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Atwater Kent – Three-Tube TA Units

BY RAY THOMPSON AND LEIGH BASSETT

This series of articles represents a tremendous amount of careful research to document the details of early Atwater Kent radios with their many variations. The early AK components and breadboards are prized by collectors; the more rare models bring high prices. While the level of detail may seem high to a collector who has no interest in AK radios, the thorough detective work by Thompson and Bassett is essential to enable future AK collectors to determine whether a particular unit is original or has been modified. - Editor

Introduction

It is the natural evolution of engineering to reduce the size of, and improve on, parts used in any design. This was true of the Atwater Kent TA units as well. In article 6A we examined the one-tube audio unit, part # 4030, and the two-tube AF amplifier, part # 3634, TA units. In article 6B we covered the Detector/Amplifier, part # 3676, and its later variant # 4940. In this article, which we describe as Part 6C of this series, we continue to document the TA units.

The radio industry in the early 1920s soon realized that the optimum configuration for the detector/amplifier was to use a detector circuit followed by two stages of audio amplification. It is therefore no surprise that the Atwater Kent factory produced part # 3812, Detector/ Two-Stage AF Amplifier unit, and its # 4135 and # 4520 variants, discussed in this article. This component

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Figure 1. Detector/amp unit # 3812, Type 1, top view.

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became a standard for the open set, (a.k.a. breadboard) era.

The # 3812 Type 1

The earliest two-tube units, both the # 3676 detector/amp and the # 3634 two-stage audio amp, had knurled thumb nuts for all external connections. In contrast, the earliest three-tube units (part # 3812, Fig. 1) used knurled thumb nuts for all connections except for B+ and the plate of the second audio tube, which used round-head slotted screws to secure the connections for the headphones or a speaker. The B+ post had four holes, one for the battery connection and three for headphones and/or speakers, while the audio tube plate post had three holes.

There are two knurled thumb nut connections provided, labeled "TIC" (an abbreviation for tickler coil) that allow the owner to make the unit regenerative (Fig. 2). Mr. Kent did not have a license for the Armstrong regenerative patent, so he could not configure units with this capability at the factory. The T/A was sold with a removable jumper installed between these two terminals. The owner could remove it and connect a variometer (AK part # 3714 or # 3488) to enable regeneration.

Figure 2. TIC terminal labels on the # 3821 Type 1.

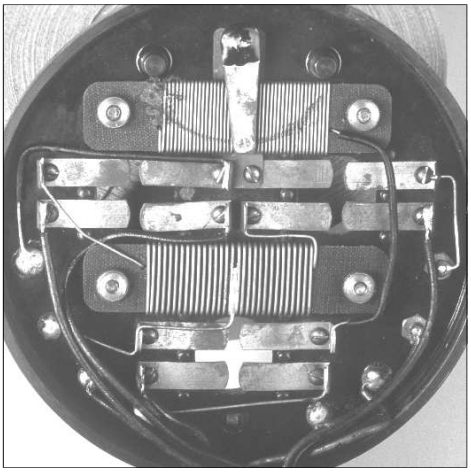

Figure 3. # 3812 Type 1, underside view of components.

Forward

It has been an awesome task to sort out the AK factory mechanical and electrical design changes made to the Detector - Two-Stage AF Amplifier TA units, part numbers 3812, 4135, and 4520. Without co-author Thompson's over 30 years of personally handling, and closely examining, hundreds of the "open sets", or breadboards as we now call them, it would have been impossible to even attempt an article such as this.

There was a considerable amount of service repair work done in the breadboard usage era (1920s-1930s), which changed many of the sets from their original state. In addition, collectors have substituted available parts they have found that are often not identical to the originals, increasing the altered condition of early sets.

The research required to produce this chapter has taken more than a year. While we cannot guarantee 100-percent accuracy, the resulting information has been as carefully checked as is humanly possible.

Our personal thanks to Roger Vitko, Mike Kreuser, and Jimmy Edington for their willing assistance in providing answers to key questions, as well as taking time to photograph the TA units from their breadboard sets. This information was critical in determining some of the data used in this article.

The tube sockets are mounted with the brass skirt keys for the detector (at the rear) and first audio (front left) pointing toward the rear, and the key for the second audio (front right) pointing to the right. The metal housing was painted a greenish color which the

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Figure 4. # 3812, Type 1 – nameplate detail.

Figure 5. # 3812, Type 1 – internal view.

factory later called "Geronimo Gray", the reason for which is unknown. This unit was sold with both black and brown rheostat knobs.

The Type 1 three-tube TA unit, part # 3812, was designed to use a UV-200 detector tube and two UV-201 audio tubes. Both types have 5-volt 1-amp filaments. These units used a rounded sliding contact on the rheostat from the very beginning, avoiding the problem with the flat contact used on earlier two-tube units (*Radio Age Vol 32, No 2*, Feb. 2007, page 4).

Filament resistance for the three tubes is divided between two components, one fixed and one variable. These are constructed on fiber forms, each mounted on its own pair of studs molded into the Bakelite top cover. The forms were mounted using thumb nuts on the earliest products, but these were soon replaced with simple brass hex nuts.

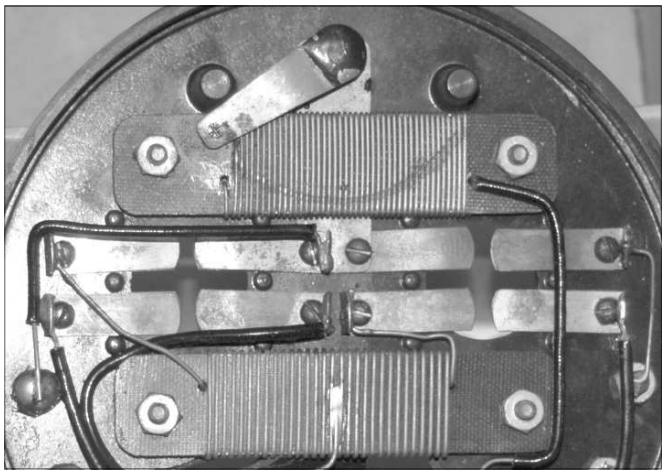


Figure 6. # 3812, Type 1 – filament resistors detail.

The 2.2-ohm variable rheostat only supplies current to the detector filament, from the **+A** supply line. The 1-ohm fixed resistor supplies both audio tubes. It is tapped at the center, which is the battery feed point from the -A supply line, with one section supplying each of the audio tube filaments.

Ten wires emerge from the tar for connection to components mounted on the Bakelite top. The grid leak condenser and resistor are connected together at one end under the tar. A single lead from this junction comes out of the tar block for connection to the detector grid pin. The other end of the grid leak resistor is tied to circuit common (the **–A –B** terminal), while the other end of the grid leak condenser connects to the **INPUT** terminal.

