AUTOMATIC INTER-STATION NOISE SUPPRESSION OR SILENT TUNING

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5100 SOUTH VERMONT AVENUE · LOS ANGELES 37, CALIFORNIA, U. S. A.

AUTOMATIC INTER-STATION NOISE SUPPRESSION OR SILENT TUNING

INTER-STATION NOISE WITH A.V.C. SYSTEMS. Although automatic volume control systems produce the desired results as far as maintaining the volume output of the receivers nearly constant is concerned, a rather disturbing condition accompanies the action, and that is inter-station noise.

As long as a station signal is tuned in, the automatic volume control system partially suppresses the amplification in the radio-frequency and inter-mediate-frequency circuits according to the increased bias on the tubes. But between stations when no signal voltage is being received, the automatic volume control action is not present, and there are no special potentials limiting the bias of the radio frequency or intermediate frequency tubes. Consequently the full power of the amplifying system is operative; and with the high sensitivity with which the modern receiver is possessed, everything that is picked up, including all sorts of stray noises, etc., is highly amplified. The result is that a most annoying racket is given out by the speaker. But as soon as a station carrier is tuned in again, the bias is increased, the sensitivity is suppressed, and the noise disappears.

Tuning such a receiver is, therefore, not very pleasant under such condi-tions, for as the dial is tuned from station to station this noise is heard intermittently and the effect is anything but agreeable. This trouble was first remedied in some receivers by using a "muting" switch, which consisted merely of a push-button switch that grounded the grid or some other part of the audio amplifier and thus rendered it inoperative so that the receiver remained silent until the button was released. The objection to this method, of course, was that the finger had to be held on the push-button as long as the set was being tuned if the noise was not wanted.

INTER-STATION NOISE ELIMINATION IN
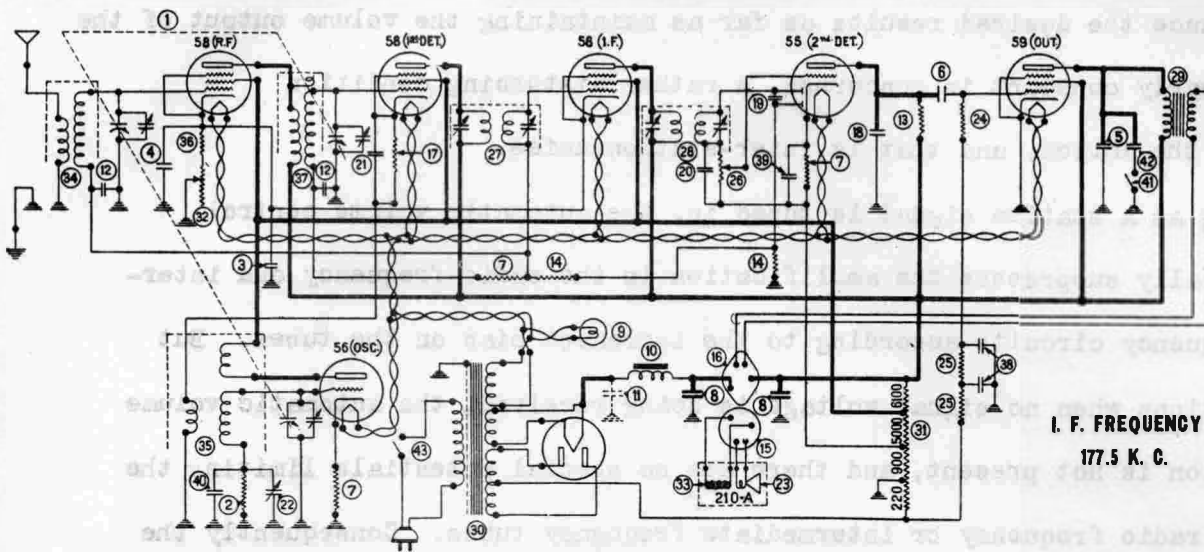## THE STEWART-WARNER MODEL R-106

I. F. FREQUENCY
177.5 K. C.

Fig. 1

The circuit arrangement used in the Stewart-Warner Model R-106 radio receiver contains a number of interesting features, including a simple system of inter-station noise elimination. The circuit is illustrated in Fig. 1, and is a standard superheterodyne with a preliminary radio frequency amplifier and a single intermediate frequency stage. The oscillator is coupled to the 1st detector or mixer tube through a pick-up coil in the cathode return line. A type 59 tube connected as a pentode is used in the audio output stage.

