

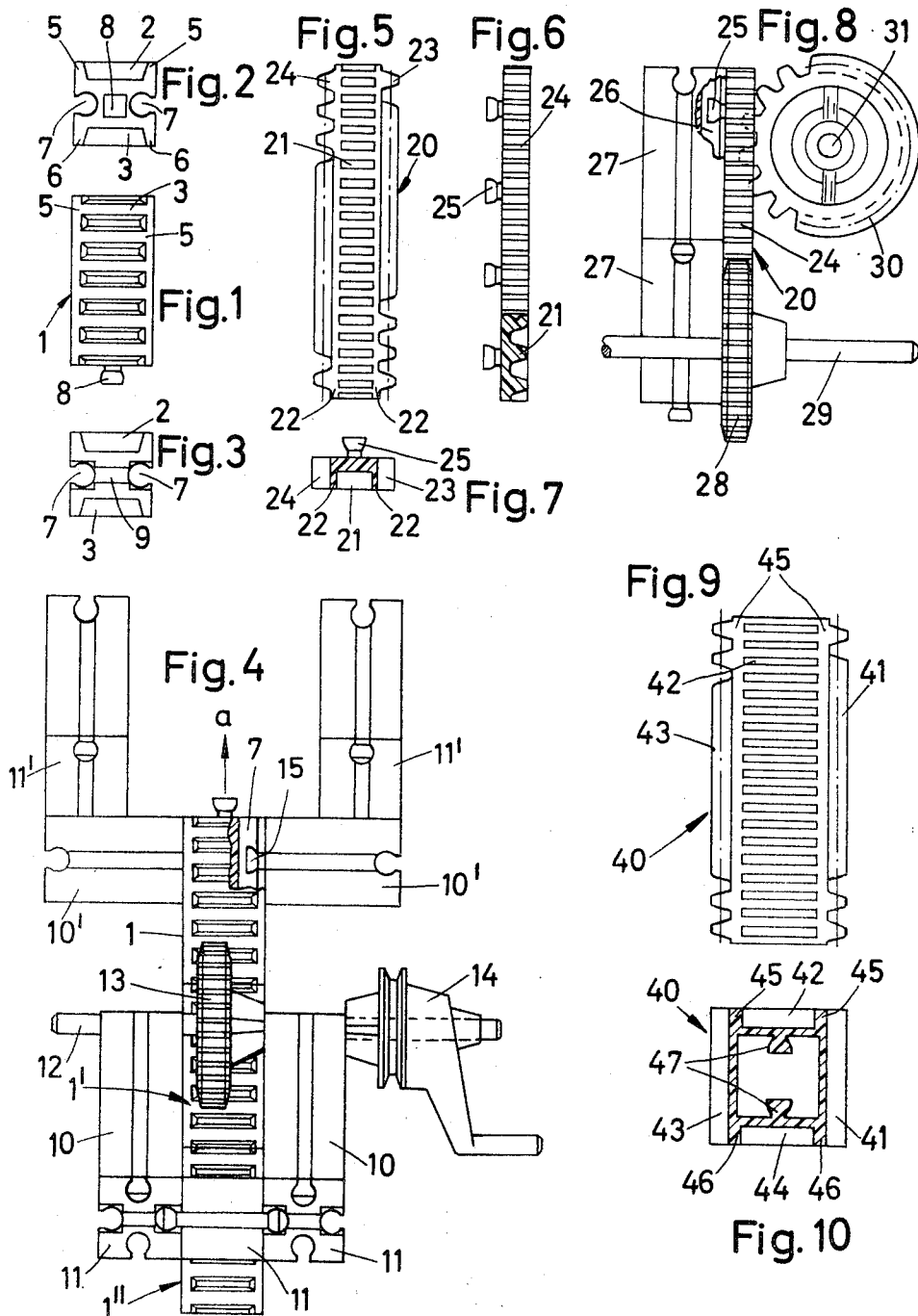
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CONSTRUCTION KIT INCLUDING TOOTHED RACK ELEMENT

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CONSTRUCTION KIT INCLUDING TOOTHED RACK ELEMENT

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14 Claims

ABSTRACT OF THE DISCLOSURE

The present invention provides a toothed rack in an assembly kit comprising structural elements with elongated undercut grooves or with male coupling portions having a wider head and a narrower neck connecting the head to the respective structural element. The toothed rack is elongated and comprises at least one row of gear teeth, cooperating coupling portions for connecting to said elements to operate as a rack or to be utilized as an additional structural element.

