

The Scott News

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No. 1

ANNOUNCING THE NEW **SCOTT IMPERIAL ALLWAVE** WORLD'S FINEST CUSTOM BUILT RADIO

Receiver With Twice the Frequency Range of Present "High Fidelity" Sets—25 to 16,000 Cycles; Six Times Greater Undistorted Power Output—35 Watt Strictly Class "A"—50 Watts Class "A" Prime; Selectivity Continuously variable and Guaranteed Absolute 10 Kc. at 5,000 Times Field Strength: Greater Useable Sensitivity for Extreme DX Reception.

ALL standards for judging radio receiver performance will have to be revised with the introduction of the new SCOTT IMPERIAL ALLWAVE.

This new instrument has advanced radio receiver design by, we believe, at least two years, incorporating as it does features which not only enable you to receive with absolute fidelity, the highest frequency being transmitted by broadcasting stations at the present time, but the complete frequency range which will, we venture to prophesy, be commonplace transmission by broadcasting stations by 1937. The frequency range of this remarkable instrument covers the entire tonal range of the human ear, from 25 to 16,000 cycles, instead of the 7,500 cycles frequency range of what is considered at the present time the highest class "High Fidelity" receiver.

There are already on the air a number of new "High Fidelity" stations, which have a frequency range from 25 to 16,000 cycles, whose reception on the new SCOTT IMPERIAL ALLWAVE will prove a revelation to all hearing it for the first time. The human voice, either speaking or singing, comes from this remarkable instrument with a clarity and naturalness that is startling in its realism. Once you listen to an orchestra, your whole idea of

musical instrument reproduction must be changed, for you will realize that up to this time you have actually been hearing only about half the complete range of most of these instruments.

One of the most thrilling features of this new receiver is its beautifully smooth reproduction, with every trace of distortion or overloading eliminated. This is largely due to the great reserve of undistorted power, 35 watts strictly class "A," which is perfectly controllable from a barely audible whisper to full volume.

The selectivity continuously variable, and any degree may be secured from as sharp as absolute 10 Kc. at 5,000 times field strength, to a band wide enough to allow frequencies up to 16,000 cycles to pass without attenuation. This means that at last a radio receiver has been produced which will allow, without interference, the most perfect reception possible at all times, from weak distant stations on channels adjacent to powerful locals.

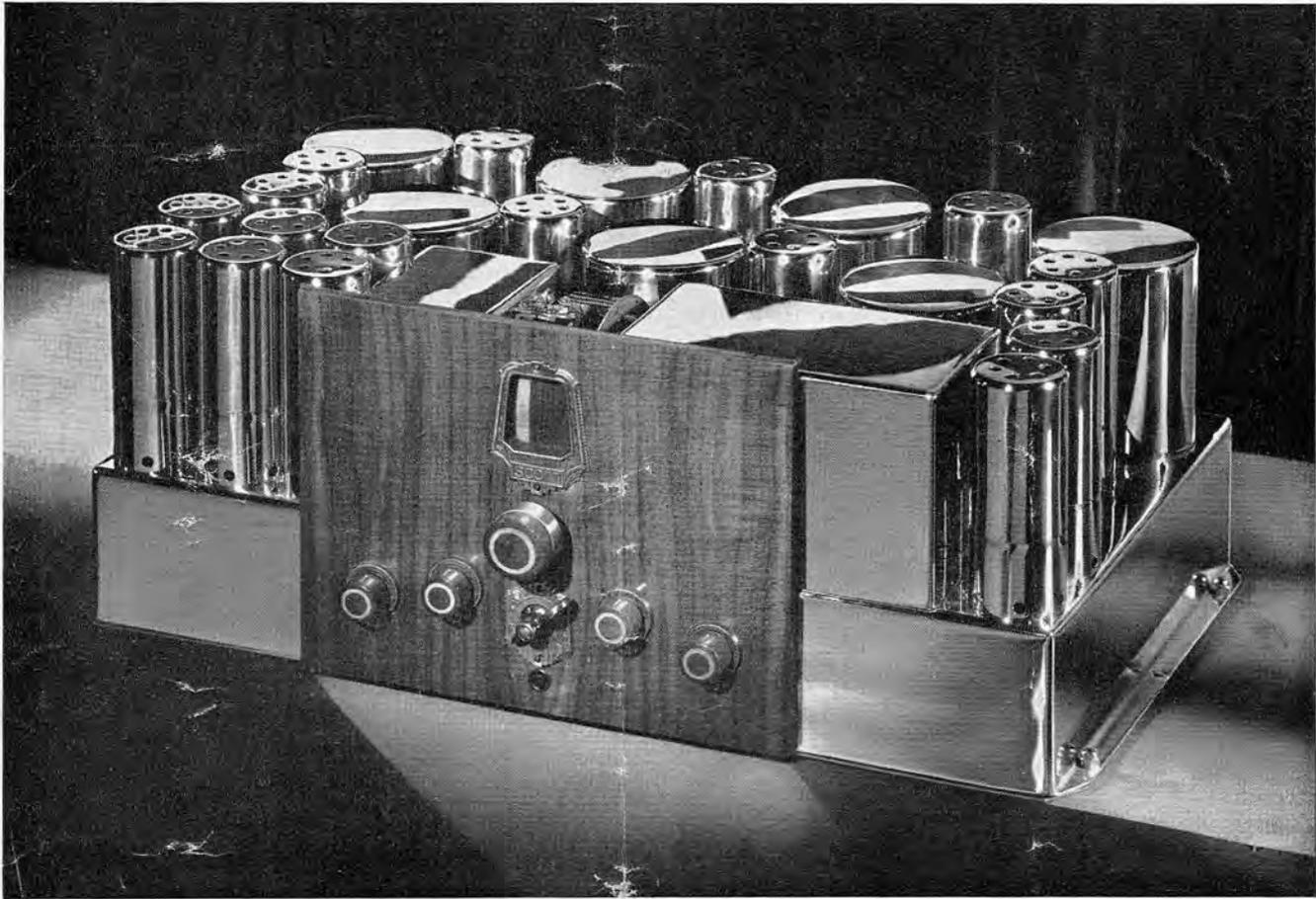
A number of detailed refinements, the work of the Scott Research Laboratory, has enabled us to develop the useable sensitivity to the point where broadcast stations in every part of the world can be tuned in with a clarity and volume that would have been considered impossible even a few months back.

The specifications of the SCOTT IMPERIAL ALLWAVE given on the following pages, will be particularly interesting to the skilled radio engineer, who will note with a great deal of interest, the many extremely advanced features incorporated in this receiver.

