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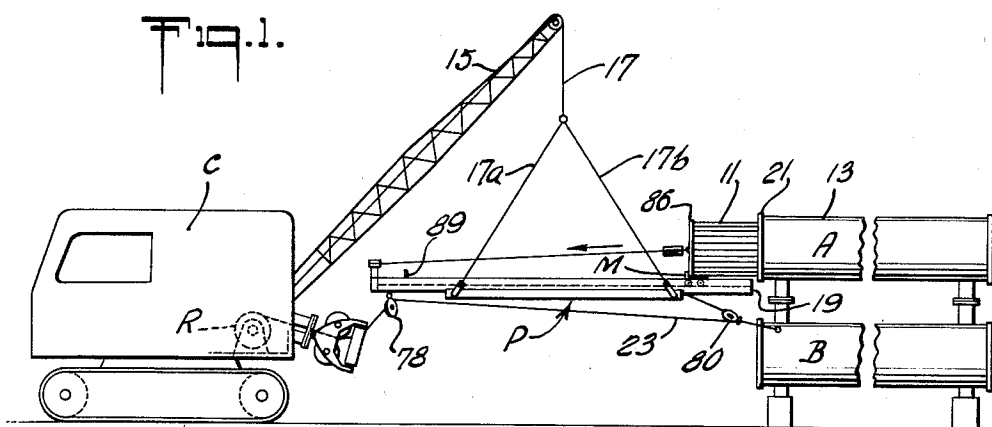
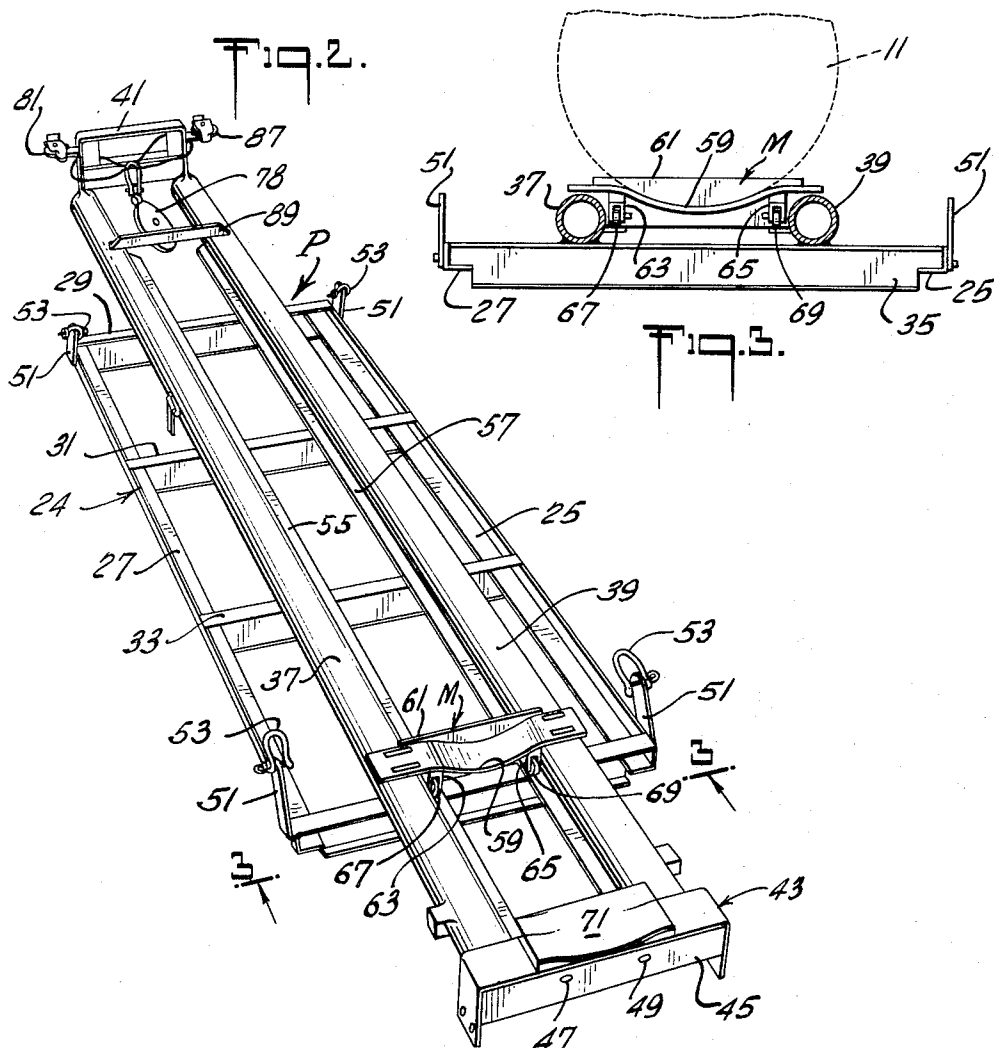
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APPARATUS FOR MOVING HEAT EXCHANGER TUBE BUNDLES

