Aug. 21, 1928. 1,681,232

P. P-G. HALL

OIL CLEANER

Filed July 8, 1924 4 Sheets-Sheet 1

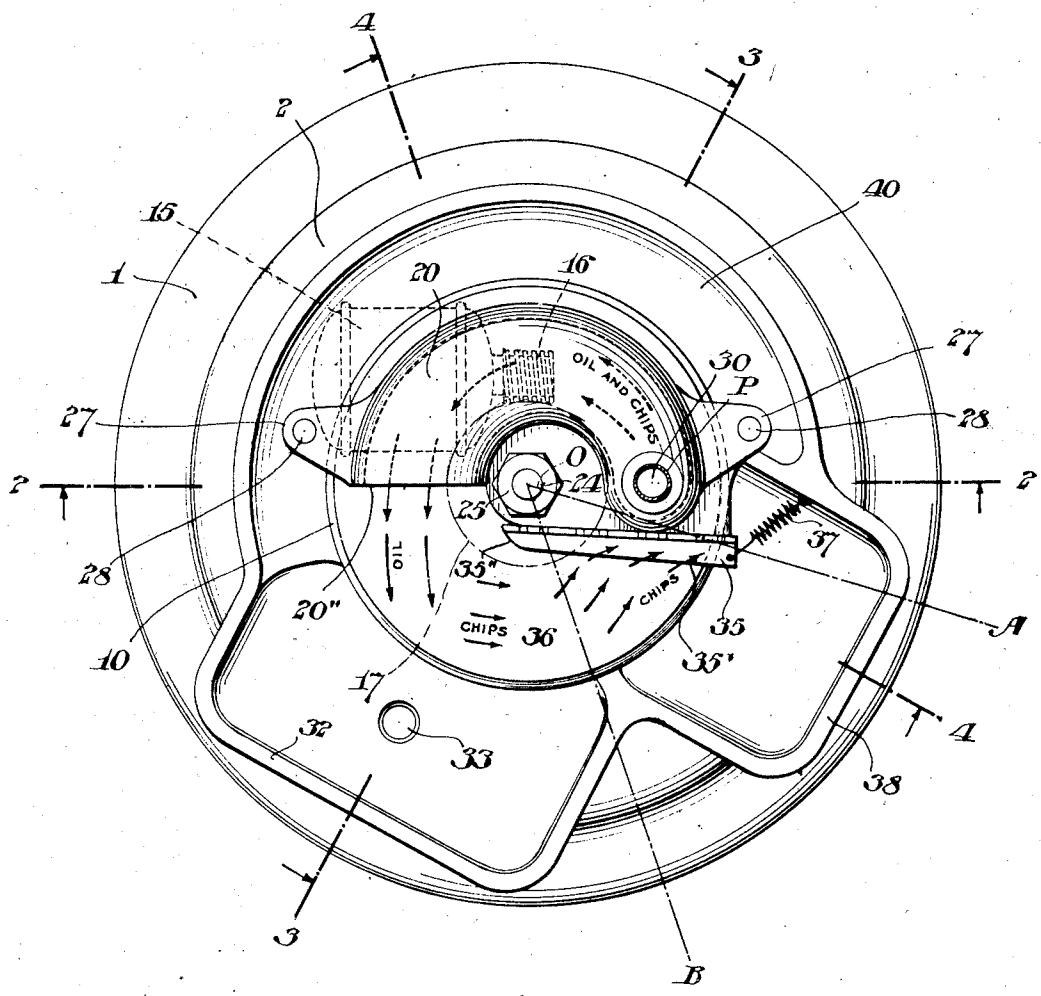


Fig. 1.