Twenty-two tubes are used, and a careful study of the specifications will show that every single tube has a very definite function to perform, and that **not one of these tubes can be eliminated without decreasing the efficiency or performance of the receiver.**

The SCOTT IMPERIAL ALLWAVE is a receiver which we have proved by scientific laboratory measurements and side by side listening tests, to have a finer tone quality by a wide margin; greater useable sensitivity, enabling it to bring in distant stations from all parts of the world with clearer tone and more volume; greater selectivity, enabling it to bring in weak stations on channels adjacent to powerful locals; and a greater undistorted power output, enabling the user to listen to any type of program without a trace of distortion; **than any other receiver with which it can be compared today, regardless of the price paid for or the number of tubes incorporated in its design.**

Technical Description of THE SCOTT IMPERIAL ALLWAVE



THE NEW SCOTT IMPERIAL ALLWAVE CHASSIS

(Unretouched Photograph)

Brief Specifications

Highly developed Superhetrodyne circuit with a wave length range from 13 to 550 meters. Twenty-two tubes used as follows: R.F. stage using 1 triple grid super control amplifier type 6D6 tube. Oscillator using 1 super triode type 76 tube. Oscillator voltage regulator using 2 high conductance gaseous tubes. Mixer stage using 1 Pentagrid converter type 6A7 tube. R.F. and converter A.V.C. amp using 1 duplex diode pentode type 6B7 tube. First, Second and Third I.F. stages using 3 super control R.F. amplifier type 39/44 tubes, Fourth I.F. stage using 1 triple grid super control amplifier type 6D6 tube. Detector,

A.V.C. system and 1st Audio stage using one duplex diode triode type 6A6 tube. Second Audio stage using two super triode amplifier type 76 tubes in push pull. Third Audio stage using 4 high mutual conductance power amplifier triode type 2A3 tubes, operating as parallel push pull pure class "A" power output tubes. Rectifiers using 1 type 83-V super heavy duty high vacuum full wave heater cathode rectifier tube and one type 5Z3 quick acting, heavy duty, full wave, rectifier tube. Noise Suppressor and Beat Frequency Oscillator using 1 duplex triode type 6A6 tube. Tuning Indicator Meter and Signal Centralizer circuits using 1 duplex diode pentode am-

plifier type 6B7 tube and one twin amplifier type 6A6 tube.

The Antenna Tuner

Maximum antenna gain is secured by using separate antenna primary coupling coils for every wave band, each of which is designed to cover efficiently the range of frequencies over which it operates.

The R. F. Stage

A separate tuned R.F. stage is used on each of the four wave bands with a triple grid super control high gain amplifier type 6D6 tube, giving maximum sensitivity with a minimum of noise and image frequency interference.

Four Stage I. F. Amplifier

Four stages are used in the I.F. Amplifier system and represents the ultimate in extremely high gain, *combined with absolute quietness of operation and exceptional selectivity.*

The cheaper class of radio receiver uses one I.F. stage; the medium priced receiver generally uses two, while some of the higher priced receivers use a maximum of three I.F. stages. Where only one or two stages of I.F. amplification are used, the tubes have to be pushed to the limit to assure sufficient sensitivity.

In the new SCOTT IMPERIAL ALL-WAVE, by using four I.F. stages, we require less gain per stage, so are able to incorporate the new 39/44 type tube. This tube has an extremely high plate resistance, thus minimizing the loss in the plate circuits of the I.F. transformers, enabling us to secure the ultimate in sensitivity with absolute stability; quietness of operation; exceptional selectivity and minimum interference, under even adverse receiving conditions.

Extreme efficiency is obtained in each of the I.F. stages thru the use of a remarkable newly developed multiple I.F. Litzendrath coil tuned by special low loss condensers, 100% shielding and filtration, and the scientific apportionment of gain per stage.

Distortionless Detector Circuit

In order to obtain distortionless detector action at all times, it is necessary to have more I.F. driving power than is supplied normally by the regular I.F. amplifier. This is secured in the SCOTT IMPERIAL ALLWAVE by a separate I.F. driver stage and assures sufficient power for the most efficient operation of both the detector and A.V.C. systems at all times, and eliminates every trace of distortion caused by overloading.

This special detector circuit at the same time accomplishes another highly desirable feature, in that it minimizes certain high modulation peak defects in the operation of the broadcast station itself, a very common cause of poor tone quality.

The Power Amplifier

To secure perfectly natural reception from all classes of programs, it is necessary that the amplifier be capable of handling the highest "peak" or loudest notes in the transmission, without overloading or distortion.

It is safe to say that 90% of the radio receivers being sold today have an undistorted output of 5 watts or less, while the remaining 10% have, perhaps, an undistorted output of between 6 and 10

watts. It is quite true that a large number of receivers have a greater *total* output than these figures, for it has become fashionable to overwork and force small tubes into giving a power output greater than they were designed for, and which should be expected only of large, rugged, heavy duty output tubes. In a radio receiver, the only output that matters is that part which is *undistorted.*

35 Watt Strict Class "A" Amplifier

One of the many remarkable features of the power amplifier of the new SCOTT IMPERIAL ALLWAVE, is the 35 watts of absolutely undistorted output with strict class "A" operation. From 35 to its full 50 watts, the operation of the amplifier becomes class "A" prime, which, while inferior to pure class "A" operation, does not reveal any detectable distortion to the human ear. As a matter of fact, most "High Fidelity" receivers now on the market that advertise a considerable power output, operate *continuously* in the class "A" prime region, even at normal signal levels.

It might be asked why we have incorporated an amplifier with such a very large output, 35 watts absolutely undistorted class "A," and up to 50 watts class "A" prime, when the great majority of radio manufacturers apparently consider 6 watts ample power output.

Probably the principal reason why most receivers have an undistorted output of 6 watts or less, is the fact, that to produce an amplifier with a 35 watt undistorted audio output, costs a very great deal more to build than the smaller 6 watt amplifier. In fact, the cost of the parts alone used in the amplifier of the SCOTT IMPERIAL ALLWAVE, amounts to more than all of the parts used in the whole complete radio receiver built by most manufacturers, and it is, therefore, impossible to incorporate such a high grade amplifier in a production type receiver which is produced to sell at a popular price.

How Perfect Reproduction Is Secured

However, with the transmissions from broadcasting stations continuously improving, if we are to secure the most perfect reproduction at all times, it is necessary that our power amplifier be capable of handling every loud passage or "peak" that comes in, *without distorting or overloading.* Most of the time, the audio level does not exceed 6 watts, but there are often dozens of passages in the course of a single program where "peak" or loud passages may rise for short periods to as high as 30 and 40 watts,

and it is necessary that we have a reserve power of about five times above the normal level, if we are to eliminate distortion during loud passages or sudden peaks in musical or speech reproduction.

These results have been attained in our new amplifier thru the use of an absolutely constant fixed bias, practically ideal plate voltage regulation having an exceptionally low resistance, the use of a total filtering capacity exceeding 100 mmfd, a 1st audio stage using a duplex diode triode type 6A6 tube, a 2nd audio stage using 2 super triode amplifier type 76 tubes in push pull, and a 3rd audio stage using 4 high mutual conductance power amplifier triode type 2A3 tubes, operating as push pull pure class "A" power output tubes.

The first automobiles produced had comparatively small engines, but as they were developed it was found that to secure smooth and comfortable performance at all speeds and under all conditions, it was necessary to have ample reserve power. If you were traveling all the time on a smooth, level road, a small engine with high top gear would provide all the speed necessary. However, we know that we do not always travel on smooth, level roads. Sometimes the surface of the road is such that considerable power is required to make any speed, as when you are traveling on a soft dirt road, or thru snow with chains on. One also travels occasionally in hilly country where the small engine would have to be pushed to its limit and would labor and vibrate badly to get you to the top. Automobile manufacturers, to meet all of these conditions, today provide cars which have engines with great reserve power so that the automobile owner may have satisfactory performance at all times.

The day of the radio receiver with a limited undistorted output is past. The new SCOTT IMPERIAL ALLWAVE is the first of a new era, for it meets all receiving conditions smoothly and efficiently and is as far ahead of ordinary radio receivers, as the modern automobile of today is ahead of the first model "T" Ford.

Another remarkable feature about the new amplifier, is that although it has such a very large undistorted output, it is under perfect control at all times, and any degree of volume can be secured, from the faintest whisper to full volume. There is no detectable hum, even under the quietest listening conditions, and this in spite of the fact that its frequency range is considerably greater than that of even the most gifted human ear.

