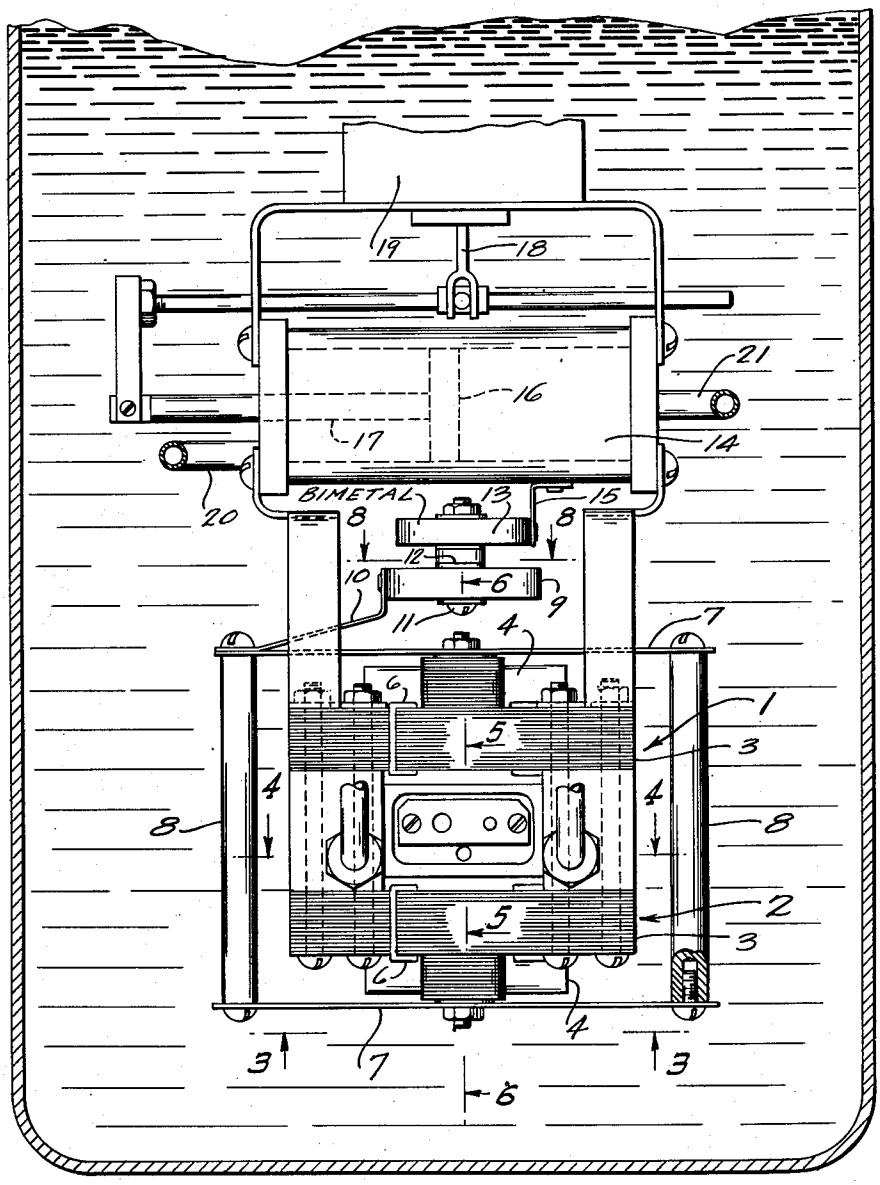
Aug. 10, 1954 E. J. WEINFURT 2,685,838

ELECTROMAGNETIC PUMP

Filed Nov. 18, 1950 3 Sheets-Sheet 1

Fig. 1



INVENTOR.
Edward J. Weinfurt
BY
Arthur R. Woolford
Attorney

