Feb. 24, 1953 F. J. VARGO 2,629,766

SOLENOID OPERATED ACTUATOR

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Fig. 1.

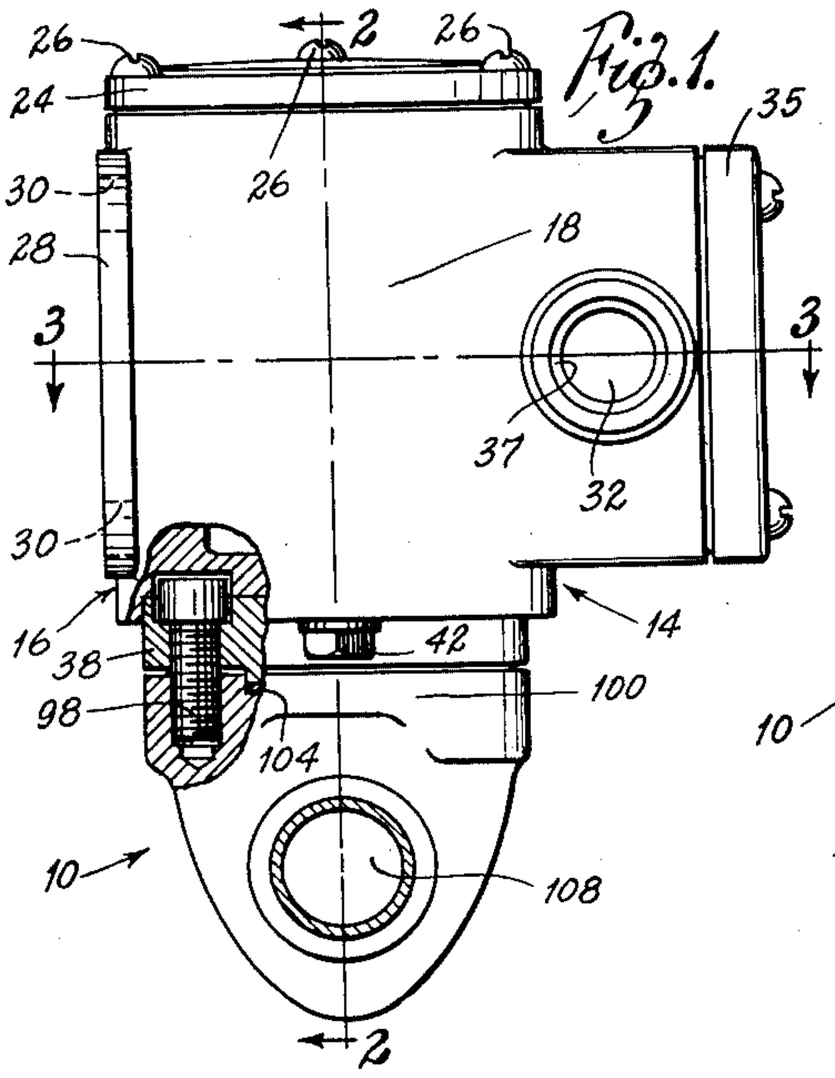


Fig. 2.

