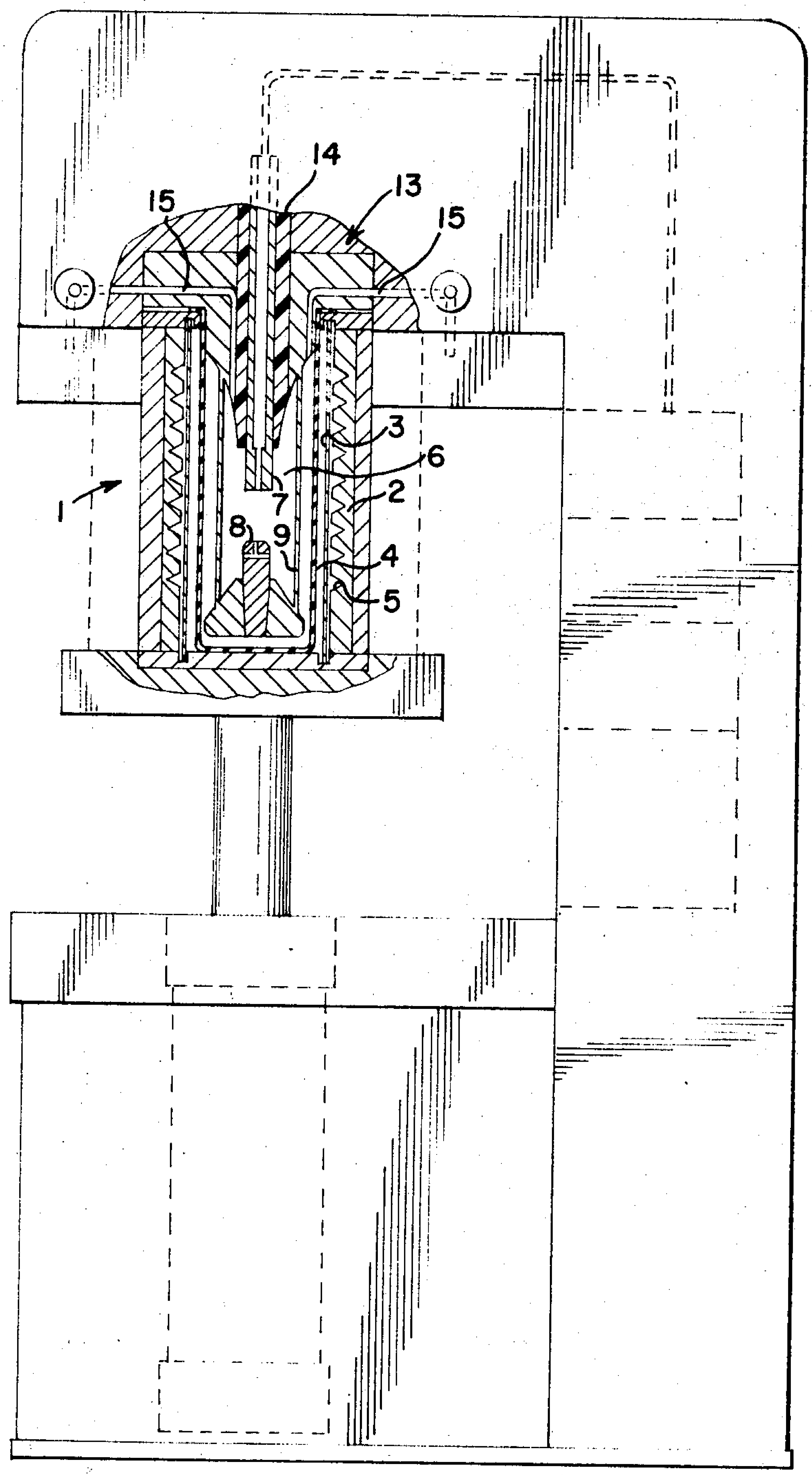
March 2, 1971 R. W. NORIN ET AL 3,566,648

PULSED LIQUID WIRE-ELECTROHYDRAULIC SYSTEM

Filed Sept. 25, 1968 4 Sheets-Sheet 1

FIG. 1



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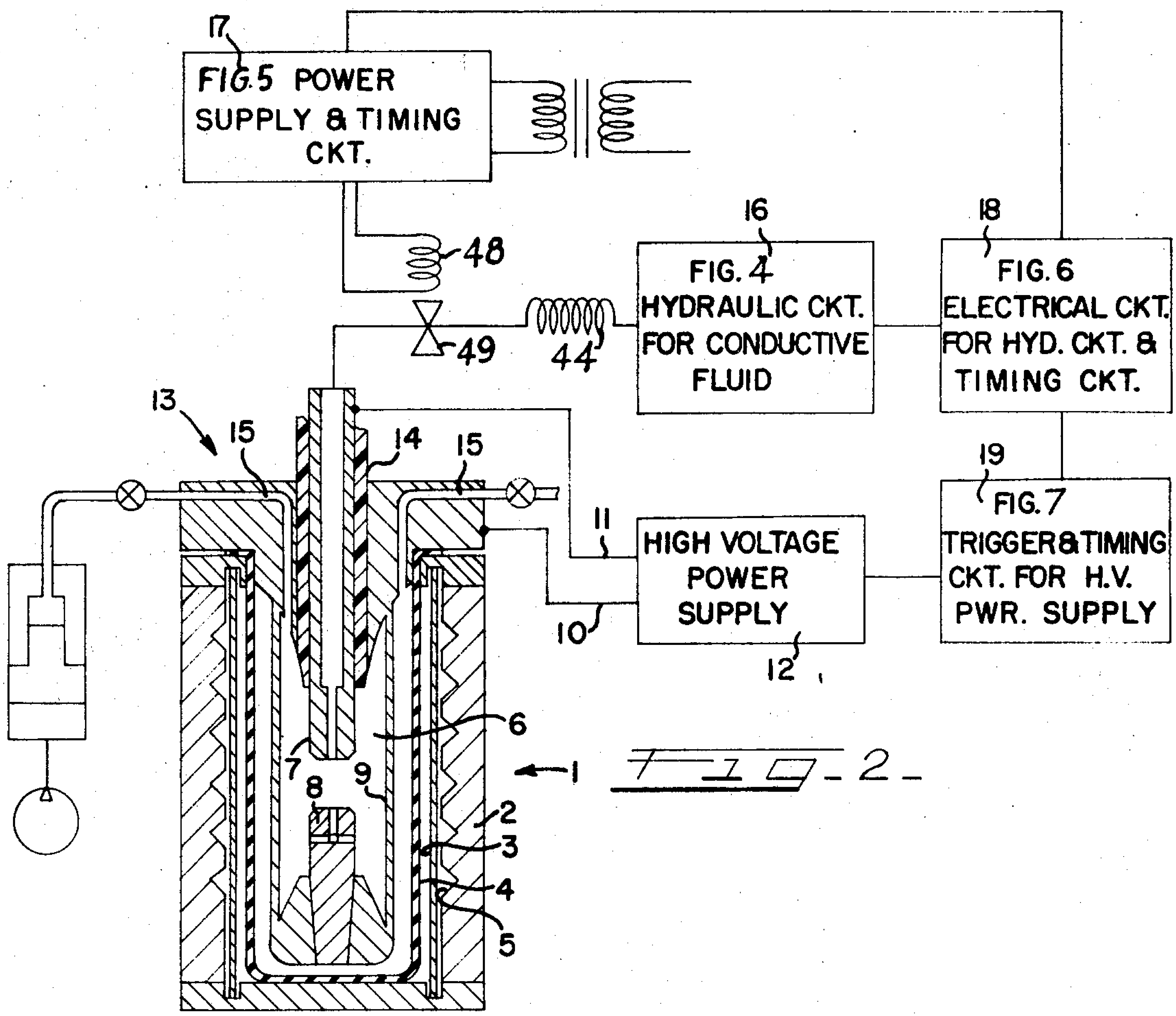

