ABSTRACT
The present invention is a pipe-joining machine for installing successive pipe units. The pipe-joining machine includes a longitudinally extending base assembly having a front plate, a rear plate spaced from the front plate and connecting bars joining the front and rear plates. A hydraulic cylinder, having a drive rod, is mounted and extends horizontally rearwardly from the rear plate. Control mechanism including a multipassage hydraulic valve is in communication with the hydraulic cylinder. A gripper mechanism is provided on the free end of the drive rod and is effective for releasably grasping a cable. One end of the cable is fed through successive ones of the pipe sections being installed and rearward movement of the hydraulic cylinder drive rod applies a pulling force to the last pipe section in the chain to properly seat the last pipe section with respect to the adjoining pipe section.

8 Claims, 8 Drawing Figures
1. PPE-JONING MACHINE

BACKGROUND OF THE INVENTION

This invention relates generally to a pipe-joining machine for installing successive ones of a number of pipe units. For a number of years, the pipe industry has been moving away from pipes which are joined together, for example, by flange and bolt connections or by bell and spigot-type joints which are sealed by lead. Within the last 15 years, the pipe industry, particularly in cast iron soil pipe for sanitary sewer work; cast iron pipe for water lines; and vitrified clay pipe for sewers, has adopted a pipe structure having a pressure fit type of joint gasket. The plain end of the pipe includes an elastomeric element which is inserted into a bell end of an adjoining pipe. The bell end of the adjoining pipe has a cooperating elastomeric element. However, a substantial amount of relative force must be exerted between the two adjoining pipe sections when they are joined together. When working with relatively small diameters of pipe, for example, 6 or 8 inches, and when the trench conditions are good, joining the pipes has not been a problem. This can be done, for example, by using a bar as a lever to force the new pipe section into seating relationship with the previously placed section. A type of prior art device sometimes used is a chain and lever arrangement in which a chain is wrapped around the exterior of the pipe which has already been laid and then using a bar or tool which is pivotally connected to the chain as a lever to force the next successive pipe unit into its seating position. However, if the trench conditions are unsatisfactory, for example, if the soil conditions are bad, these prior art methods are unsatisfactory. If the soil conditions are bad, soil particles find their way into the pipe joint and make the joining of the pipe much more difficult and the joining force which must be exerted much greater.

As the size of the pipe increases, the weight of an individual pipe section increases to such a degree that it is practically impossible to install the individual pipe sections using the prior art manual methods. For example, a low-pressure cast iron water line having an inside diameter of 14 inches and a standard 18 foot length weighs in excess of 1,300 pounds. The prior art has solved this problem by suspending the pipe section being installed from, for example, a crane boom and then using either manual or mechanical devices to force the pipe into seating relationship with the adjoining pipe. This solution has been economically unsatisfactory because of the inefficient use of heavy equipment and labor.

During the installation of very large diameter concrete sewer line, for example, 72 inch diameter pipe, the prior art sometimes uses a plurality of jacks to move an individual pipe section into position. Sometimes the jacking operation relies upon the positioning of a man inside the pipe layers and in addition the individual pipe sections are relatively short in length, for example, 3 foot sections. However, this type of prior art method is not, of course, suited for working with relatively small diameter pipe sections.

SUMMARY OF THE INVENTION

The present invention relates to a pipe-joining machine which is particularly adaptable for use in installing cast iron, concrete or vitrified pipe sections. Cast iron water mains are often supplied in 18 foot lengths and the machine according to the instant invention is particularly adaptable for use in installing pipes having internal diameters which would prevent a man from actually entering the interior of the pipe.

The pipe-joining machine, according to the present invention, has a longitudinally extending base assembly including a front plate, a rear plate, and two horizontal spaced support rails extending between the front plate and the rear plate. A hydraulic cylinder is mounted and extends rearwardly from the rear plate. The cylinder has a horizontal drive rod which extends through an opening defined in the rear plate and control means are operatively connected to the hydraulic cylinder for selectively moving the horizontal drive rod. Grip means are mounted adjacent the free end of the horizontal drive rod for releasably holding a cable. A cable is threaded through the successive pipe sections and rearward movement of the drive rod seats the last of the pipe sections with respect to the adjacent pipe section which has previously been laid in the trench.

An adjusting post is attached to the hydraulic cylinder and is suitable for adjusting the vertical position of the cylinder. Similarly, a vertical support frame is mounted adjacent the front plate and means are provided for adjusting the relative vertical position of the support frame with respect to the front plate.

