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Van Allman et al.

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[54] **APPARATUS FOR CLEANING TUBES**

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[52] **U.S. Cl.** ..... **15/304**, 15/316 R, 15/406, 134/166

[51] **Int. Cl.** **A47l 5/38**

[58] **Field of Search** ..... 15/304, 306 A, 316 R, 15/405, 406, 88; 134/152, 166 C

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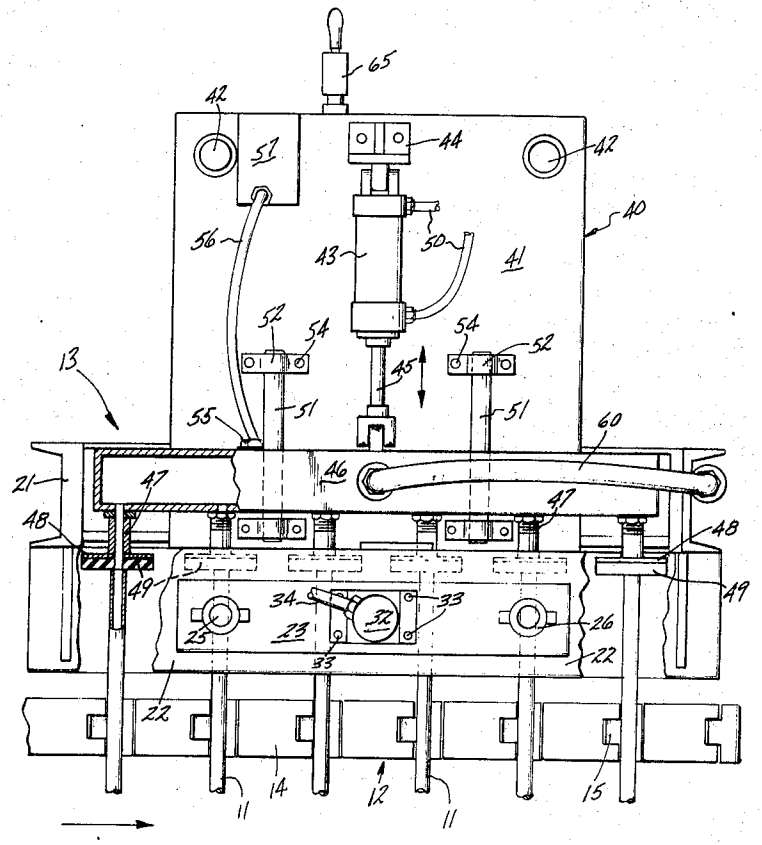
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[57] **ABSTRACT**

An apparatus for cleaning the inside of tubes which achieves a high production level and avoids manual operation. The apparatus utilizes a conveyer for transporting a predetermined number of tubes in separate, spaced relationship, a means operatively connected to a source of fluid, preferably air pressure, and having a mouth portion for engagement with said tubes, and positioning means for placing said tubes from said conveyer into fixed, contacting relationship with said mouth portion.

