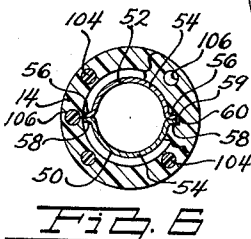
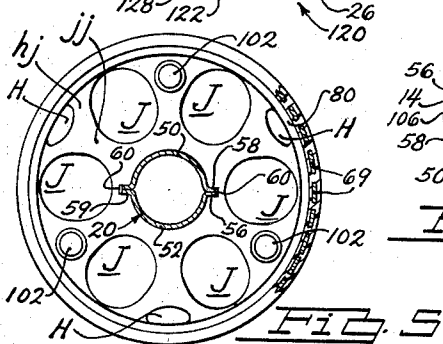
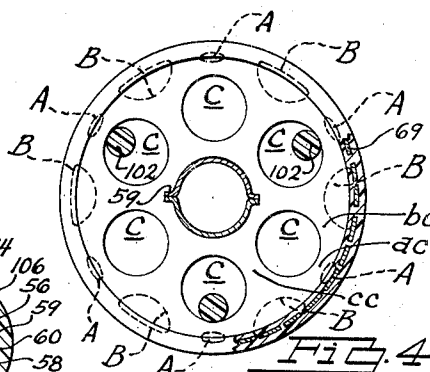
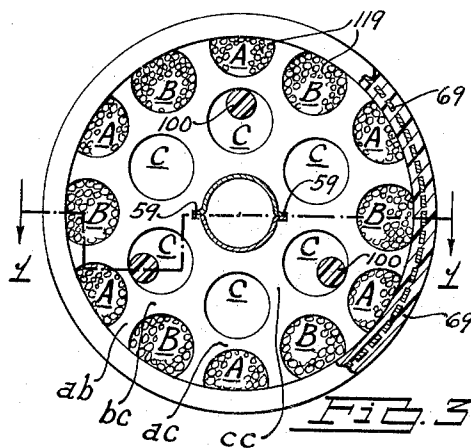
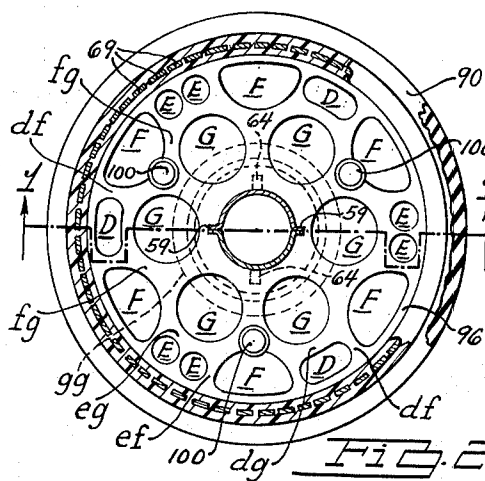


N. J. HALIP

COMPOSITE COMPOSITION BOWLING PIN

3 Sheets-Sheet 1



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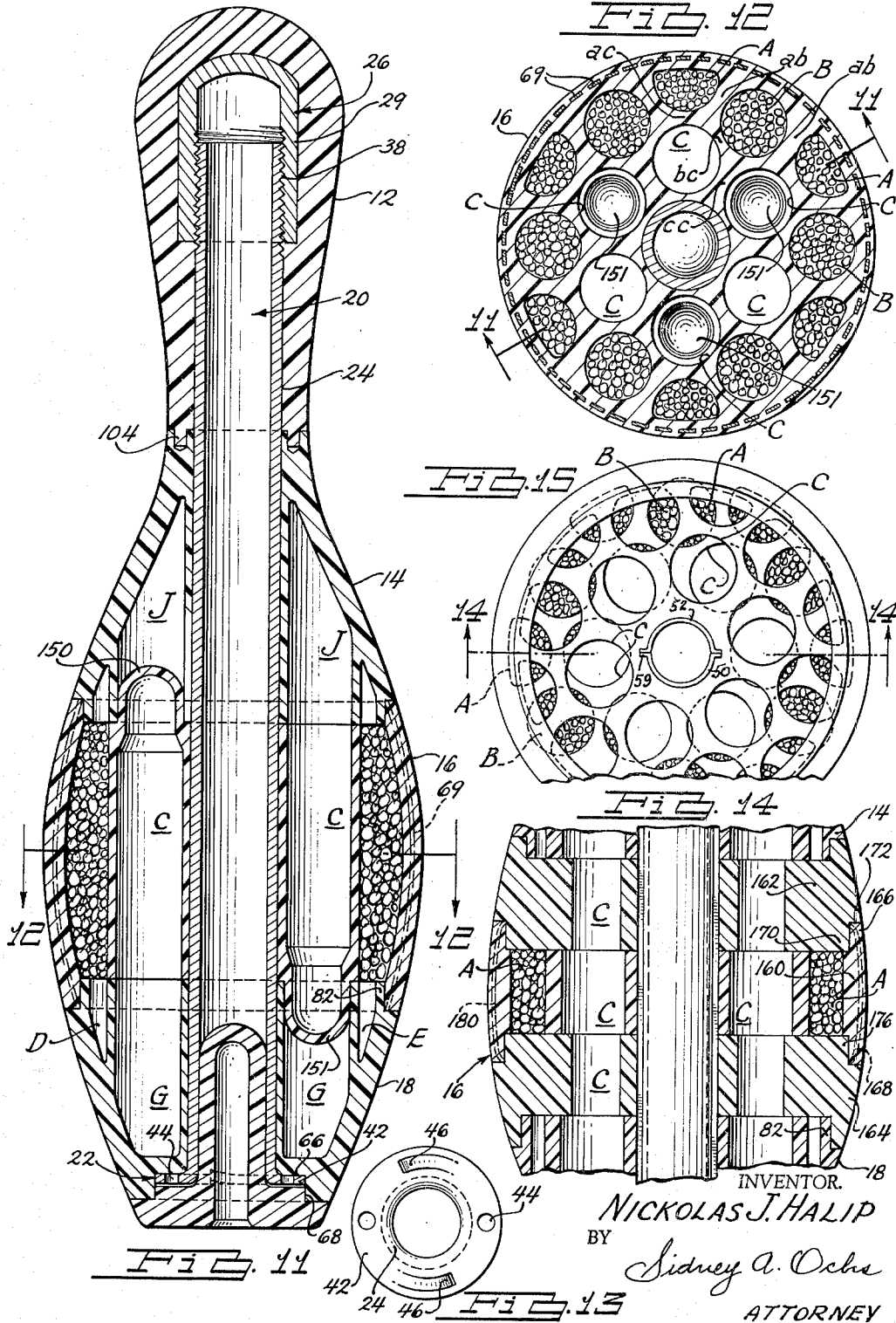
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COMPOSITE COMPOSITION BOWLING PIN

Filed Sept. 26, 1961

3 Sheets-Sheet 3



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COMPOSITE COMPOSITION BOWLING PIN

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This invention relates to bowling pins of the types known as "tenpins," "duckpins," Canadian "fivepins," "candlepins" and the like. It is especially concerned with bowling pins such as these, produced from synthetic resin compositions and which substantially simulate their conventional wood counterparts in size, shape, weight and action yet possess greater usability and uniformity.

