

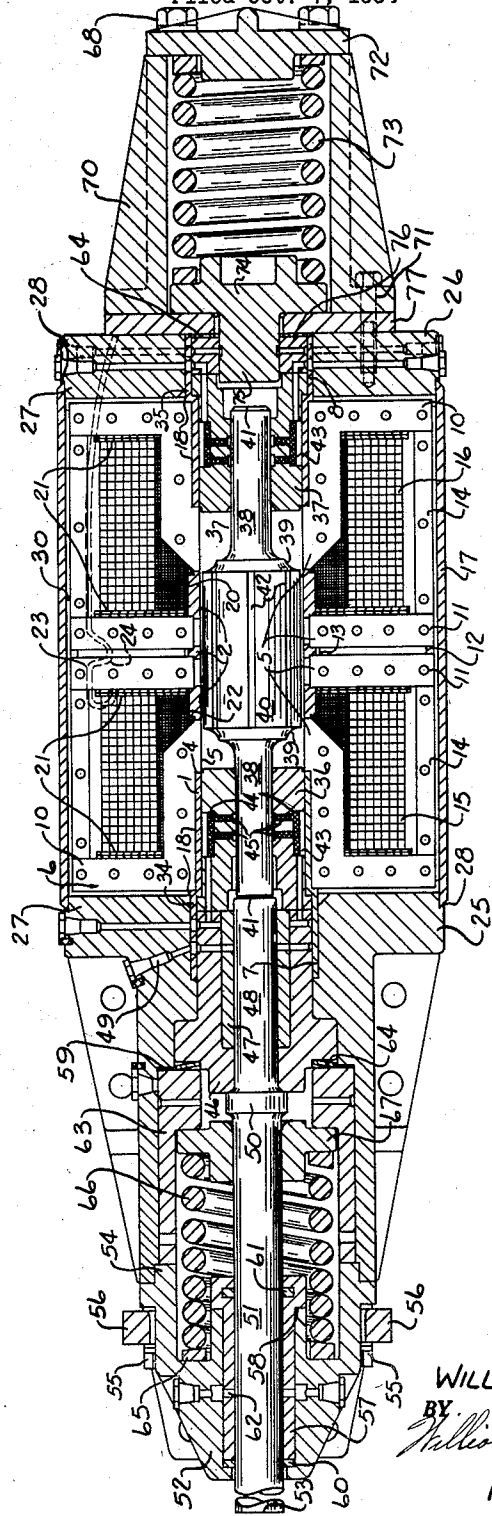
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ELECTROMAGNETIC RECIPROCATING HAMMER

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ELECTROMAGNETIC RECIPROCATING HAMMER

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4 Claims. (Cl. 255—37)

This invention relates generally to electric hammers and more particularly to improvements in the construction of the movable parts and their associated parts of electric hammers.

The electric hammer comprising this invention is large and heavy being made for mounting on a mining machine or similar apparatus for having its tool operate independently. The free magnetic piston or core in this hammer reciprocates to follow the fields of alternate coils energized by intermittent current impulses and moves through a stroke of one inch at the rate of 1,800 cycles per minute delivering a striking force of 30,000 pounds, measured by means of a strain gauge, with the hammer mounted on a special test stand.

This force in a free body requires guided distribution of the forces expended within the hammer during its reciprocation. A principal object of this invention is the provision of an impact plate to receive the spring biased force of a core stop after being disengaged by the core. This impact plate relieves the core bearing assembly of this force.

Another object of this invention is the provision of stepped ends between the stems and the body of the core. These stepped ends being smaller in diameter than the body and larger than the stems are not as effective on the magnetic flux, yet they provide the needed strength at this great change in radii from the body to the stems.

Another object of this invention is the provision of reduced clearance to limit the travel of the tool stop seat and prevent continuous flexing of the spring disk between the tool bushing assembly and the tool stop seat. This spring disk maintains pressure on these parts keeping them in contact with each other. The return stroke of the tool by its spring acting through the tool stop exerts pressure on the flange of the tool until the tool stop engages the tool stop seat at which time the spring force acts to compress the disk through only a limited extent of the spring disk which still maintains pressure because the shoulder in the nose casting prevents further flexing of the tool bushing assembly and the tool stop seat. This limited flexing of the spring disk permits the latter to accomplish its purpose and at the same time avoids excessive flexing which breaks the spring disk due to fatigue.

Other objects and advantages of this invention appear hereinafter in the following description and claims.

The accompanying drawing shows for the purpose of exemplification without limiting the invention or claims thereto, certain practical embodiments of the invention wherein the single view is in horizontal section of the electric hammer.

Referring to the drawing, the electric hammer is constructed on the stainless steel barrel 1 which has a cylindrical bore 2 that forms the magnetic piston chamber 3. The exterior of the barrel 1 has hexagonal faces that are

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provided with windows 4 to receive the pole ends 5 of the laminated core 6. The ends 7 and 8 of the barrel 1 are cylindrical externally as well as internally.

