

July 16, 1946.

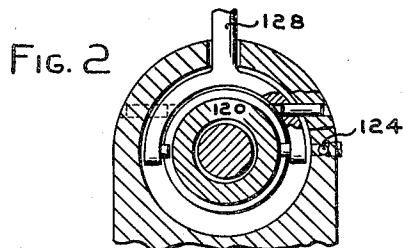
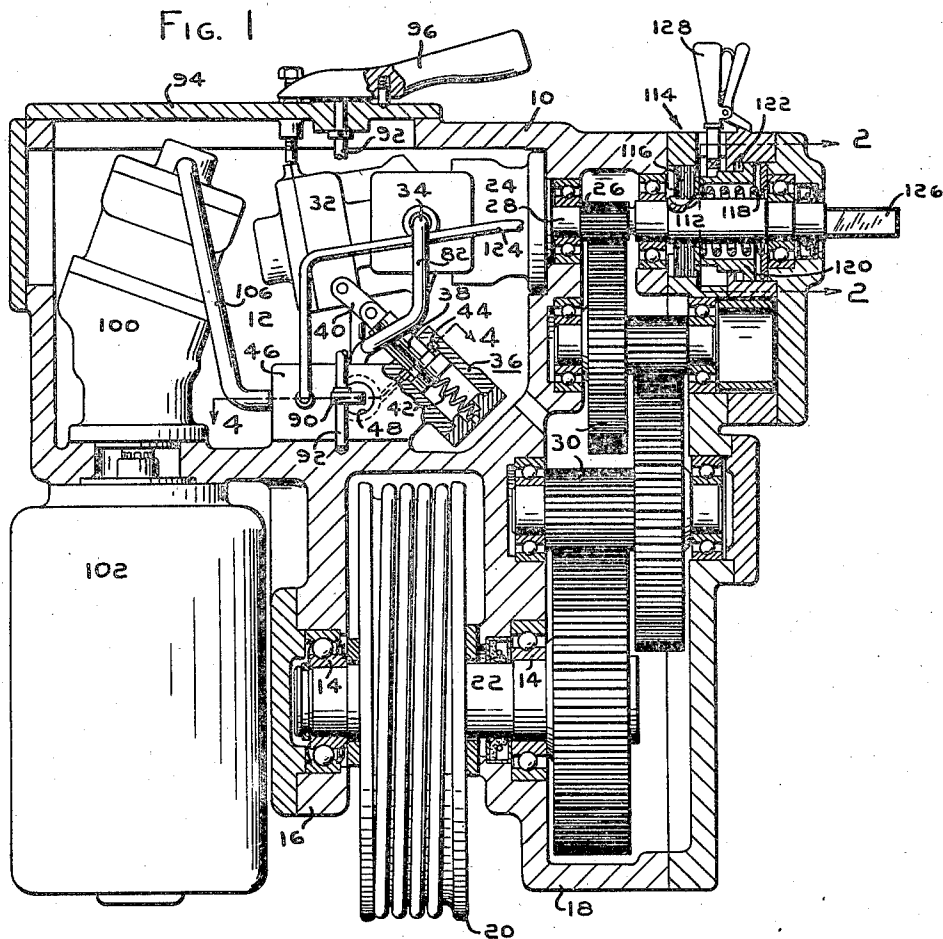
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2,403,924

