Dec. 29, 1959 J. E. MINTY 2,919,109

HYDRAULIC HOIST

Filed Oct. 14, 1955 2 Sheets-Sheet 1

Fig. 1

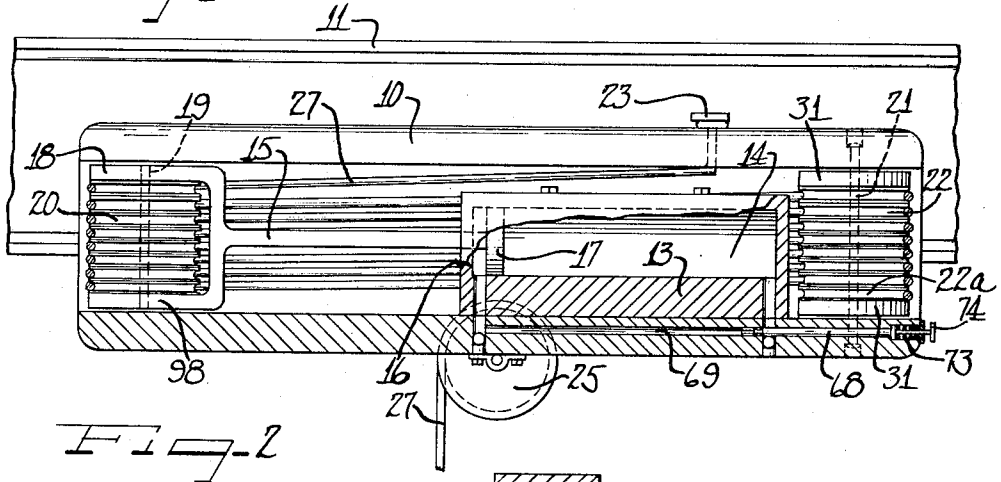


Fig. 2

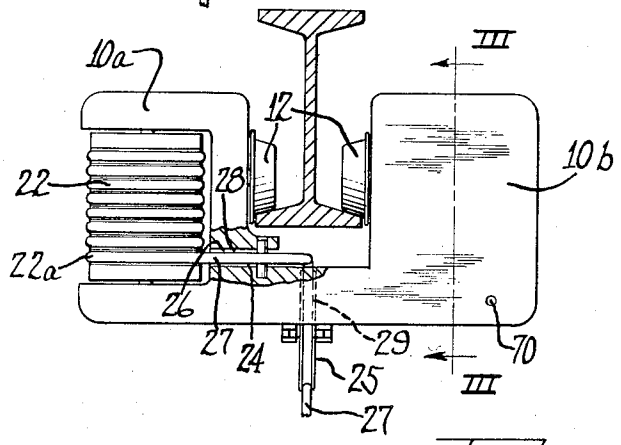
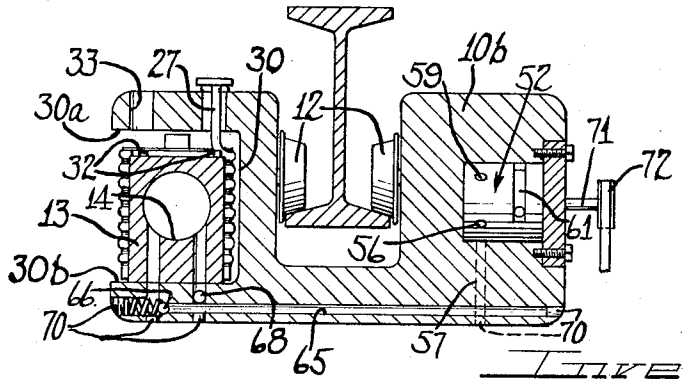