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Filed July 8, 1924 4 Sheets-Sheet 2

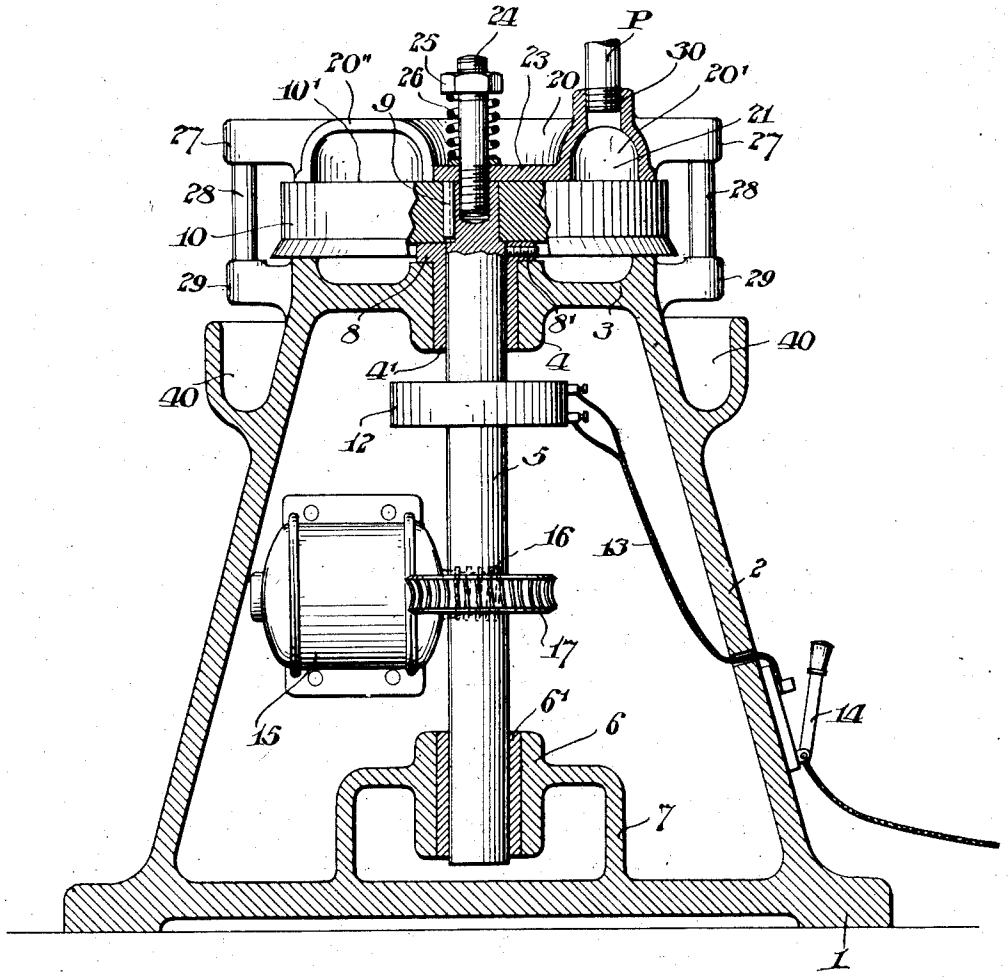


Fig. 2.

