

THE DEVELOPMENT OF SINGLE-DIAL TUNING DURING THE 1920S

Early radios often displayed a formidable array of dials, knobs, and switches on the front panel, and some amateurs and experimenters enjoyed using them to boost a weak signal up to readability. On the other hand, by early 1923, some two years after broadcast radio began in earnest, thousands were annoyed or even intimidated by the effort required to operate their radios. New customers that were tempted to choose a simpler set and avoid that situation risked the likelihood of poor performance.

Although a multitude of controls had not presented a major sales problem in earlier years, there had been some manufacturer interest in simplifying operation. One solution consisting of using just one dial for tuning. This was usually done by improving a circuit that relied upon only one tuned stage. A few exceptions to that approach were located by McMahon [1], one being in the form of advertising by the General Instrument Co. in 1921 of a three-stage tuned radio frequency (TRF) set controlled by one dial.

Two years later the Bristol Company, Cleartone Radio Division, and Great Eastern Radio Corporation advertised one-dial sets with more than one tuned stage. Unfortunately, Cleartone was the only company in this early group of manufacturers that managed to remain active in radio for more than two years. According to McMahon's tables, even that company temporarily discontinued single-dial ads during 1925 and 1926.

It is evident that these early efforts created little customer interest in single control tuning. This does not mean that there was no recognition of the need to provide for an orderly and sensible method of receiver operation. This had existed for years as an extension of rules-of-thumb for laying out and constructing circuits, and for arranging controls in a logical manner. Some manufacturers were already designing their front panels to display two or more large dials in a horizontal row for control of

the most important circuit functions.

Nevertheless, all of this had little effect on the development of single control tuning prior to an important event in the spring of 1923 that was not directly related to tuning, yet produced a rising interest in that type of operation. April of 1923 was when licenses to manufacture the Neutrodyne became available to a number of small companies that had jointly incorporated as the Independent Radio Manufacturers [2, p.127]. The Neutrodyne was an invention of Professor Louis A. Hazeltine of the Stevens Institute of Technology, who had patented a neutralization method of stabilizing radio frequency amplifiers. His first patent in a series of four being filed in 1919 [3]. The Independents learned about the Neutrodyne through their attorney, who also represented Hazeltine, and when they realized how effective it was, three of them collaborated with the Professor to develop a practical receiver.

The Independents then formalized an agreement with him for licensing its manufacture. The total number of licenses eventually reached fourteen, some of which were later transferred to still other companies. In general, the Neutrodyne was highly successful, although production and sales differed considerably among the various manufacturers.

One widely sold version consisted of two TRF stages, the detector, and one or more stages of audio amplification. The external features of this version included three large dials used for

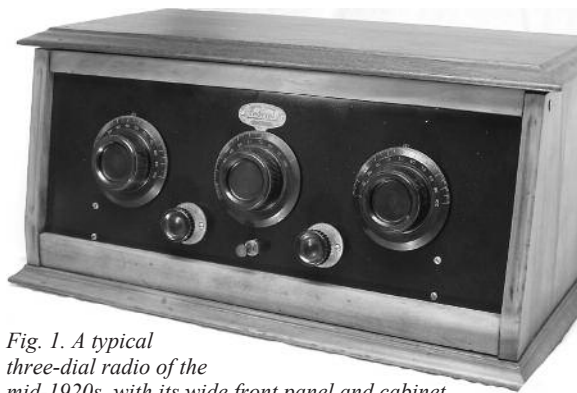


Fig. 1. A typical three-dial radio of the mid-1920s, with its wide front panel and cabinet.

tuning, arranged in a line across the front panel of a low profile, rectangular-faced cabinet. A good example is shown in Figure 1, a restored Federal Radio Corp. model A-10, housed in a typical table model cabinet [4]. This style became so popular that many customers began assuming that it was what any good radio should look like.

However, the early Neutrodyne were somewhat expensive, and other manufacturers soon learned how to become competitive at lower prices by judiciously arranging parts and wiring to give the same results without the extra Hazeltine components. Also, alternative neutralization methods were developed that (so it was hoped) would not be subject to patent litigation. All in all, with good performance and a cabinet and panel that looked like a Neutrodyne, a company could still sell radios quite competitively.

Such a radio was easier to operate than comparable predecessors, but it was still a bit tedious to tune. The general public circulated a wide variety of sarcastic jokes about it, such as the one about how convenient it was for somebody with three hands. This was the scene in the 1924-1926 period as a trend toward single-dial tuning developed and became influential.