It is the object of the present invention to provide a machine for joining successive units of pipe. Other objects and advantages of the present invention will become apparent from the following detailed description, reference being made to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of a pipe-joining machine, constructed in accordance with the present invention, and showing a pipe section being seated in an adjoining pipe section; FIG. 2 is a side elevational view of the pipe-joining machine shown in FIG. 1 and showing by dashed lines an alternative position of the horizontal guide arm; FIG. 3 is a fragmentary, vertical sectional view, taken along the line 3—3 of FIG. 1 and shown on a slightly enlarged scale; FIG. 4 is a vertical sectional view taken along the line 4—4 of FIG. 3; FIG. 5 is a fragmentary, plan view, taken along the line 5—5 of FIG. 2, and shown on a slightly enlarged scale; FIG. 6 is a fragmentary, side elevational view, shown partially in section, of the portion of the machine shown in FIG. 5; FIG. 7 is an end view of the portion of the machine shown in FIG. 5; and FIG. 8 is a fragmentary view taken along the line 8—8 of FIG. 5 and shown on an enlarged scale.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1—3, a pipe-joining machine, constructed according to the present invention, is generally indicated by the reference number 15. The pipe-joining machine 15 includes a longitudinally extending base assembly 16 having a generally vertical front plate 17, and a generally vertical rear plate 18 which is spaced from the front plate 17. In the present embodiment, the plates 17 and 18 are connected together by a pair of longitudinally extending and spaced connecting rods 19 and a plurality of nuts 20. A flat, horizontal bottom plate 21 is bolted to the bottom of plates 17 and 18.

Drive means comprising a horizontally extending hydraulic cylinder 24 is mounted on the rear plate 18. The hydraulic cylinder has an axially movable drive member or rod 25 which extends through an opening 23 (see FIG. 3) defined in the rear plate 18.

Control means are operatively connected to the hydraulic cylinder 24 for selectively moving the drive rod 25. In the present embodiment, the control means includes a multipassage valve 26 having a manually operated handle 27 for operating an internal valve spool to direct hydraulic fluid through a predetermined path. A conventional hydraulic fluid supply system is positioned adjacent the pipe-joining machine 15 for supplying hydraulic fluid through the multipassage valve 26 to the hydraulic cylinder 24. In the present embodiment, the hydraulic fluid supply means includes a conventional storage reservoir and motor-driven pump arrangement (not shown) which supplies hydraulic fluid under pressure to a fluid supply conduit 28. Hydraulic fluid is returned to the reservoir (not shown) through a hydraulic fluid return conduit 29 (see FIG. 1). It is noted that other types of conventional hydraulic fluid supply means can be used with the pipe-joining machine 15. For example, the fluid supply conduit 28 and the fluid return conduit 29 may be connected to the hydraulic system of a conventional construction site vehicle.
Referring to FIGS. 1 and 2, in the present embodiment, the multipassage valve 26 is a three-way valve. When the handle 27 is in the horizontal dashed line position shown in FIG. 2, the vertical passage 26 in the multipassage valve is directed from the supply conduit 28 through a conduit 30 and into the right side of the cylinder 24. This moves a piston 31 of the cylinder 24 to the left (as shown in FIG. 2) and constitutes the pulling or seating stroke of the machine. When the handle 27 is in the solid line position shown in FIG. 2, the cylinder 24 is in its neutral position and the drive rod 25 is in a static condition. In the neutral position, the hydraulic fluid is bypassed directly from the supply conduit 28 to the return conduit 29. When the handle 27 is in the vertical dashed line position shown in FIG. 2, hydraulic fluid from the supply conduit 28 is directed to a conduit 32 and the piston 31 is moved to the right (as shown in FIG. 2).

Referring to FIG. 2, a post 35 having a pointed lower end 36 is adjustably attached to the rear end of the hydraulic cylinder 24. A hand screw 37 is operated to release the connection between the post 35 and the cylinder 24. The post 35 performs a dual function, acting both as a hold down to reduce longitudinal movement of the machine 15 and as an adjusting means to vertically position the hydraulic cylinder 24.

