Jan. 20, 1948. B. W. SNODGRASS 2,434,725

ELECTRIC HAMMER

Filed March 1, 1946 3 Sheets-Sheet 1

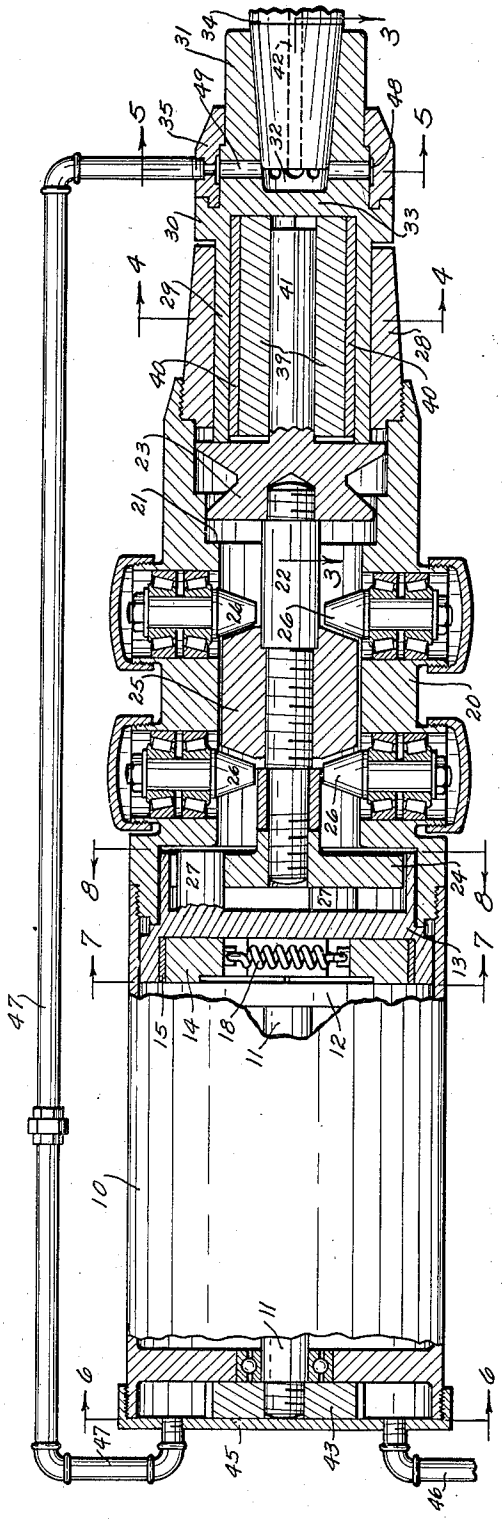


FIG. 1

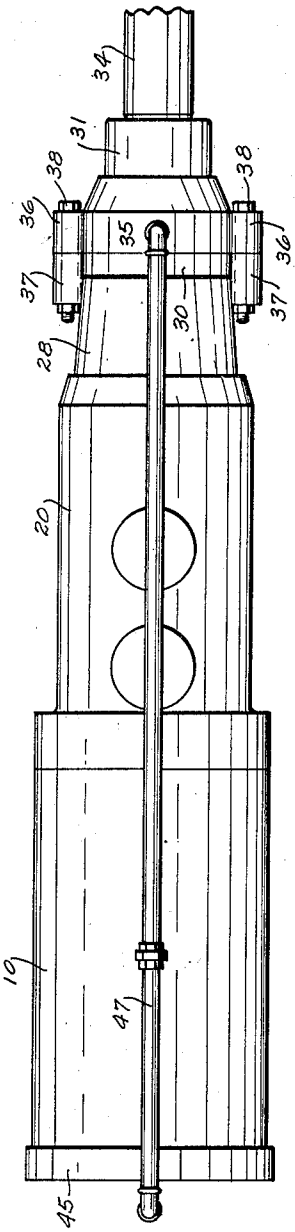


FIG. 2

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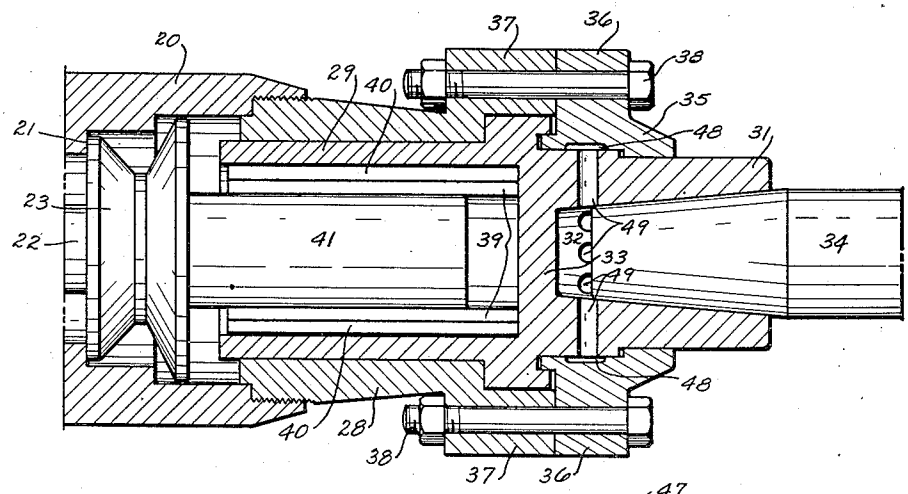


FIG. 3

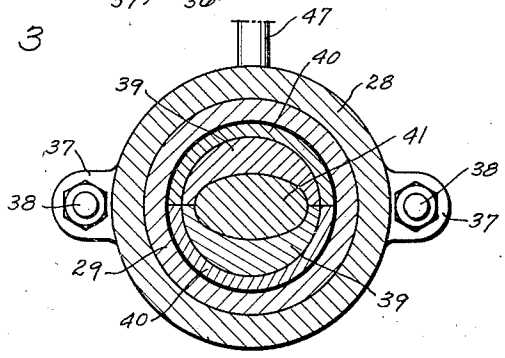


FIG. 4

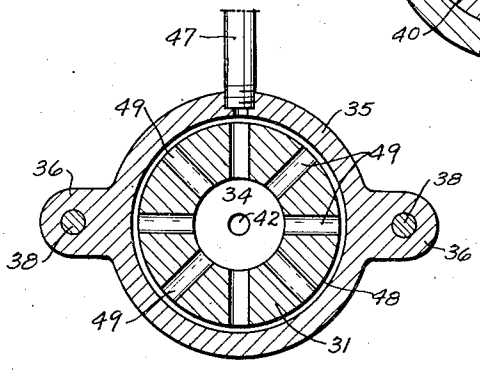


FIG. 5

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ELECTRIC HAMMER