FIG. 2

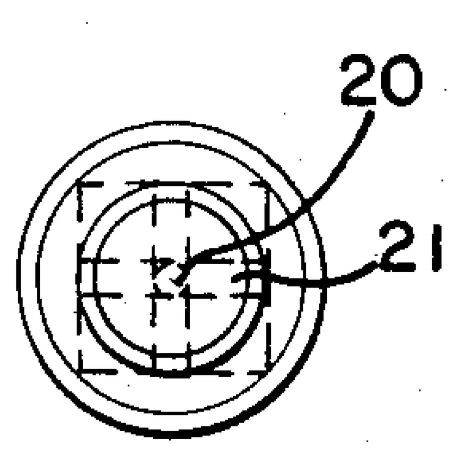

FIG. 3A

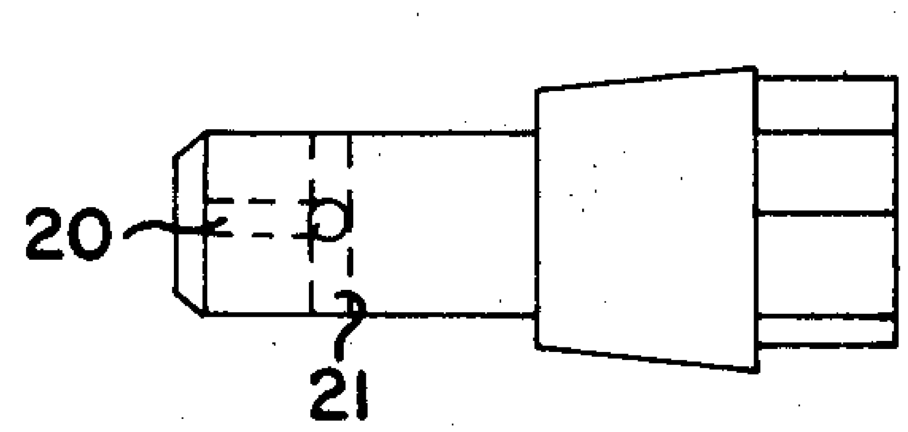

FIG. 3B

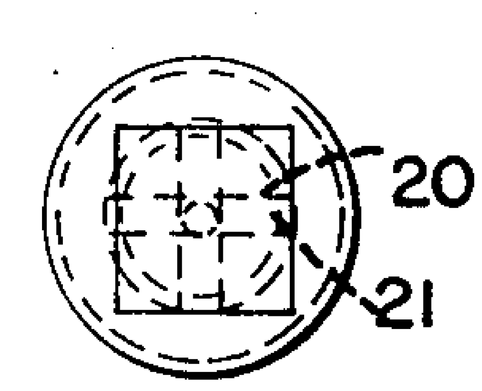

FIG. 3C

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PULSED LIQUID WIRE-ELECTROHYDRAULIC SYSTEM

