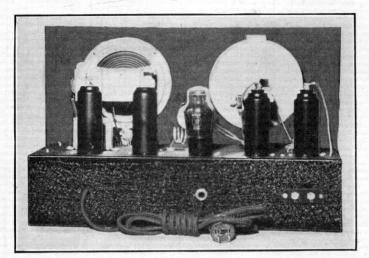
A. J. Haynes' Latest Circuit

A 21/2 to 555 Meter Receiver, the R-S-R

IT COMBINES REGENERATION AND SUPER-REGENERATION - FULLEST PARTICULARS ON CONSTRUCTION

By A. J. Haynes



The waves below 15 meters are worked super-regeneratively. The detector is the glass triode, shown in blueprint and in schematic diagram as a 76, but at left as a 37, as the two tubes are interchangeable as to service in this receiver and socket accommodation. The phone jack, applicable to all bands, is shown at rear. The twin assembly provides the antenna-ground posts.

HE R-S-R Receiver was designed for the all wave enthusiast and experimenter to enable him to have the entire active radio frequency spectrum literally at his fingertips. Beside the increasing activity on the 5 and 10 meter bands, more than two dozen of the new socalled "Apex Class" stations have been licensed for experimental broadcasting on wavelengths between 5 and 10 meters. Their unofficial designation as "Apex" stations is due
to the fact that they are all strategically located on the tops of the highest buildings in our metropolitan centers.

With a receiver that can slide smoothly over

all of these ultra-high frequencies there are surprises and thrills galore for even the blasé old time "dial twister."

Circuit Discussed

The R-S-R employs a combination regenerative and Laper-regenerative circuit. A radio frequency buffer tube and electron coupled regenerative detector are used on wave lengths from 555 down to 15 meters with a simple but efficient band switching coil arrangement which eliminates plug-in coils over this range.

On the ultra high frequencies simple band switching is not practical and straight regeneration becomes too critical. Thus, from 15 meters down (down meaning to well below 2½ meters, the low limit depending on the particular tube used and the care exercised in the wiring) super-regeneration is utilized with small self supporting plug-in coils.

The regenerative circuit is probably the most important as well as the most interesting circuit ever developed in radio. It is also the most abused. A poorly designed and constructed regenerative receiver can be just as pesky and useless as any other bad set and perhaps a bit worse. On the other hand, given a fair location and adequate antenna, a good regenerative receiver can deliver excellent long distance reception with a minimum of noise.

It is a peculiarity of this circuit that its efficiency is not a dependent toom the guilter of

ciency is not as dependant upon the quality of the parts used in it as upon the circuit design and arrangement; though the L/C ratio should be large, the proper detector tube impedence screen voltage is provided.

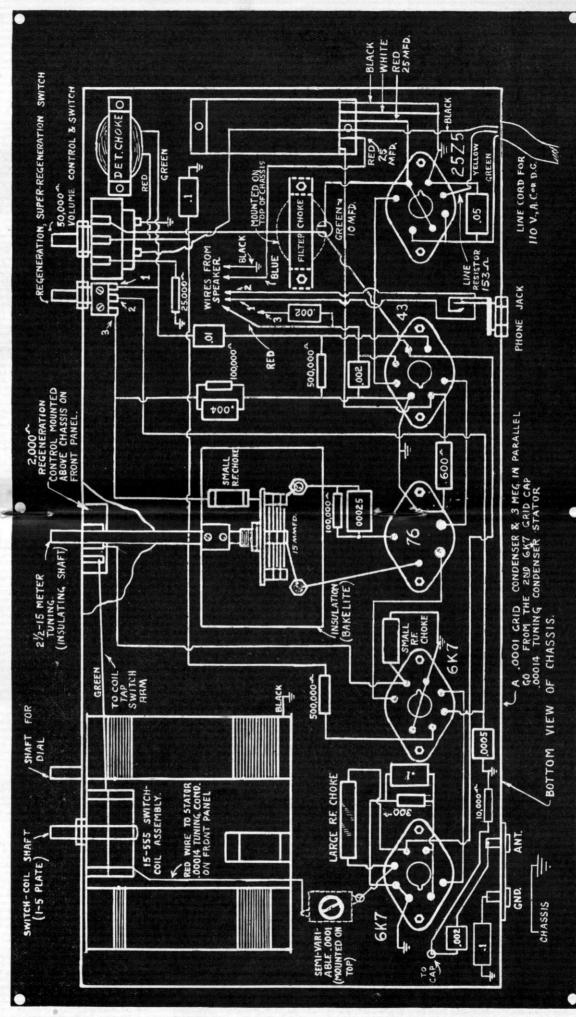
For fine distance work very smooth and accurate regenerative control is not only of the greatest importance, but is an absolute necessity. In the early 1920's when this type of circuit was the only one we had, a receiver with "sticky" regenerative control or "fringe howl"—so common today-would not be tolerated.

