

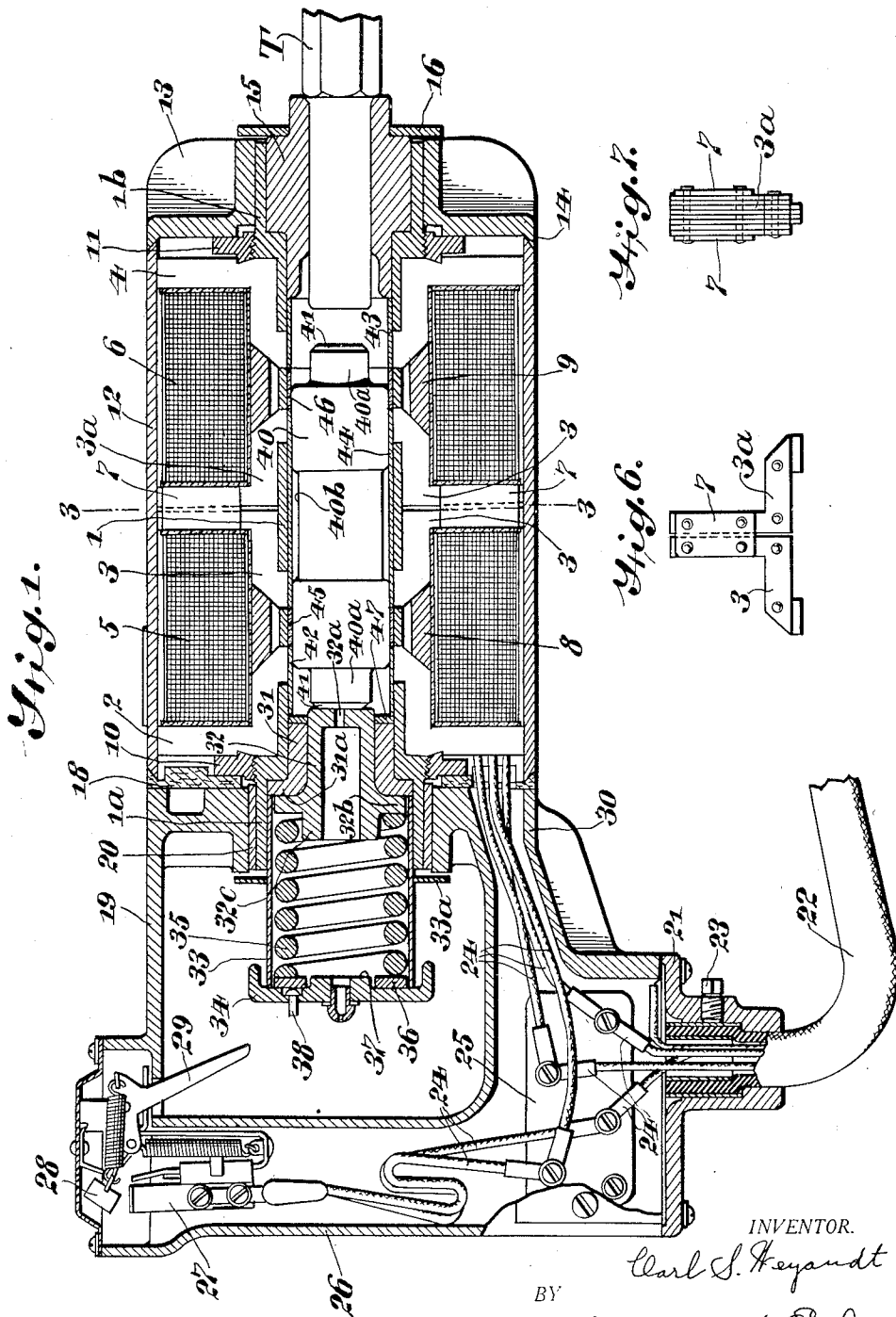
March 12, 1929.

C. S. WEYANDT
RECIPROCATING MOTOR

1,705,079

Filed May 5, 1926

3 Sheets-Sheet 1



INVENTOR.

Carl S. Weyandt

BY

Cornelius L. Chet
ATTORNEY.