Bowling pins currently in use are made only of selected hard wood such as maple and are turned from solid billets thereof or laminated sections. Each pin must be accurately contoured to bowling association specifications, carefully sanded, sealed and finished with or without a plastic coating. The pins are costly and in spite of all the care received in manufacture, these wood pins because of differences in grain character and density, vary in their action and physical attributes. This results in many rejections. More particularly, because of the severe impacts encountered from several sources in their customary use, such as between themselves and with bowling balls and through handling by pin setting machines and the friction occasioned by the rolling and spinning of the pins on the alley surface and in the pit at the end of the alley, these wood pins readily become marred or damaged. Chipping, tearing down of the wood fibers, checking, and cracking are expected disabilities. Wood pins seldom have more than nine months usability in the face of repeated stresses and shocks to which they are subjected. In fact most bowling establishments require at least three complete sets of pins for each season of nine months and in match play the pins are seldom used for more than one game.

Because of the high cost and high mortality rate of wood pins repeated efforts have been made without success to produce bowling pins of other materials that will meet the specifications and standards of action and scorability set by the various bowling associations and congresses for wood pins. Thus bowling pins have been proposed of molded hard rubber, compressed paper, fiber, bitumen, synthetic resins, cork and the like in solid and hollow form, as composites with wood cores, as coverings over metal and as interfitted fiber sections or sandwiches. All have failed either because they became dented, chipped or damaged under impact, or otherwise lacked durability or because they differed too greatly from conventional wood pins in weight, weight distribution, resiliency, reaction, and scorability.

Some idea of the problem will appear from the fact that a good hard maple wood "tenpin" for example is dimensioned within close tolerance as to height, contour and cross-section, has a predetermined specific gravity between about 0.65 to 0.85, has its center of gravity located between $5\frac{1}{8}$ " and $5\frac{15}{16}$ " above its base on its central axis and has a predetermined rebound reaction or response of between 58 to 70 Scleroscope hardness as measured by a Shore Scleroscope) on the largest diameter of the pin. A substitute pin must substantially meet these basic conditions set for a wood pin. Moreover, it must be able to maintain the scorability attributed to a wood pin as evidenced by its fall, action and scoring level.

I have discovered that a satisfactory substitute composite bowling pin may be produced that is essentially composed of synthetic resinous materials. Such a pin will comprise an integral assembly, preferably a cold welded whole, of a composite of premolded and cured

sections or portions of predetermined internal structure of such material which are stacked or tandemly arranged on a common vertical axis, which is the axis of the pin, preferably over a central stem-like reinforcing member, preferably of metal, these sections being preferably interfitted and non-rotatably located with respect to each other and having annular external surfaces shaped to a predetermined contour. The sections will together provide a durable integral structure simulating the conventional wood counterpart in size, shape, density and action and will possess substantially greater usability than a wood pin.

More particularly the section or sections comprising the belly (section at the ball line) and bottom or base portions of the pin and preferably all portions below the neck of the pin will be of an enclosed skeletal or honeycomb-like structure characterized by a plurality of vertically extending cavities, cells or pockets of predetermined maximum transverse dimension which cavities are arranged in a plurality of substantially ring-like formations each comprising a group of cavities preferably of the same general pattern, such as circular or polygonal, and of the same general cross-sectional area and substantially uniformly spaced from each other circumferentially of the ring, with each cavity of the group thereof of the outer ring of cavities of a pair of juxtaposed rings being intermediate a pair of cavities of the next ring of cavities and being backed up by the web or partition wall between said pair of cavities of the inner ring; the webs or partition walls between the juxtapositioned cavities not on the same ring of the said inner and outer rings of cavities being of predetermined thickness at their thinnest section and the cavities of the outermost ring of cavities of the pin section being separated from the outer surface of the bowling pin by a wall or web of predetermined thickness which they in part determine and the cavities of the innermost ring being similarly spaced from the central reinforcing stem and determining in part a wall surrounding the same.

I have found that for best results it is desirable to use cavities whose cross-sectional area on the ball line does not substantially exceed that of a circle of one inch diameter and that are in major number not less in area than a circle about one-quarter inch in diameter and that the greatest dimension between any two points of a cavity cross section shall not exceed about one inch and that cavities in other sections shall preferably be within the same limits. Moreover, for an optimum pin structure all the walls and webs of the composition sections except the central simulating wall should not exceed about three eighths of an inch in thickness. Thus, the web or partition walls between cavities should preferably be less than about $\frac{5}{16}$ of an inch, preferably less than one quarter of an inch and not less than about one eighth of an inch at the thinnest point. Moreover, the wall thickness between cavities of the outermost circle of the section and outer surface of the pin or bordering thereon should preferably be greater than that of the aforesaid webs, for example be at least about one quarter of an inch and up to about three eighths of an inch in order to obtain best distribution of the impact forces and a reaction on impact comparable to that of a wood pin.

I have also discovered that when the sections are properly delineated the total cross-sectional cavity to wall area in a section on the ball line of the pin and intermediate the central stem and the inner side of the outer wall at its thinnest point will in general be in the order of about six to four and at other cavitated sections of the pin other than the belly section this ratio shall be in the ratio of at least about one to one. Stated another way the total cross-sectional cavity area on the ball line will in general

be about fifty-five percent plus or minus ten percent, preferably not less than fifty percent and not greater than about sixty percent of the area intermediate said outer wall and stem.

The required cavity area at a given section may generally be expressed by the following empirical formula:

$$\text{Cavitated Area} = C \times K \times \frac{\pi}{4} (D^2 - d^2 + 4T^2 - 4TD)$$

where

T = the thickness of the outer wall;

D = the outside diameter of the pin at the section in question;

d = the outside diameter of the stem or core;

K = a sound constant varying with the character of bowling pin and sound effect desired. It will be 1.0 if no sound deadener is used, 1.125 for a tenpin and 1.06 for fivepins where a sound deadener is employed;

C = the desired ratio of cavity area to total area between the stem and outer wall of the pin such ratio being 3:5 at the ball line and approximately 1:2 at sections midway the ball line and the minor neck diameter and midway the ball line and base of the pin.