Aug. 10, 1954 E. J. WEINFURT 2,685,838

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Fig. 2

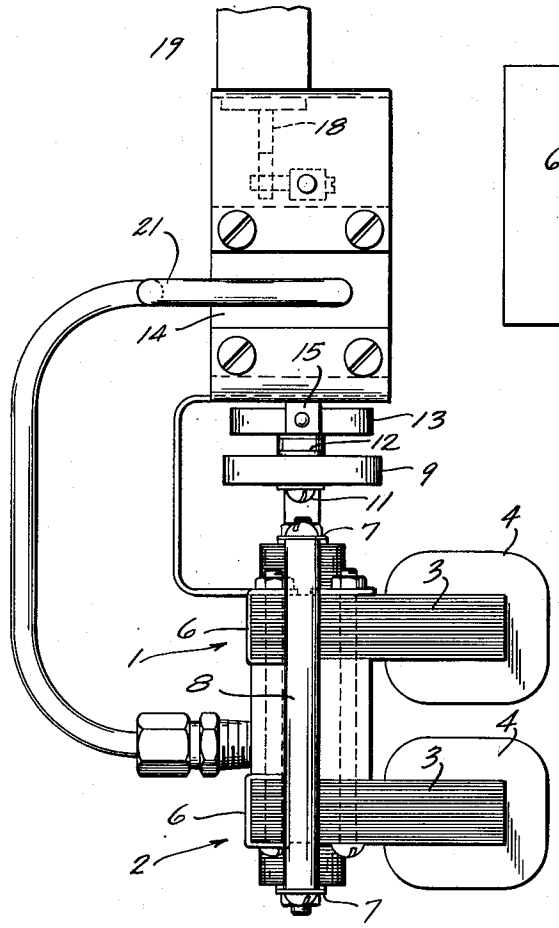


Fig. 3

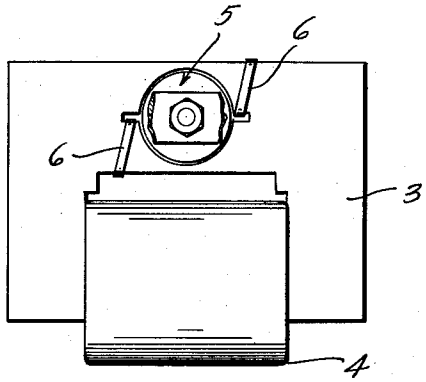
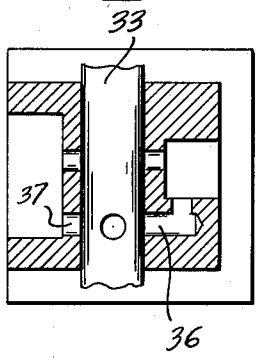