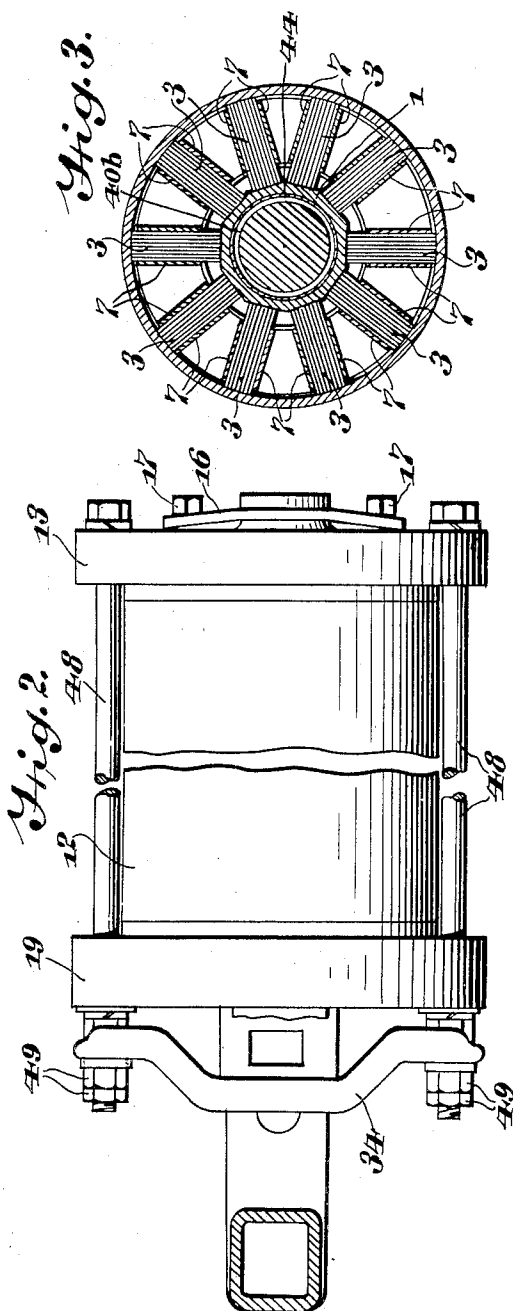
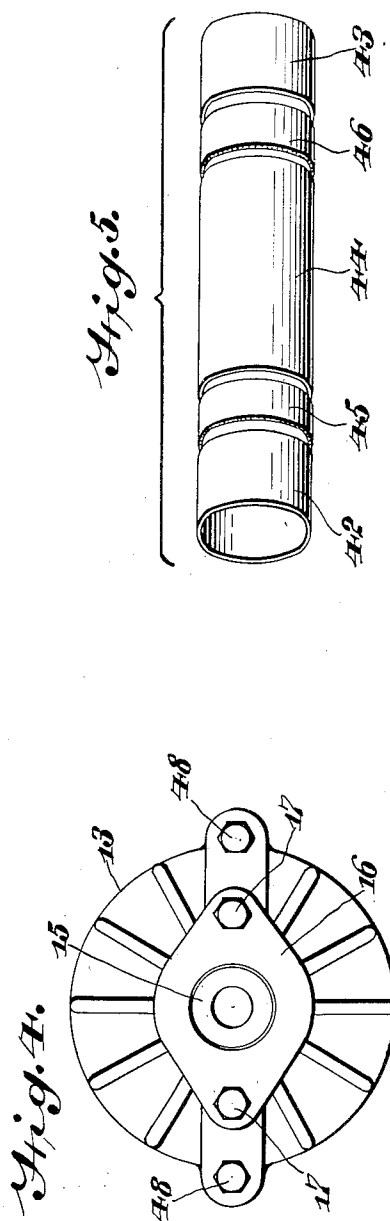
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3 Sheets-Sheet 2



INVENTOR.
Carl S. Weyandt
BY
Cornelius L. Chet
his ATTORNEY.