With an enclosed skeletal or honeycomb structure such as described in the main sections to wit the belly, base and neck sections of the pin, it is quite feasible to control weight distribution of the plastic material and to easily and accurately control the location of the center of gravity of the pin. Moreover the outer wall of the bowling pin when made as described can give resiliently under impact with a corresponding resilient response in the honeycomb structure and will return to the normal condition upon release of the force. Stated another way the arrangement of cavities, partition webs, and walls is such that the impact between ball and pin at the ball line at any point in the circumference thereof will be resiliently transmitted by the outer wall to the adjacent webs of the honeycomb structure and absorbed without permanent surface deformation. Moreover, with the described relationship of partition web and outer wall thicknesses a character of action is obtainable that is comparable to that secured from a conventional hard maple wood pin. In this connection it may be noted that if the outer wall thickness substantially exceeds the optimum value given above, the pin response will usually increase and result in a pin action unlike that of a wood pin.

I have also found it desirable in the interest of a sound pin structure to preferably reinforce the composition material of the outer wall of the belly portion or section of the pin, with suitable means such as a perforated metallic sleeve imbedded in the plastic composition and arranged to transmit stresses on impact to adjacent tandem sections of the pin and to provide as by suitable keys, dowels and the like, for rendering adjacent sections non-rotatable relative to each other. Moreover, I preferably cold weld the adjacent sections to each other by treating the sections at their joints with a solvent type of adhesive compatible with the resin composition of the sections and which has a slight softening effect thereon and then hold the sections interlocked under a predetermined pressure within the elastic limit of the material so that a cold weld takes place under an air cure. The result is a substantially unitary pin structure. This structure may be further enhanced by a subsequent heat treatment at a temperature below that at which the material tends to creep such releasing any residual stresses and assures the complete evaporation of all solvent. A temperature below about 200 degrees F. preferably between 125 to 180 degrees F. has been found satisfactory.

The unitary character and degree of resilience possible with a pin of the foregoing described structure is evident from the fact that it is possible to compress pins

made in accordance with the present invention in an endwise direction as much as $\frac{1}{4}$ of an inch under a load of 1200 lbs. and obtain a full return to the original shape and size without any breaks or separation of seams.

I have also discovered that where it is essential to provide in certain of the plastic pins of my invention a matching sound effect on impact expected of the conventional hard wood tenpin I may in most cases control such effects by introducing into the outermost ring of cavities of the pin a sound deadening material to somewhat soften the sharper sound effect usually obtained in such plastic pin structures.

Accordingly it is the principal object of the invention to provide a composite bowling pin structure of tandemly arranged premolded sections of cured synthetic resin composition having in the belly and base section a honeycomb arrangement of cavities or open cells leaving a web and wall structure capable of resiliently absorbing ball impact without permanent deformation and providing a reaction or bounce comparable to that of conventional hard maple wood pins.

Another object is to provide a plastic composition bowling pin structure as in the preceding object in which the sections are cold welded together to produce a unitary structure.

A further object is to provide bowling pin structures as in the preceding objects wherein the pin is reinforced by a central stem of complementary half sections suitably secured together and providing abutting flanges which serve as keys for guiding assembly of the tandem sections and render them non-rotatable relative to each other.

An additional object is to provide a bowling pin construction as in the preceding objects wherein adjacent tandem sections have a pin and cavity interlock to prevent relative rotation between sections and to assure a predetermined relationship rotatably between the cavities of adjacent sections.

Still another object is to provide a bowling pin structure as in any of the preceding objects wherein the density, contour shape, center of gravity, and scorability is comparable to that of a conventional hard maple wood pin.

A specific object is to provide a bowling pin structure as in any of the preceding objects wherein the plastic belly section is reinforced adjacent its outer surface by a perforated shape retaining resilient metallic sleeve imbedded in the section.

Another specific object is to provide a bowling pin as in any of the preceding objects wherein the outermost ring of cavities of the belly section contains a sound deadening material immovably secured therein.

A further specific object is to provide a bowling pin as in any of the preceding objects wherein the belly section comprises a plurality of laminae in which at least the cavities of juxtaposed laminae adjacent the outer surface of the pin are offset from each other so as to obtain a staggered pattern of cavities looking at the surface of the pin in elevation.

Other broad and specific objects and advantages of the invention will be apparent from the following description and from the drawings illustrating without limitation the novel features of the invention as applied to "fivepin" and "tenpin" embodiments and wherein:

FIGURE 1 is a vertical elevational view in section taken approximately at 1—1 of FIGURE 3 of the novel composite bowling pin of the invention as applied to a Canadian "fivepin" showing among other features the central reinforcing stem, the manner of cavitating certain sections, the belly reinforcement and interlock between sections;

FIGURE 2 is a plan view partly in section taken at 2—2 of FIGURE 1 and looking in the direction of the arrows there shown, showing reinforced wall structure.

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of the belly section and showing the honeycombed structure of the base section, the keyed connection with the stem, the separate projections for interlocking with the belly section and the rubber collar surrounding the base section and mounted thereon;

FIGURE 3 is a plan view partly in section taken at 3—3 of FIGURE 1, looking upwardly at the bottom side of the belly section and showing the honeycombed structure thereof and mode of interlocking the sections and filler in the outermost ring of cavities;

FIGURE 4 is a plan view partly in section taken at 4—4 of FIGURE 1 adjacent the joint between the neck and belly sections looking downwardly at the upper end of the belly section, and showing the honeycomb structure as it appears from this end and showing the means for rendering these sections relatively non-rotatable;

FIGURE 5 is a plan view partly in section taken at 5—5 of FIGURE 1, looking upwardly into the neck section and showing the honeycomb structure thereof and pin projections for interlocking with the belly section;

FIGURE 6 is a sectional plan view taken at 6—6 of FIGURE 1, showing the manner of interlocking the head and neck sections;

FIGURE 7 is a vertical elevational view, partly in section taken approximately at 7—7 of FIGURE 8 of a "fivepin" structure such as that of FIGURE 1 with a modified form of stem structure and showing the use of honeycomb structures in the belly, neck and base sections of the pin with the cavities aligned and interconnected by tubular dowels rendering the sections non-rotatable and providing increased rigidity at the seam lines between sections;