Dual Regeneration Control

In designing the R-S-R every effort was made to obtain the smoothest and most stable (Continued on page 37)

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The wiring as seen from the bottom is illustrated. Numbers for units not designated represent mfd. The tuning condenser is on top of the chassis,

above the coil switch unit, hence not visible. The rotor (frame) is grounded to chassis. The stator connects to the semi-variable .0001 mfd.

condenser. See notation, upper left. The regeneration-super-regeneration switch is numbered: (1) = common; (2) = 15-555 meters; (3) = ultras. (Continued from page 32)

regenerative control possible. To this end two regenerative controls are provided. One, the main control, limits the r.f. feedback to the grid circuit, while the other changes the detector tube impedance by varying the screen and plate voltage and gives a very gradual vernier regenerative control. The latter also acts as a volume control, when it is retarded more than half way, limiting the input to the power output tube on strong signals.

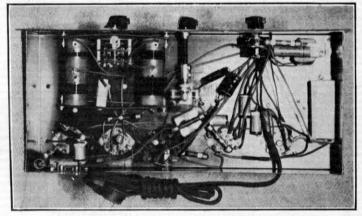
Band switching, eliminating the nuisance of plug-in coils, can be made very simple and efficient, particularly in a regenerative circuit, down to about 15 meters. By using five bands, with separate coils, the range can be covered with a low maximum capacity tuning condenser, thus giving reasonable good electrical bandspread. Then an airplane type dial with a 9 to 1 tuning ratio adds sufficient mechanical bandspread to give precise non-critical tuning.

For sensitivity and consistent results below 15 meters it is hard to beat a good superregenerative receiver. Single control tuning a.c. or d.c. Until some of the new "universal" superheterodynes were developed this type of power supply had a bad reputation because it will give fair results with even a poor filter system and many of the cheap sets used it in this manner to reduce cost. The R-S-R receiver has been designed with an entirely adequate power filter, using a 60 mfd. condenser block and with average tubes and conditions the hum level is well below that of most good commercial receivers, even when regeneration is at maximum. This applies to earphones as well as to loudspeaker reception and is an important feature because most experienced radio experimenters prefer to use earphones for fine work and 'phones are particularly recommended for the ultra-high frequencies. For this reason a phone jack is provided at the back of the R-S-R chassis and when phones are plugged in the speaker is entirely silent.

Metal or Metal Glass Tubes

The R-S-R has been designed to use the new octal metal tube sockets which will permit the

The bottom view as presented herewith occupies the same relative position as does the blueprint. The five coils are wound on three forms, covering 555 to 15 meters. Above the 15 mmfd. tuning condenser (center, behind long shaft and coupling) would be two pin jacks for the coils used from 15 to 21/2 meters. These jacks are seen protruding through the bottom just below the rear of the small tuning condenser.



allows these ultra high frequency stations to be logged with absolute accuracy. The particular circuit which has been used in the R-S-R is sensitive and absolutely stable over its whole range. It is brought into use merely by turning the small switch knob directly below the speaker.

