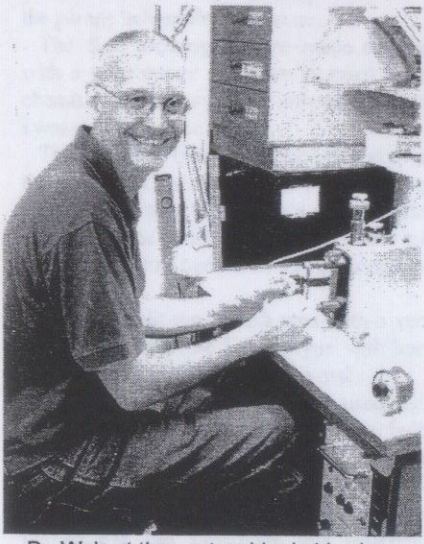
HOME-MADE VACUUM TUBES
THE WORK OF DR. RÜDIGER WALZ IN GERMANY

Abel Santoro, LU8DXI

How many people in the world have made vacuum tubes in their homes? This is a good question. The best documented case I have seen was that of Sam Diaz Pumara. I found him in an article that appeared in *QST* magazine for April 1965, in which Sam shows some tubes made in a complete workshop in the basement of his home in Pennsylvania. *[The article is reprinted in the August 2003 issue of* TC - *Ed.]*



Dr. Walz at the spot-welder in his shop

According to John Stokes, one of the first individuals to home-make vacuum tubes was the radio amateur Harold Ross, W6IS, in Baldwin Park, California, U. S. A., in the '60s. Also in the U. S. A., the late Phil Weingarten reproduced some old valve types. Between 1986 and 1989 O. Künsel and G. Bogner made some type WD-11 tubes in Ulm, Germany. In England, Gerald Wells and Peter Brian build up a small workshop for this purpose. Also in England, Philip Beckley was reported to replicate some R-type tubes in 1979. In France, M. Beaujean too tried to rebuild valves at the end of the '80s. In the nineties the "Vaic" laboratories started to make TM replicas in the Czech Republic. These same replicas are made today by "KR Audio Electronics."

One of the few people still making vacuum tubes as a home hobby is Dr. Rüdiger Walz. Dr. Walz was born in Germany in 1956; he has a Ph. D. in chemistry and has worked in that industry since 1985. Today he is general manager of a chemical company.

In June 1983, Walz and his friend Franz Pemmerl started to rebuild old radio valves as people did in the '20s.

Dr. Walz informs us: "A lot of things had to be learned, and a lot of failures resulted in a certain know-how. For all those who imagine building valves as hobby, I would like to give an insight into my hobby workshop.

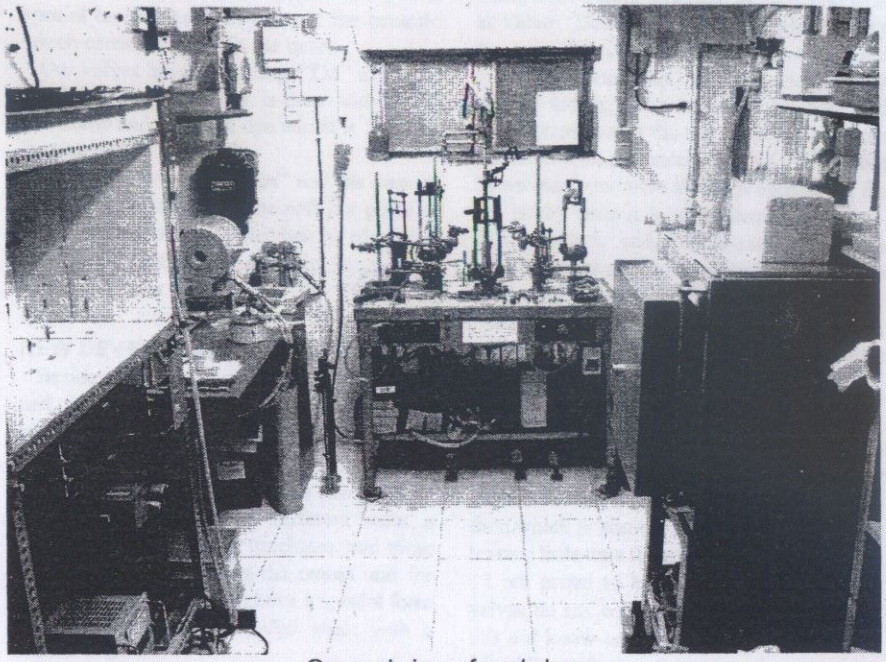
RECREATE OR REPAIR?

