Nov. 22, 1949 W. H. NOBLES 2,488,679

FLEXIBLE CHUTE

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Fig. 1

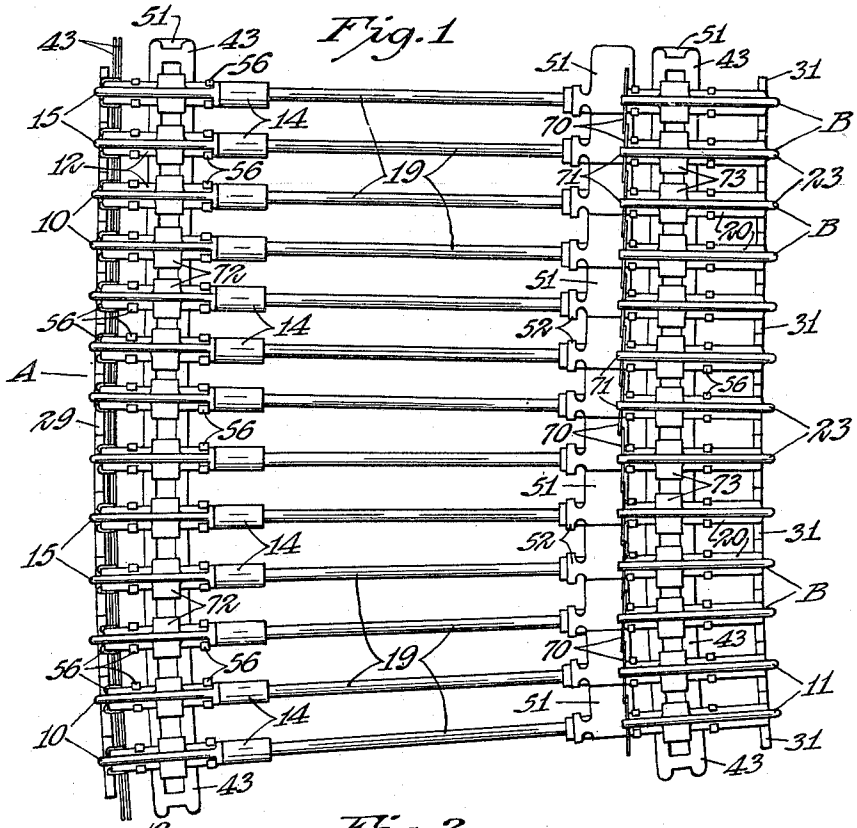


Fig. 2

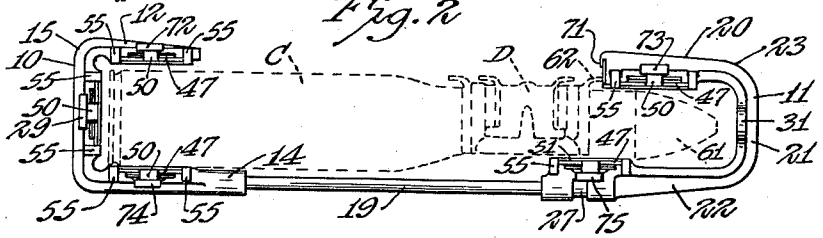
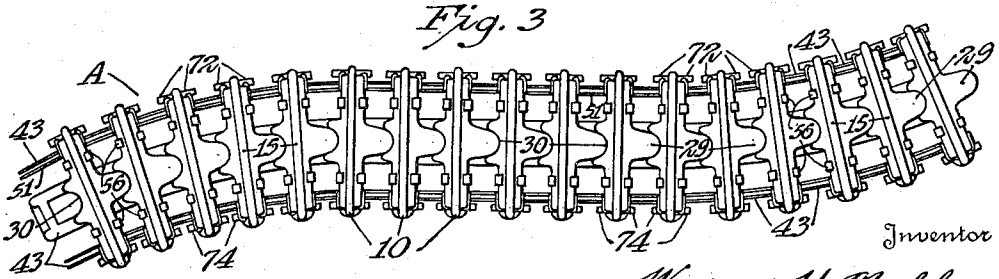