Fig. 5



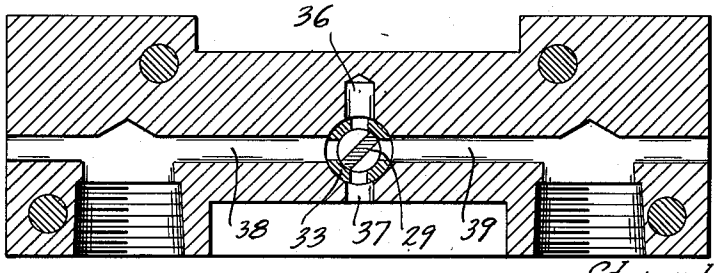


Fig. 4

INVENTOR.
Edward J. Weinfurt
BY
Arthur R. Doerfler
Attorney

Aug. 10, 1954 E. J. WEINFURT 2,685,838

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Fig. 6

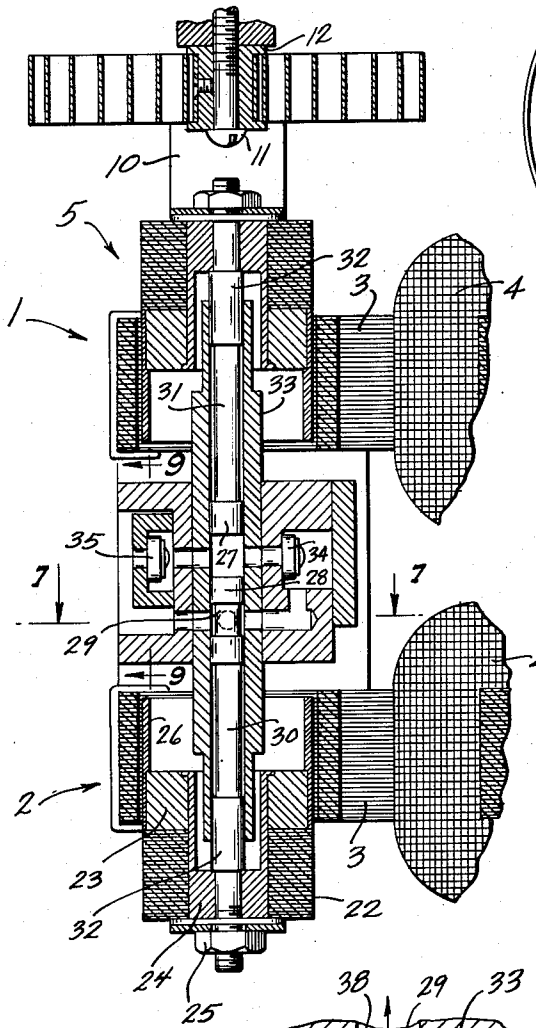


Fig. 8

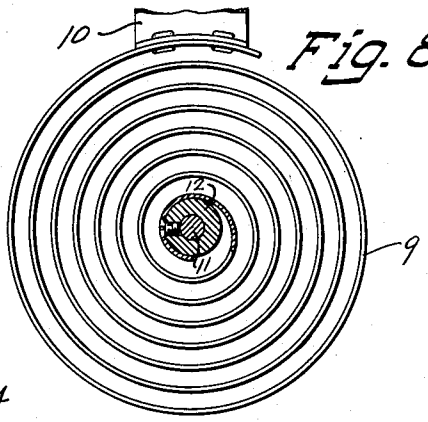


Fig. 9

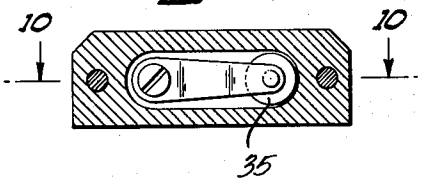
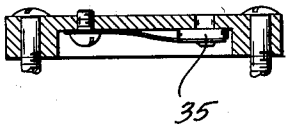


Fig. 10



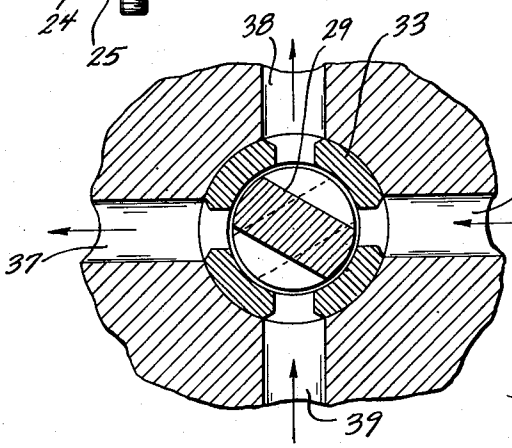


Fig. 7

INVENTOR.
Edward J. Weinfurt
BY
Arthur R. Wolfeld
Attorney

Patented Aug. 10, 1954

2,685,838

UNITED STATES PATENT OFFICE

2,685,838

ELECTROMAGNETIC PUMP

Edward J. Weinfurt, West Allis, Wis., assignor to McGraw Electric Company, Milwaukee, Wis., a corporation of Delaware

Application November 18, 1950, Serial No. 196,471

5 Claims. (Cl. 103—3)

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This invention relates to a vibratory, alternating current electromagnetic pump.

Objects of this invention are to provide a voltage sensitive device which takes the form of a vibratory electromagnetic pump, which is so constructed that it will pump oil or other fluid and will selectively control the connection of the pump to opposite ends of a work cylinder or other motor means as well as control the discharge of the fluid from such work cylinder or motor means.

This invention is an improvement over that disclosed in the copending application of Anthony Van Ryan, Serial No. 189,612, filed October 11, 1950, now Patent No. 2,627,811 dated February 10, 1953, for Electromagnetic Pump, and assigned to the same assignee as the present application, and has in general the same objects as those set forth in such copending application.