Repair is more difficult. By experience we found that the glass of an old valve becomes brittle after 70 years, so it is very difficult to join an old press with a new bulb. When is necessary to remove the base of an old valve, in most cases the copper wire breaks just where it comes out of the press.

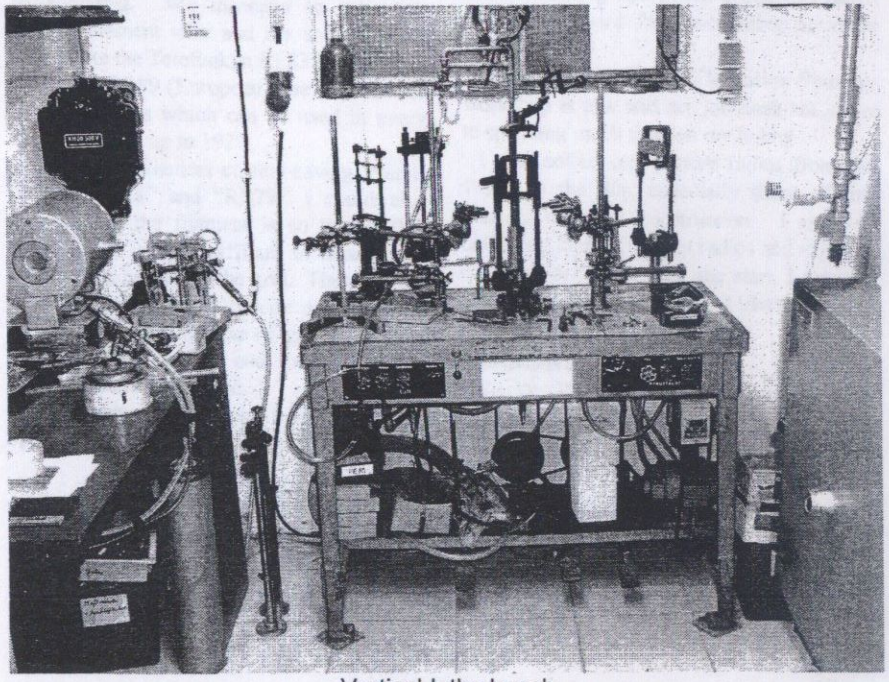
To recreate an old valve, one needs a lot of special materials. The press is made with a special lead glass, with a unique wire melted-in. This wire, called "Dumet," is formed of copper-plated iron and is as long as 12 mm. At the upper end of this wire is welded a nickel wire 30 mm long, and at the lower end is welded a copper wire as connection to the base pins of the valve. The Dumet wire adheres to the lead glass of the press, so that no cracks occur and making an air-tight joint. Dumet wire is still used in light-bulb manufacturing.

The glass of the bulb has to be so-called "soft" glass which joins to the lead glass of the press. The modern glass compositions have a higher melting point and are not easy to handle in our machinery. With this glass, the wire for the press would have been a special wire, very difficult to obtain. Then the materials to make valves are glass tubing of different sizes for the press and the bulb, nickel as sheet for the anode and wire for the grid, which was not easy to obtain. Tungsten wire for the filament could be bought from companies still producing for the light industry, but to determine its shape in old books makes every order a risk.

After three-fourths of a year telephoning,



General view of workshop



Vertical-lathe bench

we got all the materials and started building valves.

When we started, it was not clear if it would be possible to build valves as a hobby. Will this work will be successful? How to get the know-how? Where to do it?

Dr. Walz tells us: "I am a chemist and have used vacuum technology in handling very sensitive chemicals, and I have had some experience in glassblowing too. The rest I learned about valve construction was from books of the '30s. My friend Franz Pemmerl had experience in metal-working and electronics. The workshop was built in the garage behind Franz's house.

The first prototypes were made together with a glassblower and were pumped in the chemistry department at the univ-ersity where I was studying at the time.

The first valve type we decided to make was the British "R," similar to the French "TM," which is a simple valve with a pure-tungsten filament. The bulb is a good "fit" to our machine, which had been used for repairing light bulbs.

First we built the British type with a vertical mount, later the French type with horizontal mount, which is easier to make.

The first specimens we made used light bulbs as glass envelopes, but these bulbs were unfortunately of a diameter of 60 mm, compared to the original valve with its diameter of 55 mm. Believe it or not, the human eye can determine this difference easily, and the first prototypes of replicas look wrong. Some of them are still in use today.

The glassblowing turned out to be easy compared to the construction of the original step-shaped brass base, until we found a company to do this job for us. The turned metal bases that we used at first do not look well. Today the bases that we make of brass, with ceramic carrying the pins, look very well as original.

