METHOD AND ASSEMBLY FOR CLEANING AND/OR INSERTION OF A DRAW LINE IN A CONDUIT

BACKGROUND

The present invention relates to a method and assembly capable of cleaning the inside of a conduit and/or inserting a draw line through a length of conduit and also relates to a convenient and efficient method of sealing an end of a conduit to facilitate said insertion of said draw line whose leading end is advanced through the conduit by an air assisted shuttle connected to said end.

PRIOR ART

Telecommunications cables are nowadays generally laid underground in specially constructed trenches. In order to protect the cables from potential damage by water, debris and vermin, typically communications cables are laid inside plastic (usually polyvinylchloride (PVC)) conduits. There are many thousands of kilometres of such cables already laid in underground conduits, but due to the rapid increase in telecommunications and thus the need for more cables, conceivably, hundreds of thousands of kilometres of cable will be required in the future.

There are generally three categories of installed conduits, those that are left empty in reserve awaiting receipt of new cables, those that are already partially filled and those that are fully occupied with cables. It is the first and second of the two aforesaid categories that the invention is principally concerned with. The process of inserting cables into conduits is time consuming, labour intensive and thus expensive. Existing methods of insertion of draw lines in cables are slow, cumbersome and inefficient.

In order to feed a cable through a conduit it is necessary to first insert a draw line inside the conduit which is then anchored to the leading end of the cable so it can be pulled through to the end of the length of conduit. Draw lines may be inserted and simply left lying in a conduit awaiting later insertion of a cable. This is helpful to the cable installer as in this case the draw line is already placed in the conduit in advance of the cable installation enabling the draw line to be readily attached to the leading end of the cable

which is then pulled through by the draw line. One existing method for insertion of a draw line in a conduit includes the use of a crude parachute to which a draw line is connected. The parachute is inserted via an entry end into the conduit. Pressurised air is then delivered to the parachute causing it to inflate following which it exits the pipe taking the draw line with it. In order to maintain the positive air pressure required, the entry end of the conduit must be sealed to prevent escape of air. This is presently effected in a crude manner by the insertion in the entry end of the conduit of rags and the like which must be manually held in position whilst positive pressure is delivered to the inside of the pipe. Positive pressure is introduced into the conduit via a copper tube which is connected to a source of pressurised air. The rags and other packing surround the copper tube. The draw line must be loose enough to travel through or around the packing resulting in a compromise to the integrity of the seal resulting in pressure loss in the conduit via the entry end. Sealing of the conduit in the past has presented a major problem to operators and poses a particular problem when the conduit is filled with water and debris due to backwash. When a conduit is under pressure and ineffectively sealed the pressurisation may urge the water and debris outside the entry end of the conduit. Sealing of the conduit has been particularly difficult in the case where a conduit is partially filled with cables. Another problem arising from use of the above method is that of unwanted collapsing or bunching of the parachute. The presently used parachute essentially comprises a sheet of textile or analogous material to which is connected at peripherally located points one end of each of multiple lengths of string each of which terminate at their other end at a junction which also receives the leading end of the draw line.

The parachute is prone to collapsing within the conduit particularly if the air is collected asymmetrically in the parachute allowing greater air by pass around one edge compared to symmetric by pass and proper chute balance in normal operation. This imbalance can cause the parachute to rotate, tangling the connecting strings in which case the string can capture the air collecting the textile material of the parachute. This means that the tangled parachute has to be 'fished' out of the conduit and the process recommenced increasing the time and labour involved in drag line insertion.

A solution to this problem is the subject of a co-pending application by the present applicant. There are other problems with use of the prior art arrangements: for instance, the string of the draw line comes in contact with the users hands, the copper tube must be held in position by an operator, the packing rags and sponges may blow out. Further, two men are usually required in the conduit pit, one feeding the draw line and the other holding the copper air line and rags in position.

In another prior art method push rods may be inserted from either end of a conduit until they meet in the middle whereupon the conduit is cut and joined creating a further join and thus another place through which unwanted water can penetrate later on. The push rods may be inserted from either end up to 100m. The push rod approach is cumbersome and has resulted in damage to cables within the conduit particularly where the rod engages the throat of a V formed if the cables cross over in the conduit.

THE INVENTION

The present invention provides a method and assembly capable of cleaning the inside of a conduit and which also provides trouble free insertion of a draw line inside a conduit suitable for carrying cables such as communications cables. The invention also relates to an efficient method of sealing an end of a conduit whether occupied or empty to facilitate insertion of the draw line into the conduit. The assembly includes an air assisted shuttle which draws the draw line through the pipe responsive to positive air pressure. The shuttle has been made the subject of a co-pending application by the present applicant.