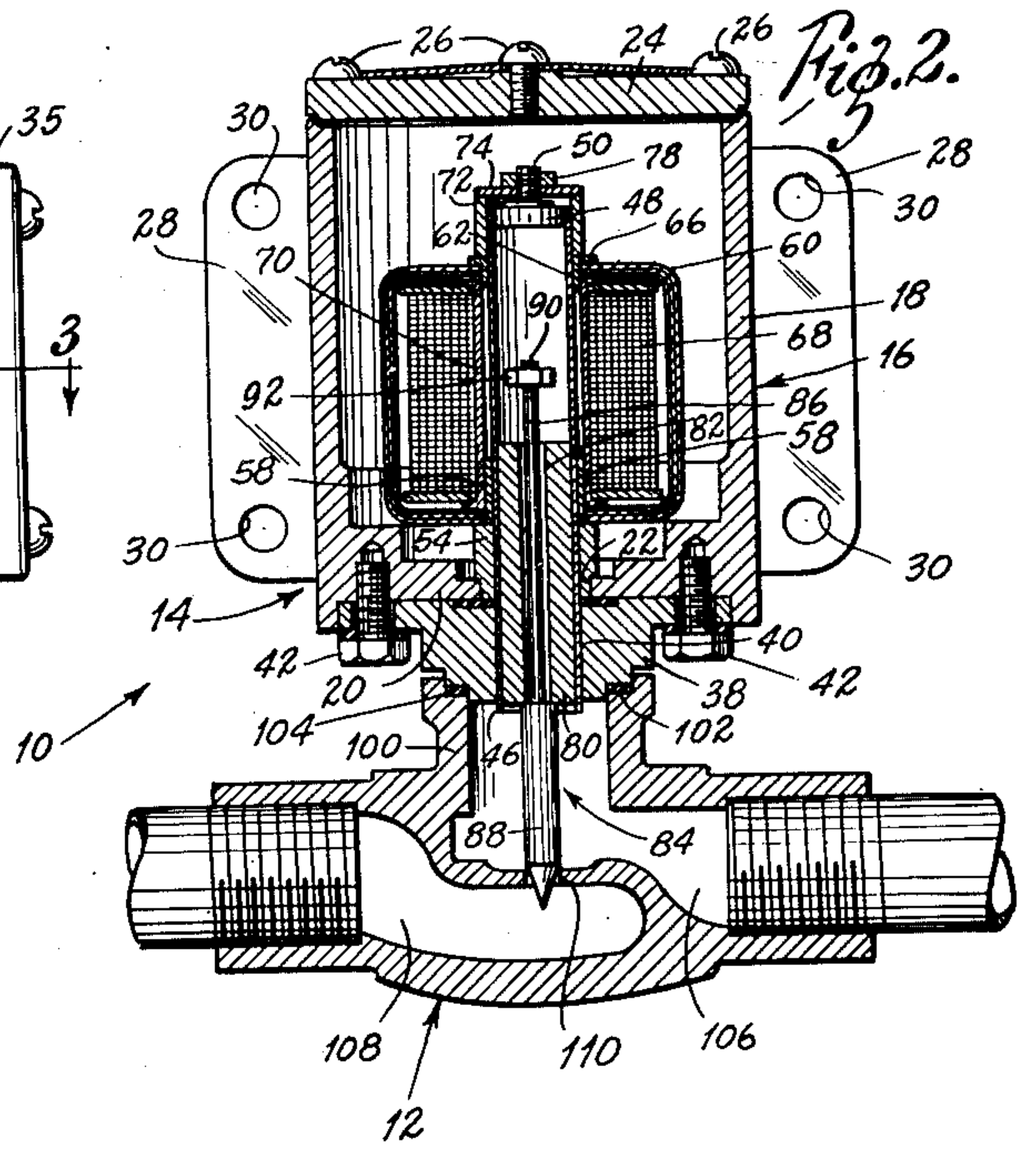


Fig. 4.