FIGURE 8 is a plan view partly in section somewhat similar to that of FIGURE 2 taken on the line 8—8 of FIGURE 7 looking down on the honeycomb structure of the base section and showing the tubular interconnection and manner of reinforcing the outer surface and wall of the belly section;

FIGURE 9 is a face plan view of the threaded locking nut employed with the central stem of the pin structure of FIGURE 8 for holding the tandem sections together and which is provided with outwardly pressed locking fingers for engagement with the under surface of the base section to prevent unturning thereof;

FIGURE 10 is an edge elevational view of the nut of FIGURE 9;

FIGURE 11 is a vertical elevational view in section of a "tenpin" to which the features of the invention of FIGURE 1 are applied and which may incorporate all those there shown and which especially features a modified form of central reinforcing stem not shown in FIGURE 1 and the use of bulbous dowel like projections formed as an integral part of the molded resin composition sections for interlocking the adjacent sections together;

FIGURE 12 is a sectional plan view taken at 12—12 of FIGURE 11 showing the honeycomb structure of the belly section and which is also typical of the base and neck sections;

FIGURE 13 is an end view of the flange end of the central reinforcing stem of FIGURE 11 showing its pressed out locking fingers;

FIGURE 14 is a vertical elevational view partly in section of a modification of the belly section and stem of the pin of FIGURE 11 and taken at 14—14 of FIGURE 15; and

FIGURE 15 is a plan view looking down on the pin of FIGURE 14 with the neck section removed and showing the manner of offsetting the layers of the belly section rotatably and rendering them non-rotatable.

Referring to the drawings wherein corresponding parts are identified by similar reference characters throughout the several views and first especially directing the description to FIGURES 1 through 5 inclusive, showing the invention applied to an exemplary form of Canadian five-

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pin generally designated by the numeral 10, the pin as there shown comprises a plurality of tandemly arranged premolded sections or portions generally designated by the numbers 12, 14, 16 and 18 respectively and which may be broadly referred to as the head, neck, belly and base sections respectively. These sections which themselves may be constituted of a plurality of interfitting subsections as hereinafter described for example with respect to FIGURE 14 may be premolded by well known injection molding procedures from suitable known synthetic resin injection molding plastic composition, preferably of the high impact type of thermoplastic resin materials and which may include the customary and well known fillers and reinforcing fibers. One example of a suitable thermoplastic resin material is an acrylic butadiene styrene resin (also known as Abs resin) which is preferred for its high impact properties and resistance to deformation by solvents as well as its suitability for imprinting. Such a resin is commercially obtainable under the name Cyclocac GS, a product of Marbon Plastics Corporation. Another suitable resin composition is ethyl cellulose resin. It is sold under the name Ethocel by the Dow Chemical Company. Still another example of a suitable resin is a high impact polypropylene resin obtainable under the name Profax from Hercules Powder Inc. This resin has good impact and dirt resistance but is more difficult to imprint than the Abs resin aforesaid and does not enable a true white color to be obtained where such is desired. Further examples of resins which may be employed in this invention are polyvinylchloride resin and cellulose acetate butyrate resin.

The bowling pin 10, is reinforced by a central stem or core generally designated by the numeral 20, preferably of metal, which may be a hollow metal member of any of the forms shown in FIGURES 1, 7, 11 and 14 and which also serves to tie the molded sections together into a unitary structure. The stem 20 may comprise a head portion generally referred to by the numeral 22 and a relatively straight tubular shank portion 24, having means for receiving a locking or clamping element generally designated by the numeral 26.

In FIGURE 7, the head portion 22 is constituted of an internally threaded metallic cap 28 which is molded in situ with the plastic head portion 12 and with or without the shank 24, the outer surface of the cap 28 being formed with a plurality of spaced projections 30 and valleys 32, or otherwise suitably roughened, to form a satisfactory anchor in the plastic composition. Moreover, the solid tubular shank 24 is externally threaded at its lower end at 34 to receive the nut 26 and is externally threaded at its upper end 36, at 38 to mate with the internal thread 40 of the cap 28. As seen in FIGURES 7, 9, and 10, the nut 26 in this embodiment is a circular disc-like locking member 41 internally threaded at 42 and provided with a plurality of spanner wrench receiving holes 44 (three being shown) and a plurality of counter clockwise directed outwardly bent flexible locking tabs or teeth 46 (three being shown) for a purpose hereinafter described.

In FIGURE 11 the head 22 of the solid tubular stem takes the form of an outwardly turned flange portion 42 while the upper end of the shank, as in FIGURE 7, is externally threaded at 38 and received in an internally threaded cap 29 molded in situ with the plastic head portion 12, but which here serves as a fixed nut or socket by which to draw the plastic sections of the pin against the flange portion 42 by rotating the stem. For this purpose the flange is provided with a pair of spanner wrench receiving openings 44 and a pair of outwardly pressed resilient locking fingers or teeth 46.

In FIGURE 1, the head 22 of the stem is formed as shown as a closed bulbous upper end 48 in the plastic head section to which it is anchored and molded in situ.

A feature of the invention is the specific construction of the reinforcing stem in FIGURES 1 and 14 whereby no threaded portions are required and wherein the stem

keys the plastic sections to it for rendering the sections non-rotatable with respect to each other. To this end the stem 20 is preferably formed of complementary half-sections 50, 52, preferably stamped from sheet metal, for instance an 18 gauge metal. These half-sections may have body portions 54 of any suitable shape, preferably semi-circular, and which increase in size in the head portion 12 of the pin to a maximum at the bulbous end 43. The half-sections 50, 52, also have side fingers 56, 58, respectively (see FIGURE 6) which abut each other and extend not only the full length of the straight portion 24 of the stem but also around the bulbous end 43 to provide a continuous double flange or key. The sections 50, 52 are secured together at the flanges 56, 58, by any suitable means such as spot welding or cementing with an epoxide metal cement. The double thickness flanges 56, 58, provide elongated keys 59 to guide the tandem plastic sections in assembly and to non-rotatably locate the adjacent sections in predetermined relationship to each other as hereinafter described. It will be understood that the molded sections which are independent of the stem 20 will have diametrically opposite key ways 60 to receive the key flanges 59 of the stem. In this connection it is preferred that the head section 12 in FIGURE 1, because of the bulbous end on the stem 20, be molded in situ with the stem. However, it will be understood that the section 12 may be made in complementary longitudinal halves subsequently bonded to the stem 20 and to each other by a suitable cement.

