December 6, 1946

VISIT TO RCA November 25-26th, 1946
Mr. Moffit and Mr. Case

In contrast to our visit of last spring, RCA are now turning out tubes in a reasonable volume, and this afforded us a better chance to observe the operations. It was noted that their volume tube, the 10BP4, was being made on wartime equipment on which practically no modifications had been made, the exceptions being their buttoning process, and the annealing (RCA did not use a lehr on their wartime tubes).

Following are some general notes:

Bulb Wash

RCA are still using wash sinks, with one girl operator at each. They are using chromic and sand on new bulbs, and hydrofluoric, followed by chromic and sand, on salvage. Mr. Artau would also prefer to follow the acid wash with a caustic, but they do not find it necessary at present time. Each operator washes approximately 35 per hour.

They are building an automatic machine but this was still under their Development Section and was not available for inspection. However, in general, it consists of a heavy cast housing, about 12 ft. square, containing an indexing turret, with the spray nozzles indexing up into the bulb. At least three tanks were observed, under subsequent heads, and these may or may not contain different materials. The machine was built to handle hydrofluoric acid and also, probably, chromic. It is designed to give 200 bulbs per hour and was manufactured to RCA design by the Harris Engr. and Mfg. Co., Cincinnati, Ohio.

Screening

There is no new equipment in their screen room, as compared to their wartime set up. Their 10BP4's are being screened with cold water, and they consider this essential if the decanting process is to be used to remove the cushion, and also to improve distribution. Settling time is 2 hours, decanting 12-15 min. They are using sulfate in the bulb, but as far as Mr. Artau was concerned this is mainly from habit.

They are using peroxide oxidation of their silicate but do not use the 5 day precipitation period formerly considered necessary. The material is allowed to stand only 1 day. This simplifies the storage set-up considerably. RCA have purchased a number of stainless steel drums which they will send to Philadelphia Quartz to have their Kasil shipped in.

Approximately 15 operators on the first shift, and seven on the second are producing 10-12000 bulbs per month, exclusive of washing.

Their difficulty with purple spots has been pretty well eliminated after a general cleanup campaign and after moving their equipment used in making bulb coating. Their outside coating contains

a copper plated silver and sufficient of this meterial was transferred thru the air to be responsible for the purple screen defects.

Screen shrinkage in the room runs 12%, and at vacuum screen check 17%, on the 10BP4. Defects are mainly holes, run screens and purple spots, in order. Their screen inspection criteria follow:

a) 5TP4

1. In a 2'' circle (centered on face) they allow only one defect, with a maximum size of .020''. Defects smaller than .005 are not considered.

2. In the remainder of the quality circle they allow a maximum of three spots, between .005 and .030''.

b) 10BP4

1. In a 6'' circle (centered on face) they allow a maximum of two spots between .010 and .020'' with a minimum spacing of 1''.

2. In the remainder of the quality circle they allow four spots between .010 and .030''.

It was particularly noted that diffuse spots are measured to the outside edge.

They are rejecting very approximately 3% of screened bulbs for glass defects (bubbles, seeds etc.);this figure has ran as high as 7%. These rejections are based on the supplier's specifications.

Their new screening machine is not in operation but they were apparently getting ready to try it out. In as much as they are also building a bulb wash machine, the screening machine is probably not to be used for bulb wash. It has been designed to give a 2 hr. settling period, altho it was observed to operate much faster than this during our visit (at faster speeds it could be used to decant from underneath the lacquer film, for aluminizing).

Glass Work

They are making the glass stem for all types being run on rotary machines, with the metal tubulation for the straight line. The sealing metal on their metal stem is Sylvania #4 (there was some doubt about this point on our last visit).

They have increased the capacity of their beading machine (which is otherwise very similar to ours) by running a continuous holder from head to head, with holes for leads approximately 1/4'' apart.

We appear to be doing a faster job on the 5TP4 face seal. RCA insert the button before sealing on the face; thus they do not lose the face because of a defective button seal. They preheat the face in an oven at 250°C before sealing. The actual sealing process, involving lapping the plate down,is rather lengthy and is followed with a flame anneal, before going into the lehr. A large blast

Visit to RCA - continued

burner is used for annealing; we should try this. The operator uses a polariscope with foot switch during annealing. The operation was timed at 7 minutes for sealing 3 minutes for annealing. Face plates are gauged 100% after annealing.