The 2000-pF phone condenser is physically attached to the first audio transformer in the tar. One end is connected directly to the transformer's plate winding contact, and a lead from both is brought out to the second TIC terminal. The other end is connected directly to the first audio grid return winding contact. A jumper wire is connected to the

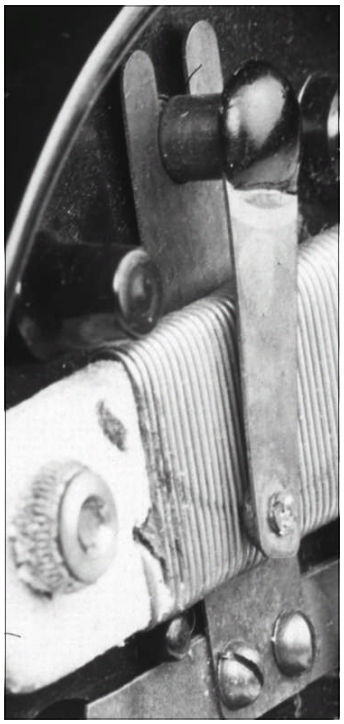


Figure 7. # 3812, Type 1 – filament rheostat contact detail.

Figure 8. # 3812, Type 2 – P1 P2 label detail.

second audio grid return contact, also under the tar. A lead is brought out to the circuit common bus (the **-A-B** terminal). The remaining leads attach to appropriate points on the top, as shown on the accompanying schematic.

The # 3812 Type 1 was used only on the # 3945 open set (the Model 2). It was also sold as a component for hobbyists and experimenters.

The # 3812 Type 2

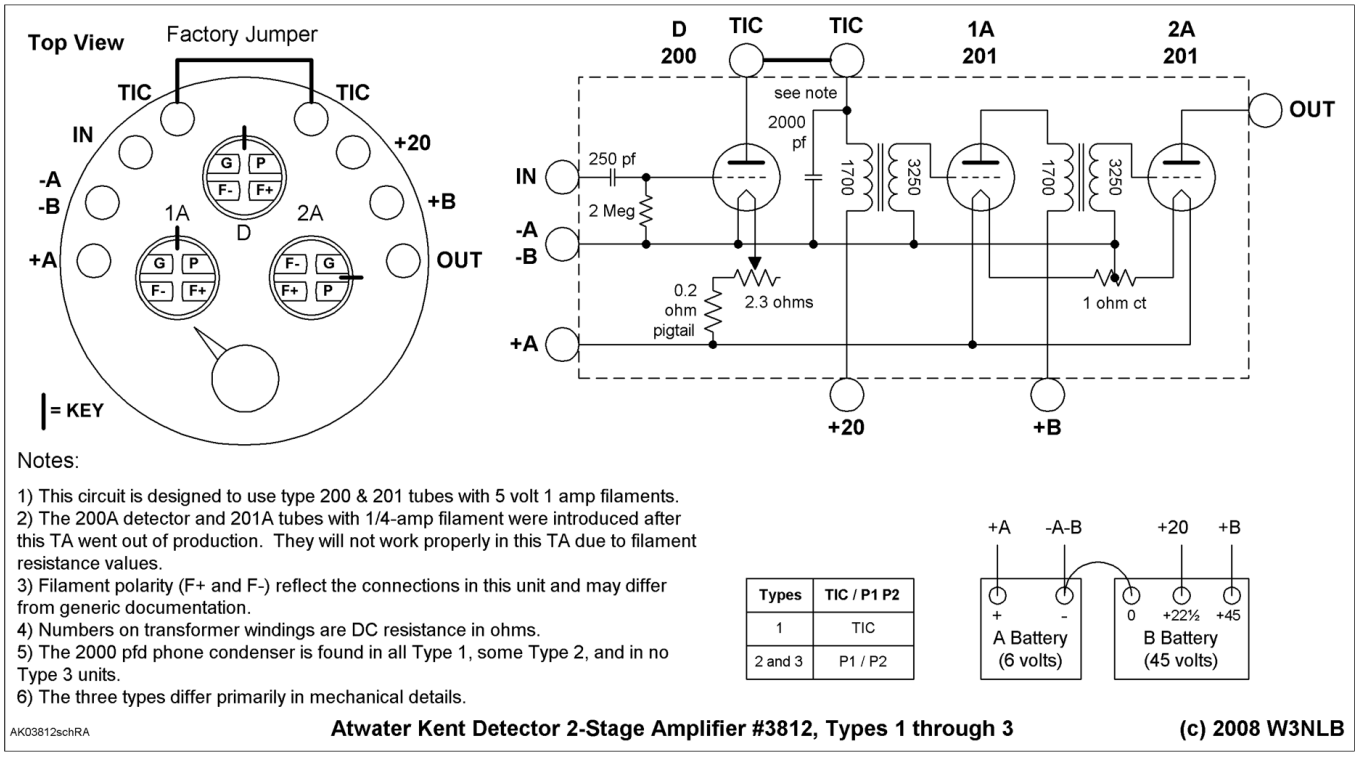
The # 3812 Type 2 is electrically identical to Type 1, with the exception of the 2000 pF phone condenser. It is also mechanically identical with the sole exception of the variometer connection labels. The **TIC** designation used on Type 1 was replaced with **P1** and **P2**, as shown in Fig. 8. Only brown rheostat knobs were available.

Why would the factory go to the trouble of changing these markings when no other upgrades were introduced at this time? Was "TIC" already an obsolete term? Was this an attempt to modernize radio terminology? Perhaps it was thought that **P1 P2** represented the tube plate connection, which was more correct.

Following the appearance of the Type 1 # 3812 TA on the # 3945 set, the factory introduced three more models: the # 3955 (the Model 3), the # 3960 (a stripped-down # 3955), and the # 3975 (the Model 4). The # 3955 and # 3975 both used the # 3634 two-tube TA, discussed in the previous installment of this series. The # 3960 had only a detector (# 3902), with no audio amplification. All of these new product introductions occurred in less than a month.

The factory then introduced a more sophisticated design in the # 4052 set (our Model 6) and the # 4066 (our Model 7). The # 3812 Type 2 made its debut with the introduction of these models.

One # 3812 was even found on a # 4205 set (the later version of the # 4066) which used ¼-amp filament tubes in the RF stages. An interesting point regarding



Notes:

1) This circuit is designed to use type 200 & 201 tubes with 5 volt 1 amp filaments.
2) The 200A detector and 201A tubes with 1/4-amp filament were introduced after this TA went out of production. They will not work properly in this TA due to filament resistance values.
3) Filament polarity (F+ and F-) reflect the connections in this unit and may differ from generic documentation.
4) Numbers on transformer windings are DC resistance in ohms.
5) The 2000 pfd phone condenser is found in all Type 1, some Type 2, and in no Type 3 units.
6) The three types differ primarily in mechanical details.

Types	TIC / P1 P2
1	TIC
2 and 3	P1 / P2

AK03812schRA

Atwater Kent Detector 2-Stage Amplifier #3812, Types 1 through 3 **(c) 2008 W3NLB**

this # 3812 is that it does not have the 2000 pF phone condenser. All indications are that it was never installed at the factory, as opposed to being removed later during a service procedure. Apparently, starting with Type 2, some # 3812's were made with this condenser and some without.