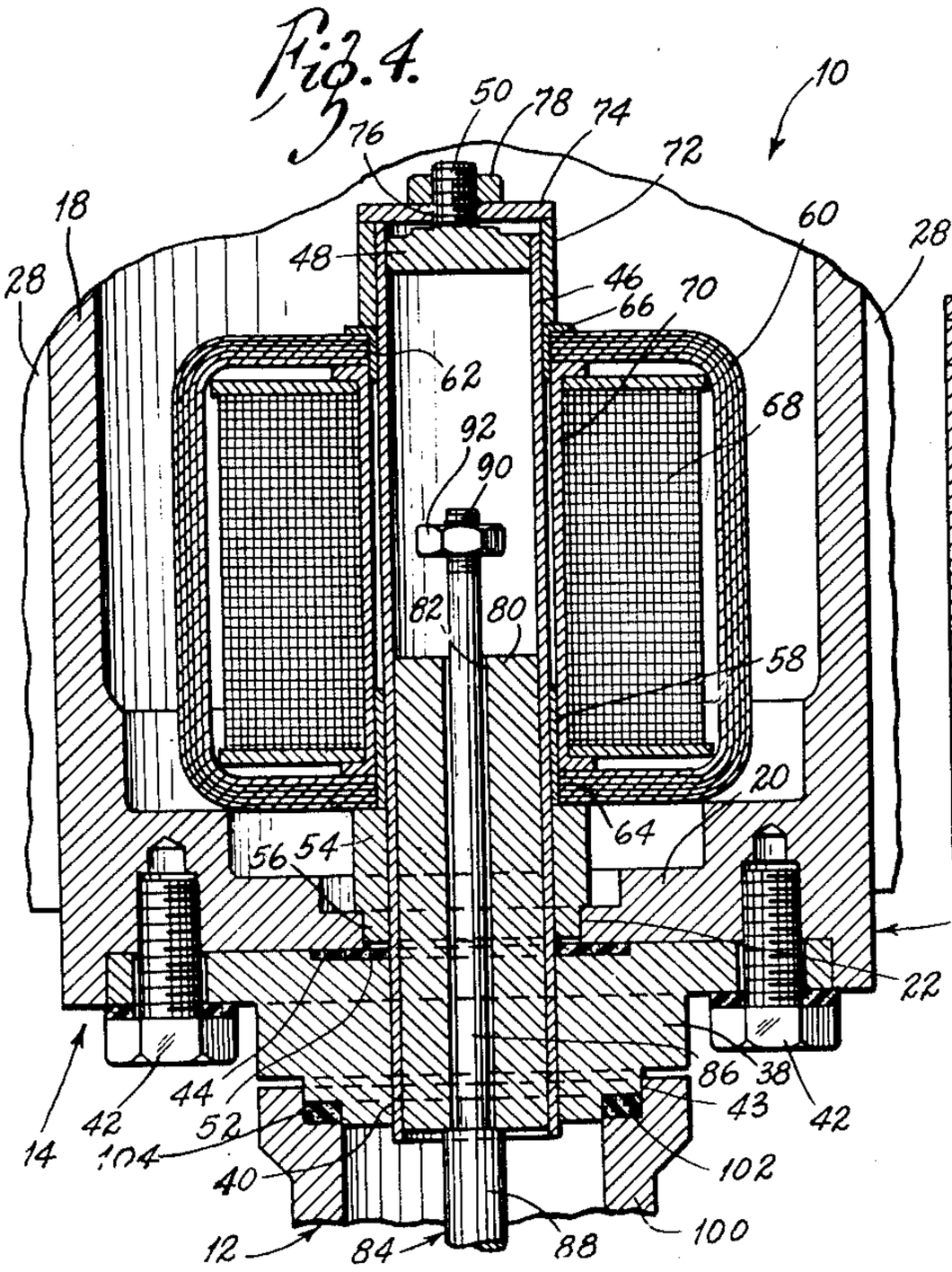
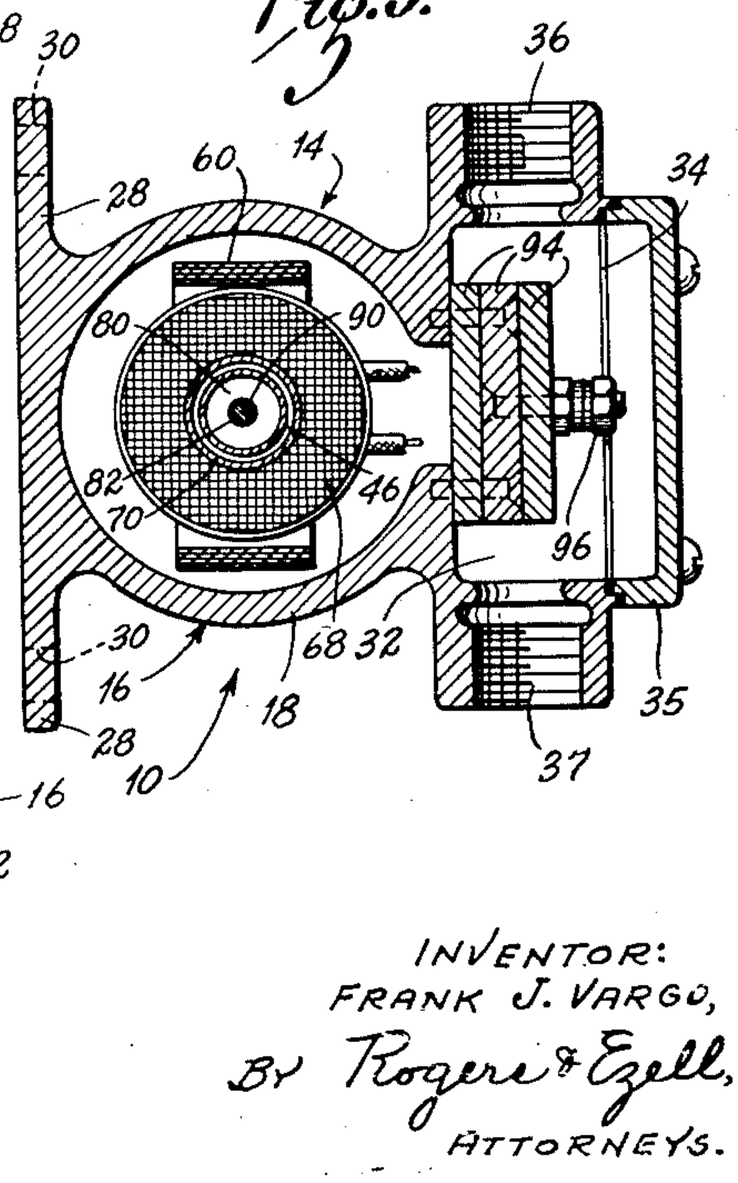