In greater detail, objects of this invention are to provide an electromagnetic pump in the form of a pair of shaded pole motors in which the rotors are allowed to vibrate axially due to cyclic variations of the alternating current and in which this multitude of rapid vibrations serves to pump the oil while the tendency of the armatures to twist or rotate due to the action of the shaded poles determines the direction of flow of fluid to and from the work cylinder or other motor means, the amount of twist being controlled by the voltage impressed on the device and the twist of the armature being resisted by a hair spring with bimetal compensation means arranged to compensate for temperature changes which vary the resistance of the wire wound on the stators or fields of the shaded pole motors, the permeability of the iron, the tension of the hair spring, and the viscosity of the oil.

A further specific object of this invention is to provide an electromagnetic pump of the above character in which there is no supporting bearing for the armatures but in which the armatures freely float due to their magnetic suspension from the field of the shaded pole motors, and in which the armatures twist or turn as a unit, such armatures being rigidly attached to each other so far as twisting movement is concerned but being free to independently vibrate.

It has been found that with vibratory pumps of this nature that the amount of torque varied with the amount the armatures projected into the field structure or pole structure of the motors. This invention has the additional object of providing means whereby the torque exerted by the armatures due to the shaded pole action

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is substantially independent of the amount the armatures project into the pole or field structure of the motors and is responsive only to the voltage variation.

An embodiment of the invention is shown in the accompanying drawings, in which:

Figure 1 is a vertical elevation of the pump with parts broken away and parts in section.

Figure 2 is a side elevation of the pump with parts broken away.

Figure 3 is a fragmentary view looking down on one of the motor elements with other parts omitted.

Figure 4 is a sectional view on the line 4—4 of Figure 1.

Figure 5 is a sectional view on the line 5—5 of Figure 1.

Figure 6 is a sectional view on the line 6—6 of Figure 1.

Figure 7 is an enlarged, sectional view on the line 7—7 of Figure 6, the clearances being exaggerated for the sake of clearance.

Figure 8 is a sectional view on the line 8—8 of Figure 1, such view showing merely the lower spring.

Figure 9 is a sectional detail on the line 9—9 of Figure 6.

Figure 10 is a sectional view on the line 10—10 of Figure 9.

Referring to the drawings, it will be seen that the alternating current, electromagnetic pump comprises two main motor units indicated by the reference characters 1 and 2. These motor units each comprise a field or stator structure formed of laminations and indicated by the reference character 3 and are provided with an exciting coil or field winding 4. These field windings 4 may be connected in series or in parallel. Each of the motor units is a shaded pole motor, as shown most clearly in Figure 3 and is provided with a rotor indicated generally by the reference character 5. The fields are each provided with shading coils 6 so arranged as to give each of the armatures 5 a twist in the same direction. The armatures are connected so as to form an assembly or unitary structure. Each armature is rigidly secured to a leaf spring 7 and the outer ends of the leaf spring are joined by light pillars or posts 8 so that the assembly of armature and associated structure can twist as a unit to the desired position depending on the voltage impressed on the field coils as will be hereinafter discussed.

The torque or twist of the armatures is resisted by means of a hair spring or helical spring

9, the outer end of which is connected to the armature assembly by means of a rigid arm 10, see Figures 1 and 8. The inner end of the helical spring or hair spring 9 is connected by means of a screw 11 and spool-like members 12 to the inner end of a helical bimetal strip 13. The outer end of the bimetal strip 13 is connected to the rigid body portion 14 of the structure by means of a rigid arm 15. The body portion 14 of the structure may consist of a pump cylinder, as indicated, in which a piston 16 is positioned. This piston is provided with a piston rod 17 which is connected to the operating lever 18 of a switch or other member 19. It is to be understood that any suitable motor means could be provided in place of the work cylinder 14. The work cylinder is merely used as an illustration. The work cylinder has opposite ends connected to the pump by means of pipes 20 and 21.

It is to be noted that the armatures 5 project outwardly from the field structure of the motors as is shown in Figures 1, 2, and 6. These armatures comprise a group of laminations 22, a mild steel ring member 23, and a cup-like member 24 which binds the ring member 23 to the laminations when the end nuts 25 are tightened. The armature also comprises a copper sleeve 26 which is secured to the member 23 and extends only up to the laminations so that only a part of the magnetic structure of the armature is covered by the copper member 26.

It has been found that with the ordinary type of rotors customarily employed, that the torque varies with the amount the rotor projects into the field or pole structure of the stator. By forming the rotors in the manner hereinabove described, it has been found possible by proportioning the copper sleeve and laminations 22, as shown in Figure 6 for instance, to have substantially uniform torque or twist irrespective of the depth to which the armature projects into the field of the motor.