The 2nd detector stage, however, is of special interest. Here a type 55 tube is used. The upper plate, it will be observed, is used as a half-wave rectifier detector, with resistor 26, a 500,000-ohm potentiometer, serving as a load. The slider of the potentiometer is connected to the grid of the triode unit which performs as a 1st audio stage. In the cathode return a 2000-ohm resistor R-7 is used, and the voltage drop across this resistor places a

constant negative bias on the detector diode plate. As a result no signal or noise detection can occur unless the signal voltage reaching the diode plate exceeds this bias. It is in effect a form of delayed signal detection, and the arrangement acts as an effective noise elimination or squelch circuit. When resistor 32, which is an 8000-ohm rheostat, is used in combination with the manually operated sensitivity control, it is possible to eliminate the objectionable noise that is heard when the tuning system is shifted from station to station.

The second plate is coupled to the detector plate through a .001-mfd. condenser and is used for automatic volume control. For this function the cathode is grounded through the 900-ohm section of the voltage dividing resistor 31, and the circuit is closed through the 1-megohm load resistor No. 14. The potential drop across the 900-ohm resistor biasss the A.V.C. plate about 15 volts negative, which means that no rectification or A.V.C. action can take place until the incoming signal is built up to this value. Also, this is the minimum signal value that is capable of giving audio output, and any station not capable of giving full audio output to the speaker, is not further reduced in volume by the action of the A.V.C. system. This is another excellent example of "delayed automatic volume control", whereby weak stations are allowed to come in with much better volume and the effects of severe fading are greatly minimized.

AUTOMATIC INTER-STATION NOISE SUPPRESSION

The automatic system of inter-station noise suppression, or quiet automatic volume control as it is also called, is a circuit arrangement that automatically renders an A.V.C. receiver silent during the tuning process, that is while the tuner is being shifted from station to station. Thsse automatic muting circuits

in some cases form an entirely independent system, while in others they comprise an integral part of the receiving circuit. Practically all automatic noise suppression or "Q" systems as they are sometimes called, operate on the grid bias of the 1st audio stage, and the various circuits differ only in the way in which this bias influence is produced.

The general action of the various suppressor systems is as follows. An extra type 57 or 58 tube is used which is commonly referred to as the Q or squelch tube. This tube is arranged so that its grid is associated with the plate circuit of the A.V.C. tube and its plate circuit with the grid of the 1st audio stage. As long as no signal is being received, the A.V.C. tube is inactive and the grid and cathode of the Q tube are allowed to be at the same potential. Under these conditions the Q tube draws a heavy plate current that builds up an appreciable potential across a load resistor in the plate circuit. This load resistor also forms part of the grid return circuit of the 1st audio tube, and hence the potential across it becomes an additional negative bias that carries the grid of the audio tube clear down to the plate current cut-off point. This renders the tube inoperative so that no signal can pass through, noise or otherwise, and the receiver is silent or muted.

When a station signal is tuned in, the A.V.C. tube becomes active and plate current flows through its load resistor, which it will be remembered is also in the grid circuit of the Q tube. The resulting potential across the resistor then automatically biases the grid of the Q tube and causes it to draw less plate current. This decreased plate current reduces the drop across the plate resistor and decreases the bias on the 1st audio tube so that it can again function and permit signals to pass through, thereby rendering the receiver operative.

The Q tube is thus a relay that operates between the A.V.C. and the 1st audio stages. At no incoming signal the A.V.C. tube is inactive, but the Q tube is over-active, as might be said, and in turn renders the 1st audio tube silent. But with an incoming signal the A.V.C. tube comes into action, decreases the activity of the Q tube and this in turn permits the 1st audio tube to operate. The same result is thus accomplished auto-electrically as was originally done manually by means of the muting switch. The suppressor systems used in the various commercial receivers differ primarily in the manner in which the Q or relay tube is excited. But practically all operate on the bias of the 1st audio tube, rendering the receiver silent between station channels. The suppressor systems illustrated in the following commercial receivers are typical of the better engineered installations; and if their operation is thoroughly understood, no difficulty should be experienced with others that may be encountered, for the basic operating principles are the same.

