the tubes being cleaned. This downward force is completely adjustable by the operator. This force applied may be varied by the operator and varies in accordance with the pressure applied to the cylinder **312**. The pressure may be released allowing only the frictional force between the driven rollers and the flexible lances to be applied, so as to gently urge the flexible lances **104** forward or backward as desired in order to optimally handle anomalies or obstructions encountered during use. This adjustable drive roller pressure feature of the apparatus **100** in accordance with the present disclosure in conjunction with its compact size greatly enhances the utility of the apparatus **100**.

[0036] The inner side section of the housing **106** is shown with the inner side door open in FIG. **7**. Here a drive sprocket **318** of the air drive motor **108** is visible. The air drive motor **108**, housed within the central cavity between inner and outer walls **112** and **114**, rotates a serpentine belt **320** that wraps around and engages a drive sprocket **322** on each axle **202**. The serpentine belt **320** is sequentially threaded over a drive sprocket **318** keyed to the drive shaft of the motor **108** and around each of the drive sprockets **322** in sequence and around idler sprockets **324** and **326**.

[0037] Each of the inner and outer walls **112** and **114** has three slots **116** through which the upper roller axles **202** carried by the elongated block **300** project. These slots **116** permit the block **300** to move the upper rollers **204** during transitions between the released position shown in FIG. **8** and the engaged position shown in FIG. **9**. Two of these slots **116** are visible in FIG. **8** as the outer wall **114** is shown as being transparent so as to reveal the block **300** and link components **302** and **304** within the mid section of the housing **106**.

[0038] Adjacent each of the pairs of roller assemblies **200** are lance guides **330** fastened to the outer wall **114**. These lance guides **330** facilitate aligning the lance hoses **104** as they are inserted through the pairs of roller assemblies **200** in the outer section of the housing **106**. A pair of guide sleeves **322** provides the same function prior to and during flexible lance entry into the array of roller assemblies **200**. These guides **330** are best shown in FIG. **6**.

[0039] In the separate side views of FIGS. **6** and **7**, the compact and easily maintainable nature of the apparatus **100** becomes apparent. If a user needs to change the rollers to accommodate a different flexible lance size, the user need only pull spring loaded pins **352** to open and lower the outer side door **350** in order to

provide complete access to the outer section of the housing **106**. Similarly, if a user needs to perform maintenance of the drive portions of the apparatus, the user need only open the inner door panel **360** by withdrawing spring loaded pins **362** and lower the panel **360** to provide access to the inner section of the housing **106**.

[0040] If a user needs to perform maintenance on the pneumatic manifold **370**, complete access is provided via the outer door **350**. Similarly, if adjustment of the serpentine belt tension is needed, a user can adjust the belt tension by adjusting position of idler pulleys **324** and **326** from the inner section of the housing **106** through inner door **360**.

[0041] Many changes may be made to the apparatus, which will become apparent to a reader of this disclosure. In some embodiments of the roller assemblies **200** the roller **204** may be provided with a straight cylindrical outer shape without grooves as currently shown. The rollers **204** without peripheral grooves may provide long roller life by elimination of stress points at the corners of the illustrated roller grooves, and the rollers **204** may be made of a resilient material to conform to the outer surface shape of the lance hoses **104**. The housing **106** may be made other than a rectangular box shape as shown. To accommodate a different number of driven roller assemblies, different positioning of the pneumatic cylinder **312**, or different arrangement of the support block **300** and hence linkage members **302** and **304**. Furthermore, the relative positioning of fixed and movable lower and upper roller sets **204** may be reversed or the offsets between the linkage members **302** and **304** changed.

[0042] If a stronger drive force is needed, additional sets of driven roller pairs **200** than three pairs as shown may be provided to drive the flexible lances **104**. The apparatus **100** is compact and weights about 45 pounds and thus may easily be easily handled via handles **121** and fastened via clevis pins **115** to a guide module **117** which is in turn supported by a lightweight positioner frame **119** in registry adjacent a tube sheet **110** as is shown in FIG. **5**.

In alternative embodiments, electrical or hydraulic actuators and motors may be used in place of the pneumatic motors shown and described. Therefor, all such changes, alternatives and equivalents in accordance with the features and benefits described herein, are within the scope of the present disclosure. Such changes and

CLAIMS

What is claimed is:

1. A quick release drive roller and axle apparatus for use in a flexible high pressure fluid lance drive, the apparatus comprising:

a cylindrical drive axle having an axially extending closed slot adjacent a distal end of the axle, wherein the slot has opposing ends and is closed at each end of the slot;

a ball nosed spring plunger disposed in a cross bore spaced from the closed slot through the distal end of the axle;

a spline disposed in the closed slot; and

a drive roller having a central bore and an axial slot along the central bore, wherein when the drive roller is assembled onto the drive axle, the spline engages the axial slot along the central bore and the ball of the ball nosed spring plunger extends outward from the cross bore radially away from the closed slot and engages the drive roller to retain the drive roller on the axle.