A cable support 40 including a reel 41 is positioned adjacent the hydraulic cylinder 24. The reel 41 is used for the storage of a length of flexible cable 42. Referring to FIG. 3, in the present embodiment, a hook 43 is mounted on the free end of the cable 42. Pressure pad means are releasably attached to the hook for applying a pulling force to a pipe section which is being installed. In the present embodiment, the pressure pad means comprises a rectangular member 44 having a length in excess of the exterior diameter of the bell ends of the pipes being installed. An eyebolt 45 is connected to the rectangular member 44. During the pipe-pulling operation (to be described later), the hook 43 is engaged with the eyebolt 45 to transfer the pulling force to the rectangular member 44 and ultimately to the pipe section being installed.

Referring to FIGS. 2, 3 and 4, grip means are generally indicated by the reference number 47. In the present embodiment, the grip means 47 includes parallel, spaced side members 48 which are mounted on the free end of the drive rod 25. A bottom member 49 having serrated teeth 50 defined in its upper surface extends between the spaced side members 48. A lock arm 51 having a serrated-tooth portion 52 is pivotally connected between the spaced side members 48. The serrated tooth portion 52 of the lock arm 51 and the serrated teeth 50 on the cooperating member 49 cooperate to releasably grip and hold the cable 47 which extends through an opening 53 (see FIG. 4) which is defined by the spaced side members 48, the bottom member 49, and the lock arm 51.

In the present embodiment, a longitudinally extending and raised guideway 55 (see FIG. 4) is mounted on the bottom plate 21 of the base assembly 16. The guideway 55 extends between the rear plate 18 and the front plate 17. A pair of depending guide members 56 are mounted on the grip means 47 and extend downwardly on opposed sides of the guideway 55. The guide members 56 and the guideway 55 are effective to move the free end of the drive rod 25 in a predetermined longitudinal path which is defined by the guideway 55.

Referring to FIGS. 3 and 6, a sleeve 58 extends through and is connected to the front plate 17. The sleeve 58 defines a passageway for the cable 42. A pair of vertical ears 59 extend upwardly from the sleeve 58. In the present embodiment, an adjacent pair of vertical ears 59 are generally indicated by the reference 60 which is mounted on the front plate 17 adjacent the passageway defined by the sleeve 58. The auxiliary chuck 60 includes a pair of chuck jaws 61 and 62 (see FIG. 5). The chuck jaw 61 is fixedly mounted to the front plate 17 while the chuck jaw 62 is pivotally mounted with respect to the front plate 17. The chuck jaws 61 and 62 have a plurality of cooperating serrated teeth 63. A handle 64 extends upwardly from the chuck jaw 62 and is used to move the chuck jaw 62 into and out of a gripping relationship with the cable 42 and the cooperating chuck jaw 61.

Referring to FIGS. 5, 6 and 7, a vertical support frame, which is mounted adjacent the front plate 17, is generally indicated by the reference number 67. In the present embodiment, the vertical support frame 67 includes vertical channels 68 joined together by a top member 69 and a bottom member 70. The spaced channels 68 each define a series of vertically aligned holes 71. Several of these vertically aligned holes 71a, 71b, 71c, are shown in FIGS. 6 and 7. The ears 59 which extend upwardly from the sleeve 58 define cooperating holes 72. In FIGS. 6 and 7, the cooperating holes 72 are aligned with the channel holes 61c and a bolt assembly 73 extends through the respective holes. The vertical support frame 67 supports the sleeve 58 at a predetermined vertical elevation above the bottom of the trench. To adjust the relative vertical position of the support frame 67 and the front plate 17, the bolt assembly 73 is removed and the sleeve 58 is moved upwardly or downwardly until the cooperating holes of the ears 59 are aligned with the proper pair of channel holes 71. An adjustment of this type is made when the pipe joining machine 15 is moved from one jobsite to another jobsite and the pipe sections being installed are of a different diameter than were the pipe sections at the old jobsite.

A horizontal guide arm 75 extends outwardly from the vertical support frame 67. In the present embodiment, the horizontal guide arm 75 includes a pair of dependent plates 76 having V-notch openings 77 at their lower edges. The horizontal guide arm 75 is mounted for vertical adjusting movement with respect to the vertical support frame 67 by a mounting assembly 78. Referring to FIGS. 5 and 6, the mounting assembly 78 includes a horizontal plate 79 which engages ends 80 of the channels 68. A guide plate 81 extends inwardly from the horizontal plate 79. A bolt assembly 82 is disposed between the plates 78 and 81. A portion of the bolt assembly 82 extends across and through a second horizontal plate 83 and a second guide plate 84 (see FIG. 5). The bolt assembly 82 includes a nut 85. The vertical position of the horizontal guide 75 with respect to the support frame 67 is adjusted by loosening the nut 85, moving the horizontal guide arm 75 to its correct vertical position; and retightening the nut 85.

