPLIFIER

March 23, 1953

APPROVED W. C. Swinyard

A FOUR-STAGE 40 MC IF AMPLIFIER

This report describes the design, construction and performance of a four-stage, 40 Mc IF amplifier which has been found suitable for use in a TV receiver where high sensitivity is required. When this amplifier was used with a typical cascode turret-type tuner, picture carrier sensitivities of the order of 98 and 95 db below one volt on Channels 2 and 13, respectively, were obtained for an output of one volt dc above noise at the video detector load. With a high-gain video stage, using a tube such as the 6CL6, it should be possible to realize overall receiver sensitivities of the order of 100 db below one volt.

desired attenuation, and the loading resistors in the stages containing the traps were readjusted to obtain the final overall response characteristic.

The circuit is shown in Fig. 1. The 1000 μμf bypass capacitors used throughout were Centralab ceramic disc-type capacitors with an average lead length of 1/8" after the unit was wired in the circuit. The series resonant frequency of the bypass capacitor and leads was approximately 48-50 Mc. A double-tuned band-pass circuit employing low-side capacitive coupling is used between the mixer plate and first IF grid. The frequency response char-

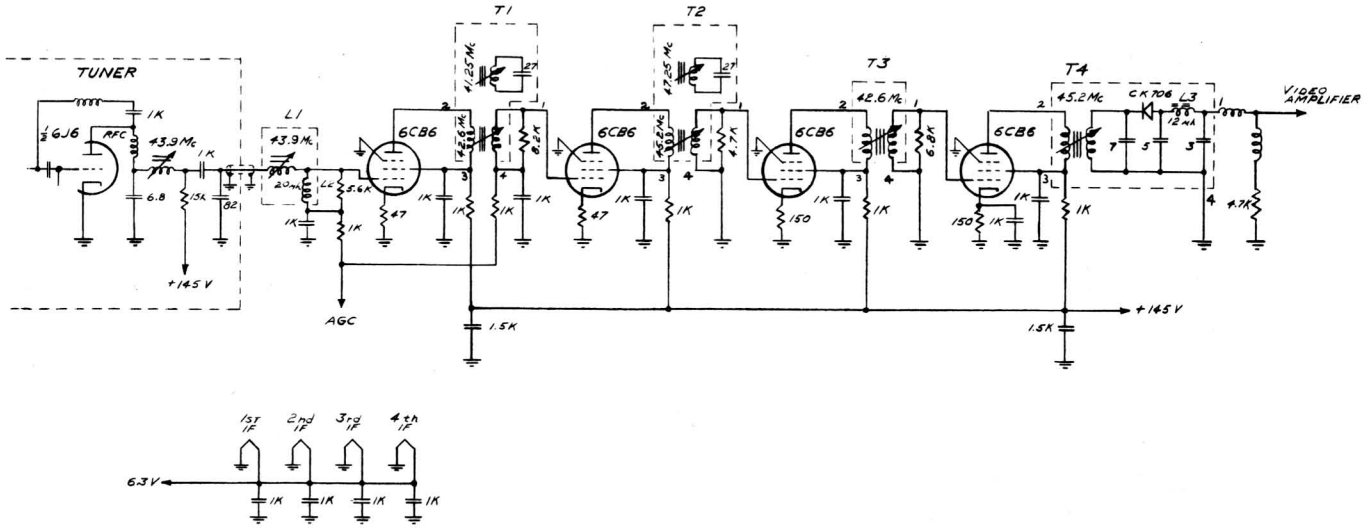

Fig. 1 - Schematic Circuit of Amplifier

The circuit chosen includes a broad-band coupling network between the tuner and the first IF grid, followed by two staggered pairs. The two staggered-pair arrangement was chosen in preference to a staggered quadruple since it appeared to offer greater stability. This was later verified experimentally. The staggered pairs also have the advantage of fewer alignment frequencies, although the staggered quadruple may have somewhat higher gain. The design procedures followed were those discussed in Henry Wallman's article, "Stagger-Tuned Amplifier Design," Electronics, May 1948, (see also letter in July 1948 issue, p. 224). The stagger frequencies and circuit bandwidths were computed, and the individual circuits were designed accordingly. Actual individual bandwidth measurements were made at this point to check the circuit Q's, and circuit loading resistors were adjusted to obtain the desired overall response characteristic. The traps were then put in and coupled to give the

acteristic of this circuit is shown in Fig. 2. The precautions ordinarily used in aligning circuits in which the coupling is greater than critical should be observed when aligning this circuit, or, pref-