Three Speakers Used to Cover Complete Frequency Range

When the design of the SCOTT IMPERIAL ALLWAVE was completed, we found that no existing speaker was capable of handling continuously the full fifty watts output of the power amplifier. In cooperation with one of the largest speaker manufacturers in the country, a speaker has been developed which can "take it." This speaker represents a new degree of perfection in dynamic speaker design, for its performance exceeds in every way anything previously accomplished. It is fully capable of handling the full 50 watt audio output of our power amplifier for an indefinite period of time, without evidencing the slightest sign of overloading.

But while this speaker surpasses in every respect, anything heretofore available, having a range practically flat from 25 to 6,000 cycles, and good response up to 9,000 cycles, even it is not able to reproduce the full tonal range of the new SCOTT IMPERIAL ALLWAVE.

New High Frequency Speaker Developed for Scott Imperial Allwave

In order to provide the ultimate in tonal realism, we have also had developed, for the new Imperial, a special high frequency unit which reproduces the higher audio frequencies and overtones or harmonics between 5,000 and 16,000 cycles, that heretofore have been missing from radio reproduction. These special high frequency units can be obtained as optional equipment, and to secure the ultimate in reproduction, two are used in conjunction with the regular speaker. This triple reproduction system assures complete realization of the finest radio or phonograph reproduction, covering the complete audible range of the human ear with a life-like quality that is startling.

Triple Automatic Volume Control System

There is nothing more annoying than to tune in a distant station and have the pleasure of your reception spoiled by the constant fading in and out of the signal.

To attain the best possible reception of stations in all parts of the world, the new SCOTT IMPERIAL ALLWAVE incorporates, not merely the regular single type A.V.C., but three distinct A.V.C. systems, each designed to provide the most efficient action and keep the signal practically constant at any desired volume level, irrespective of variations in signal strength.

Some idea of the problem involved in providing a perfect A.V.C. control in a radio receiver may be gained from the fact that it must respond efficiently to signals whose strength often varies as much as 500,000 to 1.

First Section of A.V.C.

For the finest noise-free reception of very weak to moderately strong signals, the R.F. stage should be operated at all times at maximum gain, that is, with no A.V.C. However, due to the great field strength of local and fairly distant super-powerful broadcast stations, the R.F. tube would be overloaded when tuned into these powerful stations, if it were worked without A.V.C. Scott Research Laboratory engineers have solved this problem by providing a separate I.F. stage A.V.C. system which allows the R.F. circuit to operate at maximum efficiency, but prevents overloading of the R.F. and converter tube when tuned to a very powerful local station, thus reducing noise or distortion to the minimum when tuned to a powerful local or to a distant station on a frequency close to a local station.

Second Section of A.V.C.

The second section of the A.V.C. system controls the converter and I.F. tubes. The major part of the work of maintaining the volume level constant in the reception of all signals, from the weakest to the strongest stations, is done by this part of the system. It is adjusted at the Laboratory so that its action extends completely down to the noise level of the quietest possible location.

Third Section of A.V.C.

The third section of the A.V.C. system is very sharply tuned to the center or resonance of the I.F. system, and performs two very important functions—(1) It actuates the tuning meter *only* when the station is tuned exactly to resonance, thus making certain that the receiver is *exactly tuned in at all times*. (2) A small amount of the energy from this section of the A.V.C. is reversed and fed into the second part of the A.V.C. system in such a manner that it decreases the sensitivity of the receiver when it is tuned slightly off resonance. This feature practically eliminates the objectionable "swishing" sound encountered in receivers which have any degree of sensitivity and selectivity, when the dial is tuned from one station to another. One important feature of this part of the system is that exact resonance is indicated and the "swish" is eliminated, *without in any way impairing the regular A.V.C. action or decreasing the*

sensitivity of the receiver, once it is tuned to exact resonance for reception from any desired station.

This combination of three separate A.V.C. systems, engineered to work as a unit, is only another of the advanced features that enables the SCOTT IMPERIAL ALLWAVE to bring to its owner, pleasurable reception from dozens of distant foreign stations that will never even be heard on the ordinary type of allwave radio receiver.

Self-Stabilized Oscillator With Voltage Regulation

If the plate voltage on the oscillator varies, reception, particularly on very weak or distant stations on the short wave bands, will be marred by a peculiar twisting or distorting effect, making it sound as if the signal were being tortured by an evil spirit.

The plate voltage on the oscillator may vary from two causes, or sources: (1) It will vary if the line voltage to the set varies. (2) It will vary if the strength of the signal you are receiving varies.

It requires no explanation to show why the plate voltage on the oscillator will vary if the line voltage varies. A variation in signal strength causes changes in the plate current drain of the receiver which, of course, changes the voltage applied to the plate of the oscillator.

A special voltage regulator tube and circuit has been developed, which makes the plate voltage on the oscillator independent of either line voltage or signal strength, and no matter what variation there may be in the line voltage even tho it may drop as low as 90 volts, or rise to as high as 130, and no matter what variation there is in the signal strength, this special voltage regulator keeps the plate voltage on the oscillator constant at all times to within $\frac{3}{4}$ of a volt, so eliminating another of the factors, which, up to this time, has caused distortion and poor reception on weak distant short wave stations.

The Dial Calibration

The dial on the new SCOTT IMPERIAL ALLWAVE is calibrated in kilocycles for the broadcast band, and in megacycles for the short wave bands. This precision calibration makes the locating of stations, either on the short waves, or broadcast band, a very easy matter if the correct frequency of the station transmitting is known.

To provide this accurate calibration, a special Standard Signal Generator has been designed and built at a cost of several thousand dollars, especially for the Scott Laboratory. All frequencies are

controlled by a precision Frequency Monitor, crystal and temperature controlled, which is checked regularly on the standard frequencies transmitted by the Bureau of Standards station WWV, located at Washington, D. C.

This new Standard Signal Generator which will be used for the regular calibrating and testing of every SCOTT IMPERIAL ALLWAVE, is a much more accurate standard than will be found even in the research laboratories of the large majority of manufacturers.

However, this precise calibration of the dial would be of little value unless the receiver itself were so designed that it would keep this calibration over an extended period. It is well known that a receiver is subjected to considerable vibration in transit, and also in many locations to extreme humidity and temperature changes, which, unless special precautions are taken, cause the calibration of the receiver to change.

Extensive research carried on for several years in our Laboratories, covering the effects of vibration and temperature changes on the trimming and tuning condenser and coils, together with a special method of keeping the voltage on the oscillator constant at all times, has enabled us to develop a means by which the precise calibration of the new SCOTT IMPERIAL ALLWAVE can be maintained accurately over a long period.

Wave Bands Covered

All wave lengths between 13 and 550 meters are covered by four wave bands, any one of which can be instantly switched in by means of the small bronze lever located below the main tuning knob.