POWER TRANSMISSION

Filed Sept. 2, 1939

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

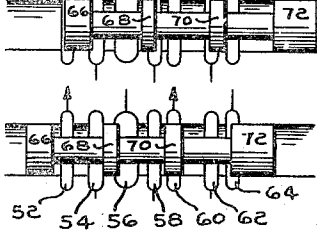
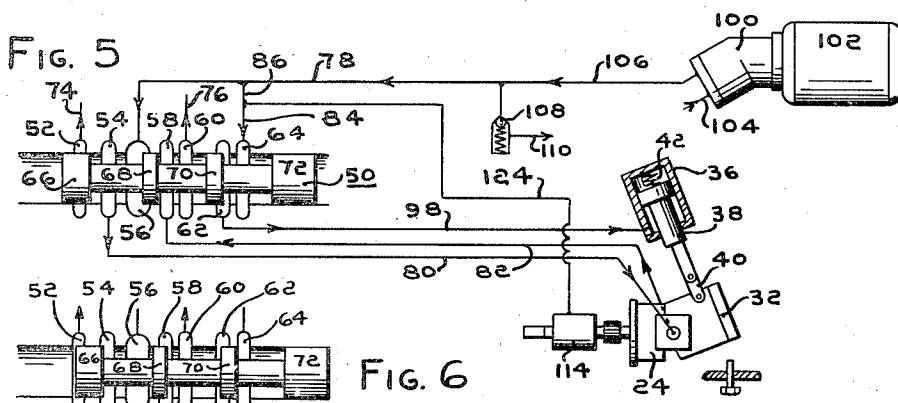
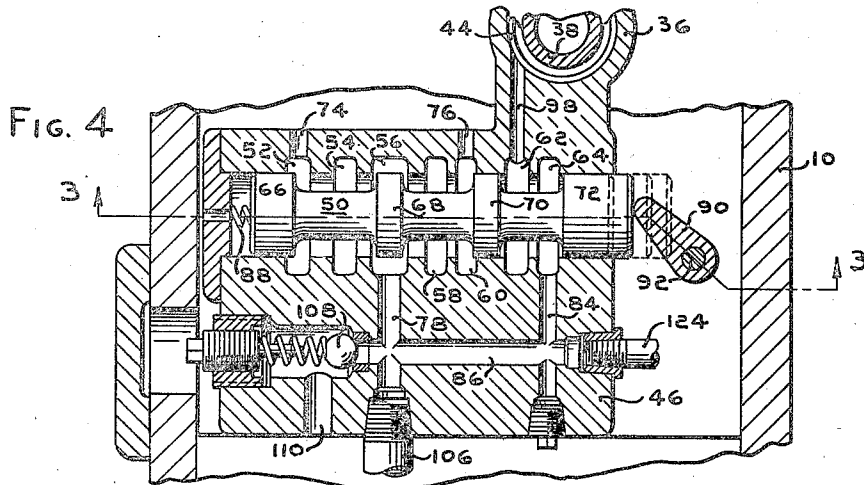
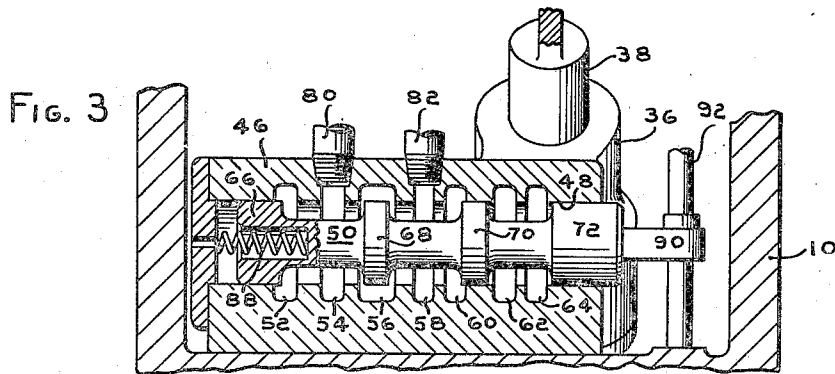


FIG. 6

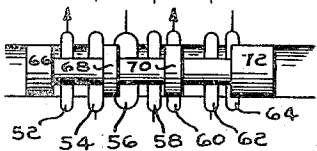


FIG. 7

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POWER TRANSMISSION

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8 Claims. (Cl. 254—172)

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This invention relates to power transmissions and more particularly to a novel power transmission device and control therefor particularly adapted to hoisting an object while relative movement between the object and the hoisting device is occurring. A device of this character is useful, for example, on shipboard for the purpose of lifting floating objects such as boats, airplanes, torpedoes, etc., from a rough sea.