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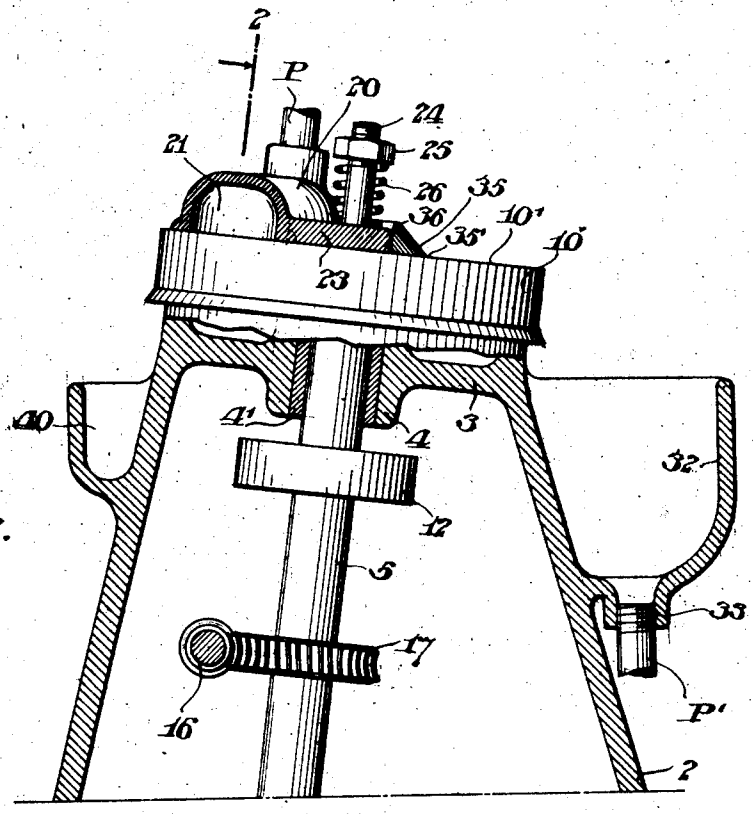


Fig. 3.

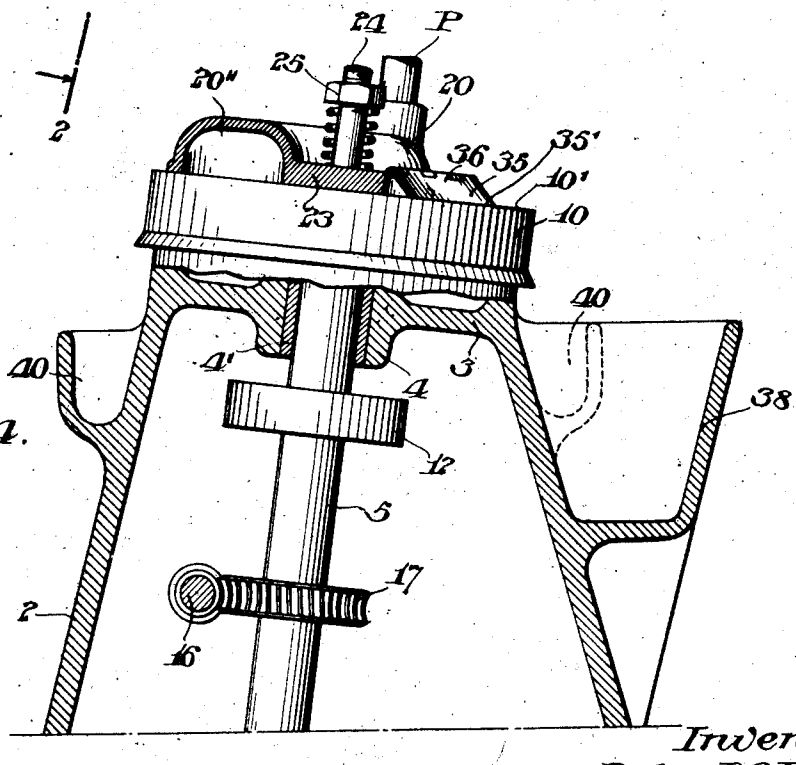


Fig. 4.

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OIL CLEANER

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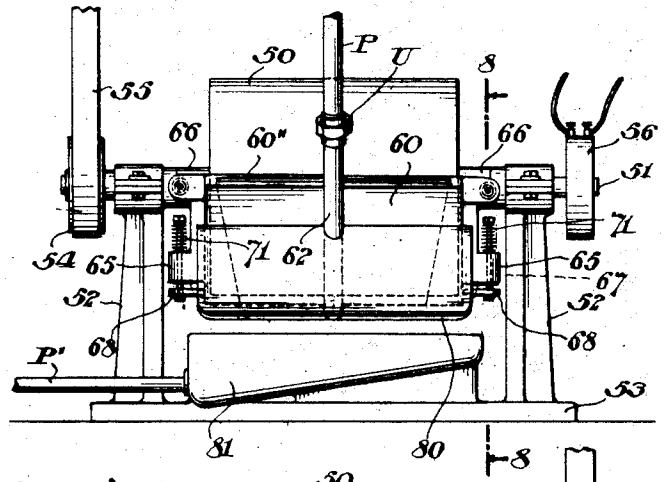


Fig. 5.

