Jan. 14, 1936. A. KRÜMMER 2,027,386

SYSTEM FOR MOVING BODIES TOWARDS AND AWAY FROM EACH OTHER

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Fig. 1

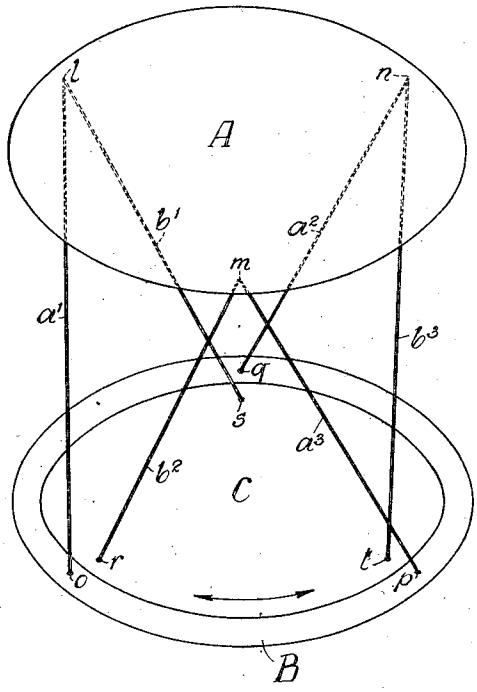


Fig. 2

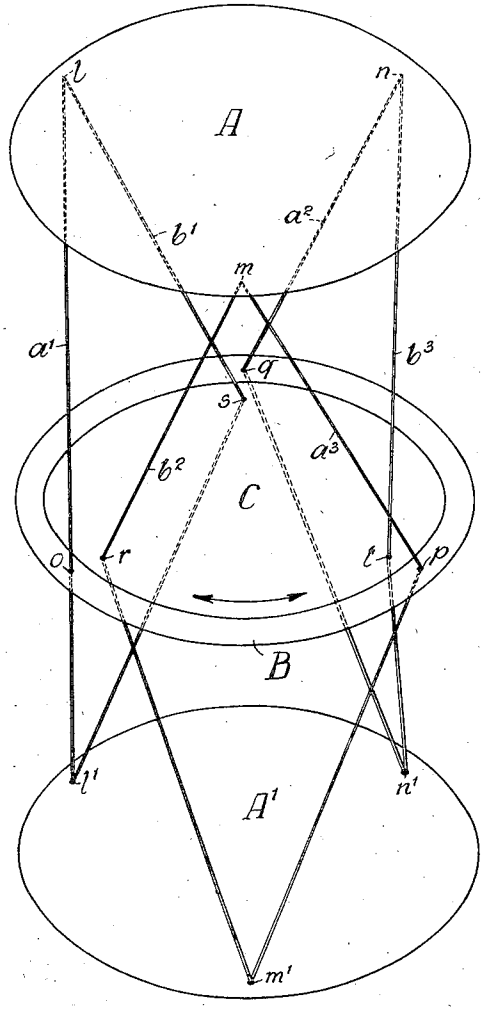
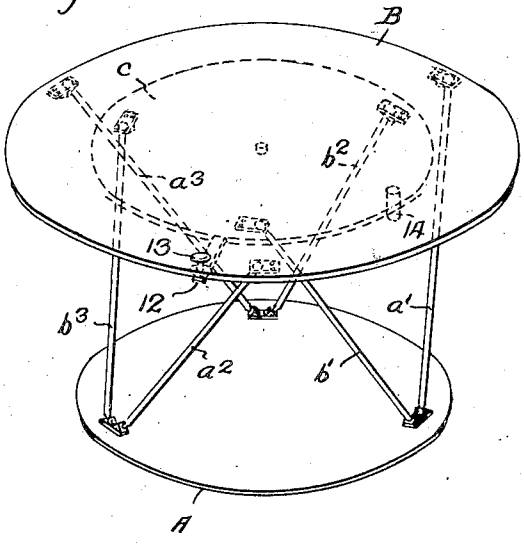


