

GRIPPER FOR OBJECTS

The present invention relates to a device for engaging objects, such as heat exchangers of varying sizes, which
5 comprise a bundle of feed-through tubes extending between two end plates, said device comprising at least one gripper provided with: at least a first and a second gripper arm, at least one of which is movable with respect to the other gripper arm for enclosing at least one object therebetween;
10 and a driving mechanism connected to at least one of said first and second gripper arms for closing or opening the gripper as needed.

Such grippers are generally known, and the gripper arms are
15 made substantially in one piece. Usually, such one-piece gripper arms are bent or curved to as to be able to enclose an elongated object to be manipulated. The circle described by the gripper arms in the closed condition thereof in fact defines a space that is available for engaging an object to
20 be manipulated. Said described circle is directly related to the bend, the curvature or the configuration of the one-piece gripper arms.

Such a configuration according to the prior art has the
25 disadvantage that an object having a smaller outer circumference than the circle described by the gripper arms can roll or slide within the gripper in the closed condition of the gripper arms. When the gripper arms are configured to exhibit a certain curvature, objects having a larger outer
30 circumference than the circle being described by the gripper arms can only be engaged with difficulty, in which case the gripper arms will not be able to enclose the object to be manipulated completely, however.

The object of the present invention is to provide a more
versatilely usable gripper, by means of which smaller objects
can be tightly and securely engaged, whilst it is furthermore
possible to adapt the gripper to the outside contour of
5 larger objects to be manipulated. In order to accomplish that
object, a device according to the present invention is
characterised in that at least one of said first and second
gripper arms comprises a first gripper arm part and the
second gripper on part, which first and second gripper arm
10 parts are pivotally coupled together, and an adjusting
mechanism provided between said first and second gripper arm
parts, said adjusting mechanism being arranged for adjusting
the angle between said gripper arm parts in dependence on the
diameter of the object to be engaged prior to engaging said
15 object. In this way the resulting curvature or configuration
of each gripper arm, or at least of one of the two gripper
arms, can be adjusted as needed. Thus, smaller objects to be
manipulated can be securely clamped down and enclosed, and
the same holds for larger objects that the gripper needs to
20 be capable of manipulating.

It is noted at this stage already that many other
configurations of the curvature or the bent form of gripper
arms that jointly form a gripper are possible as well.
25 Usually said gripper arms will consist of gripper arm
segments, however, for example more than two gripper arm
segments, which are adjustable relative to each other but
which must nevertheless still be sufficiently alike in that
case to jointly form a gripper arm.

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Various preferred embodiments of a device according to the
present invention are possible, which embodiments are defined
in the dependent claims. Thus, the device may comprise at

least two grippers. In particular in the case of comparatively elongated object it may be advantageous to provide a gripper at several positions along the length thereof so as to be able to engage a comparatively elongated object in a more stable manner. In another embodiment it is possible within this framework for the device to comprise at least one connecting element between said at least two grippers. Thus it is also possible to realise a coordinated action of the two grippers along, via or in the connecting element. A coordinated action of the two or more than two grippers is understood to mean not only a synchronised action, in which both grippers are simultaneously closed or opened. It may also be an action in which the grippers are individually closed or opened.

According to an additional or alternative embodiment, a support may be provided between two corresponding gripper arms in a configuration comprising at least two grippers for supporting the object thereon. By connecting the gripper arms of the individual grippers in this way by means of a support, an object to be manipulated can be supported over a larger distance, thus providing a larger contact area for manipulating the object to be manipulated without any risk of damage.

In another alternative or additional embodiment, the device may be characterised in that at least one of said driving mechanism and said adjusting mechanism can be selectively actuated by means of a hydraulic power source. This embodiment is in particular advantageous if a crane or other apparatus of which the device according to the present invention may form part or to which the device can be selectively connected comprises a hydraulic power source.

This is the case with a great many cranes, and for that reason such an embodiment may be advantageous. Nevertheless, it is also possible to use other power sources, such as an electric power source for electric motors, etc.

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On the other hand it may be very advantageous if a hydraulic power source is used to configure the adjusting mechanism as a cylinder extending between and acting on the gripper arm parts. In this way it is possible to adjust the angular position of the gripper arm parts relative to each other and thus also the curvature or bent form of the gripper arms as a whole. Furthermore, the driving mechanism for the gripper arms themselves may be formed by a cylinder or at least comprise a cylinder.