The entire super-regenerative tuner is mounted on a hard rubber sub-base panel with exceedingly short leads. Plain, two contact, coils are used for all frequencies below 15 meters and simply plugged into the two pinjacks on the sub-panel. As the maximum capacity is only 15 mmfd., good electrical bandspread is attained down to the very lowest wavelengths.

When using super-regeneration, hiss control is obtained with the same 50,000 ohm potentiometer that provides vernier regeneration control on the longer wavelengths (located at lower right of panel). This permits the most sensitive "super" adjustment, minimizes radiation, and lets the hiss level be reduced to the vanishing point.

Built-in Power Supply

The R-S-R can be used on either 110 volts

use of either metal or metal-glass tubes. Both types of tubes provide the simple, effective shielding which is a merit of the new tubes and both give equally good results.

The only exception is the super-regenerative detector, which uses a glass 37 or 76 tube. The first model of the R-S-R used a 6C5 metal tube in this position and it performed perfectly down to 3 or 4 meters but it happened to offer no advantage over the glass tubes, as shielding is not needed here, and the glass tubes, with their lower output capacities, will go on down to well below 2½ meters.

The Buffer Stage

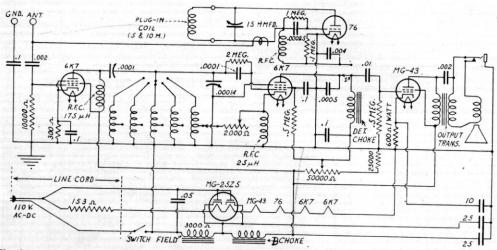
A 6K7 triple grid super-control tube is used as an untuned buffer, or r.f. amplifier, ahead of the regenerative detector. The main purpose of this tube is to stabilize the detector and allow its full regenerative gain to be utilized on all frequencies. It does more than this, however, as it shows a real r.f. gain, particularly on the short wave stations where the coupling has been designed to be most effective.

(Continued on next page)

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The results obtained from an untuned buffer stage of this type depend on several factors such as the mechanical layout, wiring, tube used, etc. But the most important factor of all is the coupling arrangement between the buffer tube and the regenerative detector. In the first place this should be adjustable, over a reasonable range, to compensate for various tubes, antennas, etc. This also allows the selectivity of the receiver to be broadened or sharpened as desired. This adjustment is accomplished in the R-S-R by a semi-variable 100 mmfd. mica condenser.

The rest of the r.f. coupling consists of a specially wound plate choke of rather low value. For some reason it seems to be an accepted custom to use a 2.5 millihenry choke here; perhaps because they can be conveniently purchased anywhere. Such a value gives splendid r.f. gain at the standard broadcast frequencies -so good in fact that the set cannot be used on an average antenna without hearing most of the local stations all over the broadcast band and often on the short wave bands as well.



The five coils for 15-555 meters are above the MG-25Z5, a bit to the left. The plug-in coils principally for 5 and 10 meter reception are indicated. Actually 15 to 2½ meters are covered by the plug-in coils. All coil data are found in the text. The second 6K7's grid leak may be 2 to 3 meg. Above 2 meg. is the designation. On the picture diagram a notation refers to 3 meg. Performance is not affected within these resistance limits.

LIST OF PARTS

Coils

One set of ultra wave plug-in coils (see text). One set of tapped coils, 15 to 555 meters (see

One 175 microhenry radio frequency choke Two 25 microhenry radio frequency chokes One detector plate audio frequency choke

One audio output transformer One B supply choke

One loudspeaker with 3,000 ohm field

Condensers

One 15 mmfd. variable One .0001 mfd. semi-variable (compression type) One .00014 mfd. variable

One .0001 mfd. One .0005 mfd. One .00025 mfd. One .01 mfd. Two .002 mfd. One .05 mfd.

One .004 mfd. Four .1 mfd.

One block of three electrolytic condensers containing one 10 and two 25 mfd. units

Resistors

One 300 ohm One 1 meg. One 600 ohm, 1 watt One 2,000 ohm rheo-One .1 meg. stat

One 10,000 ohm One 50,000 ohm pot. One 25,000 ohm One 153 ohm, 30w. Two .5 mfd. meg.

