ABSTRACT: A tool for tightening and clamping around a pipe coupling a single strand of wire formed in two laterally spaced loops connected at one end by an integral bight, with the free shanks of respective loops underlying the bight. The tool comprises a threaded shaft rotatably supported in a frame which has a fulcrum foot at one end for pivotal engagement with the bight between the spaced loops. A pair of shank-gripping blocks are mounted on either side of the shaft for independent, longitudinal, sliding movement with respect to the shaft. A pulling block is threadedly mounted on the shaft and is connected to the gripper blocks by a flexible, load-equalizing cable running freely through an arcuate groove in the pulling block, with opposite ends of the cable secured to respective gripping blocks. The threaded shaft is rotatable by a handle to retract the pulling block longitudinally on the shaft and thereby exert independent pulling force on the respective gripping blocks and, in turn, on individual shanks of the wire loops. When the respective loops have been tightened to the desired extent, the bodily rotation of the tool about its fulcrum bends the wire shanks over the bight and clamps the loops around the pipe sections. Means are provided for cutting off the excess lengths of the shanks after clamping.
APPLYING TOOL FOR WIRE-TYPE CLAMP

BACKGROUND OF INVENTION

Numerous wire clamp applying tools are conventionally used for tightening wire loops around pipe couplings and hose couplings, operating on the same basic principle as the present invention. However, none of the tools with which we are familiar are provided with means to compensate for such conditions as differences in tolerances of two pipes being connected, differences in diameters of two edges or sides of the clamp, and differences in the length of the wire shanks being pulled to tighten the wire loops around the pipe coupling. In all of these conventional tools, the shanks of the wire loops are anchored in the threaded head operated by a rotatable threaded shaft and operate, when retracted, to directly uniformly contract the two wire-clamping loops.

In other words, an equal pulling force is applied to the shanks of both loops so that differences in tolerances, for example, of the pipes being coupled are not compensated for, and an insufficient clamping force may be applied to one or the other of the sections of pipe.

The present invention is designed to overcome this difficulty and has for its object to provide a wire clamp applying tool having equalizing means to automatically compensate for tolerance differences as the loops are being tightened and clamped.

Another object of the invention is to provide a tool having separate and independent shank-gripping means for the respective loops of wire and a pulling force equalizing block for controlling the pulling force exerted on the respective gripping blocks.

Still another object of the invention is to provide novel and easily operable gripping cam means for anchoring the shanks of the wire loops encircling the coupling during the tightening operation.

A further object of the invention is to provide a tool of this character which incorporates a shank-cutting element for disposing of the excessive lengths of wire loop shanks after the loops have been tightened and clamped.

A further object of the invention is to provide a clamping tool of improved and simplified construction with which a leakproof connection between two sections of pipe may be effected with a minimum of time and effort.

With the above and other objects in view which will appear as the description proceeds, the invention consists in the novel features herein set forth, illustrated in the accompanying drawings, and more particularly pointed out in the appended claims.

THE DRAWINGS

Referring to the drawings in which numerals of like character designate similar parts throughout the several views:

FIG. 1 is a perspective view of the tool comprising the invention;
FIG. 2 is a view of the tool in side elevation;
FIG. 3 is a plan view of the tool;
FIG. 4 is a transverse sectional view taken on line 4-4 of FIG. 3;
FIG. 5 is a perspective view of a typical wire clamp and coupling with which the tool of the invention is employed;
FIG. 6 is a view of the tool in the initial loop-tightening position on the wire clamp; and
FIG. 7 is an enlarged view of the tool in its final clamping position with respect to the wire clamp.

As will be seen from FIG. 5, the numerals 10 and 11 represent two sections of pipe to be coupled in longitudinal alignment with a coupling sleeve or bushing 12 of compressible, leakproof material, such as rubber, bridging the adjacent ends of the two pipe sections. In the form of coupling for which the present tool was primarily designed, a flexible, corrugated band 13 of stainless steel or similar material, such as disclosed in the U.S. Pat. No. 3,233,922, to Evans, issued Feb. 8, 1966, overlies the sleeve 12 with its ends overlapping.

