THE GRAND OLD '01A

One of the most popular valves or 'tubes' ever produced was the UX201A, introduced by RCA in 1922, and its many copies and derivatives. It may well have been the most popular type ever made, and was certainly used in an enormous number of receivers (both commercial and home built) in the 1920's and early 1930's.

Mainstay of US radio production in the 1920's and described in Hugo Gernsback's 1932 *Official Radio Service Manual* as 'the grand old man of radio', the venerable UX201A valve is considered by some authorities to be the most popular type ever made. In 1929, *Radio News* stated that 'more tubes of this design, undoubtedly, have been made than all others combined'.

In production for the best part of 20 years, this remarkable valve was not only the workhorse of the early years of radio, especially in America, but it also remained in production as a replacement during radio's golden era of the 1930's. It was not until April 1940 that *Radiotronics* announced that the '01A was not planned by RCA for further production.

The triode valve had been patented in Germany by Robert Von Lieben in 1906, and nearly a year later in America by Lee de Forest. These were 'soft' (gas filled) valves, as it was thought that some gas was essential to their operation.

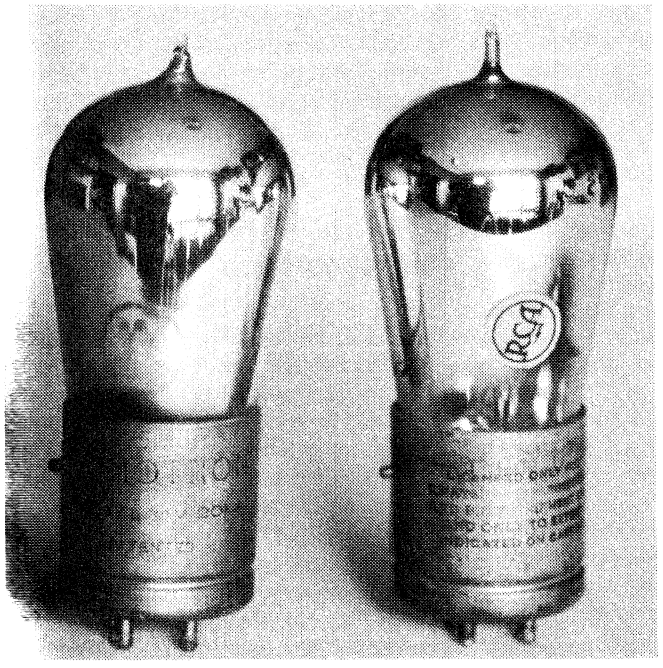
De Forest's 'Audion' remained a little understood and erratic curiosity until late in 1912, when the research laboratories of General Electric and Western Electric began independent programs of investigation and development. While Western Electric's chief interest was audio frequency telephone repeaters, General Electric concentrated on radio communication applications. By 1915, both had developed the triode valve to be a well engineered device capable of being manufactured in large quantities with predictable and guaranteed characteristics.

The presence of a small quantity of gas was acknowledged as giving extra sensitivity to detectors, but the need for a high or 'hard' vacuum for amplifier applications was firmly established.

Although there was some equivalence in the designs of the two organisations, there were also significant differences, the most fundamental being the filaments. Western Electric developed rare earth oxide coatings operating at low temperatures, whereas General Electric filaments were pure tungsten operating at white heat. Of later significance was the discovery in 1913 that the tungsten wire containing thoria, used for lamp filaments, gave increased emission at lower temperatures. However, there were problems in its use, and further investigation was shelved.

In 1914, Western Electric introduced a valve base using four contact studs and a bayonet locating pin. This was the UV (U = unit, V = vacuum tube) base, used for many of the early valves.

With America's entry into World War I, both organisations produced large



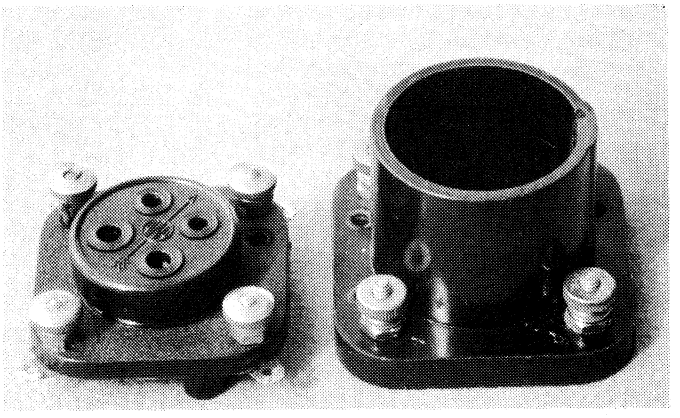


Fig.2 (above): Examples of the types of socket required for the original 'UV' four-pin base, on the right, and the later 'UX' base. The UX socket was made by AWA, and is sprung to minimise microphony.