The # 3812 Type 3

As if the Type 2 # 3812 TA isn't enough to make one wonder, yet another variation appeared—the Type 3, having the same exact electrical and mechanical configuration except for the **P1 P2** thumb nut terminals. The Type 3 has a two-hole post at each position. These use slotted round-head screws to fasten the wire jumper or external connections.

[The reason for the second hole in each post is unknown. One possible explanation would be to connect a switch to short out the variometer when receiving strong stations. The number of stations, and their transmitter power, were increasing rapidly. This could have led to overload problems on radios configured for regenerative operation. In radios of the late 1920s, local/distant switches were fairly common to prevent overloading on strong stations. An in/out switch would alleviate the problem quite simply. This is pure speculation, but it seems reasonable.

One evolutionary change is the absence of the 2000 pF phone condenser in all Type 3 units we examined. We know from analyzing many products that AK incorporated changes one at a time, as dictated by the engineering or manufacturing departments, rather than in groups. Removal of the phone condenser, as discussed above under Type 2, was probably unrelated to other observed changes.

One minor change in the internal wiring was noted. The two buried audio transformer grid winding return wires were brought out of the tar separately and tied directly to the **–A-B** terminal, instead of being tied together in the tar with a common lead brought out as in Types 1 and 2. Therefore, eleven wires exit the tar rather than ten.

The # 3812 Type 3 is found on all of the # 4052 and # 4066 sets that use the 1-amp UV-200 detector and UV-201 amplifier tubes (except a few of the earliest ones which used the Type 2).

The # 3812 Type 4 (# 4135)

The first real design changes are found in Type 4 of the

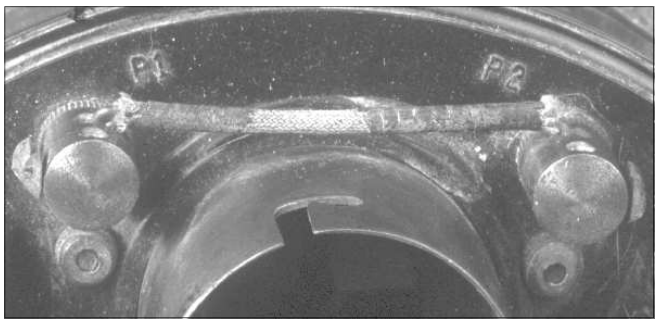


Figure 9. # 3812, Type 3 – P1, P2 two-hole terminal detail.

three-tube detector/amplifier, which has been identified in one published source as part # 4135. There is no factory material available to us to substantiate this part number assignment, but we will use it to help separate the design differences being described.

Part number 4135 does not appear on the dealer factory price list of 1 October 1923, which indicates that if it did exist, it was not available on the open market at that time, even though sets which used it were listed.

The external appearance of the Type 4 is identical to the Type 3, but the Type 4 electrical design has been changed. The 2.2-ohm rheostat and 1-ohm fixed resistor of the Type 3 have been removed, and the filaments re-wired to use a single current-sourcing resistance. The tube socket filament connection

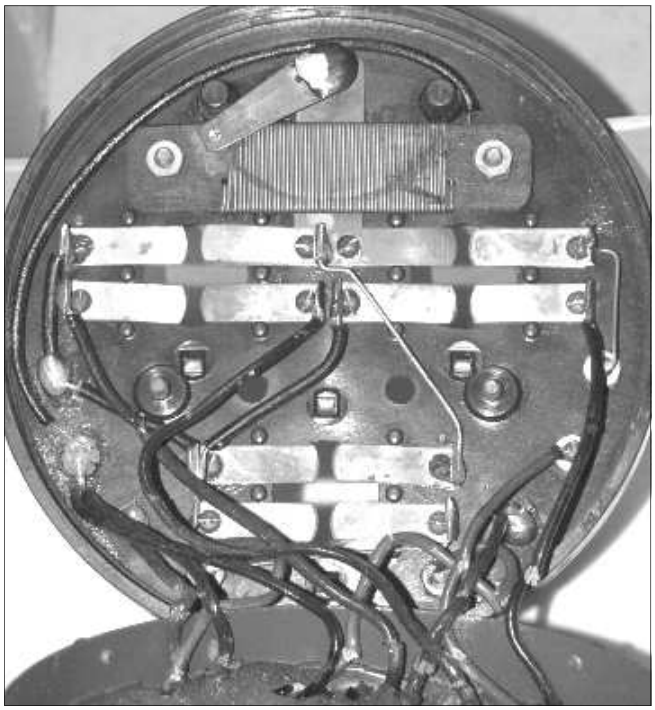
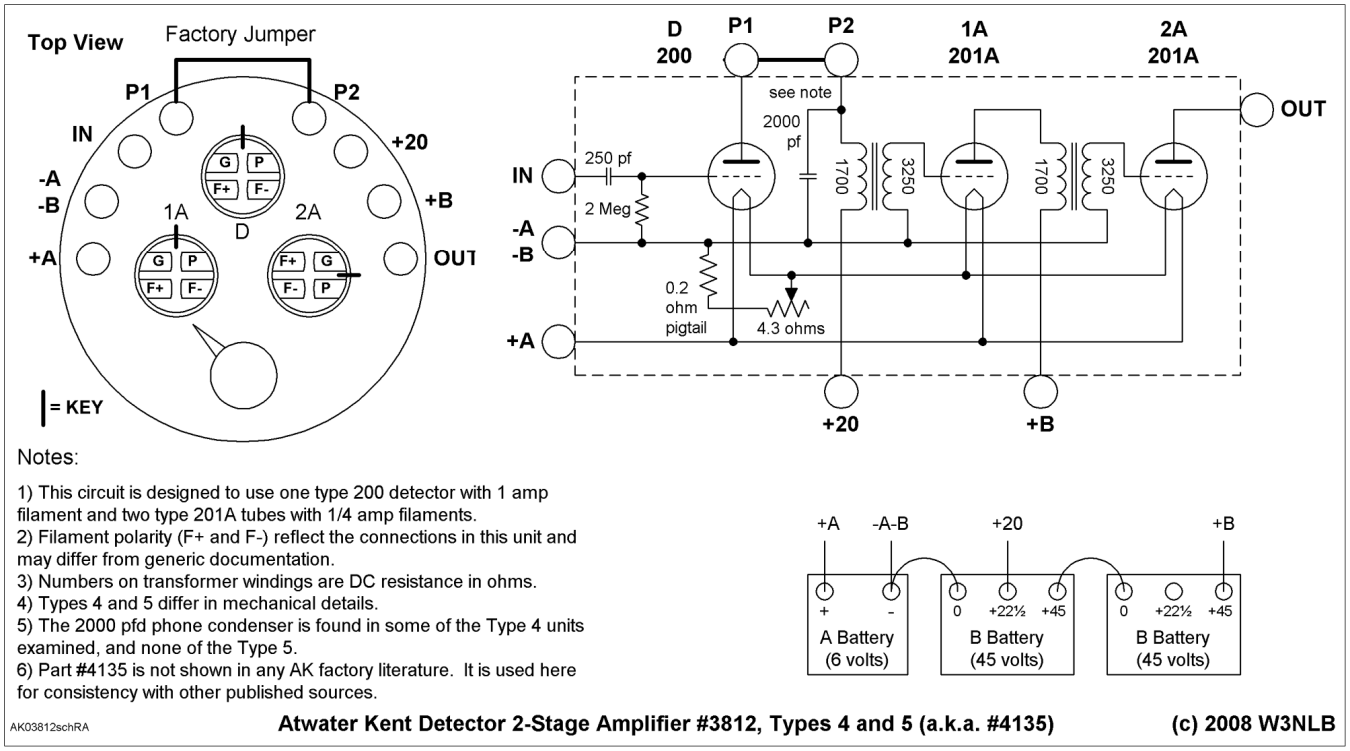