CROSS-REFERENCES TO RELATED APPLICATIONS

An assembly kit of the type for which the novel structural element is particularly suitable, and which comprises the structural elements with which the novel structural element disclosed herein is to cooperate and to be connected, has been disclosed in my copending application, entitled "Assembly Kit" and filed on Sept. 19, 1966 under Ser. No. 580,240.

BACKGROUND OF THE INVENTION

The present invention relates to a structural element, and more particularly to a structural element for use in an assembly kit of the type set forth in my abovementioned copending application, Ser. No. 580,240.

In the aforementioned copending application I have disclosed an assembly kit which comprises structural elements, or building blocks, which are provided in one or more faces thereof either with elongated undercut grooves, that is with grooves which diverge inwardly from the respective face in which they are formed, or with connecting heads which are configured in a manner complementary to the cross-section of the grooves, i.e. which have a relatively narrow neck portion connected to the respective building block and a wider head portion which is received or receivable in one of the grooves of another building block with a narrow neck portion extending outwardly beyond the groove. Such structural element or building blocks are connected to one another by inserting, as will be evident, the wider head in the groove, thus assuring that withdrawal of the head in the direction transversely of the elongation of the groove is not possible.

Assembly kits of this type are highly advantageous and have been very successful, particularly in the toy industry. However, the utilization of motion-transmitting means with such assembly kits heretofore has still presented a problem because it has until now been relatively difficult to connect such motion-transmitting means with the building blocks of the kit. In extant kits of this type, the connection of such motion-transmitting means to the building blocks provided with the undercut grooves and/or heads has required the provision of auxiliary connecting means which is undesirable because it increases the cost of the kit, provides additional pieces in the kit which, if the kit is used as a toy, will frequently be lost by the child using the kit, and which also require manipulative facilities on the part of the child going beyond those needed for

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connecting the basic building blocks to one another by means of the cooperating grooves and coupling heads.

SUMMARY OF THE INVENTION

The present invention increases further the versatility of assembly kits of the general type outlined above, and known from some of my prior applications such as the one mentioned earlier.

The invention provides a structural element for motion-transmitting purposes which can be simply and reliably connected to the other structural elements of a kit of the type outlined above, utilizing the same type of connecting means heretofore described.

In accordance with one feature of my invention I provide, in an assembly kit of the type which comprises structural elements provided with coupling means, a motion-transmitting member which includes first engaging means arranged to couplingly engage the coupling means of respective structural elements, and which further includes second engaging means arranged to engage an auxiliary member in cooperating relationship therewith for transmittal of motion from one to the other of these members.

In accordance with the invention my novel motion-transmitting member, which will generally be a toothed rack, is provided with at least one row of teeth on an exterior surface of the rack, and is further provided on a further surface of the rack which is located at the exterior or readily accessible from the exterior, with a male or female coupling portion adapted to cooperate with a mating coupling portion on one or more of the structural elements of the assembly kit in conjunction with which the novel rack is to be utilized.

The invention also contemplates the provision of a rack in such a manner that its cross-sectional dimensions correspond to the cross-sectional dimensions of the structural elements of the kit, so that the novel rack in accordance with the present invention is compatible with these structural elements in the direction of various models; in other words, this concept makes possible the utilization of the rack itself as a structural element or as an extension of one of the structural elements of the kit.

It is advantageous to provide not only a single row of gear teeth on the rack, but to provide two or more such rows, and I prefer to give the rack a quadratic cross-section and to provide a row of teeth each on two oppositely directed lateral faces of the rack, whereas the remaining two lateral faces, which are also oppositely directed with reference to one another, are advantageously provided with elongated undercut grooves by means of which the rack can be secured to structural elements of the assembly kit through the introduction of the male coupling heads of the latter into such grooves. The end faces of the novel rack are advantageously provided with such male coupling heads, but can also be provided with undercut grooves, if desired.

I also contemplate, in accordance with the invention, to provide three of the lateral faces of the novel rack with a row of teeth each, and to provide the remaining fourth lateral face with at least one male coupling head of the type outlined before.

In accordance with a further aspect of the invention, I may also construct the novel rack in tubular form, that is with a hollow interior bounded by an inner peripheral surface. The hollow interior will then have the cross sectional configuration of the exterior of the structural elements provided in the assembly kit, but the dimensions of the cross-section of the hollow interior will be slightly larger than the overall exterior cross-sectional dimensions of the structural elements so that the latter can at least partially be received in the hollow interior of the novel rack. In such an embodiment I provide one or, advantageously, two oppositely located facets of the inner peripheral surface-

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bounding the hollow interior with coupling portions, usually male coupling heads projecting into the interior, and it will be understood that on introduction of one or more of the structural elements provided in an assembly kit with which the novel rack is to be used, these male coupling heads will be received in corresponding undercut grooves of such structural elements.