Fig.1 (left): These two samples of the UV201 were made in 1923, but are externally the same as the original made in 1920. That on the left was made by Westinghouse, while the one on the right was made by GE — RCA's main producer.

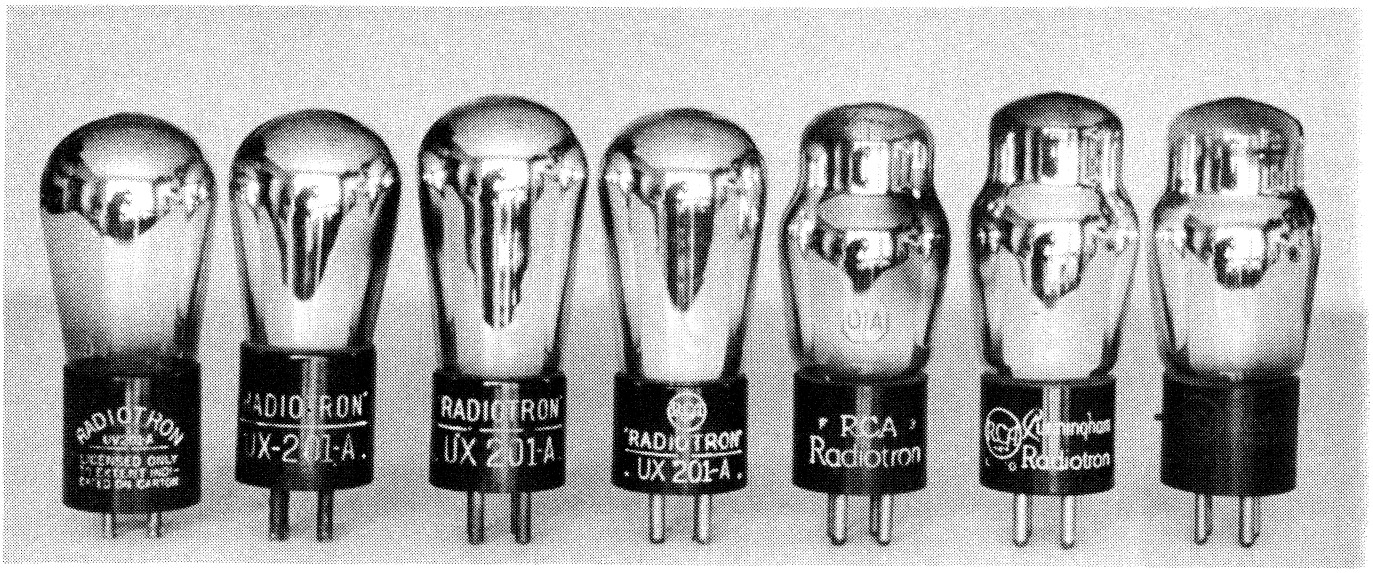


Fig.3: Over a period of a dozen or so years, the RCA 01A was a bit like Grandpa's axe — almost everything changed. From left to right here are shown seven examples with: a composition UV base (early 1925); the original UX base (late 1925); a shorter UX base (1926-7); nickel-plated pins (1928-9); stepped ST bulb and shortened name (1933); combined RCA-Cunningham brand (1934); and the final pattern of 1936.

numbers of valves for military use, General Electric alone producing over 205,000.

At the conclusion of the war, the American Navy became very concerned about the future sovereignty of US overseas radio communications. The future of long distance transmissions at this time depended on Alexanderson alternators built by General Electric, and Marconi was negotiating exclusive rights to these machines, with the potential for a worldwide monopoly.

Following a series of extremely convoluted negotiations, in which they purchased American Marconi and with it, many patent and manufacturing rights, on 19th October 1919 General Electric set up an operating company called the Radio Corporation of America. General Electric were joined progressively by American Telephone and Telegraph, Western Electric, United Fruit Co., Wireless Specialty Co. and Westinghouse.

Not only did this thwart Marconi's monopoly, it neatly bypassed a lot of potential problems with patents. Eventually RCA was itself to be in trouble over monopolies, but that is not part of this story.