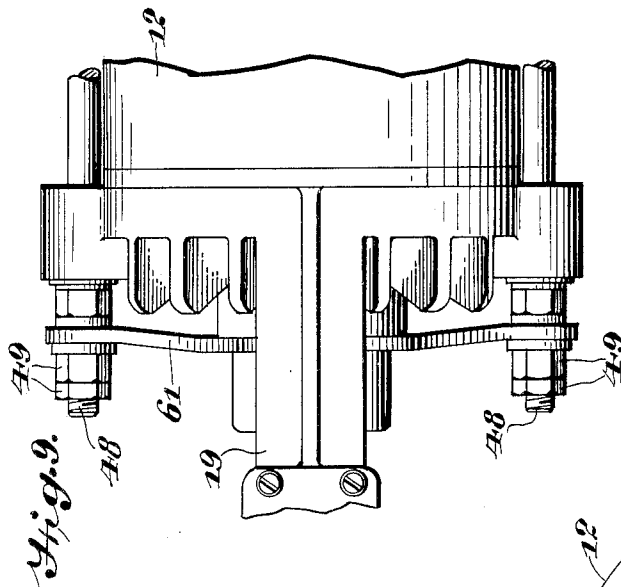
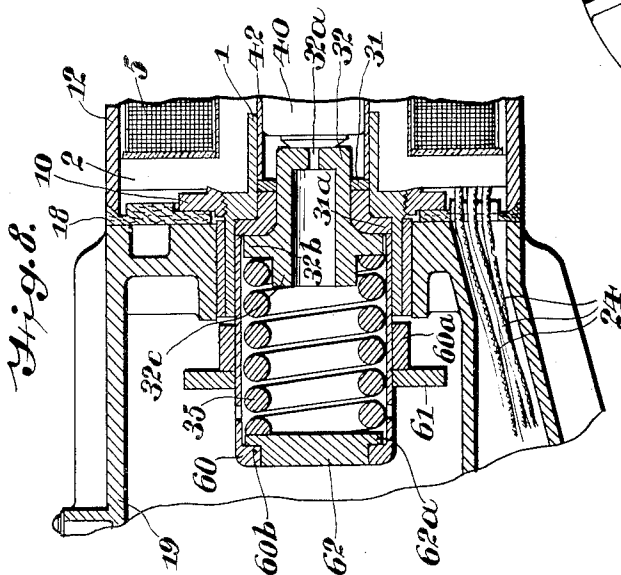
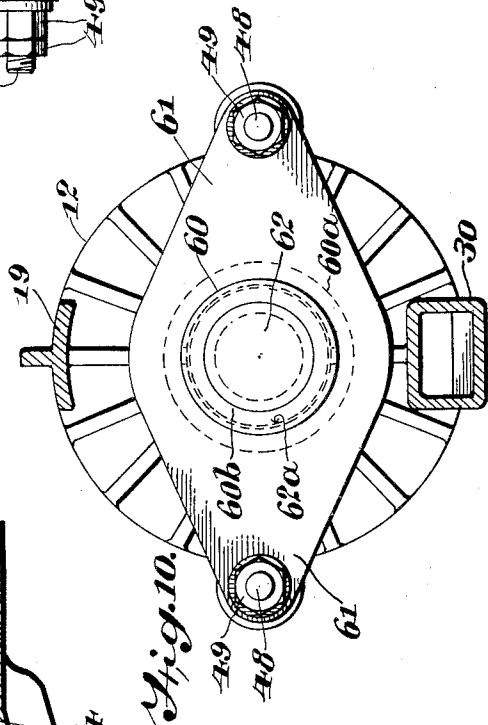
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3 Sheets-Sheet 3



INVENTOR.
Carl S. Weyandt
BY
Cornelius L. E. Lee
his ATTORNEY.

UNITED STATES PATENT OFFICE.

CARL S. WEYANDT, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO CENTRAL ELECTRIC TOOL COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

RECIPROCATING MOTOR.

Application filed May 5, 1926. Serial No. 106,811.

My invention relates to electric motors of the reciprocating type, particularly such as are utilizable as percussive tools for drilling, cutting, chipping, riveting or otherwise working metal, stone, concrete and the like.

In accordance with my invention, the impact of the reciprocatory core system of a tool of the character referred to is absorbed by novel structure comprising a buffer spring maintained in predetermined position at the end of a barrel within which the core system reciprocates by a clamp or member secured to the tool handle, the barrel aforesaid having secured therewithin a bearing bushing receiving an impact member with one end of which the core system contacts and whose other end engages the buffer spring, and more particularly, all of the parts of the aforesaid shock-absorbing structure are freely removable upon disconnection of the clamp or member from the tool handle.

Further in accordance with my invention, the reciprocatory core or piston of a tool of the character referred to is provided with a circumferential groove preferably symmetrically arranged with respect to the ends of the core or piston which are likewise preferably reduced in diameter.

Further in accordance with my invention, within the barrel of a tool of the character described there is inserted a liner structure with which the reciprocatory core frictionally engages, and more particularly, the liner structure comprises magnetic and non-magnetic portions, the former lying within the zone enclosed by the pole tips of the magnetizable members comprised in the tool-operating mechanism, and the latter lying without said zone.

My invention resides in features and details of construction of the character hereinafter described and claimed.

For an illustration of one of the forms my invention may take, reference is to be had to the accompanying drawings, in which:

Fig. 1 is a vertical sectional view of apparatus constructed in accordance with my invention.

Fig. 2 is an elevational view of the same.