Filed June 17, 1957

2 Sheets-Sheet 1



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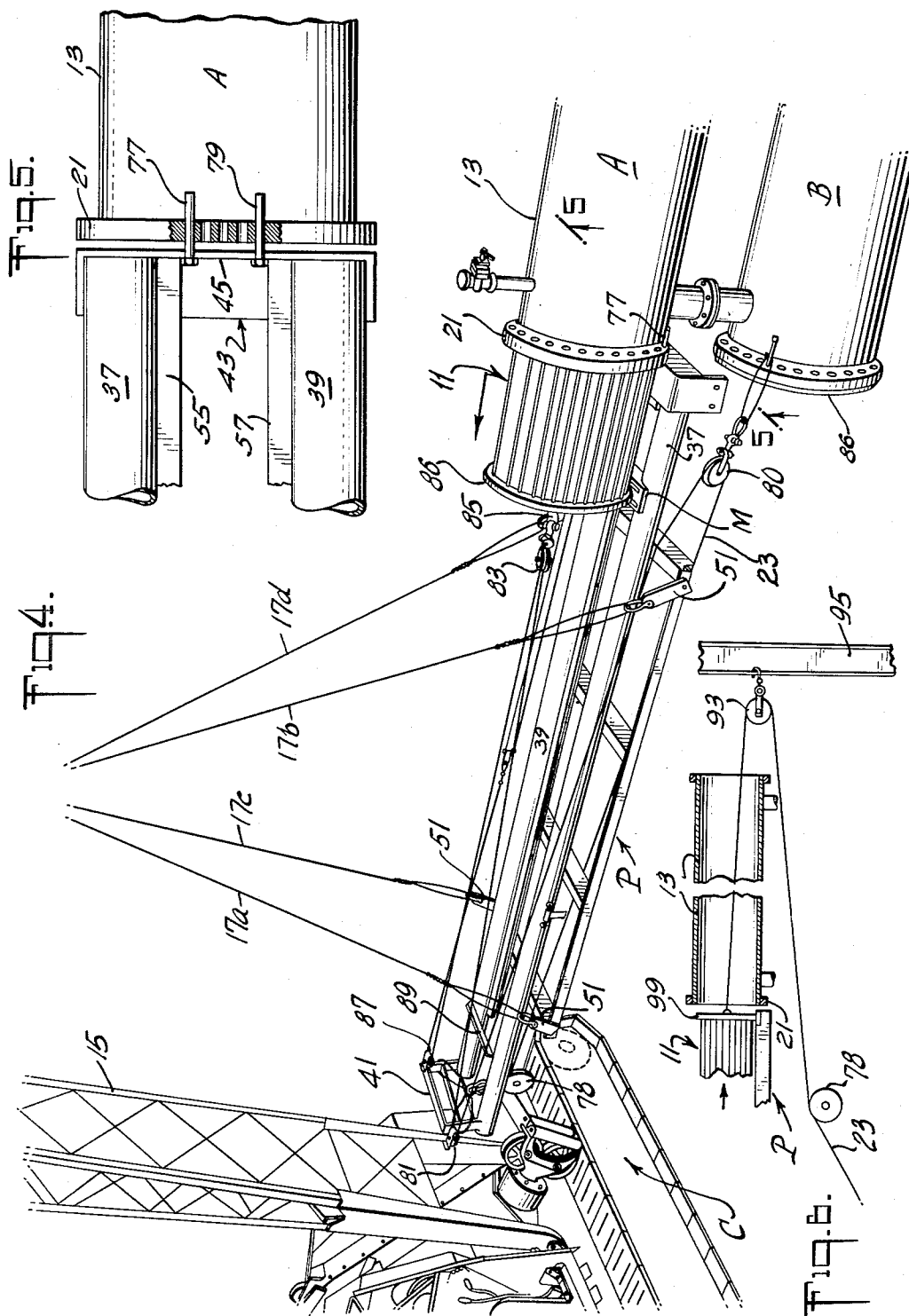
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APPARATUS FOR MOVING HEAT EXCHANGER TUBE BUNDLES

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The present invention relates to a novel method of and apparatus for moving a tube bundle out of or into a horizontal heat exchanger shell.

