July 17, 1962 S. PIERRE 3,044,819

SHEET-METAL HANDLING APPARATUS

Filed May 19, 1961 2 Sheets-Sheet 1

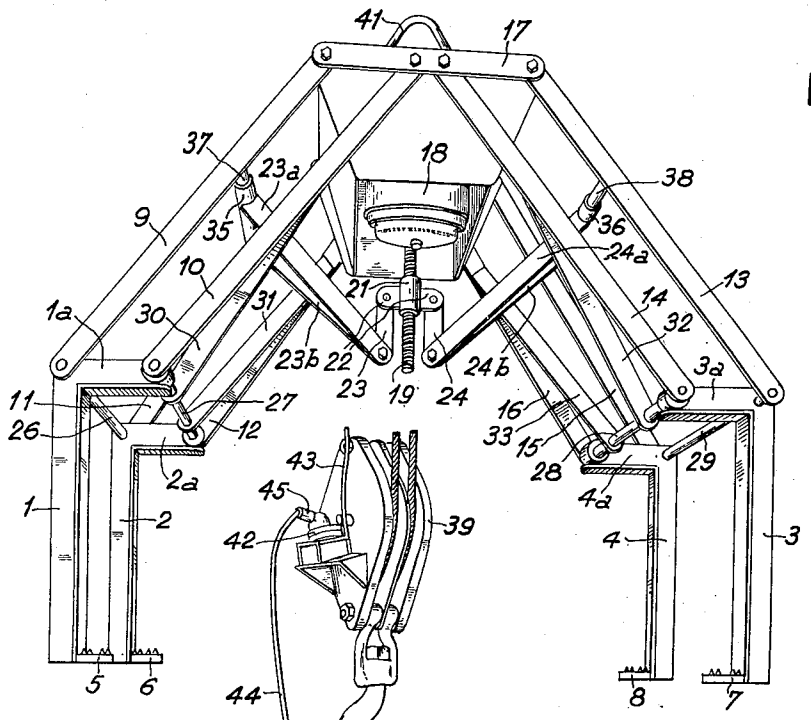

Fig.1.

Fig.2.

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SHEET-METAL HANDLING APPARATUS

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Fig.5.

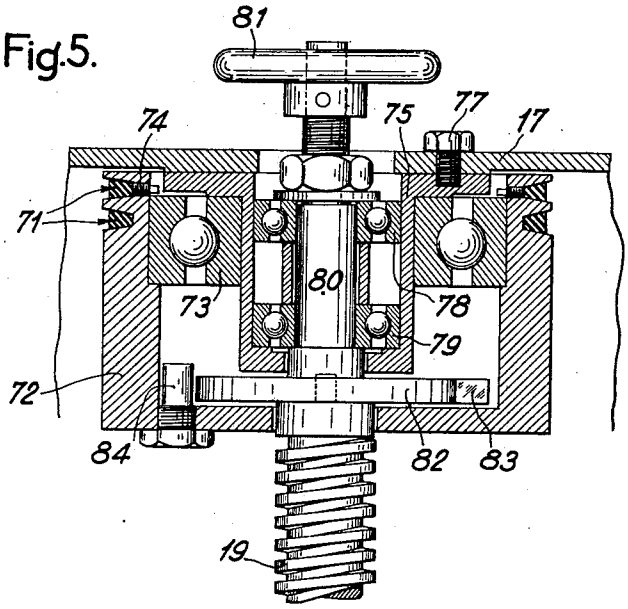


Fig.3.

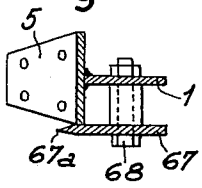
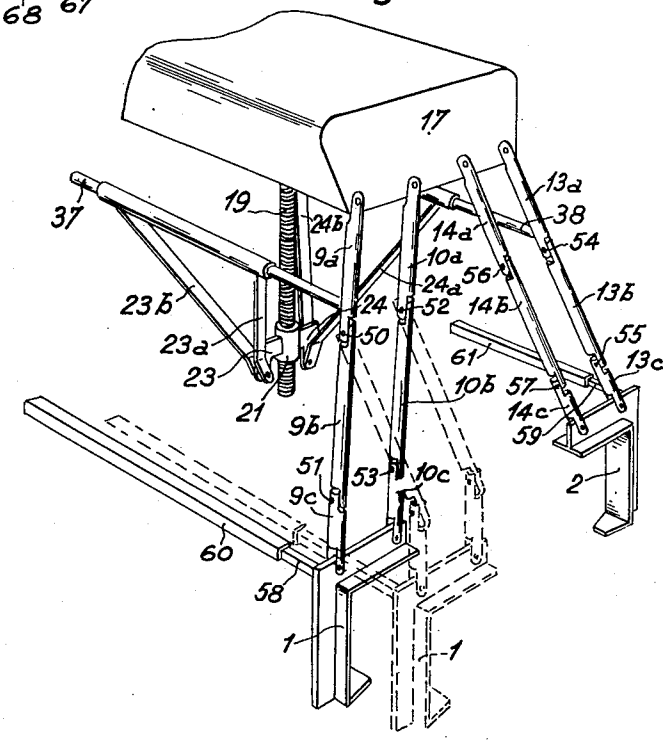


Fig.4.