Fig. 3 is a transverse vertical sectional view on the line 3—3 of Fig. 1.

Fig. 4 is an end view of structure shown in Figs. 1 and 2.

Fig. 5 is a perspective view of a liner structure.

Fig. 6 is a side elevational view of a group of laminations.

Fig. 7 is a vertical sectional view of the structure shown in Fig. 6.

Fig. 8 is a fragmentary vertical sectional view of a modified form of buffer structure.

Fig. 9 is a side elevational view of the structure shown in Fig. 8.

Fig. 10 is an end view, partly in vertical section, of the structure shown in Figs. 8 and 9.

Referring to Fig. 1, 1 is a barrel or tubular frame or member, of metal, such as brass or bronze, and preferably of a light weight alloy, as an aluminum alloy, such as duralumin, of sufficiently high tensile strength, effecting both decrease in weight of the motor and reducing the loss represented by currents induced in the tubular frame by the fluctuating magnetic field with which it is associated, this reduction of induced current losses being due to the fact that the specific resistance of the alloy is relatively high. The front and rear ends are enlarged as indicated, respectively, at 1^a and 1^b for a purpose hereinafter described.

Disposed upon the exterior of the barrel 1 are the circumferentially disposed groups of laminæ 2, 3, 3^a and 4, of silicon steel or other suitable magnetic core material. The central groups of laminations 3 and 3^a, disposed adjacent the windings or solenoids 5 and 6, are arranged circumferentially upon the flat external sides of the barrel 1. As clearly illustrated in Figs. 3, 6 and 7, individual laminations forming a group 3 are held in suitable spaced relation with respect to an aligned group 3^a by rectangular blocks 7 or the like, of suitable material, as brass, disposed on each side of the individual groups and suitably connected thereto, as by rivets. The laminations 2 and 4 may be similarly disposed in circumferential groups upon the external surface of barrel 1.

As indicated in Fig. 1, the inner ends or pole tips of the laminations extend through openings in the barrel 1, the inner ends of the laminations coming flush with the inner cylindrical wall of said barrel. As illustrat-

ed, the pole tips of the various groups of laminations are of substantially equal length, although it shall be understood that the pole tip lengths of the various groups may be varied as desired.

External to the barrel 1 and in the space between the laminations 2 and 3 is the clamping member 8, while in the space between the laminations 3^a and 4 is the clamping member 9 of any suitable material, preferably a light alloy of suitably high specific resistance, such, for example, as the aluminum alloy constituting the barrel 1, whereby not only is the weight of the motor reduced, but the waste currents induced in the members 7 and 8 are decreased. The pole tip ends of the laminations are bevelled as indicated, as also are the ends of the clamping members 8 and 9, which latter are held to the barrel 1 by screws or the like, not shown.

Upon the enlarged end 1^a of barrel 1 is threaded the annular nut 10 constituting a somewhat beveled abutment against which engage complementarily beveled edges of the laminations 2. Upon the other enlarged end 1^b of barrel 1 is similarly threaded the beveled annular nut 11 thrusting against the complementarily beveled laminations 4, holding the different groups of laminations as a unit upon the barrel and causing the beveled edges or the clamping members 8 and 9 to engage or be engaged by the associated beveled laminations, the beveling of nuts and laminations forcing the latter toward the barrel 1. Annular nuts 10 and 11 are of suitable non-magnetic material, as bronze or duralumin.

An enclosing casing 12, of silicon steel or other suitable magnetizable material, is comprised in the magnetic circuits and is engaged or closely approached upon its inner surface by the outer ends of the laminations 2, 3, 3^a and 4.

On the lower end of the motor is the end plate or closure member 13 surrounding the lower end of the enlarged portion 1^b of barrel 1, abutting against the annular nut 11 and having an annular beveled surface 14 abutting against the complementary beveled end of casing 12. Disposed within the barrel enlarged portion 1^b is a tubular member or bushing 15, of suitable material preferably magnetic in character, held in position by a bridge or clip 16 seated on a shouldered portion thereof and secured to the member 13 by bolts 17, Figs. 1 and 2.

A washer 18, of suitable material, as fibre, having an annular beveled surface engaging the complementarily beveled surface of casing 12, is disposed between the nut 10 and the end of a handle unit or member 19 received on the enlarged end 1^a of barrel 1, a cylindrical member 20 of fibre preferably being disposed between the otherwise engaging surfaces.

