

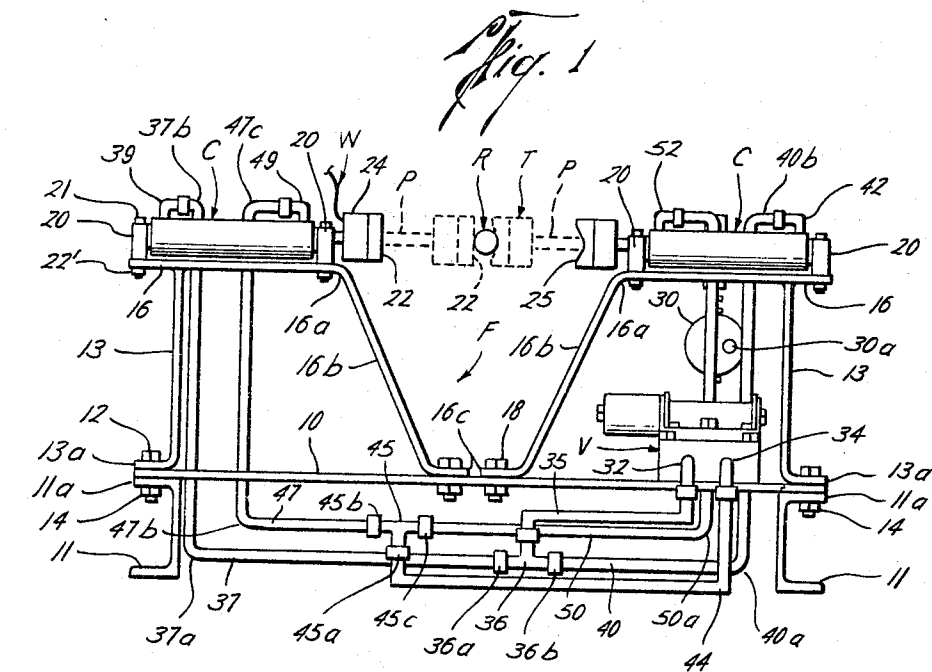
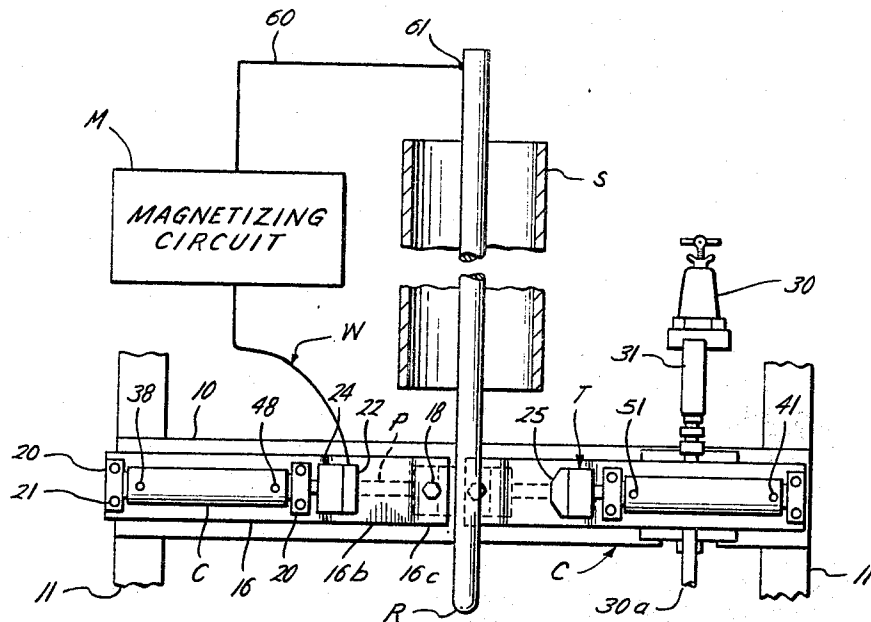
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HYDRAULICALLY OPERATED CLAMPING MECHANISM

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HYDRAULICALLY OPERATED CLAMPING
MECHANISM

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1 Claim. (Cl. 339-45)

This invention relates to a hydraulically operated clamping mechanism which clamps a metallic conductor to complete a circuit enabling current surges of 1,000 amperes or more to flow through the conductor and through a terminal block of the clamping mechanism without sparks, arcs or other damaging electrical discharges. This invention is particularly adapted for use with magnetic pipe inspection systems wherein a large current is flowed through a pipe preparatory to inspection for flaws, voids, cracks, or other structural defects.

