

Jan. 27, 1953

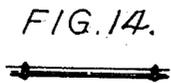
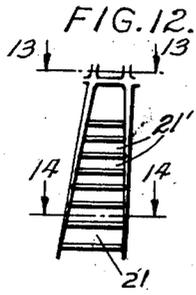
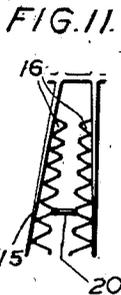
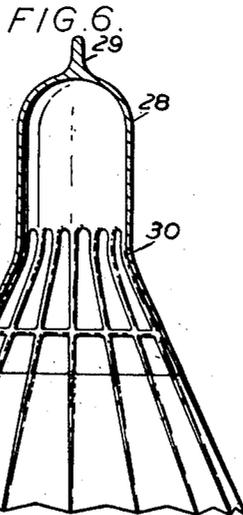
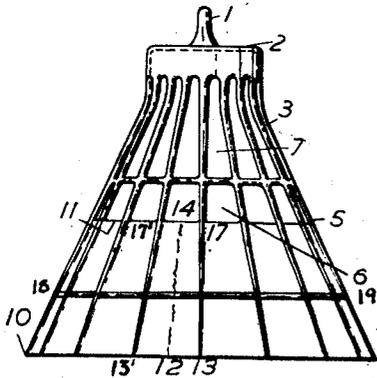
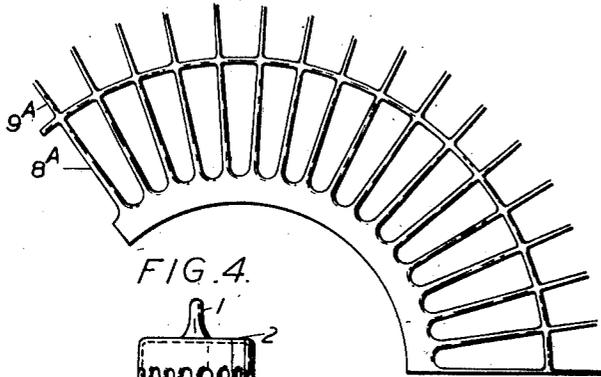
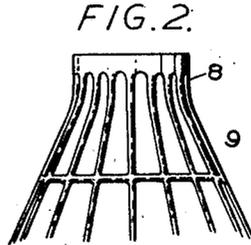
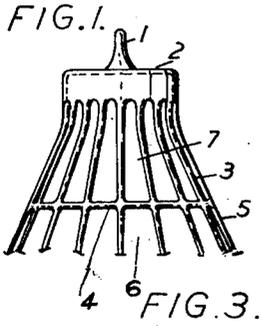
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2,626,805

SHUTTLECOCK AND METHOD OF MAKING

Filed June 23, 1950

2 SHEETS—SHEET 1



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SHUTTLECOCK AND METHOD OF MAKING

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2 SHEETS—SHEET 2

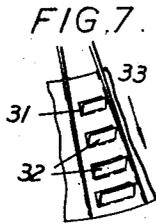
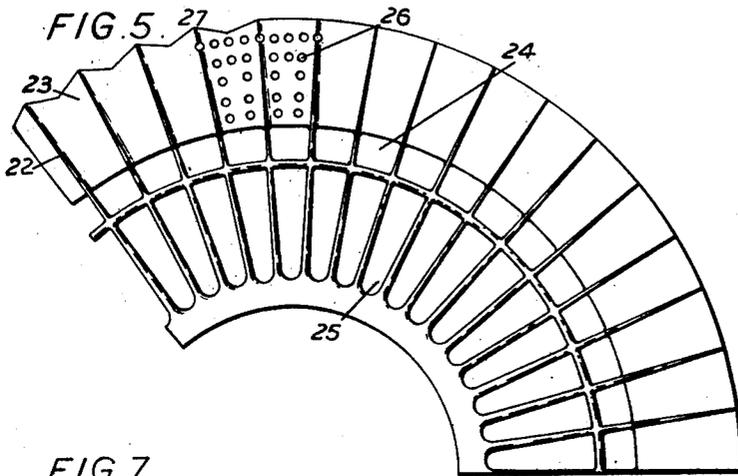


FIG. 8.



FIG. 9.