Figure 10. – # 3812, Type 4 (a.k.a. # 4135) – internal view.



designations, **+F** and **-F,** have also been changed (see schematic).

The grid winding return leads of the two audio transformers are again tied together in the tar as in Types 1 and 2, resulting once again in ten wires coming out of the tar.

A new rheostat replaced the earlier unit. It has a 4.3-ohm winding, one end of which is tied to the **–A –B** terminal through a 0.2-ohm pigtail. The slider now goes to the **–F** pins of all three tubes. The # 4135 was designed to use the new UV-201A tubes (with ¼-amp filaments) for both audio stages. The UV-200 detector was still used since the ¼-amp UV-200A was not available until 1926.

The UV-200A could be used, with a significant reduction in battery drain, but with a possible reduction in sensitivity. Urban users would probably have opted for the ¼-amp tube, since they did not need maximum sensitivity due to the proximity and higher power level of contemporary transmitters. Rural users most likely preferred the 1-amp tube.

Like the Type 3, the Type 4 does not use the 2000-pF phone condenser.

The Type 4 (# 4135) was used primarily on the # 4205 set (the Model 7) and the # 4275 (the model 6). One Type 4 was found on an early Radiodyne 10, but it has eleven wires exiting the tar (two separate audio grid returns).

The # 3812 Type 5 (# 4135)

The Type 5 can also be identified as part # 4135, to

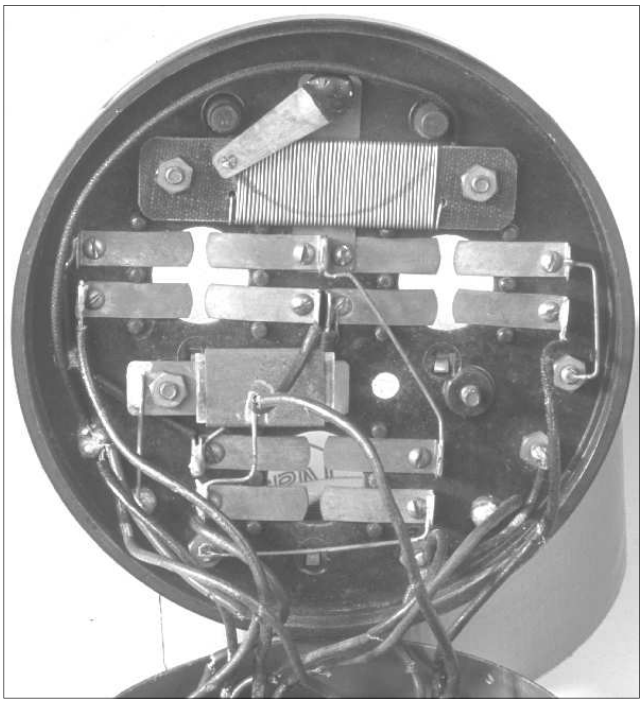


Figure 11. # 3812, Type 5 (a.k.a. #4135) – internal view.

maintain consistency with other published sources, (and lacking any published factory information to clarify the discrepancy).

Externally it looks identical to Types 3 and 4. A new-style 250-pF detector grid condenser is found in this unit. It is mounted on one of the two screws vacated by the removal of the fixed 1-ohm filament resistor, as shown in Fig. 6.

The new grid condenser, part # 4465, is wired between the **INPUT** terminal and the detector tube grid pin. The condenser that was in the tar has been eliminated.

Ten wires now exit the tar, eight of which are attached to the two audio transformers, with the two grid winding return leads brought out separately. The other two leads are attached to the detector grid leak resistor, that was still buried in the tar.

None of the Type 5s examined has a phone condenser on the first audio transformer.

The Type 5 was used on at least 2,000 of the Model 9 open sets, the early (green) version, which used terminals for power connection, and on at least the first half of the 4,000 Radiodynes.

The # 3812 Type 6 (# 4135)

Type 6 of the three-tube TA unit has a subtle mechanical design change. Unless you examine the unit closely, you might miss the fact that the first audio stage tube socket brass ring (left front) has been rotated 90 degrees counter-clockwise. This relocated the filament pins, permitting the shortest possible wiring arrangement.

[One of the brass screws molded into the underside of the Bakelite top, used to mount the fixed filament resistor, was no longer installed. The 2,000-pF phone condenser is absent, as was true of the Type 5. These details are visible in Figure 6, which shows the top with the normally buried components exposed. The grid leak resistor is shown at front center. It was still buried in the tar in the Type 6.

The green Type 6 TA unit (# 4135) was used on the remaining Radiodynes, and on Model 10 sets up to serial numbers around 10,000. It was also used on a few of the first green 9As (the first model 9s with power cables).

It should be noted that the Type 6 is the first three-tube TA to be made in both brown and black crinkle paint finishes, as well as in green. The brown Type 6 TAs were found on early Model 10 part # 4600 sets. The black Type 6 TAs were used on the earliest of the black

Figure 12. # 3812, Type 6 (a.k.a. #4135) –top (rear) view.