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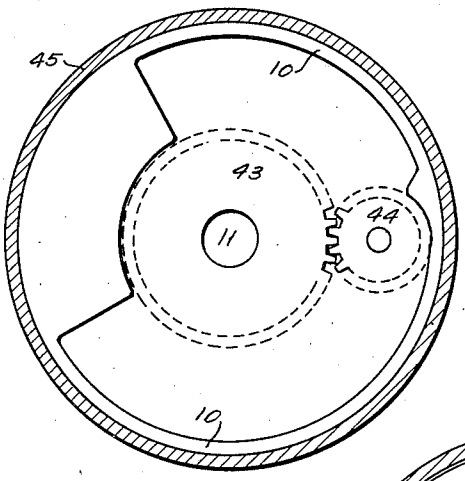


FIG. 6

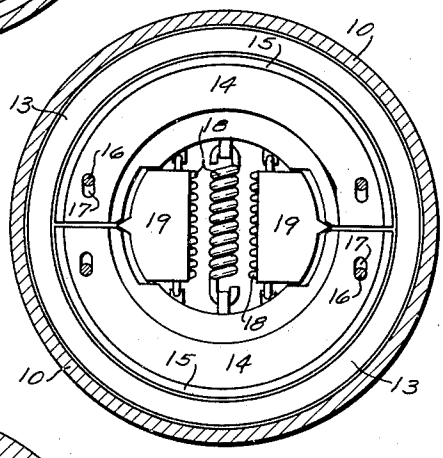


FIG. 7

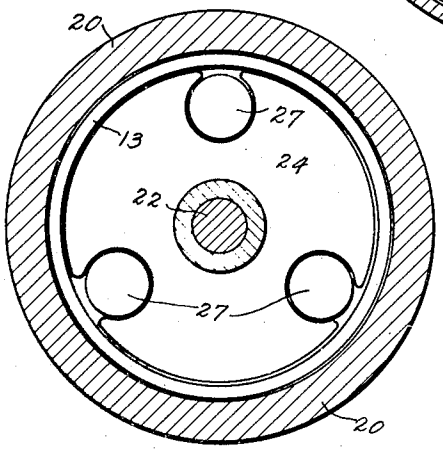


FIG. 8

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Patented Jan. 20, 1948

2,434,725

UNITED STATES PATENT OFFICE

2,434,725

ELECTRIC HAMMER

Benjamin W. Snodgrass, Denver, Colo., assignor of one-half to Benjamin F. Englander, Denver, Colo.