The high frequency button inserter was observed on J56 flat face bulbs. The process is not much faster than ours but they feel that it gives much better glass distribution around the button. (They get 100 per hour on 7 min.) Four position rotary machines for preheating and annealing are used. After preheating to 350° (a contact thermocouple is used to indicate the glass temperature), the bulb is placed in a cradle at approx. 30° to the horizontal. The small iron plug (used to make the hole) is inserted on the end of an arm, heated with H.F. and forced out down thru the glass. (This plug is part number B1449, model L-730-Z, the parts are only used once). The bulb is then turned with the hole up, and the button, also heated with H.F., sealed in.

The automatic machine for this job is still in the Development Section and could not be inspected.

Buttons on the 10BP4 are still being inserted on the oven. The machine operates at 400°C on a 3 3/4 min. index. Using an oxygen-hydrogen flame the job was timed at 2 1/2 minutes.

Their lehr is identical to ours. They are running it at 3 in. per min. with the control at 430°C. They have added brick doors, foot operated, in place of our present clean out doors, and in the case of the face seal 5'' bulbs, place them in the lehr at this point rather than at the end. All bulbs are placed face-down on 12'' diam. pads, which they obtain from U.S. Asbestos, Mannheim.

Bulb Coating

RCA are using graphite silicate as inside coating on both 5TP4 and 10BP4. Their equipment has not been changed since the war.

The RCA ovens, being much lower than ours, are faster to load. They run at 2 3/4 min. index and in the case of the 10B, operator time on coating is 1 1/2 min. We can speed up, and clean up, the job by(a) lowering turret in the oven, (b) adapting a coating machine similar to RCA's (c) rebuilding our brushes. RCA are now using brushes supported on 3/32 x 5/8'' flat arms with arm mechanism mounted on the same side as the brush (this decreases the width appreciably and they do not need to trim the necks.)

The RCA ovens are particularly flexible; it is only a minor job to change bulb holders to accomodate the various bulb shapes. Temperatures are read on contact thermocouples, so that actual glass temp. is obtained. At present they are using the lehr as final bakeout; this is probably not a permanent set-up, but is being done at present (a) to effect a further annealing (b) to accentuate screen defects so that they can be picked out before sealing.

12/6/46

Visit to RCA - continued

Sealing:

Sealing shrinkage runs in the neighborhood of 1/2%. RCA use one operator and one set up man per machine, with a material handler for several machines. The 10BP4 machine operates at 35 sec. index, giving 51 tubes per hour.

From a production standpoint the machines are quite flexible; blowout can be made on any one of six positions (blowing either into the bulb or in the cullet). There are three available positions for cut-off and the heads are readily interchangeable to accomodate different bulb shapes.

The RCA stem lends itself to a much simpler sealing pin than ours. They use fires on the pin in three positions, the mount pin being 220,280 and 325°C with stems preheated at 200°C. They do not have a tubulation chuck and there is no pulldown. The heads turn at 1 rev. per sec.

The face gauge for control of sealing length is a very simple method to compensate for variations in bulb length.

We should try some of their Selas burners on our machine, in plase of our present soft fires.

Mounting

1. RCA do not use gloves on any operations. However, they are very careful not to touch any of the critical parts with their hands. They are not adverse to leaving mounts sit for 2-3 weeks in their plant; if their plant were not air-conditioned they would make this a maximum of two days.

2. Their beading job appears to be faster than ours, mainly because they do not use complicated beading jigs. The dip beading fixture is precision-built, and the parts are assembled on mandrels which are aligned on the dipping fixture. Their mandrels are so designed that they can make the grids up and check the spacing before beading; this is a very definite advantage over our method.

They are using gas-air-oxygen to heat the beads; the operation was timed at 50 seconds per bead which is slower than ours (they are going to speed it up). They use a pipe burner, with holes at 1/16" intervals, along the whole bead, and get a much more even heating than we do. They do not use pressure on the fixture, but use a timer to get a uniform glass temperature from bead to bead. One operator turns out 18 per hour.