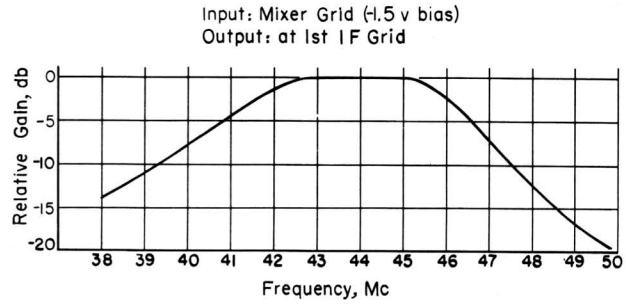

Fig. 2 - Frequency Response of Mixer Plate Circuit

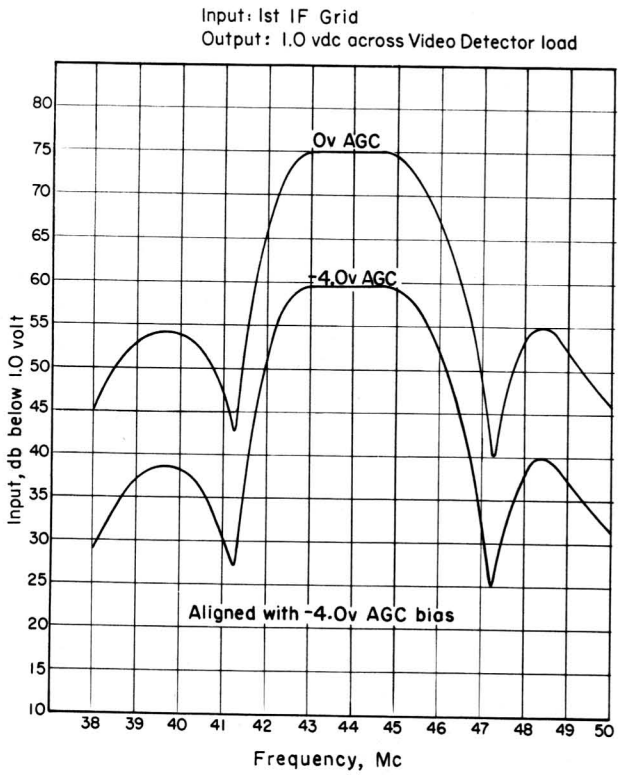

Fig. 3 - Frequency Response of Two Staggered Pairs Having Four 6CB6 Stages

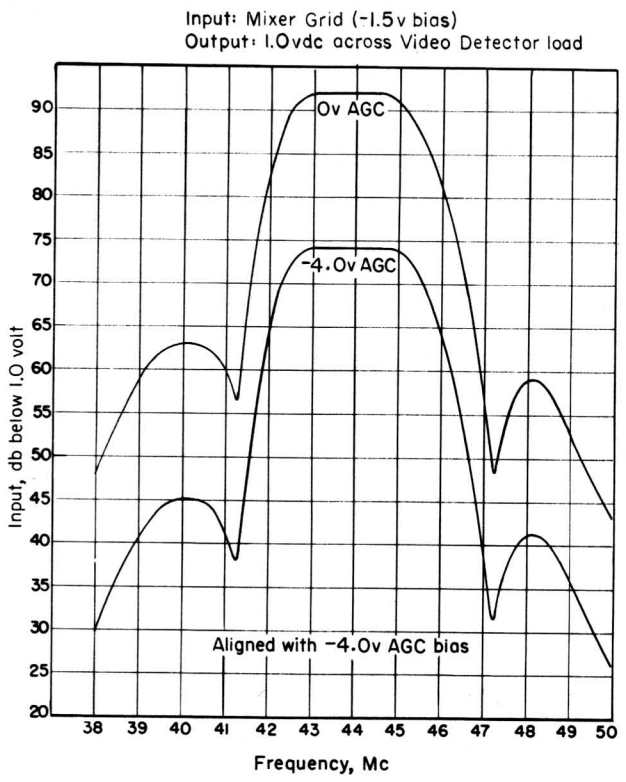

Fig. 4 - Overall IF Characteristic with Four 6CB6 Stages

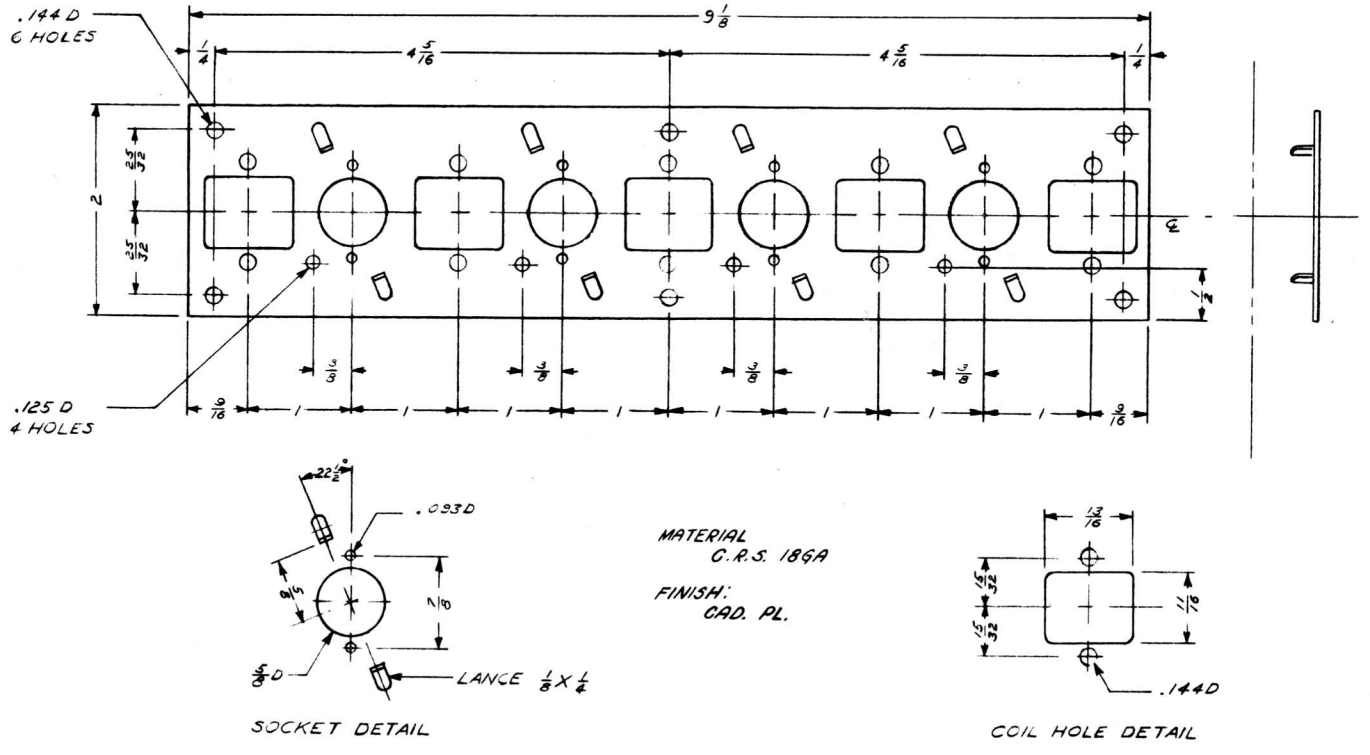

Fig. 5 - Dimensions of Subchassis of Amplifier

erably, it should be sweep-aligned. Following this circuit is the four-stage amplifier consisting of two staggered pairs using bifilar-wound transformers for interstage coupling. The frequency response characteristic for this portion of the circuit is shown in Fig. 3, and the overall IF characteristic is shown in Fig. 4. As indicated in Fig. 4, the bandwidth at 6 db down is 3.6 Mc. The sound carrier is attenuated 30 db below picture carrier level, and the adjacent channel sound carrier is attenuated 36 db. The cathode resistor in the third IF stage was left unbypassed. However, if more gain is required, an increase can be obtained by bypassing this resistor.

The subchassis in which this circuit has been tested is shown in Fig. 5. The layout allows lead lengths to be kept short and input and output circuits to be kept remote from each other. Shields were used on all tubes and the sockets had grounded center posts. With this arrangement good overall stability was obtained in all units tested. Coil data are given in Table I.