Since the novel rack is primarily a motion-transmitting means, it of course cooperates with auxiliary members, such as with gear wheels. To assure proper guidance of such gear wheel or wheels relative to the novel rack I prefer to recess the teeth of the one or several rows in the respective surface and advantageously the tips of these teeth will be at least substantially flush with the plane of the respective surface. To further provide proper guidance for a gear wheel with which the novel rack is to cooperate, the width of the teeth as seen transversely of the elongation of each row of teeth is less than the width of the surface on which they are provided so that each row of teeth is bounded laterally by non-toothed surface portions which preferably are flush with the tips of the teeth of each row. This construction has the further advantage of providing a very compact member which can be readily used in conjunction with the other structural elements of the assembly kit, with which it is compatible, and which does not comprise any projecting edges or strips which might make such cooperation more difficult.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a top-plan view of a novel structural element in accordance with the present invention;

FIG. 2 is an end view of the embodiment shown in FIG. 1;

FIG. 3 is a view similar to that of FIG. 2, but seen from the other end of the structural element shown in FIG. 1;

FIG. 4 shows, by way of example, how the novel structural element in accordance with the present invention can be utilized in conjunction with other structural elements of an assembly kit;

FIG. 5 shows another embodiment of the structural element in accordance with the present invention, in a top-plan view;

FIG. 6 is a lateral view of the embodiment shown in FIG. 5;

FIG. 7 is a transverse section taken through the embodiment shown in FIG. 5;

FIG. 8 illustrates, by way of example, how the embodiment shown in FIGS. 5-7 can be used in conjunction with other structural elements of an assembly kit;

FIG. 9 shows yet a further embodiment of the invention in a top-plan view; and

FIG. 10 is a cross-sectional view taken through the embodiment of FIG. 9.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing now the drawing with greater particularity, and firstly FIGS. 1-3 thereof, it will be seen that the novel structural element in accordance with the present invention is a toothed rack, indicated generally with reference numeral 1. In the embodiment of FIGS. 1-3 this rack is shown to be of quadratic cross-section and it will be seen that it is provided on each of two opposite faces with a row of teeth identified, respectively, with reference numerals 2 and 3. It is clearly evident from FIGS. 1-3 that the length of the teeth in the direction normal to the

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elongation of the respective rows is less than the width of the respective lateral face so that the lateral strip-shaped surface portions 5, 6 remain which bound the respective rows 2 and 3. As is also evident from FIGS. 2 and 3, the teeth of each row 2, 3 have tips which are flush with the respective lateral face, that is the teeth of each row are recessed in their respective face so that their tips are located in the plane of the respective surface and thereby in the plane of the respective strip-shaped lateral surface portions 5, 6. This construction results in a rack whose exterior cross-sectional configuration makes it compatible with the other structural elements of an assembly kit in which it is to be used, as will become more readily evident hereafter in the discussion of FIG. 4, since there are no projecting portions on any of the various lateral faces of the rack. Furthermore, and this is also a prime consideration, a gear wheel which cooperates with the novel rack 1, or more particularly with the rows 2, 3 of teeth provided on the lateral faces of the rack 1, will be properly guided and prevented from moving laterally away from the rack, or vice versa, as will be evident from FIG. 8 and from the description of this figure which is to follow later.

As indicated, the rows 2, 3 of gear teeth are provided on two oppositely directed lateral faces of the nozzle rack 1. The remaining lateral faces, which are also oppositely directed with reference to one another, are each provided with an undercut groove 7 extending in longitudinal direction of the rack, that is parallel to the elongation of the rows 2, 3 of teeth. The configuration of these grooves, as seen in cross-section, is evident from FIGS. 2 and 3 and requires no elaboration. The end faces of the novel rack are, as is shown in FIGS. 2 and 3, each provided with an axially projecting male coupling portion, respectively identified with reference numerals 8 and 9, and the configuration of these coupling portions 8 and 9 will be particularly evident in conjunction with FIG. 4, it being obvious that these male coupling portions 8, 9 are to be matingly received in grooves such as those identified with reference numeral 7 to thus permit the novel rack 1 to be connected with other structural elements of the assembly kit which are provided with such undercut grooves.