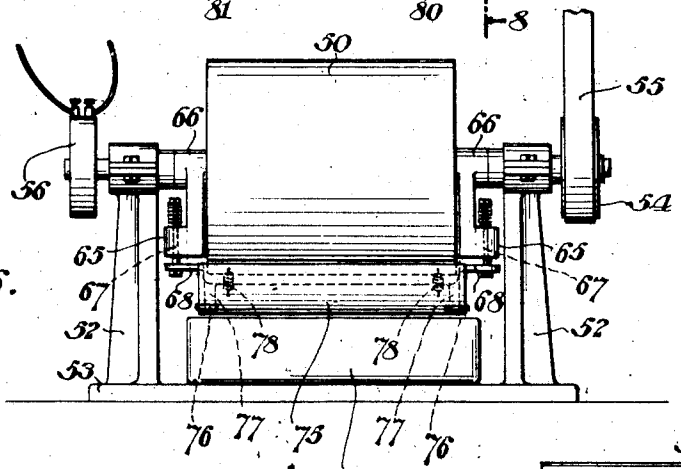


Fig. 6.

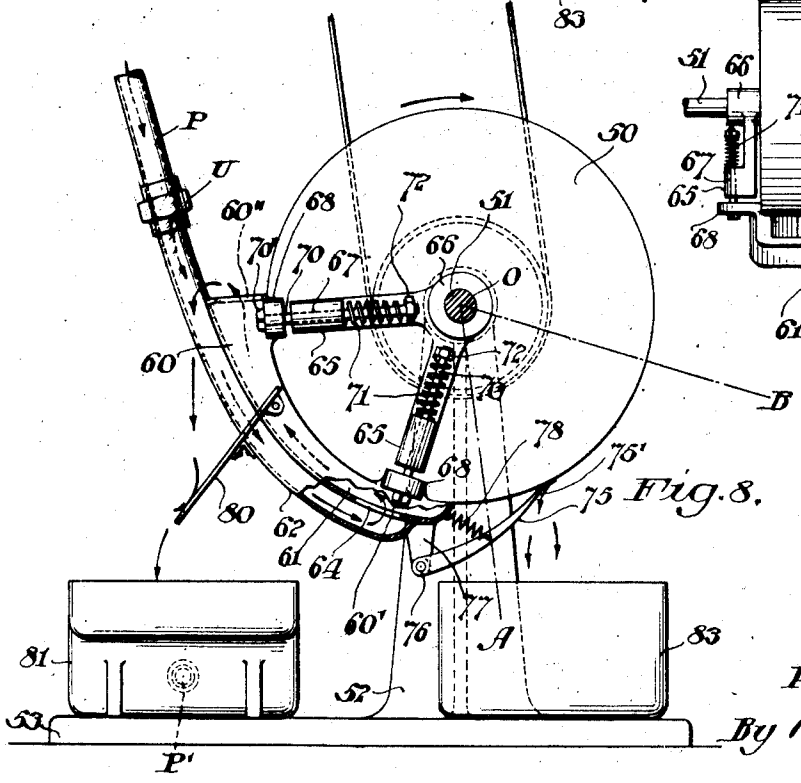


Fig. 8.

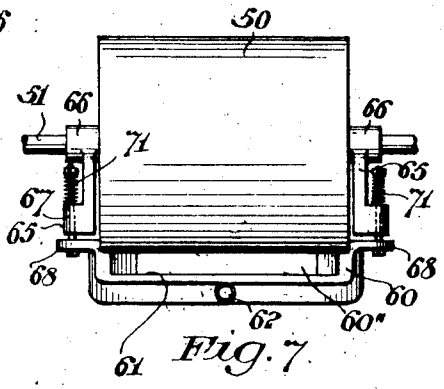


Fig. 7.

