United States Patent [19]

Cool

[11] **3,724,221**

[45] **Apr. 3, 1973**

[54] WATER CURRENT DIRECTING APPARATUS

[76] Inventor: **Arthur R. Cool**, Box 121, 111 Sunrise Drive, Livingston, Mont. 59047

[22] Filed: **Oct. 21, 1971**

[21] Appl. No.: **191,414**

[52] **U.S. Cl.** **61/3**, 61/5

[51] **Int. Cl.** **E02b 3/04**

[58] **Field of Search** 61/3, 4, 5, 1, 2

[56] **References Cited**

UNITED STATES PATENTS

339,548	4/1886	Haupt	61/4
3,595,026	7/1971	Scholl	61/5

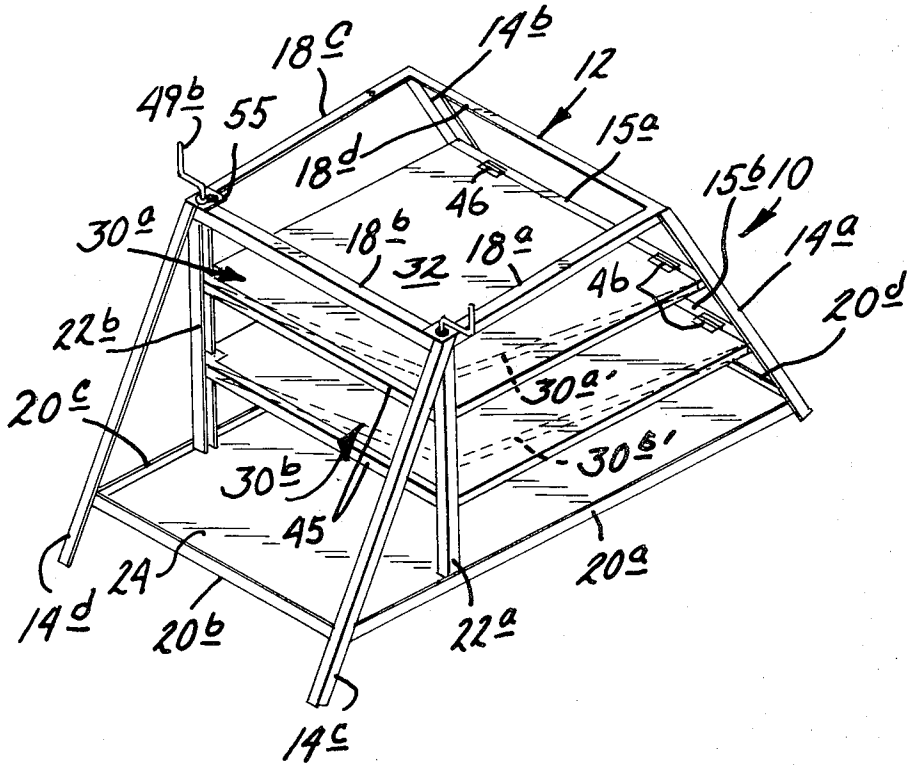
Primary Examiner—Jacob Shapiro

Attorney—Cecil C. Schmidt et al.

[57] **ABSTRACT**

A water current directing unit including an essentially open frame structure for supporting a plurality of flexible, vertically spaced current directing surfaces. Each of the current directing surfaces is inclined slightly upward from the horizontal toward the downstream end of the frame structure causing the water passing over the surfaces to force the unit toward the bottom of the stream, channel, etc. (i.e. to anchor the unit). The upstream edge of each of the current directing surfaces is pivotably attached to the frame structure and each of the corners along the downstream edges is independently moveable in the vertical direction so as to form a curved current diverting surface. A plurality of the current directing units can be positioned in either a series or parallel arrangement so as to effect the desired current diversion.