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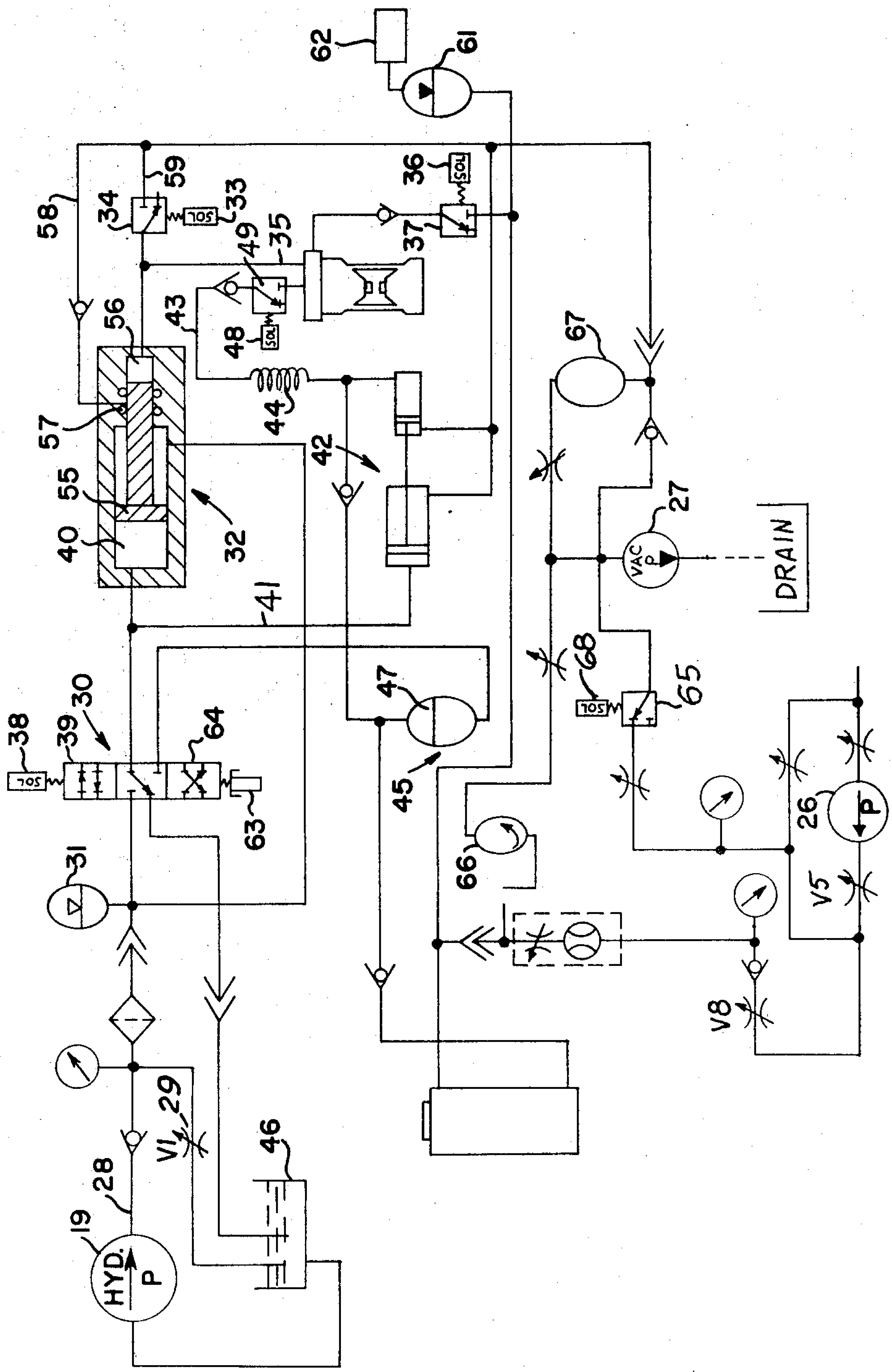

FIG. 4

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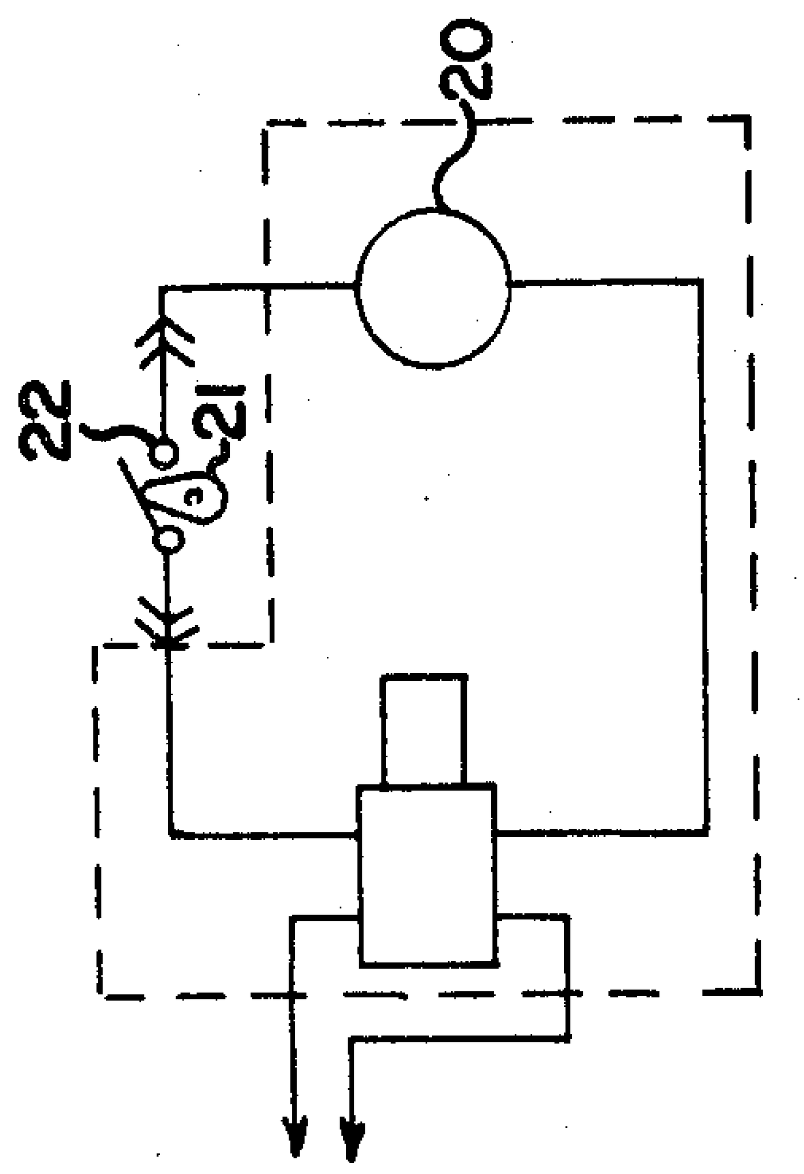

