My invention relates to bead chains and other serially interconnected articles.

Preferred forms of my invention comprise substantially duplicated elements, each element comprising essentially a socket or other hollow portion, a stem or body portion and a head or other enlarged portion, the head or enlarged portion of one element being articulately received and retained in the socket or other hollow portion of the succeeding element, such serial interconnection resulting in a chain or other interconnected product of such elements.

From a broader viewpoint, my invention relates to individual elements each generally comparable to an individual link of a bead chain or other serially interconnected article, but which individual elements are not necessarily serially connected, each of which individual elements possesses generally a non-uniform contour of its respective portions, one portion of each individual element being of hollow formation.

A suitable construction of machine for forming articles of the nature of bead chain elements, whether serially interconnected or individual, i.e. non-interconnected, is set forth and claimed in my copending application Serial #64,722, filed Feb. 19, 1936, now entitled "Machine for forming cold wrought products."

A primary feature of my invention resides in that each element is produced from an individual billet and by tools effecting swaging, drawing, forming, heading, extruding or like cold operation or operations whereby each element is formed without any machine cutting operation; accordingly, my invention permits the employment of individual billets, each billet having a cubical content equal to that of the element produced therefrom, and therefore eliminating all scrap loss or other wastage.

A further distinctive feature of my invention is that the configuration of each link or other individual element may be elected as desired, in that the configuration is not restricted to circular or cylindrical outline necessitated by machine cutting operation. Advantageously, the configuration of each link or other individual element formed pursuant to my invention, is symmetrical, and may be of square, hexagonal or other suitable polygonal contour.

A further advantage of my invention is that it lends itself to the employment of rod or wire, from which the individual billets are sheared to predetermined cubical contour, and additionally if preferred to predetermined shape.

By reason of each link or other individual element being produced by the above stated cold operation or operations of swaging, drawing, forming, heading, extruding, etc., as is more particularly set forth in my aforesaid copending application Serial #64,722 the material of each link or other individual element is solid throughout its respective portions, of high density, i.e., of compact grain structure, and the faces of the respective portions are self-finished and free from tool marks, burrs and the like unavoidable in the use of machine cutting tools and the like, and accordingly my products do not require the labor in finishing operations ordinarily required for polished, plated, lacquered or other finishes.

By reason of the compacted grain structure of each portion of each link or other individual element, particularly its hollow portion, the material of each link or other individual element made pursuant to my invention is homogeneous and free from porosity, and possesses high tensile and other strengths, accompanied by high resiliency, particularly effective at its hollow portion.

As a general result, my invention is advantageous in the manufacture of a wide range of shaped articles commonly formed on heading machines, screw machines, lathes and like turning equipment, the range of such products manufactureable pursuant to my invention being enlarged by reason of the above stated enlarged scope of election of configuration.

The method for producing my above stated links or other individual elements makes possible the employment of punches, bushings, dies and the like, which require no sharpening nor re-setting necessary in machine cutting tools, such as screw machines, lathes and the like, the stated tools employed in the production of my invention being further of low initial cost, of long life of service, low tool maintenance, etc.

My invention is particularly applicable to metal inclusive of alloys as the material of each billet. The respective billets may be of the same material, or may be of different material supplied alternately or in other relative order, in which latter arrangement the resulting chains or other serially connected formed elements are composed of elements of varied composition.

Further features and objects of my invention will be more fully understood from the following detailed description and the accompanying drawing, in which

Fig. 1 is a side elevation, partly in central section, of one form of duplicated individual links serially interconnected to form a bead chain.
Fig. 2 is a face view and Fig. 3 a plan view of an individual billet, shown on an enlarged scale. Fig. 4 is a top plan view and Fig. 5 is an elevation partly in central section of an individual element embodying my invention. Figs. 4 and 5 serve also to illustrate one form of element having a hollow portion to which is integrally connected a stem portion. Figs. 4 and 5 also illustrate an individual element in an intermediate stage applicable as an individual link of a bead chain as is shown in Fig. 1.