The side flanges 59 of the stem are transversely slotted as at 62 to receive and interlock with the inner peripheral edge of a section clamping washer 26. The washer 26 as seen in FIGURE 2 has opposite key slots 64 which permit it to pass over the key forming flanges 56, 58, of the stem and to be rotated ninety degrees when aligned with the slots 62 (see FIGURES 1 and 2) of the stem 20. In finally positioning the clamping washer 26 it is preferred that the plastic sections be placed under compression on the stem 20 such that upon release of the pressure the washer will be held tightly against the lower edges of the stem slots 62 by the face 66 of the base recess 68 of the section 18. To facilitate assembly of the clamping washer 26 to the stem the slots 62 are preferably made of greater width longitudinally of the stem 20 than the thickness of the washer 26.

In FIGURE 7, the stem 20 if it is not previously molded in situ in the head section 12 with the cap 22 is first threaded into the cap to the fullest extent possible after which the plastic sections are assembled over the stem 20 and the clamping nut 26 threaded over the stem 20 and drawn home against the base surface 66 of the recess 68 in this figure, the teeth 46 of the nut biting into the surface 66 to prevent unturning.

In FIGURE 11 the plastic sections are assembled in interengaging relationship as hereinafter described and the stem 20 threaded home in the head cap 26 by means of the flange 42 and spanner wrench holes 44, the teeth 46 of the flange biting into the surface 66 of the recess 68 of the base section 18 to prevent unturning of the stem in use of the bowling pin.

As previously described a most important feature of the invention is the provision of a honeycomb-like structure in the main sections comprising the belly and base portions of the pin which structure is characterized by a particular arrangement of vertically extending disconnected cavities, cells, or pockets of suitable configuration but preferably of limited cross-sectional area leaving a skeletonized structure of interconnecting webs and walls also preferably within limits in thickness essential to obtaining the optimum acceptable weight distribution, reaction, bounce, scorability, and sound effects, comparable to that of a hard wood pin.

To this end each of the main sections are provided with substantially concentric ring-like formations of cavities each comprising a common group of finger-like

cavities preferably of the same general pattern and of substantially the same cross-sectional area extending in the general lengthwise direction of the section and substantially equally spaced from each other circumferentially of its ring. Moreover, each cavity of the group of an outer ring of a pair of juxtaposed rings will be intermediate a pair of cavities of the juxtaposed inner ring and will be backed up by the web or partition wall of this pair of cavities which web or partition depending upon the radial spacing of the rings will be of a radial extending relatively narrow character or a circumferentially extending relatively narrow one.

The cavities may be of any desired cross-sectional shape for example, circular, hexagonal or other polygonal shape, hemi-circular, oblong and crescent, found best to accomplish the ultimate result, provided, however, that the cross-sectional area of any configuration not exceed that of a circle of one inch diameter and that the greatest dimension between two opposite points of a configuration not exceed about one inch and further that the web thickness between juxtapositioned cavities of adjacent rings but not on the same ring will be less than $\frac{5}{16}$ inch but not less than about $\frac{1}{8}$ inch at the thinnest point while the wall thickness between cavities on the outermost ring and the outer surface of the pin will be at least about $\frac{1}{4}$ inch and up to about $\frac{3}{8}$ inch.

It will be understood that where a configuration is of oblong shape it may be a composite of disconnected smaller configurations without each said smaller cavities being considered a separate one.

Thus as seen in FIGURES 3 and 4 the cavities of the belly section 16 of the pin 10 in FIGURE 1 are arranged in common groups of six cavities each forming three concentric ring-like formations, and with the cavities of each common group equally spaced circumferentially from each other. In this arrangement the cavities designated A form a common group and the outermost ring-like formation, those designated B form a common group and a ring-like formation substantially concentric to that formed by the cavities A and somewhat radially inwardly thereof and the cavities C provide a third common group forming a ring-like formation concentric to the other two and radially inwardly of that formed by the cavities B.

It will be noted that each cavity B is intermediate a pair of cavities C of the next inner ring and is backed up by a radial web CC that connects with the body or wall of the pin immediately surrounding the stem, that each cavity A is intermediate a pair of cavities B of the next inner ring and is backed up by a circumferential web AC which connects through the web CC with the inner wall portion and that the webs CC between adjacent cavities C, the webs ac and bc between adjacent cavities A and C, and B and C respectively, the webs ab between cavities A and B and the webs between the cavities C and stem 20 are substantially of the same order of thickness and within the dimensional limits previously described. Moreover, it will be evident that the cavities A and B substantially touch on a common circle and thus determine with the outer surface of the pin an outer wall 69 of substantially uniform thickness within the limits of thickness above stated and backed up by the webs ab.

It will also be noted that the cavities C extend entirely through the section 16 whereas the cavities A and B because of the upward tapering contour of the outer surface of the section preferably do not go through the section but terminate in a bottom wall 70.

The opposite ends of the section 16 are provided with annular peripheral flanges 72, 74, terminating in end faces or shoulders 76, 78 respectively providing shallow recesses snugly interengaged by reduced shouldered end portions or projections 80, 82, of the neck 14 and base 18 sections of the pin. The shoulder 84 of the projection 80 abuts the end face of the section 16 while the lower end of the neck section 14 abuts the shoulder 76 of the section 16.

Similarly the upper end of the projection 82 of section

18 abuts the shoulder face 78 of the section 16. However, since it is customary on Canadian fivepins to provide a rubber bumper adjacent the base of the pin the end shoulder 86 of the projection 82 of the base section 18 is spaced from the end face 88 of the belly section 16 to receive a resilient rubber bumper 90 which tightly fits the projection 82.

The base section 18 is provided with a honeycombed structure of finger-like cavities in much the same manner as the belly section 16 and which extend downwardly from the end face 78 to a point short of the face 66 of the base 68 as in the case of the cavities G leaving a wall 92 but not quite as deep because of the surface contour of the section in the cavities D, E, and F. Referring to FIGURE 2 it will be seen that three concentric ring-like group formations of cavities are employed here. The innermost ring consists of the group of six circular cavities G, the next of the six semi-circular cavities F and the outermost ring of the three oblong cavities D and the three pairs of small circular cavities E each pair of which may for all purposes be considered the equivalent of an oblong cavity D.

It will be noted that in each case the cavities F are intermediate cavities G and backed up by radial webs *gg* which space these cavities G circumferentially, that the cavities D and E are intermediate cavities F and backed up by webs *dg* and *eg* respectively and the webs between juxtaposed cavities are all within the general width referred to in discussing the cavities of the belly section. Also that the outer cavities D, E, and F substantially touch on a circle thus determining an outer wall 96.