Fig. 5



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Fig. 3

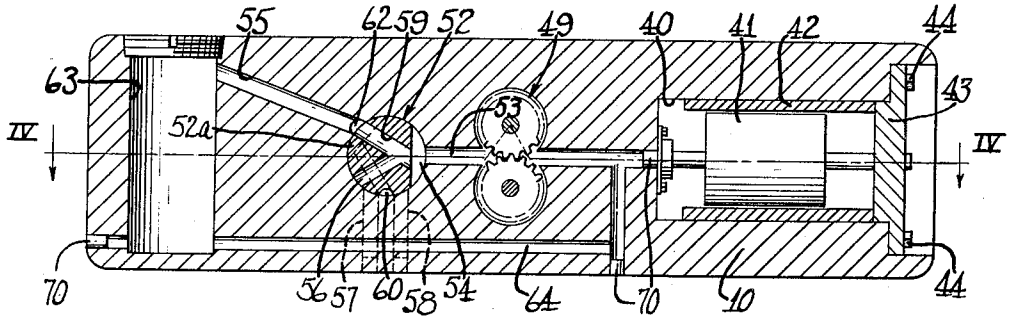
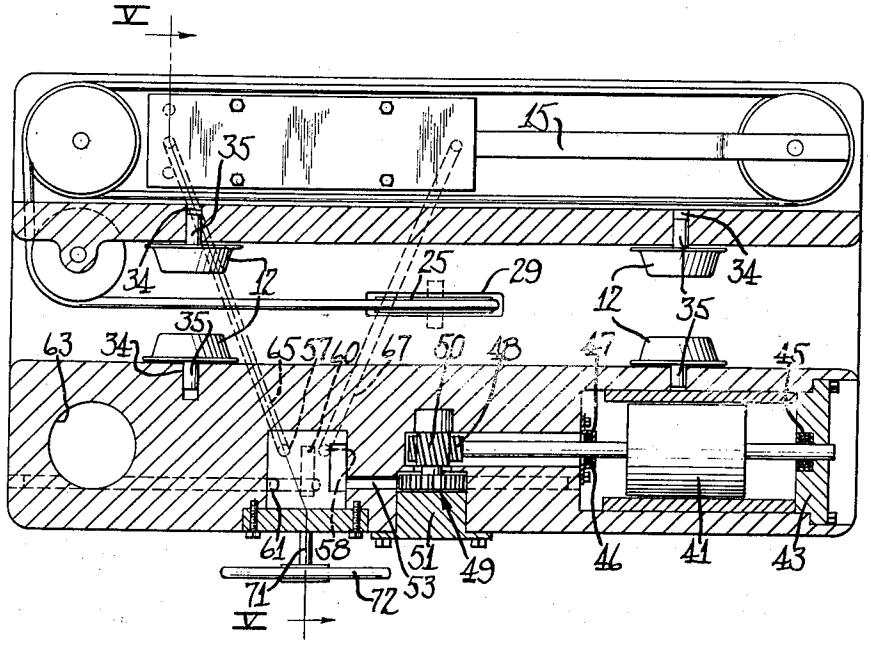


Fig. 4



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United States Patent Office 2,919,109 Patented Dec. 29, 1959

2,919,109

HYDRAULIC HOIST

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Application October 14, 1955, Serial No. 540,398

4 Claims. (Cl. 254—167)

The present invention relates to hoists of moderate load carrying capacity and is, more particularly, concerned with the provision of an improved hydraulic hoist capable of efficient use in confined quarters.

As those skilled in the hoist art are aware, there has been an ever increasing need for an efficient, small, hoist capable of use in minimum head room conditions. Such hoists are necessary for home as well as industrial shops, mass production conveyor loading and unloading, and numerous other applications where overhead clearance is very small and at the same time a relatively high lift is desired. In the prior art, hoists intended to fill this need have required reduction gearing and other similar parts of a relatively large nature which required that the hoist be suspended below the hoisting load carrying beam or other support in such a manner as to waste a substantial amount of the effective lift travel of the hoist. Further, as a result of industry demands that such hoists be extremely safe, mechanical overhauling devices of relatively complex construction were necessarily incorporated in the prior art hoists. The net result of these requirements is, and has been, a relatively expensive hoist, either manual or electrically driven, which has required an unduly large amount of head room or, conversely, provided only a relatively short overhead lift.

The present invention provides a novel and substantially improved hydraulic hoisting mechanism which utilizes an absolute minimum of head room and thereby provides a maximum of lift for any given hoist installation. Further, the present invention utilizes no gears, sprockets, or other mechanical load transferring devices for lifting the load and is instead constructed of relatively inexpensive parts capable of simple and inexpensive replacement. Also, a hoist is provided, in accordance with the present invention, having a simple and yet very effective means for preventing load-overhauling during lowering the load, thereby providing an unusually safe, simple, device.