Fig. 3



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Fig. 4

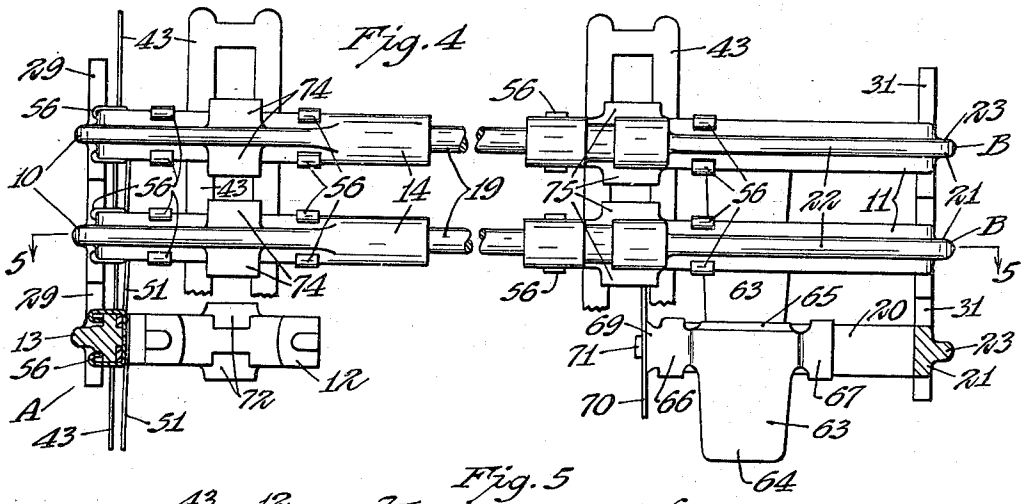


Fig. 5

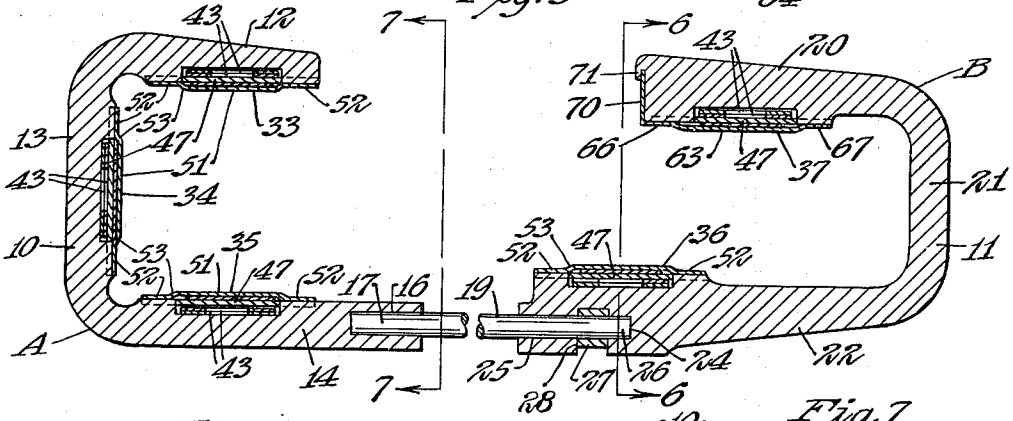


Fig. 6

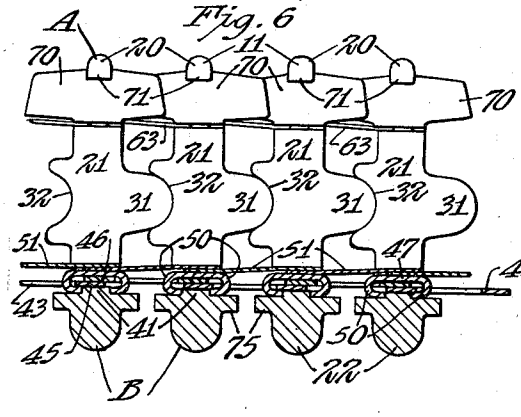
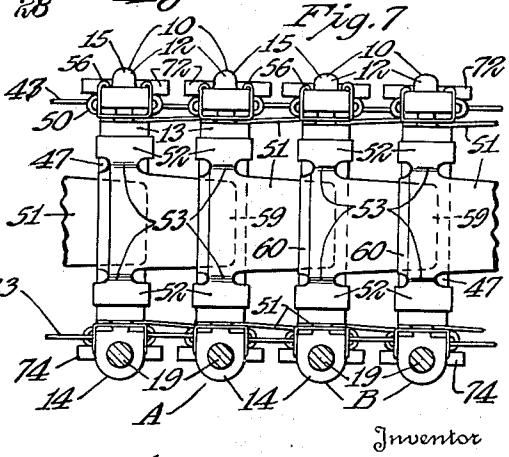


Fig. 7



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Fig. 8

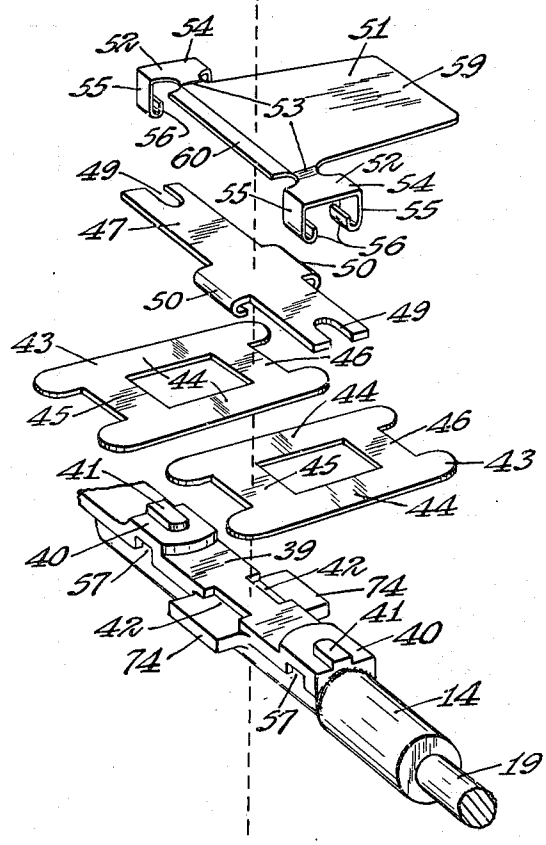
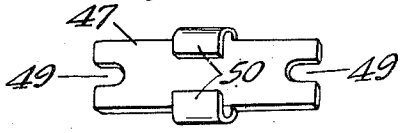


Fig. 9



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FLEXIBLE CHUTE

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Application November 23, 1944, Serial No. 564,777

20 Claims. (Cl. 193—25)

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My invention relates to an improvement in flexible chutes wherein it is desired to provide a chute which may bend in virtually any direction and which is possessed of sufficient strength to properly support high caliber shells such as those used in small cannons and the like.

The use of light cannons on aircraft and the like has made necessary a flexible chute by means of which the shells may be conveyed from the ammunition box to the cannon. Various types of flexible chuting has previously been constructed and extensively used for relatively small caliber shells. Much of this flexible chuting has been formed of sheet metal and wire and is possessed of sufficient strength to serve successfully in guiding machine gun bullets and the like into firing position. Such chutes have not been considered practical for heavy shells, however, as the necessary increase in the thickness of the sheet metal and wire increases the weight of the chuting beyond desirable limits. Thus the size of shells which could be few through flexible chuting from an ammunition box to firing position has been previously thought definitely limited to relatively small caliber size.

It is the object of the present invention to provide a flexible chute which is capable of withstanding considerable strain and may be strongly built without increasing the weight of the chuting excessively. This I accomplish by providing a series of chute elements which are flexibly connected together in spaced relation.

