

ATWATER KENT EARLY RADIO DEVELOPMENT

THE MAHOGANY AND METAL BOXES

By Ralph O. Williams, N3VT
Orient, N.Y.

INTRODUCTION

During the time that the Atwater Kent radio receivers changed from the relatively simple detector-amplifiers to the docile three-dialers represented by Models 10 and 12, broadcasting was growing rapidly as a social force in the United States. Three aspects of this development deserve a closer look, since Atwater Kent saw this force as a significant factor in his business growth and market development.

One important element in 1923 was the remarkable change in the nature of the programs which those Open Sets captured and played in America's living rooms. In that short time the content of radio reception went from items of only local concern to material of national interest. The impact of broadcasting was felt everywhere, as the living room became a theater, a sports arena, a window-on-the-world. For the first time, audience participation carried much the same emotional impact as attendance at live events. This new reality, and the awareness that the time was instantaneous, changed radio from an interesting novelty to a new form of communication and a social necessity.

While the art of programming was maturing, a second aspect, the means by which highly regarded programs were aired, was also changing. The concept of a network of stations had been reduced to practice at about the same time that the Model 10 appeared, but in the beginning only two or three stations were tied together. During 1923 and 1924 the technology of transmitting high quality material through wired circuits between distant cities had developed to the point that a network of 22 stations, stretching from New York to San Francisco, brought a major campaign speech by Calvin Coolidge to the interested nation in October, 1924.

The third element of broadcasting which changed significantly during the brief time period of the lifetime of the Atwater Kent open sets was the manner in which the medium was financially supported. In the beginning broadcasting was institutional in nature. Owners of most stations conveyed their product messages but did not make a practice of using their facilities to advertise someone else's offerings. Station owners operated their equipment in the "public interest", e.g., concerts, church services, and lectures; but it was not customary to accept monetary compensation for the air time. Of course, when the station was owned by a department store or an electrical equipment manufacturer, it was used for advertising; but the fine point was that time was not sold to an outsider. WEAf, the technically superior station owned and operated by the American Telephone and Telegraph Co., was the pioneer that broke with the owner-only tradition by renting the use of the station to

organizations that had messages to convey, but did not want to be in the business of operating a radio station.

Looking back to the inception of paid radio advertising and studying the material written at the time, the idea arises that a moral issue was involved. There seems to have been a significant number of those interested who felt that the radio spectrum was public property and was not to be used for private gain. Purists declared that institutional advertising was wrong and wanted full governmental ownership of all broadcasting facilities. Such an approach was implemented in several European countries where the post office took over all forms of electrical communication.

In direct opposition to this view were those who believed that making money by the use of radio was no different than using wires, as was done with the telegraph and telephone. There was a precedent for this view in the operation of the wireless message services, and historically, in America, individual initiative and development was the accepted approach to any new art or technology.

The solution lay in the ready acceptance by the radio audience of programs whose ultimate object was to influence the listeners favorably toward the purpose of the sponsor. Popular opinion, operating in the market place with limited governmental intervention, curbed the potential excesses and shaped the practices of broadcasting in the United States. The manner of the development of this art form during the middle 1920's illustrated the vital American tradition of balancing private gain against the public interest.

CHANGES IN THE AMERICAN HOME

These changes in broadcasting which were taking place, were, in turn, being strongly influenced by the radio audience itself. "Radio" had entered the American home to become almost the necessity that the motor car was recognized to be. In the same way that wheels and roads opened vistas of the country by making private transportation easy, the strange box in the living room was opening the minds of America to the awareness that the people of the nation shared common interests regardless of wealth, position, occupation or locale.

The public acceptance of radio had its reverse side, however. No longer would an expensive, capricious novelty be acceptable. The strange apparatus in the living room with its messy wires and inconvenient batteries had to go. Quality of production, conformal appearance, and ease of operation were demands that receiver manufacturers had to meet if they wanted acceptance by the general market. More than one brand, particularly those associated with local craft-assemblers, disappeared because of these new customer demands.

During the transition from the simpler sets to the first of the Model 10 receivers, Atwater Kent had been sampling the radio receiver market through his automotive-electrical distributor organization. As the distribution of his radio receivers matured, he expanded his sales through music studios, high quality furniture stores and home furnishing outlets, always monitoring his product acceptance and the image that his company was building in the public mind.

Atwater Kent's market findings dictated the direction of his advances in performance, technical implementation, convenience and styling. Although the "box" in the living room was the "window" through which the marvel of broadcasting streamed, it had to fit into the family milieu. The Open Sets, when introduced, won a high level of customer acceptance. They looked very much like special scientific devices, perhaps not radios, since no stereotype of what a "radio" should look like had as yet emerged, but they were impressive instruments that served to give their owners a status in the listening community. At first, the distinctive appearance of the breadboards was the hallmark of having embraced wireless as a new way of life, but after a year or two that same quality became a disadvantage because it was so hard to integrate. Worse, when it came to housekeeping, the cleaning and polishing of the Open Set became an onerous chore.

When a product such as a radio wears out and must be replaced, and when the technology it accesses advances at a rapid pace, the question of what the replacement should look like arises. Will the style conform and endure with only minor changes, like certain designs of living room furniture? Or will the replacement be so different in its styling that the original will be unacceptable because it has become old-fashioned?

By late 1923 receiver technology no longer forced styling revisions in appearance. Further, if the radio had been well accepted in the living room, the listener did not demand major changes in what the new one looked like. However, Kent did not feel that the unique, striking appearance of his Model 10 would continue to attract customers at the growth rate he wanted to maintain. To his esthetic sensibility the Open Sets really looked like "radios", but it appears that the business man in him could see that the products would not increase his image and lead to the sales expansion he required to keep the money coming in. Styling trends at the time were turning away from complexity, and while the age of art-nouveau and art-deco had not yet appeared, a simpler styling did seem to mean increased acceptance.

Because the three-dial receiver had solved the burning questions of selectivity and interference, at least temporarily, Kent's purpose in introducing a new line was purely to take advantage of styling improvements. Blending these ideas led to the Model 20, a very effective combination of unchanged, proven circuitry styled in a radically different embodiment.

THE MODEL 20

The survival rate of radios from the 1920's to the present, the mid-1980's, measures two factors about the radios. One is the number manufactured, and the second is quality. If a given radio was a good performer, it stayed in service longer and had better protection from replacement and the ravages of changing customs.

The Model 20 Atwater Kent receiver, particularly the first model, No. 4640 (Fig. 21),* is the radio that almost every beginning historian recognizes and in-

* Note: The first twenty pictures of the Atwater Kent radio sets are in *The A.W.A. REVIEW*, Volume I. The story continues here, with the illustrations starting at Fig. 21.

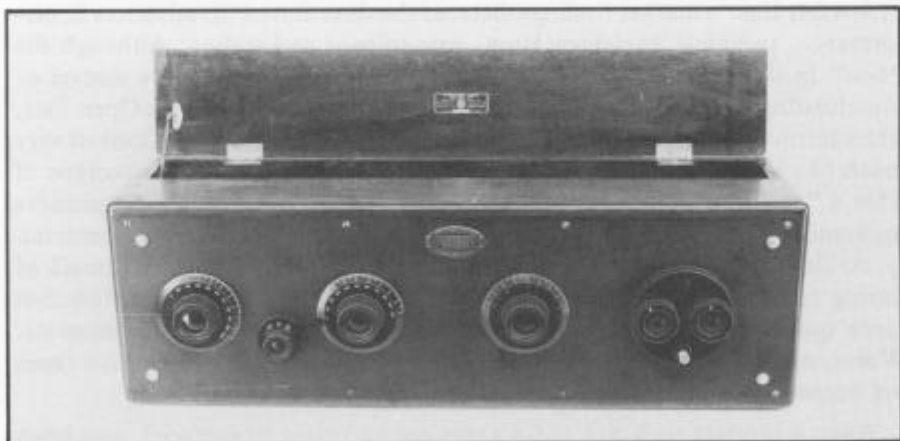


Fig. 21. Model 20, No. 4640

corporates in his collection. Their very high survival rate reflects directly on the mid-twenties acceptance of Kent's shift from his favorite Open Set to the new style which his acumen said would be the public preference. With the Model 20, sales and production continued to climb. Altogether, about 125,000 open sets were produced with nearly half being made at the same time the Model 20 was being introduced in late 1924 and early 1925. By comparison, by the end of its production in 1926, almost 200,000 "big box" Model 20's had been made.