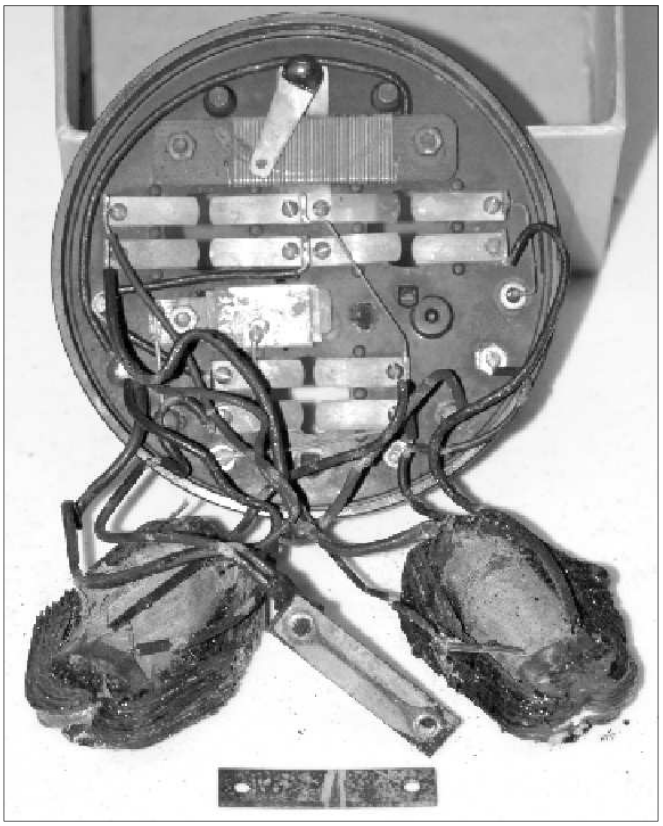
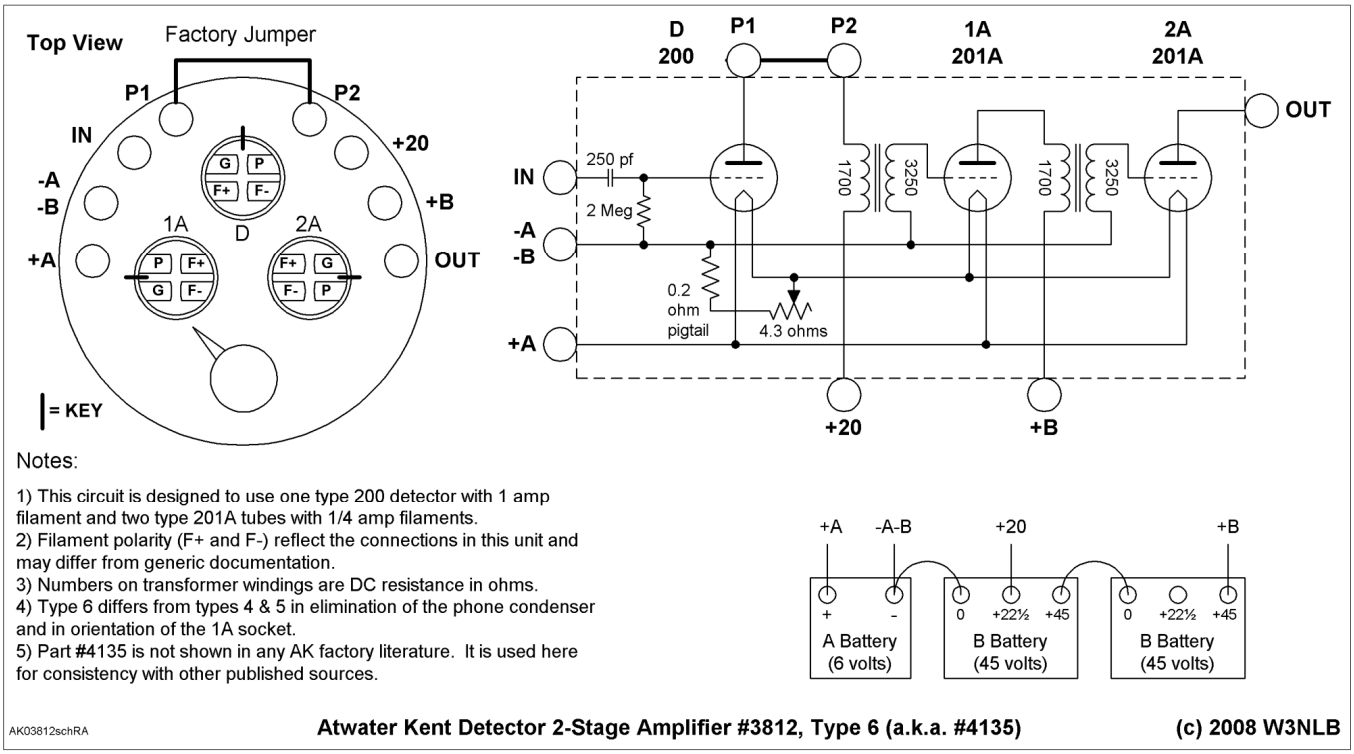


Figure 13. # 3812, Type 6 (a.k.a. #4135) – internal view.



Model 10 sets, part # 4340.

The brown Type 6 TAs had the early three- and four-hole output posts, the same as described for the earlier green TAs. However, the black TAs were fitted with a new style of two- and three-hole posts. These posts are the same height as the previous parts, but the second hole from the top has been removed from each style. The bottom hole (of three) on the new B+ post still uses a slotted round-head screw to secure the B+ supply line. But the two separated holes on each new style now use small knurled screws to connect the leads to the headphones or speaker. The middle hole which had appeared on earlier parts was eliminated to provide more finger clearance to the knurled screws.

Some Type 6 TAs were fitted with the earlier three- and four-hole output posts, but with the new knurled screws in the top and third holes. Nothing was installed in the second hole.

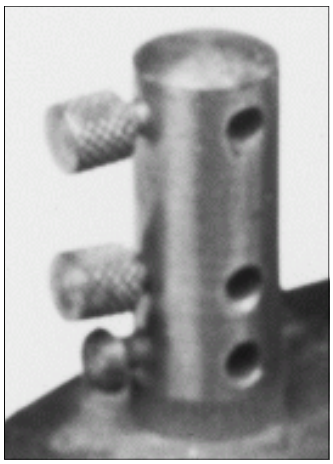


Figure 14. # 3812, Type 6 (a.k.a. # 4135) – new 2/3-hole output posts.

