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K. BENDER

COMPRESSION RESISTANT CHAINS

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3 Sheets-Sheet 1

Fig. 1

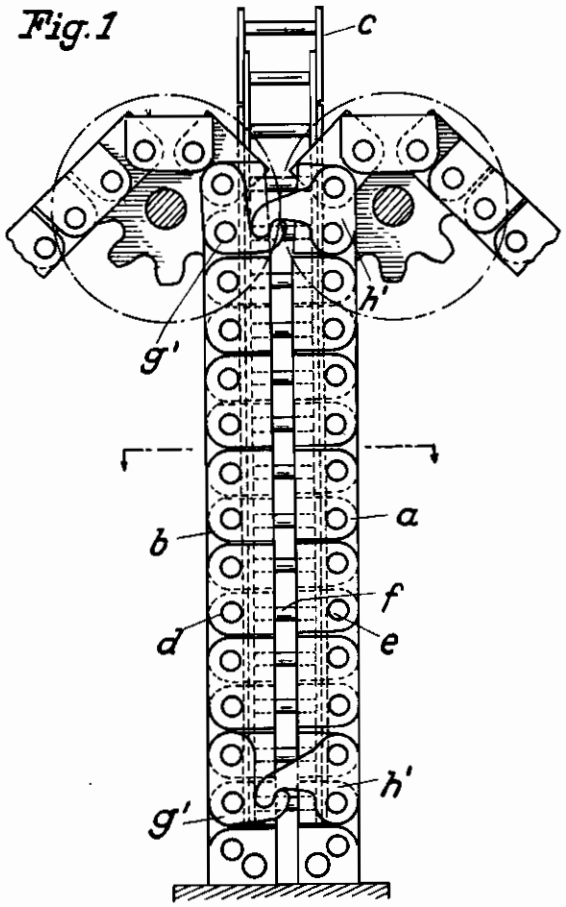

Fig. 2

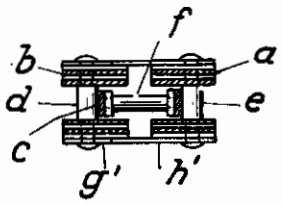