One 2 to 3 meg. (shown as 2 meg. on schematic, referred to as 3 meg. on blueprint).

Other Requirements

Four octal sockets One five contact socket

Two small grid clips

One line switch (may be attached to potenti-

One two pole five position gang switch One single circuit closed jack

One a.c. cable with line cord (153 ohm, 30w.) built in, male plug.

One single pole double throw switch One Bakelite platform with tip packs for ultra wave coils

One airplane dial with escutcheon

One 0-100 plate for ultra wave tuning

One large bar handle for ultra wave tuning Three knobs

Two MG-6K7, one 76 or 37, one MG-43 and one MG-25Z5. (All-metal tubes may replace metal-glass types with no circuit

change.)

So the R-S-R was designed primarily as a short wave receiver; a value was chosen for this coupling choke which would place the maximum gain on the short waves and allow only a reasonable gain with good selectivity on the standard broadcast band.

Super-Control Detector Tube

A 6K7, the same type tube as is used in the buffer stage, is used as a detector. The 6J7, which is usually recommended for a detector, also may be used as detector and is interchangeable with the 6K7, but the 6K7 gives a little smoother regeneration and better stability on the higher frequencies although there is not much difference.

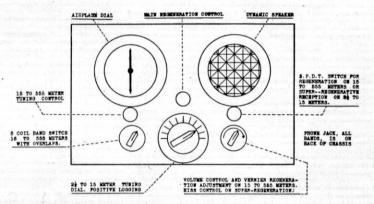
Both regenerative and super-regenerative detectors are impedance coupled to the 43 power

panel the airplane tuning dial and its control knob are at the upper left with the band changing switch just below it.

Upper center is the 2,000 ohm potentiometer for rough regeneration control, while directly below it is the super-regenerative tuning control. Just below the speaker is the S.P.D.T. switch for shifting to super-regeneration. In the lower right hand corner is the 50,000 ohm potentiometer, which also carries the "on" and "off" switch for the entire set, and serves the dual purpose of vernier regeneration and volume control above 15 meters and super-regenerative hiss control below 15 meters.

The tube sockets are located along the back of the sub-base as follows (looking from the rear—right to left) M.G.6K7, M.G.6K7, 5 prong glass tube socket, MG43, and MG25Z5.

The legends reveal the identities and purposes of the controls and other parts on the front panel. Because short waves are a principal consideration in the operation of this receiver, and ultra waves come in particularly well, every precaution should be observed to duplicate the designer's placements, even as to front panel. Mr. Haynes spent three weeks developing this receiver and it is well for the constructor to capitalize on his expert efforts.



output tube by the same audio choke coil, referred to in the diagrams as the detector choke, thus allowing the speaker or 'phones to be used with either type reception at will. Immediate shift is accomplished by simply turning the small switch knob below the speaker on the panel.

Results with any receiver mean little unless they are comparative. In testing the R-S-R in New York City the usual foreign stations—generally called the foreign locals—were received with good volume while some of the more difficult catches were clearly understandable on earphones. The English station G.S.A. was clearly received using a 4 foot indoor wire as an antenna as were also many 5 and 10 meter amateur phones, some of the latter from the far West. In fact the first 10 meter station received on the R-S-R was an amateur phone station in Denver, Colorado.

One of the interesting things about a good regenerative receiver is the fact that the results attained with it are dependant to a large extent on the skill of the operator. It has a very low noise level and can do remarkably fineDX work in the hands of a person who has learned its proper operation,

Assembly Instructions

A good idea of the location of the various parts on the panel and sub-base can be obtained by reference to the photographs and the pictorial diagram. Looking at the front of

The hard rubber sub-base in which the pin jacks are mounted for ultra wave coils fits over the cut out just in front of the center tube. The B filter choke coil is mounted to the left, behind the speaker.

The large tuning condenser is mounted on its bracket behind the airplane dial and, being on top, fastened to front panel, is not shown in the blueprint of the wiring, though the diagram carries a notation. To the right on the sub-base is the small R.F. semi-variable coupling condenser which controls selectivity.

ling condenser which controls selectivity.