According to an apparatus aspect of the invention there is provided an assembly for cleaning and/or insertion of a draw line in a conduit including an apparatus which seals an end of the conduit into which a draw line is to be placed, and which facilitates the delivery of a leading end of the draw line through the conduit upon delivery of pressurised air into the conduit between said apparatus and a shuttle responsive to said pressured air such that the shuttle is urged along the conduit until it exits the conduit pulling the draw line with it.

In its broadest form of the apparatus aspect the present invention comprises:
an assembly for air assisted insertion of a draw line inside and along a conduit from an entry end of said conduit to an exit end;
the assembly comprising;
a source of pressurised air;
an apparatus for sealing an end of said conduit and which allows the delivery of pressurised air from said air source, into said conduit through or about said sealing apparatus,
a through passage in or on said sealing apparatus which receives a draw line such that when said sealing apparatus engages the entry end of said conduit the draw line is capable of entering the apparatus external or internal of the conduit and exits the sealing apparatus inside the conduit,
means connected to a leading end of the draw line responsive to delivery of air from said pressurised air source and which urges the draw line along the conduit until it exits the conduit via said exit end.

Preferably, the air source is connected directly or indirectly to the sealing apparatus and the assembly includes a manifold including means to receive at least one air hose in communication with said pressurised air source and associated with said manifold and the sealing apparatus comprises an inflatable air envelope responsive to said pressurised air such that said envelope expands under said air pressure to seal an end of said conduit.

Preferably, the air envelope is disposed at the leading end of said sealing apparatus about a generally elongate tube like member wherein the membrane is fixed at both ends to said member and is disposed concentrically thereabout wherein a cavity is formed between the inside of said membrane and said tube like member, which cavity receives pressurised air causing the membrane to expand and engage the inner surface of the conduit.

The manifold preferably comprises at least one air inlet, an air outlet and a control valve for controlling air flow expelling air.

According to the broadest form of method aspect of the invention there is provided a method for insertion of a draw line into a conduit comprising the steps of:

a) feeding a free end of the draw line through a passage or opening in a sealing apparatus capable of sealing one end of said conduit,

b) securing the free end of the draw line to a shuttle and inserting the shuttle into the conduit via an entry end;

c) sealing the end of the conduit with the sealing apparatus.

d) introducing pressurised air through or about said sealing means and into said conduit downstream of said sealing means and upstream of said shuttle;

e) applying sufficient air pressure to facilitate travel of the shuttle along the conduit until it exits the conduit taking the draw line with it.

According to a preferred embodiment the method comprises the further step of feeding the draw line back through the sealing apparatus to remove any slack in the draw line between the sealing means and the shuttle.

According to another broad form of the method aspect the present invention comprises a source of pressurised air;

an apparatus for sealing an end of said conduit and which allows the delivery of pressurised air from said air source into said conduit through or about said sealing apparatus,

a through passage in or on said sealing apparatus which receives a draw line such that when said sealing apparatus engages the entry end of said conduit the draw line is capable of entering the apparatus external or internal of the conduit and exits the sealing apparatus inside the conduit,

means connected to a leading end of the draw line responsive to delivery of air from said pressurised air source and which urges the draw line along the conduit until it exits the conduit via said exit end; the method comprising the steps of:

a) feeding a free end of the draw line through a passage or opening in the sealing apparatus capable of sealing one end of said conduit,

b) securing the free end of the draw line to a shuttle and inserting the shuttle into the conduit via an entry end;

c) sealing the end of the conduit with the sealing apparatus.

d) introducing pressurised air about said sealing apparatus and into said conduit downstream of said sealing apparatus and upstream of said shuttle;

e) inflating an air envelope on said sealing apparatus such that the envelope engages the inside surface of said conduit so as to seal said conduit

f) applying sufficient air pressure to facilitate travel of the shuttle along the conduit until it exits the conduit taking the draw line with it.

According to another broad form of the method aspect the present invention comprises. a method for insertion of a draw line in a conduit using an assembly comprising;

a source of pressurised air;

a sealing apparatus for sealing one end of the conduit and which is in direct or indirect contact with the pressurised air source;

a shuttle connected to the draw line and which is responsive to pressurised air,

the method comprising the steps of;

a) feeding a free end of the draw line through an opening in the sealing apparatus;

b) securing the shuttle to said free end of the draw line and inserting the shuttle into the conduit via an entry end;

c) inserting the sealing apparatus into said entry end after it has been connected to a manifold which controls flow of air into the sealing apparatus and pipe;

d) sealing the end of the conduit by adjusting a control valve on the manifold to inflate an envelope on said sealing apparatus;

e) adjusting the control valve to allow pressurised air to enter the conduit thereby energising the shuttle until the shuttle exists the pipe taking the draw line with it

Preferably the method comprises the additional step of adjusting the control valve after the shuttle exits the pipe so as to release the sealing apparatus from the pipe.