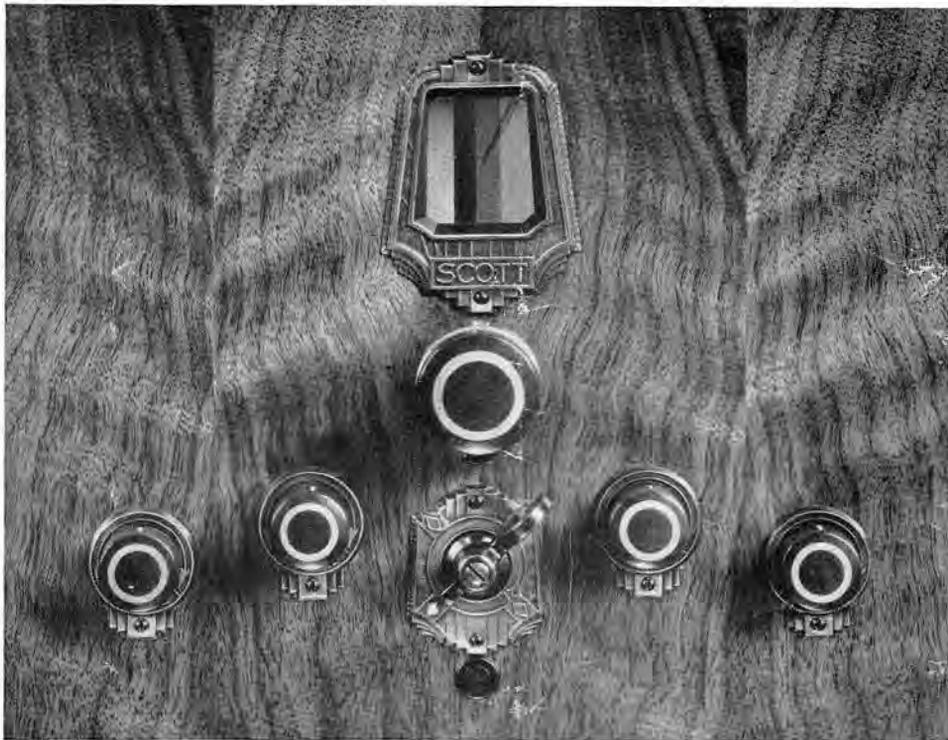
The first wave band covers the regular broadcasting stations in U.S.A., including the special "High Fidelity" broadcasting stations recently licensed by the Federal Radio Commission to transmit below the present regular broadcast band.

The second wave band covers the

wave lengths used by the Police Stations, Air Port Stations and transmitters on airplanes, and also the 80 and 160 meter amateur phone bands. Stations on this band have been made extremely easy to locate by printing directly on the dial, the section where each type of calls will be found.

The third wave band covers the wave lengths between 30 and 75 meters. On this band will be found the principal foreign short wave broadcast stations whose signals are heard during the late morning, afternoon and evening.

The fourth wave band covers all wave lengths from 13 to 30 meters, and on this band will be found the foreign short wave broadcast stations whose signals are generally heard best during the morning hours.



Controls Reading Left to Right—Volume Control—Bass Control—Two Speed Tuning Control—Sensitivity Control—Variable Selectivity and Fidelity Control. Below Tuning Control—Wave Change Switch Lever and Beat Frequency Oscillator Button.

How Wave Bands Are Selected

All wave bands are completely covered by means of an exclusive rotary mechanical coil changing switch perfected in the Scott Research Laboratory, and whose design is protected by Scott patents. The "heart" of any Short Wave Switch lies in the perfect contact between the switch points. The double wiping contacts in our switch are solid german silver, which are automatically cleaned by felt wipers at each rotation of the switch, insuring perfect contact at all times. The lever directly below

the tuning knob enables you to select, in a fraction of a second, any one of the four different wave bands.

The Short Wave Station Locator

Tuning, especially on the short waves, has been made extremely easy with the very accurate dial calibration of the SCOTT IMPERIAL ALLWAVE. However, to make it easier still, we also have a Short Wave Station Locator, or improved Beat Frequency Oscillator.

To find a short wave station, you simply press the small black button which you will notice directly below the wave change switch lever, then move the dial slightly up and down opposite the section of the dial where it should come in, and immediately the station is actually tuned in, it will make its presence known

by a whistle. You then release the pressure on the button, which disconnects the Beat Frequency Oscillator, then in comes the station and the whistle disappears.

The Beat Frequency Oscillator incorporated in our receiver uses a special compensating circuit which has been developed in the Scott Research Laboratories. This overcomes a serious defect in Beat Frequency Oscillators used up to this time which either fails to give any whistle at all on very strong signals, or else are too loud on weak signals. It gives a clear audible signal on

all stations, both strong and weak, making it just as simple and easy to tune in short wave stations as it is to tune in stations on the regular broadcast band.

Single Control Tuning

The tuning of all stations, on both the short wave and broadcast bands, is accomplished by a single knob, located directly below the dial escutcheon. Short wave stations tune much more sharply than stations on the broadcast band, and for this reason a much finer control is provided to tune them in exactly.

The tuning knob on the SCOTT IMPERIAL ALLWAVE has two speeds.

In one position, the dial can be turned rapidly from one end to the other, and is used in this position when tuning on the broadcast band, while by pressing a small lever underneath the knob, the vernier action is connected, slowing the tuning down to five times less than its normal speed, so that short wave stations that come in on a very small section of the dial can easily and quickly be tuned in "right on the head."

Visual Tuning

To secure perfect tone quality, it is necessary that the station you desire to listen to be tuned in exactly at resonance. This cannot be accomplished without a visual indicator which shows when the station is tuned in perfectly. In the SCOTT IMPERIAL ALLWAVE, the tuning indicator is projected directly on the face of the tuning dial. This eliminates a separate dial for the tuning indicator, so that the eye has only one point to watch instead of two, when tuning in a station. This is another exclusive development of the Scott Laboratory. (Patents pending.)

The tuning indicator system employed on the new SCOTT IMPERIAL ALLWAVE is a very highly developed one, employing a separate tube and a special tuned circuit, and the tuning indicator pointer acts only when the station is tuned in exactly at resonance, thus making it a simple matter for anyone to tune in a program from any station, either on the broadcast band or short waves, with perfect tone.

Most tuning indicators give a good indication only on fairly strong signals, with a fair indication on medium strength signals, and no indication at all on weak signals. Our tuning indicator entirely overcomes this defect, in that it gives a good indication, even on weak short wave stations.

Scott Imperial Allwave First Receiver to Cover Complete Audible Range of Human Ear

If a radio receiver is to give a complete and perfectly natural reproduction of all sounds and tones, it must have a frequency range covering the entire audible tonal range of the human ear. Scientific Laboratory tests show that this audible range, including the fundamental frequencies and their harmonics, or overtones, is from 25 up to 16,000 cycles.

When you are listening to any musical instrument or a human voice, you do not hear simply a pure tone consisting of one single frequency, but you also

hear a succession of weaker tones of that frequency, called harmonics or overtones. It is these *harmonics or overtones* of the fundamental frequency, that enables you to recognize one musical instrument from another and gives to each its characteristic timbre or tone. If a note were played or struck, and appropriate audio filters were used to eliminate all harmonics, leaving only the fundamental, it would be absolutely impossible to tell whether it was a flute, violin, trumpet, or exactly what instrument was being played, for the note would sound exactly the same on all instruments. *It is the overtones or harmonics associated with the fundamental frequency that enables you to tell immediately what instruments you are listening to.*

Why Complete Frequency Range from 25 to 16,000 Cycles Must Be Reproduced

Some instruments are richer in harmonics and overtones than others. For example, the important overtones of the cello go up to 8,500 cycles; the bassoon to 9,500 cycles; the bass clarinet to 10,000 cycles; the violin and oboe up to 14,000 cycles; and the flute to 15,000 cycles. The clapping of hands, the jingling of keys, or the sparkling tinkle of small bells may go up to as high as 16,000 cycles. Most people have noticed that hand clapping, when heard thru a radio receiver, sounds like a dull rumble, and the reason hand clapping does not sound natural, is because you do not hear the higher harmonics or overtones coming thru.