Because the Model 20 is in so many collections, a detailed description of its appearance and circuitry is unnecessary in this article. Some less well-known of its characteristics, however, may be of interest. One surprising aspect is revealed by comparing the Model 20 and the last of the Model 10 line, No. 4700, sometimes called the "Model 10 Compact". Electrically, they were identical, even to the same circuit diagram and the same power and signal requirements. Mechanically, they appear to be quite different, but the arrangement of the tuning dials is identical, and the spacing between them and between the radio frequency transformers is nearly the same. The transformers were smaller (two inches in diameter instead of three) and their alignment was different, but they were identical in their electrical performance.

The intriguing point about all this similarity is that a prototype Model 20 was made and sold before the familiar version was in full production. The transformers on the prototype (Fig. 22) were the same diameter as those of the Model 10, 3 inches, and they were aligned identically. A close examination of the transformers and the mounting brackets reveals scribe marks, suggesting that the tuners were made in the model shop. The author conjectures that the new, smaller transformers were difficult to design and produce with the same inductances, turns ratio, losses and strays as those in the Model 10. The time that had been allocated to meet the production and marketing deadlines (and possibly Mr. Kent's patience) became short, so the larger coils were used temporarily.

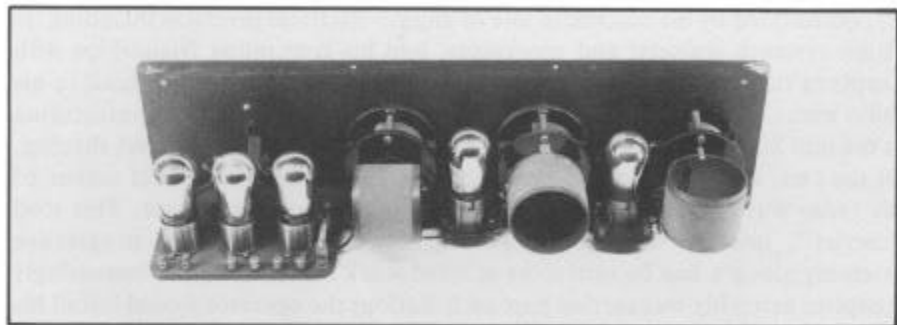


Fig. 22. Prototype Model 20 Panel

Another peculiarity of the prototype 20 was the nameplate. It was the one used on the five-tube unit produced for the Model 5. Again, this might have been the result of a production delay in the etching shop, but a more likely explanation is that the non-standard nameplate was the company internal identification of the prototype 20, which was instantly recognized by the dealers but would not have offended the customers. It could be argued that a nameplate with a different marker color or a different serial number sequence could have provided the separate identification, but then what would have been done with those old Model 5 nameplates?

Work on the design of the Model 20 must have started at about the time that the first Model 10, No. 4340, was current. The basis for this conjecture is that the big 20 and the first 10 were equipped with binding posts for connecting the power sources, but all subsequent 10's had power cords. This idea conflicts with the thought that the radio-tuner design appears to derive from the last Model 10. A possible explanation may come from the feature that distinguishes Atwater Kent's wood box sets from nearly all of their contemporaries, the steel front panel.

If the design of the Model 20 had been started at the time of the cordless 10, and if the steel panel made the design of the tuned stages difficult, work on the small coils would have been going on in the laboratory when orthogonal coils were introduced in the later Model 10's, such as the 10B and 10C. Work on their transformers would have displaced the design of the smaller coils and delayed their introduction still more. Getting uniform stage gains over the broadcast band while maintaining selectivity and avoiding regeneration had always been a difficult, cut-and-try process, which was grossly affected by removing the condenser cans and mounting the condensers on the steel panel. The laboratory people assigned to this design task must have been under great pressure, since the general mechanical design, production planning and material ordering went on in the ordinary course of affairs. However, the RF design was finally accomplished and it was very successful, since it survived all the way into the Model 30.

With his strong mechanical-technology background, Atwater Kent was ever alert for ways to improve his products through the use of new materials, or by using standard materials in new ways. His exposure to the automobile indus-

try, occasioned by his successful line of engine-electrical products including ignition systems, starters, and generators, and his continuing friendships with people in that business, led Kent to apply their experience and methods to his radio manufacturing. Two major developments in automotive manufacturing in the mid 20's were potentially valuable; machine assembly and steel shaping. Of the two, steel shaping, the means by which the major structural carrier of the radio was formed from sheet metal, was the more important. This steel "carrier", later to become known as the "chassis", enabled progressive assembly along a line by operators at fixed work stations. As the increasingly complete assembly was carried past each station, the operator would install his particular subunit on the main panel.

Introduction of the Model 20 metal panel with its L-shaped, spot-welded subpanel was a milestone in the manufacture of radios in the 3-dialer days. Few other manufacturers used steel as the main body of their radios. Stewart-Warner, Grimes, and Cleartone employed steel panels but used brackets to attach a phenolic sub-panel which in turn carried the tube sockets. The Atwater Kent steel panel assembly carried the tuning condensers, the tube sockets, the audio subassembly, and the controls; in short, all the components.

It is easy to visualize the assembly line. At one end, the painted panel started its journey. Perhaps the first steps were the installations of the filament rheostat unit and the antenna switch. Then, because of the closeness of the major subassemblies, the by-pass condenser was installed, followed by the radio amplifier tube sockets. The tuning condensers, with their coils attached, were installed in the next few work stations. The last unit was probably the detector-two stage audio amplifier. Part of the wiring was attached to each unit before it reached the production line. Some of the wiring could then be finished at stations adjacent to the mechanical installation stations. The remainder, those long wires that were run along the under side of the L-shaped shelf, were the last pieces on the nearly complete panel. After that, the finished unit went to the electrical test.

OTHER MODEL 20's

The big Model 20, with its crinkle-painted, brown steel panel enclosed in a dark brown mahogany cabinet, is generally regarded as the best example of an early Atwater Kent table model receiver. Although that version of the Model 20 was the predominant receiver made in the brand new Wissahickon Avenue factory during 1925, several variations were also produced. One was the fully assembled and tested steel panel, not installed in a cabinet but packed directly into the shipping carton, and identified as the "Model 20 Panel", Part No. 4670. This variant illustrates another interesting facet of the operation of the company; viz., a response to the market demand for console radios instead of table models.

Kent was a strong entrepreneur. This quality extended over the many business areas of his life, some of which have been identified earlier. The cabinet used for the big Model 20 exemplifies an area where his strong views became the direction his company took. He liked plain, solid wood construc-

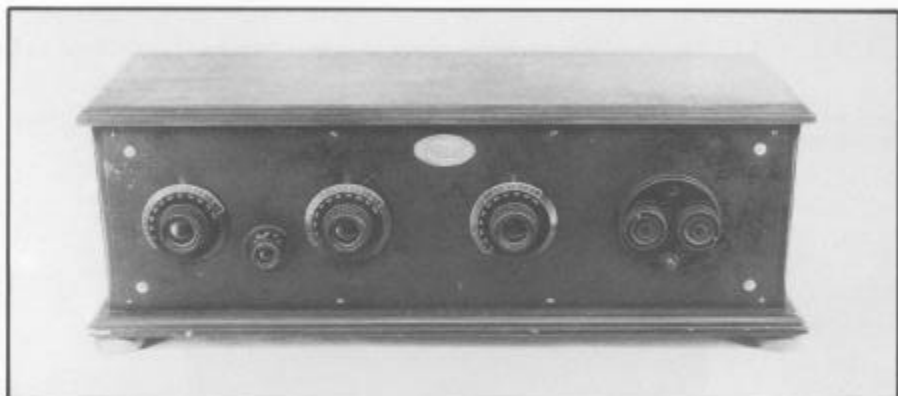


Fig. 23. Model 24, No. 4920

tion, particularly in household items that had to embody both utility and beauty. He was equally emphatic on finishes, having a marked preference for carefully filled, hand-rubbed mahogany. More important, he felt that a radio had to relate its function and its form. All of these preferences led to acceptance of the plain table model set and the rejection of the floor console.