Fig. 3



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Fig. 4

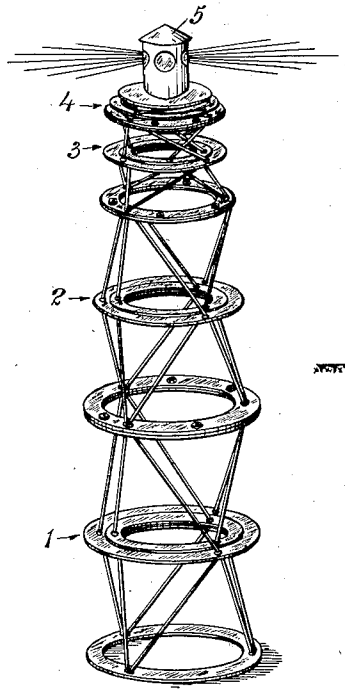


Fig. 6

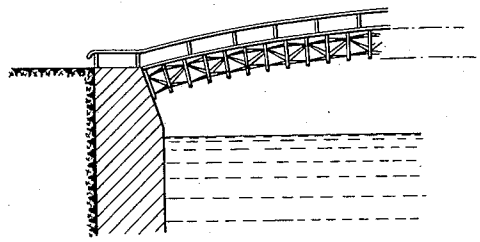
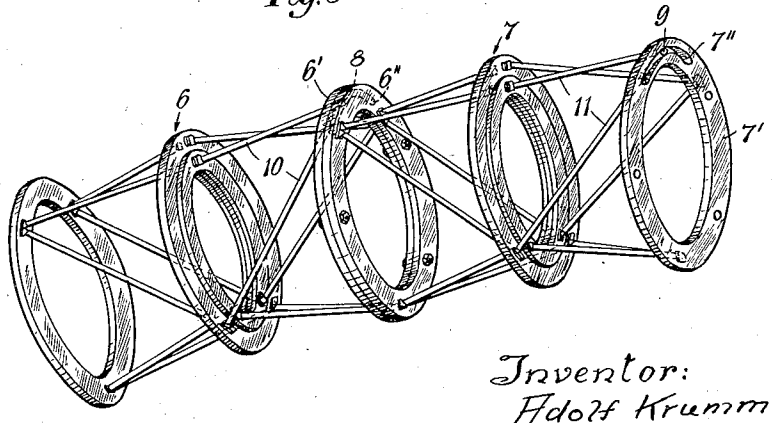


Fig. 5



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SYSTEM FOR MOVING BODIES TOWARDS AND AWAY FROM EACH OTHER

Adolf Krümmer, Berlin, Germany

Application December 1, 1933, Serial No. 700,631
In Germany December 3, 1932

14 Claims. (Cl. 74—99)

My invention relates to improvements in systems for moving bodies towards and away from each other and the object of the improvements is to provide a system which combines the functions of this moving the said bodies towards and away from each other and supporting or holding the same in their relative positions and further to increase the stability of the bodies relatively to each other. Other objects are to provide an apparatus which has a low weight, and which when folded together requires little room. With these objects in view my invention consists in connecting the bodies by means of pairs of angularly disposed links which are adapted to be inclined more or less relatively to the bodies by means of a rotary member for shifting the apices of the angularly disposed links. Thus rotary movement of the said rotary member is transformed into progressive movement of the said apices and the body connected with the links at the said apices, transverse displacement being made impossible by the location of the ends of the links, and by the outwardly projected links forming a frame work.

For the purpose of explaining the invention two examples embodying the same have been illustrated in the accompanying drawings, in which

Fig. 1 is a diagrammatical perspective view of the apparatus, and

Fig. 2 is a similar view showing a modification;

Fig. 3 is a perspective view of the invention as embodied in a table;

Fig. 4 is a perspective view showing the invention as embodied in a beacon tower;

Fig. 5 is a perspective view showing a section of a bridge construction; and

Fig. 6 is an elevation, partly in section, showing a portion of a bridge embodying a construction according to Fig. 5.

In the figures the system has been shown with the links projected. The system illustrated in Fig. 1 comprises two bodies A and B in the form of disks, a disk C disposed concentrically of the disk B and adapted to be turned relatively thereto about its axis, a set of links a^1, a^2, a^3 jointed with their top and bottom ends respectively to the disks A and B at *l*, *m*, *n* and *o*, *p*, *q*, and links b^1, b^2, b^3 connected with their top ends to the disk A at the joints *l*, *m*, *n* of the links a^1, a^2, a^3, and with their bottom ends to the rotary disk C at *r*, *s*, *t*, the said joints *r*, *s* and *t* being located on a circle which is concentric to the disk C. All the links have equal length.

If the disk C is turned clockwise through an angle of 120°, all the links are folded into a horizontal plane, and in the said plane they are arranged along two equilateral triangles located one within the other. If thereafter the disk C is turned anti-clockwise, the links are again projected outwardly and the disk A and B are spread apart and into the position shown in the figure.

Statically the last named position is the optimum in so far as the links provide six equilateral triangles providing a cylinder.