More specifically, the present hoist comprises a hydraulic ram operable through a plurality of pulleys to provide a satisfactory load lift distance from a short ram stroke. The ram is carried in a horizontal position in a hoist frame constructed to position the ram slightly above the hoist supporting beam surface and at one side thereof. The ram is preferably actuated by means of hydraulic fluid supplied from a pump and reservoir circuit carried by the housing on the other side of the beam support along with an electric or pneumatic motor means for driving the pump. Additionally, through appropriate location of the circuit components, a hoist housing construction is provided in which all hydraulic conduits are cast integrally in the housing and the motor, pump and reservoir units are likewise formed integrally with or housed simply within the confines of a one-piece housing. An hydraulic valve responsive to a positive pump pressure during hoist lowering operation is provided in the hoist raising circuit to prevent the hoist-raising fluid from escaping during the hoist lowering or let-down operation

unless a positive pump pressure is acting to cause lowering. This simple valve positively prevents the load from dropping or "running away" during the load lowering operation and accordingly provides an unusually safe, trouble free, hoist structure.

It is, therefore, an object of the present invention to provide an improved and greatly simplified hoist.

Another object of the present invention is to provide a short stroke hydraulic hoist for medium loads and maximum lift distance.

Still a further object of the present invention is to provide an improved hydraulic hoist having a simple yet extremely effective anti-load-overhauling device therein.

Yet another object of the present invention is to provide an inexpensive, simplified, hydraulic hoist of moderate load capacity and having infinitely variable hoisting velocity control while utilizing a unidirectional conventional motive power source.

A feature of the present invention is the utilization of a unidirectional electric motor-driven pump with a reversing valve for providing simplified lifting and lowering operations in a hydraulic hoist.

A further feature of the present invention is the utilization of a one-piece cast housing for hoists or the like whereby hydraulic conduits associated therewith may be formed integrally to eliminate all hydraulic fittings and incident leakage.

Still a further feature of the invention resides in the provision of a simple reciprocating plunger valve responsive to hydraulic pressure applied to load lowering to permit such load lowering but to prevent load lowering when no positive hydraulic pressure is applied to cause load lowering.

Still other and further objects and features of the present invention will at once become apparent to those skilled in the art from a consideration of the attached drawings wherein a preferred form of the invention is shown by way of illustration only, and wherein:

Figure 1 is a side elevational view of a hoist constructed in accordance with the principles of the present invention;

Figure 2 is an end elevational view of the hoist shown in Figure 1;

Figure 3 is a cross-sectional side elevational view taken along the line III—III of Figure 2;

Figure 4 is a cross-sectional view in plan, taken along the line IV—IV of Figure 3; and

Figure 5 is an end elevational view in cross section taken along the line V—V of Figure 4.

As shown on the drawings:

As may be seen from a consideration of the figures, the hoist of the present invention comprises a housing 10 mounted for reciprocation along a support, such as for example, an I-beam 11 by means of a plurality of pairs of spaced rollers 12. Preferably the housing 10 comprises a single alloy casting of high strength light weight material such as for example aluminum but it will, of course, be apparent that any of the stronger, though heavier, metals such as cast steel or the like may be utilized if desired. As shown, this housing is generally U-shaped in cross section and one leg thereof, hereinafter designated the left leg or bank 10*a* carries the hoisting ram apparatus while the right leg hereinafter termed the right leg or bank 10*b* carries the motivating component.

As shown, the left bank 10*a* carries rigidly mounted thereto, a power cylinder 13 having a longitudinally extending bore 14. A ram 15 is slidably mounted through end cap 16 of the cylinder 13 and carries a piston 17 having an external diameter cooperating with the bore 14. The ram 15 is provided with a yoke 18 carrying a transverse shaft 19 upon which a plurality

of rotatable sheaves 20 are mounted. At the end of the housing 10 opposite from the sheaves 20, a second transverse shaft 21 is mounted for the pivotal support of a plurality of sheaves 22. A single strand of conventional wire rope is secured at one end to the housing 10 as at 23 and is successively passed about the sheaves 20 and 22, finally leaving the lowermost sheave 22*a* and passing to an idler sheave 24 and thence to the guide sheave 25 by which it is directed into a vertical load lifting condition. Where an integral, one-piece, cast housing is provided, it is preferably slotted out of the aperture cast in the frame as at 26 to permit passage of the rope 27 and is recessed as at 28 to provide for reception of the sheave 24 and as at 29 for the reception of the guide sheave or pulley 25.