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UNITED STATES PATENT OFFICE.

PETER P-G. HALL, OF PHILADELPHIA, PENNSYLVANIA.

OIL CLEANER.

Application filed July 8, 1924. Serial No. 724,918.

In the operation of modern machine tools such as thread milling machines, turret lathes, automatic screw cutting machines and the like, it is usual to continuously force a stream of oil over the cutting tool and the work for the purpose of adequately lubricating the tool and washing away the chips of metal removed by the tool. Ordinarily, the oil is pumped from a reservoir in the base of the machine or other convenient position, directed over the tool and the work, allowed to flow down into a convenient receptacle, then passed through a filter, generally of the screen type, and from thence returned to the reservoir, circulation of the same body of oil being thus continuous. In the practical operation of machines of this character, it has been found that after the oil has been circulated for a short period it becomes impregnated with extremely fine particles of metal which the filters or strainers, though satisfactorily operative for removing the chips and cuttings of appreciable size, are unable to remove, with the result that these particles are held in suspension in the circulating oil and exert a detrimental action on the tool by causing it to dull more rapidly than would be the case if fresh oil were continually supplied thereto with consequent reduction in productive capacity of the machine and impairment in the quality of work turned out.

A principal object of the present invention is to provide a novel method as well as means for effectually removing from oil or other fluids, and more particularly from oil employed for the purpose aforesaid, metallic chips and particles whether the same be of appreciable size or of such fineness as to be capable of maintenance in suspension in the oil and thus substantially impossible of satisfactory removal by the means and methods hitherto employed for that purpose. The invention further contemplates the provision of a machine for effecting the function to which reference has just been made which is of relatively simple construction, entirely automatic and relatively rapid in action, not liable to become damaged or get out of order when in use and of a character suitable for employment in machine shops and other similar places.

Additional objects and novel features of construction and arrangement comprehend by my invention will appear from the following description of a preferred form of machine constructed in accordance therewith and which I have illustrated in the accompanying drawings.

I have found that adequate and satisfactory separation from oil or other fluid of metallic chips and particles, where the latter are of steel or other magnetizable metal, can be effected by causing the oil to flow over a continuously moving surface each point of which while passing through a certain area or zone and while the oil is flowing thereover is maintained in magnetized condition. As the oil passes over this magnetized zone or area the chips and particles are drawn from the oil and thereafter adhere to the surface until by reason of the movement thereof they are carried out of the stream of oil and into the unmagnetized zone or area where they are removed from the surface by suitable means, and my invention therefore contemplates, among other things, the provision of such a surface in association with means for causing the oil to pass thereover and means for removing from the surface the chips and particles abstracted from the oil and deposited thereon, these several means being preferably so arranged and correlated with other adjunctive and associated means that the cleaned oil after its passage over the said surface is directed into a suitable receptacle and the chips and particles directed into another and separate receptacle, the machine being thus arranged for continuous and automatic operation.

In the accompanying drawings I have shown two forms of machine constructed in accordance with my invention and adapted for the performance of my improved method of cleaning oil, Fig. 1 portraying with substantial accuracy a top plan view of one of said forms; Fig. 2 similarly portraying a section on line 2—2 of Fig. 1, and Figs. 3 and 4 similarly portraying fragmentary sections on lines 3—3 and 4—4 thereof, certain parts in Figs. 2, 3 and 4 being shown in elevation or slightly broken away for the sake of clearness. However, as the base and pedestal of this machine are preferably symmetrically disposed with respect to the central vertical axis of the latter, but as certain parts thereon supported are preferably slightly inclined to the vertical, it would be a matter of extreme difficulty to accurately portray in the drawings the true appearance of certain of these parts and I have therefore not attempted so to do, as such portrayal is

entirely unnecessary for an adequate comprehension of the invention and the manner in which the said machine is constructed; thus while the form, relative arrangement and disposition of the various parts are clearly shown and will be readily understood, in certain instances some of the parts in the several views would present to the eye of the observer a slightly different appearance were the same truly accurate representations in plan and in section of the machine which they are intended to represent.