Oil refineries and chemical plants employ many large heat exchangers wherein a cylindrical bundle comprising many metal tubes is located within a cylindrical metal shell, whereby heat exchange may be obtained between a fluid passing through the tubes and another fluid passing around the tubes within the shell. Such heat exchangers are often very large in size, such as 4 feet in diameter and 20 feet long, and may weight several tons. They may be located near the ground, or elevated as much as 75 feet in the air.

After a heat exchanger has been in use for some time, it is usually necessary to remove the tube bundle from its shell for cleaning and repair. In the past a tube bundle has been removed by employing a large steel scaffolding upon which workmen stand while they jack the tube bundle out of the shell. Sometimes such a scaffolding is a permanent part of the heat exchanger installation; other times it must be built for each tube bundle removal job. In either case, it is expensive and requires a great deal of space which could be used to better advantage for other purposes. Furthermore, much manual labor is required.

In accordance with the present invention the above objections are overcome by providing a novel method of removing a tube bundle from a horizontal heat exchanger shell comprising positioning a portable bundle support or pallet adjacent one end of the shell, holding the pallet firmly in position, forcing the tube bundle from its shell onto the pallet, and then moving the tube bundle and the pallet together from the vicinity of the heat exchanger shell to the location where reconditioning is to be done.

The apparatus for performing the method described above is a pallet which comprises a wide portable support bed carrying a pair of parallel spaced beams spaced from the sides of the bed, and a mobile carriage which lies between and is movable along the beams length-wise thereof, for receiving and carrying the front end of a tube bundle.

There may also be a stationary cradle adjacent the rear end of the parallel beams for receiving the rear end of a tube bundle after complete removal thereof from its shell. However, such a second cradle is not essential, since the beams may be spaced apart by a distance less than the diameter of the tube bundle so that the latter will rest directly upon the beams after removal. Further details of the apparatus will be described hereinafter with reference to the accompanying drawings, wherein:

FIG. 1 is a schematic side elevational view showing the apparatus of the present invention as it is being used to pull a tube bundle from a heat exchanger shell;

FIG. 2 is a perspective view of the apparatus of the invention, on a larger scale than FIG. 1;

FIG. 3 is a cross-sectional view taken along the line 3—3 in FIG. 2;

FIG. 4 is a perspective view showing the apparatus in greater detail than FIG. 1, as employed for pulling a heat exchanger bundle from its shell;

FIG. 5 is a bottom view taken along the line 5—5 in FIG. 4, part being shown in section; and

FIG. 6 is a vertical sectional view showing schematically how the apparatus of the present invention is em-

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ployed for moving a tube bundle into a heat exchanger shell.

Referring to FIG. 1 there are shown two heat exchangers A and B with a tube bundle 11 in the process of being removed from the shell 13 of the upper heat exchanger A. This is being done by a mobile crane C having a boom 15 from the end of which extends a suspension cable 17 fastened to a horizontal pallet P which is positioned with its front end 19 adjacent to the flange 21 of the shell. Cable 17 comprises a single main section coupled to four legs 17a, b, c, and d.

A second cable 23 extends from a reeling mechanism R on the crane through a series of sheaves so as to exert a pulling force axially upon the tube bundle 11, as will be described more in detail in connection with FIG. 4.

After the tube bundle 11 has fully emerged from the heat exchanger shell 13 on to the pallet P, crane C then moves the suspended pallet P away for reconditioning of the tube bundle.

Referring now to FIG. 2, the pallet P comprises a support bed 24 composed of a pair of longitudinal steel channel members 25 and 27, which are spaced apart by four transverse steel braces 29, 31, 33 and 35 welded to the longitudinal members.

Adjacent each of its four corners the support bed 25 has welded to members 25 and 27 a coupling device comprising an upwardly and inwardly slanted ear 51, carrying a shackle 53 which is pivotally secured thereto by a pin, for connection to the suspension cable 17.

On its upper surface the support bed 24 carries a pair of longitudinally extending parallel beams 37 and 39 which are slightly longer than a tube bundle, project at both ends beyond the ends of the bed, and are spaced apart by a distance less than the width of the bed. Beams 37 and 39 may have any suitable shape, but are shown here as heavy steel pipes which are secured as by welding to the cross braces. The beams are additionally secured together at the front end by an upwardly extending bracket 41, and at their rear ends by a box-like cross member 43 which includes a vertical end plate 45 having two apertures 47 and 49 therein spaced so as to register with bolt holes in flange 21, for a purpose to be described hereinafter.

Welded to the inner sides of beams 37 and 39 below their top surfaces is a pair of tracks 55 and 57 extending parallel to one another for substantially the full length of the beams.