It will be understood that various numbers of sheaves 20 and 22 may be provided, depending upon the amount of lift desired and the stroke of the ram 15 considered practicable. For a relatively small, medium duty hoist, a nine inch stroke of the ram 15 with eight sheaves 20 and 22 provides a twelve foot lift. This amount of lift is ordinarily ample for small machine shop practice and the relatively small stroke of the ram 15 permits construction of the entire hoist in a relatively small housing 10.

As may be seen from a consideration of Figures 1 and 5, the housing 10 may be cast or machined with a channel 30 with the upper and lower walls 30*a* and 30*b*, respectively, machined to provide guide surfaces for the yoke 18, at the left hand end as viewed in Figure 1 and as a support for the sheaves 22, through spacers 31 at the right hand end as viewed in Figure 1. While it is, of course, possible to core the cast housing 10 to provide an integral cylinder 13, in the interests of simplicity, the cylinder 13 may be constructed separately and secured in place by a plurality of cap screws 32 which may be passed through the openings 33 in the upper channel wall 30*a* during assembly. Construction of the cylinder 13 as a separate part permits drilling of the bores 34 for the reception of the stub axles 35 of the support rollers 12.

Motive fluid under pressure, for actuating the ram 15 through piston 17 is provided on the right bank 10*b*. The general arrangement is shown in detail in Figure 3 where a longitudinally extending bore 40 contains a unidirectional electric motor armature 41 and field 42. In order to simplify mounting, and to reduce cost, the field 42 may be secured rigidly to an end plate 43 which is in turn secured to the housing 10 by means of fasteners 44. The armature 41 is rotatably supported as at 45 in the plate 43 and in the housing 10 by means of a bearing 46 secured by a retainer 47.

The motor armature 41 is rigidly secured to an output driveshaft 48 which in turn drives a relatively high pressure oil pump herein illustrated as a gear pump 49, through a gear connection 50. The pump 49 may, of course, comprise any one of a number of different types of oil pumps and the gear type pump is shown as merely one satisfactory example. As in the case of the motor installation, the recesses for the gear elements of the pump 49 may be cored and machined directly in the housing 10 and closed off by a cover plate 51 to provide an integrated unit.

High pressure oil from the pump 49 is fed to a control valve generally indicated at 52 by means of a conduit 53. The control valve 52 may comprise any conventional reversing valve and is here illustrated as comprising a valve core 52*a* having a pressure port 54 which directs the output of the pump 49 to a relief conduit 55 when the valve is in neutral position, as shown in Figure 3. When the valve is moved in the counterclockwise direction fluid under pressure is directed through bore 56 to power cylinder conduit 57 and when rotated in the clockwise direction the port 54 is aligned with the cylinder conduit 58. Movement away from the neutral position will in each case cause a closing of the relief bore 59 so that pressure may build up in the hoist cylinder. At the same time that either of the cylinder conduits 57 or 58 is pressurized, the other is vented to the relief passage 55 by means of a port 60 which leads to a relief port 61 connected to the conduit 55 through a passage 62 extending longitudinally of the valve bore. The relief passage 55 leads directly to a storage reservoir 63 from which oil proceeds to the pump 49 via conduit 64.

As may be seen from a consideration of Figure 5, the cylinder conduit 57 passes through the housing 10*a* in the form of a transverse conduit 65 and, when under pressure, unseats a check valve 66 to apply pressure against the ram piston 17 to cause lifting movement of the rope 27. During such operation, the conduit 58 and its corresponding transverse conduit 67 are relieved of pressure through the port 60 and accordingly the piston 17 is unlocked and free to move. Upon lowering operation, however, the check valve 66 will close and fluid trapped between the piston 17 and the right hand end of the cylinder as viewed in Figure 1 may only pass back to the reservoir by means of a valve 68. The valve 68, which is shown in Figure 1, comprises a reciprocable core movable into the open position upon the application of fluid pressure to a longitudinally extending conduit 69 which is in hydraulic connection with conduits 58 and 67. Accordingly, when pressure is applied to the conduits 58 and 67 to positively lower the load, the valve 68 is moved to the right as viewed in Figure 1 to open a fluid path to the conduit 65, thereby unlocking the ram piston 17. However, if any attempt is made by the load to overrun the force tending to lower the load, the pressure would tend to drop in the conduit 69 and the valve 68 will accordingly close and prevent right hand movement of the piston 17. Thus, an effective load-overhauling preventive device is incorporated in the system.