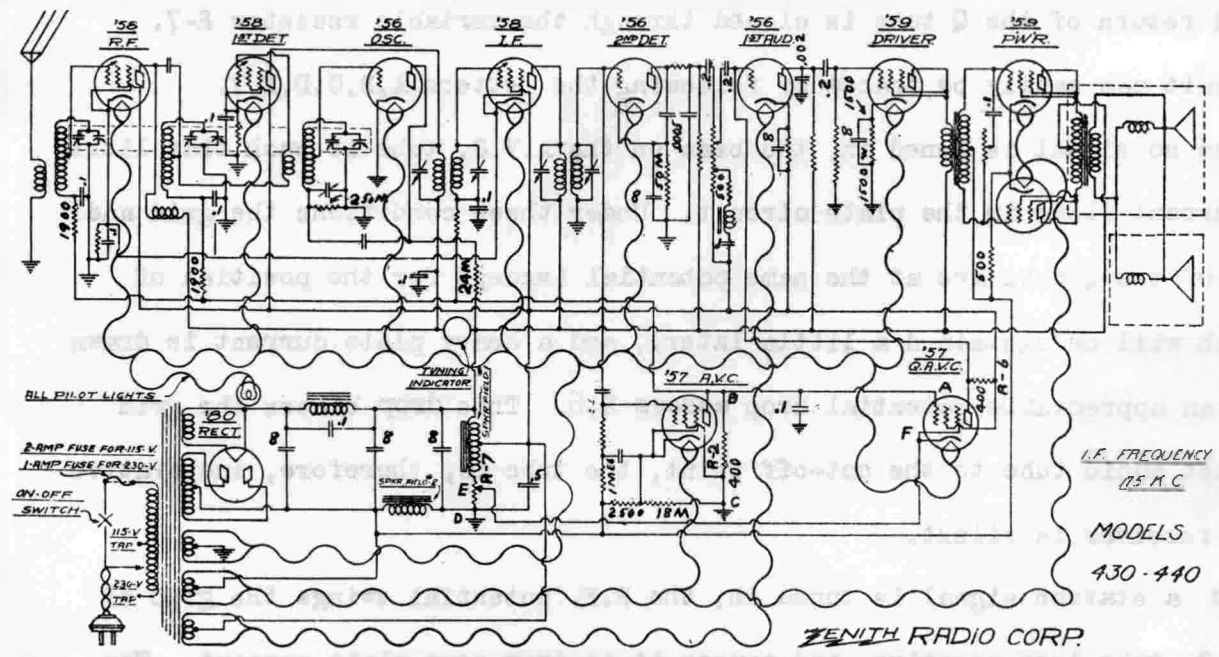## THE ZENITH MODELS 430 & 440

Fig. 2

The Zenith Model 430 circuit (same as the Model 440) illustrates very nicely the arrangement and action of the automatic inter-station noise suppressor system explained previously. As illustrated in Fig. 2 the circuit is essentially a standard superheterodyne with a push-pull power output stage similar to the Model 410 discussed previously, except that an additional type 57 tube is used as suppressor or squelch tube. It is labeled Q.A.V.C. in the diagram, meaning quiet automatic volume control

The circuit arrangement and operation of the automatic volume control tube are very similar to that employed in the Zenith Model 410: And, as was explained previously, the Q tube operates between the A.V.C. and the 1st audio tubes. The grid of the Q tube is connected to the upper end of R-2 the load resistor in the plate circuit of the A.V.C. tube. In the plate circuit of the Q tube is the load resistor R-6. If the grid return of the 1st audio tube is traced from the grid to the cathode return, it will be seen that R-6 is also part of this circuit with the grid connected to its low potential end. The grid return of the Q tube is closed through the variable resistor R-7. The circuit can easily be traced by following the letters A,B,C,D,E,F.

When no signal is tuned in, the bias on the A.V.C. tube is such that little or no current flows in the plate circuit. Under these conditions the grid and cathode of the Q tube are at the same potential (except for the position of R-7 which will be explained a little later), and a heavy plate current is drawn causing an appreciable potential drop across R-6. This drop biases the grid of the 1st audio tube to the cut-off point, the tube is, therefore, inoperative and the receiver is silent.

When a station signal is tuned in, the R.F. potential swings the grid of the A.V.C. tube less negative, and causes it to draw some plate current. The
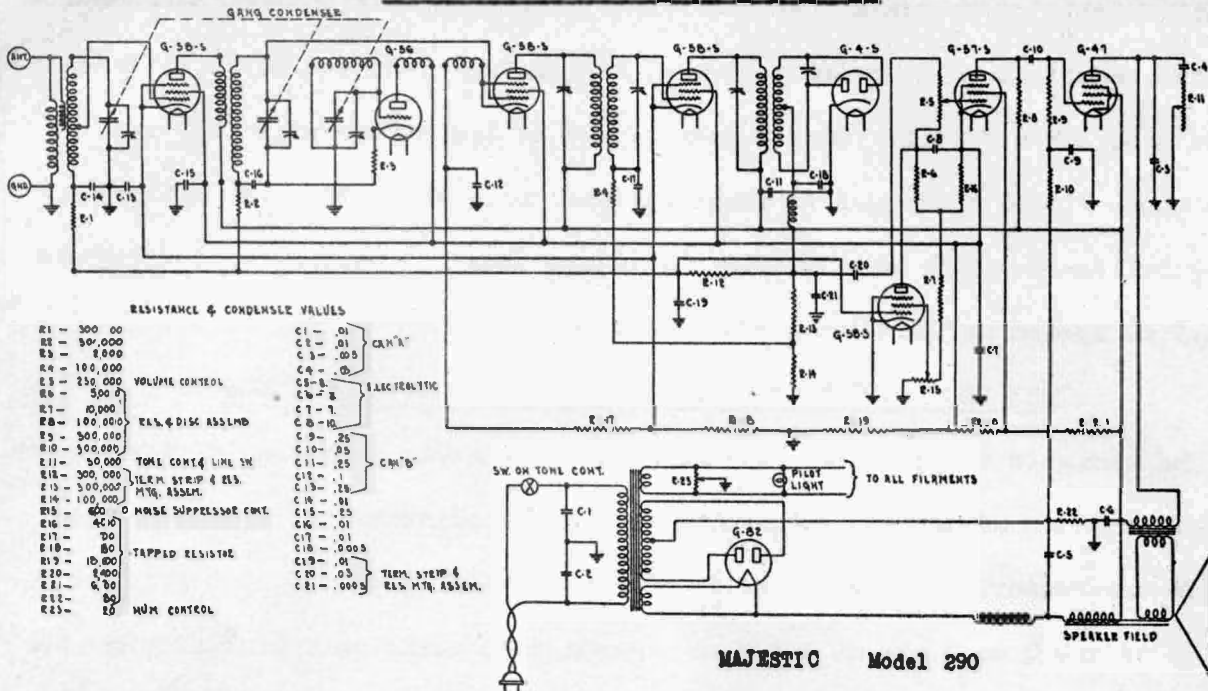
potential built up across R-2 by this plate current biases the grid of the Q tube and causes it to draw less current, thereby reducing the potential drop across R-6. This further removes some or all of the excess bias from the 1st audio tube, allows this tube to function, and renders the receiver operative. The operation of the Q tube is thus a straight relay or control action between the A.V.C. system and the 1st audio stage.