Fig. 6 is a side elevation and Fig. 7 is a bottom plan view of another embodiment of individual element pursuant to my invention. Figs. 6 and 7 serve also to illustrate an individual link at intermediate stage applicable to the formation of a bead chain as shown in Fig. 1.

Fig. 8 illustrates one manner of serially interconnected individual elements of the character shown in Figs. 6 and 7 in the production pursuant to my invention of a bead chain as is shown in Fig. 1.

Fig. 9 is an elevational view of a bead chain formed of serially interconnected links having each a hexagonal configuration, pursuant to my invention.

Fig. 10 is an elevational view of a bead chain formed of serially interconnected links having each a four face configuration, pursuant to my invention.

Without limiting the scope of my invention, I refer firstly to its embodiment in the form of a bead chain, such as is illustrated in Fig. 1. From this viewpoint, the showings of Figs. 2 through 8 represent successive stages of the production of such bead chain. Figs. 2 and 3 illustrate the billet 20 primarily having a predetermined cubical contour. As is illustrated in Figs. 2 and 3, and as will be more apparent from Figs. 4 through 8, the billet 20 shown in Figs. 2 and 3 may also be of predetermined contour.

The article shown in Figs. 4 and 5 is produced from the billet 20 shown in Figs. 2 and 3, namely by swaging, or drawing, or forming, or extruding, or like cold operation or operations, singly or plurally, a primary characteristic of which includes the formation of a hollow end portion 21 to which is integrally connected the stem portion 22. The hollow portion 21 may be of any desired contour and/or dimensions. Advantageously, the outer contour of the hollow portion 21 conforms to the outer contour of the billet 20, the stem portion 22 being produced from the cubical content of the billet 20 by the above stated cold operations, singly or plurally. The stem portion 22 may have any configuration and dimensions as desired.

Such link or other individual element shown in Figs. 4 and 5 when applied as a link in a bead or other chain is provided with an expanded portion at or adjacent the end of its stem portion, such as is illustrated at 23 in Figs. 6 and 7. Such expanded end portion is preferably in the form of individually extending tongues 23a, of any desired number and individual dimensions and/or configurations. Such enlargement 23 is of utility for its interconnection serially with a duplicate in the production of a bead chain or other article of serially connected individual elements.

Fig. 8 shows one method of interconnecting serially any desired number of such links or other duplicate individual elements with forged bead chain, such as is illustrated in Fig. 1, or other serially interconnected product. Essentially, the peripheral portion of the hollow portion 21 of each link is formed or otherwise cold worked to a relatively restricted open end formation such as is indicated at 21b of the therein lowermost link, the resulting opening 21c having a diameter or other dimensions to retain the enlargement of the succeeding, in this instance the next upper link and to afford the desired articulation.

An especial advantage attributable to my invention is that the wall 21a of the socket or other hollow portion 21 may be of highly reduced dimension, which by reason of its homogeneous and compacted structure of material possesses sufficient tensile and other strengths as well as resiliency to afford the production of a bead chain or other serially connected product fully capable of withstanding the imposed stresses and strains incidental to its use in the operation of current switches of electric fixtures, attachment of lavatory and bathtub plugs, key chains, etc.

Fig. 9 illustrates firstly an individual element 24 comprising a portion 25 of hexagonal outer configuration, a stem portion 26 and an enlarged end portion 27. Fig. 9 illustrates further the employment of a plurality of such individual elements serially interconnected with one another to form a chain such as a bead chain.

Fig. 10 illustrates two foldy an individual element 28 comprising a hollow portion 29 in this instance of "four face" outer configuration, a stem portion 30 and an enlarged portion 31 at or adjacent the free end of the stem portion 32; and the employment of a plurality of such individual elements serially interconnected with one another to form a chain such as a bead chain.

The manner of effecting serial interconnection of the individual elements shown in Figs. 9 and 10 may be had as is illustrated in Fig. 8 and otherwise described herein.

Suitable mechanism for effecting the above stated cold worked operations, and additionally in serially related and continuous stage of production, as carried out by me under commercial conditions, is set forth in my aforesaid copending application Serial No. 64,722.