A feature of the present invention lies in the provision of a flexible chute including longitudinally spaced elements each comprising a pair of end guide members pivotally connected together. As a result one end of each chute element may swing about a transverse pivot to permit extreme flexibility of the chuting.

An added feature of the present invention lies in connecting longitudinally spaced elements of the chute by interlocking members which permit a variation in the spacing between corresponding portions of these adjacent elements. As a result the lower portions of the chute forming elements may be relatively close together, while the upper extremities of these elements are spaced farther apart so as to produce a longitudinal vertical curvature. The opposite curvature may be obtained by moving the upper portions of the chute forming members into contacting relation and spacing apart the lower extremities thereof.

An additional feature of the present invention lies in the provision of projections on each chute forming element which engage in a rounded

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socket on the next adjacent element. These projections may act as fulcrums to permit vertical curving of the chute in a longitudinal direction. These projections limit the movement of adjacent sections toward one another, holding them in proper spaced relationship. At the same time the projections on one side of the chute may be engaged in the corresponding sockets while the projections at the other side of the chute may be spaced apart. Thus the chute may curve transversely longitudinally of the chute.

A further feature of the present invention lies in the provision of means cooperable with the harness of the shells carried thereby to prevent contact between the nose of each shell and the corresponding side of the chute. Certain types of shells are provided with concussion heads which act to explode the shell when the nose thereof strikes an object. It is therefore necessary with such shells to hold the nose thereof away from the corresponding side of the chute so that the shell will not be prematurely exploded.

These and other objects and novel features of my invention will be more clearly and fully set forth in the following specification and claims.

In the drawings forming a part of my specification:

Figure 1 is a plan view of a length of chute forming my invention.

Figure 2 is an end view of a section of chuting showing the manner in which a heavy caliber shell may slide therein.

Figure 3 is a side elevational view of a length of chuting showing the flexibility thereof.

Figure 4 is an enlarged bottom plan view showing a short length of chuting, part of the chute forming elements being broken away to show the construction thereof.

Figure 5 is a sectional view transversely through a chute forming element, the position of the section being indicated by the line 5—5 of Figure 4.

Figure 6 is a sectional view of one side of the chuting, the position of the section being indicated by the line 6—6 of Figure 5.

Figure 7 is a sectional view showing the other side of the chuting, the position of the section being indicated by the line 7—7 of Figure 5.

Figure 8 is an exploded view showing the relationship of the chute section connecting elements as they are assembled.

Figure 9 is a perspective view of an element acting to limit relative movement between adjacent chute sections.

The chute A is comprised of a series of chute forming elements B, each of which is substantially similar in form and construction. Thus in the fabrication of the chute it is only necessary to assemble a series of similar units and to flexibly connect these units so that the chute may bend or flex in any direction. Each of the chute forming elements B includes a pair of substantially U-shaped ends 10 and 11 which are arranged with the open ends of the U in opposed relationship. The element ends 10 include an upper or top flange 12, a side flange 13, and a bottom flange 14. The cross section of the end member 10 usually presents a generally flat inner surface and a reinforcing rib 15 which extends over the major portions of the top flanges 12, the side flanges 13 and the bottom flanges 14.

A socket 16 is provided in the end of each of the flanges 14 as illustrated in Figure 5 of the drawings, and one end 17 of a connecting rod 19 is pressed therein, or otherwise affixed in place. The rod 19 does not turn relative to the end 18 of the chute forming element, but is designed to rotate in the opposed end 11 of each chute section. Obviously it would be possible to secure the rods 19 from rotation relative to the chute section end 11 and to rotatably mount this rod in the section end 10. The opposite end 11 of each chute section includes a top flange 20, a side flange 21, and an integral bottom flange 22. A reinforcing rib 23 preferably extends virtually the entire length of the various flanges described for reinforcing purposes. A transverse slot or notch 28 is formed in the flange 22, this notch or slot extending transversely of the flange or longitudinally of the chute as a whole. A socket 24 is formed in the flange 22 and an aligned aperture 25 is formed also in the flange 22, the aperture 25 extending through the portion of the flange 22 between the slot 28 and the extreme end of this flange. The end 26 of the rod 19 extends through the aperture 25 and into the socket 24 and is rotatably supported by the socket and aperture. This socket and aperture are of slightly larger diameter than the rod 19. In order to hold the rod 19 engaged to the section end 11 a collar 27 is provided in the slot 28 which is pressed onto the rod 19 as this rod is forced into the socket 24. The collar 27 prevents axial movement of the rod 19, but permits free rotative movement.