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In another alternative or additional embodiment, the driving mechanism may comprise a linkage which is pivotally coupled to the first and second gripper arms. Said linkage can define a parallelogram configuration in combination with the gripper arms. A driving element may act on selected pivot points in the parallelogram configuration in that case. Such a driving element may be a cylinder. In this way the gripper arms of the device can be driven in an elegant manner.

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Additionally and/or alternatively it is furthermore possible

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to provide an embodiment of the device according to the present invention wherein the two gripper arms of at least one gripper are movable, and wherein the first and second gripper arms are coupled by means of meshing gears on said first and second gripper arms for synchronous movement in opposite directions thereof. Although it has been noted in the foregoing that the grippers may also be individually actuated, and although it will be understood that the same holds for gripper arms of grippers, synchronous movement in

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opposite directions of gripper arms of at least one gripper may provide an advantageous embodiment. Especially if this is realised by means of a simple configuration comprising counterrotating gears, it can be ensured that the gripper
5 arms are securely closed round an object to be manipulated.

Hereinafter an embodiment of the present invention will be described in more detail. It is noted that the description merely describes an example of a possible embodiment and that
10 the invention is not limited to such an embodiment.
Furthermore, individual elements are indicated by the same numerals, insofar as applicable, in the various drawings and views. In the drawing:

15 Figure 1 shows a perspective view of a device according to the present invention in use; and

Figures 2A and 2B show a single gripper as shown in figure 2 during various operative conditions thereof.

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Figure 1 shows a device 1 as a possible embodiment of the present invention. The device 1 comprises a suspension 2, to which a carrier beam 3 is attached. Two grippers 4, 5 are mounted to the ends of the carrier beam 3.

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The grippers 4, 5 can be used for engaging, picking up, moving and generally manipulating an elongated object 6. The cylindrical object 6 may be an industrial heat exchanger. In said heat exchanger, fluid conducting tubes extend between
30 end plates (not shown). The dotted lines only show the outside contour of the assembly or the bundle of said fluid-conducting tubes. Such cylindrical objects 6 may have varying outside contours, in particular varying diameters. The

grippers 4, 5 are designed to optimally engage and manipulate cylindrical objects 6 of varying diameters.

To that end the grippers 4, 5 each comprise two gripper arms 7, 8, respectively.

For the sake of clarity of the description, the gripper arms 7 will now be described in more detail, in which connection it is noted that the gripper arms 8 have substantially the same configuration. This only applies to the embodiment that is shown in Figure 1, however.

The gripper 4 comprises two gripper arms 7, which are suspended from the carrier beam 3 in such a manner as to be movable in opposite directions towards and away from each other. Each of the gripper arms 7 comprises two gripper arm parts 9, 10. The gripper arm parts 9, 10 are pivotally coupled together at a point of attachment 11.

A cylinder 12 extends past the connecting point 11 between two mounting points 13. When the cylinder 12 is actuated to extend, the angle between the gripper arm parts 9, 10 becomes more acute. Thus, the gripper arms 7 of the gripper 4 can be adapted to the external diameter of the object 6 to be manipulated. Said adaptation is shown in more detail in Figures 2A and 2B. The intention of this is that the gripper arms 7 can engage round the object 6 to be manipulated without excessive play. Figure 2A shows an object 6 to be manipulated that has a relatively large external diameter. In such a case the gripper arms 7 will have to include a more acute angle with each other in order to make a wider space available between said arms for accommodating the object 6 to be manipulated. The gripper that is shown in figure 2B, which

is configured identically to the embodiment that is shown in figure 2A, can be adjusted by means of the cylinders 12 to accommodate a much smaller external diameter of the object 6 to be manipulated. To that end the cylinders 12 are actuated to bridge a shorter distance between the mounting points 13. The angle between the gripper arm parts 9, 10 is thus made less acute or larger, as is clearly shown in figure 2B.

Referring back now to figure 1, the gripper arms 7 of the gripper 7, as well as the gripper arms 8 of the gripper 5, are shown to be interconnected by means of gears 14. In this way it can be ensured that the gripper arms 7, 8 of the grippers 4, 5 will move synchronously in opposite directions upon actuation of a driving mechanism 15 (schematically shown). Each of the grippers 4, 5 has its own driving mechanism 15. Said driving mechanisms can be driven, actuated or controlled to open and/or close the grippers 4, 5 simultaneously and synchronously. On the other hand it may also be possible to effect the closing of the gripper 4 and/or the gripper 5 separately by means of the driving mechanisms 15. In the embodiment that is shown in figure 1, however, the grippers 4, 5 move synchronously. This has been effected by synchronising the driving mechanisms 15, and further by means of supports 16. The supports 16 extend between the corresponding gripper arm parts 10 of the grippers 4 and 5. In this way it is ensured that the synchronous movement of the driving mechanisms 15 is effected not only by synchronising the two driving mechanisms but also by using mechanical forcing means.