Pipe, tubing, and other tubular members are often used and re-used in operations involving oil and gas wells, so that it is desirable to inspect such tubular members to ascertain the structural integrity of such items. Needless to say, the possible failure of a pipe during certain oil field operations is a dangerous hazard which is preferably minimized to avoid costly delays and prevent damage to equipment and injury to personnel. Therefore, mobile or portable pipe inspection systems are transported to well locations to inspect the tubular members considered for use in the drilling operations. Such inspection usually includes a magnetizing step in which a conductor is placed within the tubular member to conduct a very large surge of current axially of the tubular member to form a circumferential magnetic flux pattern in the structure of the tubular member. The conductor is usually placed in the tubular member to be inspected and connection is made thereto to complete the circuit.

An object of this invention is to provide a new and improved mechanism which clamps a conductor of large currents to complete a circuit through the conductor and the clamp.

A further object of this invention is to provide a new and improved clamping mechanism which hydraulically seizes a large current conductor and holds the conductor to form a low resistance connection therewith.

Yet a further object of this invention is to provide a new and improved clamping mechanism for clamping a conductor which is inserted through tubing, pipe, or other tubular members and adapted to conduct a large current therethrough, said clamping mechanism not interfering with insertion or removal of the conductor in the tubular member.

Still another object of this invention is to provide a new and improved clamping mechanism which securely clamps a conductor placed in a pipe, tubing or other tubular member so that current flow through the conductor and clamping mechanism will not arc or spark to pit, scar, heat or otherwise harm the tubular member.

An important object of this invention is to provide a new and improved clamping mechanism for conductors for use in a magnetic pipe inspection system in which a pair of hydraulically operated, opposed cylinders extend piston rods toward one another to abut the exterior of a magnetizing rod or conductor placed in a pipe to complete a circuit therewith.

Yet a further object of this invention is to provide a new and improved magnetizing rod clamping mechanism wherein a pair of opposed cylinders mounted on a frame is simultaneously actuated to clamp a magnetizing rod between a pair of terminal blocks to complete a circuit adapted to conduct a very large surge of current.

FIG. 1 is a front elevational view of the magnetizing rod clamping mechanism in the unactuated position with

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the actuated position represented in dotted line; and FIG. 2 is a plan view of the clamping mechanism of this invention with some of the tubing omitted for clarity and showing its relationship to a tubular member to be inspected and the magnetizing rod placed therein.

In the drawings, a frame F positions a pair of hydraulic cylinders C in a spaced apart, opposing relationship relative to one another. A solenoid valve V delivers hydraulic fluid to each of the hydraulic cylinders C to extend the piston rods of the cylinders C towards one another. Each of the piston rods carries engaging means designated generally at T and such engaging means contact the magnetizing rod R on the exterior surface to form or complete a circuit to permit a very large surge of current to flow through the magnetizing rod R and through the engaging means T which function as an electrical terminal when contact is made with the magnetizing rod R.

Considering the invention more in detail, FIG. 1 discloses a mounting plate 10 which is positioned on a pair of identical rails or frame members 11 which collectively secure the clamping mechanism of this invention in a fixed, spatial relationship relative to the magnetic pipe inspection system. The rails 11 are flanged at the upper edge 11a and have holes or openings therein for receiving the shanks of bolts designated generally at 12 which serve as fastening means to secure the mounting plate 10 to the rails 11. The bolts 12 also extend through the lip 13a of a vertical strut 13 and are made secure by nuts 14 which are threadedly engaged at the lower end of the bolts to abut the flanged edge 11a of the rails 11. The vertical braces 13 each extend upwardly from the mounting plate 10 and are attached by welding or other suitable means to relatively narrow support brackets 16. Each of the support brackets 16 is positioned in line with one another by the vertical braces 13 and extends towards the mounting plate 10 and is attached thereto. Specifically, each of the brackets 16 is bent at 16a to form an angular strut 16b which contacts the mounting plate 10 centrally thereof with a connective flange 16c. Each of the connective flanges is joined to the mounting plate 10 by any suitable means such as the nuts and bolts designated generally at 18 which securely positions the strut 16b relative to the framework F.