THE WORKSHOP

The workshop consists of two rooms of the size of a garage, with electricity, gas and water installed. Here a lot of devices and machines are necessary. All items are self-made or salvaged from discards of companies active in similar businesses. I will explain this, leading you through the building of one valve:

Starting material is glass tubing which must be cut into small pieces, using for this purpose a locally made machine. The small tubes are formed to a so-called disc in one end of the tubing. At the opposite end the Dumet wire is melted into a press and the mount is attached on this side. At the beginning we did not have a spot welder, and affixed the mount by soldering with copper solder, which resulted in nice red valves at the end due to copper vaporized onto the glass bulb. Later we got an old spot welder from a light-bulb company.

The stem with the mount is fused to the bulb and has to be cooled down slowly; therefore one needs a cooling oven. The valve now has to be pumped-down. During pumping the assembly has to be heated to 250 °C to remove the water film from the glass bulb, because water vapor reduces the lifetime of the valves. This process is done in a special oven which was locally made.

After two hours of pumping, a voltage of +200 V is applied to the plate and grid, with the current measured at 80 to 100 mA. In use later the valve will run with 50 V at 1-2 mA. The anode becomes red-hot and all occluded gases are removed with this process. The valve glows a nice blue due to ionized oxygen molecules in the bulb. After that the bulbs are melted from their exhaust tubes, forming the characteristic "tip."

Now the base is glued to the bulb, and the wires are soldered to the pins. After this the valves are tested for 24 hours and boxed.

GETTING EXPERIENCE

A lot of experience had to be gathered until "production" worked well. The first lot of valves were destroyed in an overheated oven because the failure of a thermostat.

As I already explained, light-bulb envelopes can not be used for the replicas, so special bulbs had to be produced by a professional glassblower because collectors like to have perfect replicas.

To get reliable seals the press has to be heated in a certain way; otherwise it is not tight. After a few years the old Dumet wire we got from a lamp works was corroded and the press was not tight anymore. It cost a lot of research to find the problem and order new wire.

We also started to build the Telefunken RE11 and RE71, and TM, valves with brass

bases, for which we developed in 1986 a special tool to insert and mount the ceramic which carries the pins in the bases.

Our valves have a marking "TM" or "Type RE 11" and a number, it is done with a rubber stamp and a special dye which is fixed by heating to 500 °C.

Inside, the word "Replica" and the year of building is pressed into the soft hot glass of the press so that the replica can be identified as such. Until the death of Franz Pemmerl in 1993, the year was signed as "19PWxx"; after 1993, "19Wxx" or now "20Wxx."

NEW DEVELOPMENTS

Besides the "R" or "TM" valves, we planned to make some usual German bright-emitter valves like the "RE11" (with Telefunken base) and "RE71" (identical but with European or Philips base). This was not very difficult: we needed only different bulbs, a little modification of our machines, and some support tools for making the mount and for making the anodes which have a special form and are stamped from nickel sheet with a special tool.

The next step was the development of more "modern" cathodes like thoriated tungsten or oxide-coated. We managed to get some special filament wire and are able to make valves like the Telefunken RE83 (Telefunken base) and RE89 (European base). These are universal tubes which can be used in every stage of radios up to 1927.

The more filament-current-saving counterparts "RE78" and "RE79," I could also produce but the filament is so thin (0.011 mm) that it is very difficult to handle and place in the middle of the grid. These valves with modern cathodes require a better vacuum and require the use of getters, in this early case magnesium, and special forming of the filament before use.

In Germany the company Blaupunkt (Blue Spot), supplied blue valves to the market in 1926, which were produced at Huth and later at Valvo. Due to the fact that these are very rare and decorative, we decided to rebuild them. Unfortunately, the blue glass is not easy to handle. The exhaust tube is located in the press, not at the top of the bulb, which results in a lot of waste. A lot of trials would be necessary to solve all the problems but for my hobby time it is a problem. Also, producing valves with oxide-coated filaments would require a lot of experiments which are costly and time-consuming.

In 1993 my friend Franz Pemmerl died, and I moved the workshop to my home near Frankfurt.

LOOKING TO THE FUTURE

I have a lot of desires: to make a Lieben valve, or rebuild Loewe multiple valves, or make neon lamps, etc., but all this requires time which is absorbed by the job and family leaving little time for my hobby.

I am proud to have succeeded in making valves on my own; to keep a small piece of this old know-how is my goal. In 1987 my friend Franz Pemmerl and I made a presentation to the Antique Wireless Association annual meeting and I was proud to receive the Tyne Award for contributing to valve history.