2. A flexible lance drive apparatus comprising:

a housing having a front wall and a rear wall, an outer section, an inner section and a mid section defined between a pair of spaced outer and inner walls perpendicular to and extending between the front and rear walls;

a drive motor disposed in the housing operably engaging a plurality of drive axles extending across the pair of spaced outer and inner walls arranged in an array of parallel axle pairs in the housing, each axle supporting a drive roller adapted to engage one or more flexible lances positioned in an axial plane through the housing perpendicular to the drive axles;

wherein at least one of the drive axles has an axially extending closed slot adjacent the distal end of the at least one axle, wherein the slot has opposing ends and is closed at each end of the slot, a ball nosed spring plunger disposed in a cross bore spaced from the closed slot through the distal end of the at least one axle, a spline disposed in the closed slot, and a drive roller releasably carried on the at least one axle covering the axial slot and engaging the spline in the axial slot and a ball of

the ball nosed spring plunger extends radially outward from the cross bore engaging the drive roller to releasably retain the drive roller on the axle.

3. A flexible lance drive apparatus comprising:

a generally rectangular housing having a front wall and a rear wall, an outer section, an inner section and a mid section defined between a pair of spaced outer and inner walls perpendicular to and extending between the front and rear walls;

an array of upper and lower drive rollers in the outer section each rotatably supported by an axle shaft passing through the spaced outer and inner walls;

a drive sprocket fastened to each of the shafts in the inner section of the housing;

wherein each lower drive roller shaft is rotatably supported in a fixed position in each of the outer and inner walls and supported by both the outer and inner walls; and

each of the upper drive roller axle shafts is parallel to the lower drive roller axle shafts and is rotatably supported by a block carried in the mid section of the housing by parallel pivoting link members each extending from the block parallel to one of the outer and inner walls and wherein each pivoting link member is fastened to one of the outer and inner walls adjacent one of the lower drive roller shafts.

4. The apparatus according to claim 3 wherein the array comprises three or more pairs of upper and lower drive rollers each configured to receive and hold therebetween a plurality of flexible lances.

5. The apparatus according to claim 3 wherein the upper shafts are each disposed in slots in the inner and outer walls and the block is pivotally supported by a pneumatic cylinder fastened to the housing.

6. The apparatus according to claim 3 further comprising a serpentine belt in the inner section of the housing connected between each of the drive sprockets and the drive motor operable to synchronously rotate the rollers.

7. The apparatus according to claim 3 further comprising at least one of the drive roller axle shafts having an axially extending closed slot adjacent a distal end of the axle;

a ball nosed spring plunger disposed in a cross bore through the distal end of the axle shaft spaced from the closed slot;

a spline disposed in the closed slot; and

a drive roller having a central bore and an axial slot along the bore, wherein when the drive roller is assembled onto the at least one axle, the spline engages the axial slot along the central bore and a ball of the ball nosed spring plunger extends radially outward from the cross bore and engages the drive roller to retain the drive roller on the at least one axle.

8. The apparatus according to claim 7 further comprising each of the drive axle shafts having an axially extending closed slot adjacent the distal end of the axle shaft, a ball nosed spring plunger disposed in a cross bore through the distal end of the axle shaft spaced from the closed slot, a spline disposed in the closed slot, a drive roller releasably carried on the drive axle shaft and wherein the spline engages the axial slot along the central bore and a ball of the ball nosed spring plunger extends radially outward from the cross bore to releasably retain the drive roller on the axle shaft.

9. A flexible lance drive apparatus comprising:

a generally rectangular housing having a front wall and a rear wall, an outer section, an inner section and a mid section defined between a pair of spaced parallel outer and inner walls perpendicular to and extending between the front wall and the rear wall;

an array of upper and lower drive roller pairs in the outer section each rotatably supported by an axle shaft passing through the spaced outer and inner walls;

a drive sprocket fastened to each of the axle shafts in the inner section of the housing and connected to a drive motor via a serpentine belt;

wherein each lower drive roller axle shaft is rotatably supported in a fixed position in each of the outer and inner walls; and

each of the upper drive roller axle shafts is rotatably supported by a block carried in the mid section of the housing by at least two parallel pivoting link members each extending from the block parallel to one of the outer and inner walls in the mid section and wherein each pivoting link member is fastened to one of the outer and inner walls adjacent one of the lower drive roller axle shafts.

10. The apparatus according to claim 9 wherein the upper shafts are each disposed in slots in the inner and outer walls and rotatably fastened to the block pivotally supported by a pneumatic cylinder fastened to the housing.

11. The apparatus according to claim 9 further comprising at least two pairs of pivoting link members connecting the block to the inner and outer walls adjacent the lower drive roller shafts.

12. The apparatus according to claim 9 further comprising at least one idler wheel contacting the serpentine belt for maintaining tension on the serpentine belt.

13. The apparatus according to claim 9 further comprising at least one of the drive roller axle shafts having an axially extending closed slot adjacent a distal end of the axle shaft;

a ball nosed spring plunger disposed in a cross bore through the distal end of the axle shaft;

a spline disposed in the closed slot; and

a drive roller having a central bore and an axial slot along the central bore, wherein when the drive roller is assembled onto the drive axle shaft, the spline engages the axial slot along the central bore and a ball of the ball nosed spring plunger extends radially outward from the cross bore engaging the drive roller to retain the drive roller on the axle shaft.

14. The apparatus according to claim 9 wherein at least one of the drive axles has an axially extending closed slot adjacent the distal end of the at least one drive axle, a ball nosed spring plunger disposed in a cross bore through the distal end of the at least one drive axle, a spline disposed in the closed slot, and a drive roller releasably carried on the at least one drive axle and wherein the spline engages an axial slot along a central bore through the drive roller and a ball of the ball nosed spring plunger extends radially outward from the cross bore to releasably retain the drive roller on the at least one drive axle.