Preferably the sealing apparatus includes a manifold which controls the delivery of air to the conduit and to a sealing apparatus connected to a leading end of the manifold

In another broad form the present invention comprises an assembly for cleaning the inside of a conduit using a cleaning element such as a pellet; the assembly comprising an assembly which seals an end of the conduit and allows delivery of pressurised air into said conduit, said pressurised air urging said pellet through said conduit urging water and/or debris before it.

The present invention will now be described in more detail according to a preferred but non limiting embodiments of the invention according to method and apparatus aspects and with reference to the accompanying illustrations wherein;

Figure 1: shows an exploded view of a draw line insertion assembly according to a preferred embodiment of the invention;

Figure 2: shows a side elevation of a manifold similar to that shown in figure 1 which controls air delivery to both the inside of the conduit and to the sealing apparatus according to a preferred embodiment; and

Figure 3: shows a sealing apparatus according to a preferred embodiment.

Referring to figure 1 there is shown according to a preferred embodiment an assembly 1 for placing a draw line in a conduit 2. This assembly may also be used in the removal of water and/or debris from the inside of a conduit. The assembly, however, will principally be described with reference to its use in inserting a draw line in a conduit. Assembly 1 includes a manifold 3 including a sealing apparatus 4, a source of pressurised air, a shuttle 6 and a draw line 6a. Sealing apparatus 4 is preferably detachably fixed to manifold 3 so that sealing apparatuses of different sizes can be substituted according to the size of the conduit to be sealed. Figure 1 shows sealing apparatus 4 inserted into conduit 2 with draw line 6a fed therethrough and connected via leading end to shuttle 6.

Referring now to figure 2, manifold 3 comprises a manifold body 3a having at one end a station 5 which receives a coupling 5a connected to air supply hose 7 (see figure 1) which is in turn connected to an air source which may for instance be a conventional air compressor 8. At or near the same end, manifold body 3a also includes a station 9 which receives coupling 10 connected to air supply hose 11 (see figure 1) which is also connected directly or indirectly to air compressor 8.

As can be seen from figure 1 hose 11 delivers pressurised air via station 9 to sealing apparatus 4. The air supply to sealing apparatus 4 is regulated by means of valve 12 which is manually actuated by an operator to deliver air to the envelope surrounding space 13 (see also figure 3) formed inside flexible membrane 14 which expands radially until it frictionally engages the inside surface 15 of conduit 2. Sealing apparatus 4 acts like a plug to seal end 16 of conduit 2 and is detachably fixed to manifold body 3a by means of coupling 17. Sealing apparatus 4 is selected according to the size of the conduit into which draw line 6a is to be placed and therefore comes in a range of sizes.

Figure 3 shows a part cross sectional view of a typical sealing apparatus 4. Sealing apparatus 4 is a generally tube like member including an air envelope formed by flexible membrane 14 which surrounds cylindrical inner tube 18 thereby forming between the membrane 14 and tube 18 a cavity or space 13. Membrane 14 is preferably a rubberised material and is anchored at two ends by means of clamps 19 and 20. Clamping of the two ends of membrane 14 ensures that cavity or space 13 is air tight. Membrane 14 has sufficient elasticity to allow it to be radially displaced in response to pressurisation of cavity 13 with pressurised air from air source 8 thereby enabling tight interfitting between membrane 14 and inner surface 15 of conduit 2 as a consequence of which the end 16 of conduit 2 is sealed such that pressurised air introduced into conduit 2 can only escape via the opposite end of the conduit according to the arrangement shown in figure 1.

Preferably, air introduced into cavity 13 is delivered from hose 11 via valve 12 following which the air travels via a narrow orifice or orifices 21 and 22 into cavity 13 to inflate the

envelope formed by membrane 14 to the desired pressure. The operator chooses the required pressure in accordance with the sealing requirements taking into account the diametric size of the sealing apparatus and the radial distance membrane 14 must travel to effect sealing against the inside surface 15 of conduit 2. Typical air pressures which may be used to effect adequate sealing are within the range 25 to 150 psi. The pressure can be monitored by means of pressure gauge 23. Once cavity 13 is pressurised to the required degree, in order to maintain that pressure whilst inserting the draw line 6a, valve 12 is adjusted to trap the pressurised air in order to maintain frictional engagement between membrane 14 and inner surface 15 of conduit 2.