Referring to FIG. 6, a guide finger 87 is mounted on the lower end of the vertical support frame 67 and extends outwardly therefrom. During operation of the pipe joining machine 15, an outer end 88 of the guide finger 87 rides in the invert of the first pipe section being installed.

A chain 89 (see FIGS. 5 and 6) has a first end 90 attached to one side of the horizontal guide arm 75. The chain 89 extends around the outside diameter of the first pipe section being installed and the other end 91 of the chain 89 is attached to a threaded makeup post 92. Referring to FIG. 6, a takeup screw 93 having a handle 94 is rotated to place the chain 89 in its correct position on the circumference of the pipe section.

Referring to FIGS. 1, 2 and 3, two successive pipe sections 96a and 96b are shown. Each of the pipe sections 96 includes a plain end 97 and a bell or enlarged end 98. Referring to FIG. 3, an elastomeric sealing gasket 99 is shown extending between the exterior diameter of the plain end 97 and the interior diameter of the bell end 98. The gasket 99 provides a tight joint after the plain end 97 has been seated in the bell end 98. Often, the sealing gasket 99 is constructed of two cooperating parts. The first cooperating part is attached to the interior diameter of the bell 98 and the second cooperating gasket part is attached to the exterior diameter of the plain end 97. A considerable amount of force is required to seat the plain end 97 within the enlarged end 98 of the adjoining pipe section 96. When using a pipe-joining machine 15, according to the present invention, a portion of the trench is excavated to its proper depth. Normally, the pipe joining machine 15 is actually placed on the floor of the trench. However, if the soil conditions are adverse, the machine 15 may be placed at normal grade elevation (not shown) and the cable 42 positioned around a pulley system (not shown) until it is horizontally aligned at the level of the trench bottom.
Under normal conditions, after the pipe-joining machine 15 is positioned in the trench, the handscrew 37 at the rear of the hydraulic cylinder 24 is released and the pointed end 36 of the post 35 is pushed downwardly into the ground. The hydraulic cylinder 24 is adjusted until it is at its correct vertical alignment and then the handscrew 37 is retightened. In a similar manner, the bolt assembly 73 (see FIG. 7) is released and the sleeve 58 which is connected to the front plate 17 is moved to its correct vertical position. This occurs when the centerline of the sleeve 58 is aligned with the centerline of the pipe sections 96 being installed. The bolt assembly 73 is then reinserted in the proper pair of aligned holes 71 in the channels 68 and through the cooperating holes 72 in the upwardly extending ears 59.

The nut 85 of the bolt assembly 82 is released and the horizontal guide arm 75 is adjusted with respect to the vertical support frame 67. When properly adjusted, the V-notch openings 77 defined by the depending plates 66 snugly receive the upper outside diameter of the first pipe section 96a. Retightening of the nut 85 holds the horizontal guide arm 75 in its proper vertical elevation. The chain 89 is positioned around the outer circumference of the pipe section 96a and the handle 94 is rotated to tighten the chain 89 which extends around the circumference of the pipe section 96a.

At this time, the outer end of the cable 42 is fed through the first pipe section 96a and through the next successive pipe section 96b. The rectangular member 44 is connected to the hook 43 through the eyebolt 45. The cable 42 is moved rearwardly until the outer ends of the rectangular member 44 are positioned against the bell end 98 of the pipe section 96a (see FIG. 1).

The plain end 97 of the pipe section 96b is aligned with the enlarged or bell end 98 of the adjoining pipe section 96c. The flexible cable 42 is manually pulled rearwardly and the lock arm 51 is rotated moving the serrated teeth 50 and 52 of the grip means 47 into a grabbing or gripping relationship with the cable 42. The handle 27 of the multipassage valve 26 is the to the horizontal dashed line position shown in FIG. 2, thereby moving the piston 31 and the drive rod 25 rearwardly as described above. This rearward movement of the drive rod 25 is continued until the plain end 97 of the pipe section 96b is correctly seated in the bell end 98 of the pipe section 96a. At that time, the handle 27 is moved to either its neutral position or to its forward position. It has been found that if a relatively few pipe sections 96 have been positioned in the trench, the handle 27 may be moved to its forward position thus releasing the tension on the cable 42. At that time, the grip means 47 is released, a new pipe section 96 is lowered into the trench and the above operation is repeated. However, if many pipe sections 96 have been laid in the trench, the handle 27 is moved to its neutral position and the auxiliary chuck 60 is activated to temporarily hold the cable 42 under tension. The auxiliary chuck 60 is operated by grasping the handle 64 (see FIG. 8) and pivoting the chuck jaw 62 into a gripping relationship with the cable 42 and the chuck jaw 61. At this time, the handle 27 of the multipassage valve 26 is moved to its forward (vertical dashed) position, moving the drive rod 25 to the right as shown in FIG. 2. It has been found that when an extensive length of the cable 42 is positioned within the installed pipe sections 96, the cable 42 stretches to such a degree that the use of the auxiliary chuck 60 is useful in maintaining the cable 42 within the installed pipe sections under tension. If the auxiliary chuck 60 is not used in this situation, it reduces the effective pulling stroke of the hydraulic cylinder 24.