THE SENSITIVITY OR QUIET CONTROL IN Q.A.V.C. SYSTEMS

The variable resistor R-7 in Fig 2 serves somewhat as a sensitivity control, for the position of the slider determines the effectiveness of the Q tube as a noise suppressor. If the slider is at the extreme lower end, the grid and cathode of the Q tube are at the same potential (chassis potential) during the no-signal intervals, and the tube through its heavy plate current is most effective in biasing the 1st audio tube to the cut-off point. But if the slider on R-7 is moved upward, the cathode of the Q tube is put above ground potential. In other words, the grid is negative with respect to the cathode, and this negative bias limits the plate current drain and also the bias on the 1st audio tube.

This sensitivity or quiet control is generally a screwdriver adjustment at the rear of the chassis and is set when the receiver is installed. If the location of the receiver is a noisy one as in a large city with much interference noise, the slider should be moved down toward the chassis potential so that the Q tube is most effective in silencing the receiver during the no signal intervals. But in the open country at great distances from the transmitting stations the slider can be moved upward and a bias placed on the Q tube for such complete suppressor action is not needed.

RESISTANCE & CONDENSER VALUES

R1 — 300 00
R2 — 50,000
R3 — 8,000
R4 — 100,000
R5 — 250,000   VOLUME CONTROL
R6 — 500 0
R7 — 10,000
R8 — 100,000   R.L.& DISC ASSEMB
R9 — 500,000
R10 — 500,000
R11 — 50,000   TONE CONT.& LINE SW.
R12 — 300,000 TERM STRIP & RES.
R13 — 500,000 MTG. ASSEM.
R14 — 100,000
R15 — 600 0   NOISE SUPPRESSOR CONT.
R16 — 400 0
R17 — 50
R18 — 50   TAPPED RESISTOR
R19 — 10,000
R20 — 3,400
R21 — 6,300
R22 — 80
R23 — 20   HUM CONTROL

C1 — .01
C2 — .01
C3 — .005
C4 — .05
C5 — 8   ELECTROLYTIC
C6 — 8
C7 — 7
C8 — 10
C9 — .25
C10 — .05
C11 — .25   CAN "B"
C12 — .05
C13 — .25
C14 — .01
C15 — .25
C16 — .01
C17 — .01
C18 — .0005
C19 — .01   TERM STRIP &
C20 — .05   RES MTG. ASSEM.
C21 — .0005

MAJESTIC   Model 290

The Majestic Model 290 chassis illustrated in Fig. 3, also employs an interesting automatic interstation noise suppressor circuit. The receiver is of the superheterodyne type, and employs a double-diode as a full-wave rectifier in the 2nd detector stage. The tube is labeled G-4-S in the diagram and is a special Majestic tube. It is similar in construction and performance to the lower portion or diode section of a type 55 tube. A type 58 (labeled G-58-S) is used as the Q or squelch tube, and a type 57 as 1st audio tube resistance coupled to a type 47 output pentode.

In general performance the receiver resembles any standard superheterodyne, but it has a number of special features in the automatic volume control and noise suppressor systems that are of interest at this time. As was stated above, the diode plates are connected for full-wave rectification across the secondary of the last I.F. transformer. The cathode is grounded to chassis, and in the return line are resistor R-13 and R-14. In series with this line is also an R.F. choke which in connection with condenser C-18 confines the

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high frequency currents to the secondary circuit. The voltage drop set up by the rectified current across R-14 serves as an A.V.C. potential for the grid of the I.F. tube, while the drop across both R-14 and R-13 serves as an A.V.C. potential for both the R.F. and 1st detector tubes.

