

An Interesting Discovery Regarding

T U B E L I F E

The Bell Telephone Laboratories report a discovery* which, if applicable to receiving and transmitting tubes as well as to the repeater tubes on which checks were made, should be of vital interest to every amateur, and of particular interest to the amateur who is considering the purchase of that pig-in-a-poke, a "slightly" used transmitting tube.

Checks on life test records of various repeater tubes, operating under unvarying conditions, showed that invariably the rate of failure in a group of tubes when expressed in per cent of the tubes remaining tends to become constant—just as though the tubes failed in random fashion. The same results were obtained in every case where sufficient data was kept on field trials. There is every reason to believe that the same law of probability will apply to receiving tubes and possibly to transmitting tubes, even when being punished in an amateur transmitter.

This means that a used tube, *still in perfectly good condition*, has a further life expectancy just as great as that of a brand new tube of the same type. At first glance this seems hard to believe, but after a little thought on the subject it is not so hard to accept. The reason is that the life of individual tubes in a large group will be found to vary widely from the average life or "life expectancy." Some will last only a few hours, some a few hundred, some a few thousand, and some many thousands of hours. If the average life for the group is say, 3000 hours, it will be found that at the end of 3000 hours only 37 per cent of the group are still in service. The extra long life of the tubes which exceed the average life makes up for those that fail before 3000 hours.

It is interesting to note that the practice of replacing all tubes periodically, whether it is done because uninterrupted service is of prime importance or because "the tubes are old and they would soon start going out one at a time as their life expectancy is reached," is pure folly. The short lived tubes already having

given up the ghost, the tubes remaining in service, even though they may have exceeded the average life expectancy, are likely to last as long as brand new tubes.

Most every amateur knows of a case where a brand new transmitting tube, of reputable manufacture, failed after a very short period of service during which the tube was not abused. This should be no reflection upon the manufacturer or his product. The tube may have a life expectancy (average for a large group) of possibly 5000 hours when run at normal ratings. Even so, an occasional one is bound to fold up after a few dozen hours, which will be compensated by an occasional one lasting 25,000 hours or even more. Theoretically all tubes of a certain type *should* have a definite life span, at the end of which all of them elevate their toes skyward simultaneously. But such is not the case in practice. Manufacturers are doing their best to get at the root of the non-uniformity, but don't seem to be able to do so. They can improve and extend the average life of a certain type of tube, but still some will last 10 times as long as others in the same service.

Of course the survival law falls down when carried to extreme. It is true that according to this law of survival, in which a certain fixed percentage of surviving tubes fail every given number of hours, sooner or later a tube would be found which would last indefinitely. Of course no tube can last forever, but it would be reasonable to believe that if a tube somehow did manage to survive say 200,000 hours, it would have just as good a chance of lasting another 1000 hours as would a new tube. This assumes, of course, a new tube which was made at the same time and on the same equipment. It would be highly probable that after 200,000 hours a manufacturer would have improved his manufacturing technique and would be turning out improved versions with a greater life expectancy.

If this law of survival applies even approximately to transmitting tubes, and there appears to be no reason why it shouldn't, used tubes should be worth a lot more than they are. This takes for granted that the tube still

[Continued on Page 74]

*See D. K. Gannett, "Determination of the Average Life of Vacuum Tubes," *Bell Laboratories Record*, August, 1940.

An Interesting Discovery Regarding Tube Life

[Continued from Page 40]

checks up to the standards of a new tube, and that it has not been rejuvenated in order to make it look good. If you know of a broadcast or police station who is in the habit of replacing tubes after so many hours, just on general principles, and you can pick up a 203-A, 211, 242-A, etc., for a couple of dollars, it would be foolish to pass up such a bet if the tubes were known to be in first class condition when removed from the transmitter. On the other hand, it would be unwise to purchase a used tube even if only a month or two old if offered for sale by a person known to be unscrupulous enough to "hop up" an ailing tube in order to sell it, because there is no assurance that the tube did not begin to go sour after a few dozen hours use, even though not abused.

Oddly, while this peculiar law of survival applies to tubes with oxide coated and thoriated tungsten emitters, it does not apply to pure tungsten filaments. The life of a tube with a pure tungsten filament can be predicted quite accurately. However, it is unlikely that any amateur is going to be interested in picking up any second hand water cooled tubes.