ABSTRACT OF THE DISCLOSURE

An apparatus for lifting a stack of sheets comprising a master leg, a pair of half legs pivotally connected at the inner ends thereof to the master leg and disposed on opposite sides of the master leg to form therewith a substantially X-shaped lifting frame, each of said half legs being movable with respect to the master leg independently of the movement of the other half leg, and a plurality of lifting feet operatively connected to the ends of the master leg and the outer ends of the half legs, whereby when the X-shaped frame is positioned over a stack of sheets to be lifted the lifting feet may be positioned under the bottommost sheet in the stack for supporting and carrying the stack when the apparatus is lifted.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to an apparatus for lifting a stack of sheets, such as a stack of rolled steel sheets. More particularly, the invention concerns a modified X-frame sheet lifter which is adapted to engage and lift stacks of irregularly shaped sheets, as well as stacks of rectangularly shaped stack sheets; and which is designed to utilize a minimum amount of lateral operating space for engaging and disengaging such stacks.

Description of the prior art

Conventional sheet lifters basically comprise an A-shaped lifting frame and generally include a pair of elongated parallel lifting feet affixed to the lower portions of the frame which engage the bottommost sheet in a stack for supporting and carrying the stack during a lifting operation. Such lifters are satisfactory for lifting a stack of rectangularly shaped stock sheets when sufficient lateral space is provided adjacent the sides of the stack to permit the lower portions of the frame to close thereon and open therefrom for positioning the lifting feet.

However, lifters of this type are unable to lift stacks of irregularly shaped sheets since the elongated parallel lifting feet are adapted to engage only the parallel bottom edges of the bottommost sheet in a stack of rectangularly shaped sheets. Also, when several stacks are placed in close lateral proximity with one another, there is often insufficient lateral space between the stacks to permit the lower portions of the A-shaped lifting frame to close on and open from the sides of the stacks for positioning the lifting feet. Due to this latter disadvantage a considerable amount of non-productive lateral space must be left between adjacent stacks if the stacks are to be lifted with a conventional A-frame sheet lifter.

SUMMARY OF THE INVENTION

The modified X-frame lifting apparatus of the present invention minimizes the foregoing disadvantages associated with conventional A-frame sheet lifters. The lifter of the invention comprises an X-shaped lifting frame formed by a master leg and a pair of half legs; the half legs being pivotally connected at their inner ends to the master leg at approximately its midpoint and being independently movable with respect to the master leg. Individua

ual lifting feet are operatively connected to the ends of the master leg and to the outer ends of the half legs for engaging the bottommost sheet in a stack to be lifted.

When it is desired to lift a stack of sheets, the X-shaped frame is positioned thereover and the positions of the half legs are adjusted with respect to the master leg so that the ends of the master leg and the outer ends of the half legs are positioned just outside and adjacent the edges of the top sheet in the stack. The lifting feet are then positioned under the bottommost sheet in the stack so that when the lifter is raised the stack will be supported on and carried by the lifting feet.

The adjustment of the half legs with respect to the master leg may be made before the lifting feet are lowered along the sides of the stack for engagement with the bottommost sheet. Thus, only sufficient lateral space need be left between adjacent stacks for the lifting feet to move vertically downwardly therebetween.

The lifting feet are connected to the legs by shafts which are journaled in the ends of the legs, so that while the feet are being lowered along the sides of a stack, they may be oriented with their longest dimension parallel to the stack sides, further minimizing the amount of lateral operating space required between stacks. After the feet have been moved downwardly below the level of the bottommost sheet in the stack they may then be oriented with their longest dimension perpendicular to the stack sides to position them under the bottommost sheet preparatory to supporting the stack.

Furthermore, since each of the half legs is independently adjustable with respect to the master leg, the apparatus of the invention may be used for lifting stacks of irregularly shaped sheets. Hence, if one end of a stack is narrower than the other end, the half leg at the narrower end is moved closer to the master leg than the half leg at the wider end so that the ends of all of the legs will be positioned just outside and adjacent the edges of the top sheet, similarly to the manner in which the legs are positioned for lifting stacks of rectangularly shaped sheets.

Accordingly, it is an object of the present invention to provide an apparatus for sheet lifting which requires a minimum amount of lateral operating space adjacent the sides of a stack for engaging and disengaging the bottommost sheet in the stack.

It is another object of the invention to provide a sheet lifter adapted to lift stacks of irregularly shaped sheets as well as rectangularly shaped stock sheets.

It is also an object of the invention to provide a modified X-frame sheet lifter having a master leg and a pair of half legs, which half legs are pivotally connected to the master leg and are movable with respect to the master leg independently of one another.

It is a further object of the invention to provide a sheet lifter having rotatably mounted lifting feet which require a minimum amount of lateral operating space adjacent a stack of sheets for engaging and disengaging the bottommost sheet of the stack.