4 Claims, 4 Drawing Figures



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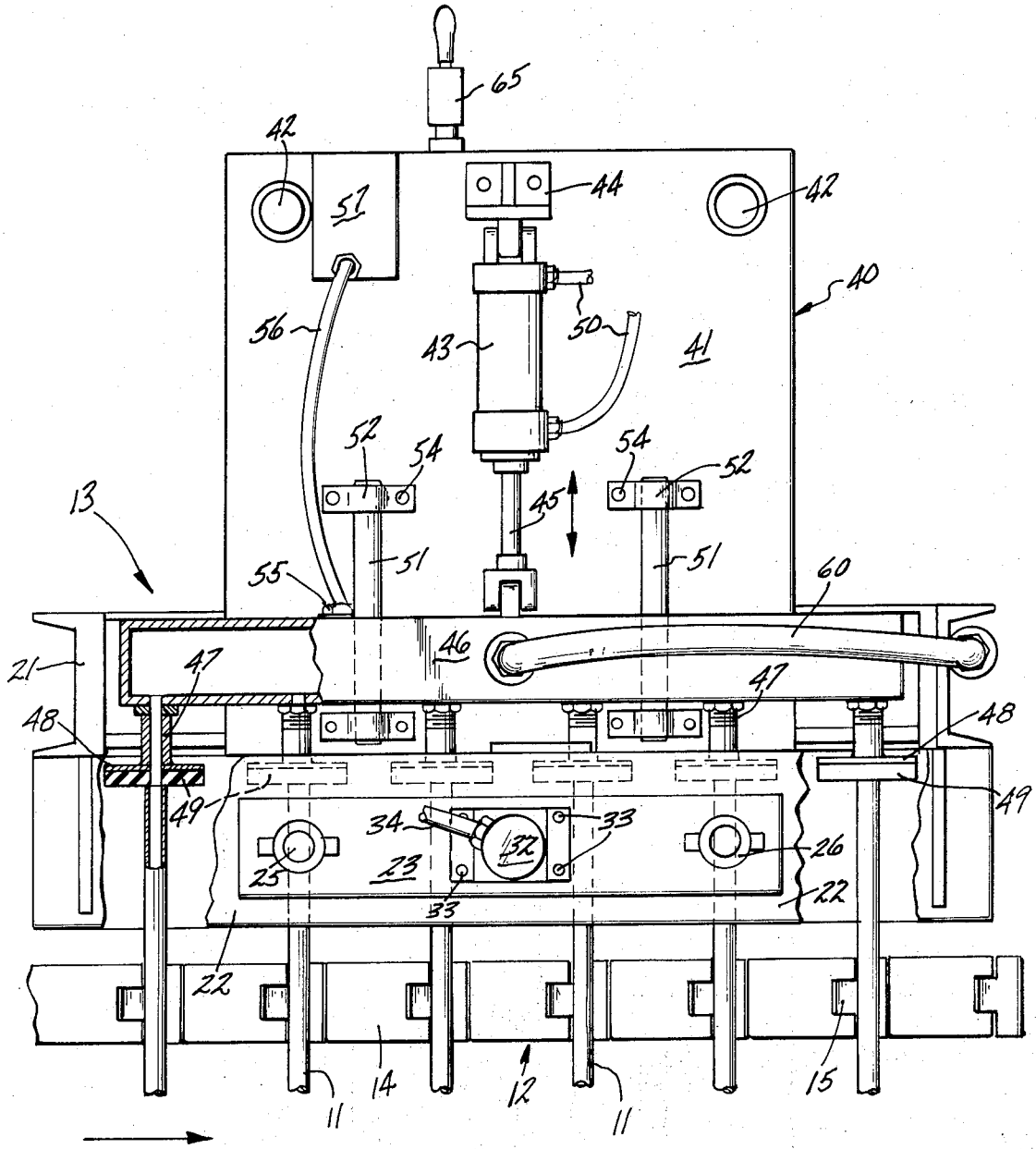