If either the disk B and C or the disk A are reduced in diameter, the links are arranged when projected along a cone, and the frame produced thereby has even higher strength in transverse direction than the frame shown in the figure. It will be understood that the system may be arranged with the links in different positions, above and below the said optimum, according to the position of the disk C relatively to the disk B, the said positions corresponding to different distances between the disks A and B.

In a modification the joints of the links are not disposed on a circle but on another curve, such as an ellipse. If now the rotary disk C is turned about its axis the movable disk A is shifted in axial direction, and simultaneously it is twisted. In this case I prefer to provide more than three links in order to insure correct twisting. In this way I am enabled to transform disks, which in the folded position of the apparatus are flat, into concave bodies, for example into concave mirrors, in which case some parts of the disk, for example the lowermost parts thereof, may be fixed in position by solid or adjustable holding means of any kind, such for example as ropes or rods exposed either to pressure or tension.

In another modification one or more of the joints are mounted for being shiftable radially of the disk A, for example by means of screw mechanism, and the said mechanisms may be constructed for independent operation or for operation together with the means for imparting rotary movement to the disk C. By this mechanism, in lieu of the parallel movement of the disks A and B relatively to each other, angular movement may be obtained.

In the modification shown in Fig. 2 two systems such as are shown in Fig. 1 are combined into a single system having the disk B in common and the links directed therefrom to opposite sides, the links and disks A being disposed symmetrically to one another. If the rotary disk C which is common to both systems is turned about its axis both sets of links are simultaneously operated, and the relative movements of both systems take place with reference to the relative

positions of the links in opposite senses. Therefore the joints *l, m, n* provided on the disk A and the joints l^1, m^1, n^1 provided on the corresponding disk A^1 located at the opposite side to the disk B and below the same are moved in the same direction and the said joints *l, m, n* and l^1, m^1, n^1 are not moved relatively to each other in circumferential direction. Therefore the disks A and A^1 are shifted horizontally only relatively to the disk B, and they are moved relatively to each other only in axial direction. Therefore, whereever relative rotary movement of the supporting body and the supported body is not desired, such relative rotary movement may be avoided by combining two system in the manner described. A system of this type may be used for example in apparatus for lifting motor cars.

By combining more than two systems of the construction shown in Figs. 1 or 2 and providing proper rigid or flexible connecting members, rotary movement of a single disk such as C may be transmitted to all the other rotary disks C. Thus the whole structure may be extended or folded together all over its length or with a part of its length by imparting rotary movement to one of the said disks C.

The construction of Fig. 3 is much similar, in basic principles, to that of Fig. 1, the latch **12**, **13** merely serving to lock the rotatable member C with respect to the body B when the bodies A and B are in their extended position, and the stop **14** cooperating with one of the hinged connections for the links, in order to limit the permissible angular movement of the member C.

The tower construction of Fig. 4 embodies a plurality of double elements according to the invention. The elements **1** and **2** may be fitted to each other, and are shown as completely extended. The element **3** is only partly extended, while element **4** is in a folded position. The beacon **5** is shown as mounted on the tower.

In Fig. 5, two double elements are illustrated, which may be used in the construction of a bridge. The rings **6'** and **7'** of the two elements **6** and **7** can be inclined towards the other rings of the elements by shifting the top ends **8** and **9** of the pairs of links **10** and **11**, respectively, in the slits **6''** and **7''**, so that any desired curvature may be produced for use in the bridge, such as shown, for example, in Fig. 6.

Where the system is subject to transverse thrust, as may be the case for example in the construction of turrets or supports for guns, ropes are provided which are automatically put under tension when the system is being spread apart. Where higher strength is needed, and where the system is subject to pressure, a plurality of spreading devices may be disposed concentrically of one another.

For preventing the play of the joints automatic means may be provided for fixing the joints in position.

My improved system is very stable, it has a low weight, it requires little room, and it permits rapid operation. It may be used in the construction of foldable tables, foldable seats, of tables which are adapted to be set to different heights, for example for the purpose of the sport, of the industry and scientific research. For these purposes a single system such as is shown in Fig. 1 will be sufficient.

The combination of two or more systems into a single device may be used for various purposes, for example for disappearing supports for machine guns, which are adapted to retract the gun from sight, for search lights and signals, for armour-plated turrets for directing battles or controlling the firing of guns, particularly such as are provided on board of ships remaining behind cover, disappearing observation masts on board of ships in which case the mast may be sunk below the deck while simultaneously the opening through which the mast is projected is closed folding turrets for fighting fire, for turrets used in assembling machinery and scaffolding, for which purpose the aforesaid radial displacement of one or more of the joints may be provided for laterally inclining the turrets so that also parts are accessible which are located laterally of the vertical axis of the turret for stationary or movable lifting devices for motor cars.