The assembly is adapted for use in the following way described with particular reference to the arrangement shown in figure 1. An operator selects conduit 2 for insertion therein of the draw line 6a. In the field, very often pipes have entrained water or debris therein which is best removed. If the conduit is empty, a pellet 23 can be used in place of shuttle 6 as this will push water and dirt before it as it travels through the conduit. Shuttle 6 can be used when the conduit into which a draw line is to be placed is partially filled with cables or empty. Shuttle 6 may to a certain extent displace some debris but vanes or air collectors 24 on shuttle 6 tend to conform under air pressure to the internal contours of the conduit and are generally not stiff enough to push debris ahead of the shuttle. In the case where the conduit already has some cables laid inside the cross section may be uneven and in this case the air collectors can ride over the uneven contours. Thus, depending upon the state of the conduit (i.e. empty or partially full of cables) the operator may choose either pellet 23 or shuttle 6 for insertion of a draw line.

Where a pellet is used, the draw line is attached to it via end 6b. According to the method aspect, the first step is to feed a leading end of draw line 6a through an opening 3b in manifold body 3a. Leading end 6b is then connected to a shuttle 6 or pellet 23 which is then fed a short distance into conduit 2. Next, manifold 3 is fixed to the end of the conduit whilst the draw line is back fed through the manifold to remove unwanted slack in draw line 6a. When manifold 3 is fitted, sealing apparatus 4 penetrates conduit 2 following which it is inflated whereupon sealing of conduit 2 occurs in the manner

hereinbefore described. Once valve 12 is closed the manifold is held securely in position. Pressured air is then delivered to the conduit by further adjustment of valve 12 whereupon the pellet 23 or shuttle 6 is driven along the conduit until it exits the conduit dragging draw line 6a with it. The sealing apparatus 4 is then released by opening valve 12 whereupon pressured air escapes from the inside of membrane 14. The trailing end of draw line 6a is then pulled out of manifold 3 in readiness to be tied to a cable to be pulled through the conduit.

The assembly described may also be used to deliver a draw line from a device known as a launcher which includes a spool of line to be fed into a conduit.

It will be recognised by persons skilled in the art that numerous variations and modifications may be made to the invention as broadly described herein without departing from the overall spirit and scope of the invention.

* C L M S *

THE CLAIMS:

1. An assembly for air assisted insertion of a draw line inside and along a conduit from an entry end of said conduit-to an exit end;

the assembly comprising;

a source of pressurised air;

an apparatus for sealing an end of said conduit and which allows the delivery of pressurised air from said air source, into said conduit through or about said sealing apparatus,

a through passage in or on said sealing apparatus which receives a draw line such that when said sealing apparatus engages the entry end of said conduit the draw line is capable of entering the apparatus external or internal of the conduit and exiting the sealing apparatus inside the conduit,

a shuttle connected to a leading end of the draw line responsive to delivery of air from said pressurised air source and which urges the draw line along the conduit until it exits the conduit via said exit end.

2 An assembly according to claim 1 wherein the air source is connected directly or indirectly to the sealing apparatus.

3 An assembly according to claim 2 wherein the air source delivers air to the sealing apparatus via an air manifold.

4. An assembly according to claim 3 wherein the manifold controls the delivery of pressurised air into the conduit.

5. An assembly according to claim 4 wherein the sealing apparatus comprises an elongated generally tubular body including an outer membrane forming an inflatable envelope.

6. An assembly according to claim 5 wherein the membrane forming said envelope is responsive to said pressurised air whereupon the membrane is urged against an inner wall of said conduit to effect sealing engagement between the envelope and conduit.

7. An assembly according to claim 6 wherein the membrane is fixed by means of a clamp or the like to either end of said tubular body one of which clamps having associated therewith a coupling which receives said manifold.

8. An assembly according to claim 5 wherein the manifold comprises at least one air inlet, an air outlet and a control valve for controlling air flow and expelling air.

9. An assembly according to claim 8 wherein the control valve moves between a first position in which pressurised air is prevented from entry into the manifold and a second position in which air is delivered to the inside of said envelope and a third position in which air is delivered to the inside of said conduit and a fourth position in which air is purged from said manifold said conduit and said envelope.

10. An assembly according to claim 9 wherein the manifold comprises couplings at two inlet ports which receive air supply hoses connected to said pressurised air source.