The arrangement of cavities H and J in the neck section 14 of the pin in FIGURE 1 follows the same pattern as those of the other section although the number of groups are less. Thus as seen in FIGURE 5 there are six cavities J of slightly radial oblong shape forming one ring-like group while the three elliptical cavities H each intermediate of a pair of cavities J and backed up by webs *dj* form a second concentric grouping. Here as in FIGURES 2 and 3 two groups touch on a common circle to determine an outer wall. The finger-like cavities H and J as seen in FIGURE 1 follow the contour of the pin surface and thus are of reduced area as they approach the upper end of the section.

It will be apparent that the honeycomb sections as described are each of such structure that they may be easily made by injection molding procedures and do not involve the use of complicated die constructions. Moreover, the walls and webs of the honeycomb structure provide the pin with a resiliency and shock absorbing character conducive to long life and proper action.

Shown in FIGURES 1-5 are supplementary means operable closer to the outer surface of the pin than the keys 59 of the stem 20 to render the adjacent tandem sections non-rotatable relative to each other and which may serve this function when a different form of stem as in FIGURES 7 and 11 for example are used. Such means are also useful to arrange the cavities of adjacent sections in a predetermined orientation as where for example in the case of tenpins it may be preferred to avoid longitudinal alignment of cavities of the adjacent sections. For this purpose the head, base, and neck sections 12, 18 and 14 respectively are provided with a plurality of dowel-like projections or pins 100, 102 respectively, three being shown on each section and the head section 12 is provided with five small projections or pins 104. As seen in FIGURES 1 to 3 the pins 100 on the base section 18 are located on the web portions defined by two cavities G and a cavity F and interengage in the cavities C of the section 16 with the radially outward portions of the pin and cavity in tangency. Also as evident from FIGURES 1, 4, and 5 the pins 102 on the neck section 14 interengage in the cavities C of the section 16 at the outermost edge of the cavities. Moreover, as seen from FIGURES 1 and 6 the pins 104 (five being shown with one

unevenly spaced) engage in recesses 106 in the upper end of the neck section 14.

In certain cases for improving the pin life and reinforcing the ball line and seam line between sections a feature is to provide a perforated annular metallic member molded in situ with the belly section in its outer wall portion 69. By preference such will take the form of an annular ring shaped like the frustum of a cone and whose opposite ends are preferably so shaped and of such diameter as to correspond respectively to the diameters of the projections 80, 82 respectively of the neck and base sections 14 and 18 respectively such that when the sections are interengaged any stress applied at the belly section is not only transmitted through the web and wall portions thereof but also to the adjoining sections.

In some cases the use of a cavitated plastic composition for the pin structure may result in a hollow sound effect upon ball impact that is somewhat different from the sound obtained with a solid hard wood pin. This is especially the case where the rubber bumper band or ring 90 is not used such as in the case of the tenpin as in FIGURE 11. Although this is not objectionable in any way so far as pin performance is concerned a sound adjustment may be made by inserting in all the cavities A and B of the belly section adjacent the outer surface thereof a flexible cellular filler 119 such as expandable polystyrene beads having gas cavities. Such beads may conveniently be applied by forcibly injecting them in a hot fusible condition into the cavity so as to form a solid adherent mass throughout the cavity. The filler acts as a deadener to reduce the sound echo produced by the open cavities. It will be understood that other fillers may be utilized providing a similar functioning cellular structure and providing a measure of flexibility such that under repeated stress on impact the filler will not break down or lose its character so as to shake or move around in the cavities. It is found that adequate sound control is possible by applying the deadener to only the cavities bordering on the outer wall of the belly section but the invention is not limited thereto.

A further feature is to provide the base of the pin structure with a combined pin locating, wear and impact resisting insert 120 that will also provide a suitable end cover for the stem 20. As shown this insert 120 will preferably comprise a T-shaped bushing having a base portion 122 and an upwardly projecting closed ended tubular finger 124 whose base 126 opens through the base 122 and that tightly telescopes with the open end of the tubular stem 20. The base portion is also provided with a short upstanding annular flange 128 of smaller diameter than the exterior of the insert that interengages in the recess 68 of the pin base section 18 and provides a shoulder portion 130 that abuts the base 132 of the section 18 and that provides an exterior contour that is a smooth continuation of the contour of the pin section 18. The insert may be made of the same synthetic composition as the pin sections but preferably will be made of a non-brittle high impact high strength, low resilience and bounce material like a long chain polymeric amide thermoplastic composition such as nylon.

FIGURE 7 shows a bowling pin of the same general type as that in FIGURE 1 and having a similar honeycombed arrangement of cavities A to J. It differs however in the stem structure previously described involving the use of a threaded tube 24, a cap 28 and a threaded nut 26 and more particularly in the orientation of its sectional cavities and means for rendering the main sections non-rotatable relative to each other.

Thus it will be evident that in contrast to the thirty degree rotational offset of the cavities C of the belly section 16 with respect to the cavities of the base section 18 and to the cavities J of the neck section 14 in FIGURE 1 the cavities C, G, and J in the FIGURE 7 pin structure are in alignment. Moreover, the section 16 is provided at its opposite ends with a plurality of short tubular metal

or rigid plastic tubes 140, 142 fitted into the cavities C. These tubes may be tightly pressed and/or cemented in place in the cavities C. The tubes 140 each have a projecting portion 144 which interengages with a cavity J to render the sections 14 and 16 relatively non-rotatable and to strengthen the seam line and the tubes 142 have projecting portions 146 for making similar connections with the cavities G of the base section 18. It will be understood that any number of tubes 140, 142 may be used as many as one in each of the cavities C as shown but it is preferred that three be used at each end of the section 16 and in different cavities C. It will be understood that the stem structure in FIGURE 7 may be replaced by a stem construction as in FIGURE 1 in which event the tubes 140, 142 may be used as supplementary connectors and for their other desirable functions described.

The construction of the tenpin in FIGURE 11 follows the same general pattern of cavities A to J and in accordance with the aligned orientation of FIGURE 7. The structure here differs in the specific stem construction which has already been described and in the featured interlock between the adjacent main sections. Thus as seen in FIGURES 11 and 12 the belly section 16 is molded with three different of its cavities C at each end closed by dome-like ended projections 150, 151 respectively such that the projections at each end are offset rotatably speaking sixty degrees. The projections 150 are arranged to interlock with the cavities J of the neck section 14 and the projections 151 with the cavities G of the base section 18.