FIG. 6

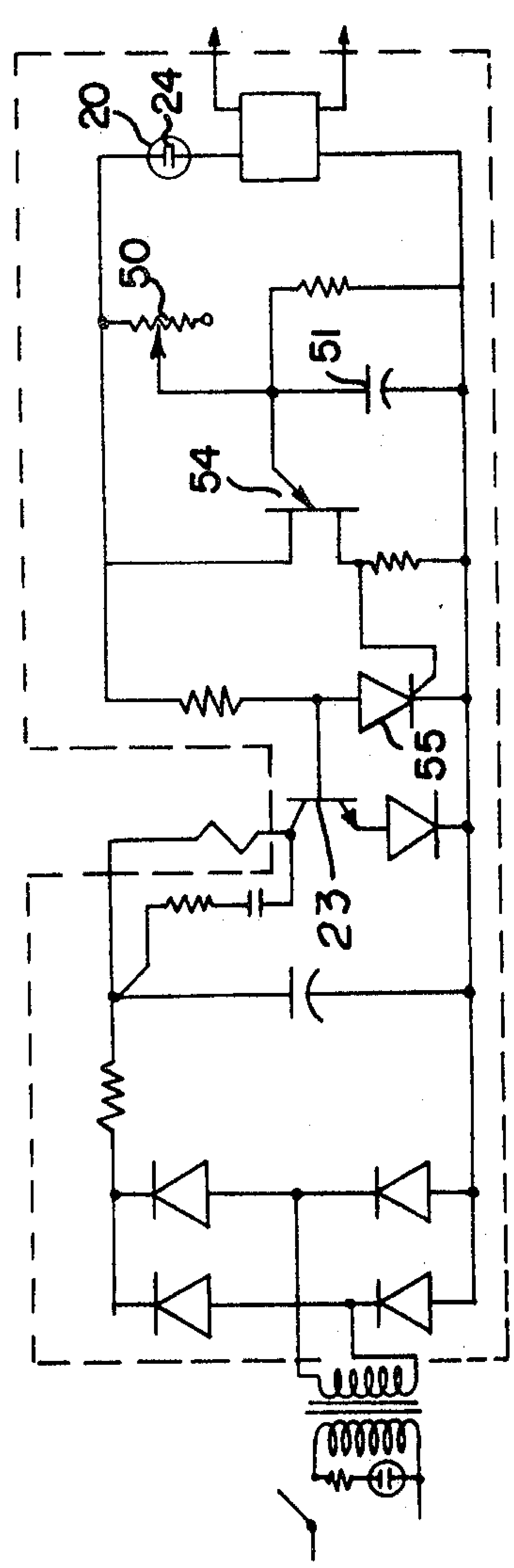

FIG. 5

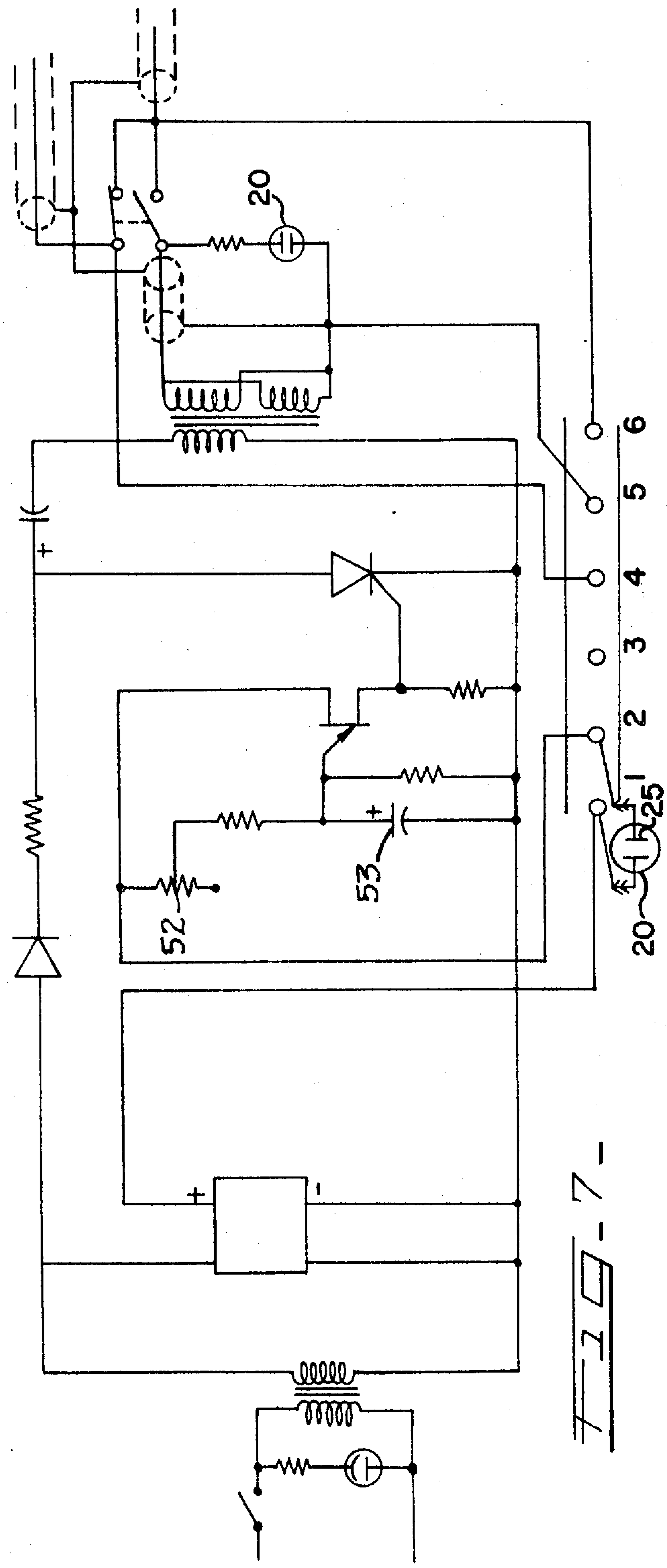

FIG. 7

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PULSED LIQUID WIRE-ELECTROHYDRAULIC SYSTEM

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Int. Cl. B21d *26/08*

U.S. Cl. 72—56 19 Claims

ABSTRACT OF THE DISCLOSURE

An electrohydraulic container forming device wherein a thin stream of conductive fluid constitutes a bridge between one electrode and the other of the shock producing electrodes. The conductive liquid is pressurized to a higher value than the internal pressure of the container. In operation the conductive liquid is emitted under pressure from one electrode by a timing circuit driving a shear type solenoid valve. A second timing circuit synchronizes the electrical discharge with the establishment of a preferentially conductive bridge across the electrode gap. A sharp jet pulse is given off from the arc thus established and this develops pressure inside the rubber diaphragm to press it against the container which is then pressed into the interstices of the die to give a fully stylized container.

Our invention relates to a conductive bridge forming device and particularly to an electrohydraulic forming device wherein the bridge is formed by an intermittent supply of conductive liquid under pressure.

The use of electric arcs for metal forming or working processes has been known for some years, however, the establishment of a preferential conductive pathway is of relatively recent origin and has been essentially limited to the use of bridge wires. In the process of forming an electrohydraulic arc the bridge wire is destroyed and before another arc can be established, a new bridge wire must be placed between the electrodes.

It is an object of our invention to provide an intermittent preferential conductive current path.

It is another object of our invention to provide a means for controlling the application of the conductive fluid to the electrode gap.