During the production of the early Model 10's, some boards were made available to other companies who marketed them independently. Customer acceptance was moderate at best, with the result that Atwater Kent's preference to stay out of the furniture business was reinforced. A good compromise among these views, while still making it possible to sample the potential market, was to make the Model 20 Panel available to other commercial firms for assembly into consoles or other pieces of furniture, for sale through their own marketing channels. An example was the Pooley Company, a major furniture manufacturer in Philadelphia.

Pooley had used the 10B and the 10C in large consoles that included a loudspeaker and accommodations for batteries. Only minor changes were needed to create a new console radio that was based on the Model 20 Panel. Some present-day collectors question whether the Pooley Co. and Atwater Kent were independent, since much of Pooley's advertising heavily emphasized the Atwater Kent name. The policy statement from one of Pooley's brochures clarifies this point: "The policy of the Pooley Co. is to specialize in a line of work in which they have no peer - fine cabinet making - and they leave to trained Radio Engineers the designing and manufacture of the Radio Equipment which is built into Pooley Radio Cabinets."

THE MODEL 24

Another variation of the big Model 20 was called the "Deluxe" and sometimes given the designation "Model 24" (Fig. 23). Because it was based on a standard 20 panel, it was also referred to as a "Model 20D". At first glance, they appear identical, but closer examination reveals that the medallions and the milled-edge escutcheon buttons were finished differently

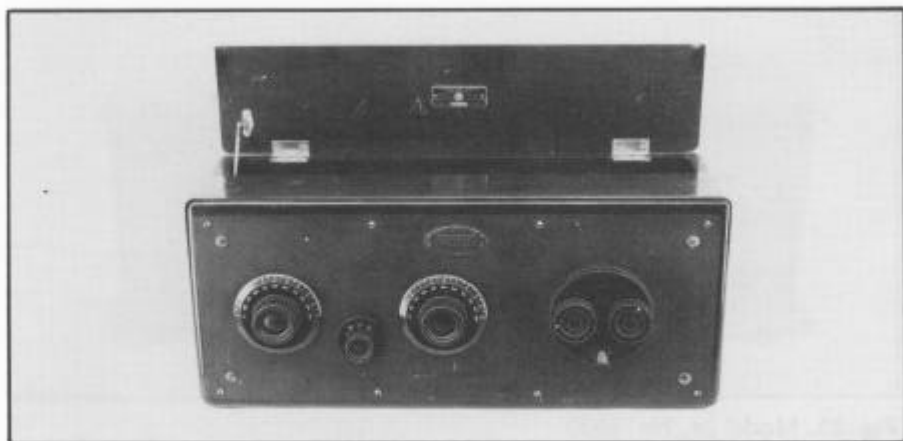


Fig. 24. Model 19, No. 4880

on the two sets. On the Model 24, both decorative elements as well as the pull-switch handle were gold plated.

For factory records and for billing, Model 24 had to have a separate part number, so it was identified as No. 4920. The nameplate on the inside of the lid was identical to the big Model 20, although a special sequence of serial numbers may have been assigned to the several production runs that became the Model 24. The cabinet of the 24 was more ornate, having a molded edge top cover and a matching molded base. It was the first of the AK receivers to have feet instead of felt scratch pads. The popularity of the style seems doubtful, since the number of Model 24's produced was less than one-twentieth of the quantity of big Model 20's, and since the molded edges were not repeated in other wood box or the subsequent metal enclosed sets. The author conjectures that this version was an effort to sample the market; the result was a justification of Mr. Kent's views on styling.

THE MODEL 19

Some localities in the United States were more favorable for radio reception, and for the "DX fan" a quiet location away from a population center was a must. The average listener, however, had by this time become more interested in program content and was not inclined to spend large amounts of time and money trying to capture strange or distant stations. A location near a city where the signals from several favorite stations were strong and where selectivity was not a controlling requirement meant that a radio with less capability than a standard 3-dialer might be adequate. A receiver having only one stage of radio amplification and a tuned detector could provide satisfactory performance and at the same time save the listener some money.

For these customers, Atwater Kent produced the Model 19 (Fig. 24). It was advertised in late 1924 for \$90, when the big Model 20 sold for \$100. The styling and design were based on the big Model 20, both mechanically and electrically, and like the big Model 20, it used the welded panel and shelf for in-

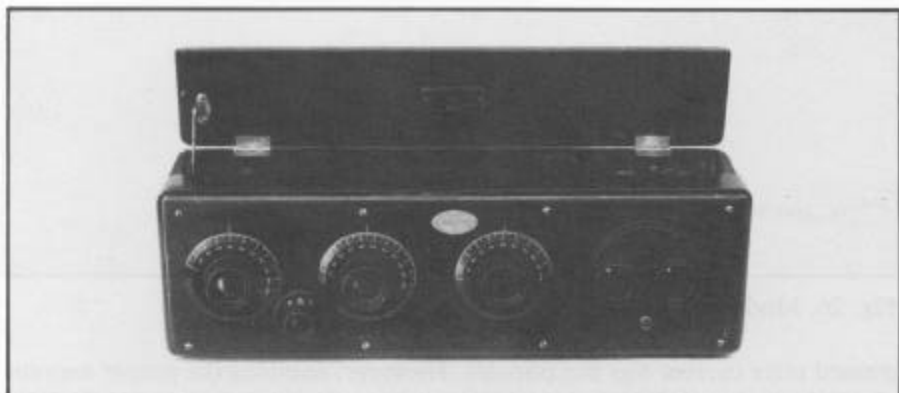


Fig. 25. Model 20C, No. 7570

tegral strength, and binding posts for the power cable. However, the second radio stage was omitted, and the overall width was reduced from 26" to 20".

The timing of the introduction, three months after the big Model 20, indicates that there was no earlier prototype version, a tribute to the RF coil and tuner design, since the coupling between the antenna and detector coils was increased by removing the intervening stage. Because the Model 19 bears the same relation to the big Model 20 that the Model 9C does to the 10C, there appears to have been some market for an "economy" set. Model 19, Part No. 4880, was manufactured in 1924 and 1925, but its production was limited, amounting to less than 6000 sets. Apparently, the market was not only small but fleeting, since no single-RF-stage receiver was later offered in the Atwater Kent line.

THE MODEL 20 COMPACT

In the development of the Atwater Kent receivers one concept recurs; it is the idea that smaller is better. The set identified as Part No. 4066 became Model 5 by enclosing all the circuit elements except the tuner in the 5-tube unit. The Model 10 series became smaller partly by improved circuitry, and partly by simple space reduction. The use of the welded-steel panel on the Model 20 brought about further size reduction, this time in depth instead of width. Although the big Model 20 continued the potential for size reduction through more efficient mechanical design, the true benefit was revealed in the compact Model 20C (Fig. 25). It used all the parts from the larger set, but enclosed them in a little less than one-half the volume.