If somewhat less gain is required an alternative design may be of interest. This employs 6BA6 tubes in the last two stages in place of 6CB6's and in addition requires the following changes in the circuit of Fig. 1:

1. The B+ isolation resistors for the last two stages were changed to 2.7 kΩ values.
2. Appropriate socket wiring changes were made for the cathode and suppressor circuits since the base connections of the two tube types are not the same.
3. The cathode resistor in the third IF stage was bypassed with .001 μf. This addition helped to offset the loss resulting from the use of tubes with lower transconductance.
4. The loading resistor across the secondary of T2 was changed from 4.7 kΩ to 6.8 kΩ.
5. The loading resistor across the secondary of T3 was changed from 6.8 kΩ to 5.6 kΩ.

TABLE I

COIL SPECIFICATIONS

T1 Standard Coil Part No. X-3469-2 or equivalent. 1 turn added to trap coil, making it an 8-turn coil. Trap coil spaced 1/16" from transformer winding.

T2 Standard Coil Part No. X-3469-2 or equivalent. Trap coil spaced 3/32" from transformer winding.

T3 Standard Coil Part No. X-3469 or equivalent.

T4 Standard Coil Part No. X-3469 or equivalent. Video detector components within the transformer shield can are not included with the Standard Coil transformer, but were added later.

