

Oct. 14, 1941.

K. KÜHNE

2,259,226

HYDRAULIC TOWING DEVICE FOR RIVER CRAFT

Filed Sept. 8, 1938

2 Sheets-Sheet 1

Fig. 1

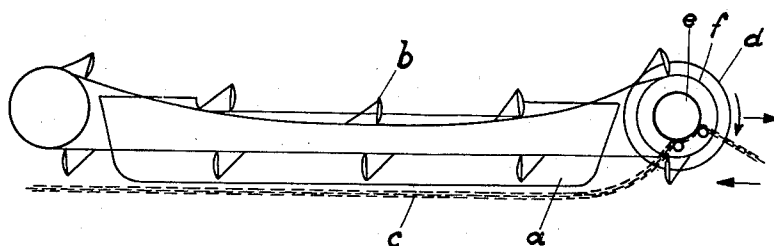


Fig. 2

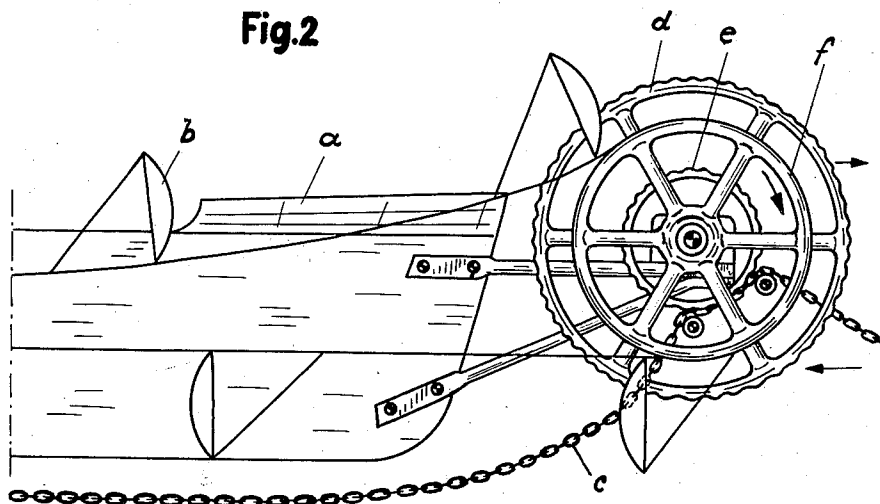


Fig. 3

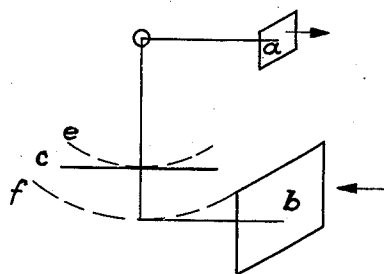
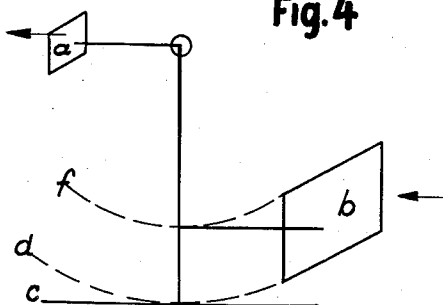


Fig. 4



Inventor:

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Fig. 5.

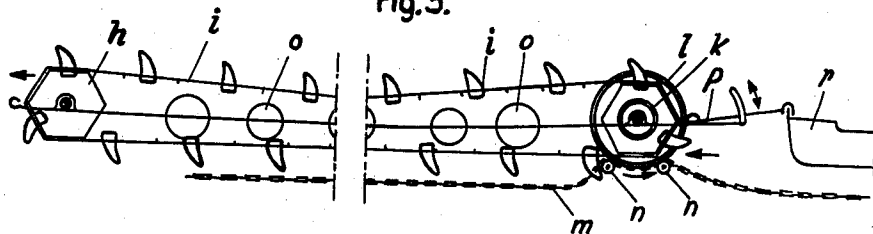


Fig. 6.

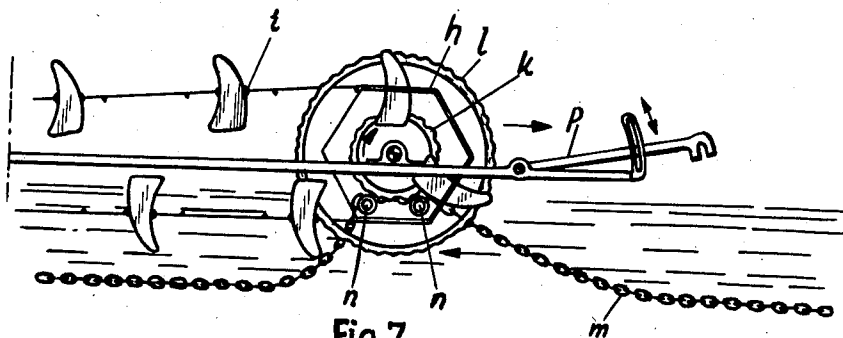


Fig. 7.