With the foregoing summary of the invention in mind, the preferred embodiment thereof is described below in connection with the following drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG 1 is a plan view of the lifting apparatus of the invention; and FIG 2 is an elevational view of the apparatus shown in FIG 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred embodiment of the lifting apparatus of the invention is indicated by the numeral 10 in FIGS. 1 and 2, and is shown appropriately positioned for engaging
and lifting a stack of sheets 12. Sheet lifter 10 comprises a master leg 14 and a pair of half legs 16 and 18. Half legs 16 and 18 are pivotally connected to master leg 14 at approximately the midpoint thereof, as shown in FIG. 1, by a pair of supporting plates 20 and 22 and a pair of pivot pins 24 and 26. As shown in FIG. 2, plate 20 is affixed to the upper surface of leg 14 and plate 22 is affixed to the lower surface thereof. Plates 20 and 22 are elongated members with semi-circularly shaped end portions and are vertically aligned with one another, having their longitudinal axes angularly disposed with respect to the longitudinal axis of leg 14. Pivot pins 24 and 26 are held by supporting plates 20 and 22 and pivotally engage the inner ends of half legs 16 and 18, respectively. As shown in FIG. 1, the half legs are disposed on either side of master leg 14 and define therewith a substantially X-shaped lifting frame.

Since half legs 16 and 18 are independently connected to master leg 14, each half leg may be moved with respect to the master leg independently of the movement of the other half leg. Power means are provided for adjusting the positions of the half legs with respect to the master leg. The power means comprises a pair of actuators 28 and 30 which are connected between half leg 16 and master leg 14, and half leg 18 and master leg 14, respectively. Actuators 28 and 30 may be hydraulic, pneumatic or electric actuators as desired, hydraulic actuators being employed in the preferred embodiment of the invention.

Actuators 28 and 30 are operated by a drive motor and pump unit 32. Unit 32 is mounted on a block 34 which is affixed to the top of supporting plate 20. The unit includes an electric motor, hydraulic pump and suitable solenoid-operated valves for delivering and receiving hydraulic fluid to and from actuators 28 and 30 through lines 29 and 31, respectively. Electric power is delivered to unit 32 by an insulated cable 36, as shown in FIG. 2, which is connected to the unit from above lifter 10.

The solenoid-operated valves within unit 32 are operated from a remote control box 38 which is connected to the unit by an insulated cable 40. By manipulating the appropriate controls at box 38 an operator may regulate the flow of hydraulic fluid to and from actuators 28 and 30 and thus control the movement and positions of half legs 16 and 18 with respect to master leg 14.

A plurality of lifting feet 42 are operatively connected to the ends of master leg 14 and to the outer ends of half legs 16 and 18 by telescopic shafts 44, the upper end of each such shaft being journaled in the end of one of the legs and the lower end carrying one of the lifting feet.

Power means are provided for rotating shafts 44 and moving lifting feet 42 between a position in which the feet do not extend under the bottommost sheet in stack 12 having their longest dimension oriented parallel to the stack sides, as shown in solid lines in FIG. 1, and a position in which the feet extend under the bottommost sheet in the stack having their longest dimension oriented perpendicular to the stack sides, as shown in phantom lines in FIG. 1. The power means comprises a plurality of motors 46, one of which is connected to the upper end of each of shafts 44. Motors 46 may be hydraulic, electric or pneumatic motors as desired, electric motors being employed in the preferred embodiment of the invention. Electrical power is delivered to motors 46 through insulated cables 43 from control unit 32. Unit 32 includes suitable solenoid-operated switches for regulating the operation of motors 46, the switches in turn being controlled from remote control box 38.

In operation, lifting apparatus 10 is suspended from a hoisting mechanism, such as an overhead crane, by a cable 50 and lifting harness 52. Preferably, the X-shaped lifting frame formed by master leg 14 and half legs 16 and 18 is positioned above a stack of sheets 12 to be lifted with lifting feet 42 just above the level of the top sheet in the stack. Stack 12 is supported above the floor 54 of a warehouse or other storage area by a pair of supporting blocks 56.

After the lifting frame is positioned over the stack, the plates 20 and 22 adjust the positions of half legs 16 and 18 with respect to master leg 14 so that the ends of the master leg and the outer ends of the half legs are just outside and adjacent the vertical planes defined by the sides of the stack. At this time lifting feet 42 are positioned with their longest dimension oriented parallel to the stack sides.