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SHEET-METAL HANDLING APPARATUS

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7 Claims. (Cl. 294—88)

The conveying and hoisting of cumbersome objects and products, for example by using travelling cranes, gantry cranes, jib cranes, hoists and the like is attended by complicated problems concerning notably the stowing and steadying operations involving necessarily long handlings and the intervention of several operators.

It is the essential object of this invention to avoid these drawbacks and to provide to this end a gripping apparatus adapted to be used in conjunction with a hoisting and/or conveying machine, this apparatus being characterized in that it comprises hook-carrying arms grouped in face to face relationship to constitute two assemblies each comprising at least one pair of arms and one pair of parallel link-systems connecting said arms to a frame supporting a power unit having its output shaft coupled to a mechanism adapted to move said assemblies toward and away from each other, said frame being furthermore provided with means for suspending it from a hoisting or conveying apparatus.

With these combined arrangements there is obtained an apparatus adapted to be remote controlled from a central station for gripping a load, displacing it and finally laying it down without necessitating any manual intervention, but its essential advantage resides in the fact that the two assemblies cooperate with each other like jaws which, due to the provision of the aforesaid parallel-link systems, move in directions parallel to themselves instead of travelling along curved paths as in conventional arrangements using jaws fulcrumed about a common axis. Thus, the gripping hooks have always the same inclination irrespective of the relative spacing of the two assemblies.

Other features and advantages of this invention will appear as the following description proceeds with reference to the accompanying drawings, it being understood that changes in the precise embodiment of the invention herein disclosed may be made within the scope of what is claimed without departing from the spirit of the invention.

In the drawings:

FIGURE 1 is a perspective view showing an apparatus constructed according to the teachings of this invention;

FIGURE 2 is another perspective view showing the apparatus during the lifting of a stack of metal sheets or plates, the gripping arms being designed differently;

FIGURE 3 is a cross-sectional view showing a gripping arm of the apparatus illustrated in FIG. 2;

FIGURE 4 is a fragmentary perspective view of a modified embodiment of the apparatus of this invention; and

FIGURE 5 is a longitudinal section showing the coupling device provided between the power unit or motor and the gripping mechanism.

As illustrated in the drawings, the apparatus of this invention comprises arms **1**, **2** and **3**, **4** bent at right angles at their upper portions to provide corresponding horizontal members **1***a*, **2***a*, **3***a*, **4***a*. At their lower ends these arms terminate with hook-like portions **5**, **6** and **7**, **8** and are grouped in face to face relationship to constitute two identical assemblies. Pairs of parallel links **9** and **10**, **11** and **12**, **13** and **14**, **15** and **16**, are pivoted on the one hand on the upper portions **1***a*, **2***a*, **3***a*, **4***a* of the arms, by means of pivot pins **26**, **27**, **28** and **29**, and on the other hand on a frame **17**, each pair of links constituting a parallel motion system.

Mounted on the frame **17** is an electromotor **18** rotatably driving through a coupling device to be described presently with reference to FIG. 5 a screw **19**, a reducing gear also acting as a stress limiter as will be explained presently. Engaging the screw **19** is a nut-forming socket **21** provided with ears **22** on which are pivotally mounted relatively short links **23**, **24** each connected to an arm and parallel-link assembly. The short links **23**, **24** are pivotally attached to pairs of divergent arms **23***a*, **23***b* and **24***a*, **24***b* respectively, the outer ends of these divergent arms being welded by pairs on cylindrical hollow sleeves **35**, **36**. These sleeves engage respectively cylindrical rods **37**, **38** interconnecting homologous links **9**, **11** and **13**, **15** of the parallel-link systems of each assembly.

The above-described apparatus can be hoisted and displaced by means of any suitable apparatus such as a hoist **39** of which the hook **40** engages a loop **41**, the side branches **41***a* of this loop extending downwards and being surrounded by coil compression springs **41***b* disposed between the top of frame **17** and relevant end nuts **41***c*. Thus, when the apparatus lifts a load, the springs **41***b* are compressed and may actuate electric switch means (not shown) inserted in the energizing circuit of the motor **18** to avoid any untimely or faulty operation by opening this circuit automatically when the apparatus is loaded.

