330. We are assured that licences are issued to any bona fide manufacturers of equipment designed to incorporate valves or tubes and that virtually all the set makers are included in the arrangements either as licensees or as licensors. The licences specifically exclude patents relating to the valves and tubes themselves. The following clause of the licence prevents the licensee from selling in the United Kingdom and in the Irish Republic:

> any Broadcast Sound or Television receiver which incorporates imported components to an extent per receiver greater in value than ten per cent. of the retail list price thereof.

We are told that this ten per cent. clause has been a feature of the licences for many years but has never caused difficulties.

331. Licences are issued for five-year periods and the royalties and the shares of royalties to the members are settled for the five-year periods. The royalties payable on the net turnover of all the television sets made by the licensee are on a sliding scale depending on output—the rate of royalty falling as the output rises. Royalties are payable at a flat rate on the net turnover of all the radio sets made by the licensee.

332. In their evidence certain set makers have criticised the patent pool and its mode of operation. One said that the pool, while a useful source of income for the holders of the patents, gave no service whatever to the licensees. He said that under a similar pooling arrangement in the U.S.A. the patent owners gave technical advice. As against this, however, the Pool commented that under their arrangements the licensees get, for a rate of royalty fixed for five years, the benefit of future research and development.

CHAPTER 15. STANDARDISATION, RESEARCH AND DEVELOPMENT

333. Since 1936 there has been no technical control by the BVA over the types of valves which the members may make, although members are required to submit new types to the Association for technical classification and pricing before offering them for sale. Further, in connection with the new arrangements about imports, precautions have been taken against a member importing a new type without giving adequate notice to the Association.

334. Although there is a wide measure of standardisation of certain basic features of valve design, valves and tubes made by one member may or may not be interchangeable with valves and tubes, of the same type and with the same function, made by another member. The make of valve which is chosen by the equipment maker for a particular function in the circuit is determined by the range of voltages to which the valve will have to respond, and how closely the actual performance of the valve corresponds to the technical details in its published data. User and distributor witnesses are in general critical of the large number of types now made, which is thought to add both to the costs of manufacture and to the costs of distribution and stockholding by distributors. The BVA told us that new types are seldom introduced except to meet the needs of an equipment maker, and only where distinct advantages over existing types can be seen.

335. In general, smaller equipment makers appear to rely entirely on the valve and tube manufacturers for information on development of new types.

The following are extracts from the evidence of three of the larger set makers:

> "Our co-operation is limited to the extent of stating our circuit details to ensure a satisfactory performance of the valves and tubes specified, and the details of new types required for future development."
>
> "Where a projected equipment calls for the design of a new valve, development of valve and equipment must proceed together, with close collaboration between the respective designers. More usually, however, a projected new equipment involves the use of existing valves and tubes and in this case the engineers and the valve manufacturers are given the earliest opportunity to check and to approve the proposed operating condition to ensure that their valves and tubes will perform satisfactorily and meet the conditions of their guarantees when used in the said equipment."
>
> "Our co-operation with valve and tube manufacturers is restricted to obtaining technical information of future valve and tube types in order to facilitate our own development."

A large apparatus manufacturer stated:

> "It can cause embarrassment where one would prefer to use, in proposed new equipment design, those valve types which have proved themselves to be consistent and reliable and which as a type are quite adequate for the needs of the equipment. However, because another 'improved' type or base design is on the way then the hand of the equipment designer is forced away, with regret, from the type which he knows by experience to be reliable and adequate."

When we put this to the Association, the BVA commented:

> "The improved type may well have been introduced for the sake of manufacturing economies which cannot be applied to the older type. These economies are passed to the equipment manufacturer in the form of either stable or lower prices but he is still free to purchase the older type if he is prepared to pay an economic price."

336. In this industry there is much talk of "interchangeability". In order that valves and tubes may be interchangeable it is necessary that they should have the same base and be about the same size, that the various electrodes should be connected to the pins and wired in the base in the same way, and that the voltages to be applied to the electrodes should be either the same or very similar, particularly as regards the heaters or filaments. On these matters there is now a wide measure of standardisation. Up to 1936 the number of types of valves which could be manufactured was to some extent limited by the application of the Association's rules but on the reconstitution of the Association in that year all technical control ceased. The difficulty is, and has always been, to reconcile standardisation in the interests of reducing manufacturing costs with the need for freedom in order to ensure the best technical development.