It will be understood that in all of the foregoing embodiments the separate neck and belly sections 14 and 16 which are individual intermediate sections may if desired be molded as a single belly or intermediate section instead of separate intermediate sections. Also that the head section 12 may be molded integrally with the intermediate neck section 14. However it is preferred to maintain these portions 12, 14, 16 and 18 as separate sections.

Moreover it is preferred that in the intermediate or belly section which receives the greatest impact in play that this section be divided into a plurality of tandem sections each rotatably offset from the next adjacent one such that the peripheral cavities instead of extending the full depth of the belly section at full width will be broken into portions of less height preferably less than one inch in height, offset from each as seen in elevation and in plan. In such cases it is preferred for the purpose of rendering the sections relatively non-rotatable to employ the sectionalized stem of FIGURE 1 providing the keys 59 for this purpose.

Referring to FIGURES 14 and 15 wherein are shown plan and elevational sections of the belly section 16 modified as aforesaid the belly section 16 is here made in three tandemly interconnected sub-sections 160, 162 and 164 each provided with the pattern of cavities A, B, C of FIGURE 12 but offset from each other by 15 degrees of angle as seen in FIGURE 15.

The middle sub-section 160 is recessed to provide opposite annular flange portions 166, 168. The section 162 has a lower projecting portion 170 which snugly interconnects with the section 160 and is embraced by the flange 166 thereof the end of which abuts the shoulder 172 of the section 162. The upper end of the sub-section 162 is recessed and fitted with the neck section 14 in the same manner as shown in FIGURE 11.

The sub-section 164 is formed with an upper projection 176 which is embraced by the flange 168 of the sub-section 160 in the same manner as the connection between the sub-sections 160, 162, also the lower end of sub-section 164 is recessed to receive the projection 82 of the base section 18 of FIGURE 1 in the manner there shown. Moreover the metal reinforcement 180 of the belly section in FIGURE 14 is confined to the section 160

but shaped in the same manner as the reinforcement 69 of FIGURE 11.

In assembling any of the bowling pins of the various figures it is preferred that each joint be treated with a solvent type of cement compatible with the composition of the sections and having a slight softening effect thereon at room temperature, prior to assembly or as each section is assembled over its stem such that the sections will be united into a cold welded whole when the assembly is completed. In the latter connection it is preferred that each section be a force fit over its stem when the character of structure permits and the tandemly connected sections be compressed under load. Moreover it is preferred that following completed assembly the pins be given a short heat treatment to complete the bond effected between the sections, as well as release any high stress points at the cold weld between sections.

From the foregoing description of my invention it will be evident that a bowling pin structure containing many novel features of construction and made principally of a plastic composition yet comparable to a hard maple wood pin in action, has been presented. It will be understood that it is intended that any novel feature shown in any of the exemplified embodiments may be used in any other embodiment and that various changes and modifications will suggest themselves to those skilled in the art without departing from the spirit and intent of the invention or the principles of structure employed. All such changes and modifications and equivalent arrangements are therefore contemplated as are within the scope of the appended claims.

I claim:

1. A composite bowling pin structure comprising a plurality of tandemly arranged shape retaining sections of molded synthetic resin composition, including a head section, an intermediate section and a base section, said pin having a theoretical ball line at the normal points of impact of a ball therewith, said intermediate and base sections each having a central bore, and each comprising inner and outer annular wall simulating portions interconnected by tortuous web portions defining an enclosed honeycomb structure of finger-like cavities said inner wall portion being contiguous said bore and said outer wall portion being contiguous the exterior of said sections, said cavities of these sections being arranged in a plurality of concentric generally circular groupings with the cavities of an outer and inner grouping respectively touching on said outer and inner wall portions respectively and in part defining these wall portions and certain cavities of each grouping being staggered circumferentially with respect to those of the immediately adjacent group such that certain of said cavities of said outer grouping are backed up by radially extending web portions that extend inwardly between a pair of cavities of an inner grouping and in part define the latter cavities, and certain cavities of these sections crossing said ball line.

2. A composite bowling pin structure comprising a plurality of tandemly arranged interengaged shape retaining sections of molded synthetic resin composition, including a head section, an intermediate section and a base section, said pin having a theoretical ball line at the normal points of impact of a ball therewith, said intermediate and base sections each comprising inner and outer annular wall simulating portions interconnected by tortuous web portions defining an enclosed honeycomb structure of finger-like cavities, said cavities of these sections being arranged in concentric generally circular groups respectively touching on said outer and inner wall portions respectively and in part defining the same and the cavities of each group being staggered with respect to those of the immediately adjacent group such that certain of said cavities of a group are backed up by radially extending web portions that extend between a pair of other cavities of another group and connect with said inner wall portion and other

cavities and backed up by web portions which connect with said radially extending web portions said web portions being of less thickness than the width of said cavities and certain cavities of these sections crossing said ball line.

3. A composite bowling pin structure comprising a plurality of tandemly arranged shape retaining sections of molded synthetic resin composition including a head section, a neck section, a belly section and a base section, said last three named sections each comprising inner and outer annular wall simulating portions interconnected by tortuous web portions defining an enclosed skeletal structure of finger-like cavities, said cavities in each of these three sections being arranged in a plurality of concentric generally circular groups with the cavities of one group touching on the inner wall portion of the section and in part defining the same and with the cavities of two groups substantially touching on the outer wall portion of the section and in part defining this wall portion and with the cavities of each group being staggered with respect to those of an adjacent group, and there being web portions between adjacent cavities of each of said three sections and which interconnect said inner and outer wall portions, certain web portions being radially extending and backing up certain cavities of each section touching on said outer wall portion and other web portions of certain of said three sections backing up other cavities which touch on said outer wall portion and connecting with said radially extending web portions.

4. The invention in claim 1 wherein said intermediate section comprises a plurality of tandem sub-sections each having the stated honeycomb structure and wherein the cavities of adjacent sub-sections are rotatably offset and overlap each other.

5. The invention in claim 1 wherein the cavities of said intermediate section immediately adjacent said outer wall portion contain a sound deadening cellular material bonded therein.

6. The invention in claim 1 wherein said outer wall portion of said intermediate section includes an annular barrel-shaped, perforated, shape retaining member embedded in the plastic composition of said section and having its opposite ends in overlapping relationship with the adjacent sections whereby to facilitate the transmission thereto of impact forces received by said intermediate section.