It can clearly be seen, therefore, that if you are to secure absolute naturalness and lifelike fidelity of musical instruments or voice, *the receiver must be capable of reproducing all frequencies without appreciable attenuation from as low as 25 cycles up to as high as 16,000 cycles.*

Ordinary Radio Receiver Covers Less Than Third of Frequency Range Necessary for Perfect Reproduction

At the present time the regular popularly priced radio receiver does not reproduce any frequency above 3,500 cycles, the medium priced receivers occasionally go as high as 5,000 cycles, some of the higher priced models go up to 6,000 cycles, and a few high priced "High Fidelity" receivers have a range up to 7,500 cycles.

New Scott Imperial Allwave Covers More Than Twice Frequency of Regular "High Fidelity" Receiver

This is the first announcement of a new development recently perfected in the Scott Research Laboratory (Patents applied for) which enables us to build a receiver with more than TWICE the frequency range of even the finest of the so called "High Fidelity" receivers available today, for it has a practically flat response covering the whole audible frequency range from 25 to 16,000 cycles.

It is simply stating a fact that the great majority of people are gradually forgetting the *actual* sound of musical instruments. This has been clearly and definitely proven here in our Laboratory during the past few weeks in a series of listening tests which have been carried out with many different groups of people, some of whom were talented musicians, and some who were not, but all more musically inclined than the average.

In these tests, various stations which were known to be transmitting very good tone quality were tuned in and the Fidelity Control adjusted about half way so that these groups were listening to frequencies up to around 6,000 cycles. Without exception, all were extremely and genuinely enthusiastic, claiming they had never before heard such lifelike reproduction. However, when the Fidelity Control was adjusted to include the entire frequency range the station was transmitting, our listeners could not find words to express their astonishment, for all were startled and amazed by the realization that they had not been hearing at all many of the higher tones of the instruments which were actually being played by the orchestra. It is practically impossible to describe on paper the tremendous difference it makes in being able to reproduce the frequencies above 5,000 cycles.

When listening to the voice of a speaker or singer coming from your present radio, do you hear the "siss" sound in a word such as "listen" or the "ning" in "listening," as distinctly and clearly as if someone were talking to you direct? The difference in what you hear from an ordinary radio receiver, and what you will hear coming from the new SCOTT IMPERIAL ALLWAVE, is even more marked when listening to an orchestra with its instruments.

We make the statement in all seriousness, that there are many instruments in the orchestra that you are not able to recognize at all with the radio receiver



THE SCOTT IMPERIAL ALLWAVE POWER AMPLIFIER

(Unretouched Photograph)

you now have, because the absence of the harmonics in the reproduction deprives the instruments of their individuality. However, you *will* recognize them on the new SCOTT IMPERIAL ALLWAVE. We fully realize this statement is an extremely strong one, but nevertheless, it is a fact that can be demonstrated in less than five minutes when listening to an orchestra that is broadcasting from a high quality station. Simply turn the Fidelity Control of the SCOTT IMPERIAL ALLWAVE to the position where all frequencies above 3,500 cycles are cut off, then gradually open it up to the full transmission range of the station. The impression you get is that the conductor is gradually bringing fresh instruments into play as you turn up the Fidelity Control. In the position where all frequencies above 3,500 cycles are cut, you simply do not hear at all certain instruments being played, while with the Fidelity Control set to reproduce the full range up to 16,000 cycles, you will hear from a high grade "High Fidelity" station, every instrument exactly as you would hear it were the orchestra in front of you.

Four "High Fidelity" Stations Now on Air

At the present time there are four "High Fidelity" broadcasting stations now transmitting frequencies equal to those it is possible to receive on the new SCOTT IMPERIAL ALLWAVE. These are stations W2XR, Long Island City, New York; W6XAI, Bakersfield, California on 1550 Kc., and W1XBS at Waterbury, Connecticut, and W9XBY

at Kansas City on 1530 Kc; all of which have a frequency response that is practically flat from 25 to 16,000 cycles. These are the first of the true "High Fidelity" broadcast stations, just as the SCOTT IMPERIAL ALLWAVE is the first "High Fidelity" receiver designed to cover the complete audible frequency range.

Attenuation Equalizer at 10,000 Cycles

At the present time broadcasting stations are separated by a frequency of 10 Kc. or 10,000 cycles. Therefore, when tuned to a broadcast station there is always present a high pitched whistle or 10,000 cycle note from the adjacent channel, *if the receiver used has a frequency response above 10,000 cycles.* This note or whistle is *not* heard on an ordinary receiver, or even on the best of the "High Fidelity" receivers which have been produced up to this time, because they do not reproduce any frequency above 7,500 cycles.

However, because the SCOTT IMPERIAL ALLWAVE "HIGH FIDELITY" RECEIVER has a frequency range which includes not only all frequencies up to 10,000 cycles, but those up to as high as 16,000 cycles, this whistle would be heard if special precautions were not taken to eliminate it. This is accomplished with an Attenuation Equalizer which effectively chops out the 10,000 cycle whistle *but which does not impair the reproduction of the frequency response either above or below this one frequency.*

As a matter of information to those technically inclined, while the attenuation at 10,000 cycles exceeds 50 db, the attenuation at 9,500 cycles or 10,500 cycles is less than 6 db. This means we are able to use the full fidelity range of the receiver both above or below 10,000 cycles with the annoying adjacent channel whistle eliminated.

The Bass Control

To bring out the full rhythmic cadence and rich tones of the bass instruments such as the bass viol, tuba, saxophone or the lowest tones of the organ, a receiver must be capable of reproducing, **WITHOUT ATTENUATION**, audio frequencies to as low as 25 cycles.

The new SCOTT IMPERIAL ALLWAVE, has a flat frequency response to 25 cycles, so that when listening to a program from a high grade broadcasting station which is not overmodulating its carrier, and whose output is free from station hum, the powerful, deep bass tones of all instruments can be fully enjoyed.

However, many of the smaller stations overmodulate badly and their carrier hum is quite objectionable, so that the best reception from this class of station can only be obtained when audio frequencies below 150 cycles are eliminated. To enable the most pleasurable reception to be obtained under all conditions, a perfected Bass Control is incorporated in the design of the SCOTT IMPERIAL ALLWAVE which enables the bass response of the receiver to be adjusted at

five separate cut off points between 25 and 150 cycles.

This control also has another advantage. Many people prefer to have the bass tones accentuated slightly, so a point has been provided on the Bass Control which enables you to accentuate the lower frequencies slightly above normal, so giving the deep, mellow tone preferred by many.

Noise When Tuning Between Stations Eliminated

If a receiver is to bring in stations from distant parts of the world, it must have a very high degree of USEABLE sensitivity. If it is to hold the signal from a distant station at a constant level, it must have a very efficient A.V.C. system. But a highly sensitive receiver with a very efficient A.V.C. system, means that when you tune between stations, your A.V.C. opens up the full sensitivity of the receiver, in which case, unless your location is an extremely quiet one and free from all forms of electrical interference, you can't help bringing in a large amount of noise when tuning from one station to another.

The idea of a Noise Suppressor between stations is not new. However, in all of the systems so far introduced, the principal fault has been to destroy the effectiveness of the A.V.C. system when the Noise Suppressor was in operation, and also to cause considerable distortion on moderately weak signals. All of these defects have been entirely eliminated in the new Noise Suppressor incorporated in the SCOTT IMPERIAL ALLWAVE, an exclusive recent development of the Scott Research Laboratory (Patents applied for).