One side or face of handle unit 19 is closed by a housing 21, to which a cable 22 is suitably secured, as by the set screw 23. Cable 22 comprises a plurality of conductors 24 connected to a panel 25 suitably secured interiorly of the handle unit. From panel 25 a pair of the conductors 24 extend through the hollow handle portion 26 and are connected, respectively to the flexible spring-like members 27 adapted to be bridged by the member 28 controlled by the trigger 29 extending within the handle unit 19. Other conductors 24 extend through a hollow portion 30 of the handle unit and a perforation in washer 18, and are suitably connected to the windings 5 and 6.

A bearing bushing 31 extends within the barrel 1 and terminates in a flange 31^a resting upon a flanged portion of said barrel. A buffer member 32, preferably hollow and having an air passage 32^a, extends through and beyond the bearing bushing 31 and comprises a flange 32^b and an open-ended sleeve 32^c. Bushing 31 and buffer 32 are preferably of magnetic material, and in the example shown are of hard steel.

A cylindrical member or tube 33 comprising a fin-like portion 33^a is mounted within the enlarged end 1^a of barrel 1, the inner end thereof normally encircling the flange 32^b and resting upon flange 31^a. A transverse clamp 34, secured to the handle unit 19 as hereinafter described, closes the end of cylinder 33. One end of a relatively heavy coiled spring 35 confined within cylinder 33 rests upon flange 33^b and encircles the sleeve 32^c, while its other end bears against a washer 36 resting upon the inner surface of clamp 34, said washer being positioned centrally of cylinder 33 by a centering lug or projection 37 preferably formed integrally with clamp 34. The shank of a rivet 38 extends from a region outwardly of clamp 34 freely through a perforation therein, and its head is confined within a recess in said clamp by washer 36 when buffer spring 35 occupies the position shown in Fig. 1. Ordinarily, it is desirable that clamp 34 be provided with an air vent 39 opening into the cylinder 33.

Slidably mounted within the bushing 15 is the shank of a tool T of any suitable character, such, for example, as is utilizable for drilling, cutting, chipping, riveting or otherwise working metal, stone, concrete and the like.

In accordance with my invention, tool T is struck by an impact member, piston or core 40, which may be of the character disclosed in my prior application Serial No. 19,311, filed March 30, 1925, wherein the magnetizable core has secured thereto non-magnetic end portions. As shown, core 40 is formed of a single piece of suitable magnetic material, each of whose ends 40^a is cylindrical, of reduced diameter, and preferably capped

with stellite, as indicated at 41, Fig. 1. By preference, the core end 40^a adjacent the buffer member 32 is of a diameter somewhat smaller than the internal diameter of bushing 31. In the example shown, the central portion of core 40 is provided with a circumferential groove 40^b of substantial length, and which may have a depth of the order of $\frac{3}{8}$ of an inch, more or less.

While the core 40 reciprocates within the barrel 1, it is prevented from contacting therewith by a composite liner tube comprising, in the example shown, the end cylindrical members 42 and 43, Figs. 1 and 5, and a centrally disposed cylindrical member 44, all of suitable magnetic material, as steel, the central member 44 being spaced from the end members 42 and 43 by the similar cylindrical members 45 and 46 of suitable non-magnetic material, as linen impregnated with a phenol condensation product. As illustrated in Fig. 1, the non-magnetic members 45 and 46, respectively, span the air gaps between the laminations 2 and 3 on the one hand, and 4 and 3 on the other hand. Disposed between the non-magnetic members 45 and 46 is the central magnetic member 44, while the end magnetic member 42 is disposed between the non-magnetic member 45 and a lock washer 47 bearing against the end of bushing 31. The other end of magnetic member 43 is disposed between the non-magnetic member 46 and the inner end of bushing 15. The washer 47 applies an end thrust to the various cylindrical members comprising the liner tube for retaining them firmly in place, thereby preventing chattering and providing for the longitudinal expansion of the liner tube due to heat.

The ends of transverse clamp 34 receive the bolts 48 passing through the closure member 13 and handle unit 19, and, through the agency of one or more nuts 49 threaded on the end of each bolt 48, clamp 34 is fixed in position and the closure member 13, casing 12 and handle 19 are clamped into a unitary structure, Fig. 2.

It has been found from experience that when the center laminae 3, 3^a are separated and maintained in position by the plates 7 as described above, the coils or windings 5 and 6 should be so connected that the polarity is in the same direction as with a common lamination, that is, so that the flux set up by both windings passes through the piston 40 in the same direction, or so that it would oppose between coils.