7. A composite bowling pin structure comprising a plurality of tandemly arranged shape retaining sections of molded synthetic resin composition, including a head section, an intermediate section, and a base section, a reinforcing stem securing said sections in abutting relationship, said stem comprising a hollow metallic member having a bulbous upper end portion bonded in said head section and having an elongated shank portion extending through said sections to adjacent the lower end of the base section thereof, said bulbous end and shank portion having an integral key-like projection extending lengthwise thereof and engaged in mating keyways in said sections for rendering them relatively non-rotatable, a recess in said base section through which said shank extends, a transverse slot in said key projection of said shank extension and a clamping member received over said shank extension in said recess in abutment with said base section and having a lip portion engaged in said slot.

8. A composite bowling pin structure comprising a plurality of tandemly arranged shape retaining sections of molded synthetic resin composition including a head section, an intermediate section, and a base section, a reinforcing stem securing said sections together including a bulbous end portion in the head section, a shank portion extending through said section short of the base section and into a recess therein, a key projection on said shank portion engaged in keyways in said sections and a clamping member received over said shank extension and interlocked with said key projection in said recess, said inter-

mediate and base sections each comprising inner and outer annular wall simulating portions interconnected by tortuous web portions defining an enclosed skeletal structure of finger-like cavities, said cavities of these sections being arranged in concentric generally circular groups with the outermost and innermost groups respectively touching on said outer and inner wall portions respectively and in part defining the same and the cavities of each group being staggered with respect to those of the immediately adjacent group such that certain of said cavities of said outermost group are backed up by radially extending web portions that extend inwardly between a pair of cavities of an inner group and connect with said inner wall portion.

9. The invention in claim 8 wherein said intermediate section comprises a plurality of interengaged sub-sections one on the ball line of the pin and wherein the cavities of adjacent sub-sections are rotatably offset from one another and wherein said sub-section on the ball line includes an annular reinforcing member in its outer wall portion adapted to transmit impact forces to the adjacent sections.

10. A composite bowling pin structure comprising tandemly arranged base and upper sections of molded synthetic resin composition, said pin having a theoretical ball line at the normal points of impact of a ball therewith, each section having a central bore and each comprising inner and outer annular wall simulating portions interconnected by web portions defining a structure of elongated cavities extending longitudinally of the sections with certain of said cavities crossing said ball line and certain cavities touching on said wall simulating portions and in part defining the same, said cavities in one of said sections being arranged in concentric groupings with the cavities of each grouping staggered with respect to those of the immediately adjacent grouping such that certain of the cavities are backed up on one side by said outer wall simulating portion and on the opposite side by radially extending sections of said web portions in part defining pairs of cavities of an adjacent concentric grouping thereof and connecting with said inner wall simulating portion.

11. A composite bowling pin structure comprising tandemly arranged base and upper sections of molded synthetic resin composition, said pin having a theoretical ball line at the normal points of impact of a ball therewith, each section having a central bore and each comprising inner and outer annular wall simulating portions interconnected by web portions defining a structure of elongated cavities extending longitudinally of the sections with certain of said cavities crossing said ball line and certain cavities touching on said wall portions and in part defining the same, said cavities on the ball line of the pin being arranged in concentric groupings with the cavities of each grouping staggered with respect to those of the immediately adjacent grouping such that certain of said cavities are backed up on one side by said outer wall simulating portion and on the opposite side by radially extending sections of said web portions in part defining pairs of cavities of an adjacent concentric grouping thereof and connecting with said inner wall simulating portion.

12. A composite bowling pin structure comprising tandemly arranged base and upper sections of molded synthetic resin composition, said pin having a theoretical ball line at the normal points of impact of a ball therewith, each section having a central bore and each comprising inner and outer wall simulating portions interconnected by web portions defining a structure of elongated cavities extending longitudinally of the sections with certain of said cavities crossing said ball line and certain cavities touching on said wall simulating portions and in part defining the same, said cavities in one of said sections being arranged in concentric groupings with the cavities of each grouping staggered with respect to those of the immediately adjacent grouping such that certain of the cavities

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are backed up on one side by said outer wall simulating portion and on the opposite side by radially extending sections of said web portions in part defining pairs of cavities of an adjacent concentric group thereof and connecting with said inner wall simulating portion and a resilient ring surrounding said pin on said ball line.

13. A bowling pin as claimed in claim 10 wherein said one section is said upper section and said ball line passes through said base section.

14. A bowling pin as claimed in claim 10 wherein said one section is said upper section and said ball line passes through said upper section.

15. A bowling pin as claimed in claim 10 wherein said one section is said base section and said ball line passes through said base section.

16. A bowling pin as claimed in claim 10 including a stem-like reinforcing member non-rotatably engaged with said sections in the central bores thereof.

17. A bowling pin as claimed in claim 11 wherein the total cross-sectional area of the cavities on the ball line is about fifty-five percent plus or minus ten percent of the total cross-sectional area on the ball line intermediate the outer wall simulating portion of the pin and the central bore thereof.

18. A bowling pin as claimed in claim 10, wherein the wall simulating portions and web portions of said sections have a thickness no greater than about $\frac{3}{8}$ of an inch.

19. A bowling pin as claimed in claim 10 wherein a majority of the cavities are between about one quarter inch to about one inch in section.

20. A bowling pin as claimed in claim 11 wherein certain cavities on the ball line of the pin and immediately adjacent the outer wall simulating portion thereof contain a sound deadening cellular material bonded therein.

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21. A bowling pin as claimed in claim 10 wherein certain cavities immediately adjacent the outer wall simulating portion of the pin contain a sound deadening material bonded therein.

5 22. A bowling pin as claimed in claim 10 wherein there is an annular perforated shape retaining member embedded in the outer wall simulating portion of one of said sections.

10 23. The invention in claim 10 wherein said pin structure has a hollow central metallic stem extending into each of said sections which stem includes an elongated integral key interengaged with a keyway in each of said sections.

15 24. The invention in claim 10 wherein the pin structure includes a hollow central metallic reinforcing stem comprising complementary flanged half sections whose flange portions provide keys for nonrotatably holding the tandem sections and a clamping washer received over said stem and having an inner peripheral edge portion engaged in slots in said flange portions.

References Cited by the Examiner

UNITED STATES PATENTS

1,515,606	11/24	Miller	273—82
1,722,557	7/29	Cherrette	273—82
2,180,676	11/39	Guimond	273—82
2,202,674	5/40	Seaman et al.	273—82
2,517,116	8/50	Klinger	273—82
2,618,481	11/52	Dosker	273—82
3,037,771	6/62	Gambino	273—82

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