What I claim is:

1. A pipe-joining machine comprising, in combination, a longitudinally extending base assembly, said base assembly including a front plate, a rear plate, and two horizontal, spaced, support rods extending rearwardly from said front plate, a hydraulic cylinder horizontally mounted on said rear plate, said cylinder having a horizontal drive rod extending through an opening defined in said rear plate toward said front plate, control means operatively connected to said cylinder for selectively moving said horizontal drive rod, a flexible cable for applying a pulling force to a pipe to be installed, means operatively connected to said flexible cable for releasably engaging one end of a pipe to be laid, grip means mounted adjacent the free end of said horizontal drive rod for releasably holding said cable, means attached to said hydraulic cylinder for adjusting the vertical position of said cylinder, a vertical support frame mounted adjacent said front plate, and means for adjusting the relative vertical position of said vertical support frame with respect to said front plate.

2. A pipe-joining machine comprising, in combination, a longitudinally extending base assembly, said base assembly including a front plate, a rear plate spaced from said front plate, and means for connecting said front plate to said rear plate, drive means adjacent said rear plate and having an axially movable drive member, control means operatively connected to said drive means for selectively moving said drive member, said control means including an auxiliary chuck mounted on said frame for applying a pulling force to a pipe to be installed, said grip means being releasably attached to said cable means.

3. A pipe-joining machine comprising, in combination, a longitudinally extending base assembly, said base assembly including a front plate, a rear plate spaced from said front plate, and means for connecting said front plate to said rear plate, drive means adjacent said rear plate and having an axially movable drive member, control means operatively connected to said drive means for selectively moving said drive member, said control means including a multipassage valve in fluid communication with said hydraulic fluid means, and a handle means for selectively operating said valve, grip means mounted on said drive member, said grip means including a pair of parallel, spaced side members, a bottom member attached to said side members, said bottom member having serrated teeth defined in the portion of its upper surface which extends between said spaced side members and said bottom member being pivotally mounted between said spaced side members, said lock arm having a serrated tooth portion suitable for cooperation with said serrated teeth on said bottom member, whereby cooperating teeth on said tooth portion and said bottom member are effective to releasably grip and hold a cable which extends through an opening defined by said spaced side members, said bottom armer and cable means for applying a pulling force to a pipe to be installed, said grip means being releasably attached to said cable means.

4. A pipe-joining machine, according to claim 3, wherein said cable means includes a flexible cable, a reel suitable for storing said cable, and means releasably attached to the free end of said cable means for applying a pulling force to a pipe section being installed.

5. A pipe-joining machine, according to claim 3, wherein said connecting means includes at least two support members extending between said front plate and said rear plate, and a horizontal bottom plate extending between said front plate and said rear plate.

6. A pipe-joining machine, according to claim 5, including a guideway on said bottom plate and guide means mounted for movement along said guideway and effective to move said drive member in a predetermined path defined by said guideway.

7. A pipe-joining machine according to claim 2, wherein said grip means also includes an auxiliary chuck mounted on said front plate for releasably securing a cable, said chuck including a pair of chuck jaws having cooperating serrated teeth, one of said chuck jaws being pivotally mounted for movement into and out of gripping relationship with the other of said chuck jaws.
8. A pipe-joining machine according to claim 3, including a horizontal guide arm adjustably mounted on said vertical support frame, said guide arm extending outwardly from said vertical support frame, and a lower horizontal guide finger mounted on and extending outwardly from the lower end of said vertical support frame, whereby said guide arm and guide finger receive a first of a series of pipes to be installed to ensure correct alignment of the pipe.