337. The published data for the common receiving types of valves include both the dimensions and the "characteristics", which are graphical representations of the behaviour of the valve when the voltages applied to one electrode are altered while those applied to the others are kept constant. These characteristics are only rough indications of the behaviour of the valve, and tolerances of up to 50 per cent. are quite common. Two valves made by different manufacturers, designed to have the same function in a radio or television receiver, may have the same characteristics and be "plug-in replacements". The sensitivity of the circuit used by the various set makers may, however, be such that very slight differences between these valves, whether in their characteristics or in the variations which in practice arise from characteristics, may make one of the so-called "equivalents" less suitable

compared with the other or even quite unsuitable. Circuits in, for example, a television set can be so sensitive that even valves made to the same specification by the same manufacturer are not invariably found to work equally well. The position is therefore that so-called equivalents may not be exact electrical equivalents in all cases, and in addition there is a very wide range of types. The number of types of valves runs to several thousands, and there are approximately one hundred different types of cathode ray tubes for domestic television sets.

338. The Government Departments have evolved their own "C.V." specifications. A few of these specifications refer to valves which are exactly similar to some of the ordinary receiving types. The Government Departments are apparently satisfied that the manufacturers can produce valves to common specifications; the BVA, however, told us that the variations in production techniques and in the machinery used make it almost impossible to produce exact equivalents.

339. To some extent the growth in types compared with the early 1930s has been inevitable. The demand for miniature and sub-miniature valves has developed. The post-war television service required an entirely new range of valves, and the introduction of commercial television and F/M transmission involved yet other ranges of valves. In addition the competition between the members of the BVA for set makers' business has led to variations in certain basic types, though the BVA told us that this has not added greatly to the number of types. It is, however, the difference in the basic types between manufacturers which the set makers and distributors criticise.

340. When in 1942 the BVA began to consider its post-war plans there was strong support among the membership for the production of a "standard range". It was realised that if the specifications were to deal with more than the type of base and the voltage ranges, etc., it would involve some interchange of manufacturing facilities, and some loss of freedom to produce improved types. There was considerable support for a limitation of the number of types of valves to be made, in order to reduce costs of manufacture. More radical proposals involving rationalisation of production between the members were not greatly favoured. It was proposed to begin with a basic set of valves suitable for sound radio sets. A base chosen by the BVA for the standard range was produced by one member but only this manufacturer, and possibly one other, could make it with existing plant and machinery and traditional techniques. Owing to difficulties of this nature arising from differing manufacturing techniques, and in view of policy differences between individual members, the proposals to adopt a full standard range were abandoned in 1949. Since then the BVA has co-operated both with the British Standards Institution and with the International Electro-Technical Commission in discussions which have resulted in agreement on certain basic features of valve design. These features have become standard engineering practice in members' factories although one member continued for some time to use the valve base which had been proposed for the standard range and a neck diameter for his tubes which was different from that in general use. Now, however, standard valve bases and standard neck diameters are in general use, apart from certain production undertaken specifically for the maintenance trade. The measure of standardisation achieved in television tubes is as yet less than that achieved in valves and the extent to which members' tubes may be interchanged is very limited. The Association maintains a close liaison on a

variety of standardisation matters with the BVA's technical counterpart in America, the Joint Electronic Tubes Engineering Council, which controls the standardisation work of the Engineering Department of the Radio Electronic Development Manufacturers' Association in America. It co-operates with Government Departments on their requirements and represents the valve industry on the Services Standardisation Sub-Committee. In order that it may be able to speak for non-members as well as for members, the non-member manufacturers of valves and tubes are free to attend meetings of the BVA's Technical Committee when Government items are discussed. This arrangement was originally made at the suggestion of the Chairman of the Services Standardisation Sub-Committee.