At each side of the chute A, I provide a means of limiting the movement of adjacent chute sections B toward one another. Each side flange 13 is provided with a rounded projection 29 projecting from one side thereof and a rounded socket 30 in the other side thereof. The sockets 30 are of insufficient radial length to limit the necessary angularity between adjacent chute sections. In other words, when the chute is bent in the manner disclosed in Figure 3 of the drawings so that the upper extremities of adjacent sections are closer together or farther apart than the corresponding lower flanges of the same chute sections, the sockets will permit such relative angularity. These same projections and sockets, however, do limit the movement of one section B toward the next and assist in maintaining the desired relationship between adjacent chute sections.

As illustrated in Figure 6 of the drawings the chute ends 11 are similarly equipped with spacing lugs. Rounded projections 31 extend from one side of each of the side flanges 21 and rounded sockets 32 are provided on the opposite side of each flange 21. The projections 31 of each chute section engage the socket 32 of the next adjacent chute section. The sockets 32 are angularly short enough to permit the necessary angularity between adjacent sections when the chute is bent as illustrated in Figure 3. These projections for the sockets do, however, limit movement of adjacent sections toward one another.

As best illustrated in Figures 2 and 5 of the drawings, the chute sections are connected at five different points. Each flange 12 is connected to the two next adjacent flanges 12 by suitable connecting elements indicated generally by the numeral 33. The side flanges 13 of each section B are also connected to both adjacent flanges 13 by connecting means indicated in general by the numeral 34. Each flange 14 is connected to the next adjacent flanges 14 by a connecting mechanism illustrated in general by the numeral 35. Each flange 22 is connected to the next adjacent flanges 23 by a mechanism illustrated in general by the numeral 36. The flanges 20 are also connected to the next adjacent flanges 20 by a mechanism illustrated in general by the numeral 37. All of the various mechanisms 33, 34, 35, 36, and 37 are virtually identical so that when one of these mechanisms is understood all of the other mechanisms will also be clearly understood. With reference now to Figure 8 of the drawings, the manner in which the various sections B are linked together is shown in exploded form. The mechanism illustrated happens to be the connecting mechanism 35. It will be understood, however, that all of the other connecting mechanisms are similar or identical as shown at the lower extremity of Figure 8 of the drawings. The flange 14 is provided with a flat upper surface 39 which has at either end thereof, a raised projection 40. The raised projections 40 present smooth upper surfaces to serve as a bearing for one element of the connecting mechanism, and a pair of opposed centrally located lugs 41 project above these upper surfaces of the projection 40. Opposed transversely aligned notches 42 are provided in the flat surface 39 for a purpose which will be later described in detail.

The actual means connecting adjacent chute sections B are flat substantially rectangular loops or links 43. The loops or links 43 each include a pair of parallel sides 44 and a pair of parallel ends 45 and 46. The ends 46 are recessed inwardly slightly from the ends of the sides 44 and form an open flat substantially rectangular connecting link or loop. In assembling the chute sections together two links 43 are rested upon the upper flat surface 39 in such a manner that the end strip 45 of one link 43 lies beneath the opposite end strip 46 of the other link 43. While held in this position a movement limiting clip 47 is placed to rest upon the upper surfaces of the projections 40. The clip 47 is provided at its opposite ends with notches 49 of a size to embrace the lugs 41 on the projections 40. These lugs 41 when engaged in the notches 49 prevent either lateral or longitudinal movement of the clip 47. The clip 47 is provided with opposed outwardly and downwardly bent ears 50, the ends of which extend into the notches 42. As a result the end bar 45 of the lowermost link 43 and the end bar 46 of the uppermost link 43 are in superimposed relationship and are limited in movement by the ears 50. The end bars 45 and 46 of the links 43 are substantially narrower than the space between the ears 50, thus permitting movement of the links 43 transversely of the chute sections

and longitudinally of the chute. The shape of the links, however, and the shape of the ears 50 hold the links 43 extending longitudinally of the chute.