Had there been any contributing developments prior to 1921 - 1923? The answer is yes, but only in a very limited way. As early as 1910, John V. L. Hogan filed a patent describing single control tuning in general terms, and even presented some specific circuits for special applications [5]. Nevertheless, few receiver circuits of that period would have benefited from it. The Hogan patent would have to wait for the 1920s to be applied to receiver models, and it, as well as other patents by Chester Rice and Ralph Hartley relevant to their work in the 1913-1915 period, would later play a part in litigation over single-dial tuning [2, p.128].

Some inventors may have been encouraged by these developments to consider alternatives to multi-control tuning, but there was little incentive for manufacturers to do so until significant numbers of radios with three or more tuned stages entered the marketplace. This suggests that the arrival of the Neutrodyne and its competitors was of prime importance in that respect, because their presence created the incentive to

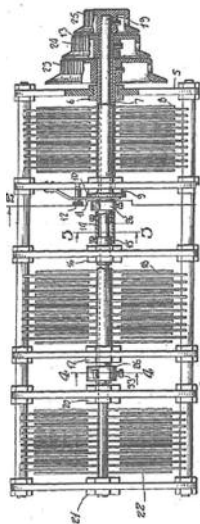


Fig. 2. Variable capacitors individually controlled by three concentric shafts and a composite three-part dial.

develop alternatives.

The urge to simplify three-dial tuning must have grown along with the increase in its popularity, but the problem of doing so was not easy to solve: it required that two or more stages of TRF amplification and the detector track together as the radio was tuned across a band of frequencies. The first stage posed a particularly difficult problem, because with the circuitry in use at that time the antenna at the input had a pronounced effect on tuning.

Since antenna characteristics varied widely, depending upon what the listener had installed, this was a formidable obstacle to overcome. A way to avoid that situation, provided that the set was sufficiently sensitive, was a loop antenna, supplied with the radio by the manufacturer. But in the early 1920s this type of set was a rarity. Tracking manufacturer-supplied equipment was less difficult because the company had full control over the design of the system. Nevertheless, it was an additional problem, requiring careful choice of circuitry, components, and layout of the wiring, plus insuring that no variations crept into the manufacturing process.

Some companies avoided addressing these problems at first by retaining three-dial tuning but making mechanical changes to simplify the tuning procedure. Figure 2 shows an invention where three tuned stages could be controlled by separate variable capacitors with three concentric shafts leading to a composite triple dial, controllable altogether or in part by one hand [6]. A simplified, and no doubt a less costly variation on this theme, was used by Consolidated Radio Corporation in the manufacture of the Arborphone Model 27. This consisted of a "two dial" radio, the second "dial" being composite and controlling two variable capacitors rather than one.

Another practical method that partially solved tracking problems was patented by Albert Roth [7] and is shown in Figure 3. Here, two dials, facing one another and controllable separately or together, could be used to operate two or more TRF stages. The troublesome antenna input stage was separately controlled, with following stages tuned as one. RCA used this basic configuration, adding some clever innovations, in at least two of its models. Some companies fully separated the two dials on the panel of a cabinet

intended to appear similar to the Neurodyne. These types of transitional models achieved some degree of popularity and bought time for manufacturers to develop their single-dial sets. In fact, two-dial tuning persisted for several years for some models that needed only two tuning controls, and for a few multistage radios tailored to the user that understood the advantage of a separately tuned antenna stage for maximum performance.

Nevertheless, with the advantage of hindsight it is evident that improvements short of true single-dial tuning were stopgap measures, at best delaying the inevitable for companies that intended to continue in the radio business. The total number of regionally and nationally advertising radio manufacturers, the fraction of that total producing three-dial Neurodynes and comparable receivers, and the much smaller number producing single-dial sets, is summarized in Table I for the 1924-1926 period.

This table was constructed using information from the trade publication *Electrical Record* [8], supplemented by additional sources [1,9,10,11]. It refers to companies that the staff at *Electrical Record* found to be offering products to distributors and retailers, excluding those that only advertised locally. It was necessary to omit a small number of companies because of insufficient (or conflicting) information, but the table is useful for making comparisons between its three categories.

One which is especially interesting is that in the early winter of 1924, when three-dial radios were beginning their rise towards widespread usage, there were already at least four manufacturers producing single-dial sets, a small but significant number compared with the 43 companies producing three-dialers. The 1925 and 1926

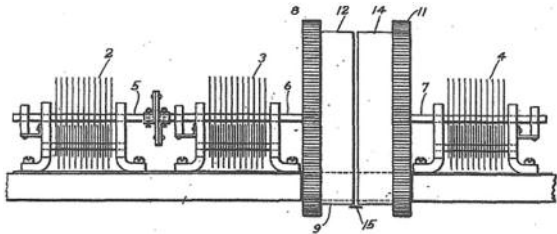


Fig. 3. Separate dial control with two dials arranged for individual or simultaneous tuning.

entries show both single-dial and three-dial manufacturers increasing in number, but with the latter companies far outdistancing the former in popularity.