Where a plurality of the systems shown in Fig. 1 are arranged for horizontal movement, the system may be used for shifting lenses for example in photographic cameras, or for landing bridges on board of ships, for foldable pontoons or foldable bridges. Further, the apparatus may be used in the construction of the supporting planes of aeroplanes which are adapted to be extended in lateral and longitudinal directions.

I claim:

1. Means for moving two bodies towards and away from each other, and for supporting them in any intermediate position, comprising two disc-like bodies disposed in substantially parallel planes, a third body substantially parallel to the said first bodies, a plurality of pairs of links, the links of each pair being angularly disposed with respect to each other and being connected at their apices to one of said disc-like bodies, the other ends of the links of each pair being connected one to each of the other of said disc-like bodies and to said third body, said third body being rotatable with respect to said first bodies, and the rotation thereof causing shifting of the apices of the angles between the links of each pair, and variation in the spacing of the two bodies.

2. Means for moving two bodies towards and away from each other and for supporting them in any intermediate position, comprising two disc-like bodies disposed in substantially parallel planes, a third body substantially parallel to the said first bodies, a plurality of pairs of substantially rigid links, the links of each pair being angularly disposed with respect to each other and being connected at their apices to one of said disc-like bodies, the other ends of the links of each pair being connected one to each of the other of said disc-like bodies and to said third body, the rigid links being capable of supporting the two first bodies in any position of extension, when the links are locked against angular variation with respect to each other.

3. Means for moving two bodies towards and away from each other and for supporting them in any intermediate position, comprising two disc-like bodies disposed in substantially parallel planes, a third body substantially parallel to the said first bodies, a plurality of pairs of non-collapsible links, the links of each pair being angularly disposed with respect to each other and being connected at their apices to one of said disc-like bodies, the other ends of the links of each pair being connected one to each of the other of said disc-like bodies and to said third body, the non-collapsible links being capable of supporting the two first bodies in any position of extension, when the links are locked against angular variation with respect to each other.

4. Means for moving two bodies towards and away from each other, and for supporting them in any intermediate position, comprising two disc-like bodies disposed in substantially parallel planes, a third body substantially parallel to the said first bodies, a plurality of pairs of links, the said bodies being substantially concentric, the links of each pair being angularly disposed with respect to each other and being connected at their apices to one of said disc-like bodies, the other ends of the links of each pair being connected one to each of the other of said disc-like bodies and to said third body, said third body being rotatable with respect to said first bodies, and the rotation thereof causing shifting of the apices of the angles between the links of each pair, and variation in the spacing of the two bodies.

5. Means for moving two bodies towards and away from each other, and for supporting them in any intermediate position, comprising two disc-like bodies disposed in substantially parallel planes, a third substantially parallel body, a plurality of pairs of links, the links of each pair being angularly disposed with respect to each other and being connected at their apices to one of said disc-like bodies, the said apices being disposed symmetrically about said body to which they are connected, adjacent the periphery thereof, the other ends of the links of each pair being connected to each of the other of said disc-like bodies and to said third body, and being disposed symmetrically thereabout adjacent the periphery thereof, said third body being rotatable with respect to said first bodies, and rotation thereof causing shifting of the apices of the angles between the links of each pair, and variation in the spacing of the two bodies.

6. Means for moving two bodies towards and away from each other, and for supporting them in any intermediate position, comprising two disc-like bodies disposed in substantially parallel planes, a third body substantially parallel to the said two first bodies, the said three bodies being substantially concentric, at least three pairs of links, the links of each pair being angularly disposed with respect to each other and being connected at their apices to one of said disc-like bodies, the other ends of the links of each pair being connected one to each of the other of said disc-like bodies and to said third body, said third body being rotatable with respect to said first bodies and the rotation thereof causing shifting of the apices of the angles between the ends of each pair, and variation in the spacing of the two bodies.

7. Means for moving two bodies towards and away from each other, and for supporting them in any intermediate position, comprising two disc-like bodies disposed in substantially parallel planes, a third body substantially parallel to the said two first bodies, the said three bodies being substantially concentric, at least three pairs of links, the links of each pair being angularly disposed with respect to each other and being connected at their apices to one of said disc-like bodies, the said apices being disposed symmetrically about the body to which they are connected, adjacent the periphery thereof, the other ends of the links of each pair being connected one to each of the other of said disc-like bodies and to said third body and being disposed symmetrically thereabout adjacent the periphery thereof, said third body being rotatable with respect to said first bodies, and rotation thereof causing shifting of the apices of the angles between the links of each pair, and variation in the spacing of the two bodies.