Application March 1, 1946, Serial No. 651,153

6 Claims. (Cl. 255—36)

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This invention relates to powered hammer devices adapted to generate rapidly successive impacts applicable for work effect and to direct said impacts to the effective actuation of drills, chisels, tamps, and analogous tools susceptible of interchangeable association therewith, and more particularly to electrically-driven such hammer devices, and has as an object to provide an improved construction and cooperative arrangement of elements constituting an improved hammer of high efficiency and wide utility.

A further object of the invention is to provide an improved construction and operative mounting for a reciprocatory impact member in an electrically-driven hammer.

A further object of the invention is to provide an improved impact-transmitting tool mounting in an electrically-driven hammer.

A further object of the invention is to provide an improved construction and arrangement of means automatically operable as an incident of impact member actuation to rotate the tool mounting and associated tool of an electrically-driven hammer.

A further object of the invention is to provide an improved construction and arrangement of means automatically effective as an incident of hammer actuation to pressure feed liquid to and through the work end of a tool associated with an electrically-driven hammer.

A further object of the invention is to provide improved operative driving connections between an impact member reciprocably responsive to rotation and a powered shaft in axial alignment with said member.

With the foregoing and other objects in view, my invention consists in the construction, arrangement, and combination of elements hereinafter set forth, pointed out in my claims, and illustrated by the accompanying drawings, in which—

Figure 1 is a view, largely in longitudinal, axial section, of a typical embodiment of the invention as assembled ready for practical use. Figure 2 is an exterior elevation of the assembly according to Figure 1 taken at a right angle and on a reduced scale relative to said latter figure. Figure 3 is a fragmentary, detail, axial section, on an enlarged scale, through tool mounting and actuating elements of the assembly according to and substantially on the indicated line 3—3 of Figure 1 depicting said elements on a plane perpendicular to the showing of said latter figure and at an opposite extreme of their range of actuation. Figure 4 is a cross section, on the same

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scale as Figure 3, taken on the indicated line 4—4 of Figure 1. Figure 5 is a cross section, on the same scale as Figure 3, taken on the indicated line 5—5 of Figure 1. Figure 6 is a cross section, on the same scale as Figure 3, taken on the indicated line 6—6 of Figure 1. Figure 7 is a cross section, on the same scale as Figure 3, taken on the indicated line 7—7 of Figure 1. Figure 8 is a cross section, on the same scale as Figure 3, taken on the indicated line 8—8 of Figure 1.

The novelties of the present invention are developments from and improvements over certain of the disclosures of my United States Patent No. 2,353,321, dated July 11, 1944, and are applicable to use with and to enhance the practicability and efficiency of electrically-driven power hammers of the type shown in said patent, particularly when such hammers are employed in the drilling of holes incident to mining and blasting operations.

As shown in the drawings, a cylindrical casing 10 operatively mounts, houses, and protects the elements of an electric motor whereof the armature or driven shaft 11 is suitably journaled in axial coincidence with said casing. Fixed to and for rotation with one end of the shaft 11, a disc-like drive plate 12 is operatively housed somewhat inwardly from one end of the casing 10 in closely-adjacent, independently-rotatable, covering relation with the axially and cylindrically recessed end of a clutch member 13 carried interiorly of said casing end for rotation about an axis aligned with that of the shaft 11. The recess of the member 13 covered by the plate 12 cooperatively receives a pair of complementary, semi-circular shoes 14 having friction-lagged, arcuate outer margins 15 adapted to conform to and engage at times against the inner cylindrical wall of the said recess, and pins 16 fixedly projecting axially from the outer face of the plate 12 are received in tangentially-elongate slots 17 formed in and adjacent the ends of said shoes to engage the latter in constant-driven relation with said plate and shaft 11 in a manner permitting of separation and rapprochment of the shoe elements diametrically of said plate within said recess. Retractile coil springs 18 of suitable tensile resistance operatively engage between inner margins of the shoes 14 and tend to hold said shoes in end abutment at the inner limit of their range of separation and out of margin 15 engagement with the member 13 recess inner cylindrical wall, in which relation said shoes are free to rotate with the plate 12 interiorly of and without driving effect on the recess and member until such

