Oct. 12, 1971 J. M. REIJNHARD 3,611,609

TOY CONSTRUCTION ELEMENTS CONNECTIBLE BY PROJECTIONS IN RECESSES

Filed Jan. 2, 1969 2 Sheets-Sheet 1

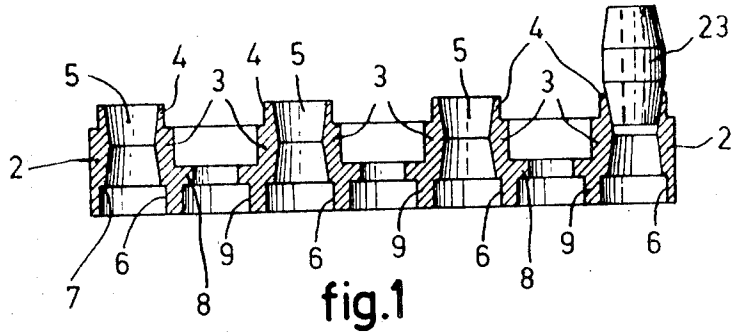

fig.1

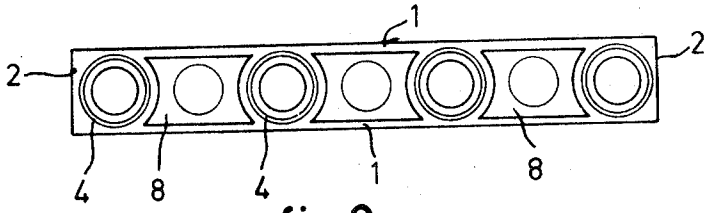

fig.2

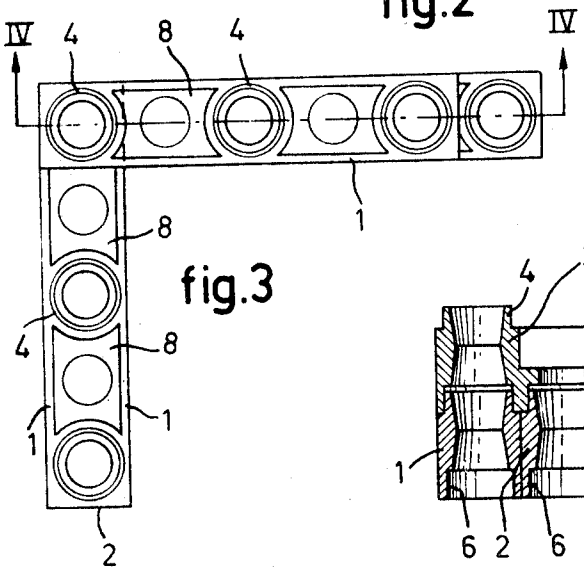

fig.3

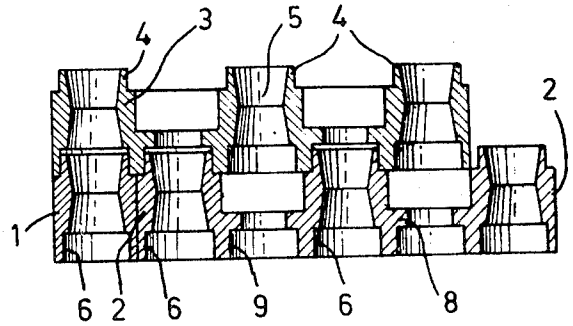

fig.4

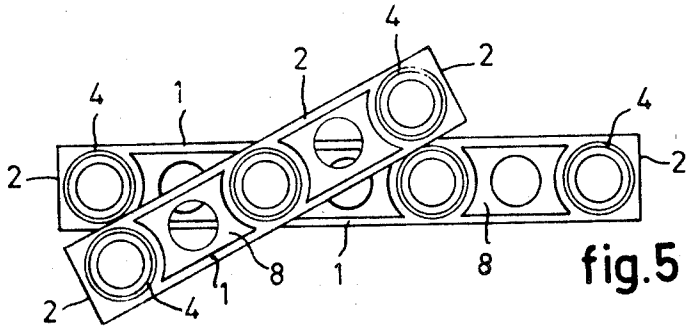

fig.5

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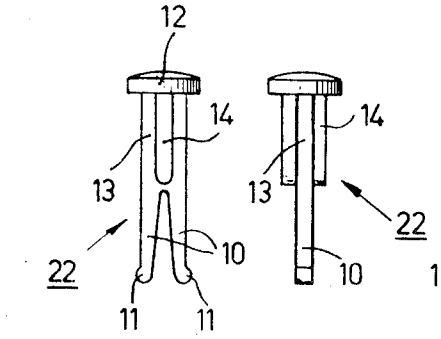

fig. 6 fig. 7

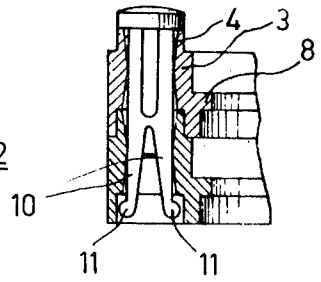

fig. 8

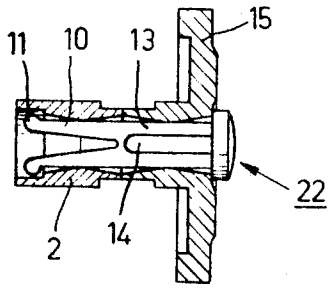

fig. 9

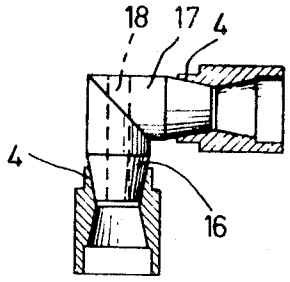

fig. 10

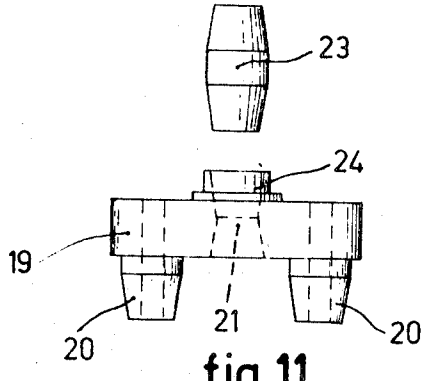

fig. 11

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United States Patent Office 3,611,609 Patented Oct. 12, 1971

3,611,609

TOY CONSTRUCTION ELEMENTS CONNECTIBLE BY PROJECTIONS IN RECESSES

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Filed Jan. 2, 1969, Ser. No. 788,465
Claims priority, application Netherlands, Jan. 3, 1968, 6800094
Int. Cl. A63h 33/08, 33/10
U.S. Cl. 46—25 8 Claims

ABSTRACT OF THE DISCLOSURE

A toy construction element having a row of projections on the top side and corresponding recesses on the bottom side, and a bore through each projection and coaxial recess; each bore defines a pair of truncated cones joined at their mutual and smaller diameter. Between each pair of adjacent projections is an auxiliary aperture having its opening on the bottom side formed as one of said recesses. Two of said elements are joinable either by insertion of a projection of one into a recess of another, or by placing a connection element having two conical ends in bores of two adjacent structural elements.

The invention relates to a toy structural element of synthetic plastics material which has a mainly prismatic shape and is provided with a row of projections in the shape of circular cylinders projecting on one side from the prismatic body, and circular cylindrical recesses located on the side facing the projections in which recesses the projections of a similar structural element fit tightly.

In known toy structural elements it is possible to construct in substantially only three mutual perpendicular directions, namely in the direction of height and in two mutual perpendicular directions transverse to the direction of height. In known structural elements having one row of projections the pitch between the projections is the same as the width of the structural element in order to enable two elements, the end face of one of which engages a side face of another element, to be connected by means of a structural element located above or below said elements. This configuration limits the possibilities of construction. To obtain a structural element of small width the pitch between the projection must furthermore be small. Fixation of a structural element to another element in such a manner that the elements form a sharp angle of small size is not possible in the known elements. Furthermore a small pitch distance may render manufacture difficult.