The airplane dial should be mounted by soldering four short lengths of wire from its frame to the small mounting screws around the circular cutout on the panel. This allows it to be accurately centered and permanently held in place.

Ground Connections Important

Make all wires carrying radio frequency current as short and direct as possible and do not bunch them together. Proper ground returns are important if a receiver is to control well. A good general rule is to return all grounds from by-pass condensers etc., to the socket ground connection of the tube whose immediate circuits they are by-passing. Remember that each metal tube has one contact which connects to its metal shell and this socket connection is grounded to the chassis as near to the socket as possible and this same ground (Continued on next page)

(Continued from preceding page) connection should be used for any other grounds

associated with that tube's circuits.

The .0001 mmfd. grid condenser with the 3 meg. leak across it is soldered directly to the large tuning condenser stator and a short flexible lead provided for the grid cap.

The remaining parts are mounted underneath the sub-base by means of the screws and mounting holes provided for them as shown on

the pictorial diagram.

The small condensers and resistors are self

supported by their soldered connections.

Three special r.f. chokes are used. They are all wound on 3/8" Bakelite rod. The largest has 220 turns of No. 34 enamel wire while the two smaller identical ones 40 turns of the same wire on the same size diameter.

The Super-Regenerative Tuner

Two of the special choke coils are mounted directly on their respective tube sockets. The longer one is soldered to the plate connection of the r.f. tube socket while a small one is soldered to the cathode connection on the de-tector tube socket. They should stand vertical-ly away from the socket base and the large one should be kept well in the clear with no

wires running along or against it.

The entire tuning assembly for the superregenerative tuner is mounted on the small hard rubber sub-base panel. The small variable condenser is mounted so that its stator and rotor connections are close to the ends of the pin jacks to which they are soldered. An insulated extension shaft and coupling is used for this condenser as well as a bushing which holds the tuning dial in place and provides a bearing for the shaft. The grid condenser and its 1 meg. leak extend from the small variable condenser stator to the grid terminal of the glass tube socket while a short rigid wire connects the rotor to the plate terminal. Such a compact assembly with very short leads gives good effi-ciency and smooth super-regeneration on the ultra-high frequencies.

The super-regenerative choke coil (either one of the small ones) is soldered directly to the condenser stator lug and the .004 mf. blocking condenser runs from the other end of this choke directly to the cathode connection on the glass tube socket, which is in turn grounded

to the chassis.

Stabilization Introduced

Note the 100,000 ohm resistor which is soldered across this condenser. This serves to stabilize the super-regenerative quenching action at the very high frequencies. With some tubes a lower value of resistance is desirable for best reception below 3 meters. The value given however is correct for most tubes. The antenna connection to the "super" de-

tector is made by running an insulated wire direct from the antenna post to the grid connection of the tube around which it is wrapped a few times but not actually connected.

It will be noted that the entire power supply is concentrated at the end of the sub-base near-est the speaker. The M.G.25Z5 rectifying tube, filter choke and filter condenser block are all located together here. The 60 mfd. condenser block is divided into four sections, 25, 25, 5 and 5 mfd. each. The red leads are the positive connections to the 25 mfd. sections and connect to either side of the lter choke. green lead is the positive 10 mfd. connection and is connected to the cathode terminal of the M.G.43 socket. The white and black leads should be grounded to the chassis.

The three wires of the power cord should be connected to the filament and plate of the MG25Z5 and the switch in accordance with

their colors as shown in the diagram.

Speaker Connections

A 5 inch dynamic speaker is used which is entirely satisfactory for a communication type receiver and actually gives very acceptable quality on broadcast reception. The 3,000 ohm field is connected directly across the power supply, on the rectfiier side of the filter choke.

The connections to the phone jack should be carefully noted. A closed circuit jack is used which is cut in series with the voice coil of the speaker so that when the phones are plugged in the speaker circuit is broken and the signal passes through the .002 blocking condenser and phones to ground.