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Fig. 3

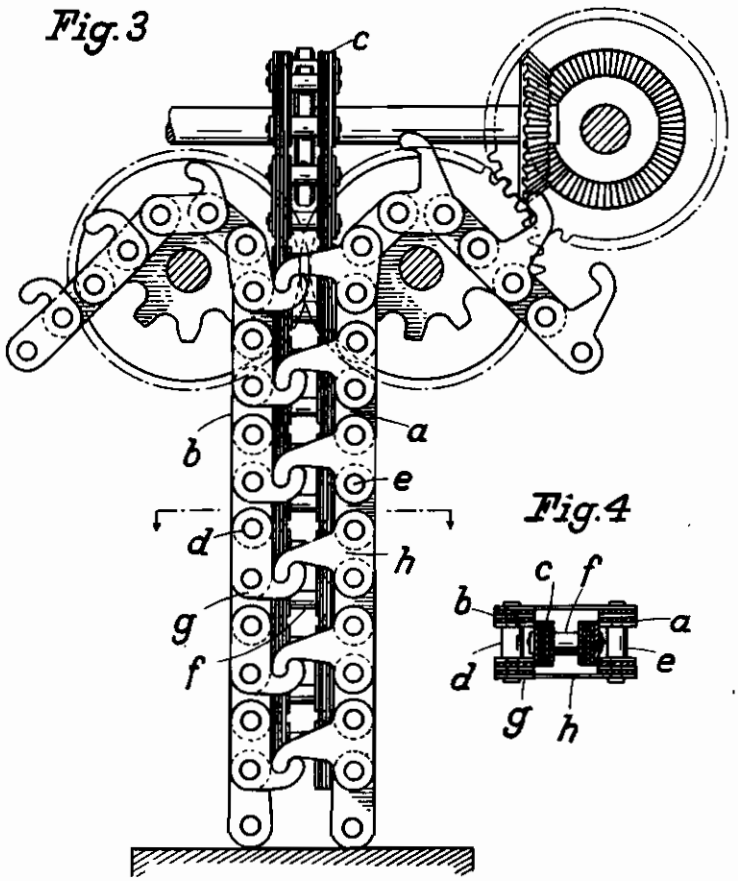

Fig. 4

Fig. 5

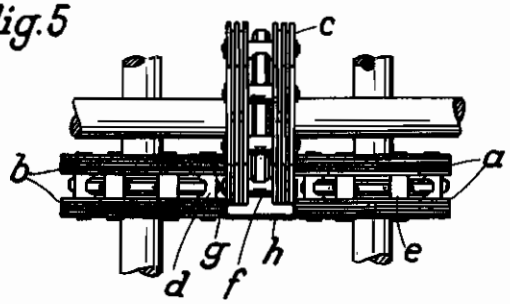

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Fig. 6.

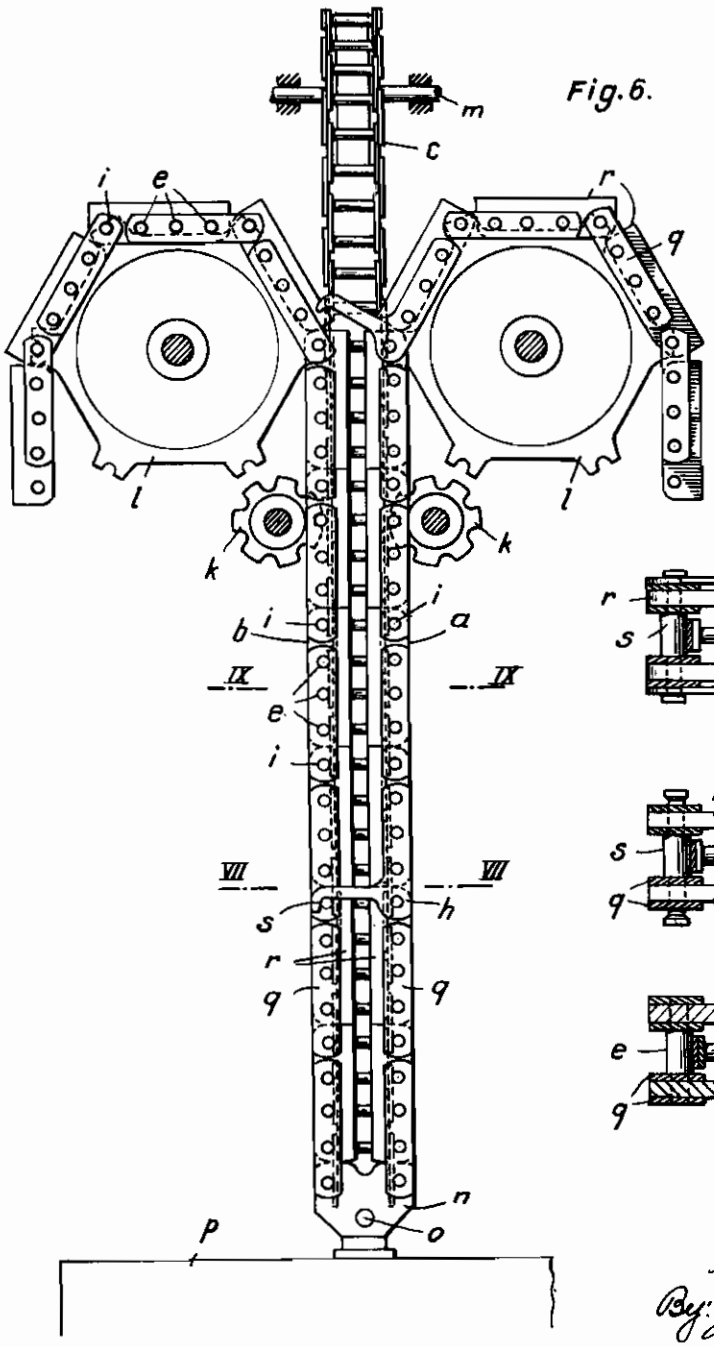


Fig. 7.