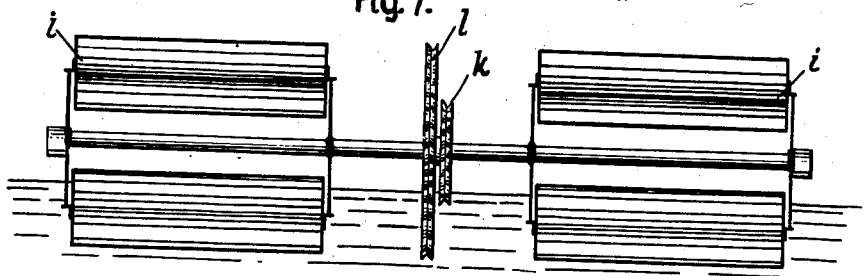


Fig. 8.

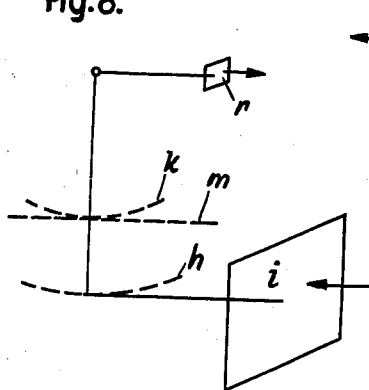
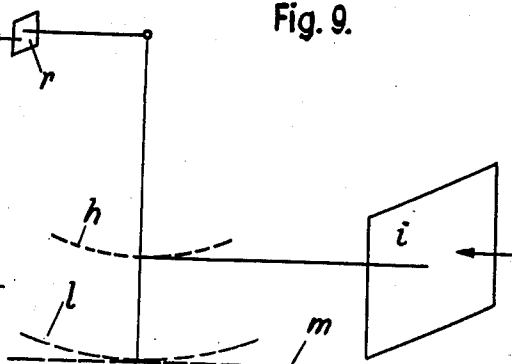


Fig. 9.



Inventor:

Kurt Kühne

UNITED STATES PATENT OFFICE

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HYDRAULIC TOWING DEVICE FOR RIVER CRAFT

Kurt Kühne, Kreisch, Germany

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In Germany December 16, 1935

2 Claims. (Cl. 115—7)

This invention relates to a hydraulically operated towing device for river craft.

It is known to equip river craft with suitable means for utilizing the flow of the water as exclusive propelling force, but the known devices of this class are open to the objection that they permit the utilization of flow in upstream direction only, due to the fact that their chain wheel is smaller than the paddle wheel.

It is the object of the invention to provide a hydraulically operating towing device for river craft, which is capable of utilizing the flow of the water for both upstream and downstream navigation by being fitted with special reversing means and an additional sprocket wheel that is larger than the paddle wheel.

The invention is illustrated by way of example in the accompanying drawings, in which Figure 1 is a side view of the device attached to a river boat; Fig. 2, a detail view of the device on an enlarged scale; Figs. 3 and 4 are diagrams indicating the application of forces during upstream and downstream navigation; Fig. 5 is a side view of the device constructed for use independently of a load-carrying hull of a vessel; Fig. 6, a view on an enlarged scale of one end of the device shown in Fig. 5; Fig. 7, a diagrammatic front view of the device; and Figs. 8 and 9 diagrammatically illustrate the mode of operation of the device and the laws governing it.

The device according to the invention substantially comprises two endless bands arranged on both sides of the body of the vessel and fitted with floatable paddles *b*, the wheels *f* for the paddle bands and the sprocket wheels *d*, *e* rigidly coupled with the wheels *f*. This propelling device is disposed at each end of the vessel by means of brackets so as to exceed the vessel both in width and length.

When a vessel equipped with devices according to the invention is to be started, one of the sprockets *d*, *e* rigidly coupled with the wheels *f* is brought into mesh with a river chain *c* by means of two adjustable auxiliary rolls, so that the hydraulic power acting upon the paddles *b* can drive the vessel. The sprocket wheel *d* is brought into engagement with the chain *c* when the vessel is to move downstream and the sprocket *e* when an upstream voyage is to be made.

Force develops at the paddles *b* only when water flows over them and they are not moving as quickly as the water, i. e. when they are lagging behind. This lag resembling a sort of slip affords the advantage that the energy of the

hydraulic motor is raised to the third power of the speed at which the water strikes the paddles *b*.