Today the demand for TM valves from my workshop is low and my job does not allow to spending much time on my hobby.

I also collect and restore radios from the 1920s to the 50s, especially those of interesting technical construction. I am also collecting literature about radios and valves.

Twenty-six years after the start, I am still making valves in my home. I like this hobby and it gives me pleasure!

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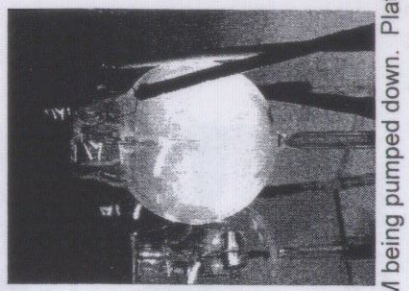
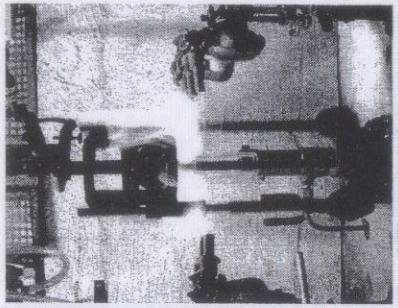
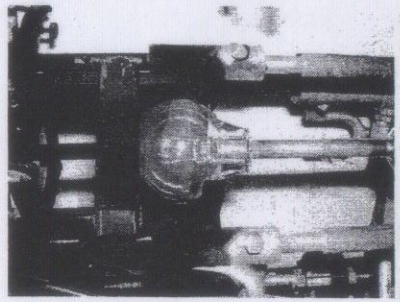
Tipping-off a TM in the pumping oven



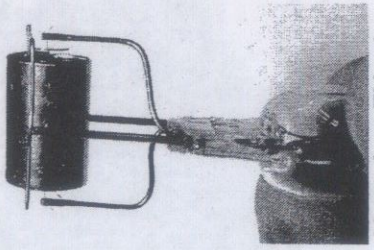
TM being pumped down. Plate bright red, gas glowing blue.