11. An assembly according to claim 10 wherein the manifold further comprises at the outlet a coupling which mates with the sealing apparatus.

12 An assembly according to claim 11 wherein the manifold further comprises a pressure gauge.

13. An assembly according to claim 12 wherein the shuttle comprises an elongated shaft having disposed radially thereabout at least one inflatable air collector.

14. An assembly according to claim 13 wherein the air collector/s comprise either a skirt having a waist fixed to said shaft and a free end which displaces radially responsive to air pressure or an array of air collection cells disposed radially about said shaft.

15. A sealing apparatus for use with an assembly for insertion of a draw line in a conduit comprising a generally elongate tubular member having disposed thereabout a flexible membrane clamped at either end to form an inflatable envelope.

16. A sealing apparatus according to claim 15 wherein the membrane forming said envelope is responsive to pressurised air whereupon the membrane is urged against an inner wall of said conduit to effect sealing engagement between the envelope and conduit.

17. A sealing apparatus according to claim 16 wherein the membrane is fixed by means of a clamp or the like to either end of said tubular body one of which clamps has associated therewith a coupling which receives and retains said manifold.

18. A manifold for use with an assembly for insertion of a draw line in a conduit wherein the manifold comprises at least one air inlet, an air outlet and a control valve.

19. A manifold according to claim 18 wherein the control valve moves between a first position in which pressurised air is prevented from entry into the manifold, a second position in which air is delivered to the inside of an envelope associated with a sealing apparatus and a third position in which air is delivered to the inside of said conduit and a fourth position in which air is purged from said manifold.

20. A manifold according to claim 19 wherein the manifold comprises couplings at two inlet ports which receive air supply hoses connected to said pressurised air source.

21. A manifold according to claim 20 further comprising at the outlet a coupling which mates with the sealing apparatus.

22. An assembly according to claim 21 further comprising a pressure gauge.

23. A method for insertion of a draw line inside and along a conduit using an assembly comprising:

a source of pressurised air;

an apparatus for sealing an end of said conduit and which allows the delivery of pressurised air from said air source into said conduit through or about said sealing apparatus,

a through passage in or on said sealing apparatus which receives a draw line such that when said sealing apparatus engages the entry end of said conduit the draw line is capable of entering the apparatus external or internal of the conduit and exits the sealing apparatus inside the conduit,

means connected to a leading end of the draw line responsive to delivery of air from said pressurised air source and which urges the draw line along the conduit until it exits the conduit via said exit end; the method comprising the steps of:

a) feeding a free end of the draw line through a passage or opening in the sealing apparatus capable of sealing one end of said conduit,

b) securing the free end of the draw line to a shuttle and inserting the shuttle into the conduit via an entry end;

c) sealing the end of the conduit with the sealing apparatus.

d) introducing pressurised air about said sealing apparatus and into said conduit downstream of said sealing apparatus and upstream of said shuttle;

e) inflating an air envelope on said sealing apparatus such that the envelope engages the inside surface of said conduit so as to seal said conduit

f) applying sufficient air pressure to facilitate travel of the shuttle along the conduit until it exits the conduit taking the draw line with it.

24. A method according to clam 23 comprising the further step of back feeding the draw line to remove any slack in the draw line between the sealing assembly and shuttle.

25. A method for insertion of a draw line in a conduit using an assembly comprising:
a source of pressurised air;
a sealing apparatus for sealing one end of the conduit and which is in direct or indirect contact with the pressurised air source;
a shuttle connected to the draw line and which is responsive to pressurised air,
the method comprising the steps of;

a) feeding a free end of the draw line through an opening in the sealing apparatus;

b) securing the shuttle to said free end of the draw line and inserting the shuttle into the conduit via an entry end;

c) inserting the sealing apparatus into said entry end after it has been connected to a manifold which controls flow of air into the sealing apparatus and pipe;

d) sealing the end of the conduit by adjusting a control valve on the manifold to inflate an envelope on said sealing apparatus;

e) adjusting the control valve to allow pressurised air to enter the conduit thereby energising the shuttle until the shuttle exists the pipe taking the draw line with it.

26. A method according to claim 25 comprising the further step of adjusting the control valve to deflate said envelope thereby enabling release of the sealing apparatus from the conduit.

27. An assembly for cleaning the inside of a conduit using a cleaning element such as a pellet, said assembly including a source of pressurised air, a sealing apparatus for sealing an entry end of said conduit and including an inflatable envelope which receives air from said

pressurised air source, said pressurised air urging the pellet through the conduit after the pellet is placed therein and the entry end sealed by said sealing apparatus.