Several other changes were made in designing the Compact 20. The binding posts for power were replaced by a cable soldered in place, but more important, the operating conditions of the power output stage were improved. The type 201A tube used was designed to operate at plate potentials up to 135 volts, even though the earlier sets had used only 67 to 90 volts. For a given signal input at the grid of the last stage, increasing the supply voltage would increase the output, but it also increased the plate current excessively. Since battery energy was the main cost of operating a radio in the mid 1920's, a greatly in-

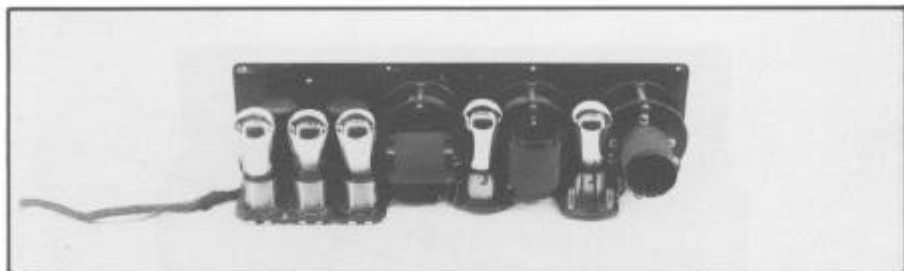


Fig. 26. Model 20C, No. 7570 Chassis

creased plate current was not popular. However, applying the proper amount of grid bias sharply reduced the plate current without reducing the available output. At the same time, the bias permitted a higher output before distortion became objectionable. Bias was applied to the last audio stage in the compact 20 by bringing out a separate lead from the secondary of its transformer to a tap on a "C" battery.

The Model 20 Compact was a very popular receiver. Altogether, nearly one-quarter million were made. They were started in 1925 while the big Model 20 was at the top of its production and continued into 1927. The first production Compact 20 was Part No. 7570; more than 163,000 of these were made, all in 1925. The main portion of the second production run of the Compact 20 took place in 1926, during which a few more than 76,000 of the new Part No. 7960 were assembled. The remainder, about 6,000 sets, were made in early 1927.

Most of the differences between the two compacts were minor. One was in the color of one of the wires in the power cable; a blue C- wire on the No. 7560 was green with a yellow tracer on No. 7960. Another was that the gold medallion on the front panel of the early set was changed to bronze on the later receiver. A third difference was a change in the filament circuit of the two audio tubes in the later set. They were fed through a fixed resistor instead of the rheostat in common with the detector, as on the early version. These three were hardly worth mentioning, but a fourth was significant.

Vacuum tubes for home use in the early 1920's were held in their sockets by a side pin that engaged an L-shaped slot in the restraining cylinder (Fig. 26). Such a socket was substantially more expensive to manufacture than one that gripped the connection pins with spring clips. Therefore, the set makers prevailed on the tube manufacturers to increase the length of the connection pins enough to give room for the grippers. The desired improvement was accomplished by the change from the UV to the UX bases in mid-to-late 1925. The Compact 20, Part No. 7570, like all the previous AK radios, was built with cylinder-type tube sockets. Part No. 7960, the later Compact 20, used shaped-spring contacts to grip the sides of the pins, thereby making electrical contact and also mechanically restraining the tubes. The change was not reversible; the newer tubes could be used in both the old and the new sets, but the old tubes could be used only in the old sets. Such a limitation was unimportant to radio purchasers of the time; it only plagues collectors who have limited supplies of 201A's for restoration work.

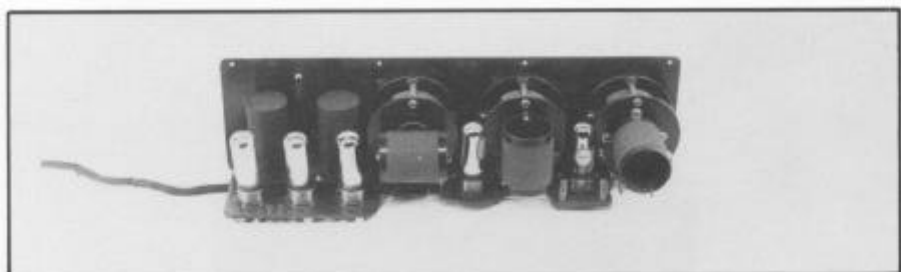


Fig. 27. Model 21, No. 7780 Chassis

THE MODEL 21

During the early-to-mid 1920's the Type 201A vacuum tube was developed into a reasonably reliable amplifier. However, it still had one drawback: the rechargeable battery required to light the filament. During the same period, another tube had been developed to ease the problem. It was the Type UV199, powered by a series of three $1\frac{1}{2}$ volt dry batteries such as the No. 6 cell. While this tube required only $\frac{1}{6}$ the amount of filament current as the 201A, it is doubtful if the cost of operation was lower, since dry battery costs were high, but they were much less messy to use. Also, without the necessity of the frequent recharging required by the wet cell batteries used with the UV201A tubes, radios with the UV199's were more convenient to maintain in the home.

To take advantage of this tube, in the summer of 1925 Atwater Kent introduced a compact receiver based on the Model 20; Model 21, Part No. 7780. It was nearly identical to No. 7570, with the main difference being the tube sockets, which were of the smaller size required for the smaller tubes (Fig. 27). The resistance of the filament rheostat was increased to enable the reduction of the 4.5 volts from new batteries to 3.3 volts, the limit for filament voltage if the risk of emitting-surface-deactivation was to be avoided. Model 21 must have not had much appeal to customers since its total production as given by the factory figures was only 17,584 during 1925. The figures for 1926 show no production, only returns of 7,208. This indicates that only about 10,000 Model 21 receivers were put into household service, a very poor showing compared to the various Model 20's. Since no other radio using either UV199 or UX199 tubes was made by Atwater Kent, one is led to conclude that only RCA was willing to utilize that type of tube, even with its advantage in reduced filament energy.

THE MODEL 30

In the steady progress of making conservative, reliable, convenient radio receivers, several major advances still remained to be achieved. One of these was single-dial tuning. The technology was within the grasp of the high-precision manufacturers in 1925. The basic problem was to produce a sufficiently precise system to permit the ganging of the several tuning condensers that were required for selectivity. The specific problem occurred at the high-frequency end of the broadcast band, where the unmeshed tuning condenser

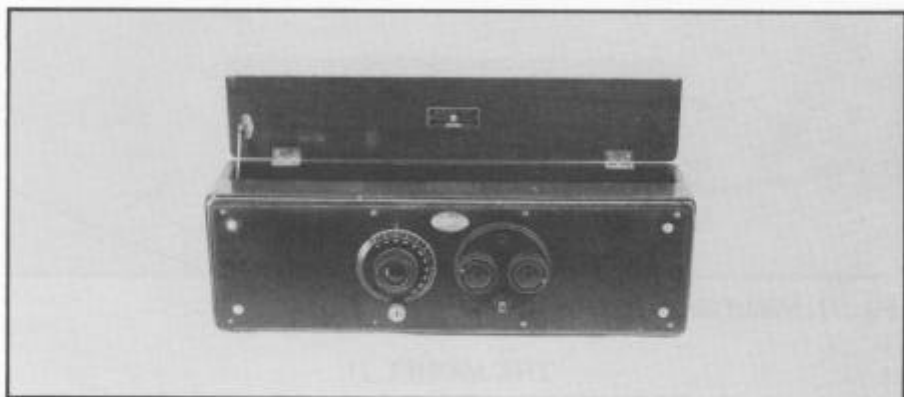


Fig. 28. Model 30, No. 7950

contributed only a small part of the total resonating capacity. Large variations in that small total capacity, caused by variations in the circuit elements, would detune one or more stages in a ganged system and desensitize the overall radio circuit beyond acceptable limits.

Condensers could be made very precisely so this factor was relatively easy to control. Another part of the problem was in manufacturing uniform interstage transformers. While this was a little more difficult than making condensers that were exact duplicates, it was accomplished with accurate coil-form production and careful operation of the coil-winding machinery.