From the foregoing description it will be obvious that the separation between any two sections is limited by the links 43 and the amount of movement between adjacent sections is determined by the difference in width in the space between the opposed ears 50 and the ends 45 and 46 of the links 43. It will also be noted that so far as has been described the two links 43 and the clip 47 are merely resting in place and are not held from vertical movement.

In order to hold the parts which have been described in assembled relation, I provide a bearing plate 51 having a pair of resilient clips 52 incorporated thereon. The clips 52 are integral with the plate 51 and are connected thereto by relatively narrow connecting strips 53. Each clip 52 includes a top portion 54 designed to overlie the ends of the clip 47 and the projections 41, these projections being of substantially the same height as the thickness of the links 43. Each clip also includes a pair of parallel spring sides 55 which terminate in reversely bent inwardly turned ends 56. The sides 55 are arranged to overlie the side edges of the clip 47 and embrace a part of the flange 14. A pair of opposed notches 57 are provided in the flange 14 into which the inwardly bent ends 56 may engage. Thus the clips 52 may be inserted by pressing the top of the clips downwardly, the sides 55 springing outwardly until the reversely bent ends 56 coincide with the notches 57, whereupon these ends 56 drop in their respective notches. When once so engaged the chute can not become accidentally disengaged, it being necessary to spring the clips 52 apart with some tool such as a screw driver or the like in order to remove the clips.

As best seen in Figure 7 of the drawings, the projecting end 59 of each plate 51 engages beneath the opposite edge of the next adjacent plate 51. In other words, the end 59 of the plate 51 is sandwiched between the body of the next adjacent plate 51 and the upper surface of the clip 47. Thus a smooth sliding surface is provided, the effectiveness of which is increased by bending downwardly at a slight incline the edge 60 of the plate 51 opposite the end 59 so as to bring the surface of the plate as close as possible to the end 59 of the next adjacent plate 51 underlying the same.

The plates 51 are obviously reversible so that the chute may be arranged for conveying goods in either direction. In guiding shells into place as shown in Figure 2 of the drawings, the plates 51 are so overlapped that movement of the shells allows the same to drop from one plate to the next, rather than to butt against the beveled or inclined edge 60 thereof. In this way the shells may be moved with a minimum of friction.

In the specific embodiment illustrated, it is necessary to prevent the nose 61 of each shell C from striking the chute as the shells will explode upon concussion. In order to accomplish this result I provide a wall of plates against which the shell harness D may slide. This shell harness, as indicated in Figure 2 of the drawings, is normally provided with ears 62 thereupon which may engage against the wall of plates provided in such a manner as to prevent axial movement of the shell to a position wherein the nose 61 will strike the side flange 21 of the end member 11.

As illustrated in Figures 5 and 6 of the drawings the connecting mechanism 37 is identical with the mechanism 35 previously described in detail, with the exception that plates 63 are substituted for the plates 51 previously described. The plates 63 are provided with a projecting end 64 which usually is sandwiched between the opposite bent edge 65 and the corresponding clip 47. Clips 66 and 67 similar to the clips 52 are also provided. However, the clip 66 is provided with an integral laterally extending ear 69 to which is secured a bearing plate 70. The bearing plate 70 is held in place at its upper extremity by being engaged beneath a lip 71 integral with the flange 29. The plates 70 are generally rectangular in form, the shape of these plates being best illustrated in Figure 6 of the drawings. These plates overlap in the same direction as the plates 63 and 51 so that the shells may be carried through the chute with the least possible friction.