FIG-1

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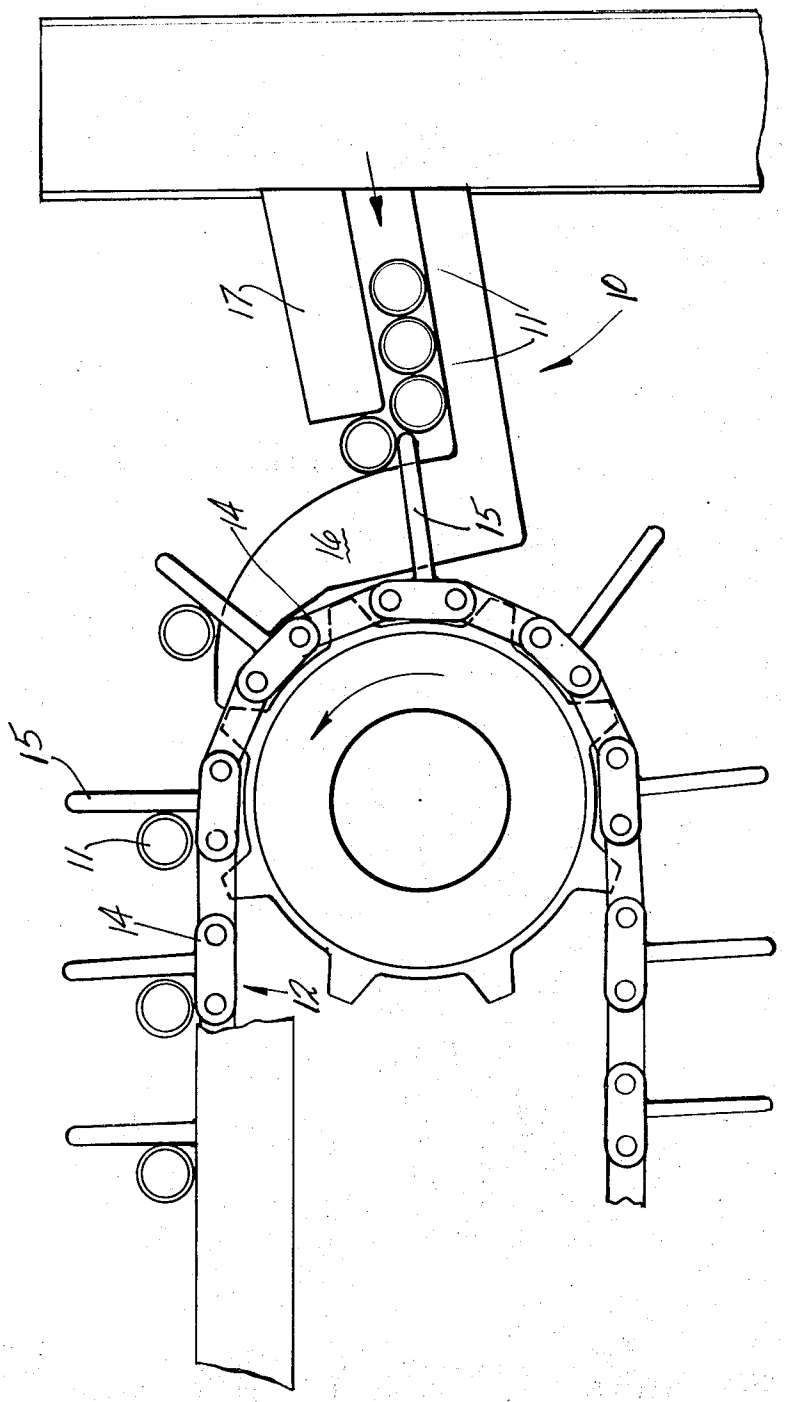


FIG-2

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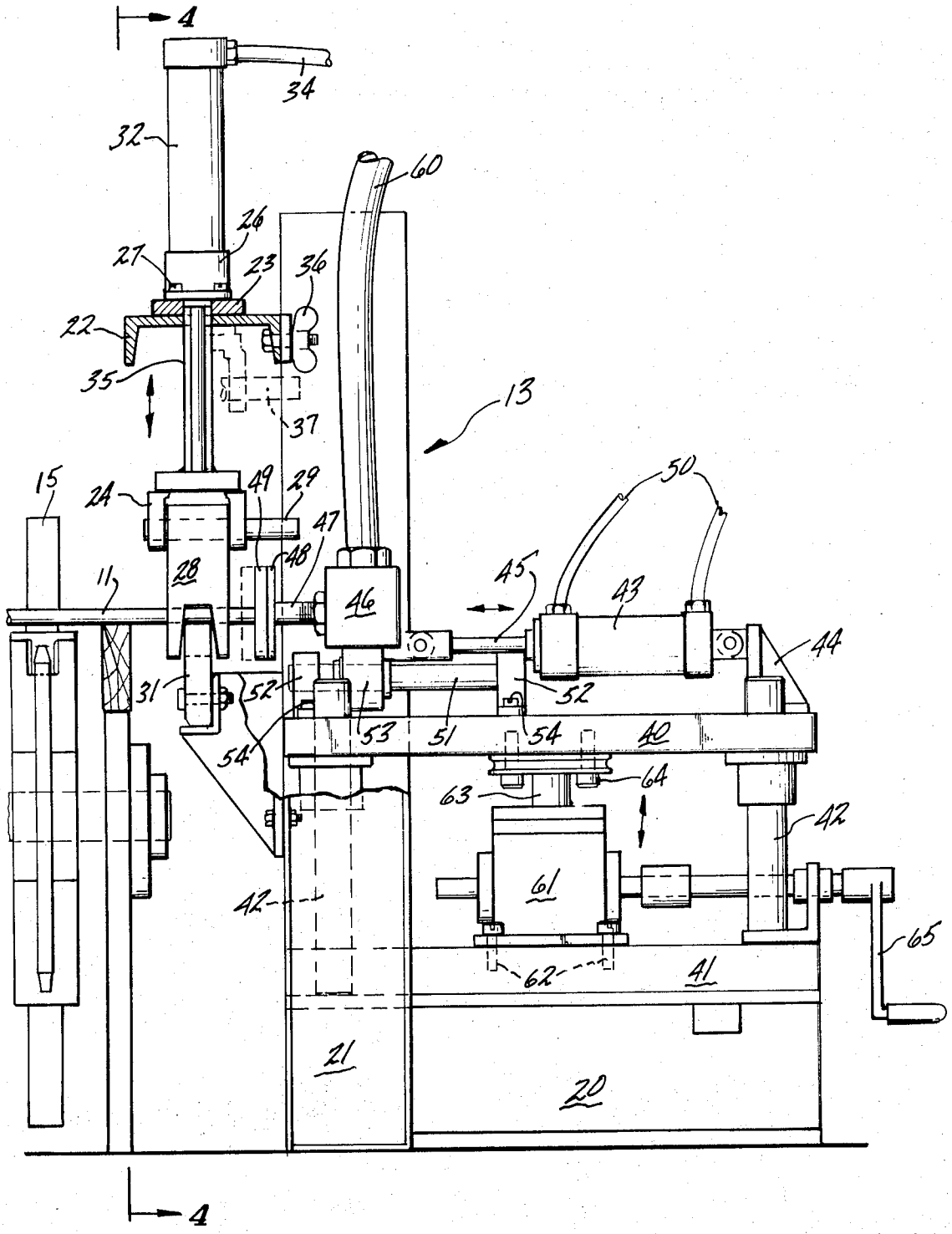