It is an object of our invention to provide an intermittent conductive bridge between electrodes.

It is another object of our invention to provide a dispersing electrode to prevent high conductivity in the surrounding gap area.

Another object is to provide a preferential conductive pathway which may be renewed without disassembly of the apparatus.

Another object of this invention is to provide an electrohydraulic forming operation of high and repeatable efficiency.

In brief, our invention is to a preferential conductive fluid path for spark discharge between cathode and anode immersed in a non-conductive or less conductive liquid than the conductive liquid for the preferential path. The liquid flows from one electrode through a small intervening space to another electrode. A high voltage, high amperage power supply is connected across these electrodes so as to fire synchronously with the pulses of the conductive liquid.

These and other objects will become apparent from the following description and drawings in which:

FIG. 1 is a representation of the electrohydraulic stylizing machine showing the machine partly in section and partly broken away.

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FIG. 2 shows the relationship of the electrical circuits, the pressure chamber and the die.

FIG. 3 shows the lower electrode in three views, A, B and C.

FIG. 4 shows a schematic of the machine hydraulic circuitry and the hydraulic conductive fluid circuit.

FIG. 5 shows a timing circuit for the conductive fluid pulse.

FIG. 6 shows a D.C. power supply and initiation circuit for the circuits of FIGS. 5 and 7.

FIG. 7 shows an electrical trigger and timing circuit for firing of the high voltage power supply.

FIG. 1 shows the electrohydraulic chamber **1** of this invention placed in a forming apparatus. This invention is adapted to be used as the electrohydraulic forming apparatus in any one of a number of machines for forming tubular workpieces.

The electrohydraulic bag or boot **4** of FIG. 2 is shown surrounded by a stylized die **2**. The side of a tubular container **3** is located between the chamber wall **4** and the inside die wall **5**. The outer wall of the chamber is made of rubber or some other durable elastomeric material to form a bag. A relatively incompressible, nonconductive liquid, such as water, which transmits pressure is used to fill the chamber. As shown, two electrodes are mounted within the chamber, one electrode **7** is suspended from the top into the chamber and the other **8** is mounted on pillars **9** and extends upward from the bottom of the chamber. The lower electrode **8** is connected to one side **10** of the high voltage power supply. Another electrode **7** is connected to the other side **11** of the high voltage power supply **12** and the entire chamber **4** fits inside the die **2** as a sort of plug device. The upper electrode **7** is separated from metal plug element **13** by an electrical insulator **14**. Passages **15** are provided through the plug device for the water or other media to be conducted into and out of the chamber.

The electrodes may be in any configuration or position relative to each other so long as a preferential conductive bridge is established between them in a manner similar to that indicated below.

In operation the jet which streams out of the upper electrode **7** and passes down into the lower electrode **8** forms a bridge. This jet is powered from the hydraulic circuit **16** for conductive fluid and is synchronized with the current discharge from the high voltage power supply **12**. It is not necessary for the bridge to be completely formed as long as a preferential path is established for the flow of electricity. The conductive bridge between the electrodes must be formed to the extent that a preferential pathway for electricity is established before the high voltage power supply **12** is connected across the bridge. The timing for the hydraulic circuit **16** is controlled through the electrical circuitry generally indicated **17** and **19′** while the synchronous timing is controlled through the circuit generally indicated **18**.

The structure of the lower electrode **8** which serves a dual purpose is shown clearly in FIGS. 3A, B and C. This electrode is generally the cathode because the anode is placed in the upper position to be more accessible for replacement. When the electricity arcs between the electrodes the anode erodes more rapidly than does the cathode.

The lower electrode **8** serves as a dispersing electrode with channels **20**, **21** located so that the thin stream of conducting liquid which is jetted from the channel in the upper electrode toward the lower electrode is passed through channel **20** in the lower electrode and deflected toward the side through channel **21**, in this way the liquid bridge is the only concentration of conductive liquid in the region between the electrodes. The electric current passes from one electrode through the conductive bridge to the other electrode and the pressure waves generated by successive arcings have similar shapes and pressures because they are generated under similar conditions.

The hydraulic circuit 16 is controlled by an electrical circuit having a switch (not shown) to turn on the pumps in the hydraulic circuit. When the hydraulic pump 19 (FIG. 4) commences operation the pressure throughout the circuit builds up. Electric switches and solenoid operation may be controlled by a series of cams mounted on a rotating shaft or alternatively may be controlled by an electrical time delay circuit. In any case the control relay 20 shown in FIG. 6 operates when the cam 21 shown in FIG. 6 closes the normally open conductive fluid bridge initiator switch 22 which activates contacts 24 of the conductive fluid timing circuit shown in FIG. 5 and the contacts 25 of the high voltage power supply time delay circuit shown in FIG. 7 thus allowing these timing circuits to begin operation.

The circuits connected to these relay contacts provide a time delay for establishing the conductive bridge and a time delay for switching the power supply to the electrodes to form an arc through the conductive bridge. The time delay circuits may be varied as pointed out later in this specification to allow the electric current and the conductive bridge to be applied across the electrode gap in a predetermined time relationship.

The hydraulic circuit is shown schematically in FIG. 4. There are basically three systems involved in the hydraulic circuit. One is the oil system used for applying pressure to the conductive fluid system, another is the conductive fluid circuit in which the conductive fluid is finally jetted through an electrode on an intermittent basis to provide a preferential power supply discharge across the electrodes and the third is the pressure transmission and flushing system.

To start the stylizing machine hydraulic pump 19, water pump 26 and vacuum pump 27 are all turned on. When the hydraulic pump 19 begins operation a high pressure is built-up in its exit conduit 28. The pressure is controlled by valve 29 and in practice ranges about 550 p.s.i. or higher. Since the master valve 30 is in its normal position no oil pressure is passed through it. Thus, accumulator 31 which has a precharge of fairly high pressure of air in it is now compressed. This pressure is passed to the oil side of the intensifier 32.

Each accumulator has a diaphragm between its fluids to avoid aeration of dissimilar fluids.

Starting from the situation in which the plug or stylizer has just completely stylized the can i.e., the can has been pre-pressurized and coined. The can is now taken out of the machine and the following operation takes place.