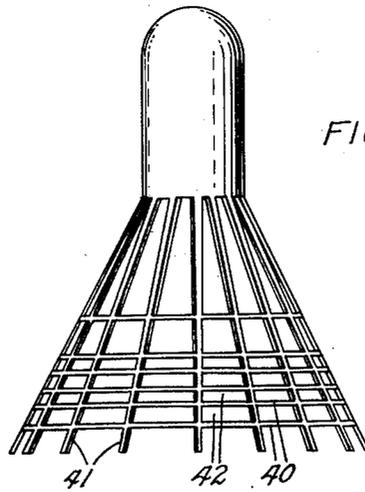
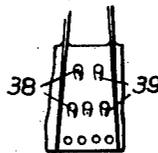


FIG. 10.

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SHUTTLECOCK AND METHOD OF MAKING

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7 Claims. (Cl. 273-106)

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This invention relates to shuttlecocks which might be used in the game of badminton.

A difficulty in shuttlecock manufacture hitherto has been to make the skirt, including the stems in one mass of material, that is, in a unitary piece. When feathers are used, about sixteen of them are required and a separate binding means is also provided. To overcome the difficulty, it has previously been proposed that a skirt having inner and outer portions should be made complete from various sheets or fabrics, and then fixed to a cap. The term "inner" is used to designate the skirt portion nearest to the cap, and "outer" is used to designate the skirt portion remote from the cap.

A successful shuttlecock, however, is of a fundamentally unsound shape for manufacture from sheet materials unless the inner skirt portion is strengthened by further thicknesses of material as the cap is approached. This is expensive.

This invention is devoted to the design and manufacture of a shuttlecock which will have strength and delicacy where each is required, and yet may be made extremely quickly, in its ultimate development, in one integral mass of material. A shuttlecock has therefore been invented which has the performance characteristics required by the laws of badminton now, and is suitable for mass production. A number of other objects have also been achieved by the invention and these will appear in the specification.

In this specification, the cap of a shuttlecock is the part normally struck by the racket, the outer portion of the skirt is the vane or flight area remote from the cap, and the inner portion of the skirt is the area connecting the outer portion with the cap and including the inner ends of the stems. A stem is an elongated body of material extending from the cap throughout the length of the skirt and forms a part of the latter. The stem is thicker at the point where it leaves the cap than any material between the stems in the outer skirt portion, and preferably reduces in cross-sectional area as it approaches the trailing edge of the skirt. Each stem is integral with another stem, and preferably all the stems of the shuttlecock are integral with each other.

This design may be produced by injection moulding of an end cap and through the end cap the stems in the form of a number of fine tapered rods, the injection being made at the big end of each rod, and arms being grown on each side of each rod at a uniform distance from the big end so that the injected material will re-

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unite at the ends of these arms and thus form a set of ribs extending transversely of the stems integral with each other and with said stems. A plurality of sets of ribs may be thus formed at spaced intervals. A suitable plastic material is used. The arms may be permitted to spread out in width by clearing the space locally between the male and female tools so that a plain vane or flight is made for the outer portion of the skirt. This is then provided with many edges which create wind resistance. These edges may be made by piercing many gaps or holes after the completion of the moulding operation. If it is desired to incorporate the holes in the moulding operation this may be achieved by connecting the spaces left for the stems by a series of shallow canals about .1" apart instead of clearing the space completely as was done for a skirt having a plain outer portion. The cap may be formed completely during the moulding operation by forcing the material around a substantially bowl-shaped space before reaching the stems, or the stems may be merely united at their cap ends during the moulding operation and the skirt then joined to a previously formed cap.

The material used in producing the first of these shuttlecocks was one in the polythene range because it combined a low specific gravity with high resistance to water absorption, an important point when a shuttlecock is stored under humid conditions. A mix was selected which is resilient and flows freely at 190 degrees centigrade under pressure. The invention is not limited to this material, but it has been given as a guide to enable a satisfactory choice to be made. It will be understood that although injection moulding has been recommended as the method of production, nevertheless the production of the basic idea is not limited to this method.

In order that the invention may be readily understood and carried into effect, various examples will now be described with reference to the accompanying drawings in which:

Fig. 1 is a fragmentary side elevation of a moulded shuttlecock in accordance with this invention plus the injection pip.

Fig. 2 is the same, with the end-cap and injection pip removed.

Fig. 3 is a fragmentary view of a developed blank for an alternative method of manufacture of the skirt of a shuttlecock.