In lifting such objects, particularly those of a fragile character, it is necessary to insure that the means, usually a cable, which connects the object to the hoist is maintained taut at all times while the object is moved up and down relative to the hoist by the action of the waves. Unless this result is insured it is possible and frequently occurs that when the hoist is operated to lift the object out of the water a sudden jerk is given to the object and the cable which may be of sufficient magnitude to rupture the cable or damage the object. Hoisting devices have been proposed heretofore for this class of service, and, while more or less satisfactory for performing their intended function, have involved considerable complicated apparatus subject to possible derangement and have been expensive to construct and difficult to maintain in service.

It is an object of the present invention to provide a unitary hoist with self-contained driving and controlling apparatus suitable for the class of service described which is of relatively simple and inexpensive construction.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of the present invention is clearly shown.

In the drawings:

Figure 1 is a horizontal cross section through a unitary hoisting device embodying a preferred form of the present invention.

Figure 2 is a fragmentary sectional view on line 2—2 of Figure 1.

Figure 3 is a fragmentary cross section on line 3—3 of Figure 4.

Figure 4 is a cross section on line 4—4 of Figure 1.

Figure 5 is a diagrammatic view of the hydraulic circuit incorporated in the device of Figure 1.

Figure 6 is a diagram of the valve in Figure 5 showing the parts in a different position.

Figure 7 is a second diagram of the valve of Figure 5 showing the parts in a still different position.

Referring now to Figure 1, the unitary hoist

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there shown comprises a main frame 10 which forms a support for the principal parts of the mechanism and provides also an oil receiving tank or chamber 12 in which a supply of oil for the power transmission and lubrication of the parts may be maintained.

Mounted in bearings 14 carried in arms 16 and 18 on the main frame is a cable drum 20 which is rigidly secured to a shaft 22 journaled in the bearings 14. The drum 20 is adapted to be driven from a variable displacement fluid motor 24 through the medium of a pinion 26 on the motor output shaft 28 and double-reduction gearing of any suitable form generally designated at 30. The motor 24 may be of any suitable type and is illustrated as of the type having a swinging yoke 32 for varying the displacement of the motor. The yoke is shown in its minimum displacement position wherein the quantity of oil displaced per revolution is small. When the yoke is swung counterclockwise about its axis indicated at 34, the displacement of the motor is increased in proportion to the angle to which the yoke is swung.

For the purpose of controlling the position of the yoke 32 a cylinder-and-piston fluid motor 36 is provided having a piston 38 connected to the yoke 32 by a link 40. A spring 42 normally biases the piston 38 upwardly and to the left in Figure 1. This bias may be overcome by the admission of pressure fluid to the operating chamber 44 of the motor 36.

The motor 36 is preferably formed integrally in a valve block 46 secured to the frame 10 on one wall of the chamber 12. The block 46 is provided with a longitudinal bore 48 better illustrated in Figures 3 and 4 in which is slidably mounted a valve spool 50. The bore 48 is provided with a series of annular ports designated as 52, 54, 56, 58, 60, 62, and 64, while the spool 50 is provided with four lands 66, 68, 70 and 72 for controlling communication between the various ports.

The ports numbered 52 through 60 inclusive together with the lands 66, 68, and 70 constitute a four-way valve operable in the conventional manner. Thus the ports 52 and 60 constitute tank ports and are open to the chamber 12 through passages 74 and 76. The ports 56 constitutes a pressure port and is supplied with pressure fluid from a suitable source, later to be described, through a conduit 78. The ports 54 and 58 are connected to the opposite sides of the motor 24 by conduits 80 and 82. Conduit 80 leads to that side of the motor which is the inlet for hoisting operation while conduit 82 serves as the outlet during hoisting. The lands 70 and 72 co-

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operate with the ports 60, 62 and 64 to act as a three-way valve for selectively connecting port 62 either to the tank port 60 or to the pressure port 64 which is in communication with the pressure port 56 through drilled passages 84 and 86.