8 Claims, 5 Drawing Figures



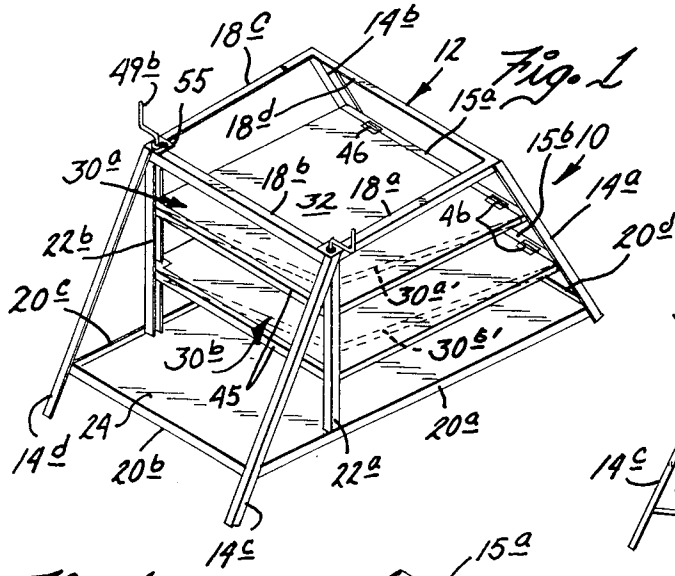


Fig. 1

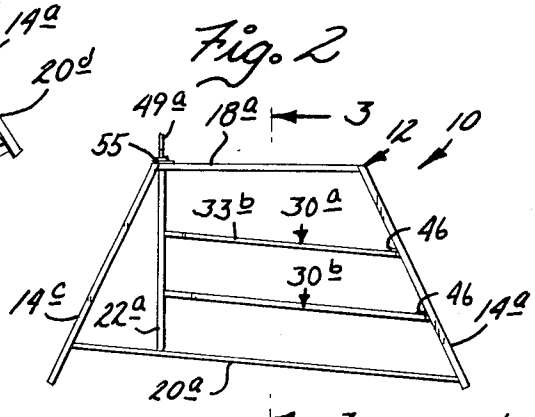


Fig. 2

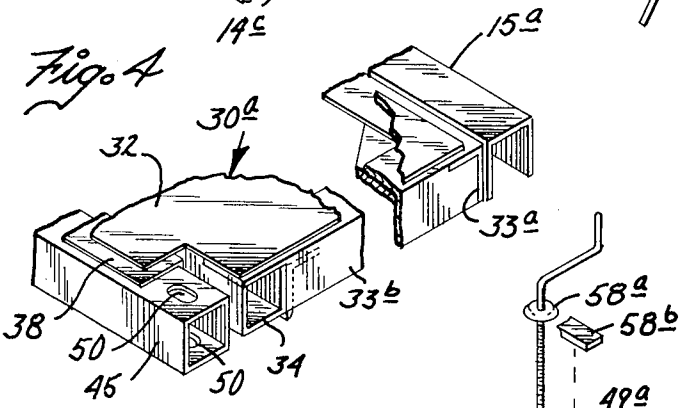


Fig. 4

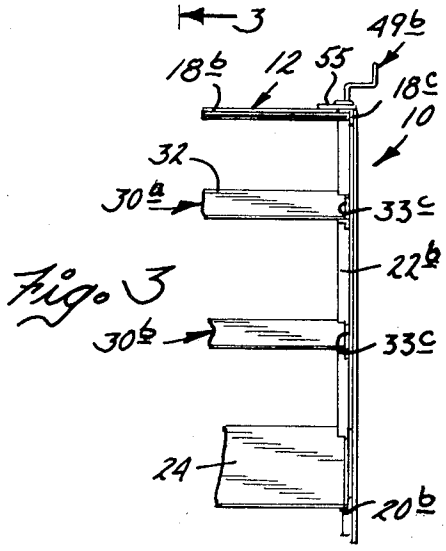


Fig. 3

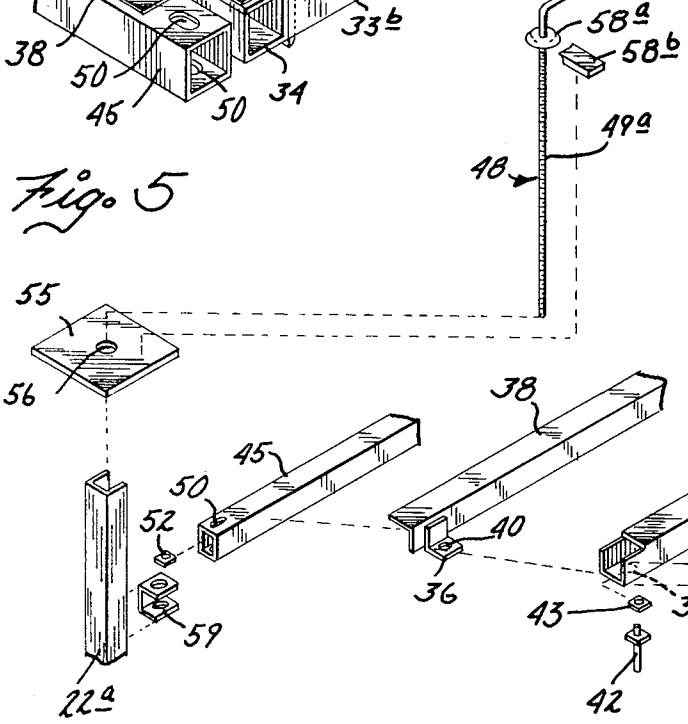


Fig. 5

INVENTOR.
ARTHUR R. COOL
BY
MERCHANT & GOULD
ATTORNEYS

WATER CURRENT DIRECTING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention pertains to apparatus for directing the flow of a fluid.

2. Description of the Prior Art

In numerous instances, it is highly desirable to control the direction of the flow of a fluid (e.g. water). For example, apparatus is frequently utilized for deflecting and controlling the flow of water so as to (1) reduce eddy currents and turbulence and, thus, reduce erosion of soil banks, (2) prevent undermining of bridge piers and road beds, and (3) concentrate the current forces of a stream to clean and deepen a stream, channel, etc. by deflecting elements of the current away from the banks and into the main current. Similarly desirable reasons for controlling the flow of fluids other than water (e.g. air) are also well known.

Numerous attempts have been made to provide apparatus for directing the flow of a fluid. For instance, various types of jetties and bulkheads are available to prevent erosion of beach lines. See, e.g. U.S. Pat. No. 1,140,140. Various additional types of current directors and retarders have also been constructed for placement adjacent the bank of a stream, channel, etc. to prevent strong currents from cutting away the soil. See, e.g. U.S. Pat. No. 1,633,530. However, such apparatus has been neither as effective in directing current flow or as simply designed and readily constructed as is desirable.

SUMMARY OF THE INVENTION

The present invention pertains to fluid current directing apparatus including an essentially open frame structure for supporting at least one flexible current directing member. Preferably, this member is inclined slightly upward toward the downstream end of the frame so that the water passing thereover forces the apparatus downward against the bottom of the stream, channel, etc. To direct the fluid flow, means are provided for vertically raising and lowering an outer, downstream portion of the current directing member so as to form a curved or warped surface. This surface diverts or redirects the water flow incident therealong. In the preferred embodiment, a plurality of generally rectangular current directing members are provided each having its downstream corners independently moveable so as to provide either right or left deflection of water current.