In Figs. 5 to 8 inclusive, I have shown another form of machine of construction somewhat modified from that illustrated in the preceding figures, Fig. 5 being a front elevation, Fig. 6 a rear elevation and Fig. 7 a fragmentary top plan view thereof, while Fig. 8 is an enlarged vertical section on line 8—8 of Fig. 1 looking in the direction of the arrows.

Referring now more particularly to Figs. 1 to 4 inclusive, the machine shown therein comprises a base 1, conveniently circular in form, from which rises a pedestal 2 preferably in the form of a truncated cone symmetrical with the vertical central axis of the base. Adjacent its upper extremity the pedestal is provided with a transverse web 3, which may be cast integral with the pedestal, and is provided with a centrally disposed boss 4 through which is extended the upper end of the main shaft 5, a bushing 4′ being disposed within the boss to form a bearing for the shaft, while the lower end of the shaft is extended through a boss 6 having a bushing 6′ disposed therein and conveniently integral with a support 7 rising from the upper face of the base. Instead, however, of the main shaft being coaxial with the central vertical axis of the base, the shaft is preferably slightly inclined with respect thereto so that while the upper end of the shaft is disposed more or less centrally with respect to the upper end of the pedestal, the lower end of the shaft is considerably to one side of the center of the base; the purpose of this angular disposition of the shaft will hereafter more fully appear.

Above the boss 4 the shaft may be provided with a collar 8 maintained in position by a set screw 8′ to prevent the shaft from sliding downwardly in the bushings, and above the collar and keyed thereto by a key 9 or otherwise arranged for rotation with the shaft is a circular element 10 having a flat upper surface adapted to be rendered magnetic. While this element may be of any suitable construction for accomplishing its allotted function as hereinafter described, I prefer to utilize for the purpose an ordinary magnetic chuck such as are well known and commonly employed for a variety of purposes in modern machine shop practice. Chucks of this character are manufactured in a variety of different styles and are so constructed that in association with a suitable commutator and brushes or other equivalent mechanism through which current from some suitable source is supplied to the chuck, the upper surface or face 10′ thereof may be rendered magnetic either over its entire area or over any desired sector thereof and as the chuck and commutator with their said associated mechanism forms no part of the present invention save as it forms a component element thereof, I have merely illustrated these parts conventionally and will omit detailed description of their specific construction. Thus the commutator 12 may be conveniently disposed on the main shaft 5 at a point below the boss 4 and current conducted thereto (ordinarily through brushes or other suitable means not shown) by wires controlled by a switch 14 disposed on the exterior of the pedestal; this is a convenient arrangement of these parts but any other desired one may be adopted and may frequently be preferable by reason of the particular form and construction of the chuck, commutator and associated parts which may be employed.

Suitable means for rotating the main shaft are provided, conveniently a small electric motor 15 bolted to the inner face of the pedestal and arranged to drive the shaft through a worm 16 on the motor shaft and worm gear 17 on the main shaft, but any other means such as a belt drive through a pulley carried by the shaft, or a gear drive may be employed if desired.

In the operation of the machine the oil containing the chips and particles is directed against the surface 10′ of the rotating magnetic element 10 at one point and discharged from said surface at another, and for accomplishing this result I provide a curved oil conduit 20 having an internal passage 21 and dispose the same upon the face 10′ of the element so that oil flowing through the passage will be in contact therewith. Preferably this conduit, which is made of brass, bronze or other non-magnetizable metal, is in planary outline of the form of a gradually increasing spiral and in cross section somewhat of the form of a semi-ellipse, the passage 21 being thus of the same vertical height at all points but of gradually increasing width from the closed smaller or inlet end 20′ of the conduit to its outlet or mouth 20″, the arc subtended between these two points being preferably about 180° or a little in excess thereof.