FIG-3

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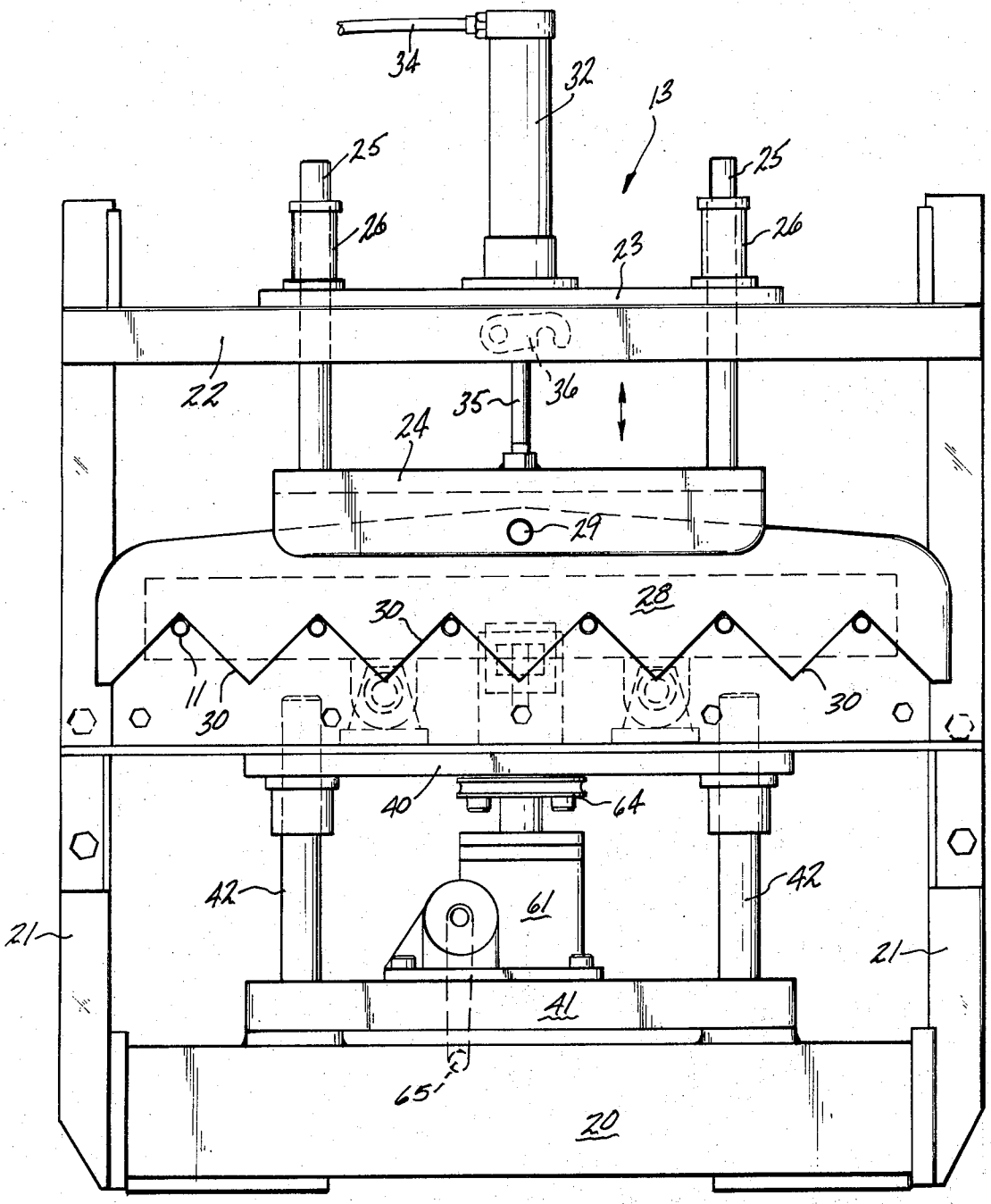