The special Q or squelch tube is also connected into the circuit so that its performance is influenced by the A.V.C. potentials built up across R-13 and R-14. The cathode of the Q tube is grounded directly to the chassis, while the grid is grounded through the load resistors R-13 and R-14 with the filter resistor R-12 in series. The plate circuit includes resistors R-6 and R-16, and makes contact with the B-supply line at the low potential end of R-20. R-16 is the normal biasing resistor for the type 57 1st audio tube, while R-6 is a plate load resistor that also forms part of the grid circuit of the 1st audio tube. The entire network operates in the following manner.

When no signal is tuned in, no rectified current flows through the detector circuit and no potential exists across R-13 and R-14. As a result the grid of the Q tube is at zero potential, that is, at the same potential as the cathode, and under such conditions the tube draws a heavy plate current. This current builds up a voltage across R-6 that automatically acts as an additional bias on the grid of the 1st audio tube, swinging it so far negative that the tube is blocked and rendered inoperative. No noise can thus get through this 1st audio tube, and the radio receiver is silent, even though the A.V.C. system permits the R.F. and I.F. amplifiers to rise to maximum sensitivity.

But when a signal is tuned in, rectified current flows through the detector, and a voltage is built up across R-13 and R-14. But since these resistors also form part of the grid return of the Q tube, this voltage biases the tube negatively and causes it to draw little or no plate current. With the plate

current thus reduced the voltage across R-6 is cut, and the abnormal bias is removed from the 1st audio tube. This permits the tube to function so that signals can pass through and the radio set operates normally.

The Q or squelch tube thus acts as a relay that cuts the 1st audio tube in or out. With no incoming signal the relay tube draws a heavy plate current that biases the 1st audio tube to the cut-off point; but when a signal does come in, the relay tube is biased and its plate current reduced, so that the extra bias is removed from the audio tube and the signals are allowed to come through. If the Q tube were removed, the set would operate as an ordinary A.V.C. receiver with the customary inter-station noise.

On account of the differences in antennas and the noise conditions in various locations, such quiet A.V.C. receivers are generally provided with an additional control that governs the point at which the Q or squelch tube cuts in or out. In Fig. 3 this suppressor control is in the form of a 6000-ohm potentiometer (R-15) in the screen circuit of the Q tube. For example, when such a set is installed, it is tuned to an off-station position, the volume control is turned full on, and the suppressor control set to the position of no suppression. The receiver is now full on and generally plenty of noise will be heard. The suppressor control is then adjusted slowly until the noise just stops. An abrupt drop will occur, and the control should not be turned beyond this point. If maximum receiver sensitivity is wanted for distant station tuning and between station noise is of no account, the suppressor control should be turned clear off to the no suppression position.

THE LYRIC MODEL SA-91 RADIO RECEIVER

The Lyric Model SA-91 receiver also employs a type 55 tube in a novel manner, for the diodes are used as a half-wave rectifier detector that also

develops the necessary automatic volume control potential, while the triode
section serves as a squelch tube for controlling the bias on the 1st audio
tube, a type 57.

Fig. 4

An inspection of the circuit illustrated in Fig. 4 shows the two diodes
of the type 55 tube connected in parallel to one terminal of the secondary of
the last I.F. transformer. The cathode is connected directly to ground, and
the circuit continues through a 500,000-ohm load resistor or potentiometer,
the slider of which is connected through a .01-mfd. condenser to the grid of
the 1st audio tube. This potentiometer, therefore, comprises the manual volume
control. From the potentiometer the circuit continues through a 70,000 and
50,000-ohm filter resistor and closes to the other side of the transformer
secondary.

The potential built up across the 500,000-ohm potentiometer provides both
the audio potential for the grid of the 57 1st audio tube as well as the A.V.C.
potential which is transmitted through a 1,000,000-ohm filter resistor to the grid
of the I.F. tube, and through another similar resistor to the grid of the R.F.

tube. The A.V.C. action is thus operative on these two tubes.

The grid of the triode section of the 55 tube is also connected to the low potential end of the cathode load through the same filter resistor that feeds the A.V.C. potential to the grid of the I.F. tube. The plate of the triode section is connected through a 170,000-ohm load resistor to the B-supply line. This latter resistor also forms part of the grid return of the 1st audio tube with a 500,000-ohm filter resistor in series. The normal bias for the audio tube is obtained across the 300-ohm section of the voltage divider, for the cathode is connected to the high potential end and the grid return to the low potential end. The drop across the 7500,10,000 and 15,000-ohm resistors constitutes the plate voltage. Plate voltage is always measured from plate to cathode, screen voltage from screen to cathode, and grid bias from control grid to cathode.

