

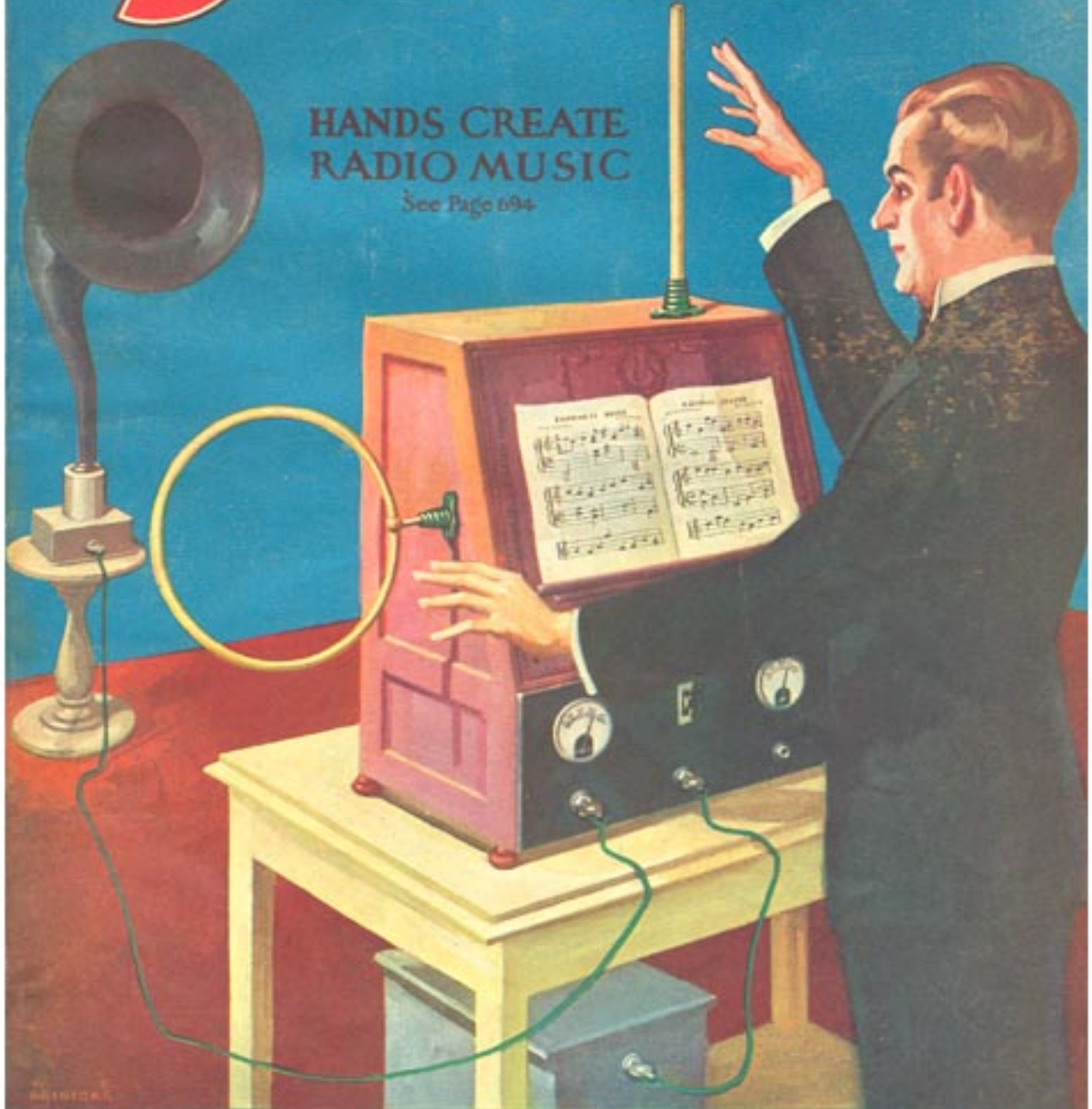
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# Science and Invention