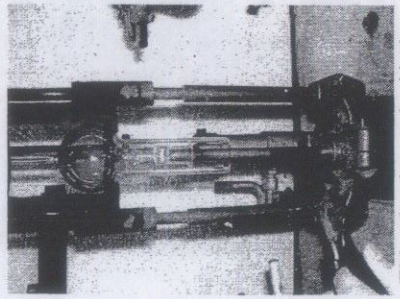
Bulb of TM being joined to stem



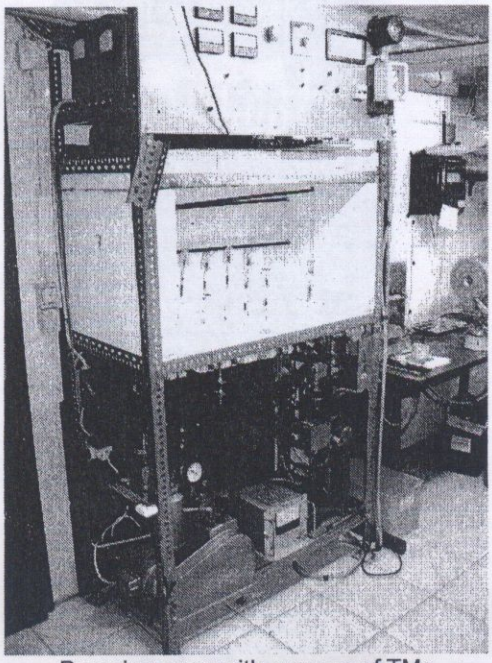
TM with stem joined to bulb



Mount for a TM valve

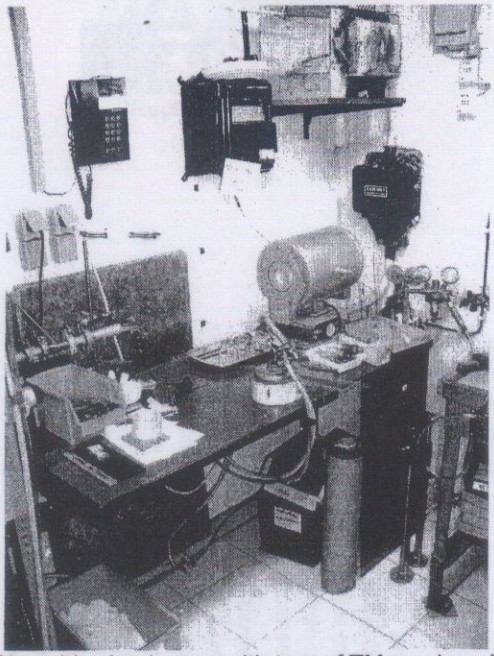


TM valve in vertical lathe

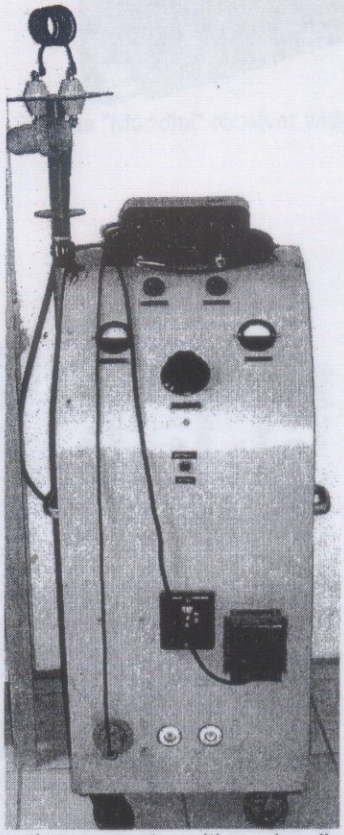


Pumping oven with a group of TMs

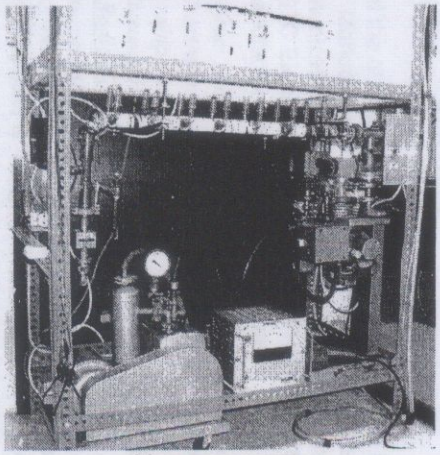
Rack of glass-tubing stock



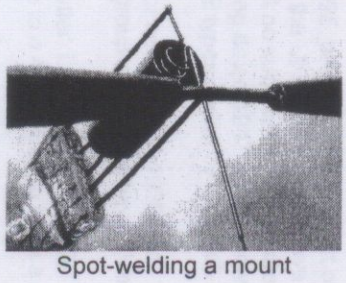
Glass-blowing burner with tray of TMs on bench



RF-heating generator with work coil at top



Vacuum pumps



Spot-welding a mount

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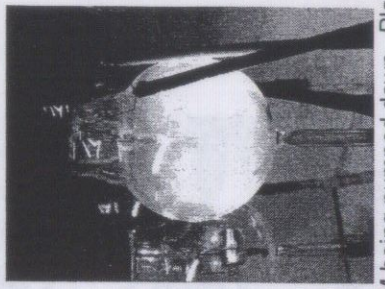

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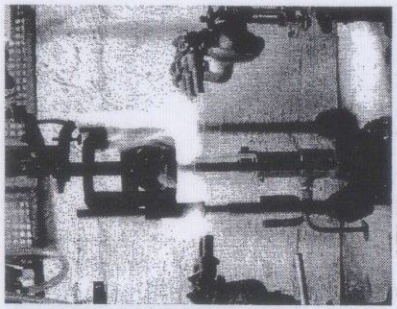
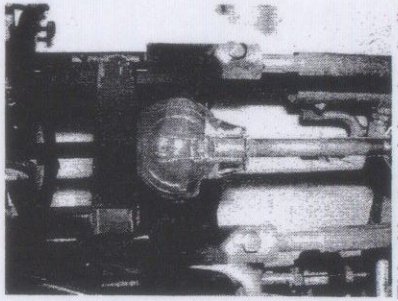
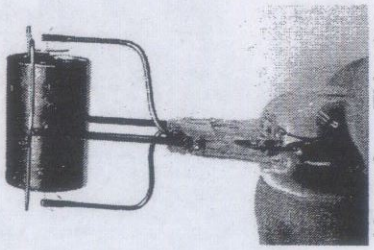


Bulb of TM being joined to stem



TM with stem joined to bulb



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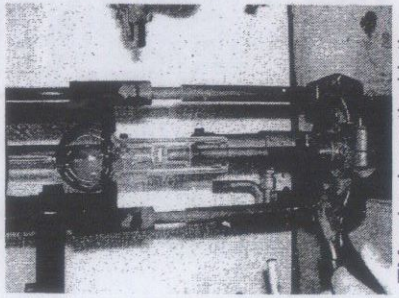

TM valve in vertical lathe