The spool 50 is biased to the right in Figures 3 and 4 by a spring 88 and may be manually shifted between the four positions illustrated in Figure 4 by means of a cam lever 90 rigidly secured to a shaft 92 which is journaled in the housing 10 and in a cover plate 94. The outer end of the shaft 92 carries a suitable operating handle 96.

In the "stop" position of the valve illustrated in Figures 3 and 4 the motor ports 54 and 58 and the pressure port 56 are all connected to the tank through the ports 52 and 60. Likewise the port 62 is connected to tank through port 64, passages 84, 86 and 78. When the valve is shifted to the right as shown in Figure 5, the pressure port 56 is connected solely to motor port 54 while the motor port 58 is connected to tank port 60. In this position the land 70 is not so far to the right as to block communication between ports 62 and 64. Thus, pressure from the source entering port 64 may pass through port 62 and through a passage 93 to the operating chamber 44 of fluid motor 36.

In the rightmost position of the valve illustrated in Figure 6, motor ports 54 and 58 remain connected as before while the land 70 is now shifted far enough to the right to cut off port 62 from port 64 and open the former to tank port 60. In this position the operating chamber 44 of motor 36 is thus connected to the tank.

With the spool 50 shifted completely to the left as shown in Figure 7, the land 70 blocks port 62 from port 60 while land 72 connects the former to pressure port 64. Also the motor port 54 is now connected to tank port 52 and the motor port 58 connected to pressure port 56.

The source of fluid pressure may be of any suitable type which maintains a constant supply of pressure fluid available. In the device illustrated, a fixed displacement pump 100 is mounted on one wall of the chamber 12 to the opposite side of which an electric motor 102 is mounted for driving the pump 100. The pump has a suction conduit 104 from which oil is drawn out of the chamber 12 and delivered to a delivery conduit 106 which enters the valve block 46 in alignment with the conduit 78. A relief valve 108 is provided for bypassing oil to the tank through a passage 110 whenever a predetermined pressure is exceeded in the passage 78.

For the purpose of holding the drum stationary when the valve 50 is in "stop" position, the motor shaft 28 is extended at 112 to connect with a load-released brake generally designated as 114. A multiple-disk brake 116 having alternate disks splined to the shaft 112 and to the frame of the device is normally biased into engagement by a spring 118 surrounding the shaft 112. The spring 118 abuts against a pressure plate 120 which contacts the outer disk of the brake 116. The plate 120 is formed as a piston slidable in an operating chamber 122 to which fluid pressure may be admitted through a line 124 which connects with the valve block 46 at the conduit 86.

The shaft 112 may have an extension 126 to which a hand crank may be applied in case of power failure. For this purpose a manual shifting fork 128 is provided for shifting the pressure plate 120 to the right in Figure 1 whenever it is necessary to operate the hoist by hand.

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It will be seen that whenever pressure builds up in the supply line 106 due to resistance to turning of the motor 24, this pressure will be transmitted through line 124 to chamber 122 shifting the pressure plate 120 to the right and releasing the brake 116. Whenever there is no pressure in the line 106, the brake is automatically engaged by the spring 118.

In operation, with the parts in the position shown in Figures 1 through 4, the brake 116 is engaged, and with the motor 102 and pump 100 running, the full pump delivery is circulated idly through conduit 106, passage 78 and through the valve 50 to the tank as previously described.

If it is desired to pay out line preparatory to connecting to an object to be lifted, the handle 96 is rotated to shift the valve 50 to the left to the position shown in Figure 7. The pressure supply is now connected to the motor conduit 82 tending to drive the motor in a lowering direction which action is resisted, however, by the brake 116. Pressure will accordingly build up in conduits 86 and 124 until the spring 118 is sufficiently overcome to permit the motor 24 to rotate, the brake 116 thus acting as a drag to maintain this balance between driving pressure and brake drag.

When the line payed out and its end attached to a floating object, the handle 96 may be shifted to its opposite extreme position in which the valve 50 lies in the position of Figure 6. Under these conditions the pressure source is connected to the motor conduit 80 urging the motor to rotate in a hoisting direction. The displacement controlling motor 36 has its operating chamber 44 connected to the tank, however, so that the piston 38 is in its extreme projected position, and the yoke 32 accordingly lies in its minimum displacement position.