By using the same kind of precision for the design and the wiring of the receiver itself, the set manufacturer could control the stray circuit capacity. The problem that remained was the variability in interelectrode capacity in the vacuum tubes used as the radio amplifiers. However, by 1925 the amount of parameter variation in the tubes sold by the Radio Corporation had been reduced to small fractions of the specified value. Capacity changes from tube to tube were so small that interchanging them between stages or replacing them for reasons of wearout did not noticeably reduce the performance of the radio amplifiers in a gang-tuned radio.

The necessity of single-dial tuning was clearly recognized by Atwater Kent before all the mechanics were reduced to practice. Comparison of Model 30 (Fig. 28) with the Compact 20 shows how the major changes incorporated in the Compact 20 anticipated gang-tuning. The shelf that was welded to the front panel of the Compact 20 to carry the tube sockets was easily widened by $2\frac{1}{2}$ inches to carry another tube for the Model 30. It was also made deeper by about $\frac{1}{2}$ inch to move the sockets away from the front panel. A second panel was used to carry the three condensers, instead of mounting them on the front panel, so they could be ganged with bands (Fig. 29). The second panel was fastened to the shelf with screws so that it was spaced about $\frac{1}{2}$ inch behind the front panel, and in the space a pulley was fastened to each of the condenser shafts. The pulleys in turn were banded together by phosphor-bronze loops so they turned as a single unit, with the shaft of the center condenser brought out through the main panel to give manual control over frequency selection.

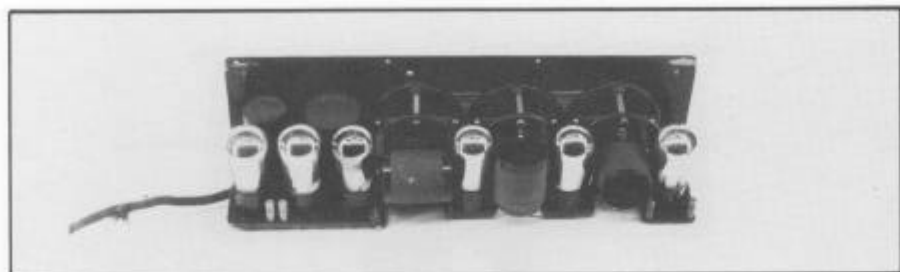


Fig. 29. Model 30, No. 8000 Chassis

Patent No. 1, 668,155 was issued to Atwater Kent in mid-1928 for this method of ganging.

When Model 30 was introduced, radios were not built with excess gain that could be used to make up deficiencies in their circuitry or in the antenna system. Long, high antennas carefully coupled to the first amplifier stage were still the accepted method of capturing radio waves. With all the different ways that radio fans built and maintained their antennas, and with the strong effects on circuit tuning which the reactances of the different antennas had, gang tuning had to take special measures to keep the first tuned amplifier working up to its capabilities.

Some manufacturers ganged only the second and third tuners, leaving the first tuner to cope with the antenna variability. Other manufacturers incorporated clutches on the tuner shafts to permit 'tweaking'. In designing Model 30, Atwater Kent chose to use an isolation tube to separate the antenna circuit from the tuning system, consequently reusing the entire tuning circuitry of the Compact 20 without change. The antenna was connected directly to the grid of the isolation tube with a return to ground through a close-wound choke. The output of the isolation stage was fed through the primary winding of an interstage transformer which had the same characteristics as all the other tuned transformers.

Atwater Kent went directly from the three separately tuned circuits of the Compact 20 to the banded-gang of three condensers in Model 30. Since these were originally taken directly from the big Model 20, it may be conjectured that part of the transformer-coil difficulty that led to producing the prototype 20 in early 1924 was caused by trying to anticipate the design of gangable tuning circuits. The word 'directly' is used to emphasize the point that the early work on the 20 series was so successful that the Model 30 was built using the same condensers, radio frequency transformers, orientations, and spacings except for the old antenna transformer. That coil had to be modified slightly, because with the same orientation as it had on the Model 20, it had to be shortened by nearly 1/2 inch and rewound with smaller wire in order to fit into the mahogany box that first housed the Model 30 (Fig. 30).

That particular mahogany box impels the author to comment: Part of the fascination that keeps historians of the radio art chained to their studies is that every once in a while the artifacts will point to a human trait that is shared between the observer and the subject. Just such a quality is revealed by the cabinet

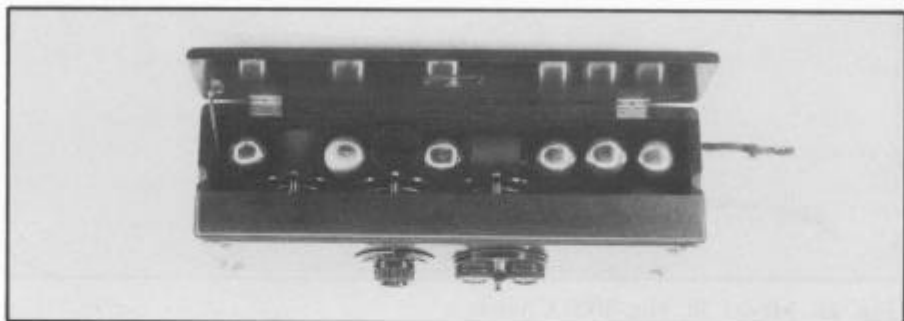


Fig. 30. Model 30, Second Version

of the first and second versions of the Model 30, which was also the one which was used on the Compact 20. Apparently at the time the Model 30 was ready for introduction, Kent felt that the sales of Compact 20's would drop, leaving a substantial inventory of unused boxes. It appears that Mr. Kent was as much of a saver as most of us are today, particularly with our old AK parts. Most collectors have heartburn over discarding just one cabinet, especially if it retains the original finish. The author sympathizes with Mr. Kent.

Because they were not quite deep enough for the Model 30, the old cabinets were changed in two ways; recesses were cut in the rear wall for the coils, and the old antenna and ground holes were plugged. New holes were bored in line with the untuned amplifier stage terminals. While the cabinet with its changes was dramatic evidence of inventory reuse, it was only one of several. Altogether, there were four versions of Model 30 receivers, but only the first two used the Compact 20 cabinets. These were recognized by their nameplates which had yellow colored AK circles. The first of the two versions used up the cylindrical tube sockets from the Compact 20 stock, and was identified as Part No. 7950. The second used push-pin sockets and was identified as Part No. 8000. The parallel with the two compact 20's is strong enough to suggest that the idea of using up old inventory was a basic tenet in Atwater Kent's factory.

The first two versions of Model 30 were put into production in November, 1925, and were tallied in the production figures for 1926. Shortly thereafter, a third version was produced (Fig. 31) which merely replaced the old too-tight cabinet with one about 3/4 inch deeper. It was given a different nameplate, this time with an orange fill for the AK circle. The sockets were the same as those of the 2nd version, the push-pin type. Whether the part numbers mentioned above followed the socket style or the nameplate color is problematic, because the published parts lists carry only Part No. 8000 for all three versions. The production figures also lumped this version into the total count of 99,000.