The hoist **39** is provided with a current outlet **42** fed through a conductor **43**. The motor **18** is supplied with current through another cable **44** provided with a plug **45** fitting in the outlet **42**.

To impart a sufficient rigidity to the apparatus, the pairs of links **9** and **11**, **10** and **12**, **14** and **16**, **13** and **15** are interconnected through rods **26**, **27** and **28**, **29**. For the same purpose, the rods **27**, **28** receive bracing members **30**, **31** and **32**, **33** each adapted to stiffen one member of the parallel-link system.

In the alternate embodiment illustrated in FIGS. 2 and 3 of the drawings the arms **1**, **2**, **3** and **4** are provided with a plate **67** bolted thereon at **68**, the inner vertical edge **67***a* of each plate **67** being recessed in relation to the hook **5** and projecting somewhat from the arm face which is to engage the load to be hoisted and conveyed. Thus, when the registering pairs of arms of the apparatus are moved toward each other for hoisting a load, the edge **67***a* of each arm engage the load and prevent it from moving longitudinally. In fact, it is a frequent occurrence that the load slips and falls when the apparatus is moved horizontally, for example by means of a gantry crane, for the load supported by the apparatus has a considerable inertia in relation to the travelling hoisting unit of the gantry crane and therefore travels with a certain time lag, thus causing the load suspended from a cable or chain to swing more or less.

In certain applications of the apparatus of this invention, it is advantageous to move the arms of a same assembly toward or away from each other in order to adapt them to loads of different dimensions, for example in the case of stacks of metal sheets or plates wherein wooden strips separate the superposed sheets or plates. This result may be obtained with the embodiment illustrated in FIG. 4. In this case the branches of each parallel-link system consist of a plurality of sections pivotally interconnected about axes extending at right angles to the sections and located in the plane of the parallel-link system concerned, the arms of a same assembly being interconnected through extensible means.

Thus, as shown in FIG. 4, the links **9**, **10** are each divided into three sections **9***a*, **9***b* and **10***a*, **10***b*, **10***c*, and likewise the links **13** and **14**, are divided into three sections **13***a*, **13***b*, **13***c* and **14***a*, **14***b*, **14***c*. The sections of a same link are pivotally interconnected about pins **50**, **51**, **52**, **53**, **54**, **55**, **56** and **57**. The arms pertaining to a same assembly (**1**, **2** on the one hand and **3**, **4** on the

other hand) are interconnected through cross members 58, 59 (the cross members rigid with arms 3 and 4 are not shown to simplify the figure) each rigid with the arms and sliding by pairs in a sleeve 60, 61 of corresponding configuration.

When it is desired to spread apart the arms of a same assembly, the operator acts manually upon these arms and the branches of the parallel-link systems assume for example the position shown in chain-dotted lines. The cross member 58 slides within the sleeve 60 and the arms may be locked in this different selected position through any known and suitable means.

According to a modified embodiment the upper portions 1*a*, 2*a*, 3*a*, 4*a* of arms 1, 2, 3, 4 are not secured on the rods 26, 27, 28, 29 but formed with two holes each engaged by these rods so that the arms may slide therealong, their axial movements being limited on one side by the links of the parallel link systems and on the other side by the bracing members 30–33. Since each assembly comprises two arms mounted on the aforesaid rods 26–29, the permissible range of adjustment is equal to twice the distance between the links and the bracing members. The arms are at their minimum relative spacing when each of them engages a bracing member, and at their maximum relative spacing when each of them engages the links of the parallel-link systems.

The apparatus described hereinabove with reference to two forms of embodiment operates as follows:

This hoisting apparatus equipped with a hoist or like device 39 and a hook 40 is brought above the apparatus of this invention. The hook 40 engages the loop 41 and the plug 45 is inserted into the current outlet 42. Thus, the apparatus is brought above the load to be hoisted and/or conveyed and the motor 18 is energized in order to rotate the screw 19 in the direction corresponding to the upward travel of the socket 21, so that the short links 23 and 24 move the rods 37, 38 toward each other. These rods cause the links of the parallel-link systems to pivot, and thus the two assemblies comprising the arms 1, 2, and 3, 4 and their hooks are moved toward each other. On the other hand, when the motor 18 and screw 19 are rotated in the opposite direction the pairs of hooks are moved away from each other. It is worth pointing out that the arms remain constantly parallel to themselves when they move outwardly or inwardly, so that the hooks remain horizontal and the load transported by the apparatus is constantly supported with the same efficiency, irrespective of the degree of relative spacing of the arms.