It has also been found from experience that the starting voltage for the device may be materially decreased by providing the groove 40^b in the surface of piston 40, thereby decreasing the bearing or contacting surface between the piston and the central magnetic member 44. Moreover, it is desirable that piston 40 be constructed of but a

single piece of metal, as described above, although it shall be understood that inserts of suitable material, as manganese steel, may be substituted for the reduced piston portions 40^a, for example, as disclosed in my Patent 1,680,311, August 14, 1928.

It will be observed that the aforesaid liner tube when positioned within the barrel 1 does not disturb the magnetic action on the piston 40. The magnetic cylinders 42, 43 and 44 form magnetic extensions of the pole tips of the various groups of laminae, thereby providing flux paths devoid of gaps between the laminae groups 2, 3, 3 and 4 and the piston 40. The non-magnetic cylinder 45 merely continues the gaps between the groups of laminae 2 and 3, while the similar cylinder 46 performs the same function with respect to the laminae groups 3 and 4. Cylinders 45 and 46, while theoretically equivalent to air spaces, have the desirable mechanical function of spacing the magnetic cylinders 42, 44 and 43.

Upon removal of bolts 17 and withdrawal of bushing 15 from barrel 1, any or all of the various component parts of the liner tube may be removed from within said barrel without disturbing the same or the windings and laminations. Therefore, due to this construction, worn parts of the liner may be readily replaced.

The transversely extending clamp 34 compresses the spring 35, the amount of compression being determined by the cylinder 33, which is of predetermined length and, therefore, functions as a gage to position the ends of the spring the proper distance apart. This feature is important, for if the proper degree of compression has not been imparted to the spring, it is apt to break when subjected to continuous impacting action by vibrating piston 40.

The buffer member 32 extends through the bushing 31 into engagement with the reduced end 40^a of piston 40. As stated above, the external diameter of the piston end 40^a is preferably less than the internal diameter of bushing 31, so that if the buffer member 32, under impact, moves toward the left, Fig. 1, beyond the lock washer 47, said piston end 40^a may freely enter the bore of bushing 31.

Should the spring 35 become broken, rivet 38 will disappear from view, since it is no longer supported in its perforation in clamp 34. Accordingly, in case of faulty operation of the tool, the operator may determine at a glance if a broken spring is the cause thereof.

Obviously, if clamp 34 is disconnected, cylinder 33, spring 35, buffer member 32 or bushing 31 may be readily removed, whereby any of such parts that have become defective or worn may be readily replaced.

Referring to Figs. 8, 9 and 10, there is il-

illustrated a modified form of bumper or shock-absorbing device for the reciprocatory piston. As shown, the spring barrel 60 comprises a circumferential shoulder or flange 60^a secured to but preferably integral therewith, which engages the member or strap 61 secured at each of its ends to the tie bolts or rods 48 by the nuts 49. Barrel 60 terminates in a circumferential flange 60^b defining a cylindrical opening within which is snugly received the stem of a removable spring seating member 62 comprising a circumferential flanged portion 62^a co-acting with flange 62^b. One end of the impact spring 35 bears against the plane inner surface of member 62, while its other end rests upon flange 32^b and encircles stem 32^c of buffer member 32. Strap 61 should be constructed of good quality steel, preferably spring steel, and member 62 should be constructed of alloy steel, heat-treated to withstand wear and impact.

Strap 61 holds or clamps the end of barrel 60 in engagement with the flanged portion 32^b of buffer member 32. By properly positioning nuts 49, the strap 61 may be so adjusted as to flex or give thereby relieving the strain on spring 35.

Member 62, in addition to functioning as a removable wearing spring seat, has the further function of acting as an indicator in case spring 35 should become broken.

Preferably, barrel 60 is provided with two holes or perforations 180 degrees apart and of relatively small diameter as $\frac{3}{16}$ of an inch more or less. These holes are useful for oiling purposes and as an outlet for air on the back stroke of piston 40.

What I claim is:

1. A portable reciprocating motor comprising the combination with a reciprocating core system, means for actuating said system, and enclosing structure therefor, of an abutment, a detachable cylindrical member of predetermined length interposed between an end of said structure and said abutment, and resilient shock-absorbing means receiving the impact of said core system likewise interposed between said structure and abutment and housed substantially throughout its length by said cylindrical member.

2. A portable reciprocatory motor comprising the combination with a reciprocatory core system, means for actuating said system, and enclosing structure therefor, of handle structure adjacent one end of said enclosing structure, a clamp spaced from the end of said enclosing structure adjustably carried by said handle structure, and a buffer spring receiving the impact of said core system extending from the end of said enclosing structure into engagement with said clamp member.