HANDS CREATE  
RADIO MUSIC  
See Page 694

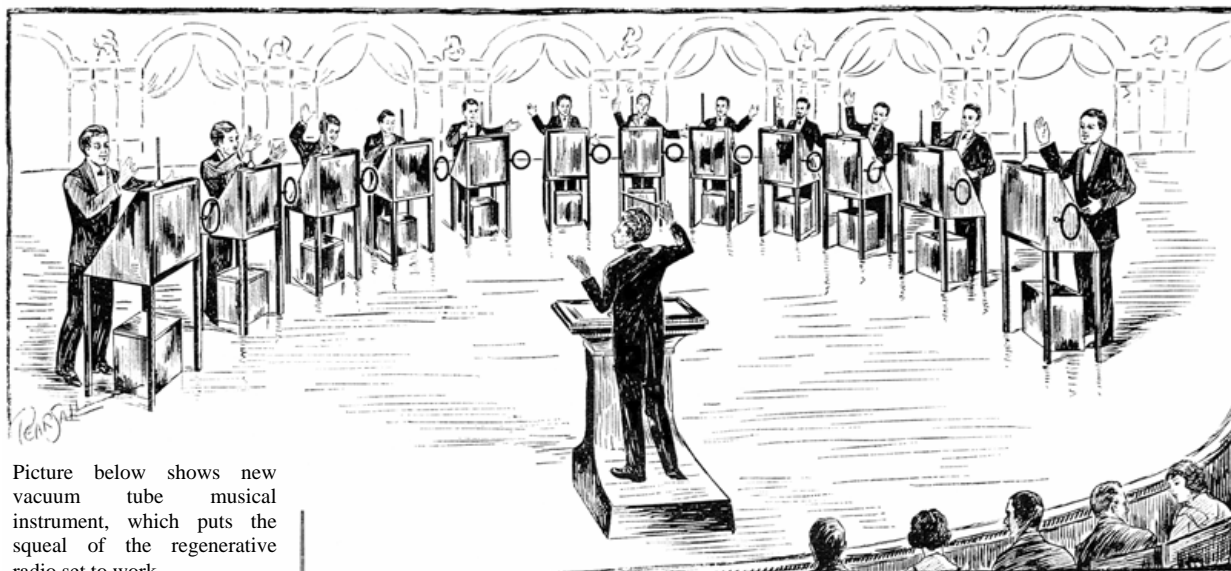


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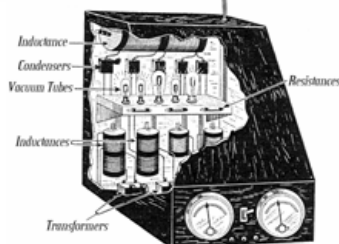
# Hands Create Radio Music

New World of Musical Tones Discovered by Experimenting with the Squeal of Radio Receiving Set

By H. WINFIELD SECOR



Picture below shows new vacuum tube musical instrument, which puts the squeal of the regenerative radio set to work.



The strange looking semicircle of musical instruments we see in the above picture represents the latest scientific discovery by Prof. Theremin, a Russian scientist. Moving the hands toward or away from the brass rod and circle protruding from the cabinet, the consequent changes in body capacity in turn cause variations in the frequency of the currents in the apparatus, and thus produce changes in the tones heard in the loud speakers. In the apparatus shown on the front cover, a horn type loud speaker is indicated; in the apparatus shown above, cone speakers are provided inside the cabinets, with silk screens over them. It is best to use a separate loud speaker on each instrument.

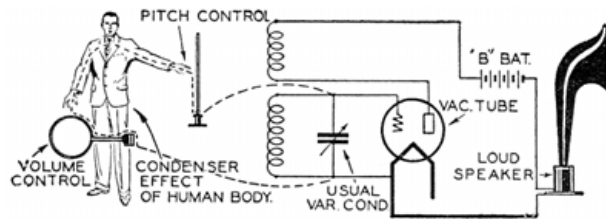
**S**OMETHING new in the musical world has been accomplished by Prof. Leo Theremin of the Physicotechnical Institute of Leningrad, who recently gave a remarkable demonstration before a large group of musicians, scientists, and music lovers in Berlin. The accompanying pictures show the appearance of the new instrument devised by Prof. Theremin, and he is at present engaged in building twelve of the instruments, so that a full orchestra effect can be demonstrated. Thus far a solo instrument has been demonstrated, and also duet playing on two instruments.

Practically all of the musical instruments with which we are acquainted require careful and tedious training for at least several years on the part of the student. This new instrument which utilizes, as we might say, the squeal heard in regenerative sets when the tickler is improperly manipulated, enables anyone with a musical ear soon to learn to

produce a wonderful range of musical notes. Aside from the fact that one does not have to spend years in training or taking musical lessons, Prof. Theremin has accomplished something infinitely greater. With the advent of this new apparatus for producing musical tones, the inventor has made it possible to produce musical notes and tone colors never heard before by the ear of man.