Now reference will be made to FIG. 5 to describe the coupling device interposed between the motor and the gripping mechanism. In fact, during the conveying of the load, for example a stack of metal sheets or plates, the arm assemblies 1, 2 and 3, 4 tend to move toward each other under the influence of the weight of this load, so that the gripping mechanism produces a self-clamping action. This increase in the clamping force makes it necessary to exert a considerable torque on the motor shaft when releasing the load. With this device the arms and load are safely released.

In FIG. 5 the motor (not shown) drives through a set of belts 71 a bell-shaped member 72 constituting the driving member of the coupling device. Inside this bell-shaped member 72 is a ball-bearing 73 retained in position by set screws 74, this ball-bearing being carried on the other hand by an intermediate sleeve 75 secured on the frame 17 of the apparatus by means of screws 77.

Mounted inside the sleeve 75 are a pair of ball-bearings 78, 79 carrying the shaft 80 rigid with the screw 19. The upper end of shaft 80 projects within the frame 17 and has wedged thereon a handwheel 81 for manually controlling the rotation of the screw 19 for example when it is desired to release the arms by hand, in case of motor or current failure.

A disk 82 solid with the shaft 80 carries on its outer periphery a radial lug 83 engageable by a pin 84 screwed in the bottom of the bell-shaped member 72 driven from the engine. This disk 82 constitutes the driven member of the coupling device.

When the load has been clamped between the arms, the pin 84 contacts the lug 83 on one side thereof in order drivingly to rotate the screw 19. When it is desired to release the load, the electromotor is fed in a direction to cause the bell-shaped member 72 and therefore the pin 84 to revolve firstly alone, as the pin 84 moves away from the face of lug 83 which it had previously engaged.

After the pin 84 has revolved through almost a complete revolution it engages the other face of lug 83 and the shock thus applied to the disk 82 and therefore to the screw 19 releases the device instantaneously and therefore permits the unclamping movement of the arms.

The safety feature obtained during the hoisting and conveying movements as well as the certainty of properly holding the objects to be transported result from the weight of these objects themselves. As a matter of fact, no accidental movement of the arms away from each other can take place due to their specific shape and to the direction in which the gravity forces are exerted. Even an accidental starting of the motor will not divaricate the arms since the screw 19 is driven through belts calculated to slip when the gravity effort exceeds a predetermined value.

The apparatus according to this invention may be used for transporting rigid or semi-rigid objects, such as sheet metal stacks, steel bars, tubes, paper rolls, logs, vehicles, etc. With this apparatus, cold or hot, fragile or sturdy objects can be handled indifferently while eliminating any risk of scoring or damaging them as frequently observed when conventional cable hoisting means are used.

Of course, this invention is not limited to the few forms of embodiment shown and described, as many modifications and variations may be brought thereto without departing from the spirit and scope of the invention as set forth in the appended claims.

What I claim is:

1. A gripping apparatus comprising pivoted arms for conveying and hoisting different loads, notably sheet metal stacks, which comprises a frame, hook-carrying arms supported by said frame and grouped in face to face relationship into two assemblies, each assembly comprising at least one pair of arms, deformable parallel-link systems pivoted on the one hand on said frame and on the other hand on each one of said arms, a motor carried by said frame, means operated from said motor for moving said two arm assemblies toward and away from each other in order to grip and release the load respectively, and a coupling device disposed between said motor and said means for moving said arm assemblies toward and away from each other, said coupling device comprising a driving member actuated from said motor and a driven member operating said means, said driving and driven members being such that they permit a free relative rotation through an angle sufficient to cause said motor, when the coupling takes place, to attain under no-load conditions a speed sufficient to release the arms previously clamped on the load transported by the apparatus.

2. Apparatus as set forth in claim 1, comprising at least one horizontal longitudinal member on which said hook-carrying arms are slidably mounted independently of one another.

3. Apparatus as set forth in claim 2, wherein the movable sides of said parallel-link systems are mounted on the ends of said horizontal longitudinal members on which the hook-carrying arms are slidably mounted.

4. Apparatus as set forth in claim 2, wherein each longitudinal member is common to the homologous movable sides of the parallel-link systems of a same assembly.

5. Apparatus as set forth in claim 1, wherein each arm is provided with a vertical, relatively sharp edge recessed from the relevant hook and projecting somewhat from the arm face which is to co-act with the loads to be transported.

6. Apparatus as set forth in claim 1, wherein a bell-shaped member rotatably driven from said motor has a pin secured in its bottom, a radial lug rigid with said driven member being adapted to be engaged on one or the other side by said pin.

7. Apparatus as set forth in claim 1, comprising a hand control wheel mounted externally of said frame and rigid with said driven member.

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