Mounted on the tracks 55 and 57 is a mobile carriage M comprising a downwardly concave cradle 59 which extends transversely of the beams and over-lies them on each end, and a vertical stop plate 61 on the front end of the cradle. Two downwardly extending bifurcated legs 63 and 65 are welded to parts 59 and 61, and carry two pairs of rollers or casters 67 and 69 (only two being shown) journaled therein. These rollers rest upon tracks 55 and 57 whereby carriage M can be moved along the beams.

At the rear end of the beams there is a concave stationary cradle 71 which is welded or otherwise secured to the top of the cross piece 43 to receive the tube sheet at the rear end of a tube bundle after complete removal of the bundle.

When using the apparatus described above in the manner illustrated in FIGS. 4 and 5, the pallet P is suspended from cable 17 with its rear end plate 45 against the shell flange 21 so that the apertures 47 and 49 are aligned with two of the bolt holes in the flange. This position is then rigidly maintained by inserting a pair of dowel pins 77 and 79 through the registering holes, as shown in detail in FIG. 5.

Then the tube bundle 11 is eased from the shell 13 by reeling in the cable 23, which passes first over a sheave 78

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hanging from the bracket 41, then through a sheave 80 mounted on an independent support such as the heat exchanger B, then forwardly through a sheave 81 mounted on one side of bracket 41, then rearwardly to another sheave 83 which is secured to an eye-bolt or other connecting device 85 threaded centrally into the front of a tube sheet 86, then forwardly again through a sheave 87 on the other side of bracket 41 and then back again to the eye-bolt 85 where it is fastened. It is evident, therefore, that the reeling mechanism R, the pulling means or cable 23 and the portable support or pallet P are so constructed and arranged that when force is exerted on cable 23 to pull the tube bundle in one direction out of shell A, a force in the opposite direction is exerted on the pallet and thence on shell A.

When removal begins the carriage M is positioned near the rear end of pallet P so that the front tube sheet 86 enters the cradle 59 and abuts against plate 61. Upon continued withdrawal from the shell 13, the tube sheet 86 and carriage M travel together along the tracks 55 and 57 until the carriage stops against a cross piece 89. At this point the rear tube sheet of the tube bundle leaves the shell 13 and settles in the stationary cradle 71 completely outside of the heat exchanger.

Then the pins 77 and 79 are withdrawn, the cable 23 is disconnected at the eye-bolt 85 and is reeled in by the reel R whereupon the pallet P swings free and is carried away by the crane C for reconditioning. Stability during transportation is assured by the width of bed 24, which is substantially greater than the diameter of the tube bundle. If desired the tube bundle may be shackled to the pallet P with cables, but this is usually not necessary.

Upon completion of reconditioning, tube bundle 11 is reinstalled within the heat exchanger shell 13 with the same apparatus, but rigged a little differently. Referring to FIG. 6, the pallet P again is suspended against the shell 13 and secured by pins 77 and 79. The cable 23 passes over sheave 78 an through a sheave 93 which is mounted on any suitable support in back of the heat exchanger A and spaced therefrom, such as a vertical column 95. Cable 23 then turns back and passes forward within the shell 13 to an eye-bolt 97 threaded centrally into the rear tube sheet 99 of the tube bundle. The cable 23 is then reeled in and pulls axially on the tube bundle 11, drawing it into the shell 13 while the mobile carriage M rolls along the tracks 55 and 57 and supports the front tube sheet 86.

From the foregoing description it is apparent that there has been provided a novel and highly advantageous method of and apparatus for moving a heat exchanger tube bundle out of or into a heat exchanger shell while avoiding the expensive and space consuming scaffolding which has been found necessary heretofore, and while reducing the amount of manual labor required.

Obviously, many modifications and variations of the invention, as hereinbefore set forth, may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated in the appended claims.

We claim:

1. Apparatus for moving a tube bundle out of a horizontal heat exchanger shell comprising, in combination, a portable support including, (a) a pair of parallel horizontally spaced beams, (b) a mobile carriage much shorter than said tube bundle for receiving only a front end portion of said tube bundle, said carriage extending transversely between said beams, having a surface upon which said front end portion rests, and being movable along said beams lengthwise thereof over a distance at least as great as substantially the length of said tube bundle, and (c) means for connecting an end of said support to a heat exchanger shell for maintaining a fixed relationship therewith; pulling means carried by said support and engageable with such a tube bundle at will; and mechanism operatively connected to said pulling means

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for exerting a pulling force thereon, said mechanism, said pulling means and said support being so constructed and arranged that when force is exerted on said pulling means to pull said tube bundle in one direction out of said shell, a force in the opposite direction is exerted on said support and thence on said shell.