FIG-4

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APPARATUS FOR CLEANING TUBES

BACKGROUND OF THE INVENTION

Normally, in a commercial operation, the inside of tubes must be cleaned prior to shipment to a customer or use. This is particularly true with respect to metal tubes made by welding an elongated strip. The inside of the tube may have mill lubricant, oil, water or internal scarf which must be removed in order to provide an acceptable product. In fact, the removal of internal scarf stringers quite often requires hand removal and/or manual removal using air or fluids or a combination of both.

A manual operation for cleaning the inside of the tube with air or water is slow and cumbersome in a commercial operation. Similarly, immersing the tubes in water is inconvenient, slow and not necessarily effective.

Accordingly, it is a principal object of the present invention to provide an apparatus for cleaning the inside of tubes.

It is an additional object of the present invention to provide an apparatus which can effectively clean the inside of tubes and achieve a high production level simply and economically.

It is an additional object of the present invention to provide an apparatus as aforesaid which is versatile and easily operated.

Further objects and advantages of the present invention will appear from the ensuing specification.

SUMMARY OF THE INVENTION

In accordance with the present invention, it has now been found that the foregoing objects and advantages may be readily achieved, as well as others. The apparatus of the present invention utilizes a conveyer for transporting tubes in separate, spaced relationship, means operatively connected to a source of fluid, preferably air pressure, and having a mouth portion for engagement with said tubes, and positioning means for placing said tubes from said conveyer into fixed, contacting relationship with said mouth portion.

The apparatus of the present invention can effectively clean a plurality of tubes simultaneously in a fully automatic manner. Furthermore, the apparatus of the present invention achieves a high production level, is simple and convenient to operate and is quite versatile so that it can be readily used under a variety of conditions with many different tube sizes. For example, tubes of from ½ inch diameter to 3⅛ inches diameter have been effectively cleaned with the apparatus of the present invention. Furthermore, the apparatus of the present invention is readily adaptable to the use of accessories to achieve particular results. For example, the insertion of plugs, balls, fluids, etc. as desired for critical cleaning. Inspection stations may be added to detect unclean tubes and/or to inspect tubes with a critical inside diameter.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 represents a top view of the cleaning apparatus of the present invention, and

FIG. 2 is a sectional view of the storage means and that portion of the conveyor adjacent thereto for transferring the tubes to be cleaned to the cleaning apparatus, and

FIG. 3 is a side elevation of the cleaning apparatus of the present invention, and

FIG. 4 is a view along lines 4—4 of FIG. 3.