The conduit may be provided with a central substantially flat area or plate 23 which is bored for the passage of a stud 24 which extends therethrough and is screwed into the upper end of the main shaft (see Fig. 2). This stud is threaded at its upper end for the reception of a nut 25 between which

and the upper surface of the plate is disposed a compression spring 26 which is operative to hold the plate snugly against the surface of the element 10, it being understood that the under surface of the plate as well as the lower face of the outer wall of the conduit is preferably carefully machined or otherwise finished so as to seat snugly against said surface. I also prefer to provide means for steadying the plate in its operative position on the element and for preventing any tendency which it might have in the absence of such means to rotate with the former, and for this purpose I may provide the conduit with laterally directed ears 27 which are drilled for the passage of studs 28 mounted in lugs 29 conveniently formed integral with the pedestal, but other means suitable for the purpose aforesaid may be employed. The conduit adjacent its inlet end may be provided with an internally bored and threaded boss 30 for the attachment of a pipe P through which the oil to be cleaned may be directed to the inlet end of the conduit, which is of course entirely closed, so that the oil, which is usually pumped to the conduit under moderate pressure, will flow therethrough and out of the mouth or outlet end thereof in the direction of the large arrows in Fig. 1.

It will be noted that the conduit is so formed as to cover substantially one-half of the surface of the magnetic element which, by reason of the inclination of the shaft 5 to which reference has been made, is correspondingly slightly inclined to the horizontal, and further that the conduit is disposed on the more elevated portion of the element with its mouth 20″ directed generally toward the lowest point of the former so that as the oil leaves the conduit it tends to flow directly down over the face and vertical edge of the element to be received in an oil receptacle or basin 32 disposed on the side of the pedestal and conveniently cast integral therewith. This basin is provided at its lowest point with a bored and threaded boss 33 for connection with a pipe P′ through which the cleaned oil may be drawn from the basin.

In the operation of the machine as the magnetic element 10 is slowly rotated in a counter-clockwise direction through the operation of the motor 15 or other driving means, the oil containing the chips and particles, or "dirty" oil as it may be termed, is introduced to the inlet end of the conduit through pipe P and after flowing through the conduit passes out of the mouth 20″ and thence over the face of the element to the basin 32. During the passage of the oil through the conduit and over the face of the element, which, save for the area, sector or zone substantially included between the lines AOB in Fig. 1, is rendered magnetic through the operation of the commutator and associated parts which are suitably adjusted for this purpose, the fine particles of metal as well as the larger chips and cuttings which are contained in the oil when introduced into the conduit are attracted to the surface of the element and adhere thereto; they are thus carried out of the mouth of the conduit and in a direction generally away from the stream of cleaned oil flowing therefrom to the basin and toward the line OB in the direction indicated by the small arrows in Fig. 1. As each point on the surface of the element passes the line OB it becomes demagnetized and is thereafter maintained in such condition until it reaches the line OA, and means are therefore provided for automatically freeing the surface of the element from the metallic particles, cuttings and chips within this demagnetized area; for this purpose I prefer to provide a scraper blade 35 and hingedly secure the same along its rear edge as by a hinge 36 to the adjacent edge of the plate 20 in such manner that the free edge 35′ of the blade will rest on the surface of the element, the blade from this point inclining angularly upward to the hinge as best shown in Figs. 3 and 4, and for constantly holding the blade in close but yielding contact with the element I may arrange a spring 37 between the blade and some convenient point on the pedestal in such manner that the spring will exert a constant downward pull on the free edge of the blade.