A wire clamp generally represented by the numeral 14 comprises a single strand of wire of suitable dimensions bent in the form of a "U" to provide a bight 15 with leg portions 16 and 17 coiled around the coupling one or more times with the shanks 16a and 17a of the coiled leg portions passing through and under the bight 15. The coils are then tightened and clamped by the use of the tool of the present invention. When the coils are sufficiently tight to clamp the coupling in leakproof engagement with the pipe sections, the shanks of the coiled leg portions are bent back over the bight portion to lock the coils in their tightened positions.

Referring now to FIGS. 1-4 which represent the tool per se, the frame of the tool, generally represented by the numeral 18, comprises two longitudinally extending, laterally spaced rails 19 secured at one end by a crosshead 20 and at their opposite ends by a base member 21. A threaded shaft 22, lying between the spaced rails 19, is supported at one end for free rotation by the crosshead 20, its opposite end, in the form of the invention shown, terminating short of the base member 21. An unthreaded portion of the shaft 22 extends through the crosshead 20 and carries a torque-limiting device 23 of any suitable type and is rotatable by a handle 24 through the torque-limiting device 23.

A pulling block 25 threadedly engages the shaft 22 and is longitudinally movable on the shaft by rotation of the latter, said block being accurately recessed on both sides as at 26 for slidable support by the rails 19. A pair of shank-gripping blocks 27 and 28, to be described, are independently slidable on the rails 19 between the pulling block and the base member 21, accurately recessed portions 29 being provided in the sides of these blocks for guiding engagement with the rails 19. The adjacent faces of these blocks are provided with complementary grooves 30 to accommodate their free-sliding movement with respect to the threaded shaft 22. A flexible, load-equalizing cable 31 is suitably fixed at its opposite ends, as at 32, for example, by threaded terminals on the cable, to the independently slidable gripping blocks 27 and 28 (FIG. 3), and its intermediate portion passes slidable through an arcuate groove 33 in the pulling block 25. A top plate 34 is fastened to the block 25 by suitable screws 35 for retaining the cable 31 in place in the groove 33.

Extending longitudinally from the base member 21 is a fulcrum foot 36 which protrudes beyond the frame and is provided at its extremity with a transverse pivot groove 37 which, as will later appear, pivotally engages the bight between the loops of the wire clamp. On either side of the fulcrum foot, a grooved guide track 38 is provided for receiving and directing the protruding free shanks 16a and 17a through passageways 39 extending through the base member 21. These passageways 39 are aligned with passageways 40 in the respective gripping blocks 27 and 28 which ultimately receive and grip the shanks 16a and 17a of the wire clamp.