The four manufacturers, shown in *Electrical Record*, that in 1924 chose to buck an already evident trend and introduce single-dial models were: The Shepard-Potter Co. (Thermiodyne) in July, Magnavox (September), Mohawk (November), and Brandeis (November or earlier). (See Douglas [9, vol 1, p. xv] for the dates relating to the first three companies, and *Electrical Record* [8, vol. 2, p.18] for Brandeis).

Thermiodyne tuning consisted of three master-controlled variable capacitors mounted in line behind the front panel, a single large dial at its center, all controlled by a rack-and-pinion gearing system. Single dial tuning was a loosely defined term in those days, in this case ignoring the fact that the Thermiodyne required no less than four small trimmer knobs, two on each side of the master dial, in order to make the system track properly across the broadcast band. It was up to the user to tweak the trimmers in order to bring in a weak signal.

The Magnavox version of a single-dial system also used rack-and-pinion gears, but instead of variable capacitors a compact form of variometer marketed as the Telos Variocoupler did the

tuning. Although there were no front panel trimmer knobs, according to Douglas [9, vol. 2, p.133] hidden trimmers inside the cabinet sometimes needed adjustment when the master dial setting was changed. This was no doubt a source of considerable irritation for the listener.

The Mohawk Corporation's single-dial radio, the model 100,

A Comparison of Radion Manufacturers that Advertised Regionally or Nationally in the 1924-1926 Period			
Year and Season	Radios of all Kinds	Three-Dial Radios	Single-Dial Radios
Early Winter 1924	116	43	4
Fall of 1925	172	100	8
Early Spring 1926	158	108	13

Table 1.

was unusual in several respects. First of all, again referring to Douglas, it was a true single tuned set, having no need for trimmer adjustments by the listener, the latter having been factory set. Mohawk was well ahead of the competition in this respect, and it was the first large company to use a form of tuning which would later become a standard of the industry, the ganged variable capacitor.

Another harbinger of things to come was a narrower, deeper cabinet with a correspondingly narrow panel. This was an arrangement to accommodate the large three gang capacitor, which was mounted directly behind the panel center with its shaft coming straight through the panel to receive the tuning dial. This cabinet styling had one drawback: its appearance was quite different from the three-dial radio that was enjoying its rising tide of popularity. Retailers must have worked hard to counter such competition, but the set did sell well.

Electrical Record [8, vol.2, p.18] lists the J. F. Brandeis Corp. at a Newark, New Jersey address as the manufacturer of Brandola single-dial sets, and includes a photograph of a table model with its cabinet shaped much like a three-dial set, but with just one large dial in the center of the panel. Some sources refer to the company using the above spelling; others use the spelling "Brandes." For example, John Slusser [12] enters the Brandola as a 1925 Brandes model, the company address being identical with that of Brandeis.

It remains unclear whether two companies existed in the legal sense, or if they were simply two divisions of one business enterprise, but it is evident from *Electrical Record* that a single-dial receiver was available to dealers by November 1924. Some other companies listed in *Electrical Record* or by McMahon advertised single-dial models that may have qualified for inclusion here, but pertinent information is incomplete or in conflict with other sources.

Such information does have one thing in common: a lack of data describing how the simultaneous control of more than one tuned circuit was accomplished, if such were actually the case. One manufacturer described by McMahon [1, p. 16] deserves specific mention. This was A. C. Dayton with its Super Polydyne Six, shown for one year in 1924. It was a six tube, three stage, TRF receiver. No information on this model has been located elsewhere, and Dayton did not offer another single-dial set until 1927.

Table I shows how these and other relatively large companies initially responded as the Neutrodyne became available, but there was also a much larger number of small, newly organized

companies, as well as manufacturers of products with little or no relation to radio, all entering the business in that same period. Companies like Baltimore Hub Wheel & Manufacturing Co., Cleveland Auto Accessories Co., and New York Album & Card Co., began advertising radios. McMahon [1] covered this wide array of manufacturers in his tables, which were based on advertising for each calendar year between 1921 and 1932.

Results from study of this information follow. First, during the period between 1923 and 1928, the number of companies advertising radios with three or more separately tuned circuits increased from a very few in that first year to a peak in 1925. Then the number dropped so much during 1926-1927 that it was nearly zero in 1928. During that same five-year interval only a handful of manufacturers advertised single-dial sets at first, but then rose to dominate the radio business.

The casualty rate in the radio industry as a whole was high, and it was not just the tuning problem that was responsible. In addition to the usual problems of a highly competitive business in a fluctuating market, the need to convert from battery powered radios to AC sets developed during the same period. Nevertheless, whatever the position a company might have been in, single-dial tuning became a necessity.