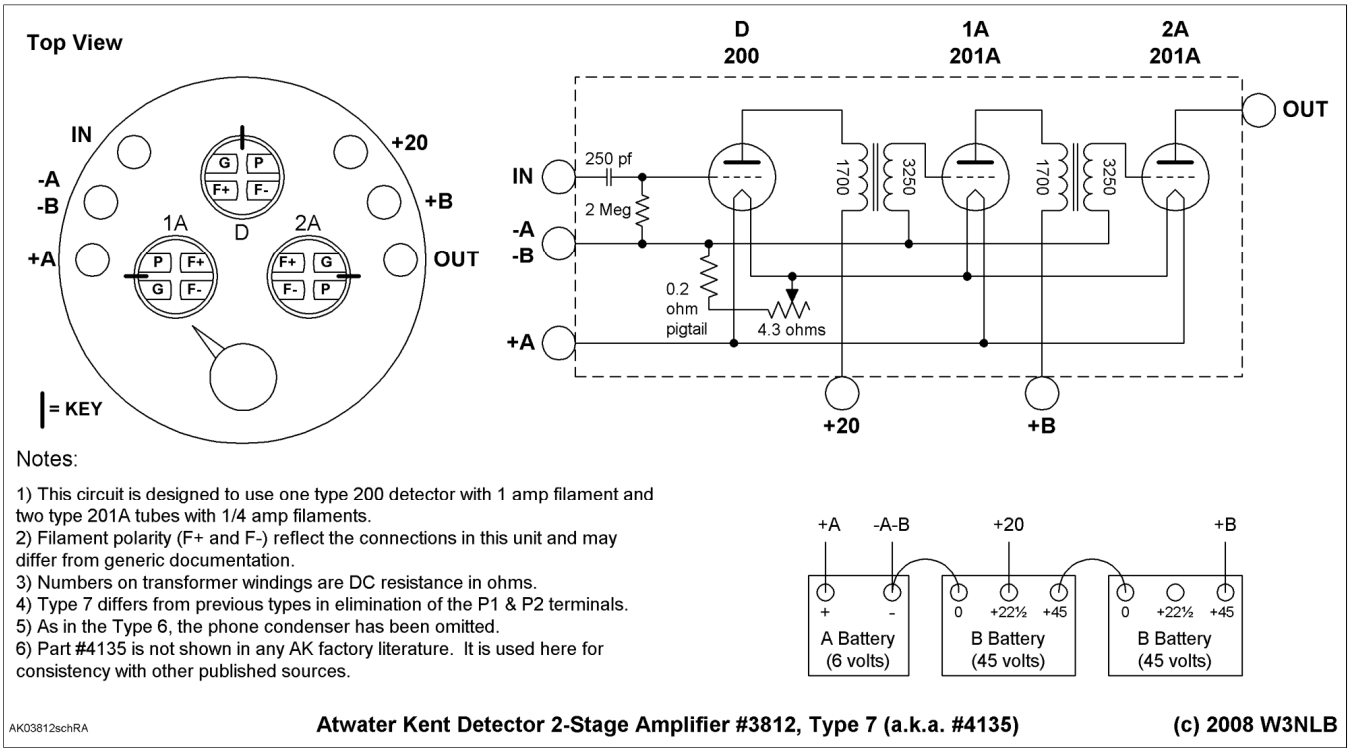
The # 3812 Type 7 (# 4135)

The major difference between Type 7 and Type 6 is the removal of the **P1** and **P2** posts, which permitted field installation of a variometer to enable regenerative operation. The upper lead of the first audio transformer primary is connected directly to the detector tube socket plate pin.

The holes for these posts were no longer drilled out, although the **P1** and **P2** designators can be found on some early examples of the Type 7. These designators were removed from later revisions of the mold. Both Bakelite top styles can be found on factory-made open sets.

Type 7 TAs were produced in green, black, and brown. The green TAs were used on the last of the green Model 10 open sets. Serial numbers over 20,000 have been found on green sets.

It is important to note that by this time the factory was producing open sets in all three colors (green, black, and brown) simultaneously. As an example of the serial number ranges, the brown Model 10 # 4600 sets have been found with serial numbers just over 5,900, while the black Model 10 # 4340 first appears with serial numbers around 7,500. Yet a green Model 10 # 4340 has been found with serial number A10,821, a black Model 10 # 4340 with A12,502, and a brown Model 10 # 4600 with A15,497.



Around this time the factory started to use a serial number "block" system. This will be covered in subsequent articles which discuss the complete radios.

To summarize, the majority of the earlier open sets (through most of the 10B sets) used the Type 7 TA. This includes the Model 10s discussed above, as well as the Model 10A # 4550 (brown) and # 4560 (black), and the Model 10B # 4550 (brown) and # 4560 (black). The Type 7 was also used on the Model 9A (with power cables) variometer set. The 9As can be found in green, black, and brown.

The # 3812 Type 8 (# 4135)

The Type 8 TA was manufactured only as a replacement part. Based on examination of the components used, it was produced after the introduction of the Model 20 # 4640 "Big Box" set. This will become obvious in the following discussion.

Externally the Type 8 is identical to the late Type 7, having no **P1 P2** markings on the top. The units examined have all been painted green.

The two audio transformers buried in the tar are the late style, with thin cloth-covered stranded leads, rather than the earlier spaghetti-covered flat braided leads. This transformer was not produced until the end of 1924, after production of all the open sets had ended.

The 2-megohm grid leak resistor was mounted under the Bakelite top with its return lead connected to **+A**, rather than to **-A** as in earlier types of this TA. The first of the Type 8s used grid leak part # 4814, with yellow paper under glass. The # 7639 resistor made with white glass was used in later units. (This was the same part as used in the Model 20 compact.)

This TA does contain a 2,000-pF phone condenser, unlike its recent predecessors. The part number is # 7690. But on the Type 8 the condenser is mounted under the Bakelite top rather than being buried in the tar. Eight wires, all of them connected to the audio transformer windings, exit the tar.

Consider the types of tubes available on the market at the time these TAs were produced. It appears that the Types 1 through 3 could use only the 1-amp UV-200 and UV-201 tubes. The filament voltage on both audio tubes would be much too high if ¼-amp tubes were fed through the fixed ½-ohm resistances.

Types 4 through 8 were designed for a 1-amp UV-200 detector and the ¼-amp UV-201A audio amplifiers. These types could also use the ¼-amp UV-200A detector when it became available.

Not all of the three-tube Type 1 through 8 TA units, were available to the radio set builder and experi0-menter. The Type 1 tube unit (Part # 3812), the Types 4 through 6 (Part # 4135), and the Type 8 (Part # 4135)

Figure 15. # 4520 − top view.

are known to have been sold as individual parts.

The # 4520

Part # 4520 was the last of the three-tube TAs, and was based on a redesign of the #3812 Type 7.

[The first obvious change is a redesign of the keyway on the brass tube socket skirt. This has a small upward notch at the end, designed to hold the pin on the side of the tube socket thus preventing accidental rotation. In the # 4520 this notch is much shallower than on earlier TAs.