Operation

Any antenna may be used but an average length straight L antenna is about as satisfactory as anything for all around reception. A good ground is particularly desirable with regenerative receivers and hand capacity on the short waves. (Note—Try the power cord plug both ways in the socket for best results as one side of the power line is also grounded.)

CAUTION: Do not let the ground wire touch any part of the receiver except the ground connection on the terminal strip.

The receiver may be made more or less se-lective as desired by tightening or loosening the small semi-variable condenser at the left end of the sub-base. The proper adjustment of this condenser will depend somewhat on the antenna used. If it is too tight, tuning will be broad and there may be some places in the tuning range where maximum regeneration cannot be obtained-commonly called dead-spots. If it is too loose the signals, particularly in the regular broadcast band, will be weakened and the tuning will become too sharp and critical. The proper adjustment for any an-

An Activities of the section of

Frequency Range | 130 turns No. 34 En. wire tapped at 8T. No. 4—1000—2000 K.C. | 130 turns No. 34 En. wire tapped at 8T. No. 3—1950—4800 K.C. | 152 turns No. 26 En. wire tapped at 5T. No. 2—4700—10,000 K.C. | 141 turns No. 26 En. wire tapped at 3T. No. 1—9600—20,000 K.C. | 153 turns No. 26 En. wire tapped at 3T. No. 1—9600—20,000 K.C. | 154 turns No. 26 En. wire tapped at 8T. No. 1—9600—20,000 K.C. | 155 turns No. 27 D.C.C. wire tapped at 8T.

^{*}Wound on 1¼" bakelite tubing.
**Wound on ½" dowel.

tenna and location can be found after a few trials. This condenser also has a secondary effect on the tuning so that if it is changed the stations will shift their position on the dial. This fact makes it impossible to give the exact wavelength ranges of the different bands but they are approximately as given in the coil data tabulation on opposite page.

A substantial overlap is provided between bands and their limits can be shifted up or down by varying the semi-variable coupling

condenser mentioned above.

Regeneration

Regenerative receivers are absolutely dependent upon good regeneration for their sensitivity; hence they are only as good as their regenerative control. Two regenerative controls are provided on the R-S-R. The 2,000 ohm potentiometer, controlled by the small knob in the center of the panel, is the main control and is used first when a station is being tuned The vernier regeneration control (the 50,000 potentiometer at lower right of panel) is used for the final fine adjustment particularly when tuning in very weak distant stations. It gives precise, gradual control over the greatest regenerative gain possible. This control is so smooth and gradual that when a station is properly tuned in the regeneration can be run right up into "zero beat" without knowing when the oscillation point has been reached.

Working Vernier Control

The vernier control should be kept well over toward the right, and used for final adjustments on weak signals. When it is retarded more than half way it acts as a volume control to reduce strong signals.

Super-Regeneration

Very few instructions are necessary for superregenerative operation on the wave lengths below 15 meters. Merely throw the "super" switch (just below the speaker) and you immediately hear the characteristic super-regenerative rushing sound. Tuning is now done with the large pointer dial at the bottom center of panel. It is not at all critical and tunes exactly so a band-spread tuning dial on a superheterodyne. When a station is "tuned in" the rushing sound disappears completely except on very weak carriers and then it can be cut down with the hiss control potentiometer.

Be sure to use sufficient antenna to grid coupling. A small trimmer condenser can be used here if desired instead of just twisting

the wire around the grid lead.

When using super-regeneration, stations can be logged exactly on the dial and will always be formed at the same spot unless they change

their frequency.

The coils used in the super-regenerative tuner should be wound from No. 14 trimmed copper wire. They are simple, self supporting coils with their ends straightened out so that they can be plugged into the two pin jacks on the hard rubber sub-panel. Any number of coils can be quickly wound in a few minutes for the various bands. Specifications for the 5 and 10 meter band coils are as follows: 10 meters—16 turns No. 14 wire, 34" diameter; 5 meters—7 turns No. 14 wire, 34" diameter. After winding, the coils are opened out until their ends will fit the pin jacks which are spaced 134 inches apart.