DETAILED DESCRIPTION

Storage means **10** is provided for retaining a plurality of tubes **11** to be cleaned. The storage means **10** is operatively connected to a conveyer means **12** for transporting said tubes to the cleaning apparatus **13.** The conveyer means **12** may be of any desired design for transferring the tubes from the storage means **10** to the cleaning apparatus **13** so that the tubes **11** may be individually positioned at the cleaning apparatus **13** in separate, spaced relationship. In the preferred embodiment as shown clearly in FIGS. **1** and **2,** the conveyer means is an endless belt with one end thereof adjacent the storage means **10,** the other end thereof adjacent a finished product collection means, not shown, and intermediate thereto passing adjacent the cleaning apparatus **13.** The belt or conveyer means **12** has a plurality of compartments **14** with each compartment being adapted to hold a single tube. The compartments **14** are separated by flanges **15** which serve as spacers between compartments and as an indexing means for withdrawing one tube at a time from the storage means and indexing the appropriate number of tubes to the cleaning apparatus. Any desired means may be chosen for withdrawing only one tube at a time from storage means **10.** For example, as shown in FIG. **2,** tube stops **16** may be provided at appropriate intervals along the length of the tube. Flanges **15** pick up only one tube at a time by properly adjusting the tube stops **16** with regard to the flange **15** and the diameter of tubes **11.** In addition, a tube hold down **17** may be provided to prevent tubes **11** from jumping over one another and to force proper alignment of tubes **11** within storage means **10.**

The conveyer **12** may be actuated in any desired manner, such as a motor operatively connected to the conveyer. The conveyer **12** should be adapted to withdraw the desired number of tubes **11** from the storage means **10,** for example, four, five or six, by simply setting counting dials on a main control panel. The conveyer **12** would then move the appropriate distance to withdraw the appropriate number of tubes and simultaneously move the same number of tubes to the cleaning apparatus. The number of tubes which are indexed per cycle is based on the capacity of the cleaning apparatus and the particular production or quality requirements. It is an advantage of the present invention that many tubes may be effectively and simply cleaned per cycle, providing high production. Naturally, the conveyer **12** should be equipped with adjustable time delays between indexing to permit the cleaning apparatus **13** to effectively complete its cycle and clean each tube. It is an additional advantage of the present invention that the entire operating cycle is relatively short, on the order of 2 to 20 seconds, further permitting a high production level.

The cleaning apparatus **13** is supported by base **20** and upstanding frames **21** connected thereto by bolts or weldments. The yoke frame **22** is firmly connected to the upstanding frames **21** by means of bolts or weldments and extends horizontally between the upstanding frames in a plane substantially parallel to base **20.** Yoke frame plate **23** is welded to yoke frame **22.** Lifting yoke **24** is moveably mounted on the yoke frame **22,** move-

able in the up and down direction by means of yoke guide posts **25** integrally connected to the lifting yoke **24** at one end thereof and the other end thereof passing through the yoke frame **22,** yoke frame plate **23** and yoke guide bushings **26.** The yoke guide bushings **26** are bolted to the yoke frame plate **23** by means of bolts **27** and insure true travel on the yoke guide posts **25.** The hold down clamp **28** is connected to the lifting yoke **24** by means of connecting pin **29** and extends downwardly therefrom. The hold down clamp **28** is a platelike member having a plurality of downwardly facing cut out portions **30** for firmly holding the tubes **11** to be cleaned. The number of cut out portions **30** represents the maximum number of tubes which can be cleaned per cycle and is dependent upon the desired capacity of the particular apparatus. Six cut out portions **30** are shown in the illustrated embodiment. A larger or smaller number may be utilized if desired, limited only by desired production considerations and practical size factors. In view of the fact that larger units require larger air cylinder and air supply capacity, it is believed that a capacity of from 10 to 12 tubes per cycle represents a practical upper limit. Furthermore, in view of the speed of the cycles, a larger capacity is not believed necessary. The cut out portions **30** are preferably V-shaped as shown in order to insure that the hold down clamp **28** contacts any tube not within the desired centers and transfers them to a positive position for mating with the air nozzle for cleaning in a manner to be described below. For example, the tubes may be required to be on 4, 5 or 6 inch centers. The cut out portions **30** or notched portions may also be curved, if desired.