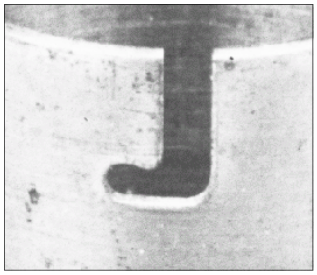
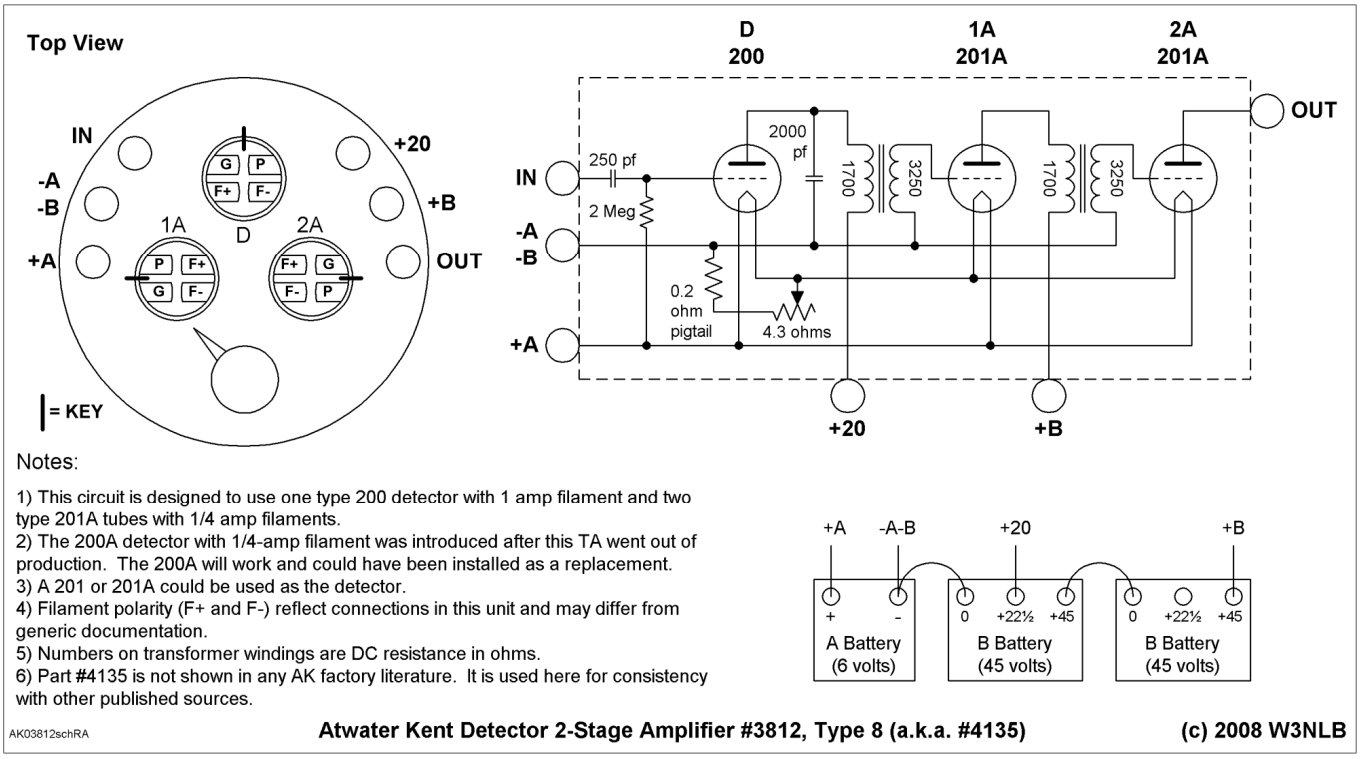


Figure 16. # 4520 Keyway detail.

Inside, under the Bakelite top, the mounting screw post has returned. Why put it back? To find the possible answer to this, we must review design progress from Type 6 when it was removed. Although the 250-pF grid condenser had been mounted to one of the screws since Type 5, the grid resistor, being a high resistance value (2 megohms) was still buried in the tar—probab-ly to prevent humidity from affecting its value. Sometime after the type 6 TAs were in production it was discovered, possibly in service shops, that the grid leaks were degrading despite being hermetically sealed.

A brown Type 6 belonging to an early Model 10, Part # 4600 was found that had the post installed and one end of a flat style grid leak mounted to it (see Figure 6B-21 in *Radio Age Volume 32, No. 8*, August 2007). The return lead is tied to the **-A** terminal rather than **+A**.



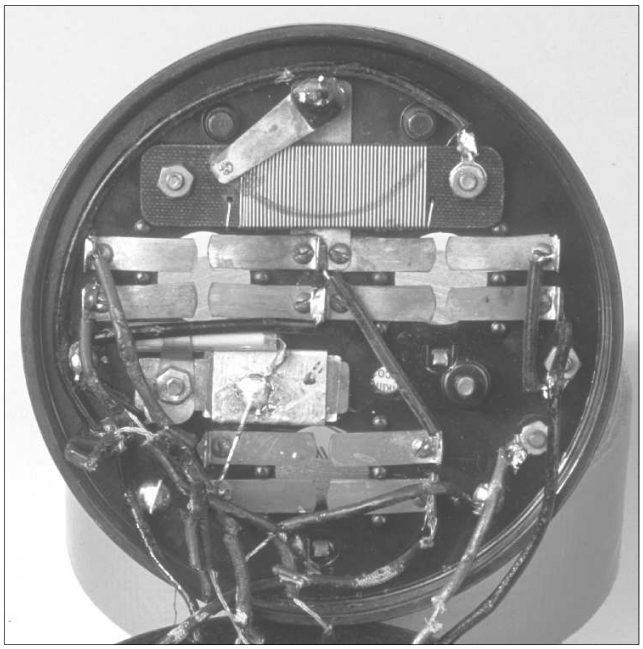


Figure 17. # 4520 Internal view.

This installation appeared to have been done in a shop rather than in the factory.

A few late black Type 7 TAs used on the last of the Model 9As, part # 4445A, (with power cable), had the flat grid leak mounted in a manner similar to that found in the Type 6, only the return lead was connected to **+A**. These units appeared to be factory produced.

With the above knowledge in mind, it is quite possible that the factory's thinking was to begin mounting the grid resistor out of the tar using the second screw thread post.

But, by the time the Type 4520 TA design was put into production, the new grid leak part # 4814 was available, making obsolete the use of the screw thread post. Over 50,000 of the Type 4520 TA units were installed on breadboards, but no use has been found of these posts, used from the start of the earliest transitional 10 B/C sets through the 9C, 10C and 10C compact sets.

This is one example where an idea put in motion finds it way into production despite it becoming obsolete before ever serving its purpose.

A small clip was supplied to hold the glass tube firmly in place. One end of the grid leak resistor is tied to the grid condenser, with a wire from this point to the detector socket grid pin. The other end of the resistor goes to the **+A** terminal. The other end of the

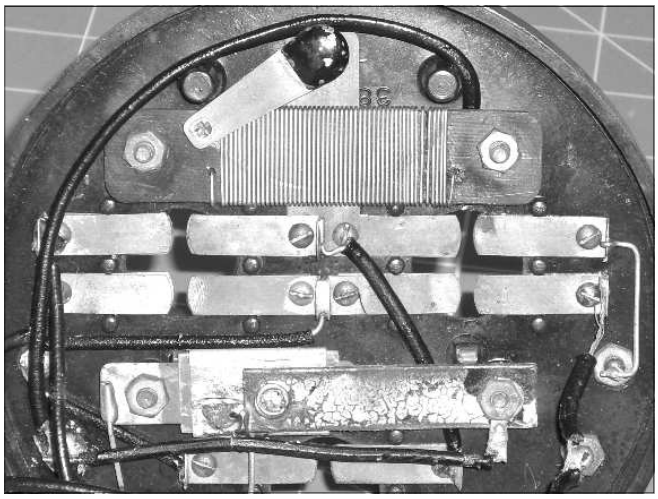


Figure 18. # 4520 – grid leak resistor to -A

condenser goes to the **INPUT** terminal.