MODEL 30A

The 4th version, Part No. 8000-A (Fig. 32), was substantially different in the mechanical design of its radio amplifier. The variation was not large enough to generate a new model number, but neither was it small enough to keep the old

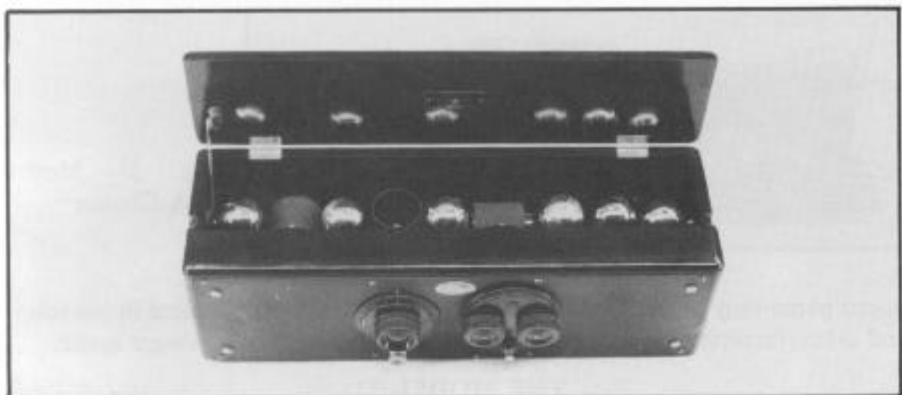


Fig. 31. Model 30, Third Version

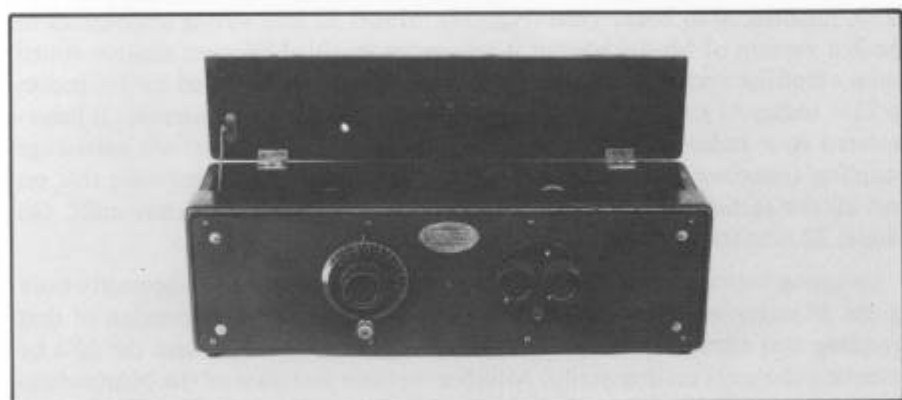


Fig. 32. Model 30A, No. 8000-A

one. A compromise resulted in its identification as Model 30A. A new set of smaller coils and a new construction of condensers that were free of expensive bakelite castings formed the basis of the new design (Fig. 33). Because of the use of the new radio amplifier design on subsequent sets, e.g., Model 35, it will be described then. The rest of the Model 30A - the cabinet, the detector-audio amplifier, the general performance, and the nameplate - remained the same as those in the 3rd version. From the outside the Model 30A was quickly recognized by the larger medallion on the front panel and the way the rheostat unit passed through a large hole punched in the front panel.

Available information on production quantities does not tabulate Model 30A explicitly. Because of its introduction so late in 1926 (November), the author assumes that the production figures for 1927 implies the Model 30A. There may have been a few of the third version of the Model 30 included in the listed quantity, but the number must have been small. The 1927 quantity was 21,500 radios, making the total of all the versions of Model 30 cabinet sets a few more than 120,000. In addition to the cabinet models, Atwater Kent pro-

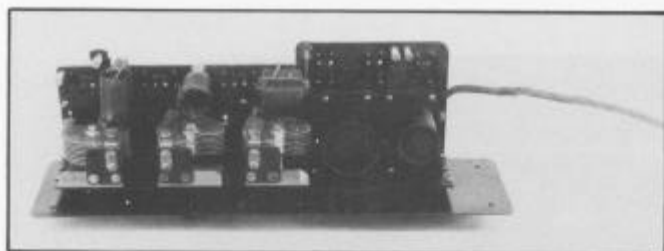


Fig. 33. Model 30A Chassis

duced panel-only Model 30 sets that other manufacturers installed in consoles and other furniture. In all, about 39,000 Model 30 Panel sets were made.

THE MODEL 32

Between the production start-up times of Models 30 and 30A, another closely related receiver was added to the total sales line. It was Model 32, Part No. 8270, introduced in May, 1926 (Fig. 34). Model 32 had strong similarities to the 3rd version of Model 30, but it was more sensitive because another tuned radio amplifier stage had been added. The cabinet was extended by $3\frac{1}{2}$ inches to $23\frac{1}{4}$ inches to give room for the extra bakelite mounted condenser. It incorporated four radio amplifiers and a detector, and all four of the interstage coupling transformers were gang-tuned. The big difference between this set and all the earlier ones was in the design of the radio transformer coils. On Model 32, the transformer coils were binocular pairs (Fig. 35).

Coupling between the radio amplifier stages in receivers as compactly built as the 30 series would have been predominantly inductive. Reduction of that coupling was accomplished in the later Model 10's, the 20's, and the 30's by orienting the coils orthogonally. Another method was part of the Neutrodyne system, in which the coils were inclined at a particular angle. Model 32 used a third method, binocular coils, where the field of one coil in a parallel pair was somewhat confined by the action of its mate. The result was that the external field several inches away from the pair was too small to cause difficulty in adjacent pairs. Consequently, all pairs could be mounted on the variable condensers without concern about their orientation.

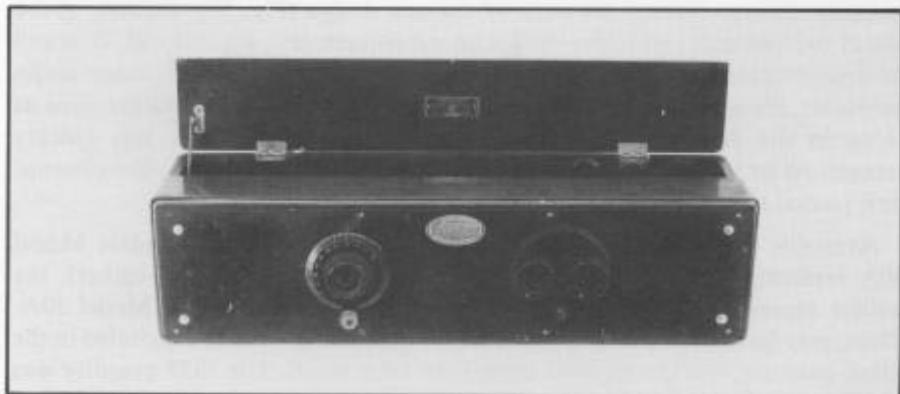


Fig. 34. Model 32, No. 8270

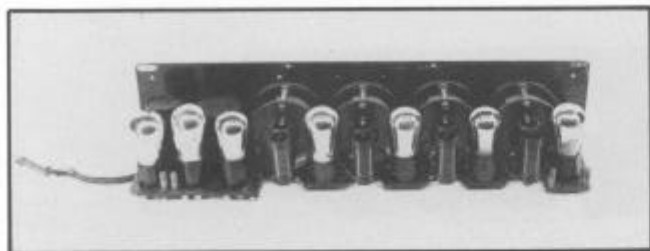


Fig. 35. Model 32 Chassis

Today, the calculation of binocular transformer parameters, e.g., field confinement, coefficients of coupling of mated coils and of adjacent pairs, and effective turns ratio can be done quite precisely using computer approximation techniques. Before computers, reasonably accurate estimates could be made using empirically established formulas, but in the mid-1920's the only practical way to design binocular transformers was with experiments on real parts. The Atwater Kent laboratory was assigned a hard problem in the design of Model 32's radio amplifier section, especially considering the four transformers. The people who solved that problem must have felt good about their work when the design survived into the day of the electric sets.

Model 32 was also produced in a panel-only version for assembly in cabinets or consoles not made by Atwater Kent. The total number of both versions, the cabinet and the panel sets, was almost exactly 38,500, of which all but a few were made in 1926. The whole production run was completed in less than a year. At the same time, other 30 series sets were being made in much larger quantities. This indicates that Model 32 was a specialty set offering the extra amplification that was most effective in rural locations where all stations were faint. With a strong station, the set must have been difficult to control since the only means of signal reduction had to be either filament starvation or disabling the antenna.