RCA announces the UV201

Prior to 1930, RCA was purely an operating and trading organisation, relying on General Electric and Westinghouse for research and equipment. General Electric developed a series of valves for experimenters, amateurs and a potential new market in broadcasting, and in November 1920 a general purpose UV based receiving triode named the UV201 was introduced. A companion UV200 using the same electrodes but containing a small quantity of argon gas was offered for detector use.

At 90 volts HT and a grid bias of 4.5 volts, the UV201 had an amplification factor of 8, a plate resistance of 11,000 ohms and a mutual (trans-) conductance of 0.675mA per volt. Although by later standards this was a very modest performance, the mutual conductance was twice that of the equivalent European 'R' valve and Marconi V24.

General Electric's pure tungsten filament needed far too much current for economical dry battery operation. A more practical source was the freely available American standard 6 volt car battery, which could be discharged to about 5.5 volts. Allowing for 0.5 volt drop in the wiring, the filament voltage of the UV201 was set at 5.0 and this became a US standard. The current at 5.0 volts was 1 ampere.

New filament

Even for car batteries, the drain of a set of UV201 valves was considerable, so the addition of thoria was again researched. Thoria forms an atomically thin layer on the surface of a tungsten filament, but any excessive filament voltage will evaporate this layer, causing a loss of emission. Another problem to be overcome was that of residual oxygen. Pure tungsten will 'clean up' a vacuum, but thoriated tungsten was found to be very susceptible to the slightest trace of gas.

The remedy was plenty of 'gettering', the release of a reactive material such as magnesium inside the envelope after evacuation. This is recognisable as a patch of mirror finish on the envelope, and for the '01A, sufficient was used to cover the whole bulb — a distinctive characteristic of valves with thoriated tungsten filaments.

Although the other specifications remained the same, the new valve required only 0.25 amperes filament current.

The UV201A was released in December 1922, just two years after the UV201. Another significant development from this project was the UV199, a small triode with a 3.3 volt 60mA filament suitable for dry cell operation.

The availability of the economic UV201A was well timed to meet the needs of rapidly growing numbers of broadcasting listeners. In 1922 the number of licenced broadcasting stations in the US had grown to 253 and in 1924 alone, RCA sold nearly six *million* UV201A valves.

More modifications

The original UV base, consisting of a brass sleeve with a ceramic insert carrying the contact pins, was expensive to produce. Late in 1923 a cheaper moulded bakelite base was introduced. At the same time, the exhaust tube was shifted to the base and the mutual conductance raised slightly.

At the end of 1925, a major modification was made to the socket. UV sockets were relatively costly and the stubby valve pins did not always make reliable contact. A new base, the UX, was devel-

RADIOTRON
Model UX-201-A

RATING

Filament Volts	5.0
Filament Amperes	.25
Plate Volts (Maximum)	135
Plate Volts for Average Use	90

GENERAL

FILAMENTS SHOULD ALWAYS BE OPERATED AT THE LOWEST VOLTAGE WHICH WILL GIVE SATISFACTORY RESULTS.

If by accident excessive filament or plate voltage is applied to the Radiotron, it may be damaged temporarily. Its normal action may be restored by lighting the filament at rated voltage for 20 minutes or longer with the "B" battery disconnected.

GREAT CARE SHOULD BE TAKEN TO PREVENT THE PLATE VOLTAGE FROM BEING APPLIED ACCIDENTALLY TO FILAMENTS. THE PLATE VOLTAGE SHOULD BE DISCONNECTED BEFORE THE RADIOTRON IS PLACED IN THE SOCKET OR REMOVED FROM THE SOCKET, OR BEFORE ANY CHANGES ARE MADE IN THE CONNECTIONS OF THE CIRCUIT.

Radiotrons should be mounted on cushion or spring supports to prevent noise from vibration. It is preferable to mount Radiotrons vertically.

LARGE STANDARD RADIOTRON BASE

Radiotron UX-201-A is electrically identical with Radiotron UV-201-A. It is equipped with the new large standard Radiotron base (large "UX" base), and the connections to the contact pins are shown in the diagram at the bottom of this sheet.

AS A DETECTOR

When the Radiotron is used as a detector it is usually preferable to connect the grid return lead to the positive side of the filament. A grid leak resistance between 2 and 5 megohms is satisfactory for average work. A resistance between 5 and 9 megohms is somewhat better for very weak signals.

It is preferable to use not more than 45 volts on the plate of the detector tube. Critical adjustment of the plate voltage is not required.