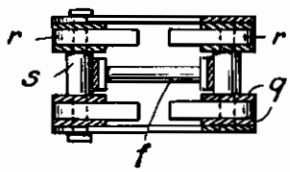
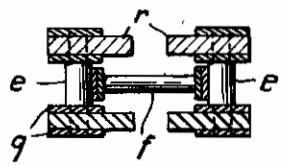


Fig. 8.

Fig. 9.



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ALIEN PROPERTY CUSTODIAN

COMPRESSION RESISTANT CHAINS

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Application filed September 29, 1941

The present invention relates to a compression resistant group of flat link chains for lifting gears of sluices, flood- or lifting-gates, mitred lock gates and the like purposes, comprising two oppositely acting flat link chains capable of being rolled up in the same plane.

For this purpose racks have been proposed, which consist of members pivoted to each other and which when transmitting pressure, are rendered resistant against buckling by guides provided at at least two points. This construction, however, has the drawback that such guides always are required and that a compression resistant structure is only present as far as this guide extends. For this reason the application of these known racks is strongly limited.

Moreover, it has been proposed to produce by means of interlocking steel bands extensible masts having a certain resistance against buckling which, however, are not adapted to exerting considerable pressures.

Furthermore, a proposal has become known to so render four chains stiffened with regard to each other that each chain is connected by means of a toothing to the two adjacent chains, arranged at right angles. This structure also is not adapted to satisfactorily solve the problem and this already due to the complicated construction and lack of reliability of service.

It has also been suggested to produce a compression resistant lifting device adapted to be wound up from two oppositely acting link chains the links of which consist of solid blocks bearing against each other over their entire length, but even this construction cannot be considered to be an ideal solution as the distance the pivot points in this structure are spaced from each other has, of necessity, to be rather small, so that the resultant profile has only a comparatively small moment of resistance against buckling.

According to the invention a more favorable compression resistant structure of the type set forth is obtained by providing a compression resistant group of flat link chains in which a third flat link chain arranged at right angles bears against the two oppositely acting chains and together with the latter forms a compression resistant profile.

To this end the arrangement may be such, that the links of the two oppositely acting chains support each other by eccentrically arranging their chain pins whilst the third chain bears against the chain pins of the two oppositely acting flat link chains.

The two oppositely acting chains may be interlocked by hook-shaped members arranged in spaced relation from each other.

The chains may also be so constructed that the individual links of the two oppositely acting chains may be hook-shaped and locked with the oppositely arranged links without one bearing upon the other.

The manufacture of such groups of compression resistant flat link chains is relatively cheap, whereas the reliability of service and the resistance against buckling and compression are high.

According to a preferred construction of the invention chain links are used the length of which amounts to a multiple of the pitch of the chain pins. The middle axes of the pins are fixed to connecting links in such a manner that the connecting links extend about half the pitch of the pins beyond the centre links. Hereby a fork is formed into which engages the pivot pin of the next following centre link. These connecting links may be constructed as locking hooks which engage the oppositely arranged elongated chain pins and lock the chain. The locking hooks may detachably be connected to the centre links.

The centre chain preferably serves as a counter bearing for the chain pins of the two cooperating chains so that disengagement of the chain pins from the teeth of the driving gears or of the reversing wheels is prevented.

In the accompanying drawings some constructions according to the invention are shown by way of example.

In these drawings:

Figure 1 shows a group of flat link chains in which the links of the two oppositely acting chains bear against each other,

Fig. 2 is a cross section on line II—II of Fig. 1,

Fig. 3 shows a modification, in which the opposite links of the chains are interlocked without bearing against each other,

Fig. 4 is a cross section on line IV—IV of Fig. 3,

Fig. 5 is a plan view of the construction shown in Fig. 3,

Fig. 6 shows a side elevation of another construction of chains according to the invention,

Fig. 7 is a section on line VII—VII of Fig. 6,

Fig. 8 is a detail view on a somewhat larger scale, and

Fig. 9 is a section on line IX—IX of Fig. 6.