Reference to FIG. 3 will show the shank-gripping mechanism of the gripping blocks 27 and 28, the top cover plate 41 of block 28 having been removed. In each block, an internal pocket 42 is cut out to accommodate a pivotally mounted cam element 43 having a serrated cam surface 44 which, when in normal position, intersects the shank passageways 40. The cam element 43 is normally urged into gripping position within the passageways 40 by a coil spring 45 projecting from a well 46 in the interior of the block. An upstanding lug 47 on the cam is engaged by the base 48 of a release lever 49, which extends through a suitable opening in the cover plate 41 for the block, the release lever 49 being located outside of the gripping block adjacent the upper face of the cover plate 41. The cover plates are retained in place on the blocks by suitably formed upstanding lugs 17a which are introduced by guide tracks 38 through passageways 39 and into passageways 40 of the gripping blocks, the cam elements 43 are rotated against their springs by the shanks in directions to respectively clear the passageways 40, and when
A pulling force is exerted on the shanks, the cams 43 are automatically urged into engagement with the shanks to lock them within the respective passageways 40. After the tool has completed its tightening and clamping function, the shanks are automatically urged back through the passageways 40 by release levers 49 to urge the cam elements 43 in directions against their respective springs 45 to clear the passageways 40. As will be seen from FIG. 1, the release levers 49 are so arranged that they can be activated simultaneously by two fingers of one hand of the operator and squeezed together. Preferably, the release levers 49 are pivotally mounted in the lower part of the shanks which are inwardly beveled at 40a to facilitate the insertion of the free ends of respective shanks in the gripping blocks. After the loops 16, 17 are finally tightened and clamped, it is desirable to dispose of the excess lengths of the shanks 16a, 17a, and for this purpose, the base member 21 is provided with a shank cutoff device which, in the form of the invention illustrated, comprises a bore 51 which extends through a portion of the base member in a direction transverse to the passageways 39 and intersecting the same so that the shanks 16a, 17a pass through the bore, as shown in FIGS. 6 and 7. A boss 52 (FIGS. 1 and 3), formed integrally with the base member 21, projects laterally from one side of the frame and rotatably supports a cutting bar 53 which extends longitudinally through the bore 51. That portion of the cutting bar which intersects the passageways 39 is circular in cross section to form a knife slot 54. An arcuate slot 55 is provided in the periphery of the boss 52 to receive a cutter lever 56 for connection at one end of the rotary cutter bar 53. Thus, upon rotation of the cutter bar 53 in clockwise direction, as viewed in FIG. 7, the cutting edge of its knife 54 severs the shank 17a extending through passageway 39 and bore 51. Normally, the lever 56 is in its lowermost position at the bottom of the arcuate slot 55, which places the cutting knife 54 in the upper area of the bore 51 as shown in FIGS. 1 and 2, so that the shanks can pass freely through the bore 51. However, in the cutting operation, the lever 56 is raised to its uppermost position in the slot 55 to actuate the cutting knife 54 across the passageways 39 as shown in FIG. 7. In operation, the two sections of pipe 10 and 11 are placed in end-to-end position with the compressible sleeve 12 bridging the junction, and the corrugated band 13 is wrapped around the sleeve 12. The clamping wire is then looped as at 16 and 17, FIG. 5, around the band 13 with one loop adjacent to each edge of the band and the shanks 16a, 17a inserted under the bight 15 connecting the loops. The shanks 16a, 17a are then inserted by way of the guideways 38 through the passageways 39 in the base member 21 and then through the passageways 40 of respective gripping blocks 27, 28, where they are gripped by the cam locks 43 under the normal tension of the springs 45. By turning the handle 24 on the threaded shaft 22, the latter is rotated in clockwise direction to draw the pulling block 25 to the right, as viewed in FIG. 6, and the pulling block, which is connected to the gripping blocks 27, 28 by the freely slidable, load-eliminating cable 31, applies pulling force to the independent gripping blocks which are now firmly engaged with the respective shanks 16a, 17a. As before pointed out, due to the arcuate slot 33 in the pulling block through which the cable 31 slides freely, an equalized pulling force is applied to the independent gripping blocks. Thus, in the event of any nonuniformity in the diameter of one of the pipe sections 10, 11, for example, a sufficient independent tightening force is applied to either loop 16 or 17 despite such irregularity or nonuniformity. This equalization of the pulling force is, of course, effected simultaneously in one operation of the handle 24 and threaded shaft 22. After the loops have been sufficiently tightened about the corrugated band 13, the tool 18 is bodily tilted or rotated in counterclockwise direction, as seen in FIG. 7, approximately 145°, so that the Bight 15 is held in the passageways 40, and the tool is then returned to the initial position and firmly clamp the shanks 16a, 17a over the bight of the loops 16, 17. The lever 56 of the cutting device is then elevated to rotate the cutting knife 54 clockwise (FIG. 7) and sever the excess lengths of the shanks 16a, 17a. Thereafter, by means of the levers 49 on the gripping blocks, the shanks are released from the passageways 40, and the tool is removed from the coupling. In order to firmly secure the clamped