THE MODEL 33

During the development and early production of the single dial receivers in the first part of the 30's series, several approaches to the antenna detuning pro-

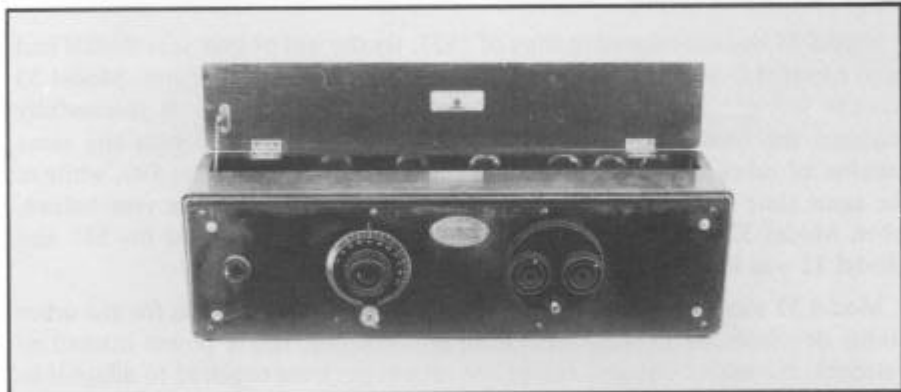


Fig. 36. Model 33, No. 8930

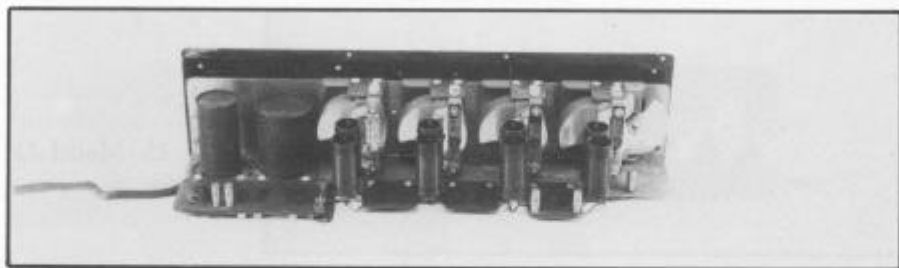


Fig. 37. Model 33 Chassis

blem were implemented. Model 30 used an isolation tube; Model 32 continued with the isolation tube and added a radio frequency amplifier. While this combination enabled the user to cover any situation, it was more expensive than necessary. Model 33 (Part No. 8930, Fig. 36) utilized another method to solve the detuning problem; eliminate the isolation tube and still retain the radio frequency amplification. A trimmer capacitor was added across the secondary of the antenna transformer and a tap was made in its primary. With these two adjustments most of the antennas used in the mid-to-late 1920's could be accommodated.

Model 33 used four tuned, binocular radio-frequency transformers, one of which used the tap for long or short antennas. Otherwise they were identical to one another and very similar to those on Model 32. The three amplifier stages and the detector were tuned by newly designed ganged condensers that were similar to those used on the Model 30A. They were mounted on a L-shaped sub-panel about 20 inches wide which was screwed to a pair of brackets, which were in turn welded to the back side of the main panel. This, too, was similar to the arrangement of Model 30A, but four inches wider.

The shaft of the trimmer was brought out near the left end of the main panel. A small uncalibrated knob enabled the listener to trim the Model 33 for maximum sensitivity if that was needed, or to use the trimmer as a primitive volume control. The trimmer was a single plate that rotated alongside the stator of the first tuning condenser.

Model 33 was introduced in May of 1927. By the end of that year 70,000 had been produced, along with more than 38,000 of the panel version. Model 33 was the last of the battery-operated, mahogany-box AK sets. It successfully replaced the Model 30 series by providing more sensitivity with the same number of tubes at only a small difference in price. It listed for \$90, while at the same time the Model 30 sold for only \$10 less at \$80. The year before, when Model 32 was at the top of the line, Model 30 was sold for \$85 and Model 32 was listed at \$140.

Model 33 was successful in another way. It provided the basis for the other major development in radio operating convenience, house power instead of batteries. No major changes except for tube types were required to adapt it to alternating current operation. With a power supply unit it reappeared in the Atwater Kent line for 1928 as the Model 36.

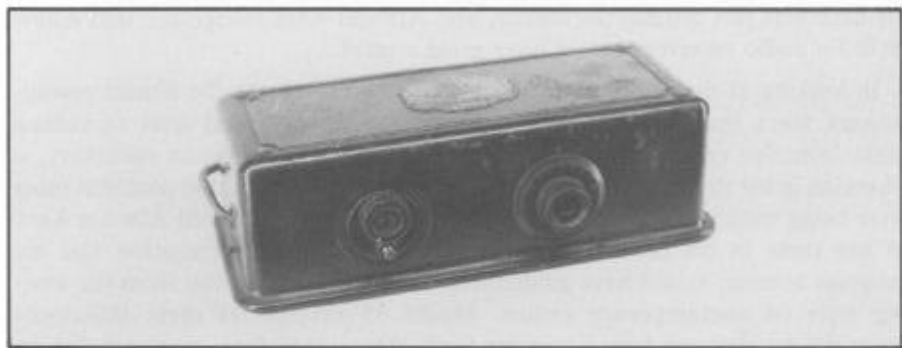


Fig. 38. Model 35, No. 8100

THE MODEL 35

In telling of the development of Atwater Kent radio receivers, the author has chosen to use a brief technical review of each set as it appeared on the scene, as a way to give order to the story. Where a major change in the technology of radio design or of manufacturing capability took place, it has been illustrated by describing the changes to the radio sets that were affected, e.g., ganging the tuners. Where a major change in the expectations of the general radio listener or in the content of radio programming came along, it too has been related to the radios current at the time, e.g., spreading the broadcast stations across a wide spectrum. The effects of styling trends have been described when they became apparent, e.g., changing from the Open Sets to the simple mahogany boxes.

In the fast-paced twenties, more influences like those above became strongly apparent in the American scene, and their near-simultaneous impact radically altered Atwater Kent's response to the whole new way of life called "radio". Model 35 stands as undeniable evidence of these extensive changes. For instance, during the late 1920's, there was an acceptance in the United States of machine-shaped steel that was almost a love affair.

The last part of the decade was the time when automobile bodies went from coaches made with large amounts of wood in their structures to large panels of contoured steel that were welded together to make complete bodies. It was a time when stoves changed from cast-iron affairs that had been in vogue for cooking since women knelt before their fireplaces to ranges made of stamped steel panels. It was the time when the refrigerator with its dramatically shaped steel compartments replaced the ice box. Without stamped, punched, shaped steel none of these would have been available to change the way of life of the general public. Atwater Kent recognized that this technology could and would be used to make a modern radio.

The advances that were wrought in appliances and automobiles would not have come about if the public weren't ready for major changes in style. A revolution in clothes, in art, and in architecture was quietly taking place. Radios in wooden boxes that had offered the traditional comfort of familiar furniture could be displaced by unfamiliar shapes and finishes. The era of

art-deco was just around the corner, and Atwater Kent recognized that a new style for radio receivers would have great appeal.

In looking at the first part of the 1920's and examining the almost revolutionary ways that Atwater Kent had already used shaped steel to reduce manufacturing costs, and at the same time to increase product reliability, a historian is led to ask what came next. Surely the new ways that machine tools were being used in the automobile industry would have inspired Atwater Kent to use them in his factory. Equally surely, his market perception and his business acumen would have guided him to a marked excursion from the waning style of contemporary radios. Model 35 exemplifies these influences superbly, by showing how a new art form constructed from new material on efficient new machinery found a secure place in the public's affection.

When viewed from the vantage of the user, Model 35, Part No. 8100, presented an entirely new appearance for a radio (Fig. 38). The soft curves of its case, faintly reminiscent of the ogee that marked the breadboards, but given a modern touch by the vertical section between the curves, was a sharp contrast in style to any of its predecessors in the Atwater Kent line. Although its shape was unique insofar as any other receiver was concerned, the way the nearly flat top flowed into the sides and the way the bottom flared to join the plane of the supporting surface may be found in some of the minor dress panels of contemporary automobiles.