In general terms, single-dial radio "arrived" in 1927, and by the end of 1928 a three-dial radio must have appeared quite out of date to shoppers. During that year only three companies shown in McMahon's tables were still advertising such sets for the living room listener: Midwest Radio, Ozarka, and Powerphonic Co. Midwest was already offering single-dial models, and Ozarka introduced its single-dial sets during the year. Powerphonic was active only during 1928, entering the market with a three-dialer at a most inopportune time.

The distinctive three-dial cabinet shape was no doubt a factor leading a number of companies to delay styling changes, and these delays extended to retaining long narrow panels for the console models that were becoming common. Further, those converting three-dialer production to similar single-dial models were probably motivated to design layouts that did not require extensive production line changes. These considerations would help to explain why Mohawk's distinctive layout and cabinet design remained almost alone at first in retailer stores. It would also explain why so few designers ignored the relative simplicity of a ganged tuning capacitor compared with an equivalent set of in line units.

This fixation on in line methods seems to have extended to inventors filing single control

patents. For 1925, a very active year in terms of single-dial developments, analysis of information from Harrison [13, p.299] reveals that less than 15% of single-dial patents filed in that year were for ganged variable capacitors. Harrison tabulated his patent data in terms of four general categories of single controlled types:

- 1.) rack-and-pinion, units side by side;
- 2.) four-bar mechanism, linked units side by side;
- 3.) pulley, units side by side;
- 4.) units fore and aft (includes the ganged variable capacitor).

All four methods were used before ganged tuning finally prevailed. An important example is the pulley arrangement that was used extensively by Atwater Kent, beginning with his Model 30 and continuing for about three years, until the third version of the Model 60 arrived with a ganged variable capacitor [14, p. 82; 15, p. 21]. These models used true single-dial tuning from the outset, achieved by careful circuit design, virtually identical components, and wiring that was not permitted to deviate from a standardized layout.

Of course it was the ganged variable capacitor that became the universal choice by 1929. The first such design adopted for practical applications was that of Paul A. Chamberlain, and was used by Mohawk [13, p. 308]. A two gang version of his invention [16] is shown in Fig. 4. Although it appears relatively modern in the figure, some refinements were added by others. One was an improved trimmer capacitor design developed by scientist Frederick A. Kolster [17,18] in 1926.

Another was for so-called "bathtub" construction by Henry C. Forbes [19] about a year later in 1927. Forbes used the term bathtub in his patent description to emphasize the importance of a rigid one-piece frame for two or more sets of rotating plates on a single continuous shaft. This contrasted with the then-current practice of assembling ganged units by connecting individual parts together.

One-piece construction became particularly important for the TRF consoles manufactured at the close of the 1920 - 1930 decade, because some of these had four or even five tuned stages. The ganged capacitors for these radios were big, making overall rigidity a must; some of them were over a foot long.

Such multistage radios resulted in part from an effort to compete with the superheterodyne, which was finally emerging as a formidable competitor destined to replace the TRF radio. Circuits for the single-dial version of the superhet had evolved concurrently with its TRF rival, but patent and license restrictions had delayed it from

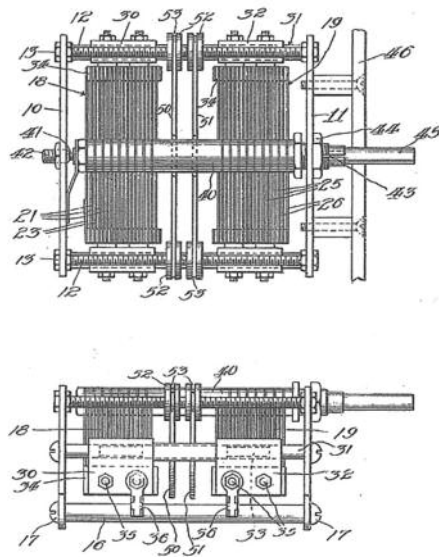


Fig. 4. The first ganged capacitor design using a one-piece frame and shaft to control two or more units.

widespread usage. At the end of 1929 some innovations remained unexploited. Perhaps the most important of these was miniaturization, which in the case of the variable capacitor was a matter of developing the necessary manufacturing methods.

Other such improvements were in their infancy, including remote control, pushbutton tuning, and electrical band spread for console model radios that included short wave bands. So far these improvements had not produced much public interest, although vernier dial forms of bandspread were already fairly common. Late in the 1930s even a brief revival of the variable inductor would begin, in the form of permeability tuning. Such features were really supplements to the inventions that were already in place and which counted most for single-dial control: the circuits that made it possible, and the ganged variable capacitor as the component best suited for its application.

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