As illustrated in the drawings, all of the necessary hydraulic conduits may be integrally bored in the housing 10 and accordingly the only possibilities for leakage occur at the various closure plugs 70. These plugs are a conventional type taper plug and when properly fitted will cause absolutely no maintenance problem. Accordingly, leakage of the hydraulic system ordinarily encountered in hydraulic devices having externally mounted conduits, is completely eliminated in the instant hoist apparatus. Further, by coring or drilling the housing 10 to provide for not only the motor 41 but also the pump 49, the valve 52 and the reservoir 63, an extremely inexpensive and strong system is provided.

In operation, the valve core 52 may be rotated by means of an extending valve stem 71 connected to a rope operated rocker arm 72 for manual operation from below. Preferably, a push button switch of any conventional design is attached to the control rope leading from the rocker arm 72 for purposes of energizing the motor when the hoist is to be placed in operation. In view of the reversing nature of the valve, however, it will be understood that the motor may be left running constantly during operation of the hoist and that all control of the hoist may be accomplished, insofar as lifting and lowering is concerned, through actuation of the valve 52. Infinitely variable speed control is provided for the hoist lifting by the valve 52 since the relief port 55 is gradually closed off with rotation of the valve control stem 71. This gradual closing permits a gradual build-up and complete control of the pressure applied to the cylinder conduits 57 and 58 and accordingly the load may be lifted very gradually even though it is low in weight. It will be apparent, of course, to those skilled in the art that the utilization of the most inexpensive type of unidirectional electric motor is permissible with the present hoist since the motor is completely independent of the lifting parts. Thus, the motor need not only not have reversibility but its inertia characteristic, or ability to stop and start in short spaces

of time, is in no sense critical. This is an important advantage over prior art hoist structures in which expensive electrical components have been considered essential to satisfactory operation.

As above described, the load-overhauling preventing valve **68** will prevent dropping of the load under all circumstances. This is an important safety feature but it is recognized that in some instances it may be desirable to lower the load during a power failure or other circumstances which would make it impossible to apply pressure to the valve control conduit **69**. Accordingly, the valve core **68** which is ordinarily spring biased into valve closed position by a spring **73**, may be manually moved into the valve-open position by means of a knob **74** which may be appropriately indicated to be an emergency lowering control.

It will thus be seen that I have provided a novel hoist capable of operation with an overhead supporting beam, such as for example an I-beam, which requires substantially no head room and which provides utmost strength with a minimum of manufacturing cost.

While it will be apparent that the component parts may be varied as to dimension and power, it has been found that a very satisfactory moderate load may be provided where the motor **41** comprises a one-half horsepower 1800 r.p.m. motor driving the gear pump **49** to provide an oil pressure maximum of 1500 pounds per square inch. Using these components, a fairly wide range of load capacities may be provided merely by changing the diameter of the piston **17**. With a piston diameter of four inches, however, and utilizing a maximum hydraulic pump outlet pressure of 1500 pounds per square inch with a 16 to 1 lift-to-stroke ratio, a load capacity of over 1000 pounds may readily be provided.

While not shown in the drawings it will be understood that the hoist of the present invention may be powered to move the housing **10** along the rail **11** in a simple manner. For example, any one or more of the rollers **12** may be actuated by a reversible hydraulic motor deriving its source of power from hydraulic conduit **53** through a conventional reversing valve under manual control. For example, the roller **12** shown in the lower left hand corner of the housing **10** in Figure 4 may be driven by a hydraulic motor controlled by a second valve positioned beside the valve **52** and controlling the fluid from the high pressure conduit **53**. Rotation of the roller **12** will, of course, cause the housing **10**, with the load carried thereby, to move along the rail **11** to any position desired and this additional power may accordingly be found desirable where the hoist is to be used with large, ungainly objects or the like.