2. Apparatus in accordance with claim 1 wherein said portable support also includes a support bed of greater width than the space between said beams, wherein said beams rest upon said support bed, and wherein means is provided on said support bed on opposite sides of said beams for attachment to a suspension device.

3. Apparatus in accordance with claim 1 wherein said beams are spaced apart a distance less than the diameter of said tube bundle, for supporting said tube bundle when completely outside said shell.

4. Apparatus in accordance with claim 1, also comprising tracks on the inner sides of said beams below the top surfaces thereof and extending parallel to one another, and rollers on said mobile carriage extending down between said beams and resting on said tracks.

5. Apparatus for removing a tube bundle from a heat exchanger shell comprising a portable support bed; a pair of parallel spaced beams on said bed; a mobile cradle for receiving the front end of said tube bundle, said cradle extending transversely between said beams and being movable lengthwise thereof; a bracket adjacent the front end of said parallel beams remote from said shell; a pair of sheaves carried by said bracket and spaced laterally from one another; a third sheave extending downwardly from said bracket; a crane having a boom extending above said support bed and beams; cables extending down from said boom to said support bed and holding said support bed and beams in a horizontal position; a fourth sheave mounted at a position adjacent said shell near the rear end of said parallel beams; a fifth sheave mounted centrally on the front end of said tube bundle; mechanism on said crane for winding a cable; and a cable extending from said mechanism through said third sheave to said fourth sheave, then forward and through one of said pair of sheaves, then through said fifth sheave, then forward and through the other of said pair of sheaves, and then secured at the end thereof, whereby when cable is wound in by said mechanism, force is exerted through said sheaves on said tube bundle and pulls said tube bundle from said heat exchanger shell onto said beams.

6. Apparatus in accordance with claim 5, also comprising a transverse connecting member adjacent the rear end of said beams, said member having at least one aperture therethrough adapted to register with a corresponding bolt hole in a flange on said heat exchanger shell, and a pin extending through said aperture into said bolt hole, for holding said support steady.

7. Apparatus for moving a tube bundle out of a horizontal heat exchanger shell comprising, in combination, a portable support including a pair of parallel spaced beams; means for connecting an end of said support to a heat exchanger shell for maintaining a fixed relationship therebetween; a mobile carriage carried by said support much shorter than said tube bundle and said support for receiving only a front end portion of a tube bundle, said carriage extending transversely between said beams, having a surface upon which said front end portion rests, and being movable lengthwise of said beams over a distance at least as great as substantially the length of said tube bundle; pulling means engageable with such a tube bundle at will, said pulling means being independent of said carriage; mechanism operatively connected to said pulling means for exerting a pull thereon; and a cradle carried by said support extending transversely between said beams at a position so located as to support a rear end portion of such a tube bundle after said tube bundle has left said shell.

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8. Apparatus for moving a tube bundle out of a horizontal heat exchanger shell comprising, in combination, a portable support including, (a) a pair of parallel horizontally spaced beams, (b) a mobile carriage much shorter than said tube bundle for receiving only a front end portion of said tube bundle, said carriage extending transversely between said beams, having a surface upon which said front end portion rests, and being movable along said beams lengthwise thereof over a distance at least as great as substantially the length of said tube bundle, and (c) means for connecting an end of said support to a heat exchanger shell for maintaining a fixed relationship therewith; pulling means carried by said support and engageable with such a tube bundle at will; and mechanism operatively connected to said pulling means for exerting a pulling force thereon, said mechanism, said pulling means and said support being so constructed and arranged that when force is exerted on said pulling means to pull said tube bundle in one direction out of said shell, a force in the opposite direction is exerted on said support and thence on said shell, said apparatus also comprising means for holding said beams in a horizontal position adjacent to said heat exchanger shell.

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References Cited by the Examiner

UNITED STATES PATENTS

857,856	6/1907	Baehr et al.	
918,411	4/1909	Adams	254—30 X
1,323,575	12/1919	Brahe	212—135
2,182,902	12/1939	Nye et al.	
2,448,324	8/1948	Pool	214—2.5
2,455,736	12/1948	Conley	254—29
2,547,398	4/1951	Lee	212—61
2,581,971	1/1952	Perrault	294—67
2,692,565	10/1954	Cummings.	
2,811,240	10/1957	Fenton	214—16.4 X
2,857,922	10/1958	Effinger.	

OTHER REFERENCES

Power Magazine, vol. 59, No. 26, June 24, 1924, pp. 1032, 1033.

GERALD M. FORLENZA, *Primary Examiner*.

ERNEST A. FALLER, HUGO O. SCHULZ, MORRIS TEMIN, *Examiners*.