An object of the invention is to provide a toy structural element which permits a greater extent of freedom in construction than known structural elements and in which the width of the element may still be smaller than the pitch of the projections. According to the invention to achieve this at least one further cylindrical recess is provided between each pair of recesses which faces two projections located side by side in which cylindrical recess a projection fits tightly, the centre distance between the projections being a multiple of the centre distance between two recesses located side by side.

The projections arranged in a row and located on one side of the structural element are now placed in such a manner that they have a pitch which is larger than the width of the structural element, namely at least twice as large. A recess faces each projection. Furthermore, at least one identical recess is provided between these recesses. Since the projections are comparatively far apart the structural elements may alternatively be connected together at a sharp angle which angle may have a slight

value and in which this connection may be used as a hinge. Since the structural elements have more recesses than projections any desirable configuration can be constructed, for example, also for structural elements in which an end face of one element engages the side face of the other. The distance between the two adjacent projections of the two elements is then smaller than the pitch between the projections of each element, but since there are sufficient recesses in the elements these projections fit in a recess of a structural element which connects the two previously mentioned elements.

The structural elements according to the invention are preferably formed of four walls, approximately cylindrical bodies being provided between two walls, the upper sides of which bodies form the projections and the lower sides of which encircle the recesses, while a partition is provided between the upper and lower faces of the structural element, which partition also forms the upper side of the recess. Thus, a robust construction is obtained which requires little material.

In a further embodiment according to the invention the cylindrical bodies are hollow and the cavities extend conically from their centres towards both ends in which cavities conical connection members tightly fit while a bore is provided in the partition at the area of the recesses not facing a projection. Since the cylindrical bodies have cavities, it is possible to insert lead-through elements through these cavities such as little spindles which may serve, for example, as additional connection elements between a plurality of structural elements or as conductors for an electric current. The connection of the structural elements with the aid of conical connection elements may furthermore be effected in a simple manner.

In another embodiment, a connection element consisting of two conical legs located at an angle of 90° is provided in at least one of the conical cavities. This makes it possible to build constructions in which the structural elements are relatively displaced about their direction of length at an angle of 90°. In a further embodiment a connection element is provided in two conical cavities which element consists of two parallel conical legs which are connected by a bridge piece at one end, said bridge piece being provided with a conical bore.

In a still further embodiment the cavity of at least one mainly cylindrical body includes a connection element made of synthetic plastics material and having a circular head of a diameter which is larger than that of the cavity of the projection, said element further having a flat web which terminates in two legs which are resilient relative to each other, the end of said web being provided with transversely protruding projections which can fit in the recesses of the structural element. An extra coupling between two elements can then be obtained and this provides also the possibility of hinging coupled elements without the risk of the structural elements coming loose. According to the invention the web of the connection member preferably has two ridges which are located transversely to the web and which adjoint the head of the connection member. Together with the web these ridges form a centring which can simply be obtained.

In order that the invention may be readily carried into effect it will now be described in detail by way of example with reference to the accompanying diagrammatic drawings in which:

FIGS. 1 and 2 show a longitudinal section and a plan view of a structural element according to the invention.

FIGS. 3 and 4 show connections of structural elements.

FIG. 5 shows a further connection.

FIGS. 6 and 7 show a resilient connection member.

FIGS. 8 and 9 show uses of the resilient connection member.

FIGS. 10 and 11 show coupling members for the structural elements.