Since in this position the torque produced by the motor 24 under a given available maximum pressure is very low, the maximum pressure available at the source as determined by the relief valve 108 is insufficient to lift the load but instead maintains a constant light tension on the lifting cable. As the load floats upwardly on a wave, this light tension maintains the cable taut. In other words, the motor 24 will rotate in a hoisting direction to follow the upward movement of the object. As the object reverses and moves downwardly on a wave, the pull of the cable will turn the motor 24 reversely delivering oil back through conduit 80, ports 54 and 56, passage 78 and relief valve 108 to the tank. At the same time, the full pump delivery also passes through the relief valve 108 to the tank. Thus the object floats on the waves with a constant light lifting effort being exerted by the cable so long as the valve 50 remains in the position of Figure 6.

When it is desired to hoist the object the operator shifts the handle 96 to move the valve into the position of Figure 5 in which the motor 24 remains connected to the source as before, but the operating chamber 44 is connected with the pressure source through passages 84 and 86. The piston 38 is accordingly moved downwardly in Figure 1 shifting the yoke 32 into full displacement position. In this position the motor, when supplied with pressure at or less than the setting of the relief valve 108, exerts sufficient torque to lift the load but, of course, at a slower speed than the wave-induced movements previously taking place. The object is accordingly lifted clear of the water. It is necessary that the operator exercise some judgment in determining the

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time at which the handle 96 is shifted from float position to hoist position. This should be done while the object is moving upwardly on a wave if sudden jerks on the cable are to be avoided.

It will be noted that if, after hoisting has begun, a subsequent wave should contact the object and lift it upwardly at a speed greater than the hoisting speed, the cable will be maintained taut during such action. This follows from the fact that the displacement regulating motor 36 has its operating chamber in communication with the pressure side of the motor 24 through conduit 30, ports 54 and 56, passages 78, 86 and 84, ports 64 and 62, and passage 98. Accordingly, when the wave first begins to lift the object and relieves the load on the motor, the pressure in these lines is accordingly reduced permitting the spring 42 to project the piston 38 outwardly as fast as the reduction in pressure takes place. Thus, the displacement of the motor 24 is decreased causing its operating speed to be increased thus winding in cable as fast as is necessary to keep the same taut. As the wave recedes, the pressure again builds up forcing the piston 38 inwardly until the motor is again at full displacement position. From this point hoisting continues at the same slow speed as before.

In order to insure this operation it is preferable that the setting of the relief valve 108 be considerably higher than the pressure required to shift piston 38 completely inwardly. Likewise the minimum displacement position of the yoke 32 must be so correlated with the relief valve setting and with the maximum load to be lifted as well as with the desired constant tension value to be maintained during floating operation as to insure that the maximum load to be lifted will not cause the relief valve to open during hoisting and that the minimum load to be lifted will be certain to open the relief valve during downward movement on a wave while the apparatus is set for floating operation.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In a device for pulling on an object while subject to varying external forces, the combination of a winch, a variable displacement fluid motor connected to drive the winch, means responsive to motor operating pressure for varying the motor displacement and arranged to increase the motor displacement upon an increase in pressure, means forming a source of pressure fluid for operating the motor, means for selectively controlling the delivery of fluid from the source to the motor to operate the latter in either direction, valve means for selectively connecting the pressure responsive means to said source or to exhaust the pressure responsive means, and a common actuator for the delivery controlling means and said valve means.

2. In a fluid power transmission system the combination with a load device subject to varying external forces imposing a load resistance which at times may be either positive or negative, of a fluid motor for driving the load device, means forming a source of pressure fluid for operating the motor, means for limiting the maximum pressure effective on the motor to overcome positive load resistance, a second fluid motor for varying the motor displacement, normally biased to a po-

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sition of minimum displacement in which said maximum pressure is sufficient to drive the first motor only at negative and slight positive load resistance, and means for selectively connecting the second fluid motor to said source for increasing the motor displacement to a maximum at which said maximum pressure is sufficient to drive the first motor against any positive load resistance within the designed capacity of the system.