Prof. Theremin's apparatus for utilizing the principle of heterodyning, or super-imposing, one electrical current frequency upon another will, the inventor states, free the composer from the despotism of the twelve-note tempered piano scale, to which even violinists must adapt themselves. The composer can now construct a scale of the intervals desired; he can even have intervals of thirteenthths, if he desires them. It is in fact now possible to produce any gradation of musical tone or tones detectable by the human ear. Also an

entirely new range of tonal colors is available, and instead of the usual average of say, twenty tone colors, represented by that number of different orchestral instruments, Prof. Theremin opens up an almost limitless field comprising thousands of tone colors.

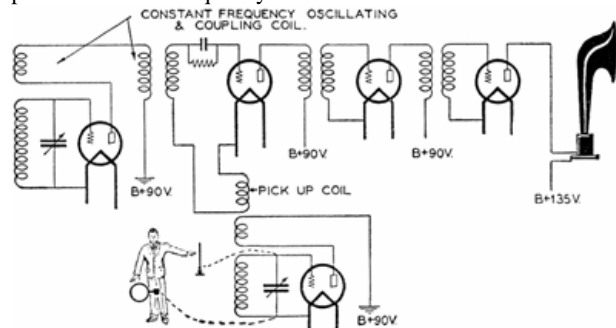


The simple vacuum tube oscillator circuit shown above will provide a clear idea as to the general electrical action taking place in Prof. Theremin's new musical instrument. With the proper size coils connected in a circuit like that shown, the different notes in the musical scale are obtainable by varying the capacity connected across the main inductance, as indicated.

As the pictures show, each instrument comprises suitable arrangement of coils or inductances, condensers, and vacuum tubes. The instrument is similar to a super-heterodyne radio receiving set, as the larger diagram at once indicates. As explained in the captions, variations in the body capacity are created by moving the hands toward or away from the brass rod or circle, and these variations in capacity in the control oscillator circuit, cause variations in the oscillator current super-imposed, through the pick-up coil, on the detector circuit. The constant frequency current is supplied by a master oscillator, as shown at the left of the large diagram. The note heard is that due to the difference between the two frequencies.

remembered that when the brass rod and circle are used, together with variations in body capacity, caused by moving the hands in proximity to the metal electrodes, that the usual variable condenser connected across the main oscillator inductance, is dispensed with. In other words, the body capacity takes the place of the electrical capacity usually supplied by the metal plate condenser, connected across grid and filament of the oscillator tube.

Changes in the body capacity caused by moving the hands, cause variations in the frequency superimposed by the first oscillator upon the circuit energized by the master oscillator at left. The difference between the two oscillator frequencies produces a third frequency.

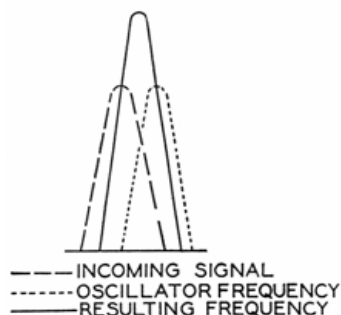


The "difference frequency" causes the musical note heard in the loud speaker. The note frequency is amplified by two stages of audio frequency amplification.

It should be noted that when the right hand, for instance, is moved toward or away from the circle electrode, that variations in the volume of the music are obtained; when the left hand, for instance, is moved toward or away from the straight rod electrode, which is connected to the grid side of the oscillator circuit, changes in the pitch of the musical tone are obtained. This is important to remember in carrying on any experiments with this apparatus. For those interested in experimenting with a "vacuum tube organ," as we might call it, the writer would suggest that they read the article by Mr. Clyde Fitch, describing Mr. Hugo Gernsback's "Pianorad," which appears in the November-December 1926 issues of RADIO NEWS.

In the simple musical audion circuit shown in the illustration, and which is similar to that used in building the "Pianorad," described one year ago in our sister publication, RADIO NEWS, as aforementioned, it will be found that quite large inductances, in this form of honeycomb coils, are necessary to produce the difference frequencies necessary for the average scale of musical notes.

HETERODYNE PRINCIPLE



The diagram above shows the action taking place when one current is super-imposed upon another, giving rise to a third or resultant frequency, as indicated by the full line curve.

In studying the diagram, it should be

With the more elaborate, yet really quite simple, heterodyne circuit shown in the larger diagram, it becomes possible to produce a considerable range of musical notes without using extra large inductances, due to the peculiar operation of this form of circuit. Referring to the last diagram, which shows the heterodyne principle on which the action of Prof. Theremin's instrument is based, we perceive how it is that a new or resultant frequency

is produced, whenever two slightly differing frequencies are super-imposed one upon the other. This is the action taking place in the super-heterodyne receiving set, with which most radio fans are more or less familiar. If the incoming signal has a fixed frequency, any changes in the oscillator frequency will cause a change in the resultant frequency, and vice versa.