3. The stem-mount assembly is made on a small double-ended jig. The operation, at 18 per hour, is about the same as our mounting lathe. However, they definitely get straighter mounts, and probably better welding (since the support leads are made on a Taylor-Winfield rather than with tweezers). They sand blast all leads to ensure a good weld.

12/6/46

Visit to RCA - continued

Mounting

4. A special tweezer welder was noted with bowed electrodes which pass around the mount; this is probably an advantage in getting at inaccessible points.

5. RCA are using the breakdown method for 100% testing on K-G spacing. They have built a new unit to handle 16 grids simultaneously. The grids are slipped into a jig which contacts the cylinder as well as the tab.; no clips are needed. Each grid is in a circuit with a small glow lamp; the lamps light up while there is an arc between the Cathode and grid. To operate, the voltage is gradually increased to the maximum limit, at which point all lamps should be lit. It is then dropped off to the minimum limit, at which point the lamps should all be out.

For example, on the 10BP4 grids, the max. and min. limits are 1600-1275v. resp., for a spacing of .0065 ± .001.

Reject grids are salvaged by pushing in on the grid aperture, or by bulging it out (by pushing on the sides of the grid.)

6. RCA are electropolishing their limiting apertures and also are mechanically polishing the angle-cut parts on the 10BP4.

7. Their new continuous hydrogen furnaces are in operation and appear to be doing an excellent job. They use 1150°C for stainless steel.

(It was noted that this job, as well as the Cathode spray, has been moved from the Parts Prep. Dept. which is not under control of the Cathode Ray Dept.)

8. RCA use a notch in the rim of their angle-cut parts. This is a good method to line up the high part of the angle, but is not particularly applicable to our tubing-made parts.

9. RCA get approx. 100 mounts per operator hour, using the ceramic-supported mount. This is compared to 18 per hour on the beaded mount.

Exhaust

A.) Rotary: RCA were exhausting all their 10BP4's on rotary machines, using mercury pumps and a 6 minute index. (the index is limited by the length of the oven i.e. if run any faster they get tubes imploding as they are brought out into the air). The machines are 15'' head to head i.e. not satisfactory for 15'' tubes.

The oven proper consists of 9 positions, of which the first six are heated. There are two strip curtains in the oven, one at the end of the heated section, and one at the next position. This enables them to cool the bulbs more rapidly than would be possible otherwise. They also use false roofs which are set approximately 4'' above the bulb face; since their strip heaters are located at the bottom of the oven this allows them to ''squeeze'' the heat down. The oven was being run at 435°C max. giving a glass temperature of 390°C (Distribution was

12/6/46

Visit to RCA - continued

Exhaust

(a) top 395, 395, 440, 435, 395 (b) bottom 140, 190, 230, 290, 225) RCA were degassing the getter in the second last oven position, and vacuum firing the anode in the last.

There were seven positions out of the oven, although one of these, at the load end, was shielded top and sides with a metal housing, and heated with the regular strip heaters (there was no curtain on this section). There are three activating positions out of the oven; they were not using high frequency on the third.

The pump heaters are turned off in the loading position and in the following ''roughing out'' position. Continuity check is made on each tube in the loading position.

Using a 1/2'' tubulation, the bulbs were allowed to float (were not supported on the bulb holders) . Tip off time was approx. 1 1/4 - 1 1/2 min. Tip annealers were used, at 350°C and 250°C.

They gas test two tubes per head / machine at the beginning of each shift. A general machine check up is made and recorded at this time i.e. oven, activation etc. They have tightened their back up requirements somewhat and now change a pump if the backup is greater than 10 microns; they find that most Kinney's will give this for a year, and on occasion, 2-3 years.

The machines were operated by one girl, who handled the liquid air (front and back of machine), tipped off, loaded, degassed the getter, ran the short check, and threaded and aligned the bases. One material handler covered two machines and also apparently aided in the basing.

Incidently, they were not using the sight tube to control the level of the liquid air.

An ingenious base threader was being employed; the threading and aligning was timed at 20 seconds. The base was fitted into a socket and the tube suspended above it, then small tubes were indexed up thru the pins, using a foot pedal. The leads were threaded into the tubes, and then the base was shoved up over the neck, using a second pedal. Base alignment was marked by sliding a gauge over the neck and putting a mark on the neck and one on the base.