New Noise Suppression System Especially Valuable in Noisy Locations

The new Noise Suppressor is especially valuable in locations where local electrical interference is bad. It is continuously variable and enables the operator to adjust the maximum sensitivity of the receiver to whatever noise level is prevalent at the time. This control, however, differs from all other sensitivity controls in that it *does not impair the action of the A.V.C. in any way, nor does it affect the tone quality, or cause distortion on any station, either local or distant.*

The operation of this system will be readily understood when it is likened to the action of a speed governor on an automobile truck. The governor may be set so that it allows the truck to travel

at a certain maximum speed, and no faster. However, the governor *does not affect, in any way*, the operation of the machine at any speed *under* the maximum for which the governor is set. In like manner, our new Between Station Noise Suppressor enables you to adjust your receiver to the point where all noise caused by local interference, etc., is eliminated, then all stations which are tuned in will be heard without interference or noise. This development means that the receiver can always be operated at the maximum sensitivity possible, in your particular location, to give the most satisfying reception.

Selectivity Continuously Variable from Hair Line Sharpness to 24 K.C.

The degree of selectivity possessed by a receiver determines its ability to tune thru powerful local stations and bring in weak distant signals. The new SCOTT IMPERIAL ALLWAVE incorporates a very remarkable new Selectivity-Fidelity control which enables the user to obtain, at all times, not only any desired degree of selectivity, but also the maximum fidelity of reproduction possible from any station, with the minimum of noise and interference. This new Selectivity-Fidelity control is continuously adjustable. In the most selective position, adjacent channel discrimination of approximately 5,000 to 1 is obtained, while in the maximum fidelity position, audio reproduction up to the limit of the human ear, or the limit of the highest frequency being broadcast by the station selected is obtained. The I.F. Selectivity-Fidelity system used in the SCOTT IMPERIAL ALLWAVE, is an exclusive development of the Scott Research Laboratory (Patents Applied for) which enables the user to reach out and bring in weak distant stations, which ordinarily would be blanketed by interference from powerful nearby stations on adjacent channels.

This new feature also enables the user to secure satisfactory reception from stations which he has not, up to this time, been able to bring in on any radio receiver with any degree of satisfaction, on account of interference from stations on adjacent channels.

On the other hand, when listening to local stations, a high degree of selectivity is not necessary or desirable, and under these circumstances, the receiver can be adjusted to reproduce every tone from the lowest fundamental to the highest harmonic which the highest fidelity station on the air is capable of broadcast-

ing. However, "High Fidelity" reproduction for the owner of the SCOTT IMPERIAL ALLWAVE is not limited to reception from local stations, since in most cases, reception with a degree of fidelity heretofore considered unobtainable, can be had from the higher quality stations up to considerable distances. Thus, for any station which may be tuned in, a setting of the Selectivity-Fidelity control can be found which will afford the maximum degree of fidelity in reproduction from this station, with interference eliminated from stations on nearby frequencies.

Another very interesting feature of our new variable Selectivity-Fidelity control, is that with it you secure maximum sensitivity when the receiver is in the *maximum selective position*. This, with its extremely high degree of *useable sensitivity*, makes it the ideal receiver for those who are particularly interested in reception from very weak distant stations, as well as for those who are interested primarily in tonal perfection.

High Useable Sensitivity Brings in Weak Distant Stations With Good Volume

It is not a very difficult matter to incorporate extreme sensitivity in a receiver, provided the word "useable" is not inserted before the word "sensitivity," but IT IS an extremely difficult matter to provide a high degree of useable sensitivity, that is, sensitivity free from noise.

To secure a high degree of useable sensitivity, means that special precautions must be taken in the form of very careful shielding, thorough filtration of the R.F., I.F., Oscillator, and Audio Systems to prevent feed back between one element of the system and another. If there is any feed back or regeneration present, it invariably results in noisy reception, especially on weak distant signals, and generally introduces into the reception a heavy rumbling. These effects have been so minimized in the new SCOTT IMPERIAL ALLWAVE, that you are able to use, to the greatest degree, the full sensitivity of the receiver.

The very advanced design and the high degree of efficiency developed in the antenna coupler, the antenna tuner, the R.F. stage, and the four I.F. stage combined with an especially efficient A.V.C. system, makes possible the reception at good volume, of extremely faint distant signals. (Continued on Page 9)



Museum of Science and Industry Honors the Scott Laboratories

IN Chicago is located one of the world's most interesting exhibition buildings, the Museum of Science and Industry. When completed, it will contain the highest achievements in the machinery used in every major industry. There will be models of the machines and methods employed in mining gold, silver, copper and iron. You will first see the iron sand as it is taken from the earth, then working models of Bessemer furnaces, rolling mills and wire drawing plants show you how the iron is converted into the steel that is used to build skyscrapers and bridges.

You will be able to step into a reproduction of the Laboratory in which Faraday, greatest of experimenters, made his discoveries, and find reproductions of the apparatus he used in developing his inventions. You, too, can experiment with them and pretend you are Faraday, and learn how electromag-

netic induction was discovered. You will see, by actual working machines, how current is generated in a dynamo, then proceed from this to a replica of a modern electric power station in which you will see how the current is distributed to our homes and factories.

There will be working models which will show you in miniature an oil field, with cut-away models of oil wells, depicting how the oil is pumped up from the earth, then how the various products such as kerosene, naphtha, gasoline, and lubricating oils are obtained from this crude oil.

Walk into another room and you will see a diorama of New York Harbor. Here you can step on to a replica of the bridge of a modern liner, and actually manipulate for yourself, the instruments used by the Captain to navigate his ship.

You can follow the history of land

transportation by six full sized engines, most of them sectioned and operative, with full scale models, illustrating the whole story. There are ship models which will tell the story of water transportation, with a full sized submarine with all its intricate mechanism.

In the Museum of Science and Industry you will find either full size or scale models of the most marvelous machines in the mechanical world.

We here at the Scott Laboratory felt honored when the request came from the Director of the Museum of Science and Industry that he would like to install in the Museum, as an exhibit of the radio industry, a SCOTT ALL-WAVE RECEIVER, together with a duplicate of the testing equipment we use here at the Laboratory to make life tests on the various parts incorporated in our receivers.

All Parts Protected to Withstand Climatic Changes and Guaranteed Against Defect for Five Years

If a receiver is to give continuous trouble-free operation over a period of years, it is necessary not only that all parts, particularly in humid, tropical climates, be protected against moisture, but also that all coils be treated so that they will maintain their characteristics indefinitely.

All coils used in the SCOTT IMPERIAL ALLWAVE are impregnated by a special process, all audio transformers and chokes are hermetically sealed to prevent moisture entering and causing breakdown in damp locations. The field coil of the special Scott Speaker is treated with a moisture proof

compound, and a damp proof cement is used on the speaker cone to insure continuous operation, under even the most severe climatic conditions. All metal parts, such as chassis on both receiver and amplifier, tube shields, coil shields, condenser covers, etc., are chromium plated, which not only makes these parts rust proof, but insures that the receiver will preserve its beautiful finish for many years, even when continuously exposed to the air.

A special study has been carried on for many years in the Scott Laboratory, observing the effect of climatic conditions in different parts of the world on the parts used in our receiver. We believe no other radio manufacturer goes to such extremes as we do in the building of SCOTT RECEIVERS, to insure that they will give their owners satis-

factory trouble-free operation over a long period of time.

Most radio manufacturers will guarantee their receivers against defects for 90 days only, while every SCOTT RECEIVER produced for many years past has carried with it a *Five Year Guarantee against defects*. This remarkable guarantee is possible because Scott Receivers are built from such high quality parts; the actual building of them done by such highly skilled technicians; the most of whom have been employed continuously in our laboratories for many years; all units are so completely and thoroughly impregnated and treated to protect them against the effects of moisture; and all adjustments so carefully made and permanently fixed to protect them against vibration, that it is very rare indeed for any part of a Scott Receiver to break down (tubes excepted).