The group of chains consists of three flat link chains *a*, *b* and *c* all of which are connected by bolts to the body to be lifted. The oppositely arranged chains *a* and *b* are each driven by a

sprocket wheel and constitute the lifting members proper of the lifting gear. The sprocket wheels of the two chains *a* and *b* are coupled by a pair of gears so that they are simultaneously driven with the same number of revolutions. The distance the two sprocket wheels are spaced from each other is so chosen that the hook-shaped chain links *g*, *h* of the chains *a*, *b* constructed as shown in Figures 3–5 securely interlock as soon as they reach the vertical position after having moved over the sprocket wheels.

The third chain c operates between the two chains *a* and *b* and is turned about 90° with respect thereto so that the links of the chains *a* and *b* come into contact with those of the chain c and are pressed against the links of the latter as soon as the hook-shaped links *g* and *h* of the chains *a* and *b* are in engagement. If, however, narrower links are chosen for the chain c then instead of the links the pins *d* and *e* of the chains *a* and *b* will bear against the links of the chain c.

After the engagement of the chains *a*, *b* and *c* a cross section of I shape results as shown in Figure 4, which, when pressure is exerted upon the group of chains, cannot deflect to any side and, therefore, is resistant against buckling.

The chains *a*, *b* and *c* may also be constructed as shown in Figures 1 and 2 of the drawings.

In this case, the links of the chains *a* and *b* are so formed, that the bores for the link pins *d* and *e* are not arranged in the centre of the links, but are spaced from the longitudinal edge of the links facing the sprocket wheels in the smallest distance allowed to ensure sufficient strength of the links. The force acting upon the flat link chain therefore, is eccentrically applied. The lengths of the chain links are so dimensioned that in stretched position of the chains the links always are in contact with each other. To render the chains movable towards one side only, the two inner edges of the links facing the sprocket wheel, are to be rounded off at a radius corresponding to half the inside length of the links. The two other edges, however, remain intact, so that the chains cannot deflect in the direction of the side of the chain at which the rounded off edges are located.

The arrangement of the chains *a* and *b* is as above described, but it is to be observed, that the not rounded off edges of the links of both chains are facing each other.

The chain *c* operates between the two chains *a* and *b* and is turned about 90° with respect thereto. For this purpose, however, a narrow chain comes into consideration the links of which come into contact with the pins *d* and *e* of the chains *a* and *b*. The pins *f* of the chain *c* therefore, are countersunk in the outer links of the latter.

After the chains have passed the sprocket wheels, an I-shaped cross section results. Due to their eccentrical formation the chains *a* and *b* cannot bulge outwardly when pressure is applied. Bulging towards the interior is prevented by the chain *c* operating between the chains *a* and *b* and turned about 90° with respect thereto. In case of great buckling lengths, hook-shaped links *g'* and *h'*, similar to the links *g* and *h* shown in Figures 3–5, are provided, which are secured in a definite spaced relation to the eccentrical links outside the latter so that by the interengagement of such hook-shaped links these links themselves are particularly interlocked.