The armatures, it will be seen from the description thus far given, vibrate axially or longitudinally in a rapid manner in accordance with cyclic variations of the alternating current. They also impart a twist to the armature assembly and this twist is opposed by the hair spring 9. The amount of twist is determined by the voltage impressed on the field coils. It is to be noted particularly that the motors twist together as a unit, but they vibrate independently of each other. If desired, the leaf spring 7 and the mass of weight of the armatures may be so proportioned, taking into consideration the oil within which they are immersed, that resonance is obtained at the line frequency. The vibration of the armatures axially is towards and from each other and each armature vibrates independently of the other.

The axial vibration of the armatures is utilized to pump oil or other fluid to the work cylinder or motor means 14. This is accomplished by providing each armature with a piston. For example, the upper armature is provided with a pumping piston 27 and the lower armature is provided with a piston 28, below which is positioned a valve portion or valve member 29. This valve member 29 is made by forming a flat on each side of a portion of the piston rod 30 of the lower armature. The piston rod of the upper armature is indicated by the reference character 31. It will be seen that each of the piston rods is provided with an outer guiding portion 32.

The pistons 27 and 28 and the guiding portions 32 fit within a sleeve 33 which forms a pumping cylinder. Obviously, as the pistons approach each other, oil will be forced or pumped from the cylinder and will escape past the outlet valve 34. As the pistons recede from each other, oil will be drawn past the inlet valve 35. These vibrations are minute but they are very rapid and serve to pump a sufficient quantity of oil to operate the motor means.

The twisting or turning of the armature assembly determines the angle at which the valve 29 will be set, see Figure 7. This valve, it will be seen, determines the direction of flow of oil to and from the work cylinder. For example, the pump outlet or pressure supply port is indicated by the reference character 36 in Figure 7 and the exhaust or discharge passage by the reference character 37. The pipes 20 and 21 are connected to the delivery passages 38 and 39. It is apparent that when the valve 29 occupies the position shown, see Figure 7, that oil will flow from the passage or port 36 to the passage or port 38 and consequently to the pipe 20 and to the left-hand end of the work cylinder as viewed in Figure 1. The oil discharged from the right-hand end of the work cylinder through the pipe 21 will pass through the port or passage 39 to the discharge port or passage 37. As the voltage varies, the position of the valve 29 changes. It will move in such a manner as to connect one end of the work cylinder with the pressure outlet port of the pump when the voltage drops below a predetermined value since the helical spring 9 will turn the valve in the opposite direction from that produced by the torque of the armatures. The balance between the torque produced by the armatures and that of the helical spring 9 determines the position of the valve.

It is clear that when the temperature varies, that there are various changes in the character of the pump mechanism. For example, the resistance of the wire of which the field coils are composed varies as does the permeability of the iron. Also the tension of the hair spring and the viscosity of the oil varies as the temperature changes. The bimetal, helical member 13 which is connected to the hair spring centrally thereof changes its position and consequently changes the tension of the hair spring to compensate for the above changes so that the valve 29, see Figure 7, will occupy a definite position for a definite voltage impressed on the field coils irrespective of temperature variations.

It is to be noted that the armatures are magnetically suspended from the fields and do not require any bearing to support them. The pistons and the guiding portion 32 attached to the armatures fit within the pumping sleeve or cylinder 33 and properly center the rotors without, however, supporting them. They freely vibrate in accordance with the cyclic variations of the alternating current and freely adjust themselves in their angular position in accordance with the voltage impressed on the motors. In this way, the operation of the hydraulic motor means is controlled in accordance with voltage variations.

It has been found that the device may be simply made and is effective in operation. It is reliable and is corrected, as stated hereinabove, for temperature variations so that a very accurate response to voltage variations is obtained. Also it has been found that a fairly high pressure amply sufficient to operate the hydraulic motor means is obtained due to the longitudinal, rapid vibrations of the armatures or rotors.