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It is furthermore noted that the driving mechanisms 15, too, comprise a hydraulic cylinder 17. The cylinders 17 extend from the carrier beam 3 to a pivot point in a linkage 18. The

linkage 18 comprises pivotally coupled-together arms 19, which are pivot-mounted to the gripper arms 7, 8 in mounting points 20. When the cylinder 17 of the driving mechanism 15 is actuated to extend in the configuration that is shown in 5 figure 1, the gripper arms 7, 8 of the grippers 4, 5 will be moved closer together. When on the other hand the cylinders 17 are driven or controlled to retract the piston rods thereof, the gripper arms 7, 8 of the grippers 4, 5 will be moved apart. Thus the arms 19, together with parts of the 10 first gripper arm parts 9, form a parallelogram configuration, which forms part of the driving mechanism 15 together with the cylinder 17.

Several alternative and additional embodiments and 15 possibilities will be available to a person skilled in the art who has perused the foregoing, which embodiments all fall within the scope of the appended claims, unless said additional and/or alternative embodiments and possibilities depart from the letter and the spirit of said claims. Thus it 20 is possible for the individual grippers 4 and 5 to be driven separately without synchronisation, in which case the supports 16 must be left out, however. The gripper arms 7, 8 may also be driven separately other than synchronously in opposite directions, as is effected by means of the gears 14 25 in the embodiments illustrated and discussed herein. Each of the gripper arms 7, 8 may be separately driven. It is also possible to use power sources other than a hydraulic power source for driving the gripper arms 7, 8 and/or adjusting the angular position of said gripper arms 7, 8. It is noted, 30 however, that the adjusting possibilities provided by the individual gripper arm parts 9, 10 make it possible to realise an individual adjustment for each individual gripper arm 7, 8, and thus an adaptation to the outside contour of an

object 6 to be manipulated. It is preferred to use hydraulic drive means, since a crane or similar apparatus for manipulating objects to be manipulated will generally be provided with such a hydraulic power source.

CLAIMS

1. A device for engaging objects, such as heat exchangers of varying sizes, which comprise a bundle of feed-through tubes extending between two end plates, said device comprising at least one gripper provided with:

- at least a first and a second gripper arm, at least one of which is movable with respect to the other gripper arm for enclosing at least one object therebetween; and

- a driving mechanism connected to at least one of said first and second gripper arms for closing or opening the gripper as needed,

wherein at least one of said first and second gripper arms comprises a first gripper arm part and the second gripper on part, which first and second gripper arm parts are pivotally coupled together, and an adjusting

mechanism provided between said first and second gripper arm parts, said adjusting mechanism being arranged for adjusting the angle between said gripper arm parts in dependence on the diameter of the object to be engaged prior to engaging said object.

2. A device according to claim 1, comprising at least two grippers.

3. A device according to claim 2, further comprising at least one connecting element between said at least two grippers.

4. A device according to claim 2 or 3, wherein a support is provided between two corresponding gripper arms for supporting the object thereon.

5. A device according to at least one of the preceding claims, wherein at least one of said driving mechanism and said adjusting mechanism can be selectively actuated by means of a hydraulic power source.

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6. A device according to claim 5, wherein the adjusting mechanism comprises a cylinder extending between and acting on the gripper arm parts.

- 10 7. A device according to claim 5 or 6, wherein said driving mechanism comprises a cylinder.

8. A device according to at least one of the preceding claims, wherein the driving mechanism comprises a linkage which is pivotally coupled to the first and second gripper arms, which can define a parallelogram configuration in combination with the gripper arms, as well as a driving element, such as a cylinder, which acts on pivot points in the parallelogram configuration.

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9. A device according to at least one of the preceding claims, wherein the two gripper arms of at least one gripper are movable, and wherein the first and second gripper arms are coupled by means of meshing gears on said first and second gripper arms for synchronous movement in opposite directions thereof.

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