3. A portable reciprocatory motor comprising the combination with a barrel ter-

minating in an enlarged end, a core system reciprocatory in said barrel, and enclosing structure therefor, of a bearing bushing having a portion seated on a shoulder within the enlarged end of said barrel, a buffer member slidable in said bearing bushing under the influence of the impact of said core system, and a buffer spring engaged by said buffer member.

4. A portable reciprocatory motor comprising the combination with a barrel terminating in an enlarged flanged end, a core system reciprocatory in said barrel, and enclosing structure therefor, of a steel bearing bushing mounted in the enlarged end of said barrel and having a flanged portion co-acting with the flanged portion of said barrel, a steel buffer member slidable in said bearing member under the influence of the impact of said core system, and a buffer spring actuated by said buffer member.

5. A portable reciprocatory motor comprising a barrel, a core system reciprocatory therein, and shock-absorbing structure therefor disposed adjacent one end of said barrel, said structure comprising a bearing bushing and a co-acting buffer member supported entirely by and within, but freely removable from said barrel.

6. In a reciprocating electric motor, a non-magnetic barrel, a magnetic core reciprocable therein, electro-magnetic means disposed on said barrel comprising magnetizable members having spaced-apart pole tips projecting through the barrel, and removable magnetic means lining the barrel within the zone enclosed by the pole tips and frictionally engaged by the core during reciprocation thereof.

7. In a reciprocating electric motor, a non-magnetic barrel, a magnetic core reciprocable therein, solenoid windings arranged in axial alignment thereon, magnetizable members for each winding having spaced-apart pole tips projecting through the barrel, and removable magnetic means lining only those portions of the barrel within the zones enclosed by the pole tips and frictionally engaged by the core during reciprocation thereof.

8. In a reciprocating electric motor, a non-magnetic barrel, a magnetic core reciprocable therein, solenoid windings arranged in axial alignment thereon, magnetizable members for each winding having spaced-apart pole tips projecting through the barrel, removable magnetic means lining those portions of the barrel within the zones enclosed by the pole tips and frictionally engaged by the core during reciprocation thereof, and non-magnetic means lining the barrel between said magnetic means.

9. In a reciprocating electric motor, a non-magnetic barrel, removable liner structure therein comprising magnetic end and

central portions and non-magnetic portions between the opposing ends of the magnetic portions, solenoids arranged in axial alignment about the barrel, magnetizable members for each solenoid having spaced-apart pole tips projecting through the barrel and into contact with the magnetic portions of the liner, the portions of said barrel between opposing pole tips enclosing the non-magnetic portions of the liner, and a removable core reciprocable within the liner and in contact therewith.

10. In a reciprocating electric motor, a non-magnetic barrel, removable liner structure therein comprising magnetic end and central portions and non-magnetic portions between the opposing ends of the magnetic portions, solenoids arranged in axial alignment about the barrel, magnetizable members for each solenoid having spaced-apart pole tips projecting through the barrel and into contact with the magnetic portions of the liner, the portions of said barrel between opposing pole tips enclosing the non-magnetic portions of the liner, a removable core reciprocable within the liner and in contact therewith, and removable means preventing longitudinal travel of the liner in the barrel.

11. In a reciprocating electric motor, a non-magnetic barrel, removable liner structure therein comprising magnetic end and central portions and non-magnetic portions between the opposing ends of the magnetic portions, solenoids arranged in axial alignment about the barrel, magnetizable members for each solenoid having spaced-apart pole tips projecting through the barrel and into contact with the magnetic portions of the liner, the portions of said barrel between opposing pole tips enclosing the non-magnetic portions of the liner, a removable core reciprocable within the liner and in contact therewith, removable means preventing longitudinal travel of the liner in the barrel, and yieldable means for exerting an end thrust on the liner.

12. The combination with a reciprocatory motor comprising a reciprocating core system, means for actuating said system, and enclosing structure therefor, of a strap secured to said enclosing structure in transverse relation with respect to the movement of said core system, a barrel in longitudinal alignment with said core system urged by said strap toward said enclosing structure, and a buffer spring confined in said barrel receiving the impact of said core system.

13. The combination with a reciprocatory motor comprising a reciprocating core system, means for actuating said system, and enclosing structure therefor, of a strap secured to said enclosing structure in transverse relation with respect to the movement of said core system, a perforated barrel in

longitudinal alignment with said core system urged by said strap toward said enclosing structure, and a buffer spring confined in said barrel receiving the impact of said core system.