From the above, it appears that my invention resides in a new article of manufacture of preferably metallic composition wrought to its final configuration from a billet of predetermined cubical content, and also preferably of a billet of predetermined outer configuration.

From the above, it appears that the more preferred forms of my invention comprise individual elements having a hollow portion to which is integrally connected a stem portion, the finished product being wrought to the final configurations of its respective portions.

It further appears that my invention includes the serial interconnection of individual elements, each individual element comprising a hollow portion open-ended at one end, a stem portion integrally connected with the base of its hollow portion, preferably centrally thereof, and an enlarged portion at or adjacent the end of the stem portion, the enlarged portion of successively connected elements being received within and articulated laterally retained in the hollow portion of its succeeding element.

In general, my invention is directed to individual elements of non-uniform outer and/or inner configuration and comprising a plurality of parts of different outer and/or inner configuration, each element being produced from a billet of predetermined cubical content, and cold wrought to final status, each element being further characterized by the metal or other material of all
portions being solid, of compacted grain structure and surface finished by the cold wrought opera-
tion or operations employed in attaining its final status.

I claim.

1. As a new article of manufacture, an element comprising a hollow portion including a wall hav-
ing a non-cylindrical configuration, a stem por-
tion integrally connected to the hollow portion,
and an enlarged portion at or adjacent the free
end of the stem portion, said hollow portion and
said stem portion and said enlarged portion being
of solid metal and wrought to their respective final configurations solely by cold operation.

2. As a new article of manufacture, an element
comprising a hollow portion of polygonal outer
configuration and a stem portion integrally con-
ected to the hollow portion, each of said por-
tions being of solid metal wrought to their respec-
tive final configurations solely by cold operations.

3. As a new article of manufacture, an element
comprising a hollow portion of polygonal outer
configuration, a stem portion integrally con-
nected to the hollow portion, and an enlarged
portion at or adjacent the free end of the stem
portion, said hollow portion and said stem por-
tion and said enlarged portion being of solid metal and wrought to their respective final configurations solely by cold operation.

4. As a new article of manufacture, an element
comprising a hollow portion of non-cylindrical outer configuration, a stem portion integrally
connected to the hollow portion, and an enlarged
portion at or adjacent the free end of the stem
portion, said hollow portion and said stem por-
tion and said enlarged portion being of solid metal and wrought to their respective final configurations solely by cold operation.

5. As a new article of manufacture, an element
comprising a hollow portion of non-cylindrical outer configuration, a stem portion integrally
connected to the hollow portion, and an enlarged
portion at or adjacent the free end of the stem
portion, said hollow portion and said stem por-
tion and said enlarged portion being of solid metal and wrought to their respective final configurations solely by cold operation.

6. As a new article of manufacture, serially in-
terconnected elements, each element comprising
a hollow portion, a stem portion integrally con-
nected to its hollow portion, and an enlarged por-
tion at or adjacent the free end of its stem por-
tion, the enlarged ends of successive elements
being received within and articulately retained
in the hollow portion of its succeeding element,
each of said portions being of solid metal wrought
to their respective final configurations solely by
cold operations.

7. As a new article of manufacture, serially in-
terconnected elements, each element comprising
a hollow portion of polygonal outer configura-
tion, a stem portion integrally connected to its
hollow portion, and an enlarged portion at or
adjacent the free end of its stem portion, the
enlarged ends of successive elements being re-
ceived within and articulately retained in the
hollow portion of its succeeding element, said
hollow portion and said stem portion and said
enlarged portion being of solid metal and wrought
to their respective final configurations solely by
cold operation.

8. As a new article of manufacture, serially in-
terconnected elements, each element comprising
a hollow portion of non-cylindrical outer config-
uration, a stem portion integrally connected to its
hollow portion, and an enlarged portion at or
adjacent the free end of its stem portion, the
enlarged ends of successive elements being re-
ceived within and articulately retained in the
hollow portion of its succeeding element, said hol-
low portion and said stem portion and said en-
larged portion being of solid metal and wrought
to their respective final configurations solely by
cold operation.

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