FIG. 4 shows, by way of example, how the novel rack of FIGS. 1-3 can be used in constructing a structure in conjunction with the other structural elements of an assembly kit. Building blocks 10, 11 constitute the basic structural elements of such a kit, as is evident in FIG. 4, and since these building blocks 10, 11 are provided with undercut grooves and with male coupling portions corresponding to the various portions 7, 8 and 9 of FIGS. 1-3, the building blocks 10, 11 are secured to one another by means of these portions. A shaft 12 is supported by the thus connected building blocks and a gear wheel 13 is non-rotatably carried by the shaft 12. A crank 14 is also arranged on the shaft 12, non-rotatable relative thereto, and it will be understood that the shaft 12 with its associated gear wheel 13 can be turned by rotating the crank 14. Guides are provided, which are not specifically illustrated since they form no part of the invention, along which a composite rack consisting of inter-connected racks 1, 1' and 1'' can move in a straight line, and such movement is accomplished by engagement of the teeth on the gear wheel 13 with the teeth provided on the composite rack consisting of the individual rack members 1, 1' and 1''. Additional structural elements or building blocks 10', 11' are rigidly connected with the composite rack, or more specifically with the rack element 1 thereof, by introducing male coupling portions 15 of the structural elements 10' in the lateral undercut grooves 7 of the rack member 1. It will be evident that with this arrangement the composite rack consisting of the rack members 1, 1' and 1'' and carrying the structural elements 10' and 11', can be moved in the direction of the arrow *a*, and oppositely to this direction, by rotating the crank 14 and thereby the gear wheel 13.

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A second embodiment of the invention is shown in FIGS. 5-7 where the novel rack is identified with reference numeral 20 and is shown as carrying on its upper face a row 21 of teeth which latter are again bounded by lateral surface portions 22. FIG. 7 shows that the lateral faces, that is the faces which extend at a right angle to the upper face, are each provided with a further row 23, 24 of gear teeth, and this is also evident from FIG. 5. The underside of the rack shown in FIGS. 5-7 is flat, as evident from FIGS. 6 and 7, and is provided with at least one end, as shown in the drawing, preferably several male coupling portions 25 of a configuration which enables these coupling portions to mate with undercut grooves corresponding to those identified with reference numeral 7 in FIGS. 1-3. To make the embodiment of FIGS. 5-7 compatible with the other structural elements of the assembly kit, such as the elements identified with reference numerals 10, 11 and 10', 11', in FIG. 4, the cross-sectional dimension as measured from the tips of the teeth in row 23 to the tips of the teeth in row 24 again corresponds to the corresponding cross-sectional dimension of the structural elements 10, 11 and 10', 11' and by this it is possible to use the embodiment of FIGS. 5-7 in a fully compatible manner with such structural elements.

FIG. 8 shows how the embodiment of FIGS. 5-7 can be employed in conjunction with other structural elements of the assembly kit, and it will be seen that the novel rack 20 is secured by introduction of its male coupling heads 25 into the undercut grooves 26, two structural elements or building blocks 27, it being understood that with this arrangement the rack 20 can be shifted relative to the building blocks 27 in the direction of the elongation of the grooves 26. A gear wheel 28 cams with its teeth with the cooperating teeth of the row 24 provided on the rack 20, and the gear wheel 28 is carried by a shaft 29 which, it will be evident although not specifically illustrated, is suitably supported in bearings of any type. A second gear wheel 30 is arranged on a shaft 31 extending normal to the shaft 29 and the teeth of the second gear wheel 30 in turn cam with the teeth of the row 21 provided on the upper face of the rack 20. This construction evidently makes it possible to transmit motion between the shaft 29 and 31 by linear movement of the rack 20.