a speed of rotation is attained as will generate centrifugal forces acting on the mass of said shoes sufficient to induce outward separation of the shoe elements such as will overcome the tension of the springs 18 and frictionally engage the shoe margins 15 against the recess wall and in driving relation with the member 13. Wedge blocks 19, having each an outwardly-directed point disposed for wedging engagement between abutted ends of the shoe 14 elements, are associated with and interiorly of said shoes for limited travel radially of the assembly and for outward shifting in response to speed-generated centrifugal forces, said blocks 19 functioning in an obvious manner to enhance and maintain the frictional grip of the margins 15 against the member 13 recess wall, at proper rotative speeds, and to thereby minimize vagrant fluctuations in the so-established frictional driving relation. The speed-responsive clutch just described is functionally identical with and structurally very similar to that shown in my earlier patent and in and of itself forms no part of the instant invention, being herein illustrated and described merely to facilitate understanding of the structural and operative relationships of a complete hammer assembly.

The clutch member 13 is formed with a transverse web closing the end of its shoe-containing recess remote from the plate 12 and an annular flange outstanding axially from said web to define a cylindrical cup concentric with the plate 12 and opening outwardly of the casing 10 therefrom; said annular flange projecting axially beyond the adjacent end of the casing 10 for journaled reception within the cylindrically-recessed end of a tubular casing member 20 fixedly end-engaged with and forming an axially-aligned extension of said casing 10. The casing member 20 is axially traversed by a straight, cylindrical bore opening at one end into the cup defined by the member 13 annular flange and at its other end into a radially-enlarged, concentric, two-diameter, cylindrical chamber whereof the lesser portion is adjacent and communicates through an abrupt angular shoulder 21 with said bore and the greater portion is adjacent and arranged to open outwardly through the casing member 20 end remote from the clutch member 13. A suitably-worked, straight stem 22 is disposed axially of and to extend entirely through the straight bore portion of the casing member 20 in adjustable, interconnecting relation between a double-cone impact head 23 housed within the two-diameter chamber at one end of said bore and a drive disc 24 housed within the cylindrical cup of the clutch member 13 at the other end of said bore, said stem, impact head, and drive disc constituting a unitary assembly rotatable and reciprocable relative to the casing member 20. Work-effecting reciprocation of the stem 22, head 23, and disc 24 assembly is developed as a consequence of assembly power rotation through the agency of a double-faced, suitably-contoured cam block 25 adjustably fixed to an intermediate portion of the stem 22 within the casing member 20 bore between and for reaction against independently-rotatable cam followers 26 radially overhanging the block 25 cam margins from their diametrically-opposed, axially-spaced, paired mountings in the casing member 20 wall, in much the same manner and with the same effect described in my earlier patent, and power to rotate said assembly is transmitted thereto from the clutch member 13

through a plurality of posts 27 fixedly outstanding from the member 13 web in uniformly-spaced angular relation inwardly adjacent and axially paralleling the annular flange surrounding the drive disc 24, which posts register with and slidably engage through corresponding marginal notches or apertures intersecting said disc 24, thereby locking said drive disc to and for rotation with the clutch member in a manner to accommodate limited reciprocation of said drive disc and its associated elements axially of and relative to the clutch and casing members. Obviously, whenever the speed-responsive clutch reacts during operation of the shaft 11 to frictionally engage and drive the clutch member 13, the stem 22 is correspondingly rotated by means of the drive disc 24 and posts 27 to rotate the cam block 25 relative to the followers 26 and thereby simultaneously reciprocate said stem and its attached elements repetitiously through a cycle determined by the lobe arrangement and contour of the block cam faces; the illustrated construction being designed to effect two complete reciprocatory cycles for each revolution of the stem 22 and to free the reciprocatory assembly from every mechanical actuating force or restraint at each limit of its reciprocatory travel, in the manner and for the purposes set forth in my above-identified, previous patent.