First, all solenoids except solenoid 33 are de-energized. Solenoid No. 33 is energized and valve 34 is opened. In this situation the bag 4 or rubber diaphragm surrounding plug 13 has suction applied through conduit 35 by the vacuum pump 27. While the bag is being evacuated by the vacuum pump an unformed can is placed around the bag and the forming die 2 closes around the bag and can. The die holds the can securely in place.

Now solenoid 33 is de-energized and its valve 34 closed while solenoid 36 is actuated, and valve 37 is opened. Water pressure from the water pump 26 fills the bag with water under pump pressure. This pressure is regulated by V5, V8 and other pressure regulators.

To complete this cycle the solenoid 36 is de-energized as are the other valves and the chamber formed by the bag is cut-off from all other pressures.

Solenoid 38 is now energized and valve 39 of the master valve 30 is open in the circuit. All other valves are de-energized. The 550 lbs. pressure in accumulator 31 is now connected to the oil chamber 40 of intensifier 32. A somewhat higher pressure of about 600 lbs. will come out of intensifier 32 and pre-pressure the container at about 600 p.s.i. At the same time the 550 lbs. pressure

passes through conduit 41 to tandem cylinder intensifier 42 and generates a conductive solution pressure of approximately 1,000 p.s.i. in the 40′ insulation hose 43. This hose is in a coiled form 44 to act as an impedance to the passage of electric circuit through it. When the pump pressure of about 60 p.s.i. is applied to the chamber any air which may be entrapped between the bag and the tubular workpiece is totally eliminated and the machine is in condition so that when the subsequent very high pressure is put on the inside of the chamber the tubular side of the can is pressed into the die to rough form the can into the general configuration of the die. Any air which may be entrapped between the can and the die is minimized. Concurrently, the oil side of accumulator 45 is connected to the oil reservoir through the master valve configuration 39 so that the conductive solution 47 under pressure flows into the accumulator 45 to replenish the supply. The conductive solution is under a pressure of approximately 60 p.s.i. In the pre-pressuring step the can is loaded with a pre-pressure of less than the ultimate internal pressure but high enough to rough form the can into the general contour of the die.

After the can has been pre-pressured a quite high pressure is applied to the inside of the can so that it is forced against the die to form an almost exact replica of the die i.e. the can is coined. To bring about the high pressure a preferential conductive pathway of conductive liquid is formed between the electrodes 7 and 8 and a quick surge of electric current is passed through the preferential conductive pathway to form an arc and generate a pressure wave. Contact relay 20 of FIG. 6 is activated to effect closing of their respective contacts 24 and 25 when switch 22 of FIG. 6 is closed by the revolving cam 21. Time delay circuits 19′ and 17 (FIGS. 5 and 7) are regulated in such a manner as to allow solenoid 48 to open the wire jet initiator valve 49 before electrical power or potential is applied across the electrodes 7 and 8. In this way, the preferential path bridge is established before electrical potential is applied across the electrodes.

The volume of the conductive liquid in the bridge is small and the resilience of the conduit and hose is sufficient to provide an accumulator effect of this magnitude. If higher volumes of conductive liquid are needed a hydraulic accumulator may be installed.

Contacts 25 of the time delay trigger circuit (FIG. 7) closes as the same as contacts 24 of the conductive fluid (FIG. 5) timing circuit as pointed out above. However, these circuits do not actuate their operators at the same time because the variables of the time delay trigger circuits are adjusted so that the time delay trigger circuit 19′ of the power supply fires a thyratron and ignitron (not shown) in electrical circuit at a predetermined time interval after the electrode hydraulic liquid wire jet initiator valve 49 has opened to cause the preferential pathway to be formed. In this connection it is noted that the variable resistor 50 and capacitor 51 of FIG. 5 may be varied to whatever value is necessary to cause their respective circuits to operate at a predetermined time after the initial closing of the contacts 24 in the circuit. Similarly, the time delay trigger circuit (FIG. 7) has a variable resistor 52 and capacitor 53 which may be varied to cause this circuit to operate a predetermined time after solenoid 48 has opened the wire jet initiator valve 49.

The operation of the relaxation circuit of FIG. 5 is as follows. Once the relay contacts 24 close in the timing circuit, transistor (2N3055) 23 becomes conductive and allows current to flow through solenoid 48 to open valve 49 (FIG. 4) because of the voltage increase across silicon rectifier 55 (SCR–C6B). Once voltage is built-up across the capacitor 51 (10 mfd.), transistor 54 (2N489) becomes conductive causing silicon rectifier 55 (SCR–C6B) to become conductive and reduce the voltage across it. The net effect of this relaxation circuit is to give a timed pulse to the solenoid 48 and cause solenoid valve 49 to be open only during such period of times as is required to bring about a preferential pathway for electric current between the electrodes.

The operation of the relaxation circuit of FIG. 7 is essentially the same as that of FIG. 5, with the exception that the output pulse generated from the trigger circuit for the power supply is delayed until such time that the preferential conductive bridge is established across the electrode gap.

The power supply has now discharged across the electrodes and has formed a pressure wave having a steep front which pressed against the bag side and coined the pre-pressurized tubular material into the surrounding die.

Solenoid **38** is now de-energized and the master valve **30** returns to normal. The intensifier piston **55** now goes to the left since its left side is connected to the oil reservoir **46** at atmospheric pressure and its right side is connected to the accumulator **31** with a pressure of 450 p.s.i The solution inside the chamber goes a part way up the conduit **35** between the intensifier and the chamber and water from the conduit fills space **56**. The change of volume of the space **56** is less than the volume of the conduit **35** so that the debris and other impurities are drawn up into the conduit **35** but not into space **56**. The volume of the space **56** is larger than the amount of water used to pre-pressure the can because intensifier **32** pre-pressures the can to give it its initial rough forming. Dies vary in contour and the amount of water necessary to give a rough forming varies depending on the contour of the die. Thus different intensifiers may be used with different dies depending on the die contour to give a different intensifier space **56**. Oil and water may leak past O-rings **57** as the piston **55** works back and forth. The leakage is conducted away by mixture drain **58**. The bag size, however, is somewhat shrunk due to the forces now acting on it since the outside is connected to atmospheric pressure and the inside is under negative pressure through the lines **35**, **59** and **60**. Thus the bag is shrunk around its supporting framework.