FIGS. 1 and 2 show examples of structural elements according to the invention, which consist of synthetic plastics material and have a mainly prismatic shape with two side walls **1** and two head walls **2**. Four mainly cylindrical bodies **3** are provided between the side walls, a projection **4** of which projects above the walls **1** and **2**. The cylindrical bodies **3** are hollow, the cavity **5** being double tapered. The half apex angle of the conical angle is preferably 2°. A cylindrical principal recess **6** which has a diameter such that projections **4** tightly fit therein is provided on the lower side of the cavity **5**. The upper surfaces **7** or shoulders of these recesses are bounded by a partition **8** which is provided between the walls **1**, **2** and which serves to reinforce the structural element.

A further or auxiliary recess **9** which has the same shape as the principal recesses **6** is provided between each pair of cylindrical bodies **3** located side by side. An aperture is provided in the partition **8** above the recesses **9**. Thus, the structural element has projections **4** which are located at a certain pitch distance, while the pitch between the recesses **6** and **9** is half that of the first-mentioned pitch. The width of the structural element is the same as the pitch between the recesses **6** and **9**. By using the recesses **9** it has been achieved that the width of the structural element can remain fairly small although the distance between the projections **4** is comparatively large. The structural elements therefore provide more possibilities of application and the projections may have an external diameter which is substantially equal to the width of the structural element. Due to this large circumference of the projections a satisfactory clamping force between stacked structural elements is obtained in spite of the comparatively small number. Furthermore the cavity **5** may now be fairly large. A double tapered connection element **23** is shown in one of the projections **4**. With the aid thereof two structural elements can be connected together extra rigidly.

FIGS. 3 and 4 show that, due to the chosen number of recesses **6** and **9**, connections of structural elements are alternatively possible in which the end face of one element engages the side face of the other. It is true that two projections **4** are located closely together at the connection, namely exactly at a distance which is equal to half the pitch between two projections **4** of a structural element, but since the recesses are located at said half pitch distance, connecting does not present any difficulty.

FIG. 5 shows that two structural elements can be connected together at a sharp angle of small size. This creates the possibility of easily giving constructions to be built a shape which cannot be obtained with known structural elements or in a cumbrous manner and with the aid of more elements. Furthermore this figure shows that it is very simple to obtain hinged connections between elements which can then be mutually displaced at a large angle. In order to ensure that the elements connected do not come loose in spite of frequently using hinges, advantageous use can be made of a pin **22** shown in FIGS. 6 and 7 which is provided with resilient legs **10** the ends of which have a projection **11**. A circular head **12** is provided on the upper side of the pin. Two ridges **14** which serve as centring members when the pin is inserted in a cavity are provided transversely to the flat body **13** which terminates into the resilient legs **10**. The pin as shown in FIGS. 6 and 7 has a length such that it fits in two stacked structural elements as shown in FIG. 8. Constructions of larger length are of course alternatively possible. As is shown in FIG. 8 the projections **11** of the legs **10** fit in the recess **6** of the lower structural element; the head **12** lies on the projection **4** of the upper element. Due to the resilient property of the legs **10** simple insertion and removal of pin **22** is possible, while an inserted pin ensures that the elements will not come loose, even not if they are very frequently hinged. Such a pin **22** has also further possibilities of application in combination with the structural elements described. For example, FIG. 9 shows an embodiment in which a wheel **15** is secured to a structural element with the aid of a pin **22**. The flat body **13** and the ridges **14** form four surfaces which guide the wheel. If furthermore the projections **4** of two structural elements engage each other a connection can be established with the aid of the double tapered coupling member **23** one of which is shown in FIG. 1. In this case the pins **22** may alternatively be used as connection members. The head **12** then fits in a recess, the projections **11** in the other recess. Double tapered coupling members may alternatively be used if the recesses **6**, **9** face each other.