The Scott Imperial Allwave— A Custom Built Radio

**PROVED BY EVERY TEST THE WORLD'S FINEST
ALLWAVE RADIO RECEIVER**

WHEN anything is described as "custom built," you immediately think of something that is exclusive, finely built by hand by expert craftsmen, from the very highest grade of materials. You imagine something outstanding in design, and above the average in every respect. The words "custom built" or "custom made" implies an exclusive product, made in very limited numbers for those who desire something far above the ordinary.

When we talk about a "custom built" radio receiver, just what does it imply? In what way is it different from the regular commercial type?

First—It implies a receiver that is designed to give performance far beyond the ordinary commercial receiver.

Second—It implies a receiver designed by one whose name is known thruout the engineering profession as an outstanding figure in radio receiver design.

Third—It implies a receiver built from the very highest quality parts.

Fourth—It implies a receiver built in limited numbers by Laboratory technicians with years of experience in the building of fine receivers.

Fifth—It implies a receiver which is checked in every step of its construction by experienced Laboratory engineers.

Sixth—It implies a receiver which is actually designed and built in the Laboratory of its maker and sold exclusively by him, and which in every way conforms to the generally accepted high standards associated with true "custom" construction.

Every Step in Construction Carefully Checked

Thruout every operation in the building of a Scott Receiver, there is constant testing, checking and rechecking to assure consistently perfect performance in the finished receiver.

The technicians who build Scott Receivers have all been trained in precision work by Scott Laboratory Engineers, and the result is, naturally enough, a

product of fine craftsmanship. To cover all the interesting and vitally important tests a Scott Receiver goes thru before it is delivered to its purchaser would require a volume. Suffice it to say that not one single point is neglected, and



SCOTT RECEIVERS are designed, built and tested in this modern Laboratory. On the top floor, left side, is located Research and Experimental Laboratory—on right side Construction and Test Departments—the second floor houses the General Offices and Demonstration Studios—on the first floor is located the Foreign Department.

the time spent merely checking and testing each step in construction of a Scott Receiver is, I believe, MORE than the total construction time required for the complete assembly and testing of about ten ordinary production type radio sets.

Every Scott Custom Built Receiver Tested on Foreign Station

With the building completed, the testing and checking of the Scott Receiver really begins. Each one must go thru a series of precision measurements and adjustments, which assure keenness of selectivity and sensitivity, fineness of tone quality, perfection of calibration. Finally, each set must demonstrate its ability in actual performance on the air when it must bring in with good volume stations in various parts of Europe, Central and South America, as well as various broadcast stations in the U.S.A.

To carry on such extensive and exact-

ing tests under proper engineering control, requires a vast amount of delicate and unusual laboratory equipment to say nothing of much time on the part of the highly skilled technical men.

One of the instruments used to make the final tests on the SCOTT IMPERIAL ALLWAVE is shown on next page. The particular piece of equipment shown has just been finished after nearly a year's development work, and is the new Standard Signal Generator which will be used to calibrate, measure and test, the new SCOTT IMPERIAL ALLWAVE.

Our new Standard Signal Generator has a primary frequency which is crystal and temperature controlled, and is checked regularly with the Bureau of Standards Frequency station WWV, at Washington, D. C. An idea of its extreme preciseness may be gained from the fact that the maximum variation in its frequency calibration up to this period has been less than 5 cycles in a million, and on most checks has been accurate to within 2 cycles in a million.

This new equipment gives accurate signal intensities at all frequencies down to .1 of a microvolt, while on other Signal Generators, .1 of a microvolt cannot be read with any degree of accuracy.

Starting at the upper left hand corner of the photograph shown, is the standard frequency source, consisting of a temperature controlled crystal oscillator with its associated buffer amplifiers to isolate the standard frequency amplifier from the crystal.

Immediately below this is the modulator unit which provides a constant modulation of 30% at all frequencies. Below the modulator unit is the power supply for the crystal oscillator and its associated equipment. Below the power supply is the fixed 400 cycle audio oscillator and the patching panel to connect the output of either variable or fixed oscillators to the various circuits.

Below the patching panel is located the variable beat frequency oscillator with its individual power supply. The oscillator covers a range of from 5 to 16,000 cycles.

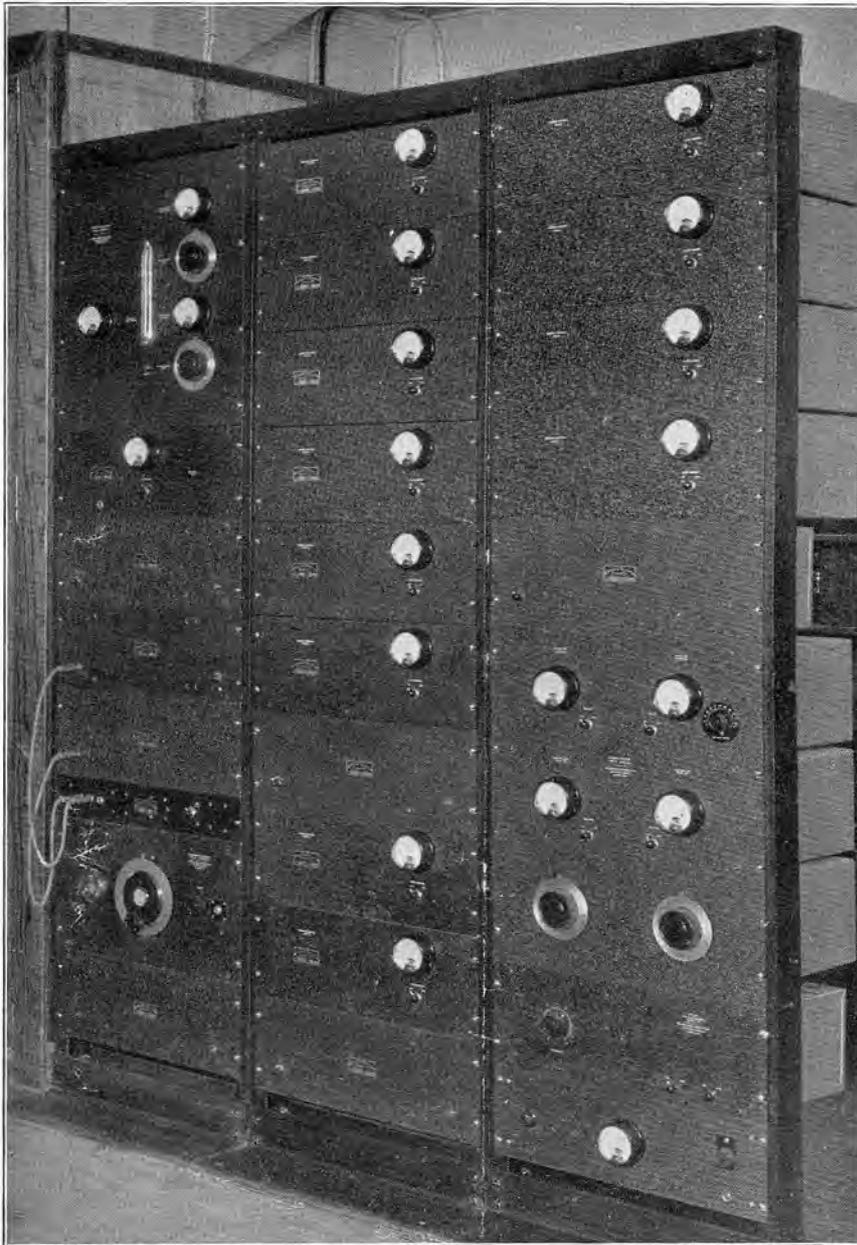
The middle rack contains the amplifier for the individual short wave test

frequencies of 2, 4, 6, 10, 12, and 22 megacycles. In addition to the fixed frequencies, all other frequencies are available which are multiples of two of the megacycles mentioned above.