ends of the loops over the bight, the ends of the cutoff shanks may be bent down onto the wrapped band 13. It will be apparent that the present invention provides an improved and highly effective wire loop-clamping tool which automatically tightens two spaced loops of a single strand of wire with an equalized pulling force, firmly secures the loops in their finally tightened positions, and then severs the excess lengths of loop shanks from the coupling. A bottom cover 57 may be employed to protect the assembly from foreign matter. Also, release levers 49 may be used to allow removal of the tool and coupling before the clamps are tightened for use of the coupling elsewhere. From the foregoing, it is believed that the invention may be readily understood by those skilled in the art without further description, it being borne in mind that numerous changes may be made in the details disclosed without departing from the spirit of the invention. We claim: 1. A tool for tightening and clamping around a pipe coupling a single strand of wire formed in two laterally spaced loops connected by an integral bight with the free shanks of respective loops underlying said bight, said tool comprising a frame, a threaded shaft rotatably mounted therein, a fulcrum foot projecting longitudinally from one end of said frame for pivotally engaging said bight, a pair of gripping blocks slidably mounted on said frame, one on either side of said threaded shaft for independent longitudinal movement free of the threads of said shaft, for anchoring the free shanks extending from respective wire loops, a pulling block threadedly engaging said shaft, means for rotating said shaft, and load-equalizing means connecting said pulling block to said gripping blocks, whereby, upon rotation of said shaft, said pulling block simultaneously and individually imparts to respective gripping blocks and the wire shanks anchored therein an equalized pulling force to independently tighten respective wire loops, the bodily shifting of said tool in an arcuate path about said bight after said loops are tightened serving to bend said shanks back over said bight to lock said loops in their tightened position. 2. A tool as claimed in claim 1, wherein said load-equalizing means comprises a flexible cable connected to opposite ends to respective gripping blocks, the intermediate portion of said cable being slidably supported by said pulling block. 3. A tool as claimed in claim 2, wherein said pulling block is provided with an arcuate groove for slidably receiving the intermediate portion of said cable. 4. A tool as claimed in claim 1, wherein said frame includes a pair of laterally spaced, longitudinally extending guide rails arranged to slidably support said gripping blocks and pulling block. 5. A tool as claimed in claim 1, wherein torque-limiting means are provided between said threaded shaft and its rotating means. 6. A tool as claimed in claim 1, wherein said gripping blocks are provided with passageways for slidably receiving said free shanks, and spring-urged cam means intersecting said passageways for gripping said shanks. 7. A tool as claimed in claim 6, including manually operated means for releasing said cam means. 8. A tool as claimed in claim 1, including cutting means on said frame between said fulcrum foot and gripping blocks for severing the excess lengths of the shanks of said wire loops remaining after tightening and clamping. 9. A tool for and clamping around a pipe coupling a single strand of wire formed in two spaced loops connected by an integral bight with the free shanks of respective loops underlying said bight, said tool comprising a frame consisting
of a pair of laterally spaced, longitudinally extending guide rails connected at opposite ends by a crosshead and a base member, a threaded shaft supported by and freely rotatable in said crosshead, extending between and parallel with said guide rails, a fulcrum foot projecting longitudinally from one end of said frame adjacent said base member, said fulcrum foot presenting a transverse slot on its projecting end for pivotally engaging said bight, a pair of gripping blocks slidably supported by and between said guide rails, one on either side of said threaded shaft, said gripping blocks being free of the threads on said shaft, means on said gripping blocks for receiving and anchoring the free shanks of respective wire loops, a pulling block threadedly engaging said shaft, means for rotating said shaft, load-equilizing means connecting said pulling block to said gripping blocks, whereby, upon rotation of said shaft, said pulling block simultaneously and individually imparts to respective gripping blocks and the wire shanks anchored therein an equalized pulling force to independently tighten respective wire loops, the bodily shifting of said tool in an arcuate path about said bight, after said loops are tightened, serving to bend said shanks back over said bight to lock said loops in their tightened positions, and cutting means on said frame between said fulcrum foot and gripping blocks for severing the excess lengths of the shanks of said wire loops remaining after tightening and clamping.

10. A tool as claimed in claim 9, wherein said base member includes a knife housing, shank-receiving passageways extending through said housing, a cutting knife in said housing having a cutting edge which intersects said passageways, and means for actuating said cutting knife.

11. A tool as claimed in claim 9, wherein said base member is provided with a bore running transversely of said frame, shank-receiving passageways in said base member intersecting said bore, a parti-cylindrical cutting knife rotatable in said bore having a cutting edge which intersects said passageways, and means for rotating said knife in said bore.