Each of the brackets 16 provides a mounting for one of the hydraulic cylinders C, which are preferably double acting with ports at each end. Each of the cylinders C is positioned firmly on the mounting brackets 16 by placing a yoke 20 on the flanged end of the cylinders C and bolting the yoke 20 to the brackets 16 with a bolt 21 which is threadedly engaged with a nut 22' adjacent the mounting bracket 16. Two such yokes 20 are placed on each of the hydraulic cylinders C with one of the yokes secured about the flange at the rear of the hydraulic cylinder C and the other such yoke placed about the flanged collar at the forward end of the hydraulic cylinder C through which the piston rod extends. The piston rods P of each of the cylinders C are shown in dotted line representation in FIGS. 1 and 2 to illustrate the travel of the pistons contained within the cylinders C. Each of the piston rods P may be similar to one another and has mounted at the outer end the engaging means T which engages the magnetizing rod R.

The engaging means T connected to the piston rod P on the left hand side of the drawings is basically rectangular in shape and has a contacting face 22 made of some conducting material which is adapted to form a low resistance connection with the magnetizing rod R when urged into an abutting position against the exterior of the rod R. The conducting material on the face 22 is connected to a suitable wire or conductor W which connects at the other end to a magnetizing circuit M for purposes

which will be more evident hereinafter. The conducting portion 22 of the terminal block is mounted on a backing 24 which provides structural strength and rigidity for the conducting material 22 while insulating the conducting material 22 from the piston rod P to avoid connecting voltages on the face 22 to the remainder of the apparatus. The surface 22 serves as a mating terminal T for the engaging means carried on the piston rod P of the right hand cylinder C. The right hand engaging means T has a grooved or slotted face 25 which engages the exterior of the magnetizing rod R and co-acts with the surface 22 to grip the magnetizing rod R in a manner similar to a pipe vice.

Pressure fluid is supplied to a pressure regulator 30 through an inlet port 30a from some appropriate source (not shown) and the pressure regulator 30 supplies the pressure fluid through a tube 31 to a solenoid valve V. The solenoid valve V is preferably a double acting solenoid valve having two outlet ports designated at 32 and 34. The valve V, in response to an electrical signal, responds to flow pressure fluid through either of the exhaust ports 32 or 34. Exhaust port 32 is connected to a conduit 35 which connects to a T 36 having two outlet fittings 36a and 36b. The fitting 36a is connected to a tubular member 37 which extends from the T 36 toward the left hand inspection system frame member 11 and is bent at 37a to extend parallel to the left side vertical brace 13. An inlet port 38 (FIG. 2) is provided at the rear of the left hand cylinder C and is preferably engaged with an elbow 39 which connects to the end 37b of the tubing member 37. The fitting 36b of the T 36 is connected to a pressure fluid conductor 40 which is bent at 40a and extends parallel to vertical brace 13 at the right hand side of the frame F. An inlet port 41 (FIG. 2) is located on the right hand hydraulic cylinder C to admit pressure fluid to the interior of the cylinder C to act on the piston therein and the port 41 receives an elbow 42 in leak proof engagement therewith. The elbow 42 is engaged with the upper end 40b of the tubing 40 so that pressure fluid may flow from the solenoid valve V through the tubing 35, the T 36, and the tubing 40 to act on the piston within the cylinder C.

The outlet port 34 is connected to the tubular member 44 which is connected to a T 45 which has three outlet ports or fittings, 45a, 45b and 45c. Port 45a is connected to the tubular member 44 while the port 45b is connected to an additional tubular member 47 which has an elbow at 47b and extends upward of the framework F toward the left hand hydraulic cylinder C. The left hand hydraulic cylinder C has a second hydraulic port designated at 48 near the forward end and positioned on the opposite side of the piston therein relative to the hydraulic port 38. An elbow 49 is placed in the hydraulic port 48 and is connected in a pressure tight connection with the upper end 47c of the tubular member 47. The fitting 45c of the T 45 is connected to the tubular member 50 which extends toward the right hand side of the frame F and bends at 50a to extend upwardly thereof to a point near the hydraulic cylinder C on the right hand side of the framework F. The right hand hydraulic cylinder C has an opening or inlet 51 which is connected to the tubular member 50 by means of an elbow 52 to permit entrance of pressure fluid from the tubular member 50 to the forward cylindrical chamber to act on the piston within the cylinder C.