(B.) Straight line:

RCA had several hundred metal tubulation 10BP4's ahead of this machine but were not using it since a strain was induced at the face seal during bakeout. They had turned it over to the Dev. Section until this had been straightened out.

Some general points were noted as: overall length 105 ft. 20 positions ahead of activation, 8 activating positions, 41 exhaust buggies, thermo-couples located 4'' over tube face. Inasmuch as the H.F. coils went around the neck they used a small mirror to read grid temp. An automatic tipper has been installed which indexes out and

Visit to RCA - continued

(B.) Straight line

centers on the tubulation. They anticipate a 2 min. index. on 10BP4's. The oven will handle 15'' bulbs.

RCA figure the effective floor space of a straight line machine to be approximately equivalent to two of the rotary, presumably because of the decreased work in progress. They figure the labor cost per tube to be roughly two thirds and the maintenance time about the same. The main advantage is the ease of maintenance and the lack of shut down time (with consequently smoother production time) and the flexibility of the equipment.

Finishing

They were using two basing reels to handle all production. These reels have split heads, which open up with a foot pedal; thus the tube can be loaded straight ahead, and it is not necessary to shove it up into the head. (This practically eliminates base alignment shrinkage).

RCA were not tinning the leads and were apparently depending on the freshly cut ends to effect a solder joint.

Their equipment for outside painting has been improved somewhat. Tubes are carried on a hand-operated conveyor thru a caustic spray, a tap water spray and an air dry, before being manually loaded to a spray booth (operates at 60 rpm)

They are using two new coatings for this job (a) a resistance coating, 33-L-605, for 5TP4, (b) a conductive coating 33-L-603, for 5TP4, and 10BP4. We should try these. The resistance coating will withstand 30 Kv. at 95% humidity; a spot check is made on this point.

All tubes are being AC sparked, with an additional high voltage DC spark on 5TP4. This DC spark is also used as a salvage operation for breakdown and field emission, and they recover around 40% of these rejects.

Testing

RCA are testing 10BP4's at 20-25 per hour. Data as to tests made, and limits, was not available. They check 100% for color, using a two filter systemthat is set on the green and use ''go-no go'' limits for the blue.

Their monoscope is piped on three lines i.e. two for horizontal and vertical synchronizing, a third for the signal.

They pressure test a percentage of their tubes at 30# gauge; if any failures occur they check 100% all tubes back to exhaust.

Mechanical inspection is rather cursory; they gauge at each operation rather carefully and consequently do not feel the need of a close final inspection. A close check up is given, however, on appearance

12/6/46

Visit to RCA - continued

Testing

i.e. loose particles, dirty bulbs, loose pins, broken dowels etc. They allow 1/2'' total length on face scratches (count anything that will catch a fingernail); bulbs scratched on the sides are pressure tested 100%.

5TP4 faces are checked 100% for curvature and they have a few rejects at this point, in spite of a prior check after annealing.

Shrinkage:

Each department is set up as an economic unit and is expected to make money. Credits are given and received as each part or bulb is moved along the floor, and the Salvage Dept. gives credit for salvageable material.

Shrinkage is picked up by the Salvage Dept. at 2 hour intervals, at which time all production and shrinkage records are brought up to date. Each Dept. hands in a separate record; in the case of tubes (which are counted at sealing) these figures are accumulated on a master sheet (a copy of which was obtained) and a charge-back system used to portion out blame for the various shrinkages.

Shrinkage symbols are not used.

10BP4's were running approx. 5% floor scrap, 10% test scrap (gross 15%) with a net of 7-8%.

Miscellaneous:

1. RCA's biggest production problem at the moment is exhaust. Hence they are banking heavily on the straight line machines, of which they expect to have four by 1948. At the present their production is limited by floor space and lack of holding areas but they expect the increased exhaust capacity to clear this up. It was pointed out that their ultimate production will be in the neighborhood of 40000-10''.

They figure, for purposes of layout, that around 75% of their manufacturing floor space should be available for work in process, with 25% occupied by machinery. It was noted that their two high bays have room available for office or light assembly use.

2. RCA are using bulbs to the glass manufacturers specifications but are trying to get these tightened up. They seem to be getting a better overall face quality than we received originally from Libbey, although our recent Libbey shipments have shown a definite improvement.

BUFFALO TUBE WORKS
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