341. In their evidence the set makers did not make much of the need for technical collaboration with the manufacturers of valves and tubes. There is apparently no co-operation between set makers and individual valve and tube manufacturers on research and development, and the main concern of the set makers seems to be to obtain valves and tubes which will meet the requirements of their circuits. They therefore test all supplies received. In general, the set makers leave development to the valve manufacturers and make little or no contribution of their own. Once they have chosen the make of valve or tube which best meets the requirements of their circuits, the extent to which they can choose their suppliers is very limited, and most of the set makers say they would like a greater measure of interchangeability. One set maker, for example, said:

> "As equipment designers and manufacturers we would like to see a greater measure of interchangeability between valves and tubes made by different manufacturers in order to simplify the set maintenance problems of our dealers. . . . In general we are satisfied that where differences exist between the products of different manufacturers there have been good technical reasons arising from competition for these variations. Now that the design of television receivers has become more stabilised the case for interchangeability becomes stronger."

Another set maker said:

> "Unfortunately despite the many efforts over the last 25 years there has been no agreement on standardisation of valve and tube types. Therefore many types are not interchangeable and with one equipment design we may be tied to the product of one supplier for whose product the equipment has been designed."

Some witnesses, however, thought the position had improved. One apparatus maker, for example, said:

> "There is much greater interchangeability between the same types made by different manufacturers at the present time than in the immediate post-war years, and this may have been occasioned by increased interchange of information between the United Kingdom and the United States of America. A number of current British types seem to be based on American designs and, whereas it was customary at one time for British valve manufacturers to incorporate a new type of base in the valve, they now consider it better policy to ensure interchangeability with the American product. One company, however, produces a base exclusive to its own valve; how far an arrangement presumably intended to force users to purchase replacements supplied by this company is successful or not we cannot attempt to say."

Another equipment manufacturer said:

> "In our view a valve should be standard, reliable and interchangeable, capable of adequately performing practically anywhere and not only on one system. If one is foolish enough to use the products of certain British

manufacturers one is restricted to one or a very few manufacturers. American normally and certain British types are, however, adequately interchangeable and careful choice can minimise this difficulty. The interchangeability of British valves tends to improve but the bad habit of giving different type numbers to normal interchangeable valves of various makes still persists. In general, American makes are still far better in this respect, a valve of particular type number being fully interchangeable with that of other manufacturers with rare exceptions. Although it may be claimed that individuality makes for higher performance we consider this factor to be outweighed by other considerations. As far as cathode ray tubes are concerned interchangeability hardly seems to exist at all.

342. Since the lack of full interchangeability seems to be due to the existence of divergent manufacturing techniques and to different policies on technical matters pursued by the individual members, we questioned the Association about the extent of collaboration between the members on technical and engineering matters.

343. The BVA explained that there is a routine exchange of technical information within the Association in connection with which sample valves and tubes and sometimes equipment are exchanged. The Engineering Advisory Committee, the Technical Committee and the various Panels provide a "continuous forum" for the discussion of technical problems. However, the members have not considered it desirable to collaborate systematically on research and development, and this has to some extent affected the collaboration they can offer to other bodies in the industry. There has been no formal collaboration on such matters as techniques for the production of "reliable" and "ruggedised" valves, although to some extent discussions on these matters are pursued through development contracts placed by the Government. The Royal Naval Scientific Service Co-ordination Valve Development Department, with which the manufacturers co-operate, is a medium for the exchange of information on these Government development projects. But there is no formal collaboration, within the Association or within the industry on research and development.

344. Expenditure on these items is therefore a matter solely for the individual manufacturers. Our inquiry into costs and profits showed that in 1954 the average expenditure on research and development by manufacturers accounted for 5½ per cent. of the total cost. The figure for each of the three largest manufacturers was about the same as the average for all manufacturers, but for one of the smaller manufacturers it was 3½ per cent. and for another 15 per cent. The position in the other years covered by our costs inquiry was similar. These figures include payments for "know-how" agreements and, in the case of Mullard a charge for the facilities it is given by N.V. Philips at Eindhoven. Valve and tube patent royalties do not form an appreciable element in either costs or profits.