AS AN AMPLIFIER

On Plate Voltages Exceeding 45 Volts

When the UX-201-A Radiotron is employed as an amplifier, a "C" battery should be used whenever the plate potential exceeds 45 volts. The filament rheostat should be placed in the negative lead of the "A" battery, and the grid return lead should be connected to the negative side of the "C" battery. The positive side of the "C" battery is connected to the negative side of the Radiotron filament, as shown in Fig. 1.

PLATE VOLTAGE	NEG. GRID BIAS
67.5 Volts	1.5 - 3.0 Volts
90.0 Volts	3.0 - 4.5 Volts
112.5 Volts	4.5 - 6.0 Volts
135.0 Volts	6.0 - 9.0 Volts

On Plate Voltages of 45 Volts or Less

When no "C" battery is used, and the plate voltage is 45 volts or less, it is important that the filament rheostat should be placed in the negative lead of the "A" battery, and the return lead from the grid circuit should be connected to the negative side of the "A" battery and not to the negative side of the filament. This method places a desirable negative grid bias on the grid.

RETURN OF DEFECTIVE APPARATUS

ANY RADIOTRON WHICH IS BELIEVED DEFECTIVE SHOULD BE RETURNED TO THE DEALER OR DISTRIBUTOR FROM WHOM IT WAS PURCHASED, WHO HAS COMPLETE INSTRUCTIONS FOR HANDLING SUCH CASES.

THE MOST SATISFACTORY RESULTS CAN BE OBTAINED BY THE CONSISTENT USE OF RADIOTRONS IN RADIOLAS.

PATENT NOTICE

In connection with devices it sells, Radio Corporation of America has rights under patents having claims (a) on the devices themselves and (b) on combinations of the devices with other devices or elements, as for example in various circuits and hook-ups.

The sale of this device carries a license under the patent claims of (a), but only for (1) talking machine uses, (2) radio amateur uses, (3) radio experimental uses and (4) radio broadcast reception; and only where no business features are involved.

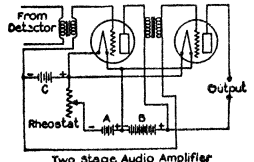
The sale does not carry a license under patent claims of (b) except only (1) for legitimate renewals and repairs in apparatus and systems already licensed for use under such patent claims on combinations, (2) for assembling by amateurs and experimenters, and not by others, with other licensed parts or devices, or with parts or devices made by themselves, but only for their own amateur and experimental radio uses where no business features are involved, and not for sale to or for use by others, and (3) for use with licensed talking machines and licensed radio broadcast receiving devices; and only where no business features are involved.

Radio Corporation of America

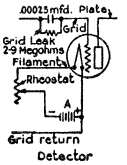
CAUTION!

DO NOT USE EXCESSIVE FILAMENT OR PLATE VOLTAGE.

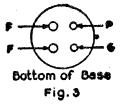
HANDLE RADIOTRON CAREFULLY.



Two Stage Audio Amplifier
Fig.1



Detector
Fig.2



Bottom of Base
Fig.3

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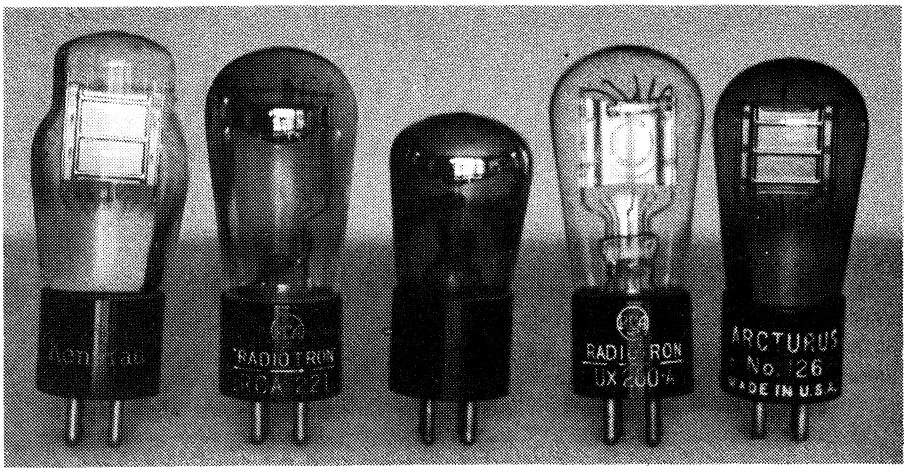

Fig.4: Some close relatives, all requiring less 'gettering' than the conventional 01A. From left, Kenrad's model of 1935, with a conventional oxide-coated filament; RCA's own 221, made with a 60mA oxide-coated filament for export only; the Philips A609, with very similar performance to the 01A but only 1/4 the filament current; the 'soft' UX200A detector, containing a small amount of caesium vapour; and an Arcturus 26 (effectively an 01A with a 1.5V/1.05A oxide-coated filament, suitable for AC heating), in that firm's distinctive blue glass bulb.

oped. This had longer pins which could be contacted over a larger area by simple sockets.