The present fluid current directing apparatus provides numerous advantages not provided by the commercially available devices for deflecting and controlling current flow. For instance, the design of the present apparatus provides diversion of the current in a manner causing the redirected current elements to act as a buffer for the balance of the current stream. Thus, the redirected portion of the current is utilized to divert other elements of the current and highly accurate current control is obtainable. Also, the design of the present apparatus eliminates the necessity for separate means to anchor each unit within the stream. Additional advantages of the present invention, such as its relatively simple design and ease of manufacture, will become apparent from a reading of the Detailed Description which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a preferred water current directing unit provided by the present invention;

FIG. 2 is a side elevational view of the water current directing unit illustrated in FIG. 1;

FIG. 3 is an enlarged, cross-sectional view taken along the line 3—3 of FIG. 2;

FIG. 4 is an enlarged, fragmented perspective view of the current directing member and associated frame structure of the preferred water current directing unit; and

FIG. 5 is a fragmented, perspective view of the frame structure for supporting the current directing member and for moving the member into a position so as to divert water flow incident therealong.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to the drawings, the numeral **10** generally designates the preferred current directing unit provided by the present invention. While this apparatus can be advantageously utilized to deflect and control the flow of various fluids, it finds a highly desirable application in controlling the flow of water such as present in rivers, streams, channels, etc. Although the description herein will be directed solely to such application, it is not in any way intended to limit the scope of my invention.