The end of the casing member 20 remote from the casing 10 fixedly engages and cooperates with one end of a tubular sleeve 28 thereby mounted and supported in axial alignment with and as an extension outwardly beyond said casing member end, said sleeve having a straight, axial bore of a diameter somewhat less than that of and communicating at its inner end with the larger portion of the two-diameter chamber housing the impact head 23, so that the sleeve 28 inner end serves to partially obstruct and limit the axial length of said chamber. A tool mounting unit is formed with a straight, tubular end portion 29 of a length slightly greater than that of the sleeve 28 and an external diameter engageable within the sleeve bore to rotatably and reciprocably mount said portion 29 within and through said sleeve with its inner end projecting into the greater portion of the two-diameter chamber for engagement at times by the impact head 23. An annular, radially-outstanding collar 30 formed integrally about a midportion of the tool mounting unit determines the exterior length of the tubular portion 29 and is adapted to engage at times against the outer end of the sleeve 28 and thereby limit projection of said portion 29 inwardly beyond the adjacent sleeve end, and a cylindrical extension 31 of said unit axially and outwardly beyond the said collar 30 is formed with an end-opening, concentric, inwardly-tapered socket 32 separated from the bore of the tubular portion 29 by a solid transverse web 33 and adapted to telescopically receive, seat, and frictionally grip the correspondingly-tapered end of a tool stock 34. The tool mounting unit is held against separation from and limited in its range of reciprocation outwardly of the sleeve 28 by an annulus 35 rotatably and reciprocably embracing the extension 31 adjacent the collar 30, said annulus being equipped with fixed, radially-outstanding ears 36 adapted to register with and end-abut against corresponding ears 37 fixedly carried by the sleeve 28 outer end and be clamped thereto by means of bolts 38 engaged through registered holes intersecting said ears in parallelism with

the longitudinal axis of the tool assembly, adjustment in the spacing between the sleeve 28 outer end and the annulus 35, and hence in the reciprocatory range of the tool mounting unit as determined by engagement of the collar 30 within such space, being conveniently had in a usual manner through the use of shims or spacers between adjacent ends of the ears 36 and 37.

As should be manifest from the drawings and foregoing description, axial reciprocation of the stem 22 deriving from actuation of the shaft 11 is reflected adjacent the limit of stem travel remote from the casing 10 as impact engagement of the head 23 against the inner end of the tool mounting unit tubular portion 29, and through the elements of said tool mounting unit to and for work effect through the stock 34 and tool associated therewith, weight or feed pressure of the tool assembly applied to the stock 34 serving to normally urge the tool mounting unit to maximum inward projection of its tubular portion 29 for maintenance of said tubular portion in position for repetitious impact engagement by said head 23. Stem 22 travel toward the casing 10 is arrested by engagement of the impact head inner cone base against the annular shoulder 21, and the range of stem travel, normal position of the tool mounting unit tubular portion inner end, and clearances between cam surfaces of the block 25 and the followers 26, are so correlated with other pertinent operative factors and with each other as to synchronously utilize rebound of the head 23 and associated elements for initiation of travel in a direction adapted for smooth subsequent acceleration by means of the powered associations provided.

Certain operations to which the improved hammer is applicable are facilitated and expedited by providing for rotation of the working tool, to which end means and operative associations effective for such purpose are incorporated in and with the elements hereinabove described. The tool mounting unit of the improvement being rotatably, as well as reciprocably, carried by the sleeve 28 and annulus 35, and arranged for frictional, rotation-imparting grip with the associated end of the tool stock 34, it is convenient and wholly feasible to apply the powered rotation of the stem 22 and head 23 to effect tool mounting unit rotation in a practical manner free from disastrous consequences occasioned by sticking tools. As shown, a pair of complementary, semi-cylindrical shoes 39, of suitable rigid material, have their exterior, cylindrical surfaces suitably friction-lagged, as at 40, and are sized to slip axially within and cooperate to substantially fill the bore in the tubular portion 29 of the tool mounting unit; the lengths of said shoes 39 being slightly less than that of the tubular portion bore, so as to clear said shoe ends from any possible driving engagement with the impact head 23. The plane, diametric faces of the shoes 39 interengageable to complete a shoe cylinder housable within the tubular portion 29 are centrally and longitudinally grooved or routed to form corresponding transversely-arcuate, relatively wide, shallow channels cooperable when the said shoes are assembled as shown to define a transversely-oval bore extending axially of and entirely through the cylinder comprised from the shoes; the so-formed oval bore being adapted to fit snugly about and slidably accommodate a similarly transversely-oval tongue 41 fixedly projecting axially and outwardly from the impact head 23 a distance slightly less than the axial depth of the