After the shock has been formed, gas bubbles remain in the liquid and a certain amount of debris from the electrodes is carried into the chamber. If air bubbles are allowed to remain in the chamber they cause softening of the shock wave and the coining effect is small. The electrode debris if allowed to remain in the chamber, detrimentally affects the electrical characteristics of the material filling the chamber. To avoid these results the chamber is flushed with fresh water after each firing. By energizing solenoids **33** and **36** and opening the connected valves fresh water from the pumps passes in through valve **37** and out through valve **34**. The amount of water passed in through valve **37** is as nearly as possible balanced by the amount passing out through valve **34**. If a greater amount of water comes into the bag that is passed out of it, the bag will expand.

Since it is difficult to exactly balance the water coming in with the water going out, now valve **37** is closed and vacuum applied through valve **34** evacuates the bag again so that the bag is shrunk onto the framework **9** (FIG. 2). The speed of response of the system is heightened by the reservoir **61**. Reservoir **61** is under a base pressure of 20 p.s.i. of air from the air pump **62**. Water pump **26** delivers a higher pressure of about 60 p.s.i. used for flushing the chamber. Thus reservoir **61** and its air are usually under a pressure between 20 and 60 p.s.i. depending on the degree of exhaustion of water from the reservoir.

At the same time or immediately after the bag is shrunk onto the framework, solenoid **3** moves the master valve **30** to configuration **64**. Intermediate pressure of about 550 p.s.i. is thus applied to the oil side of intensifier **32** and 550 p.s.i. is applied to the larger cylinder of intensifier **42** for replenishment.

When configuration **64** of the master valve **30** is actuated. 550 p.s.i. is applied to the oil side of the accumulator **31**. The oil in the accumulator is replenished. This in turn will apply 550 p.s.i. to the conductive solution **47** in top of the accumulator **45** and this brine will apply about 550 p.s.i. to the smaller cylinder of the tandem cylinder **42** to replenish the brine in the tandem cylinder intensifier.

Finally to complete the cycle the master valve **34** is returned to normal by de-energization of solenoid **63**, the dies are withdrawn from around the stylized can and the stylized can drops off of the shrunk bag.

The cycle is now ready to be repeated again.

The can stylizing machine and its electrohydraulic chamber may operate to stylize many cans per minute. Thus the cycle set forth above is repeated many times per minute. Any device may be used to make and break the conductive fluid bridge initiator switch **22** (FIG. 6) to start and stop each cycle. For example, an off center cam may be synchronized with the stylizing machines operation to open and close the circuits and to move the valves. The valves may be spring loaded to return the valves to their original position after the can has passed. The pumps run continuously. To avoid burning out of the vacuum pump, valve **65** opens when valve **34** closes and vice versa. In this way a small amount of material is passed into the vacuum pump at all times during operation of the machine.

Tanks **66** and **67** are air collection tanks. As pointed out above, air in the water lessens the effectiveness of this machine particularly and slows the speed of response of any hydraulic machine. Tanks **66** and **67** are mounted at the top of the machine in such a way that air included in the water supplied to the system finds its way into the top of these tanks and is bled from time to time.

To summarize the system operation:

(1) Chamber evacuation step
SV**63**, **38**, **48**, **36** and **68** de-energized
SV**33**—energized
(2) Fill chamber cycle (pick up new can over bag, dies close around bag and can)
SV**63**, **38**, **48**, **33** and **68** de-energized
SV**36**—energized
(3) Cutoff
SV**36** de-energized
(4) Bulge or pre-pressure can
SV**38**—energized
(5) Pulse for preferential conductive path and power supply electric discharge
Electrical timing circuits commence
SV**48** energizes momentarily to form a preferential conductive pathway
High voltage circuit fires to supply sharp electric discharge and coin can
(6) Evacuate bag
SV**38** de-energized, master valve back to normal
(7) Flush-out explosion chamber
SV**33** and **36** energized
(8) Vacuum applied to evacuate chamber and to shrink bag to framework
SV**36** de-energized
SV**33**, **63** energized
(9) System recharged by step above
SV**63** deenergized
(10) Cycle completed
Master valve to normal, dies withdrawn, stylized can dropped off.

It is apparent from the above that the chamber is pre-pressurized to rough form the can before a conductive solution is fed through electrode **7** (FIG. 2) to form a preferential bridge circuit. Fresh water is put under pressure through intensifier **32**, and sufficient pressure is applied to the side of the can wall to rough form it into the surrounding die **2**.

A first advantage is that by pulsing the conductive solution across the electrodes there is a saving of conductive solution.

A further advantage is that the establishment of a preferential path causes the arc to take place at the same place and with the same strength and pattern each time.

Another advantage is that the use of a dispersing electrode prevents accumulation of highly conductive materials throughout the gap area.

Another advantage is that many cans per minute may be turned out by this machine.

Another advantage is low consumption of salt.

A final advantage is higher energy conversion efficiency compared to conventional electrohydraulic arc discharge.

The foregoing is a description of the illustrated embodiment of the invention and it is applicants' intention in the appended claims to cover all forms which fall within the scope of the invention.

What is claimed is:

1. An electrohydraulic forming apparatus including a means defining a die cavity having an entry opening therein in combination with:

a means defining an elastomeric boot having two electrodes therein for insertion into said opening;

a high voltage power supply;

a trigger circuit for intermittently connecting said high voltage power supply across said electrodes at spaced intervals of time;

a hydraulic circuit for pumping electrically conductive fluid having means for establishing at spaced intervals of time a preferential electric current path of electrically conductive fluid between said electrodes in repetitive synchronism with the triggering of said high voltage power supply.

2. In an electrohydraulic forming apparatus as set forth in claim **1** in which:

one of said electrodes has a channel through it for passing a stream of fluid, and

the other of said electrodes has a means for dispersing said stream of fluid and causing it to mix with the surrounding liquid.

3. In an electrohydraulic forming apparatus for forming a tubular element including a means defining a die cavity having an opening therein, the combination of:

a means defining an elastomeric boot having means mounting two electrodes in a first fluid therein to be fitted into said die opening and about which a tubular element is adapted to be exteriorly telescopically positioned,

one electrode of said pair of electrodes having a channel therethrough for the passage of a second fluid of higher conductivity toward a second electrode,

a voltage supply source for supplying a high voltage,

a triggering circuit for automatically intermittently applying said voltage across said electrodes, and

a hydraulic circuit for pumping said second fluid through said channel synchronously with said triggering circuit.