Fig. 3.



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SOLENOID OPERATED ACTUATOR

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1 Claim. (Cl. 175—341)

1

The present invention relates generally to the actuator art, and more particularly to a novel solenoid operated actuator for use with frequencies above sixty cycles per second.

In the present disclosure, the actuator is shown and described with a valve solely for the purposes of illustration, and it is to be understood that it is not limited to such usage.

In its preferred form, the actuator includes a yoke formed by spirally winding a strip of magnetic material, such as an alloy of iron and silicon, into a closed loop, the strip having low core loss and high permeability in the longitudinal or winding direction. A tubular member containing a laminated armature extends through opposed openings formed in the legs of the yoke, and a coil is disposed around the tube within the confines of the yoke, the latter being of a size to fit closely around the coil whereby the flux path is of a minimum length and contains a minimum number of parts.

As is well known in the art, the eddy current and hysteresis losses in a magnetic core or yoke are proportional to the frequency. Consequently, a core or yoke which is to be used with frequencies in the neighborhood of four hundred cycles per second requires much more consideration in its design than does one which is to operate on the standard sixty-cycle frequency.

It is an object of the present invention, therefore, to provide a solenoid operated actuator which has relatively low eddy current and hysteresis losses at frequencies above sixty cycles per second.

Another object is to provide a solenoid operated actuator containing a core or yoke having relatively high permeability in the direction of the flux path.

Another object is to provide a solenoid operated actuator containing a yoke made without using the standard type of steel punchings.

Another object is to provide a solenoid operated actuator containing a yoke formed by spirally winding an elongated strip of magnetic material into a closed loop.

