TENNIS STRINGS AND METHODS OF MAKING THEM
(Review)

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The development of large-scale physical-culture sports and tourism in our country is being retarded to a considerable extent because of insufficient assurance of goods for sports and tourist purposes to the population. Among the goods in short supply are strings for tennis rackets. The problem has been presented to the man-made fibre industry of increasing the manufacture of tennis strings and improving the technology for preparing them.

In 1978 in the Kiev "Khimvolokno" PO, from the developments of the Kiev branch of the VNIIVproekt, the manufacture of synthetic tennis strings from nylon fibres at a production rate of 1.6 metric tons/yr was developed. During 1988-1990 the institute developed technology and equipment for organizing the manufacture of strings based on nylon monofilament with a modified coating, an increased resistance to abrasion, and with improved elastic properties. The Kiev "Khimvolokno" PO will produce 350,000 sets of such strings per year.

In the domestic scientific and technical literature there is very little information on studies of the service characteristics of tennis strings or on improving the technology for manufacturing them. In connection with this, a review of foreign literature sources is being published, which mainly concerns patents and advertising material.

Classification and Structure of Tennis Strings

In material composition, tennis strings can be of three types: natural strings of animal origin, synthetic, and combined natural—synthetic.

In the initial period of development of the sport of tennis, only natural strings were used for stringing rackets, for example, strings from the intestines of cattle, sheep, or cetaceous mammals. Strings from natural gut have exceptional playing properties: flexibility, elasticity, and a very high ability to undergo elastic restoration after repeated loading. However, they have significant defects — a high hygroscopicity, which weakens the tension of the strings in the racket, reduces its elasticity, and correspondingly reduces the string lifetime. A change in relative humidity of the air from 25 to 80% causes a change of approximately 4% in the dimensions of natural strings [1]. Moreover, the technology for making these strings is complex, and consists of numerous operations, in connection with which they are expensive.

At present, tennis strings from scarce natural raw materials have been practically completely displaced by strings from thermoplastic synthetic materials, which have a large lifetime, constancy of tension in the racket frame, resistance to all climatic conditions, and economy. The principle adverse property of these strings is insufficient elasticity, which lowers their playing quality. On forceful impacts because of the stiffness of the synthetic strings, stress arises in the region of the elbow and in the forearm tendons of the player.

In this connection, increasingly, new methods of preparing synthetic strings have been aimed primarily at increasing their elasticity and flexibility, i.e., toward giving them properties which approach the properties of natural strings. But, nevertheless, so far no form of synthetic string can replace the natural ones in playing properties.

Natural—synthetic strings are known, which together with high elasticity and comfort in play, have an adequately high lifetime because of the application of a protective coating of synthetic polymeric materials on a core of twisted gut bands.

There are two types of synthetic strings which differ in structure: without a core and with a core.

Strings of the first type consist of a single monofilament or of a bundle of complex yarns, but most often of monofilaments, which are twisted together and then are impregnated with a binder, which simultaneously fulfills the role of a coating. The string may consist of twisted bands of a fibrillated film, impregnated with a binder of a polymeric cement.
Fig. 1. Varieties of tennis string structures without a core: a) from a single monofilament (France); b) from a bundle of twisted complex yarns (France); c) from a bundle of twisted monofilaments (Great Britain); d) from twisted bands of fibrillated polypropylene film (Austria).

In Fig. 1 we show microphotographs of the transverse sections of strings without a core, prepared under an MBI-15 polarizing microscope in transmitted light. Monofilaments for these strings are prepared by extrusion from various polymers: polyamide (PA), polyurethane (PU), polyethylene terephthalate (PET), polyethylene (PE), polypropylene (PP), modified polyvinylchloride (PVC), and so forth. The number of twisted monofilaments may vary within wide limits — from 3 to 1400, which...