FIG. 10 shows a connection member which has two legs **16** and **17** located at an angle of 90° each of which extends conically at half an apex angle of 2°. By inserting a leg in a conical bore of a body **3** of a structural element and inserting the other leg in a conical bore of another structural element these elements are connected together at an angle of 90°. The leg **16** preferably has a bore **18** through which, for example, a spindle can be passed. Since the bodies **3** have double tapered cavities the connection member can be inserted into the cavity both on one side and on the other side. A further connection piece is shown in FIG. 11. It consists of a bridge piece **19** in which two legs **20** are rigidly secured. A double conical bore **21** is provided in the centre of the bridge piece in which bore a double tapered connection element **23** can be inserted, if necessary. A bore is provided through the legs **20** through which, for example, again a spindle can be passed. A projection **24** has the same shape as the projections **4** of the structural element and thus fits tightly in a recess **6** or **9**.

It will be evident that the structural elements according to the invention provide a great many possibilities of application. More important aspects are the use of the recesses **9** and the concave bodies **3**. It is possible to pass bodies through these cavities which may serve for a mechanically rigid construction, but it is alternatively possible to pass a spindle through these cavities. Furthermore they may serve as passages for electric connection elements. To this end bores are also present in the partition **8**.

It will furthermore be evident that the structural elements may have different longitudinal dimensions, a larger or smaller number of cylindrical bodies **3** thus being provided. The number of recesses **9** between two recesses **6** may alternatively be larger than one. It is possible to build base plates by means of a number of these structural elements which base plates may, however, advantageously be made as a unit, for example, by injection moulding of synthetic plastics material. Furthermore it is alternatively possible to manufacture, for example, triangular and other shapes as a unit. It is furthermore interesting to form structural elements which consist of two structural elements the side walls of which face each other. These elements may be manufactured as a unit.

What is claimed is:

1. A toy comprising at least two structural elements that are releasably connectible, each element having a generally prismatic shape including top and bottom surfaces, and having a row of spaced cylindrical projections extending outward from the top surface, each projection having height above the top surface, an outer diameter, and a cavity therethrough extending downward to the bottom surface, the portion of each cavity in the vicinity of the top surface defining a truncated cone with its base at the top surface, and the portion of each cavity in the vicinity of bottom surface being a principal recess having a cylindrical wall and a shoulder extending inward from said wall defining a downwardly facing upper surface, said principal recess having a diameter and depth corresponding to and for receiving one of said projections of another, generally similar, structural element, this recess diameter thus being greater than that of said cavity within

said projection, each element also having an auxiliary recess identical to and located centrally between each two adjacent principal recesses in said bottom surface, the pitch distance between two adjacent projections being a multiple of the pitch distance between any two adjacent principal and auxiliary recesses.

2. A toy having first and second generally similar and cooperating structural elements according to claim 1 wherein the second structural element has a predetermined width of the top and bottom surfaces, at least the first element has a pitch distance between a pair of adjacent projections substantially greater than said width of the second element, whereby the second element, when any of its recesses is connected to one projection of the first element, is pivotable thereon through more than 90° from an initial position parallel to the second element.

3. A toy according to claim 1 wherein at least one of said structural elements comprises four side walls, with adjacent edges of the walls defining said top and bottom surfaces, a partition disposed in a plane parallel to and intermediate said top and bottom surfaces, the cavities extending through said partition, which partition also defines the upper surface of each recess.

4. A toy according to claim 1, including a cooperating connector element comprising a head part having greater diameter than said cavity diameter, a body part adapted to fit within said cavity diameter, and a base part defining flexible feet spaced apart a distance corresponding to said recess diameter, the feet being sufficiently compressible together to permit axial insertion of the body and base parts through one of said cavities.

5. A toy according to claim 1 in combination with at least one connection element having a body part with each end formed as a truncated cone having a minimum diameter at the terminal part thereof, the truncated cone part corresponding in size to the conical portion of said cavities.

6. A connection element according to claim 5 wherein the axis of one of said two conical sections is disposed at 90° relative to the other.

7. A toy according to claim 1, further comprising a cooperating connector element having a cylindrical body part with each end formed as a truncated cone having a minimum diameter at the terminal part thereof, the truncated cone part corresponding in size to the conical portion of said cavities.

8. A toy according to claim 1 wherein the taper angle of the conical parts is approximately 2°.

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E. BARRY SHAY, Primary Examiner

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