tubular portion bore. With the arrangement of elements shown and described, rotation-induced reciprocation of the impact member carrying the head 23 is reflected without impairment or restriction by a corresponding axial play of the tongue 41 longitudinally within and between the shoes 39; the powered rotation of said impact member operating, by virtue of the interengaged tongue and shoe bore cross-sectional outlines, to rotate the shoe assembly and to simultaneously urge said shoes radially apart and into such frictional engagement of their lagged surfaces against the tubular portion 29 inner wall as will rotate the tool mounting and the tool therewith associated. While the centrifugal forces of rotation and the wedging action of the tongue 41 combine to establish and maintain a strong frictional grip of the shoe surfaces 40 against the tubular portion 29 and correspondingly effective rotation of the tool stock 34 during hammer assembly actuation, it is to be noted that such frictional grip is the only linkage rotatably interconnecting the tool mounting with the positively-driven impact member, so that any severe resistance to rotation encountered by the tool may instantly be accommodated through slippage between the shoe surfaces 40 and tubular portion 29 without undue strain on, damage to, or interruption in the operation of the hammer assembly elements.

In rock, coal, concrete, and like drilling operations to which the improved hammer is effectively applicable, it is a highly desirable common practice to continuously supply liquid, such as water, to the working face of the drill for cooling effect on the latter and to free the working area of dust and chips which impair drilling efficiency, it being usual and convenient to form the tool stock 34 with an axial bore or channel 42 wherethrough such liquid may be fed to and outwardly from the tool working end, and a further novelty of the instant invention resides in the provision of means automatically operable as an incident of hammer actuation to pressure-supply liquid to and through the tool stock. Conveniently adapting the improved hammer for liquid supply to the tool actuated thereby, the driven shaft 11 of the hammer motor is extended, through suitable packing glands (not shown), axially and outwardly beyond its supporting bearing remote from the drive plate 12 and into an end-opening compartment formed in the casing 10 free end, where said shaft engages in driving relation with a gear 43 rotatably housed in said compartment. Radially-offset from and in meshing relation with the gear 43, a second gear 44 is housed and mounted for rotation about its axis within said casing end compartment, and the inner walls of said compartment are formed and contoured to provide chambers on each side of the diametric plane containing the axes of the gears 43 and 44 and inwardly-extending abutments closely cooperating with the outer opposite arcs of said gears in separating relation between said chambers. A cap 45 removably and replaceably cooperates with the free end of the casing 10 to operatively confine the gears 43 and 44 and to complete the chambers oppositely adjacent thereto, said cap being apertured to provide access to the casing chambers covered thereby and supporting flow lines 46 and 47 communicating through the cap apertures and with the respective chamber interiors. The meshed gears 43 and 44 constitute a pump operable to draw liquid through one of the flow lines and into the chamber served thereby, to transfer the incoming liquid from the in-

flow chamber to the other chamber of the casing compartment, and to deliver the liquid under pressure as outflow through the other of the flow lines, according to the direction of gear rotation, the line 46 in Figure 1 accommodating liquid inflow and the line 47 functioning as a conduit for pressure outflow when the gear 43 of Figure 6 is rotated in a clockwise direction. The gear pump being productive of operatively adequate suction effect, the inflow line 46 may connect with any convenient source or supply of liquid, such as a sump, tank, reservoir, or the like, and need not be pressure served. The pressure outflow line 47, which may be either a flexible conduit or a rigid pipe assembly, is led exteriorly of and along the hammer assembly to connection of its delivery end with and radially through the annulus 35, said latter element advantageously being formed with an annular groove 48 shallowly intersecting its inner face and arranged to receive and distribute liquid inflow circumferentially about the adjacent exterior area of the tool mounting extension 31, and with annular marginal shoulders cooperating with complementary elements on the collar 30 and extension 31 to minimize liquid leakage therebetween. A plurality of flow channels 49 is formed radially of the extension 31 in communicating relation between the inner end of the socket 32 and the outer surface portion of said extension underlying the groove 48, so that the flow delivered to said groove from the line 47 may freely enter the inner socket end and the bore 42 of the tool stock 34 engaged in said socket and be thence pressure-impelled through and outwardly of the tool working face. Thus, actuation of the hammer power unit may be directly and automatically applied to maintain a liquid flow to and through the tool actuated thereby, whenever and wherever liquid serving of the tool is desired.