Fig. 4 is a side elevation of a modified form of the skirt of a shuttlecock plus the injection pip.

Fig. 5 is a developed blank of the skirt of a shuttlecock as moulded in an alternative manner.

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Fig. 6 is a sectional side elevation of a shuttlecock made from one mass of material before removing the injection pip.

Fig. 7 is a fragmentary view of a modified form of shuttlecock skirt.

Fig. 8 is a fragmentary view of a further modified form of shuttlecock skirt.

Fig. 9 is a fragmentary view of a still further modified form of shuttlecock skirt.

Fig. 10 shows a side elevation of another form of shuttlecock in accordance with this invention.

Figs. 11 and 12 show fragmentary views of alternative forms of skirt.

Figs. 13 and 14 are sectional views twice full size as indicated at two points in Fig. 12.

Referring to Figure 1, a pair of tools are made with spaces between them so that when they are mated in the normal operating manner for moulding tools, and a hot plastic is forced through the aperture which eventually causes the pip 1; the material flows via the space left for the end-cap 2 to each of the spaces left for the stems 3, and thence along each stem until it branches into the spaces left for the arms or ribs 4. The material meets approximately in the middle of each of the ribs and merges into one mass. The material continues to flow along the stem spaces up to and beyond 5 and on leaving 5 the material continues through the length of the shuttlecock diminishing as it goes. It will thus be seen that openings 6 and 7 are formed simultaneously with the formation of the stems and ribs of the skirt.

When the shuttlecock is struck hard in play, a considerable load is imposed on the material between 2 and 5, and collapsing occurs in this area unless strength is provided. It has been established that provision must be made for considerable passage of air in this area such as through the openings 6 and 7, otherwise the reversal of the shuttlecock after impact is poor. It has further been established that the quality of a shuttlecock is improved if this area is reasonably rigid. The stems, therefore, are thick at 2 and continue substantial between 2 and 5 and then reduce in thickness as they continue to the trailing edge. The object of this is to make the outer portion of the skirt very light as this is necessary for good shuttlecock performance.

The end-cap 2 is then cut off as shown in Figure 2, and we have a shuttlecock skirt which has the smaller area of its surface at 8 compensated for by increased thickness in the stems, and as the spread of the stem is increased beyond 9, the thickness is reduced. The arrangement recommended is for the whole mass of the skirt and stems to be made in one piece.

A somewhat inferior method, in that a separate jointing operation is necessary, of combining stems with variation in thickness into one mass comprising at least two stems would be by compression moulding in the flat. The area is developed as shown in Figure 3, and the necessary strength at 8A is provided by greater thickness between 8A and 9A than is provided beyond 9A.

The method illustrated in Fig. 3 is carried forward in Fig. 5 wherein thin webs 23 are formed between the stems 22 adjacent their trailing edges. At the same time that the stems, ribs and webs are formed by providing suitable spaces between the mould sections, the openings 24 and 25 are formed due to the abutment of the mould sections in the areas of these openings. Relatively small openings 26 may be punched or otherwise formed in the webs 23 to decrease weight

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and increase drag as more fully described hereinafter.

Returning now to the method illustrated in Figures 1 and 2, the idea is further developed in Figure 4. The moulded tools are modified so that the spaces between the stems are cleared to a depth as thin as possible consistent with strength and the ability of the material to run freely. The area 13-13'-17'-17 is the result of a typical space so cleared, and when the material running down the stem spaces reaches this area it will grow outwards to form thin leaves which may weld together where the edges of the leaves from two stems meet, for instance, down the line 12-14. In practice, with such thin leaves as these should be, it is more likely that the material will merely butt, and the joint 12-14 may appear as a "cold shut." The point is not material so long as a series of areas 13-13'-17'-17 are formed in the lower skirt of a shuttlecock, and that the material in these areas is very thin.

Referring now to Figure 6, the method suggested in Figure 1, and developed in Figures 2 and 4, is now still further developed in Figure 6 to include the cap of the shuttlecock. It will be seen that the end-cap 2 in Figure 1 has been replaced by a cap 28 which is bowlshaped, and serves the same purpose as the end-cap 2 in facilitating the injection moulding operation, but in addition, replaces the usual cork cap fitted to a badminton shuttlecock. After moulding, the pip 29 is removed.