Projecting laterally from each of the sections I provide spacing means which limit the movement of these sections toward one another. When the chute is flat and not curved, the chute sections are all substantially parallel and are spaced apart by the projections 29 and 31 and their corresponding sockets 30 and 32. However, when the chute is bent as shown in Figure 3 of the drawings, the flanges 12 and 20 of adjacent sections move closer together and the lower flanges 14 and 22 move farther apart, or alternatively the flanges 14 and 22 of adjacent sections move together while the flanges 12 and 20 separate. In order to limit pivotal movement in a definite way, the flange 12 is provided with laterally extending abutments or ears 72, while the flanges 29 are provided with projections 73 which extend transversely of the flange or longitudinally of the chute. Similar spacing lugs or abutments 74 and 75 are provided on the flanges 14 and 22, respectively. Upon extreme flexure of the chute, these projections will abut and prevent additional pivotal movement.

The manner in which the plates 51 overlap one another is believed clear upon an examination of Figures 6 and 7 of the drawings. Figure 6 also shows the size of the ends 45 and 46 of the links 43. It will be seen that the links may move longitudinally of the chute within the confines of the ears 50 to permit movement of adjacent chute sections toward or away from one another.

In accordance with the patent statutes, I have described the principles of construction and operation of my flexible chute, and while I have endeavored to set forth the best embodiment thereof, I desire to have it understood that obvious changes may be made within the scope of the following claims without departing from the spirit of my invention.

I claim:

1. A flexible chute comprising a series of chute forming sections, and longitudinally aligned apertured link means connecting each section to the next adjacent sections to permit said sections to move apart or together within defined limits the apertures of adjacent links overlapping.

2. A flexible chute comprising a series of chute forming sections, longitudinally aligned apertured links connecting each section to the next adjacent sections together at spaced points, the apertures of adjacent links overlapping, and means on the sections extending through overlapping apertures, said links permitting restricted separation or closing together of said sections.

3. A flexible chute comprising a series of chute sections, each chute section including a pair of

relatively rigid end members connected together to permit relative rotation therebetween on a general transverse axis, and means connecting said adjacent sections together to permit limited separation or closing together of said sections.

4. A flexible chute comprising a series of chute sections each including a pair of relatively rigid end members, transversely extending means connecting each pair of end members to permit relative rotation therebetween about an axis extending transversely of the chute, and link means connecting the relatively rigid end members of adjacent sections to permit limited movement of said sections together or apart.

5. A flexible chute comprising a series of sections each including a pair of relatively rigid end members, transversely extending means connecting said end members together in a manner to permit relative rotation therebetween, link means connecting adjacent end members together to permit limited relative movement between adjacent sections, and means holding said links in place.

6. A flexible chute comprising a series of connected sections, each section including a pair of relatively rigid end members, a rounded projection on each end member extending longitudinally of the chute, a socket on the next adjacent end member in which said projection may engage to limit movement of said sections toward one another, and means connecting adjacent sections to permit limited separation and closing together of said sections.

7. A flexible chute comprising a series of sections each including a pair of end members, said end members each including an end wall, said end walls of opposite end members of each section lying on substantially parallel planes, a rounded projection on each end wall projecting longitudinally of the chute, and a socket on the other side of each end wall to accommodate the rounded projection of the next adjacent chute section, and means connecting adjacent sections to permit limited separation and closing together.

8. A flexible chute comprising a series of sections each including a pair of substantially U-shaped end members arranged with the open ends thereof in opposed relationship, means connecting said one side of said opposed end members, and apertured link means connecting the end members of adjacent sections, the apertures of adjacent links overlapping, and means on the end members extending through the overlapping apertures to permit limited separation and closing together of adjacent sections.

9. A flexible chute comprising a series of sections each including a pair of U-shaped end members having one side of the U arranged in opposed relation, means connecting said opposed sides to permit relative pivotal movement between end members, and means connecting adjacent end members together to permit limited separation and closing together of adjacent sections.