Another object is to provide a solenoid operated actuator which has a relatively tight, short flux path containing a minimum number of parts.

Other objects are to provide a solenoid operated actuator which is of simple and rugged construction, and which is relatively easy to assemble.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred embodiment of the present invention is shown, in which:

Fig. 1 is a side elevational view of a solenoid operated actuator embodying the teachings of the

2

present invention, shown used with a standard type of valve, the housings being broken away to show the manner of fastening the two members together;

Fig. 2 is a vertical, transverse, sectional view taken on the line 2—2 in Fig. 1;

Fig. 3 is a horizontal, transverse, sectional view taken on the line 3—3 in Fig. 1; and

Fig. 4 is an enlarged view of the solenoid, as shown in Fig. 2.

Referring to the drawing more particularly by reference numerals, 10 indicates generally a solenoid operated valve which comprises a valve body 12 and a solenoid operated actuator 14 constructed in accordance with the teachings of the present invention.

The solenoid operated actuator 14 includes a cylindrical cup-like housing 16 having a side wall and a bottom wall 20, the latter containing a step-like opening 22. A cover 24 is removably secured to the upper end of the housing 16 by bolts 26.

Flanges 28 extend outwardly from the side wall 18 at one side of the housing 16 and contain openings 30 for securing the unit to a fixed support.

A chamber 32 extends outwardly from the side wall 18 of the housing on the opposite side opposite to the flanges 28. It contains a large opening 34 which is closed with a removable cover 35, and opposed threaded openings 36 and 37 which are normal to the opening 34.

A body flange 38 (Fig. 4) which contains a cylindrical opening 40 in its center smaller than the opening 22 is removably secured to the bottom wall 20 of the housing 16 by bolts 42. The bottom of the body flange 38 contains a cylindrical step-like projection 43, and the upper surface of the flange contains a cylindrical recess 44, both being concentric with the opening 40.

The lower end of a vertically extending cylindrical tube-like member 46 is secured in the opening 40 as by welding or brazing.

A plug member 48 having a threaded stud-like portion 50 extending upwardly therefrom is fixedly positioned in the top of the tube-like member 46.

A gasket 52 is disposed about the tube-like member 46 in the recess 44 between the housing 16 and the body flange 38.

A bottom cylindrical bushing 54 having a stepped body portion 56 is disposed about the tube-like member 46, the bottom portion 56 being positioned in the step-like opening 22.

A lower coil sleeve 58 is disposed about the tube-like member 46 on top of the bottom bushing 54.

A square-shaped, spirally wound yoke 60 having opposed cylindrical openings 62 and 64 formed

in its upper and lower portions, respectively, is disposed on the tube 46, the latter protruding upwardly through the openings 64 and 62. The yoke 60 is built up by spirally winding a strip-like magnetic alloy, such as iron and silicon, into the form shown. The material used has a low core loss and high permeability in the longitudinal or winding direction, which is also the direction of the magnetic flux path.

An upper coil sleeve 66 having a flanged upper portion is disposed around the tube 46 and in the opening 62.

A coil 68 and a coil supporting bobbin 70 are disposed about the tube 46 within the area defined by the yoke 60, the coil windings lying in planes normal to the axis of the tube 46.

A cylindrical shaped top bushing 72 is disposed around the tube 46 and on top of the upper coil sleeve 66.

A retaining washer 74 containing an opening 76 in the center thereof is disposed around the stud 50 above the bushing 72, and a nut 78 is disposed upon the stud 50 above the washer 74 so as to maintain the above enumerated parts in their assembled positions.

A laminated armature 80 containing a longitudinal passage 82 therethrough is slidably disposed within the tube 46.

An elongated rod-like valve member 84, including a stem portion 86 and an enlarged body portion 88, has its stem portion 86 slidably mounted in the passage 82. The upper end of the stem portion 86 contains a threaded portion 90 having a nut 92 removably disposed thereon. The lower end of the body portion 88 is conical in shape for a purpose to appear.