The lifter is then lowered, permitting lifting feet 42 and shafts 44 to move downwardly along the stack sides, until the lifting feet are below the level of the bottommost sheet in the stack, as shown in FIG. 2. The operator then closes the half legs slightly until all of shafts 44 are in the sides of the stack, and thereby energizes motors 46 to rotate the lifting feet under the stack with their longest dimension oriented perpendicular to the stack sides. After the apparatus has been so positioned, it is ready to lift the stack when cable 50 is raised by the hoisting mechanism. As will be apparent, the stack is carried on and supported by lifting feet 42 during the lifting operation.

After the stack has been transferred to the location at which it is to be deposited, the above sequence of operations is reversed and lifter 10 is removed from about the stack.

In addition to the capability of being able to lift a stack of rectangularly shaped stock sheets, as shown in FIGS. 1 and 2, lifter 10 may be used for lifting stacks of irregularly shaped stock sheets, having, for example, one end narrower than the other. In such instance, half legs 16 and 18 are adjusted independently with respect to master leg 14 in such a manner that the ends of the master leg and the outer ends of the half legs are positioned just outside and adjacent the edges of the top sheet, similarly to the manner in which the legs are positioned for lifting a stack of rectangularly shaped stock sheets. However, when the half legs are adjusted for lifting a stack of irregularly shaped sheets, the angle included between each half leg and the master leg will be different than the angle included between the other half leg and the master leg, and the lifting frame will assume an asymmetrical X-shape.

Irrespective of whether the apparatus is employed for lifting a stack of rectangularly shaped stock sheets, or irregularly shaped sheets, however, since the half legs may be adjusted independently with respect to the master leg, the ends of the legs always may be positioned just outside and adjacent the edges of the top sheet in the stack. This capability provides the lifting apparatus of the invention with a substantial advantage over conventional A-frame sheet lifters because the lifting frames and elongated lifting feet of conventional lifters are not adapted to close on and engage stacks of irregularly shaped sheets.

Also, lifter 10 requires only a minimum amount of lateral operating space adjacent the sides of a stack to be lifted. As mentioned above, during the preferred sequence of operations, the half legs are adjusted with respect to the master leg before lifting feet 42 and shafts 44 are lowered along the sides of the stack. Further, while the lifting feet are moving downwardly along the stack sides, their longest dimension is oriented parallel thereto so that they require a lateral lowering space no wider than the diameter of motors 46, as shown in FIG. 1. This construction is to be distinguished from conventional A-frame sheet lifters which require sufficient lateral space adjacent the sides of a stack to permit the lower portions of the frame to close on and open from the stack.

In addition to these several advantages, the lifting apparatus of the invention is of a sturdy and compact construction requiring a minimum of maintenance. Also, the lifter may be operated by a single operator from a remote control box which controls all of the power-driven mov-
able elements of the lifter employed during a lifting operation.

I claim:
1. An apparatus for lifting a stack of sheets comprising:
   a master leg;
   a pair of half legs pivotally connected at the inner ends thereof to said master leg at approximately the midpoint of the master leg, one of said half legs being disposed on each side of the master leg and extending outwardly therefrom so that the master leg and half legs form a substantially X-shaped lifting frame;
   power means associated with the half legs for moving each half leg toward and away from the master leg independently of the movement of the other half leg;
   means for controlling the operation of said power means to thereby control the movement and positions of the half legs with respect to the master leg; and
   a plurality of lifting feet, one of said feet being operatively connected to each end of the master leg and to the outer end of each half leg, said lifting feet being positionable under the bottommost sheet in a stack of sheets to be lifted for supporting and carrying the stack when the X-shaped frame is positioned over the stack and the ends of the master leg and the outer ends of the half legs are positioned outside and adjacent the edges of the top sheet in the stack by adjusting the positions of the half legs with respect to the master leg.

2. The apparatus as recited in claim 1, wherein the half legs are connected to the master leg by a plurality of support plates secured to the master leg at approximately the midpoint thereof and a pair of pivot pins, each of said pins being held by said plates and pivotally engaging the inner end of one of the half legs.

3. The apparatus as recited in claim 1, wherein said power means comprises a pair of actuators, one of said actuators being connected between each of the half legs and the master leg.

4. The apparatus as recited in claim 1, wherein the lifting feet are connected to the ends of the legs by shafts, one end of each of said shafts being journaled in the end of one of the legs and the other end carrying a lifting foot, so that when the ends of the master leg and the outer ends of the half legs are positioned outside and adjacent the edges of the top sheet in the stack, the shafts and lifting feet lowered about the sides of the stack, the shafts may be rotated to position the lifting feet under the bottommost sheet in the stack.

5. The apparatus as recited in claim 4, further comprising additional power means associated with the shafts for rotating the shafts, and means for controlling the operation of said additional power means to thereby control the rotation of the shafts and positions of the lifting feet.

6. The apparatus as recited in claim 5, wherein said additional power means comprises a plurality of motors, one of said motors being connected to said one end of each of the shafts.

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