The wire W is connected to a magnetizing circuit M to form a very large and very short surge of current in the wire W which is passed through the magnetizing rod R. The magnetizing circuit M is connected to a conductor 60 which is connected at 61 to the far end of the magnetizing rod R. The magnetizing rod R is illustrated in FIG. 2 as being a straight metallic conductor having a tubular specimen S positioned thereabout for testing which requires operation of the magnetic circuit M. The magnetizing rod R is preferably held by means (not shown)

in a fixed position relative to the clamping mechanism of this invention for reasons which will be more obvious hereinafter.

In operation, the tubular specimen S is positioned over and about the magnetizing rod R so that the surge of current generated by the magnetizing circuit M will flow through the magnetizing rod R to form a circumferential magnetic field within the specimen S to enable subsequent inspection for flaws in the specimen. Once the specimen S has been positioned as shown in FIG. 2, the clamping mechanism of this invention may be operated to clamp the magnetizing rod R and complete a circuit therewith subsequent to the formation and discharge of a large surge of current in the magnetizing circuit M. An electrical signal is applied to the solenoid valve V to operate the valve V to permit pressure fluid to flow through the port 32 and into the tube 35. The pressure fluid in the tube 35 flows to and through the T 36 and through both fittings 36a and 36b which are connected to the tubes 37 and 40, respectively. The tube 37 is connected to the port 38 of the left hand hydraulic cylinder C and pressure fluid is admitted to the port while pressure fluid flows through the tubular member 40 simultaneously to the rearward port 41 of the right hand hydraulic cylinder C. The pressure in both cylinders C acts on the pistons therein to urge the pistons through their full excursion ranges to subsequently extend the piston rods P from the cylinders as is more clearly shown in dotted line in both FIGS. 1 and 2. The engaging means T contacts the magnetizing rod R with the contacting face 22 which is made of conducting material. The magnetizing rod R is further contacted on the opposite side by the grooved or slotted face 25 of the engaging means T which seats the magnetizing rod within the groove or slot to increase or improve the surface contact with the magnetizing rod R. The grip of the two contacting surfaces 22 and 25 secures the rod in a vice-like clamping action to cause a very firm contact between the magnetizing rod R and the contacting face 22 which, as previously mentioned, is made of conducting material.

The positive engagement of the engaging means T with the magnetizing rod R brings the contacting face 22 into firm engagement with the magnetizing rod R to reduce electrical resistance therebetween to a minimum value. Such physical contact with the rod R completes a circuit through the contacting face 22 which is more fully disclosed in FIG. 2 as including the magnetizing circuit M, the wire W and the wire 60. When the magnetizing circuit M discharges to create a very large and very short surge of current within the circuit, the charge is conducted to and through the magnetizing rod R to create a circumferential magnetic field about the magnetizing rod which is concentrated in the wall or structure of the specimen S. The low resistance formed by the contact of the face or surface 22 on contact with the magnetizing rod R reduces the heat generated at such resistance when the current flows through the magnetizing rod and crosses the juncture formed with the engaging means T so that the specimen S is protected from overheating. Further, the specimen S is protected from the damage which is attributable to arcs and sparks which can possibly damage the specimen S. The firm contact of the face 22 of the engaging means T with the magnetizing rod R completely eliminates arcs and sparks, a fact which materially reduces the danger inherently found in handling currents of 1,000 or more amperes, and also reduces the possibility that escaping gases may be ignited by the spark. Further, the reduction and total elimination of sparks and arcs prevents pitting of the surface of the member of specimen S which is usually coated with plastic in the form of a thin film. The plastic coatings are useful only to the extent that they cover the surface totally and completely so that a small pit or flaw in the plastic coating destroys or reduces the utility of the entire plastic coating. It is to be noted also that the equipment automatically clamps the magnetizing rod R without the possibility of operator injury or harm.