L1 43.9 Mc Coil. 11 turns of No. 26 formex wire on 9/32" o.d. form. (Mechanical parts and powdered-iron core from a Standard Coil transformer, Part No. X-3469, were used for this assembly).

L2 20 μh RF Choke. (Universal winding).
Form : 1/2" x 1/8" d bakelite form, Speer Part No. CF-1/8.
Wire : 40 SSE
Cam : 0.093"
Gears : 82/79
Turns : 75

L3 12 μh Tweet Filter Coil. (Solenoid winding).
Form : Stackpole S.O. No. 99-1163 powdered-iron form.
Wire : 40 SSE
Turns : 40, close wound.

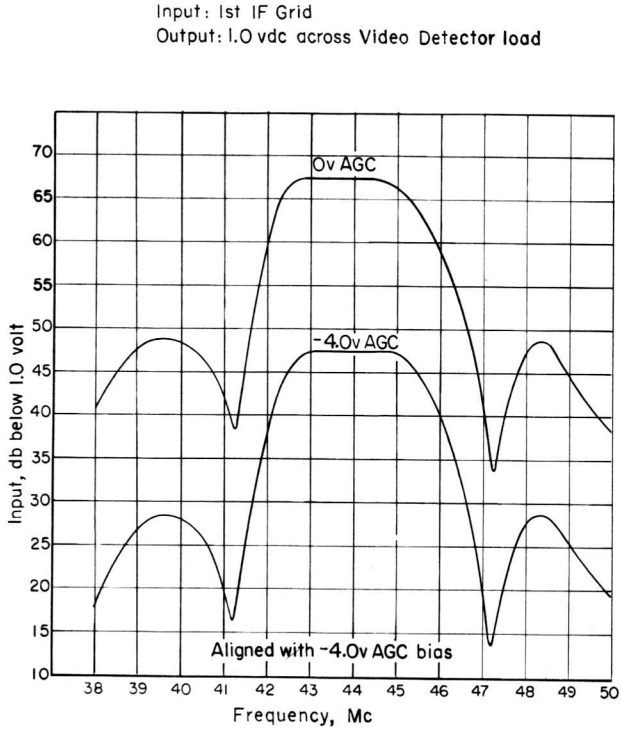

Fig. 6 - Frequency Response of Two Staggered Pairs Having Two 6CB6 Stages and Two 6BA6 Stages

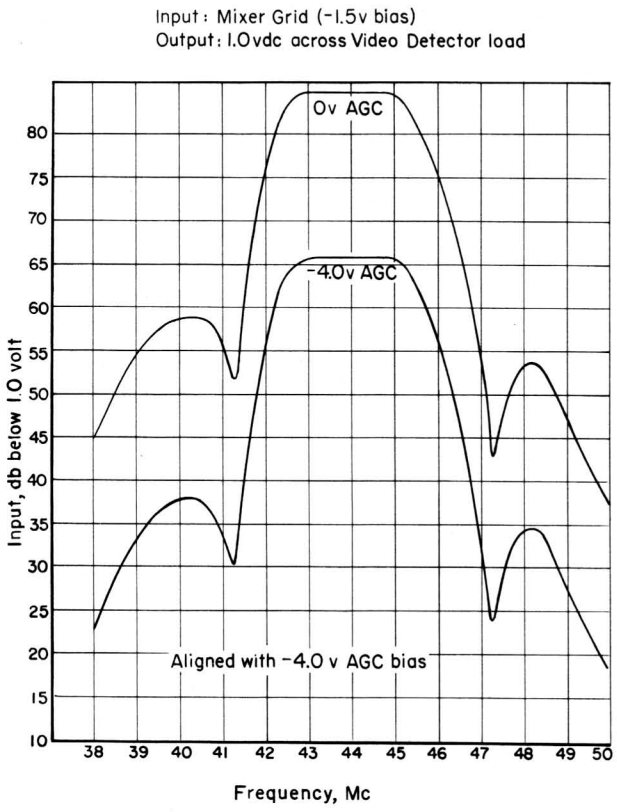

Fig. 7 - Overall IF Characteristic With Two 6CB6 Stages and Two 6BA6 Stages

6. The capacitor across the secondary of T4 was changed from 7 μμf to 2 μμf.

With these changes, the frequency response of the staggered pairs was as shown in Fig. 6, and when combined with the tuner band-pass circuit gave the overall IF characteristic shown in Fig. 7. The performance obtained is essentially the same as for the previous case with the exception of a 7 db reduction in gain and a cost saving of approximately eleven cents.

HAZELTINE RESEARCH, INC.

Colbert K. Nakata
Engineer

Stephen P. Ronzheimer
Supervising Engineer

March 23, 1953