4. In an electrohydraulic forming apparatus for forming a tubular workpiece as set forth in claim **3** in which:

said electrode mounting means comprises,

a plug adapted for insertion into said opening and having electrically conducting means for conducting electric current through said plug, and

electrically conductive support means attached to said plug for supporting said second electrode and forming an electrical connector between said plug and said second electrode.

5. In an electrohydraulic forming apparatus for forming a tubular workpiece as set forth in claim **3** in which:

the second electrode of said pair of electrodes is a dispersing electrode having a longitudinal channel extending part way along its longitudinal axis and having channel means extending laterally from said longitudinal channel whereby said second fluid passes into said longitudinal channel means and is dispensed outwardly through said channel means.

6. A fluid circuit for an electrohydraulic machine for forming tubular workpieces comprising:

a flexible forming chamber,

means mounting two electrodes in said chamber,

a hydraulic pressuring system for applying pressure to the interior of the flexible forming chamber to fill it out with fluid so that no air exists between the chamber and the workpiece to be formed and to flush the flexible forming chamber,

a conductive fluid system for applying pressure to a conductive fluid to cause it to jet intermittently from a first electrode and form a conductive bridge between said first electrode and the second electrode, and

a vacuum system for evacuating said chamber to eliminate debris and in order that said workpiece may be removed from adjacent said chamber.

7. A fluid circuit for an electrohydraulic forming machine as set forth in claim **6** in which said hydraulic pressuring system comprises:

a first source of hydraulic pressure,

a first intensifier for changing the pressure from said source and connected to said chamber to apply a pre-pressure to the interior of the chamber so that said workpiece is started and said chamber fits snugly against said workpiece;

a second intensifier for doubling the pressure of said pressure source having its input connected to said source and having its output connected to said conductive fluid system to impart pressure to said system,

a second source of hydraulic pressure of less intensity than said first source connected to said chamber for flushing said chamber of residues formed during arcing of electric current through said conductive bridge.

8. A fluid circuit for an electrohydraulic forming machine as set forth in claim **6** in which:

said conductive fluid system comprises:

a source of conductive fluid,

means for connecting said conductive fluid source to one of said two electrodes whereby a current of conductive fluid is jetted between said first and second electrodes,

a valve means in said connecting means for disconnecting said fluid source from said electrode, and

means for applying high pressure to said conductive fluid, whereby when high electrical potential is applied across electrodes an electric arc is generated between said electrodes.

9. A fluid circuit for an electrohydraulic forming machine as set forth in claim **8** in which said connecting means comprises:

hydraulic tubing having a one-way valve located in said tubing near said electrode whereby conductive fluid flows in the direction of said electrode and is stopped in the reverse direction.

10. A fluid circuit for an electrohydraulic machine for forming tubular workpieces as set forth in claim **6** in which said vacuum system comprises:

an evacuation pump,

a conduit connected between said evacuation pump and the inside of said chamber whereby said chamber is evacuated by said pump, and

hydraulic valve means positioned in said conduit to connect and disconnect said pump from said chamber.

11. A fluid circuit for an electrohydraulic machine as set forth in claim **7** in which said conductive system comprises:

a source of conductive fluid,

means for connecting said conductive source to a first electrode of said two electrodes whereby a current of conductive fluid is passed between said first and a second electrode, valve means in said connecting means for connecting or blocking said source from said electrodes, and

means connecting said conductive source connecting means to the output of said second intensifier whereby the pressure of the conductive fluid at said first electrode is substantially the same as that at the output of said second intensifier, and

said conductive connecting means comprises a tubing having a coil as part of its means whereby voltage is blocked from escaping from the electrodes into the rest of the hydraulic circuit.

12. A fluid circuit for an electrohydraulic machine as set forth in claim **11** in which:

hydraulic accumulator means is connected to said conductive connecting means for insuring a nearly constant supply of conductive fluid under high pressure.

13. In an electrohydraulic forming apparatus for use with a die cavity having an entry opening the improvement comprising:

a chamber having elastomeric walls and two electrodes mounted therein one above the other for fitting into said opening and about which a tubular element is adapted to be exteriorly telescopically mounted;

means for supplying a high voltage on an intermittent basis across said electrodes;

means for establishing an intermittent preferential electric current path between said electrodes in synchronism with the application of said high voltage power supply.

14. A method of electrohydraulically forming a tubular workpiece into a surrounding die comprising the steps of:

evacuating liquid from an elastomeric chamber,

mounting a tubular workpiece about said chamber,

pressuring and adding to the liquid in the chamber until air is eliminated from the space between the chamber and the workpiece,

pressuring the liquid in the chamber to a higher pressure until air is eliminated between the workpiece and the die and said workpiece is rough formed into the die,

establishing an intermittent preferential electric conductive pathway between electrodes mounted in said chamber, and

arcing an electric current across said electrodes at about the same time as said conductive pathway is formed to give a pressure wave, and repeating the above steps.

15. A method of electrohydraulically forming a tubular workpiece into a surrounding die as set forth in claim **14** with the additional step of:

closing dies around said tubular workpiece after mounting the tubular workpiece about the chamber.

16. A method of electrohydraulically forming a tubular workpiece into a surrounding die as set forth in claim **15** comprising the additional step of:

flushing out the interior of said elastomeric chamber to eliminate debris and gas from the interior of said elastomeric chamber.

17. A method of electrohydraulically forming a tubular workpiece into a surrounding die as set forth in claim **16** with the additional step of:

applying a vacuum source to the interior of said elastomeric chamber to shrink the chamber onto the framework supporting the electrode structure.

18. A method of electrohydraulically forming a tubular workpiece into a surrounding die as set forth in claim **17** with the additional step of:

removing the stylized tubular workpiece from around the chamber.

19. A method of electrohydraulically forming a tubular workpiece into a surrounding die comprising the steps of:

applying suction to the inside cavity of an elastomeric chamber,

mounting a tubular workpiece about said chamber,

adding to the fluid in the boot until air is eliminated from the space between the chamber and the workpiece,

pressing the fluid in the chamber to a higher pressure until air is eliminated between the workpiece and the die and said workpiece is rough formed into the die,

jetting a conductive fluid between electrodes mounted in said chamber, and

applying an electric current across said electrodes at about the same time that said conductive fluid is jetted across said electrodes to form an electric arc.

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