On the right hand rack are carried the amplifiers for the broadcast band test frequencies with the power supply feeding them located directly underneath. These frequencies are controlled from the 100 Kc. primary standard in the Research Laboratory. In the lower section of this rack are contained the amplifiers used in checking the long wave frequencies on receivers built especially for use in Europe.

Scott Custom Built Receivers never have, and never will be built at a price mark, but always to a quality standard. The unrivaled richness of tone of Scott Receivers; their ability to bring in clearly foreign stations in every part of the world; the accuracy of their calibration; their unflinching perfection of service in every part of the world; are the result of untrammelled efforts in the Research Laboratory.

From the Scott Research Laboratories, have come many of the new and revolutionary developments in radio. The list of Scott "Firsts" which have been pioneered and developed in our Laboratory, during our ten years in the radio business, is long and distinguished.



The Standard Frequency Signal Generator used to check and calibrate the Scott Imperial Allwave



General View of Assembling and Wiring Department

Perhaps the most outstanding "FIRST" is the now universally used "ALLWAVE" receiver.

Our first "ALLWAVE" was the SCOTT SHIELD GRID NINE, which was brought out in 1928, tuning all wave lengths from 20 to 550 meters, and since that time all SCOTT RECEIVERS have been "ALL-WAVE."

It is only within the past twelve to eighteen months that most other manufacturers have introduced "ALL-WAVE" receivers, proving, that in this feature, the Scott Laboratory was at least five years ahead of commercial receiver manufacturers.

The now universally used Transmission Type Noise Reducing Short Wave Antenna, which has been copied in various forms by practically every other manufacturer in the radio industry, was first introduced and sold with the SCOTT ALLWAVE in 1930.

When the SCOTT WORLD'S RECORD SUPER TEN was introduced in 1927, it gave to the radio world an entirely new conception of what really fine tone quality could be obtained from a radio receiver, for it was the first receiver to use the 210 power tube as part of the design in a radio receiver.

To this record is now added the first true "High Fidelity" receiver, the SCOTT IMPERIAL ALL-WAVE, covering the complete audible range from 25 to 16,000 cycles.

The Scott News

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Chicago

E. H. SCOTT, Editor

During the past few weeks here at the Laboratory, we have been enjoying some of the most interesting and thrilling experiences in our whole history.

Night after night, we have listened, literally spell-bound, to music from orchestras of all kinds, in which the instruments came in so clearly and with such realism, you could easily distinguish every single instrument. You could visualize the harpist plucking each individual string; the scrape of the bow on the violin, with the highest notes coming thru clear and strong above those of the other instruments. When the cymbals clashed you immediately visualized the two round brass plates striking. To hear piano reproduction was an absolute revelation.



E. H. SCOTT

Listening Test Reveals What's Missing in Present Radio Receivers

Last Sunday afternoon, we listened to the broadcast of Brahms's First Symphony played by the New York Philharmonic Symphony Orchestra, and conducted by Toscanini. It is quite impossible to find words to express the impression created. I might say that all present, with the exception of the Laboratory staff and myself, were very accomplished musicians, and all were unanimous in the opinion that we had produced an instrument that would revolutionize musical education.

Those present brought out the fact that for every one that can attend in person a Symphony Concert, or an Opera, there are thousands who live in cities that do not have their own Symphony Orchestra and do not have the time or the money to attend these concerts in other cities. Now, these thousands of music lovers spread all over the land can join with those fortunate ones listening to the performances in person, and will lose practically none of the realism being experienced by the actual audience.

Many of those we have invited to listen

to our new instrument are prominent in the musical world, both as artists and teachers. They all have been enthusiastic in pointing out, that now the most famous artists in the world can be heard on the air, students of music can listen to these masters, note their technique and so improve their own.

It is quite impossible without an actual listening test, in which a direct comparison can be made, between what is now considered a high grade radio receiver and our new instrument, to appreciate the tremendous difference between them.

Half Musical Tones Not Heard

Perhaps the following illustration may convey some idea of this difference. Visualize yourself in a dimly lighted room in which you can barely distinguish the various objects, then imagine turning a control which gradually brings up the illumination in the room until everything in it is clear and distinct. Your reaction will be very much the same when you listen to the radio receivers available today and the new SCOTT IMPERIAL ALLWAVE. First, you hear music which you will consider perfectly pleasing and satisfactory until you switch over to the Imperial, and then, and then only, do you realize what you have been missing. I am quite sure that after you have listened for fifteen minutes or more to the new SCOTT IMPERIAL ALLWAVE, you will never be satisfied with an ordinary receiver which reproduces only about half of the musical tones of the various instruments being broadcast.

Noted Musical Leader Tells What Is Required for Perfect Reproduction

It is significant that within recent months there has appeared articles in the leading magazines on the subject of faithful radio reproduction. Probably one of the most authoritative articles is that by Leopold Stokowski, conductor of the Philadelphia Symphony Orchestra, in the January issue of "The Atlantic Monthly." Mr. Stokowski has this to say:

"The adequate transmission of harmonics in operatic or orchestral music includes frequencies or vibrations as rapid as 13,000 per second. By frequency is meant, roughly, what musicians call 'pitch'—whether a tone, or group of tones, high, low, or in the middle register.

"Instead of the 13,000 frequencies per second which are necessary for the adequate transmission of orchestral music, radio listeners in most of the homes in

the country, are hearing at the present up to about 5,000 frequencies or vibrations per second and sometimes fewer. That part of the music which should be conveyed from five to thirteen thousand frequencies is obviously lost."

What Mr. Stokowski says is perfectly correct, as at the present time the great majority of radio receivers in use do not have a higher frequency response than 5,000 cycles.

At the present time, all broadcasting transmitters operated by the National Broadcasting System, among them WEAf, WENR, WMAQ, WCFL, WHO, WJR and WJZ, are engineered to transmit within one or two db. all frequencies from 30 to 10,000 cycles.

KMOX, WHAS, WABC, WCCO and WCAU, some of the principal stations of the Columbia Broadcasting System's chain, have speech input and transmitters with a flat frequency response of from 30 to 10,000 cycles.

In addition to the stations mentioned, there has come on the air during the past few months four new special "High Fidelity" transmitters, whose response is flat within one or two db. from 25 to 16,000 cycles.

From these facts, it is quite clear that a large percentage of the broadcast stations on the air are capable now, and have been for some time, of transmitting programs with a degree of fidelity much higher than can be received on the ordinary "High Fidelity" receivers whose frequency response is limited to 7500 cycles.

At the present time, these stations are not able to use their full frequency range, being limited by the telephone circuits connecting the studio and transmitters, or in the case of chain programs, to the telephone lines between the "key" station, and the local station transmitting the program. These telephone circuits are now flat from 14 to 7000 cycles. However, developments recently announced by the Bell Telephone Laboratories, have made it possible to install lines between studios and transmitters putting out chain programs which will pass, without attenuation, all frequencies from 25 to 16,000 cycles or higher if necessary.

The information given in this issue of the "News" on page 6, covering the fidelity of the new SCOTT IMPERIAL ALLWAVE, explains clearly why it is necessary to reproduce all frequencies between 25 and 16,000 cycles to secure reproduction that will sound to the human ear the same as the original.