Referring particularly to FIGS. **1–3**, the water current directing unit **10** includes an essentially open frame structure **12** having a generally trapezoidal side elevation (see, FIG. 2). The frame structure **12** includes a first pair of leg members **14a** and **14b** which, as explained subsequently, define the upstream end of frame **12**. Legs **14*a*** and **14*b*** extend angularly upward and inward toward the downstream end of frame structure **12**. A pair of vertically spaced, horizontally extending support members **15*a*** and **15*b*** extend between the upstream legs **14*a*** and **14*b***. A second or downstream pair of leg members **14*c*** and **14*d*** oppositely disposed from legs **14*a*** and **14*b***, respectively, extend angularly upward and inward toward the upstream end of frame **12**. The legs **14*a*–14*d*** are interconnected so as to define the aforementioned trapezoidal shape by brace members **18*a***, **18*b***, **18*c*** and **18*d*** extending horizontally between the upper ends of the leg members and by brace members **20*a***, **20*b***, **20*c*** and **20*d*** attached adjacent the lower ends of legs **14*a*–14*d***. The side brace members **20*a*** and **20*c*** are inclined slightly upward from the upstream end of frame **12** toward the downstream end thereof. Finally, a pair of support members **22*a*** and **22*b*** are attached to the lower brace members **20*a*** and **20*c***, respectively, and extend upward therefrom in a vertically upright manner. The upper ends of support members **22*a*** and **22*b*** are attached to the respective upper brace members **18*a*** and **18*c*** adjacent the upper ends of downstream leg members **14*c*** and **14*d***, respectively.

Anchoring means in the form of a generally flat, rectangular surface **24** is carried by the inclined rectangular frame defined by braces **20*a*–20*d***. Upon passage of water over surface **24**, the surface inclination causes the water to exert a downward force component thereon anchoring the current director unit **10** on the bottom of the river, stream channel, etc. This

eliminates the necessity for separate anchoring means and also facilitates the diversion of current as subsequently described.

Current directing means are provided in the form of first and second current directing members **30***a* and **30***b* positioned in a vertically spaced relationship above the anchoring surface **24**. As shown, current directing members **30***a* and **30***b* have a generally rectangular shape extending between the upstream leg members **14***a* and **14***b* and the upright support members **22***a* and **22***b*. Each of the members **30***a* and **30***b* is inclined slightly upward from upstream leg members **14***a* and **14***b* toward the upright support members **22***a* and **22***b* elevating the downstream edge of members **30***a* and **30***b*. This upward inclination (as can be seen particularly well in FIG. 2) provides further anchoring of the director unit **10** and, for reasons given subsequently, facilitates the deflection of current flowing over the members.

Except for a slight variation in size (lower member **30***a* being slightly larger than upper member **30***b*), the members **30***a* and **30***b* are identical and only one member need be described herein (e.g. member **30***a* as shown enlarged in FIG. 4). Current directing member **30***a* includes a continuous, flat sheet or surface **32** which is supported about its upstream edge by right angular member **33***a* and about its two side edges by right angular members **33***b*. The downstream edge of surface **32** is supported by a tubular member **34** having a rectangular axial cross-section. As can be seen particularly well in FIGS. **4** and **5**, the lower surface of support member **34** engages an inwardly directed bracket member **36** attached adjacent each of the ends of a right angular bar member **38**. As illustrated, bar member **38** terminates slightly inward from each of the ends of support **34**. An opening **39** through support member **34** adjacent each end thereof is aligned with an opening **40** in brackets **36**. An elongated guide bolt **42** extends downwardly through each of the pairs of openings **39** and **40** a distance sufficient to allow limited guided movement of support **34** and overlying surface **32** relative to bar member **38**. A nut **43** secures guide bolt **42** in position. As shown, the surface **32** preferably overlaps the right angular member **38** to prevent undue turbulance at the junction between support **34** and member **38**. Finally, the upper surface of right angular bar member **38** freely engages the upper surface of an elongated deflection control member **45**. Control member **45** is coextensive with tubular support **34** of current directing member **30***a* and has a rectangular axial cross-section. As shown, the oppositely disposed ends of control member **45** are received within the U-shaped support members **22***a* and **22***b*.