The entire circuit system around the 55 tube functions in the following manner. As long as no signal is tuned in, no rectified current flows through the detector circuit and no voltage exists across the load resistor. There is no A.V.C. potential impressed on the R.F. and I.F. tube, and these tubes are consequently at maximum sensitivity. Plenty of noise would then be heard in the speaker if it were not for the squelching action of the triode section.

With no voltage across the load resistor, the grid of the triode is at the same potential as the cathode, and under these conditions it is well known that a tube draws a heavy plate current. The heavy plate current in turn builds up a high voltage across the 170,000-ohm plate load resistor, and this voltage becomes an additive bias on the grid of the 1st audio tube, swinging it clear to the cut-off point and rendering it inoperative. No noise or other disturbing signals can thus get through.

But when a signal is tuned in, rectified current flows in the detector circuit, and voltage is built up across the load. This voltage serves as an A.V.C. potential for the R.F. and I.F. tube, and also biases the grid of the triode, the result being that the triode draws very little if any plate current. With the plate current down, the excess bias voltage on the grid of the 1st audio tube is removed and the tube can function normally. The triode section thus acts as a relay which is actuated by the load potential and which in turn controls the 1st audio tube by regulating its bias voltage.

The circuit is also provided with an additional control in the form of a 7500-ohm rheostat at the negative end of the voltage divider for regulating the squelching action of the triode section. As illustrated in the diagram, when the control is moved to the extreme left, a total of 20 volts is impressed on the plate of the triode section and the squelching action is at maximum, for the largest plate current can flow under these conditions. As the control is moved to the right, the plate voltage is reduced, and at the extreme right it is reduced to zero and all squelching action is eliminated.

THE LYRIC MODEL SA-130

The Lyric Model SA-130 radio receiver illustrated in Fig. 5 has a number of circuit features that are really quite individual as far as automatic volume control and squelch action are concerned. Three special control tubes are used, one for the A.V.C. and two for the squelch action. All three could be removed, and the receiver would then operate as a plain conventional superheterodyne system.

For automatic volume control a type 57 tube is used labeled A.G.C., meaning automatic gain control. The cathode of this tube is connected to the —90 volt point on the divider resistor and the plate to the —3.5-volt point,

Fig. 5

LYRIC MODEL SA-130

the net plate potential thus being 86.5 volts. The control grid is connected to the lower end of the resistor which is at --95 volts. The normal bias on the tube is thus --5 volts, sufficient to carry it clear to the cut-off point. At the same time, the grid is coupled through a .00001-mfd condenser to the plate of the 2nd I.F. tube, a No. 58.

The A.V.C. system is operative on the R.F. and the 1st and 2nd I.F. tubes. The cathodes of these three tubes are connected directly to ground, and the grid returns are brought through suitable filter resistors to the --3.5-volt point on the divider. The normal bias on these tubes is thus --3.5 volts. The grid return also contains a 900,000-ohm resistor that at the same time serves as a load resistor in the plate circuit.

As long as no signal is tuned in, the A.G.C. tube is under no special influence, and no current flows in its plate circuit. The R.F. and two I.F. tubes are then under normal bias and hence at maximum sensitivity. When a signal is tuned in, however, the signal voltage in the plate circuit of the 2nd I.F. tube swings the grid of the A.G.C. tube less negative and permits it to draw plate current. Voltage is built up across the 900,000-ohm load resistor which becomes an additive bias on the R.F. and I.F. tubes, decreasing their sensitivity and reducing the volume proportionately.

The squelch system is an entirely independent network. The last I.F. transformer has a third winding that is very sharply tuned and loosely coupled so that it operates at practically 4-kilocycle selectivity. It is connected across the grid and cathode of the "channel control" tube, so-called because it comes into action only when the receiver is tuned to a station channel. It operates at a plate pressure of 86.5 volts (90--3.5) and a grid bias of 5 volts, both values of course depending on the setting of the 15,000-ohm poten-

tiometer. In the plate circuit is a 70,000-ohm load resistor that also forms part of the grid return of the squelch tube, labeled "silencing tube" in the diagram. The plate circuit of this tube in turn extends through a 1,000,000-ohm and a 300,000-ohm resistor to the positive B supply line. The 300,000-ohm unit also forms part of the grid return of the 1st audio tube. The normal bias on this tube is established by the 2000-ohm cathode resistor. The entire arrangement works in the following manner.

As long as no signal is tuned in, the channel control tube is under no external influence, and due to the high normal bias (5 volts) the tube is at the cut-off point and no plate current is flowing. Under these conditions there is no drop across the 70,000-ohm load resistor, and consequently the grid of the silencing tube has only the normal bias of 2 volts, and plate current is drawn. The plate current builds up a potential across the 300,000-ohm resistor in the grid return of the 1st audio tube, and this potential becomes an additive bias on the tube swinging it clear to the cut-off point where it becomes inoperative. Hence, even though the absence of an A.V.C. potential brings the R.F. and I.F. tubes to maximum sensitivity, no noise or stray signals can get through the set because the 1st audio tube is rendered inoperative by the silencing tube.