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After the magnetizing circuit M has operated to pass a large surge of current through the magnetizing rod R, the clamping mechanism of this invention may be disconnected from the magnetizing rod to permit removal of the tubular specimen S from about the magnetizing rod R. This is customarily accomplished by actuating the solenoid valve V to flow pressure fluid through the exhaust port 34 and into the tubular member 44. The tubular member 44 is connected to the fitting 45a of the T 45 and when fluid flows through the member 44, the T 45 distributes that fluid through the fittings 45b and 45c thereof. The fitting 45b is connected to a tubing member 47 which conducts the fluid therein to the port 48 of the left hand hydraulic cylinder C. The pressure fluid in the tubing member 47 flows into the chamber of the cylinder C formed or defined by the forward face of the piston positioned therein, so that the pressure fluid may act on the forward face of the piston to urge the piston toward the rearward end of the cylinder. Consequently, movement of the piston within the left hand hydraulic cylinder C draws a portion of the piston rod P within the hydraulic cylinder C to withdraw the contacting face 22 of the engaging means T from contact with the exterior of the magnetizing rod R. The piston rod P is withdrawn to an extent which positions the contacting member 22 and the backing member 24 adjacent the hydraulic cylinder C as is more clearly shown in the solid line in FIGS. 1 and 2. Simultaneously therewith, pressure fluid is conducted from the T 45 through the fitting 45c into the conductor 50 which is secured at its upper end to the elbow 52 having a passage there-through entering into the forward port opening 51 of the right hand hydraulic cylinder C. The fluid admitted to the port 51 acts on the piston within the cylinder to urge the piston through its full scope of travel to withdraw the piston rod P (represented in dotted lines) to the solid line position which breaks contact of the grooved face 25 with the magnetizing rod R. Since both of the engaging means T are returned to the positions illustrated in full line, the magnetizing rod is free of contact forward of the specimen S so that the specimen S may be moved longitudinally of the magnetizing rod R to free the specimen S of engagement with the magnetizing rod R. This is particularly aided by the fact that the stroke of the piston rods P opens a span of adequate width within the framework F to permit the specimen S to pass therethrough if such is necessary. Further, the simultaneous withdrawal of the terminal blocks contacted against opposite sides of the magnetizing rod R prevents the magnetizing rod R from being bent or misaligned resulting from unbalanced forces applied to the end of the magnetizing rod R which is cantilevered into space.

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Certain alterations may be incorporated in the invention without departing from the spirit thereof. For example, the engaging means T may be altered in number and shape to grasp or contact the magnetizing rod R more or less firmly as the need may arise. Likewise, the hydraulic cylinder C may be altered in position and number to increase or decrease engagement of the terminal blocks T with the magnetizing rod R. Also, the source and distributing system for the pressure fluid may be replaced with other actuating means such as electrically operated solenoids or the like. Of course, the frame F may take any form adequate to hold or secure the hydraulic cylinder C in a controlled, spatial relationship relative to the magnetizing rod R and the specimen S.

Broadly, this invention relates to a clamping mechanism and associated equipment which firmly contacts a conductor for carrying a large current to complete a circuit therewith so that current may flow through the conductor and the clamping mechanism without creating arcs, sparks or other damaging electrical discharges.

What is claimed is:

A clamping mechanism for clamping a metallic rod-like conductor to thereby complete a circuit, comprising:

- (a) a pair of opposed, in line double-acting cylinders having openings therein facing one another;
- (b) a piston positioned in each of the cylinders;
- (c) a piston rod connected to each of the pistons and extending through the openings in the cylinders;
- (d) a terminal block of conducting material carried on the end of one of the piston rods;
- (e) engaging means on the end of the remaining piston rod for engaging metallic conductor, said means including a grooved surface extending fully across the face thereof for gripping the rod-like conductor;
- (f) source means for supplying pressure fluid to the cylinders to extend and withdraw the piston rods to clamp and unclamp the conductor between the terminal block and engaging means; and
- (g) circuit means connected to the terminal block and adapted to electrically cooperate with the conductor.

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