Coming, finally, to the embodiment shown in FIGS. 9 and 10 it will be seen that this deviates from the preceding embodiments in that the novel rack, which here is identified with reference numeral 40, is hollow. Its cross-section, including its interior cross-section, is quadratic in keeping with the cross-section of the other structural elements or building blocks 10, 11, 10', 11', 27 and each of its four exterior faces is provided with a row of teeth extending in longitudinal direction, such rows being respectively identified with reference numerals 41, 42, 43 and 44. The rows 42 and 44 are again bounded by lateral surface portions 45, 46 although it will of course be evident that these surface portions 45, 46 could be eliminated so that all rows of teeth would be similar to the rows 41 and 43 which are not so bounded, or that conversely the rows 41 and 43 could also be provided with such surface portions in the manner illustrated with reference to the rows 42 and 44. The hollow interior of the rack 40 is bounded, as is evident from the cross-sectional view of FIG. 10, by an inner peripheral surface comprising four mutually inclined facets and two opposite facets are provided with male coupling portions 47 which may be elongated in the direction of elongation of the rack 40, if so desired. Of course, the purpose of the embodiment shown in FIGS. 9 and 10 is to make it possible to at least partially receive one or several of the building blocks 10, 11, 10', 11', 27 in the hollow interior of the rack 40, and to make this possible it is necessary that the cross-sectional interior dimensions of the rack 40 be slightly larger than the exterior overall cross-sectional dimensions of these aforementioned building blocks. With

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such a construction these building blocks can be completely or, more likely, partially inserted into the interior of the rack 40 and it will of course be necessary to assure that only such building blocks are used which are provided with undercut grooves into which the male coupling portions 47 of rack 40 can extend, thus connecting the rack 40 securely to whichever building block or building blocks are secured to the rack in this manner.

Evidently, various modifications are possible and are intended to be encompassed herein. For instance, it is by no means necessary that the building blocks or basic structural elements of an assembly kit be of quadratic cross-section; they could, for instance, be of polygonal cross-section, or specifically of triangular cross-section or of any other cross-section which is desired. Accordingly, the cross-section of the rack in accordance with the present invention evidently also need not be of quadratic configuration but can be of any other desired configuration. Again, the arrangement of the rows of teeth, of undercut grooves and of the projecting male coupling portions can be varied at will without deviating from the inventive concept disclosed herein.

Different materials are suitable for construction of the novel rack in accordance with the present invention, and it has been found that plastic materials, such as nylon and the like, are particularly suitable for reasons of manufacturing economy, cost and other factors.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of elements differing from the types described above.

While the invention has been illustrated and described as embodied in a rack, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. An assembly kit comprising structural elements provided with coupling means and an elongated rack member having lateral surfaces and two end surfaces normal to said lateral surfaces, said rack member further comprising first engaging means including an undercut male coupling portion on one of said end surfaces projecting therefrom and an undercut female coupling portion recessed in the other of said end surfaces, and second engaging means including at least one row of teeth provided on one of said lateral surfaces and extending between said end surfaces, said second engaging means being operative for engaging an auxiliary member in cooperating relationship therewith for transmittal of motion between said auxiliary member and at least one of said structural elements through the intermediary of said rack member.

2. An assembly kit as defined in claim 1, wherein said surfaces are exterior surfaces.

3. An assembly kit as defined in claim 1, said undercut male coupling portion including a head spaced from said one end surface and a neck narrower than said head and connecting the same to said one end surface.

4. An assembly kit as defined in claim 1, said undercut female coupling portion comprising an elongated undercut groove provided in said other end surface and having a cross-section which diverges inwardly away from said other end surface.

5. An assembly kit as defined in claim 1, wherein the cross-sectional configuration of said rack member corresponds to the cross-sectional configuration of said structural elements of said assembly kit.

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6. An assembly kit as defined in claim 1, said lateral surfaces including two surfaces located in substantially parallel spaced planes.

7. An assembly kit as defined in claim 1, said lateral surfaces including two surfaces inclined with reference to one another.

8. An assembly kit as defined in claim 1, and additional second engaging means in form of at least one additional row of teeth provided on another of said lateral surfaces and also extending between said end faces.

9. An assembly kit as defined in claim 8, wherein said other lateral surface is spaced from and extends parallel to said one lateral surface.

10. An assembly kit as defined in claim 9, wherein the remaining lateral surfaces are provided with undercut grooves extending between said end surfaces.

11. An assembly kit as defined in claim 9, wherein a third one of said lateral surfaces is also provided with a row of teeth similar to said first-mentioned rows, and wherein a remaining lateral surface is provided with an undercut male coupling portion projecting therefrom.

12. An assembly kit as defined in claim 1, wherein the overall cross-sectional dimensions of said rack member

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correspond to those of said structural elements of said kit.

13. An assembly kit as defined in claim 1, wherein said teeth are narrower than the dimension of said one surface as seen in a direction normal to the elongation thereof, whereby said row is bounded by lateral surface portions which are free from such teeth.

14. An assembly kit as defined in claim 13, wherein said teeth are recessed in said one surface so that the tips of said teeth are located substantially in the plane of said one surface and thereby of said lateral surface portions.

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