14. The combination with a reciprocatory motor comprising a reciprocating core system, means for actuating said system, and enclosing structure therefor, of a strap secured to said enclosing structure in transverse relation with respect to the movement of said core system, a barrel in longitudinal alignment with said core system urged by said strap toward said enclosing structure, a removable seating member in the end of said barrel, and a buffer spring in said barrel co-acting with said member and receiving the impact of said core system.

15. The combination with a reciprocatory motor comprising a reciprocating core system, means for actuating said system, and enclosing structure therefor, of a strap secured to said enclosing structure in transverse relation with respect to the movement of said core system, a barrel in longitudinal alignment with said core system, said barrel having a shoulder between its ends engaged by said strap, and a buffer spring confined in said barrel receiving the impact of said core system.

16. A reciprocatory motor comprising the combination with a barrel terminating in a flanged end, a core system reciprocatory in said barrel, and enclosing structure therefor, of a bearing bushing co-acting with the flanged end of said barrel, a buffer member slidable in said bearing bushing under the influence of the impact of said core system, a strap secured to said enclosing structure transversely of the direction of movement of said core system, a barrel confined between said strap and buffer member, and a buffer spring in said barrel receiving the impact of said core system.

17. A reciprocatory motor comprising the combination with a barrel terminating in a flanged end, a core system reciprocatory in said barrel, and enclosing structure therefor, of a bearing bushing co-acting with the flanged end of said barrel, a buffer member slidable in said bearing bushing under the influence of the impact of said core system, a strap adjustably secured to said enclosing structure transversely of the direction of movement of said core system, a barrel confined between said strap and buffer member, a removable seating member in the end of said barrel, and a buffer spring in said barrel co-acting with said member and receiving the impact of said core system.

18. In a percussion tool, energy absorption structure comprising a cylindrical barrel, a spring plate through which a portion of said barrel extends, said plate engaging and urg-

ing the barrel in an end-wise direction, and a spring member within said barrel opposing said spring plate and tending to move said barrel in an opposite direction.

5 19. In a percussion tool, in combination, a housing, a member adapted to reciprocate within said housing, a spring plate secured to the opposite sides of said housing, a cylindrical barrel supported in said housing and
10 resiliently engaged by said spring plate, and resilient means within said barrel opposing the force exerted by the spring plate, said means adapted to absorb the energy of the backward stroke of said member.

15 20. The combination with a reciprocating motor, of a reciprocating core system, a member within which the core moves, and electromagnetic means for actuating said system, of removable liner structure within
20 said member comprising a portion of high reluctance and another portion of low reluctance.

21. In a reciprocating electric motor, a housing, field producing structure, a reciprocating core system, a removable liner structure within which said core operates, and detachable energy absorption means disposed
25 at one end of said liner and tending to maintain the same in position, said liner and means adapted to be replaced through one end of said housing without disturbing the field-producing structure of said motor.

22. The combination with a reciprocating motor comprising a reciprocating core system, a member within which the core system moves, and groups of magnetizable elements
30 of a magnetic circuit disposed outside of said member, of means comprising clamping plates for securing the individual magnetizable elements of a group together and forming a structural unit thereof.

23. A reciprocating motor comprising, in combination, a reciprocating core system, a member within which the core system moves,
35 groups of magnetizable elements of a magnetic circuit disposed outside of said member, and non-magnetic clamps for securing the individual magnetizable elements of a

group together and forming a structural unit thereof.

24. A reciprocating motor comprising, in combination, a reciprocating core system, a member within which said core system moves, a unit comprising magnetizable elements of different magnetic circuits disposed
40 outside of said member, each of said elements comprising a plurality of laminæ, and structure for securing to each other a plurality of elements to constitute said unit and for securing to each other the laminæ of the different elements of said unit.

25. In a percussive tool, a reciprocating core, a member within which said core reciprocates, and energy absorption structure disposed adjacent one end of said member
45 comprising a resilient member to which said core transmits impact on return from its working stroke, a support for said resilient member, and a second resilient member engaging said support and adapted to absorb a portion of the impact of the non-working stroke.

26. In a percussive tool, a reciprocating core system, energy absorption structure for said core system disposed adjacent one end
50 thereof comprising a spring, a member for enclosing said spring and maintaining the same under predetermined tension, and a seat for one end of said spring within said member adapted to indicate fracture of the spring.

27. A portable reciprocating motor comprising the combination with a reciprocating core system, means for actuating said system, and enclosing structure therefor, of an abutment, a detachable cylindrical member of
55 predetermined length interposed between said structure and said abutment, and resilient shock-absorbing means interposed between said structure and abutment adapted to receive the impact of said core system and initially compressed to an extent determined by the length of said cylindrical member.

CARL S. WEYANDT.