According in the preferred construction shown in Figs. 6 to 9 as low a number of individual links and pins as possible is used to reduce to a minimum the wear of the chain and thereby to extend its usefulness. As may be seen from the drawings, a chain link consists of a single centre link *r* of a thickness as large as possible and two connecting links *q* of a smaller thickness. The length of the chain links, moreover, amounts to a multiple of the pitch of the pins. One of the pins *i* provided at the end, either the upper or lower pin of each link is pivotally arranged, whereas the other pins *e* are fixed to the appertaining chain links and serve as driving pins. The chain links are unsymmetrically constructed. The bores for the reception of the pins are not arranged in the centre of the link but are spaced from the longitudinal outer edge of the link in the smallest distance allowed to ensure the required strength of the latter. Facing this side the links are rounded off as described above, whereas towards the inner side of the group of chains they are extended exactly half the pitch of the pins at right angles to the axis of the chain. In the stretched position of the chain, the latter may, as explained already, bulge towards one side only. A further simplification of the chain with regard to the constructions already described is obtained by the fact, that the centre links *r* located between the symmetrically constructed inner and outer links *q* only are unsymmetrically formed relatively to the chain *a* and *b* respectively. The symmetrical inner and outer links *q* are fixed to the centre links *r* and the parts of the links *q* having the bore *i* receiving the chain pin extend about half the pitch of the pins beyond the appertaining centre link *r*. Between these extended portions of the links *q* the centre link *r* of the following chain link engages. Due to the outer links *q* being fixed to the centre link *r*, a safe guidance of the latter connected to the pivot pin *i* in the fork so formed is obtained and a lateral deflection or giving way of the centre links *r* of the entire chains *a* and *b* under compressive strain of the chain is excluded. Moreover, owing to this construction the centre links *r* must, in the stretched position of the chain, positively occupy a position in a line extending in parallel to the axis of the chain.

In connection with chains having links which may pivot about all chain pins, however, under compressive strain the centre links may be displaced in a vertical direction relatively to the chain pins, particularly if the latter are not exactly fitting and if a certain wear of the pins or the holes receiving them has occurred respectively. Even after wear this is impossible with the chain according to Figs. 6 to 9. If in this case also the connecting links extending to the centre links would connect the pins provided at the ends of the same only then here again two pivot points would be present between two centre links, whereby the above mentioned drawbacks would be caused. As indicated, however, each two connecting links belonging together are rigidly connected to a centre link by a plurality of chain pins, so that between each two centre links one pivot point only is present i. e. in the end extending beyond the connecting links. Hereby all centre links of the chain positively are adjusted in parallel to the axis of the chain in the stretched position of the latter.

The two gears *k* engage the two chains *a* and *b*. A disengagement of the chain pins from the gears *k* is prevented by the centre chain *c* as the latter simultaneously forms the required counter

bearing. After the chains *a* and *b* have passed the gears *k* they are guided over the sprocket wheels *l*. The pitch of the teeth of the sprocket wheels corresponds to the distance the pivot pins of the chain links are spaced from each other. The sprocket wheels *l* are so arranged above the gears *k* that the pivot pins of the chains moving upwardly when engaging the appertaining space between the teeth of the sprocket wheels are still pressed against the centre chain, whereby deflection or disengagement of the pins is prevented. In definite distances from each other the outer connecting links are provided with hooks *h* which, after engaging the opposite elongated chain pins *s* mutually lock the chains *a* and *b*, whereby, after the chains having passed the sprocket wheels, a rigid compression resistant unit is obtained below the gears *k*. A simplification of the locking with regard to the already described locking arrangements is obtained by the fact that locking hooks are provided in definitely spaced distances from each other on one chain only, whereas elongated chain pins *s* engaging the locking hooks *h* only are provided at the opposite chain instead of locking hooks.

Locking and releasing respectively of the chains *a* and *b* by the locking hooks *h* and the oppositely arranged elongated pins *s* is effected during movement of the chains *a* and *b* towards the sprocket wheels and away from the latter at these wheels and not, as described above, at the lifting gears *k*. To ensure a uniform load of the chains *a* and *b* on lifting and compressing respectively, the lower ends of the chains *a* and *b* are pivotally connected to a compensating device *n*.

The centre chain *c* is connected to the body or member *p* to be lifted at the point o of application of the chains *a* and *b* and extends between the latter upwardly until the roller *m* mounted above the sprocket wheel *l* is reached. A relative displacement of the chains in the direction of the axis of the latter is impossible.

The group of flat link chains according to the present invention shown by way of example in vertical position may also be used in any other inclined position, for instance in connection with mitred lock gates of sluices and the like.

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