However, when a signal is tuned in, the grid of the A.G.C. tube is swung less negative, and the tube draws plate current. This builds up a voltage across the 900,000-ohm plate load resistor, and an additive bias is placed on the grids of the R.F. and I.F. tubes, decreasing the sensitivity of the tubes and reducing the signal strength at the input to the second detector.

The action of the channel control tube is particularly interesting. As the tuning dial is turned and a station channel approached, the signal will

begin coming in as soon as the tuning is within 5 kilocycles of the resonance point (assuming 10-Kc. tuning selectivity for the receiver). At this point the A.V.C. action also begins. But due to the action of the channel control tube, the silencing tube will not permit the lst audio tube to operate or pass on the signals until the tuning is within 2 kilocycles of the resonance point. At that point the influence begins on the channel control tube, for the selectivity of the third tuned circuit was put up to 4 Kc., the grid is swung less negative, and plate current begins to flow. The resulting voltage across the 70,000-ohm load resistor further biases the grid of the silencing tube and cuts off its plate current flow. This in turn removes the excess bias from the lst audio tube, and permits it to function and pass on the signals.

The influence straight through, of course, is most intense at the resonance point, and decreases as the tuning passes beyond the resonance point. It continues for 2 kilocycles, and then the channel control tube influence stops, the silencing tube becomes active, and the lst audio tube is rendered inoperative.

As far as signal tuning is concerned the receiver operates at 10-kilocycle selectivity, but the circuit controlling the gateway through the lst audio tube functions at 4-kilocycle selectivity. If the channel control and the silencing tube were removed, the receiver would operate as a straight 10-kilocycle superheterodyne with A.V.C. action, but would be noisy between stations. If the A.G.C. tube were also removed, the set would operate as a plain superheterodyne receiver.

The circuit is also provided with the customary control for regulating the point of entrance of the squelching action. This control is a 15,000-ohm potentiometer that governs the grid bias on the channel control tube. As the control is moved downward, the grid and cathode of the channel control tube
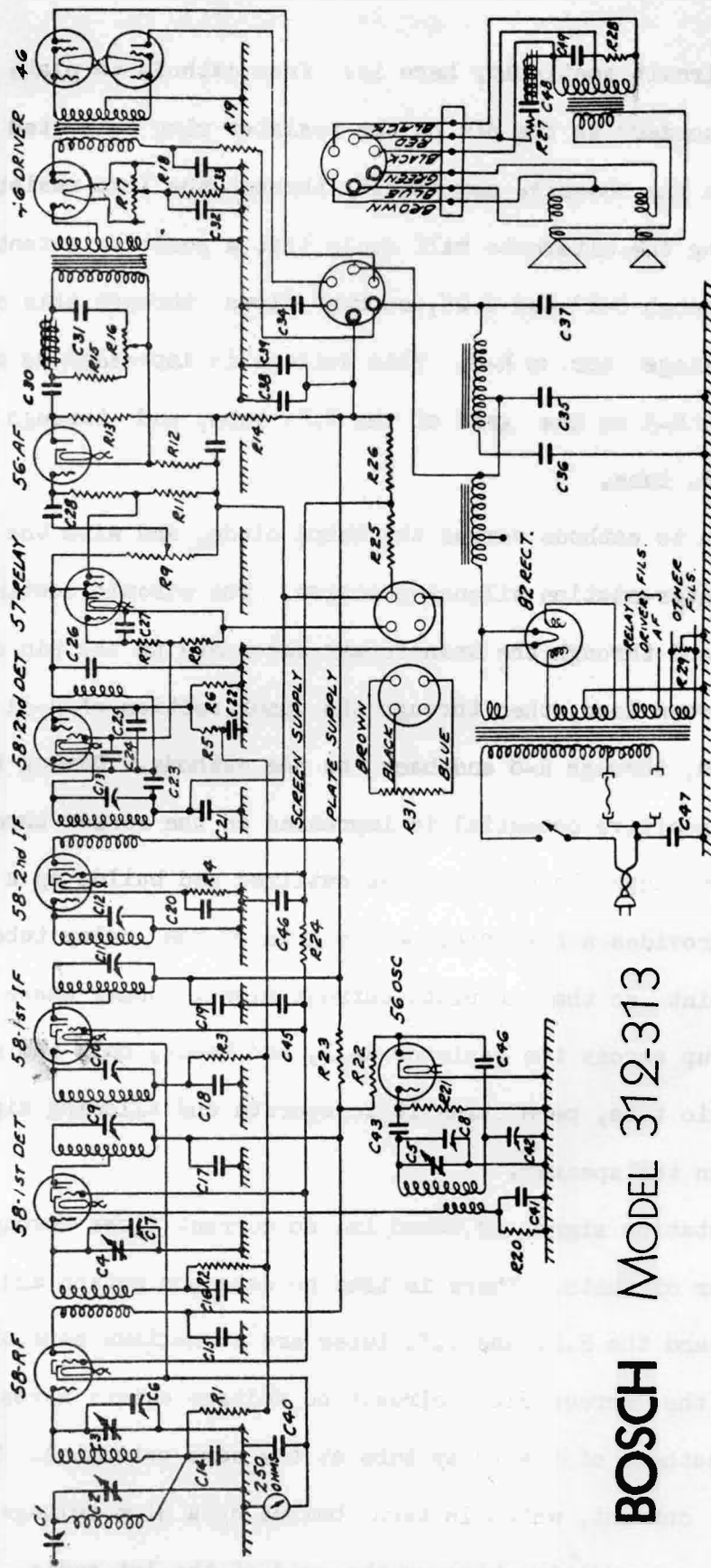
approach the same potential, and the resulting heavy plate current biases the silencing tube to the cut-off point where it has no influence on the 1st audio tube. At this point the squelching action is at minimum. As the control is moved upward, the squelching action becomes more prominent and is maximum when the control is at the top.