The hold down clamp **28** having sufficient clearance nests over the hold down runner **31,** as clearly shown in FIG. **3,** firmly holding a plurality of tubes therebetween, with one tube being held by each cut out portion **30.** Preferably, but not necessarily, at least one of the hold down clamp **28** or the hold down runner **31** should be resilient in the area of contact with the tube **11,** such as having rubber padding, so as to minimize the danger of marking or otherwise damaging the outside of the tubes as well as assure that all tubes are equally clamped securely.

Hold down air cylinder **32** is connected to yoke frame by means of yoke frame plate **23** and bolts **33.** The hold down air cylinder is fed by means of hold down air supply line **34** and supplies air pressure to actuate lifting yoke **24** by means of piston **35.**

At the completion of the indexing cycle, an electrical signal is sent through a time delay mechanism, which activates a hold down air valve (not shown). The air valve discharges a controlled amount of air into the hold down air cylinder **32** via the hold down air supply line **34,** which in turn actuates the lifting yoke **24** by means of air pressure actuating piston **35** downwardly, lowering the entire mechanism and clamping tubes **11.** The lifting yoke **24** lowers the hold down clamp **28** over the indexed tubes below, with each cut out portion **30** firmly grasping a tube **11** as described. The hold down clamp air valve preferably sends an electrical signal when initially activated at the completion of the indexing cycle, through a second time delay mechanism in the main control panel. The resulting time lag guarantees that the hold down clamp **28** is properly in place. An additional safety feature which may be provided is the use of safety latch **36** and pin **37** connected to the yoke frame **22** to lock the hold down clamp **28** in the up position during changes from one product to another. The safety latch permits nozzle or other adjustments without turning off the air and holds the yoke assembly up, avoiding accidental catching of hands or arms should a switch fail or false signal release air into the cylinder, forcing the assembly downward.

A four post die set or accurate table having a top portion **40** and a bottom portion **41** is mounted on base **20** and has four die set posts **42.** Nozzle positioning air cylinder **43** is mounted on the top portion **41** of die set **40** by means of bracket **44.** The air cylinder piston **45** is attached to the manifold **46** on the forward end and the nozzle positioning air cylinder **43** on the rearward end. The manifold **46** is moveably mounted on the top portion **41** of the die set **40** and carries a plurality of blower means such as air nozzles **47** on the forward portion thereof corresponding to the capacity of the cleaning apparatus. Each air nozzle **47** has a mouth portion for engagement with said tubes **11.** The mouth portion may comprise simply a metal plate **48** attached to each air nozzle **47.** Optionally, a resilient seal **49,** such as a rubber seal, may be attached to each metal plate **48** to insure that there will be no air leakage when the tubes are in cleaning position. A cup-like member or cone-like member may be employed if desired. As indicated hereinabove, the capacity of the apparatus will determine the number of air nozzles. Each air nozzle **47** is positioned adjacent, on center of the V of the cut out portion **30** of the hold down clamp **28.**

The nozzle position air cylinder **43** is fed by air supply lines **50.** In operation, at the completion of the hold down cycle, with appropriate time delay as indicated above, an electric signal activates an air valve (not shown) to discharge a controlled amount of air into the nozzle positioning air cylinder **43** via the air supply lines **50.** This activates piston **45** which comes forward moving the manifold **46** forward on manifold guides **51** and manifold guide bushings **52** and manifold guide sleeves **53** connected to the top portion **41** of die set **40** via bolts **54.** The manifold guides **51,** manifold guide bushings **52** and manifold guide sleeves **53** permit the manifold **46** to slide back and forth freely as required. The forward movement of the manifold **46** moves each air nozzle **47** and air nozzle plate **48** forward into positive contacting engagement with the tubes **11** to be cleaned. It is preferred that the nozzles **47** striking the end of the tubes **11** continue a slight forward movement to insure sealing of the tube ends and prevent air leakage.

Microswitch **55** connected to the manifold **46** senses the end of this cycle when the manifold **46** is in the forward most position and sends an electrical signal via electric sensing line **56** to control box **57** mounted on the top portion **41** of the die set **40** to start the next cycle, which is the cleaning cycle. Naturally, this may be done by time delays, if desired, as in the previous cycles. Appropriate time delays may be provided to insure that the nozzles **47** are completely forward and in the cleaning or blowout position.