As can best be seen in FIG. **1**, the current directing members **30***a* and **30***b* are pivotably attached to the cross braces **15***a* and **15***b*, respectively, by conventional hinges **46**. This allows the downstream end portions of members **30***a* and **30***b* to move arcuately upward from the position illustrated in FIG. **1**. By virtue of means subsequently described, the downstream corner portions of the pivotably mounted members **30***a* and **30***b* are independently moveable in an upward direction so as to cause deforming or warping of the members, and particularly surfaces **32**. Preferably, a sufficiently flexible or resilient material is utilized in the construction of current directing members **30***a* and **30***b* so that the upward movement of the corner portions does not result in permanent deformation of the members. In the embodiment shown, aluminum has been utilized for this purpose, but other materials can be utilized (e.g. various resilient plastics).

The elongated control members **45** and actuating means, generally designated **48**, provide means for independently raising and lowering the downstream corner portions of each of the current directing members **30***a* and **30***b*. The actuating means **48** includes two threaded crank members **49***a* and **49***b* extending vertically downward within the U-shaped upright members **22***a* and **22***b*, respectively, and through a respective opening **50** adjacent each end of the control members **45**. A pair of nuts **52** are loosely positioned within each of the members **45** in alignment with each of the openings **50** so as to threadedly receive a different one of the cranks **49***a* and **49***b* extending through the respective openings **50**. The size of each nut **52** is sufficient to prevent turning thereof within the member **45** upon rotation of crank **49**. This allows raising and lowering of member **45** and, consequently, the downstream corner portions of members **30***a* and **30***b* upon cranking of either of the cranks **49***a* and **49***b*. A plate **55** having an opening **56** therethrough is affixed to the upper end of each of the upright support members **22***a* and **22***b*, the threaded cranks **49***a* and **49***b* extending through the openings **56**. A generally flat, circularly shaped member **58***a* is fixedly secured to each of the cranks **48***a* and **48***b* above the plate **55**. A cleat member **58***b* is secured to plate **55** and engages the upper edge of member **58***a*. Members **58***a* and **58***b*, plate **55** and cranks **48***a* and **48***b* are designed so that the force exerted in turning cranks **48***a* and **48***b* is absorbed by respective plate **55** and members **58***a*. Also, the engagement of circular member **58***a* and cleat **58***b* prevents undesired vertical movement of the cranks **48***a* and **48***b* after the desired positioning thereof. Finally, a positioning lug **59** is rigidly positioned within each of the upright members **22***a* and **22***b* beneath the outer ends of each of the members **45**. Positioning lugs **59** prevent further downward movement of the member **45** and associated current deflecting members **30***a* and **30***b* past the position shown in solid lines in FIGS. **1** and **2** (i.e. the undeflecting position).

The operation of water current director unit **10** can be explained as follows. When it is desired to deflect and control the flow of water in a given river, stream, channel, etc., director unit **10** is placed within the flow at the point where it is desired to achieve redirection of the current (e.g. at a point of high erosion). The current flow over the inclined surfaces **30***a* and **30***b*, and particularly surface **24**, urges the unit **10** toward the botton of the river, stream, channel, etc. and holds it firmly (i.e. anchors) the unit at the desired location. In addition, the inclined surfaces **24**, **30***a* and **30***b* exert a lifting force on the current creating a turbulent damming action. This results in a reduction in the current velocity facilitating diversion of the water flow.

To redirect the water flow, the handle of one of the cranks **49***a* and **49***b* is rotated (e.g. handle **49***a*) so as to raise the control member **45** connected thereto. As control member **45** moves upward, the corner portion of each of the two overlying current directing members

30*a* and 30*b* attached to the upwardly moving member 45 is also raised. Lifted upward in this manner, the members 30*a* and 30*b* are slightly deformed causing the surfaces 32 to become slightly curved or warped (as shown in dotted lines in FIG. 1 and denoted 30*a'* and 30*b'*). Thus, the rotation of crank 49*a* of actuating means 48 results in movement of the attached corner portion of each of the surfaces 32 between a first position generally coplanar with the remainder of the surface to a second or warped position inclined upwardly to the plane of the remainder of the surface. This distortion of the surfaces 32 redirects a portion of the water flow passing thereover in a direction generally away from the raised corner portions. The diverted elements of the current act as a buffer on the balance of the water flow thereby causing diversion of additional current elements. The amount of diversion is, of course, dependent upon the amount of deformation of current directing members 30*a* and 30*b* which is, in turn, dependent upon the amount of upward rotation of crank 49. Since the position of the current deflecting members 30*a* and 30*b* is continuously variable within its limit of travel, highly accurate aiming and control of the water flow is obtainable. Additionally, since either corner of the deflecting members 30*a* and 30*b* can be independently raised to provide the desired current diverting surface, the present apparatus can provide either left or right hand diversion.