It is to be noted particularly that the field structure of the motors is rigidly held or suspended from the body portion or work cylinder of the device and that the armatures are connected to each other in such a manner that they may independently vibrate but add their tendency to twist in opposition to the twist of the hair spring. All of this is accomplished without requiring any support for revolubly supporting the armatures. The armatures themselves are axially suspended or supported by magnetic force and they are each rigidly attached to their supporting leaf springs so that there is, in reality, no frictional loss at this point and the utmost freedom of adjustment of the armatures angularly with respect to voltage variation is thus obtained.

Although this invention has been described in considerable detail, it is to be understood that such description is intended as illustrative rather than limiting, as the invention may be variously embodied and is to be interpreted as claimed.

I claim:

1. A vibratory, alternating current electromagnetic pump comprising field means having shaded poles, energizing coil means on said field means, armature means located between said poles and yieldingly supported for vertical vibration due to cyclic variations of the alternating current, torsional spring means acting on said armature means and opposing the torque of said armature means produced by said shaded poles, temperature responsive means operatively connected to said torsional spring means for adjusting said torsional spring means in accordance with temperature variation, pump means actuated by said armature means upon longitudinal vibration of said armature means, a body portion having a pair of delivery ports, and valve means controlled by the rotary movement of said armature means for selectively connecting the delivery ports with said pump means.

2. A vibratory, alternating current electromagnetic pump comprising field means having shaded poles, winding means on said field means, armature means located between said poles and comprising a pair of aligned armatures yieldingly supported for longitudinal vibration due to cyclic variations of the alternating current, means connecting said armatures for causing said armature means to rotate as a unit to different angular positions, torsional spring means acting on said armature means and opposing the torque of said armature means produced by said shaded poles, pump means actuated by said armature means upon longitudinal vibration of said armatures towards and from each other, a body portion having a pair of delivery ports, and valve means controlled by the rotary movement of said armature means for selectively connecting the delivery ports with said pump means.

3. A vibratory, alternating current electromagnetic pump comprising a pair of field structures having shaded poles, energizing windings on said field structures, an armature located between the poles of each field structure, said armatures being axially aligned and arranged in opposition to each other, leaf springs supporting said armatures for independent longitudinal vibration due to cyclic variations of the alternating current, means connecting said leaf springs for causing said armatures to rotate as a unitary armature means to different angular positions under the action of said shaded poles, torsional spring means acting on said armature means and opposing the torque of said armatures produced by said shaded poles, pump means actuated by longitudinal vibration of said armatures, a body portion having a pair of delivery ports and having a pressure supply port extending from said pump means and a discharge port, and a rotary valve controlled by the rotation of said armatures for selectively connecting the delivery ports with the pressure supply port and the discharge port when said armatures rotate to different angular positions.

4. A vibratory, alternating current electromagnetic pump comprising a pair of field structures having shaded poles, energizing windings on said field structures, an armature located between the poles of each field structure, said armatures being axially aligned and arranged in opposition to each other, leaf spring means supporting said armatures for independent longitudinal vibration due to cyclic variations of the alternating current, said leaf springs extending outwardly beyond said armatures, means connecting the ends of said leaf springs whereby said armatures and the leaf spring and connecting means constitute an armature assembly, pump means operated by the longitudinal vibration of said armatures, a body portion having a pair of delivery ports and having a pressure supply port extending from said pump means and a discharge port, a rotary valve controlled by the rotation of said armature assembly for selectively connecting the delivery port with the pressure supply port and the exhaust port when said armature assembly rotates to different angular positions, and torsional spring means acting on said armature assembly and opposing the torque of said armatures produced by said shaded poles.

5. A vibratory, alternating current electromagnetic pump comprising field means including an energizing winding and having opposed shaded poles, at least one armature located between said poles, spring means supporting said armature and allowing longitudinal axial motion of said armature due to cyclic variations of the alternating current, said armature including a laminated portion projecting outwardly beyond said poles and an electrically conducting portion arranged in an annular manner in reference to the axis of said armature and secured as a unit to said laminated portion and located between said poles, said laminations extending beyond said conducting portion, the shaded poles of said field means tending to produce rotary movement of said armature, torsional spring means opposing rotary movement of said armature, a body portion having a pair of delivery ports, a pump operated by the longitudinal vibration of said armature, and rotary valve means controlled by the rotary movement of said armature for selectively connecting the delivery ports with said pump means.

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