Each of the six faces on the barrel 1 is provided with three sets of laminations, two L-shaped 10 and one straight dual section 11 as shown in Patents 2,354,723 and 2,439,230. As shown in the first patent the straight dual sections 11 are connected with a heavy center plate 12 which stops short of the barrel as shown at 13 and does not extend to the outer surface as indicated. Each L-shaped lamination 10 is connected to one of the dual sections 11 by a straight outer lamination member 14 to close the outer magnetic circuit over the coils 15 and 16. This avoids excessive magnetic losses in the outer steel cylindrical casing 17.

Each of the six sets of laminations 10 and 11 are welded along only one side and at their ends to the exterior of the barrel, as indicated at 18. This breaks the path of the eddy currents by having the laminations welded only on one side and at the ends.

Each circular set of the laminations 10 and 11 has high temperature insulating cord 20 wound between the insulating ends 21 to fill up the interlocking notches in the laminations as the magnetic gap 22 and thus provide a base for the coil. Each coil is wound of square wire which aids in locking the coil in place where wire of circular cross section may shift. Again a number of circular mils may be obtained for a given length and number of turns of wire. The coil leads 23 are brought out between the coils and are provided with expansion loops 24, to avoid destruction of the coil due to expansion and contraction due to heat; as these coils are not ventilated but are completely enclosed.

The end castings 25 and 26 are mounted to engage the cylindrical ends 7 and 8 of the barrel 1 which seat on shoulders in these end castings and prevent these end castings from engaging the coil laminations. These end castings are made of manganese bronze and each is provided with a cylindrical seat 27 of material width which terminates in the sharp groove 28. The ends of the casing 17 have a beveled sharp edge that fits into the sharp grooves 28 and their inner surfaces are machined to tightly fit on the seats 27 to provide a gastight seal of the coil chamber 30 within the case 17.

Tie rods, not shown, are bolted to the front end casting 25 and the rear end casting 26. These tie rods cause the ends of the casing 17 to bite into the V-shaped grooves 28 of the end castings and hold the latter castings in assembled relation with the barrel 1 and the outer casing 17.

The cylindrical bore of the barrel 1 has the shoulders 34 and 35 for receiving the complementary shoulders on the bearings 36 and 37 which are accurately formed and positioned to provide aligned bores in which to receive the stems 38 of the free electromagnetic piston 40. The piston 40 must be of magnetic material. It must be integral, made of one piece, and it must be strong. It is therefore constructed as a forging. Between the body of the core, the stems 38 and the piston 40 an annular step 39 is formed. The annular step is filleted to the small diameter of the stems 38 and is also filleted to the large diameter of the central body of the core. These stepped and filleted reinforcements of this forging materially strengthen the piston where a great reduction in diameter is required. However, these stepped fillets do not alter the operation of this magnetic core. It is preferable to polish these fillets as well as the other faces of this core. This maintains a smooth surface that is not apt to fracture due to the high impact loads it must transmit.

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The ends of the piston stems 38 have the contact surfaces capped with stellite by welding the same thereto, as indicated at 41.

The body of the piston 40 is fluted longitudinally by eight slots 42 which are cut approximately one quarter of an inch deep. These slots serve two purposes of equal importance. One, they reduce the eddy currents by interrupting their paths of flow. Secondly, they provide channels through which the atmosphere in the piston chamber 3 may be quickly forced from one end of the chamber to the other and avoid the generation of excessive pressure and rarefaction zones.

The bearings 36 and 37 provide for only a few thousandths of an inch for sliding clearance between the stems and bores of these bearings. Each bearing has an annular external groove 43 which has an annular wick 44 and radial wicks 45 which conducts the oil to the surface of the stems. These oil reservoirs 43 are lubricated through passages that extend from the bearings 36 and 37 into the end castings 25 and 26 where they extend to the surface and are provided with ball check oil seal fittings.

The front end casting 25 has the tool bushing assembly mounted in its inner end and which comprises the housing 46 which is bored from its inner end to receive the tool bushing 47 that slidably supports the tool shank 48 that is lubricated from the passage 49.

The shoulder 50 of the tool is approximately three-fourths of an inch thick and the fillets to the tool shank 48 and the tool bits 51 are three-eighths of an inch. The shank 48 is ground to one and one-half inches, whereas the tool 51 is ground to 1.875 inches for a distance of thirteen inches from the shoulder edge. This is larger than the shank and extends to the end of the nose casting 52. The tool is thirty inches over-all, the shank is six inches, thus the balance of the bit is approximately ten and one-quarter of an inch long and this length tapers from 1.875 inches to 1.5 inches and the end of the bit is a flat transverse face 53. These dimensions are important owing to the manner that the tool is supported.