8. Means for moving two bodies towards and away from each other, and for supporting them in any intermediate position, comprising two disc-like bodies disposed in substantially parallel planes, a third body substantially parallel to the said two first bodies, a plurality of pairs of links, the links of each pair being angularly disposed with respect to each other and being pivotally connected at their apices to one of said disc-like bodies, the other ends of the links of each pair being pivotally connected one to each of the other of said disc-like bodies and said third body, said third body being rotatable with respect to said first bodies, and rotation thereof causing shifting of the apices of the angles between the links of each pair, and variation in the spacing of the two bodies.

9. Means for moving bodies towards and away from each other and for supporting them in any intermediate position, comprising a centrally disposed, disc-like body, two additional disc-like bodies disposed one on each side of said first-mentioned body, the three bodies being disposed in substantially parallel planes, a fourth body substantially parallel to the said three bodies, two sets of links, each consisting of a plurality of pairs, the links of each pair of one set being angularly disposed with respect to each other and being connected at their apices to one of said two similar disc-like bodies, the other ends of the links of each pair of the said set being connected one to each of the first said disc-like body and to said fourth body, and the links of the second set connecting the other of the two similar disc-like bodies to the first disc-like body and to the fourth body in like manner, said fourth body being rotatable with respect to the first three bodies and rotation thereof causing shifting of the apices of the angles between the links of each pair of each set, and causing variation in the spacing of the two similar bodies with respect to the first said body on opposite sides thereof, while maintaining unchanged the angular relation of the two similar bodies with respect to each other.

10. Means for moving two bodies towards and away from each other, and for supporting them in any intermediate position, comprising two disc-like bodies disposed in substantially parallel planes, a third body substantially parallel to the said first bodies, a plurality of pairs of links of equal length, the links of each pair being angularly disposed with respect to each other and being connected at their apices to one of said disc-like bodies, the other ends of the links of each pair being connected one to each of the other of said disc-like bodies and to said third body, said third body being rotatable with respect to said first bodies, and the rotation thereof causing shifting of the apices of the angles between the links of each pair, and variation in the spacing of the two bodies.

11. Means for moving two bodies towards and away from each other, and for supporting them in any intermediate position, comprising two disc-like bodies disposed in substantially parallel planes, a third body substantially parallel to said two first bodies, the said three bodies being substantially concentric, a plurality of pairs of links of equal length, the links of each pair being angularly disposed with respect to each other and being connected at their apices to one of said

disc-like bodies, the said apices being symmetrically disposed about the body to which they are connected, adjacent the periphery thereof, the other ends of the links of each pair being connected one to each of the other of said disc-like bodies and to said third body and being disposed symmetrically thereabout adjacent the periphery thereof, said third body being rotatable with respect to said first bodies, and rotation thereof causing shifting of the apices of the angles between the links of each pair, and variation in the spacing of the two bodies.

12. Means for moving two bodies towards and away from each other, and for supporting them in any intermediate position, comprising two disc-like bodies of substantially the same size disposed in substantially parallel planes, a third body substantially parallel to the said two first bodies, the said three bodies being substantially concentric, a plurality of pairs of links of equal length, the links of each pair being angularly disposed with respect to each other and being connected at their apices to one of said disc-like bodies, the other ends of the links of each pair being connected one to each of the other of said disc-like bodies and to said third body, said third body being rotatable with respect to said first bodies, and the rotation thereof causing shifting of the apices of the angles between the links of each pair, and variation in the spacing of the two bodies.

13. Means for moving two bodies towards and away from each other, and for supporting them in any intermediate position, comprising two disc-like bodies of different size disposed in substantially parallel planes, a third body substantially parallel to the said two first bodies, the said three bodies being substantially concentric, a plurality of pairs of links of equal length, the links of each pair being angularly disposed with respect to each other and being connected at their apices to one of said disc-like bodies, the other ends of the links of each pair being connected one to each of the other of said disc-like bodies and to said third body, said third body being rotatable with respect to said first bodies, and the rotation thereof causing shifting of the apices of the angles between the links of each pair, and variation in the spacing of the two bodies.

14. A mechanism for spreading apart or moving towards each other two bodies by means of links disposed thereon, in which the said links are disposed in pairs, the apices of each pair of links being attached to one of said bodies in at least three places, the base end of one of the links of each pair being connected to the second body and being movable to the right, and an auxiliary member disposed rotatably with respect to both of said first-mentioned bodies and to which the base end of the second link of each pair is connected, and which is adapted to move to the left.

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