Further diversion of the current can be readily accomplished by placing additional current directing units within the trace of the water flow. Such a series or tandom arrangement of a plurality of directing units 10 can be utilized to shift the current in an appropriate direction and amount. Also, parallel arrangements of a plurality of current directors 10 (i.e. a side-by-side arrangement) can be utilized when it is desired to divert a wider flow front. It should be noted that the optimum point of placement of each director unit is at the very edge of the current section of highest velocity resulting in the greatest current force being utilized to accomplish the diversion action.

Since my invention has been described in conjunction with a preferred embodiment thereof, it should be understood that numerous modifications thereto are well within the skill of the artisan. For instance, it is readily apparent that sophisticated controls can be provided for allowing motorized, automatic and remote control of the current deflecting members 30*a* and 30*b*. This being the case, it is my intent to be limited solely by the spirit and scope of the appended Claims.

What is claimed is:

1. Apparatus for directing the flow of a fluid, comprising:

a. means defining a generally open frame structure suitable for positioning in the fluid flow;

b. means defining a current directing member mounted within said frame structure for allowing fluid flow thereover and including a generally planar, flexible continuous surface having a portion thereof moveable between a first position and a second position inclined to the plane of the remainder of said flexible continuous surface so as to redirect the fluid passing thereover; said flexible continuous surface having a pair of oppositely disposed, downstream corner positions;

c. actuating means associated with said current directing member for moving said moveable portion between said first and second positions and for causing deformation of said flexible continuous surface, said actuating means including a pair of vertically extending threaded crank members, each mounted for rotation within said frame structure;

d. means connected to said current directing member for threadedly receiving each of said crank members to provide vertical movement of one of said downstream corner portions upon rotation of one of said crank members and vertical movement of the other of said downstream corner portions upon rotation of the other of said crank members.

2. The fluid flow directing apparatus of claim 1 wherein said current directing surface is upwardly inclined from the horizontal toward the downstream end of said frame structure.

3. The fluid flow directing apparatus of claim 1 wherein said current directing means includes first and second generally similar current directing members extending essentially parallel to one another within said frame structure in a vertically spaced relationship.

4. The fluid flow directing apparatus of claim 3 wherein each of said current directing members are a generally flat, rectangular shaped member having the upstream ends thereof pivotably connected to said frame structure.

5. The fluid flow directing apparatus of claim 4 including an anchoring member fixedly mounted within said frame structure below said current directing surface and having a generally planar surface inclined upwardly toward said downstream corner portions for causing the fluid passing thereover to exert a downward force thereon anchoring the apparatus within the flow.

6. Apparatus for directing the flow of a liquid comprising:

a. a generally open frame structure suitable for positioning in the fluid flow;

b. at least one deformable current directing member mounted within said frame structure, said current directing member being inclined slightly upward from the horizontal toward the downstream end of said frame structure and having a generally rectangular planar surface and the upstream corners of said surface pivotably attached to said frame structure;

c. actuating means carried by said frame structure and connected to the downstream corner portions of said current directing member for independently moving either of said corner portions in an upward direction so as to cause temporary upward deformation of a said downstream corner portion of said generally rectangular planar surface; and

d. an anchoring member fixedly mounted within said frame structure in a vertically spaced relationship below said current directing member and having a generally planar surface inclined upwardly toward said downstream corner portions for causing the fluid passing thereover to exert a downward force thereon anchoring the apparatus within the flow.

7. Apparatus according to claim 6 wherein said apparatus includes a second current directing member

mounted within said frame structure in a generally parallel, vertically spaced relationship above said anchoring means and below the other current directing member.

8. Apparatus according to claim 6 wherein said actuating means includes a pair of crank members each mounted for rotation within said frame structure and said current directing includes means for receiving each of said crank members to provide independent vertical movement of each of said corner portions upon rotation of either of said crank members.

* * * * *