The end casting 25 extends forwardly and has an internal shoulder 54 to receive the inner end of the nose casting which is bolted thereto by the bolts 55 which also bolt on the roof trimming blade 56 which has a sharpened tooth to chip the roof smooth as the whole hammer is reciprocated. The nose casting 52 is bored to receive the bearing 57 which rests on the shoulder 58, leaving space for the circular ring packing 60. Another ring packing 61 is mounted in a groove adjacent the other end of the bearing 57. Thus the bearings 47 and 57 suspend the tool and one is mounted in the housing 46 and the other in the nose casting 52, both of which are aligned in coaxial bores in the end casting 25. Lubricating passageway 62 is provided to lubricate the tool bit 51 through the nose casting between the ring seals.

A lock sleeve 63 is a tool stop seat placed in the bore of the end casting 25 and abuts the nose casting 52 at one end but is spaced from the housing 46 at its other end. This space provides room for the continuous circular spring washer 64. The clearance 59 between the end of the end casting 25 and the lock sleeve or tool stop seat 63 is materially less than the clearance between the lock sleeve 63 and the bearing housing 46 where the circular spring washer is seated. The reason for this is to prevent the spring 66 from collapsing the washer 64 at each stroke of the piston causing fatigue of the spring washer. Thus by reducing the clearance 59 the spring washer 64 is flexed very little and it continues to maintain its pressure between these parts.

The interior of the nose casting has a seat 65 to receive one end of the coil spring 66, the other end of which engages the spring seat 67. This spring seat 67 has clearance with the tool bit 51 and the bore of the lock sleeve 63.

A bell opening is provided in the bores of the housing

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46 and the spring seat 67 to receive the filleted sides of the tool shoulder 50 which engages both of these parts, the first as a rebound from the coil or due to the spring and secondly at the end of the power stroke when the piston stem 38 engages the shank 48 of the tool.

The end casting 26 has the rear spring support 70 bolted thereto by the bolts 71. The support 70 is open and has an end cap 72 which seats the outer end of the spring 73 and is secured by the bolts 68. The springs 66 and 73 are the same in size and shape. The other end of the spring 73 engages the solid core stop 74 which has a projection 75 that reciprocates in the bore of the core stop guide 76 which is retained by the heavy plate 77 bolted between the end casting 26 and the spring support or head casting 70. The core stop 74 engages the impact plate 77 when the stem of the core leaves the stop 74. The force of the core stop striking the impact plate 77 is due to the spring 73. None of these forces are transmitted axially to the bearing 37 or the core stop guide 76.

When the coils 15 and 16 are energized by alternate electric impulses the core piston 40 reciprocates toward the center of one coil then the center of the other coil causing the capped ends to strike the projection 75 of the core stop 74 compressing the spring 73 and then traveling in the opposite direction to strike the shank 48 of the tool bit 51 which moves the tool against the work being performed in the ground until the flange 50 strikes the spring seat 67 to compress the spring 66. As the piston 40 returns the spring 66 acts through the spring seat 67 to force the tool stop seat 63 to strike the nose casting 25. The bearing housing is thus relieved from this return blow of the spring 66. The same is true of the opposite end of the hammer where the heavy impact plate 77 and the casting 26 takes the blow of the spring 73 through the core stop 74 and the bearing assembly 37 is relieved of this shock.

I claim:

1. An electromagnetic reciprocating hammer comprising a tubular housing having spaced coaxially mounted coils, a nose casting on one end and a head casting on the other end of said housing, a magnetic core reciprocally mounted in said housing and operated by said coils, said core having a body portion with a stem at each end, bearings carried by said housing to slidably support said stems, said nose casting carries a tool with a flange and having a bit end and a shank end on opposite sides of the flange, a tool stop engaging said tool flange, spring means in said nose casting urging said tool stop against the flange of said tool, a tool stop seat slidable with limited clearance in said nose casting and engaged by said tool stop, a tool shank bushing, and a spring disc between the tool stop seat and the bushing capable of greater flexible movement when in place than the tool stop seat clearance will allow.

2. An electromagnetic reciprocating hammer having a tubular barrel carrying bearings and nose and head castings at opposite ends with spaced coaxially mounted coils mounted between said castings, a magnetic core having a body portion with axially projecting stems slidably supported in said bearings to reciprocally support said body portion in the barrel under the effect of the magnetic field produced by the alternate energization of said coils, characterized in that the body and stems of said core are made from a single integral piece of magnetic material, and an annular step of reduced diameter formed between the body and each stem to make the magnetic flux less effective on the core ends.

3. The electromagnetic reciprocating hammer of claim 2 characterized in that each of said steps has a fillet to the small diameter of each stem and a fillet to the large diameter of said body portion.

4. An electromagnetic reciprocating hammer comprising a tubular housing having spaced coaxially mounted coils, a nose casting on one end and a head casting on

the other end of said housing, a magnetic core reciprocally mounted in said housing and operated by said coils, said core having a body portion with a stem at each end, bearings carried by said housing to slidably support said stems, a retaining impact plate mounted transversely between said head casting and said housing and having a transverse opening aligned with the core stem, a core stop seated on the outer face of said plate, a projection on said core stop extending through said plate opening into said bearing in the path of said core stem, and 10 spring means urging said core stop against said plate.

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