A new filament rheostat element measuring 4.0 ohms was used in the 4520, as compared with the 4.5-ohm part used in the # 3812 variants. The resistance is incorporated entirely in the winding on the fiber mounting board, as opposed to the resistive pigtail that connected the earlier rheostats to the battery terminal. Removal of this pigtail probably accounts for the lowered resistance. A solder lug is mounted on the battery end of the element, from which a copper wire connects to the **-A** terminal.

Solder lugs are used on both output posts, instead of soldering directly to the post threads. A wire runs from

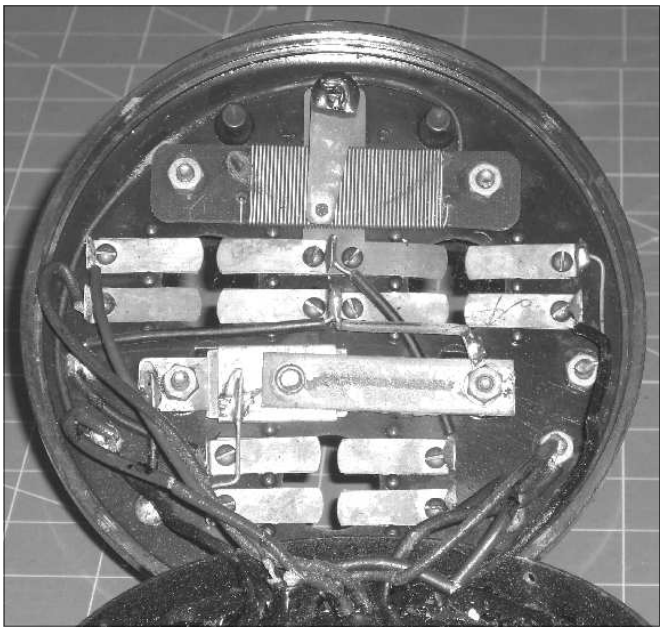
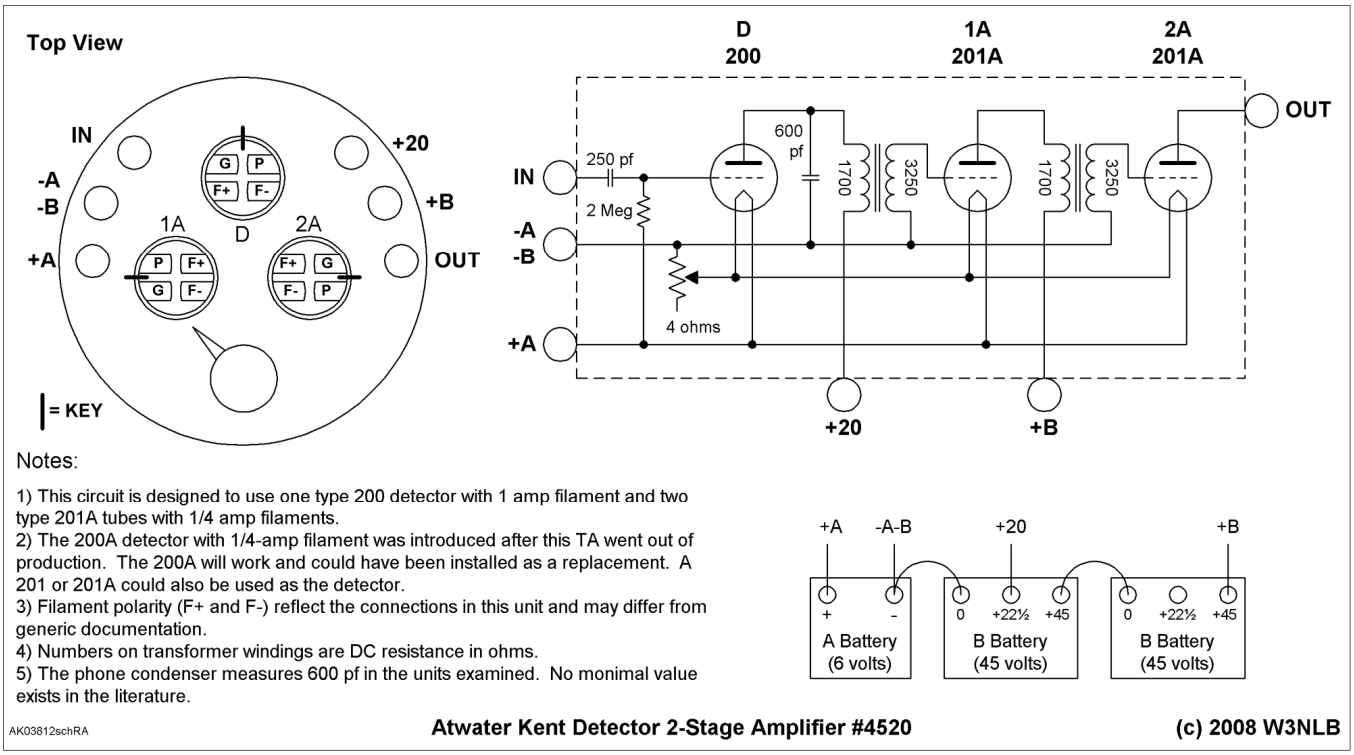


Figure 19. # 4520 – grid leak resistor to +A.



the output post lug to the plate pin on the audio output tube socket. The low side of the second audio transformer primary is connected to the solder lug on the **B+** post.

All eight wires emerging from the tar are connections to the two audio transformers. The 2,000-pF phone condenser has returned, connected between the detector plate lead and the grid return lead of the first audio transformer, and now buried in the tar with the audio transformers.

The # 4520 TA was first introduced on the transitional 10B/C model. More about this in a later article. The # 4520 was used on all of the later Model 9C and 10C sets. The very last # 4520 TA found, on a Model 10C Compact, had a # 7690 2,000-pF condenser mounted under the Bakelite top, not in the tar, and a # 7639 white glass grid leak resistor. (The same parts were also used in the Model 20 compact.)

The # 4520 TA was produced only with brown paint. It was sold exclusively on radios, not as a retail part for hobbyists and experimenters.

Conclusion

It is interesting to consider that all of the innovations described in our articles to date occurred in something just over three years. The vision, skill, and effort required for this accomplishment is truly remarkable.
Our next article will discuss the Model 5 open set and its unique five-tube TA. This will provide a smooth transition from the general subject of components to that of complete radios.

Errata

In Chapter 2 (January 2004 *Radio Age*), the Type R transformer, catalog # 3509, was erroneously identified as a Type F. There was never a Type F transformer produced. Note that this transformer has been identified with an erroneous part number in other publications. The number given here is that shown on bulletin # 30 list of AK equipment, dated November 15, 1923.

Links

As always, your comments and suggestions are welcome at the links below. Email Ray at AKRadio@aol.com or Leigh at
Leigh@AtwaterKent.Info

Online copies of this series can be found on the Articles page at http://www.AtwaterKent.Info along with additional drawings, photos, and schematics. ■