That part of the invention which relates to the inducement of drag is now reached. In Figure 7 is shown a fragment of a typical outer portion of the skirt of a shuttlecock in which slits 31 have been made, and the material raised to form a number of small flaps 32, secured at their trailing edges, which interfere with the air-stream 33 as it passes the outside of the shuttlecock. When it is desired to reduce the weight of the lower skirt without reducing the diameter of the cone-like section, a number of small openings 34, 35, 36, 37 are made in the outer portion of the skirt as shown in Fig. 8. These serve three purposes, they reduce weight, increase surface drag, and change the air-flow over the trailing edge of the shuttlecock. It will be noticed that four different shaped openings have been illustrated to indicate that almost any shape of opening is effective so long as it is not too small in diameter. Another limiting factor is that the openings must not be too close together otherwise strength and rigidity in the lower skirt is lost and irregular flight results. In Figure 9, the advantages illustrated in Figures 7 and 8 are combined, the openings 38 being pierced to reduce weight and the material 39 at the trailing edges of the openings being slightly raised so as to interfere with the air stream.

Referring to Figure 10, a series of closely spaced ribs 40 have been made in the outer portion of the skirt by cutting a series of canals to join the spaces left in the tools for the stems 41, with flow to areas other than the canals being blanked off so that the resulting shuttlecock is complete with openings 42 direct off the moulding operation. This means that a shuttlecock complete with openings need be handled once only, i. e. to remove from the moulding machine and cut off the injection pip.

Figs. 12, 13 and 14 illustrate the relative thickness of the stems and ribs, and the decreasing cross sectional area of the stems in a direction to-

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ward the trailing edge of the shuttlecock. In this form, a web 21 is formed in the area between the two outermost ribs and the stem portions adjacent thereto. The web is materially thinner than the adjoining ribs and stem portions, thus providing shallow air resisting pockets and also increasing to some extent the rigidity of the trailing edge portion of the skirt without materially increasing weight. Drag or air resistance is further increased by the openings 21¹ formed during the moulding operation between the other ribs in the outer portion of the skirt.

In Fig. 11, the space between adjacent stems in the outer portion of the skirt is partially filled by short broad ribs or leaves 16 projecting laterally from the stems, two only of such short ribs being connected as shown at 20. The connecting rib 20 adds strength and rigidity while the edges of the short ribs 16 increase air resistance.

I claim:

1. A method of making a shuttlecock consisting of forming a cap open at one end by injecting a plastic into a mold, then forming a plurality of diverging stems by continuing the injection of the plastic to overflow the same from the open end of the cap through a plurality of passages divergently extending from the cap, and then forming a set of transversely extending ribs by further continuing the injection of the plastic to overflow the same laterally from said diverging passages through communicating lateral passages.

2. A method of making a shuttlecock consisting of forming a cap open at one end by injecting a plastic into a mold, then forming a plurality of diverging stems by continuing the injection of the plastic to overflow the same from the open end of the cap through a plurality of passages divergently extending from the cap, then forming a set of transversely extending ribs by further continuing the injection of the plastic to overflow the same laterally from said diverging passages through communicating lateral passages, and then forming webs between the stems and adjacent the ribs by still further continuing the injection of the plastic to overflow the same into shallow pockets extending laterally from the diverging passages adjacent said lateral passages.

3. A method of making a shuttlecock consisting of forming a cap open at one end by injecting a plastic into a mold, and then forming a skirt

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provided with openings by continuing the injection of the plastic to overflow the same from the open end of the cap into passages divergently extending from the cap and also into a plurality of sets of transversely extending passages communicating with each other and with the divergently extending passages.

4. A shuttlecock comprising a cap and a moulded skirt composed of an inner part adjacent the cap and an outer part remote from the cap, and incorporating stems extending from the cap and material between the stems in said outer part, the stems being thicker where they leave the cap than the material between the stems in said outer part and being flared outwardly from the cap, and moulded integrally, and characterized in that each stem has integral with it a plurality of ribs projecting laterally from it in the area of the skirt remote from the cap.

5. A shuttlecock as in claim 4 and characterized in that at least one of the ribs makes a circumferential connection between the stems in the area of the outer part of the skirt.

6. A shuttlecock as in claim 4 and characterized in that air spaces are left between the ribs in the area of the outer part of the skirt.

7. A shuttlecock as in claim 4 and characterized in that the outer part of the skirt incorporates ribs with intervening plain vane portions.

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