This process involves two leverages if the vertical connecting line of the three points of application is taken as lever, as indicated in Fig. 3 for upstream and in Fig. 4 for downstream navigation, the arrows showing the direction of motion and the fulcrum being always located at the point of application of the chain *c*. To attain the effects aimed at by the invention there must of course be flow along the river chain and the sprocket rolling over it must be smaller than the wheel *f* during upstream navigation and larger during downstream navigation. All wheels *d*, *e*, *f* must be rigidly coupled with one another. Upstream navigation requires the force of the chain, which is equal to the total resistance of the vessel and paddles, to act on a small lever arm and the downwardly directed force of paddle pressure, on a long lever arm, the momentary fulcrum of the system represented by the point of application of the chain being located between the fulcrum at the vessel and the point of application of the hydraulic force at the paddle (Fig. 3). During downstream navigation the momentary fulcrum of the system is also represented by the point of application of the chain, but in this instance the fulcrum at the vessel and the point of application of hydraulic force on the paddle are located on the same side of the momentary fulcrum so that accelerated downstream motion results until the moment of the upwardly directed resistance of the vessel acting on the long lever arm is equal to the moment of paddle pressure directed downstream (Fig. 4).

The acceleration or overtaking of the current in downstream navigation is due to the fact that the force of the river chain directed upstream produces a momentary fulcrum of the forces developed, which serves for causing the available kinetic energy acting on the paddles to act at the upper end *a* of the lever at greater speed, so that the vessel is propelled at a speed greater than that of the current. This greater travelling speed is attained and maintained automatically by the forces developed.

It should be mentioned that the actual ratio of resistance of the developing forces is still more favorable and greater than the theoretical ratio of area, since the body of the vessel separates the medium of flow which is thus caught at the paddles.

To change the direction of travel it is only

necessary to bring the chain *c* into engagement with the other sprocket by means of the two adjustable auxiliary rolls and thereby to shift the momentary fulcrum of the system, which effects instantaneous changing of the direction of rotation of the wheels. It is not required to veer the vessel when changing its direction.

In further accordance with the invention a similar construction may be used independently of the body of a vessel and serve as towing device for river craft, so that it has not to wait for loading and discharging but is always ready for towing. Owing to the absence of the load-carrying body of a vessel, which is compensated by the increased floating ability of the device, the internal resistance of the carrying member is reduced to a minimum.

The device shown in Figs. 5 to 9 substantially comprises two pairs of endless chains *i* fitted with floatable paddles and the wheels *h* with which two sprocket wheels for upstream or downstream navigation are coupled. These sprocket wheels *k*, *l* are of the type described and against them the river chain *m* is pressed by the adjustable auxiliary rolls *n*. The paddles constructed like floats have a buoyancy great enough to float the complete outfit. There is further an adjustable support *p* for supporting the outfit on the vessel to be towed so as to counteract the obliquely downwardly acting pull of the river chain. The entire device is arranged on rigid supports corresponding in length to that of the device and supporting also the wheels *o* which practically without friction compensate the depressing load of the upper chain strand and the buoyancy of the lower strand by rolling over the chains.

As indicated in Fig. 7, two spaced pairs of paddle chains are employed instead of one pair, which affords the advantage that the current passing through the space between them is delayed by the paddles and their mode of operation. The practical effect is such as if the spaced paddles of the two chains formed a unit and the space between them were filled also. Owing to the space, however, the mass of the device is reduced still more.

The mode of operation of the device is based on the principle described. The total of the im-

mersing paddles produces approximately the area *i* in Figs. 8 and 9 while the vessel to be propelled represents only the small area *r*. The ratio of the areas *i* and *r* is therefore much greater than the leverage of the vertical lever concerned, so that the vessel is safely propelled in the manner described. The momentary fulcrum of the transmitting lever is always located on the river chain *m*, and is shifted as described to change from upstream to downstream navigation.

However, all forms of the invention are based on the principle of utilizing the flow of water for propelling a vessel by means of a chain in connection with two sprocket wheels differing in size the changing engagement of which with the chain causes a displacement of the momentary fulcrum and thereby a change in the direction of rotation and travel.

I claim:

1. A hydraulically operating towing device for river craft, comprising two endless bands arranged on both sides of the body of a craft to be towed, floatable paddles on said bands, wheels for the paddle bands, two sprockets rigidly coupled with said wheels and having, respectively, a larger and smaller diameter than said wheels, a river chain and adjustable means for alternately bringing one of said sprockets into mesh with said chain to cause the hydraulic power acting upon said paddles to drive the craft downstream or upstream.

2. A hydraulically operated towing device for river craft to be used independently of the hull thereof, comprising rigid supports on which are mounted two pairs of endless chains, floatable paddles attached to said chains, a set of wheels, two sprockets coupled with said wheels and having, respectively, a larger and smaller diameter than said wheels, a river chain, adjustable means for alternately bringing one of said sprockets into engagement with said chain, an adjustable support for supporting the outfit on the craft to be towed so as to counteract the obliquely downwardly acting pull of the river chain and a second set of wheels for compensating the depressing load of the upper chain strand and the buoyancy of the lower strand by rolling over the chains.

KURT KÜHNE.