It will, of course, be understood that still further variations and modifications may be made in accordance with the principles of the present invention without departing from the scope of the novel concepts thereof. Accordingly, it is my intention that the scope of the present invention be limited solely by that of the hereinafter appended claims.

I claim as my invention:

1. A unitary hoist apparatus comprising a one-piece housing having an upwardly opening channel extending longitudinally therealong, a hydraulic hoisting ram secured to said housing on one side of said channel and extending longitudinally therealong, said ram comprising a reciprocal piston rod carrying sheave means, sheave means on said housing and a hoisting cable trained about said sheave means for lifting movement when said piston rod is extended, a cable guide in said housing immediately under said channel and guide means directing said cable from said sheave means to said cable guide to thereby direct said hoisting cable downwardly in a substantially vertical direction from the same point at all times immediately under said housing means, hydraulic means on the other side of said channel for reciprocating said ram during hoisting operations, said hydraulic means comprising a pump, a reversing valve and a hydraulic fluid reservoir all integrally housed in said housing, motor means for driving said pump, and a pair of hydraulic conduits beneath said channel and connecting said valve with opposite sides of said ram to control reciprocation of said piston rod, said conduits comprising the sole drive connection between opposite sides of said channels.

2. A hydraulic hoist comprising a housing having a centrally mounted support means for maintaining said hoist in an overhead position, a substantially horizontally disposed hydraulic ram positioned on one side of said support means, said ram comprising a reciprocal piston rod carrying a plurality of rotatable sheaves, a second group of rotatable sheaves mounted about a fixed pivot on said housing, said pivot comprising an axis lying transverse and substantially normal to the axis of reciprocation of said rod, rope means trained about said sheaves and having one end secured to said housing and the other end trained over a sheave discharging said end in a substantially vertical direction immediately under said support means, hydraulic fluid pressure source means positioned on the side of said support means opposite from said ram and a pair of hydraulic conduits connecting said source means to said ram transversely of said support means for reciprocation thereof in opposite directions, and interlock means between said pair of conduits for preventing reverse flow through the one thereof applying a lifting force to said ram unless a positive pressure is applied to the other tending to lower the ram.

3. A hydraulic hoist comprising a housing having a centrally mounted support means for maintaining said hoist in an overhead position, a substantially horizontally disposed hydraulic ram positioned on one side of said support means, said ram comprising a reciprocal piston rod carrying a plurality of rotatable sheaves, a second group of rotatable sheaves mounted about a fixed pivot on said housing, said pivot comprising an axis lying transverse and substantially normal to the axis of reciprocation of said rod, rope means trained about said sheaves and having one end secured to said housing and the other end trained over a sheave discharging said end in a substantially vertical direction immediately under said support means, and hydraulic fluid pressure source means positioned on the side of said support means opposite from said ram, and a pair of conduits connecting said source means to said ram for reciprocation thereof, said source of fluid under pressure comprising a fluid pump, a valve, a fluid reservoir, and a motor for driving said pump, said motor, pump, valve, conduits, and reservoir each having the housing thereof formed integrally with said hoist housing.

4. A hydraulic hoist comprising a housing having a centrally mounted support means for maintaining said hoist in an overhead position, a substantially horizontally disposed hydraulic ram positioned on one side of said support means, said ram comprising a reciprocal piston rod carrying a plurality of rotatable sheaves, a second group of rotatable sheaves mounted about a fixed pivot on said housing, said pivot comprising an axis lying transverse and substantially normal to the axis of reciprocation of said rod, rope means trained about said sheaves and having one end secured to said housing and the other end trained over a sheave discharging said end in a substantially vertical direction immediately under said support means, and hydraulic fluid pressure source means positioned on the side of said support means opposite from said ram and connected to said ram for reciprocation thereof, said source of fluid under pressure comprising a fluid pump, a valve, a fluid reservoir, and a motor for driving said pump, said motor, pump, valve, and reservoir each having the housing thereof formed integrally with said hoist housing, and said pump comprising a rotary gear pump having a pair of meshed gears rotatably mounted in overlapping cylin-

drical bores in said hoist housing, and a cover plate secured over said bores to provide an enclosed pump housing.

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