3. In a fluid power transmission system the combination with a load device subject to varying external forces imposing a load resistance which at times may be either positive or negative, of a fluid motor for driving the load device, means forming a source of pressure fluid for operating the motor, means for limiting the maximum pressure effective on the motor to overcome positive load resistance, a second fluid motor for varying the motor displacement, normally biased to a position of minimum displacement in which said maximum pressure is sufficient to drive the first motor only at negative and slight positive load resistance, and means for selectively connecting the second fluid motor to said source for increasing the motor displacement to a maximum at which said maximum pressure is sufficient to drive the first motor against any positive load resistance within the designed capacity of the system, said second fluid motor when connected to said source being responsive to a predetermined decrease in load to decrease the motor displacement whereby to increase the motor speed at low values of load resistance.

4. In a device for pulling on an object while subject to varying external forces, the combination of a winch, a variable displacement fluid motor connected to drive the winch, means forming a source of pressure fluid for operating the motor, means responsive to motor operating pressure for varying the motor displacement and increasing the motor displacement upon an increase in pressure, means for selectively controlling the delivery of fluid from the source to the motor to operate the latter in either direction, and valve means manually shiftable for selectively connecting the pressure responsive means to said source for positive hoisting of the object and for exhausting the pressure responsive means for exerting a constant pull insufficient to hoist the object.

5. In a device for pulling on an object while subject to varying external forces, the combination of a winch, a variable displacement fluid motor connected to drive the winch, means forming a source of pressure fluid for operating the motor, a relief valve for limiting the maximum pressure effective on the motor in a hoisting direction, a second fluid motor for varying the motor displacement, normally biased to a position of minimum displacement in which said maximum pressure acting on the first motor is insufficient to overcome the normal external force on the object, but maintains a constant pull on the object, and a valve manually shiftable to connect said second motor to the source of pressure for increasing the motor displacement to a maximum in which said maximum pressure is able to overcome the maximum external force on the object.

6. In a winch for hoisting an object floating in a seaway, the combination with the winch of a variable displacement fluid motor for driving the winch, means forming a source of pressure fluid for operating the motor, means for limiting the

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maximum pressure effective on the motor in a hoisting direction, a second fluid motor for varying the motor displacement, normally biased to a position of minimum displacement in which said maximum pressure acting on the first motor is insufficient to lift the object whereby the winch exerts a constant light lifting effort on the object throughout its wave-induced movements, and a valve manually shiftable for connecting the second motor to said source of pressure for increasing the motor displacement to a maximum for positively hoisting the object out of the seaway without exceeding said maximum pressure.

7. In a winch for hoisting an object floating in a seaway, the combination with the winch of a variable displacement fluid motor for driving the winch, means forming a source of pressure fluid for operating the motor, means for limiting the maximum pressure effective on the motor in a hoisting direction, a second fluid motor for varying the motor displacement, normally biased to a position of minimum displacement in which said maximum pressure acting on the first motor is insufficient to lift the object whereby the winch exerts a constant light lifting effort on the object throughout its wave-induced movements, and a valve manually shiftable for connecting the second motor to said source of pressure for increas-

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ing the motor displacement to a maximum for positively hoisting the object out of the seaway without exceeding said maximum pressure, the values of said maximum pressure limit and said minimum and maximum motor displacements relative to the weight of the object being such as to cause the hoisting speed to be increased to follow any upward movements of the object induced by a subsequent wave action when positive hoisting has been started.

8. In a winch for hoisting an object floating in a seaway, the combination with the winch of a variable displacement fluid motor for driving the winch, means forming a source of pressure fluid for operating the motor, means for limiting the maximum pressure effective on the motor in a hoisting direction, pressure responsive means for increasing the motor displacement in response to increased operating pressure at the motor to positively hoist the object, and manually shiftable means for selectively disabling said pressure responsive means causing the motor displacement to be decreased and held at a minimum value for causing the winch to exert a constant light pull on the object.

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