THE BOSCH MODELS 312 & 313.

The circuit used in the Bosch Model 312 and 313 radio receivers also has several interesting features for automatic volume control and inter-station noise suppression. The circuit is illustrated in Fig. 6. As is shown, a type 58 tube is used as a "triple diode" to perform simultaneously the functions of 2nd detector, automatic volume control, and inter-station noise suppression. The control grid to the cathode acts as one diode, the plate (with the suppressor tied to it) to cathode as the second diode, and the screen grid to cathode as the third diode.

The control grid to cathode forms the detector diode, and the circuit continuity is as follows: from the lower terminal of the last I.F. transformer secondary through condenser C23 to the grid, within the tube from cathode to grid, externally from the cathode through the transformer secondary to potentiometer R-9, and finally through an R.F. choke coil back to the grid of the tube. The A.C. voltage in the secondary winding impresses a positive potential on the grid through condenser C-23 every alternate half cycle, and during this interval current flows through the circuit just outlined. In flowing through potentiometer R-9 it builds up an audio voltage that is picked up at the slider and transmitted through C-28 to the grid of the 1st audio tube, a type 56.

The second diode is between plate and cathode and provides the A.V.C.

BOSCH MODEL 312-313

Fig. 6

46 DRIVER
7-6 DRIVER
56-AF
57-RELAY
58-2nd DET
58-2nd IF
58-1st IF
58-1st DET
58-RF
56 OSC
82 RECT.

SCREEN SUPPLY
PLATE SUPPLY

BLACK
RED
GREEN
BLUE
BROWN

BROWN
BLACK
BLUE

RELAY
DRIVER
AF
OTHER
FILS.

action. The circuit continuity here is: from cathode to plate and through the transformer secondary to the pin on the resistor plug connected to the brown lead, through R-31 to the chassis, and finally through the load resistor R-6, back to the cathode. During the alternate half cycle that a positive potential is impressed on the plate through C-2? and C-25, current flows through this circuit outlined and builds up a voltage acr. is R-6. This voltage is impressed as an A.V.C. potential through R-5 and R-3 on the grid of the I.F. tube, and through R-5 and R-1 on the grid of the R.F. tube.

The screen to cathode serves the third diode, and with the type 57 relay tube provides the inter-station silencing action. The circuit continuity is: from cathode to screen and through the transformer secondary to the pin on the resistor plug carrying the brown lead, then through the upper section of R-31 and back through the black lead, through R-8 and back to the cathode. During the alternate half cycles that a positive potential is impressed on the screen through C-23 and C-24, current flows through the circuit just outlined and builds up a voltage across R-8. This voltage provides a high bias on the grid of the relay tube, and swings it to the cut-off point so that no plate current flows. Under these conditions no voltage is built up across the resistor R-11, and hence, only the normal bias exists on the 1st audio tube, permitting it to operate and allowing signals to pass through and be heard in the speaker.

When no station signal is tuned in, no current flows through any of the three diode rectifier circuits. There is thus no detector action and no A.V.C. potential is developed, and the R.F. and I.F. tubes are at maximum sensitivity. Also, with no current in the screen diode circuit no voltage exists across R-8, this putting the grid and cathode of the relay tube at the same potential. The tube thus draws a heavy plate current, which in turn builds up a high voltage across R-11. This voltage becomes an additive bias on the grid of the 1st audio tube, swinging this tube clear to the cut-off point and rendering the set inoperative and silent.

EXAMINATION QUESTIONS ON FOLLOWING PAGE