When the nozzles **47** are properly positioned in firm contacting relationship with the tubes **11,** an appropriate electrical signal at the end of the time delay activates an air valve (not shown) to discharge air via the manifold air supply **60** into the manifold **46,** for example, from the main line. The mass of air is allowed to escape through the individual nozzles **47** and into the

tubes **11** adjacent thereto. The volume and pressure of the air is controlled to suit the particular product and to be sufficient to remove residues from the tubes and insure proper cleanliness within the tubes. For example, an air pressure of 10 – 100 lbs. in each tube is quite satisfactory, depending, of course, on tube size being cleaned.

Naturally, any fluid may be used depending upon particular requirements. Air has been found to be effective and particularly convenient since it avoids the necessity for fluid collection means. Also, if desired, means may be provided to blow a plug of cloth or foam plastic or rubber or the like through each tube.

At the completion of the cleaning cycle, an electrical signal is given to retract the manifold **46,** for example, by means of an appropriate timer. The manifold **46** actuates the microswitch **55** at its rearward most movement. Simultaneously, the hold down clamp **28** may be set to retract and strike a microswitch at its rearward most movement. The microswitches are safety features in order to prevent the conveyer **12** from indexing before all moving equipment is clear.

The nozzles **47** on the manifold **46** can be readily adjusted to the centerline of each product through the use of locator **61** mounted on bottom portion **42** of die set **40** by bolts **62** and screw head **63** mounted on top portion **41** of die set **40** by bolts **64.** By turning the adjusting crank **65,** which is operatively connected to the locator **61,** in either direction, the entire assembly may be raised or lowered, thereby locating the nozzles **47** appropriately.

The next cycle is then commenced, feeding the cleaned tube into a product collection means (not shown) via the indexing conveyer **12.**

This invention may be embodied in other forms or carried out in other ways without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered as in all respects illustrative and not restrictive, the scope of the invention being indicated by the appended claims, and all changes which come within the meaning and range of equivalency are intended to be embraced therein.

We claim:

1. An apparatus for cleaning the interior of open-ended tubes of various outer diameters comprising:
- an indexing conveyor operable to advance an array of tubes of a given outer diameter intermittently;
- said tubes being spaced from one another and having a first end projecting in a predetermined direction;
- a movable array of fluid nozzles operatively connected to a source of fluid under pressure;
- each nozzle being individual to a mating tube and having a mouth portion operable to make a fluid-tight connection with a first end of its mating tube;
- means for controlling the intermittent advance of said tubes;
- clamp means for retaining said tubes in a fixed position while said first ends project in said predetermined direction;
- means for moving said nozzles in a first direction into alignment with said tubes;
- means for moving said nozzles in a second direction to effect said fluid-tight connection with said open ends; and
- control means responsive to motion in said second direction to limit the stroke of said nozzles.

2. The apparatus of claim **1** in which the clamp means includes a platen-like member having a plurality of cutouts operable to receive and center tubes of different diameters.

3. An apparatus operable to clean the interior of tubes of different outer diameters comprising:
- an indexing conveyor operable to transport tubes of a given outer diameter intermittently in separate, spaced relationship, said tubes having open ends;
- timing means for controlling said intermittent transport;
- means for clamping said tubes in a fixed position;
- an array of nozzles operatively connected to a source of fluid under pressure and each nozzle having a mouth portion operable to engage and make a fluid-tight connection with a mating open end;
- means for moving said nozzles toward said tubes to effect said fluid-tight connection; and
- switch means for controlling motion of said nozzles relative to the tubes.

4. An apparatus operable to clean the interior of a plurality of tubes having open ends, and settable to receive groups of tubes of various outer diameters comprising:
- an indexing conveyor operable to advance a plurality of tubes of a given outer diameter intermittently and in spaced array, each tube having a longitudinal center line;
- a timer for controlling the intermittent advance;
- a corresponding array of nozzles operatively connected to a source of fluid under pressure, each having a center line, and each operable to make a fluid-tight connection with an open end of a mating tube;
- means for clamping the tubes in a fixed position relative to the nozzles;
- means for moving the nozzles relative to the tubes so that center lines of mating tubes and nozzles are co-axial; and
- means for moving the nozzles toward said tubes along said center lines to bring the nozzles into contact with mating open ends and control means for sensing the occurrence of said contact and operable to insure a fluid-tight seal.

* * * * *