As shown in Fig. 3, terminal blocks 94 containing terminal stud assemblies 96 are mounted on the side wall 18 within the chamber 32.

The valve body 12 (Fig. 2) which is removably fastened to the solenoid actuator 14 by bolts 98 (Fig. 1) includes an upwardly extending tubular portion 100 which contains an annular groove 102 in the upper end thereof.

An annular gasket 104 is disposed in the groove 102 between the valve body 12 and the lower end of the body flange 38.

As shown in Fig. 2, the valve body 12 also contains an inlet chamber 106, an outlet chamber 108, and a valve seat 110 therebetween for cooperation with the conical shaped lower end of the valve member 84.

Operation

With the coil 68 deenergized, the weight of the armature 80 bearing against the upper shoulder of the body portion 88 maintains the conical portion of the valve member 84 in contact with the valve seat 110.

When the coil 68 is energized, magnetic flux flows through the armature 80 and the magnetic circuit comprising the tube 46, the yoke 60 and the upper and lower sleeves 66 and 58, respectively. Because the tube 46 is substantially non-magnetic, only a relatively small portion of the magnetic flux is diverted from the armature 80. Furthermore, because of the minimum number of members in the flux path and the fact that the path is relatively short, and because the strip from which the yoke 60 and armature 80 is made has high permeability in its longitudinal direction, which is also the direction of the flux path, the construction has relatively low core loss and high permeability.

When the magnetic flux flows through the armature 80, the latter is lifted upwardly against the nut 92, thereby causing the valve member 84 to move upwardly and away from the valve seat 110.

Because of the relatively large mass of the laminated armature 80 and the high frequency of reversal of the magnetic flux, there is no chattering problem.

When the coil 68 is deenergized, the armature 80 drops downwardly, thereby striking the shoulder at the upper end of the body portion 88 of the valve member 84, causing the conical shaped lower end of the body portion 88 to engage the valve seat 110.

Thus, it is apparent that there has been provided a novel solenoid operated actuator for use with frequencies above sixty cycles per second which has a relatively low core loss and high permeability, which is simple and rugged in construction, and which is relatively easy to assemble.

It is to be understood that the foregoing description and the accompanying drawing have been given only by way of illustration and example, and that changes and alterations in the present disclosure, which will be readily apparent to one skilled in the art, are contemplated as within the scope of the present invention which is limited only by the claim which follows.

What is claimed is:

In a device of the type described, in combination, an upwardly extending tube-like member having a closure member at the upper end thereof which contains an upwardly extending stud-like portion; a coil disposed around the tube-like member; a magnetic yoke containing opposed openings disposed on said tube-like member and surrounding said coil, said yoke comprising an elongated strip-like member spirally wound into a continuous loop, the upper end of the tube-like member extending through one of said openings; a sleeve-like member slidably disposed on the upper end of said tube-like member above the yoke, the upper end of said sleeve-like member extending above the upper end of the tube-like member; a disc-like member containing an opening therein disposed on the stud-like portion above the sleeve-like member; and removable retaining means adjacent the end of the stud-like member maintaining the disc-like member against the upper edge of the sleeve-like member.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
663,346	Johnson et al.	Dec. 4, 1900
2,096,763	Ray	Oct. 26, 1937
2,146,930	Bassett	Feb. 14, 1939
2,260,398	Otte	Oct. 28, 1941
2,291,599	Ray	Aug. 4, 1942
2,324,642	Peterson	July 20, 1943
2,383,411	Obszarny	Aug. 21, 1945
2,423,869	Blessing	July 15, 1947
2,467,439	McClain	Apr. 19, 1949
2,582,351	Olson	Jan. 15, 1952

FOREIGN PATENTS

Number	Country	Date
7,856	England	May 10, 1889
349,203	France	May 17, 1905
624,241	Germany	Apr. 16, 1932