To enable the new valve to be used in existing receivers, the locating pin was retained but repositioned so that the spacing from the bottoms of the pins remained the same. The new UX socket became the standard for small and medium sized American four-pin valves.

A minor problem was that although the UX base would fit either socket, the original UV based valves could only be used in pre- 1926 receivers.

AWA makes the '01A

Overseas, the '01A was in good demand, and in Australia, AWA (note: not AWV) commenced making valves under licence in 1924. Among the types made were AWA101A and AWA101X, UV- and UX-based '01A's.

The popularity of the UX201A inevitably attracted other makers. Between them, RCA's principals controlled all significant valve patents and initially were not prepared to licence other manufacturers. But this was the prohibition era, with 'bootlegging' a popular activity, and it was not long before bootleg '01A's were available.

Fig.5 (left): During the 1920's, information sheets were included with each valve sold. This 1925 revision of the 01A sheet covers the recently introduced UX base. Note the instructions for re-activating damaged filaments.

Small outfits, with frequent factory relocation and brand name changes, kept RCA investigators on the run. But eventually RCA was obliged to grant manufacturing licences.

The number of brand names used is incredible. American valve historian Brother Patrick Dowd has been compiling a register of '01A brand names, and the score to February 1990 was 451!

Many of these valves varied in appearance from the standard RCA pattern. Some were given fancy tubular shapes and coloured glass — generally blue — was popular.

As with the AWA valves, other makers often had variations in their naming. Arcturus, a major user of blue glass called their version 101A, and in Holland, Philips made the C509. Cunningham valves, although supplied by RCA were called CX301A. Increasingly, colloquial and magazine practice was to refer to them all as type '01A.

Offspring

During the mid 1920's, various methods of using mains power were researched. Indirectly heated triodes, such as the McCulloch, with heater connections at the top of the envelope, and with characteristics very close to those of the '01A, were available during 1925.

RCA's first mains-powered general purpose triode, the UX226, first used in 1927 was however, directly heated. It was in fact a UX201A with a heavy 1.5 volt/1.05A oxide coated filament, the

thermal inertia and low voltage minimising hum. An indirectly heated companion detector valve was the stalwart 5-pin based UZ227, again with characteristics very close to those of the '01A.

It was around this period that RCA abandoned tungsten filaments for new designs of receiving and small transmitting valves, but tungsten is still used even today for large valves.

Although the '01A was popular in Australia and New Zealand, car batteries were not always available. Philips obliged with dry cell alternatives, the A409 and A609, requiring only 25% of the filament current.

The popularity of these valves seems to have been noted by RCA, who took the unusual step of producing a valve for export only. This was the equivalent RCA221, with a 5 volt 60mA oxide coated filament. A 125mA filament current version was called UX201B. This current was within the capabilities of gaseous or the then-recently introduced UX280 rectifiers, and the UX201B was intended for receivers using series-connected filaments, supplied by a rectified mains supply.

Final changes

In line with popular usage, and coincident with taking over its own manufacturing, RCA dropped alphabetic prefixes in 1930. The following year the first digit was also discarded, the UX201A finally becoming the 01A.

During 1932, there was one more modification. The familiar constriction was put at the top of the envelope, supporting a mica collar to give improved electrode rigidity. This 'ST' envelope was adopted for practically all receiving valves, which had previously used the traditional 'pear shaped' S bulb. One exception was the 00A, successor to the UV200 — a likely reason being a small demand and a large inventory at the time of changeover.

During its eventful career, the 01A underwent some major modifications, and later practice would have been to give each variation a new type number. Fortunately for the historian, this did not happen.

Although manufacture ceased in 1940, the 01A remained on sale for many more years, and is still available from vintage radio suppliers.

Footnote

Although the 01A was outstandingly successful and popular, RCA rarely used it in their own receivers. They preferred instead the small and economical 199.