10. A flexible chute comprising a series of chute sections, each section comprising a pair of U-shaped end members having one side thereof in opposed relation, means connecting the opposed sides of said end members to permit rotation about the axis of the connecting member, and means flexibly connecting adjacent sections together to permit limited separation and closing together of the sections.

11. A flexible chute comprising a series of sections each including a pair of end members of

U-shape having one side of one end member substantially aligned with one side of the other end member, means connecting said aligned ends to permit rotation of one end member relative to another about the axis of the aligned ends, and means connecting together adjacent sections to permit limited separation and closing together thereof.

12. A flexible chute including a series of sections each comprising a pair of substantially U-shaped end members having one side of each thereof substantially aligned, means connecting said aligned sides, a rounded projection extending from the closed end of each end member longitudinally of the chute, a socket on the closed end of each end member engageable with the rounded projection of the next adjacent section, means connecting the sides of each end member with the corresponding sides of the end member of the next adjacent section, said connecting means permitting limited separation and closing together of adjacent sections.

13. A flexible chute comprising a series of independent sections each comprising a pair of connected end members, each said end member being connected to the corresponding end members of the next adjacent section, said connection comprising links, means connecting an end of each said link to said end member in a manner to permit limited longitudinal movement of the link relative to the end member, and clip means extending over said rings and secured to said end member for holding said links engaged upon said end members.

14. A flexible chute comprising a series of sections, link means connecting adjacent sections, each said link means connected between two adjacent sections and secured to at least one section in a manner to permit limited longitudinal movement of the link relative to the section, and means secured to each said section overlying each said link of each said section to hold said link engaged upon the said section.

15. A flexible chute comprising a series of sections, apertured links connecting each pair of adjacent sections, means connecting one end of each link to one of the said sections to permit relative longitudinal movement of the link, the apertures of adjacent links overlapping means on said sections extending through the overlapping apertures, and means holding said links secured connecting said sections.

16. A flexible chute comprising a series of sections, longitudinally extending links connecting each adjacent pair of sections, means connecting one end of each of said links to its corresponding section in a manner to permit relative longitudinal movement of the link, and clip means secured to said corresponding section for holding said links engaged to said sections.

17. A flexible chute comprising a series of sections, a link connecting each pair of adjacent sections, means connecting one end of each said link for limited longitudinal movement, said last named means extending through the link, and a series of overlapping plates on adjacent sections, each said plate overlying said link to hold the link secured to its corresponding section.

18. A flexible chute for shells connected in a series by a shell harness, the chute comprising a series of sections, each section comprising a pair of opposed U-shaped members having one side thereof connected, means connecting said sections together for limited relative longitudinal movement, and means on the free end of one end

member of each pair engageable with the shell harness to limit axial movement of the shells in the chute.

19. A flexible chute comprising a pair of rigid end members of substantially U-shape, means pivotally connecting one side of each end member of every pair to permit relative pivotal movement between end members, a rounded projection on the closed end of each end member projecting toward the next adjacent end member, a socket on the closed end of each end member to accommodate the rounded projection of the next adjacent end member, means connecting the end members of adjacent sections to permit limited relative longitudinal and pivotal movement between sections, and spacing means projecting longitudinally from the sides of each of said U-shaped end members to limit movement of adjacent end members together.

20. A flexible chute comprising a series of sections each including a pair of end members of U-shape, means connecting one side of one of said end members to one side of the other end member of said pair, said connecting means being pivotally connected to one of said end members

to permit pivoting of said one end member about a transverse axis, and a series of means connecting adjacent sections, each said means including a link connecting end members of adjacent sections and permitting relative longitudinal movement therebetween, a clip overlying each end of each of said links, said clip extending through the link and acting to limit longitudinal movement of the link relative to the end member, and a plate resiliently engaging the end member to overlie each clip to hold the clip in place, the plates of adjacent sections overlapping to provide a continuous support.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,310,884	Trevaskis	Feb. 9, 1943
2,351,370	Schaff	June 13, 1944
2,419,315	Elliott	Apr. 22, 1947