The improved hammer assembly may be equipped with manipulating and operating handles and switch in such specific construction and arrangement as may be deemed to be practical, such features being conventional in association with hammers of the type disclosed herein, and suitable lugs and brackets for operative engagement with manual or powered feeding mechanisms and supports may be provided in fixed relation with the casing 10 and casing member 20, as is customary in the application of powered hammers to particular uses.

Since many changes, variations, and modifications in the specific form, construction, and arrangement of the elements shown and described may be had without departing from the spirit of my invention, I wish to be understood as being limited solely by the scope of the appended claims, rather than by any details of the illustrative showing and foregoing description.

I claim as my invention:

1. In an electric hammer of the character described having a tubular casing assembly, an electric motor housed in one end and with its power shaft axially of said assembly, and a speed-responsive clutch including a shaft-concentric driven member operatively associated with the motor power shaft inner end interiorly of said assembly, a tool mounting unit rotatably and reciprocably carried in the end of said assembly remote from said motor, an impact member rotatable and reciprocable axially within said assembly between said clutch driven member and tool mounting unit, an axially-slidable, angularly-fixed, rotational driving connection between said clutch driven member and one end

of said impact member, a head on the other end of said impact member for repetitious work-effecting engagement against the tool mounting unit adjacent end, cooperating impact member cam and casing assembly follower means effective to reciprocate said impact member as an incident of its rotation, a tongue fixedly projecting axially from said impact member head in slidably-supported association with said tool mounting unit, and means reactive to rotation of said tongue for frictional engagement with and consequent rotation of said tool mounting unit.

2. Apparatus as set forth in claim 1, wherein the rotational driving connection between the clutch driven member and the impact member comprises a plurality of studs fixedly projecting toward the adjacent impact member end from, in axial parallelism with, and in angularly-spaced relation on said clutch driven member, a disc radially of and fixed to said impact member adjacent end, and holes in said disc in registration with and to telescopically receive said studs.

3. Apparatus as set forth in claim 1, wherein said tool mounting unit comprises a generally cylindrical body formed with a radially-projecting annular collar intermediate its ends, an axially-bored tubular portion on one side of said collar for journaled reception through the casing assembly end and impact-receiving cooperation with the impact member of the hammer, and a cylindric extension on the other side of said collar formed with an end-opening tool-receiving socket and adapted for journaled cooperation with an annulus fixedly supported from and in axial alignment with said casing assembly.

4. Apparatus as set forth in claim 1, wherein the impact member comprises a stem disposable axially of the casing assembly, a disc radially of and threadedly fixed to one end of said stem for driven association with a rotatable hammer clutch member, a spool-like, double-cone head concentric with and threadedly fixed to the other end of said stem for impact engagement against work-transmitting elements of the hammer, a slide tongue projecting fixedly and axially from said head, a tubular cam block on and threadedly fixed to said stem between said disc and head, and cam faces formed on the ends of said block for member-reciprocating cooperation incident to member rotation with followers supported by and in radially-inward projection from said casing assembly.

5. Apparatus as set forth in claim 1, wherein the tool mounting unit rotating means reactive to rotation of the impact member tongue comprises a tool mounting unit tubular portion axially aligned with and opening toward the impact member in telescoping relation over the impact member tongue, a pair of semi-cylindrical shoes nested within and substantially filling the bore of said tubular portion, complementary, transversely-arcuate grooves axially of the juxtaposed shoe diametric faces to define an axially-straight, transversely-oval throat, and a throat-conforming, exterior contour on the impact member tongue.

6. In a hammer of the character described having a casing assembly, an impact member power-rotatable within and reciprocable as an incident of its rotation axially of said assembly, and a tool mounting unit journaled in an end of said assembly in axial alignment with said impact member to receive and transmit impacts therefrom, means responsive to impact member rotation for frictionally engaging and yieldably

rotating said tool mounting unit, said means comprising a tubular unit end portion aligned with and opposed to said impact member, a pair of semi-cylindrical shoes nested within and substantially filling the bore of said tubular portion, friction lagging on the shoe cylindrical surfaces, complementary, transversely-arcuate grooves axially of the juxtaposed shoe diametric surfaces to define an axially-straight, transversely-oval throat, and an axially-straight, transversely-oval tongue projecting fixedly and axially from the adjacent impact member end for slidable, non-rotatable engagement within said throat.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,353,321	Snodgrass	July 11, 1944
2,299,881	Demo	Oct. 27, 1942