Had the shape that distinguished the Model 35 been very difficult to produce, it might never have been brought to market. The opposite was true; the shape was moderately easy to draw using ductile sheet steel. ('Drawing' is the metal forming process that presses a flat sheet into a three-dimensional figure, such as a cup.) Because the depth of the Model 35 case was about equal to its height, the draw to make it was considered deep. This meant very careful control of metal stretching and called for several separate steps. The corners probably determined how difficult the drawing process was and consequently how much the drawing dies cost. Briefly the steps would have been (and if the author has analyzed correctly, they were): stamp out the blank, about 18 x 29 inches; make the first draw to get a pan, 12 x 23 inches and three inches deep; make the 2nd draw to get a box near the final size; make the 3rd draw to come to the final size and flare the edge. Finally, several piercing steps were performed to punch out the holes in the sides for the dial, the connections, and the filament control.

Since each of these steps was done on a separate press and since the process was quite different from the simple stamping, piercing, and folding required for the other models in the 30 series, the investment in new presses and dies must have been very large. As many as 20 different presses were required to perform all the sequential steps necessary to make the Model 35 case, and another ten were needed to fashion the other parts such as the brackets, the bottom, and the condenser sub-panel. Altogether, a minimum line of 30 presses would have been set up for one complete cycle. If the presses could each have produced one stroke per minute for a full eight hours, they would have piled up a few less than 500 cases in one day. In a year at that unbelievable rate, 125,000 sets would have been produced. But in a single year,

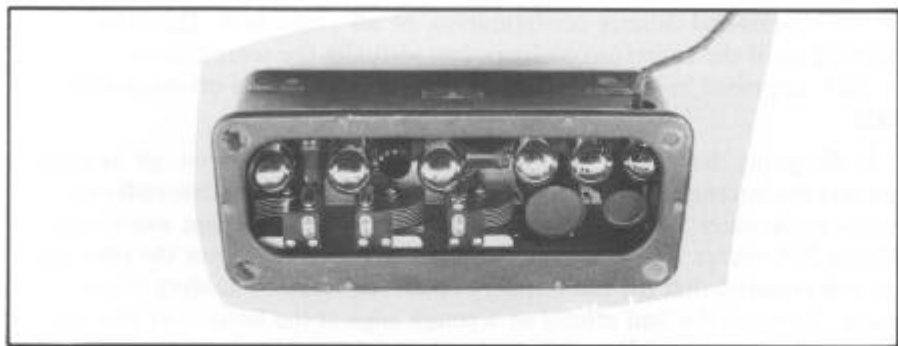


Fig. 39. Model 35, Bottom

1926, 200,000 Model 35 radio sets were manufactured.

To meet that production, along with the other sets that were manufactured at the same time as the Model 35, more than 100 presses must have been on-line and running at their optimum (not maximum) rates. Model 35 was the precursor of the Model 40 series, the metal box receivers. The rate of production of the latter was even higher, and required still more presses. When the factory closed in 1936, there were over 400 presses to be disposed of on the resale market.

Model 30 introduced one-dial tuning. Its fourth version, Model 30A, was the same electrically as the others but with a substantially changed mechanical design. Model 35 was almost identical to the 30A, and both were designed around a new L-shaped sub-panel. The earlier Model 30 condensers were replaced with a new design based on a single stamped and folded end-plate. Only one rotor bearing was used, but it was strong enough to cantilever the rotor. With no rear end-plate, the radio frequency transformers had to be mounted independently of the condensers. This was accomplished by molding a thin bakelite strip for the three radio amplifier tubes, leaving enough space between the tubes for the transformer mounting brackets. The coils of these transformers were also changed to reduce their diameters and to decrease the size of the winding wire. The transformers were still arranged orthogonally with the direction of each coil the same as before.

The most important change in going to the new design for Models 30A and 35 was the replacement of the welded shelf with an L-shaped sub-panel that was really an independent internal chassis. This new chassis was made about two inches narrower than the welded shelf of the other versions of the Model 30. It carried all the internal parts of the receiver, including the rheostat unit, and was screwed to welded brackets on either end of the front panel of Model 30A or the case of the Model 35.

The use of the L-shaped chassis ushered in a new approach to radio manufacturing. A major styling change, intended to meet the changing market trends, no longer implied a redesign of the entire receiver. By making the internal operating elements of the receiver completely separate from the case and its appearance items, Atwater Kent put into practice a concept that later emerged

as the chassis-and-cabinet configuration of all radio sets. This idea is not startling until the collector considers that virtually the same chassis, designed in 1925, appeared in Models 37, 40, 41, 42, 43, and several others in 1927 and 1928.

In designing the Model 35, the case was made just wide enough to accommodate the internal chassis. Model 35 was therefore the smallest radio set produced by Atwater Kent in the 1920's. Its internal arrangement was similar to Model 30A except that everything was upside down. That put the tube bases up and required that the pin grippers do all the work of holding the tubes in place. To avoid the bad effects of a rough edge at the bottom of the flare, a rectangular base was designed. It fitted closely inside the case, and had a smaller rectangular opening to give access to the tubes (Fig. 39). Four pads in the corners of the rectangular base protected the surface on which the radio was used.

Four versions of Model 35 were produced. The first two had cases that were pierced on the left side for the power cable and on the right side for the antenna and ground wires (Fig. 40). The name plates had an orange fill in the AK circle. The difference between these two was in the decorative buttons in the corners of the top of the case. The first version used the same milled-edge, circular buttons that had been used on all sets since the big Model 20. The 2nd and later versions of Model 35 were fitted with a new design that incorporated the curved-square motif that characterized Model 35.

The last two versions had cases in which the sides had no holes. On these, the power cable, the antenna and ground wires, and the speaker wires came through holes in the rear (Fig. 41). These rear-hole versions had nameplates with yellow fill in the AK circles.

There was another difference among the four versions of Model 25; the number of plates in the variable condensers. In the first three designs, the total number of plates in each condenser was 13. In the last, which had serial numbers higher than 900,000, the condensers had 17 plates. Since all the sets tuned the entire broadcast band, the transformers must have had different inductances in their grid coils.



Fig. 40. Model 35,
First Version, Rear

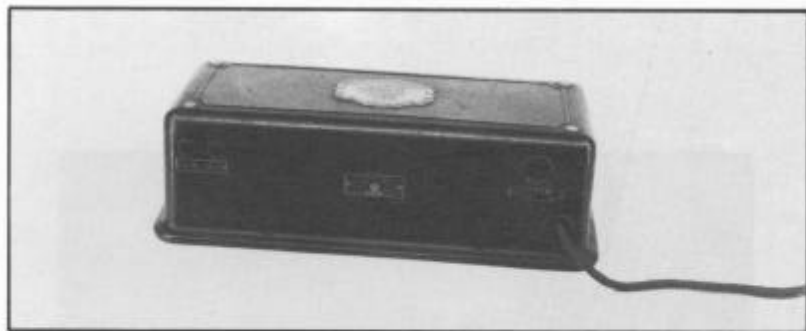


Fig. 41. Model 35, Second Version, Rear

Radio historians, looking back at Atwater Kent's production, accord to Model 35 another recognition. This set included the 1,000,000th receiver made by the factories that started on Stenton Avenue and expanded into the new facilities on Wissahickon Ave. Number 1,000,000 must have been made early in 1927, since the factory totals for the years up to and including 1926 were almost 985,000. In 1927, 122,000 additional Model 35 receivers were produced along with the other popular battery set, the Model 33.

CONCLUSION

The major influences on radio development, technical, social, and manufacturing have been related to the particular radios where their effects became apparent. The last major influence, house power, was making itself felt in a moderate way in 1927; it would revolutionize radio receivers within three years. The limitations of space have made it necessary to postpone a review of this last influence. How Atwater Kent used the customer demand for electric sets to become a still greater force in the radio business will be taken up in the next part of this story.

Photos: R.O. Williams