It will be noted from an inspection of Fig. 1 that the blade is not disposed in a radial direction with respect to the element 10 but that its inner end, that is, its end most nearly adjacent the center of the element, is considerably offset from such center in a direction toward the lowest point of the element so that if the blade were prolonged entirely across the surface of the element its free edge would form a chord thereof subtending an arc of something less than 180°. Preferably, however, the inner end of the blade, which may be curved or rounded as at 35″, is terminated slightly beyond the center of the element while its outer end is extended over the marginal edge of the element to terminate above a chip pan 38 carried by the pedestal and conveniently cast integral therewith. By reason of this non-radial disposition of the blade the chips and particles as they are scraped by the blade from the surface of the element are gradually urged outwardly along the blade by the following chips and particles as they are brought thereto so as to finally drop off of the outer end of the blade into the chip pan from which they may be removed by hand when a sufficient accumulation thereof has taken place therein. It is obvious, however, that if the blade were radially disposed with

respect to the element this result could not be so successfully accomplished as the chips, instead of moving generally longitudinally of the blade, would tend to move transversely thereof and thus accumulate in the rear of the hinged edge of the blade instead of being automatically and continuously directed to a point above the chip pan from which they can fall by gravity thereinto.

While the conduit rests on the face of the magnetic element sufficiently snugly to prevent the escape of any substantial quantity of oil between the contacting surfaces of the conduit and the element, I prefer to provide the pedestal of the machine with an encircling gutter or trough 40 which extends around that portion of the pedestal not occupied by the oil basin and chip pan and is operative to catch and direct into the basin 32 any small amount of oil which may find its way down over the superjacent edge of the element.

It is thought that the operation of the machine will be readily apparent from the foregoing description without further particularization; attention, however, is directed to the fact that as the chips and particles tend to move directly toward and adhere to the surface of the magnetic element very shortly after they pass into the conduit from the inlet pipe P, they become disposed thereon in a band or ring but little wider than the narrowest part of the passage 21 and as this passage is of gradually increasing width from its inlet end to its mouth any abrasive or cutting action by the chips and particles upon the wall of the passage is thus avoided as, save closely adjacent the inlet end of the passage, there is, as the element revolves, an ever increasing clearance or space between the wall of the passage and the edges of the band or ring of chips, while adjacent the inlet end of the conduit and before the adherence of the chips to the element of former are more or less in a state of suspension in the oil and thus not in a condition to exert a materially destructive abrasive or cutting action on the conduit wall.

In Figs. 5 to 8 inclusive I have shown another form of machine adapted for the performance of my improved method for cleaning oil and in which, instead of making use of a magnetizable element having a flat surface against which the oil is directed, I employ a magnetizable element of cylindrical contour, the curved surface of which is adapted to be rendered magnetic over any desired area or zone through suitable adjustment of a commutator or other controlling means as in the case of the element 10 hitherto described, in combination with means for directing the oil to be cleaned against the cylindrical surface of the element while the same is rotating.

More specifically and referring to the said figures, I may employ a cylindrical element 50 of the character aforesaid which is mounted on a horizontal shaft 51 journaled for rotation in the upper extremities of pedestals 52 rising from a base 53. One end of the shaft may be supplied with a pulley 54 for engagement by a belt 55 for driving the shaft, but other forms of driving means such as a motor drive or gear drive may be employed if desired, and upon the opposite end of the shaft or at any other convenient point may be disposed a commutator 56, shown conventionally in the figures, operative, in association with other mechanism such as brushes (not shown), to control the magnetization of the cylindrical surface of the element.

For conducting the oil to be cleaned to the surface of the element and maintaining it in contact therewith for a sufficient period to permit the metallic chips and particles to be attracted to said surface from the oil, I may provide a conduit 60 which in this instance is in the form of a curved hollow shoe providing an interior passage 61 open at the top or mouth 60″. This conduit or shoe is in cross section of substantially channel shape and is provided at its outer or closed side with an integrally formed pipe or duct 62 which extends from adjacent the lower or inlet end 60′ of the conduit to a point somewhat above the mouth 60″ for the attachment of a pipe P, as by a union U, through which the oil to be cleaned is conducted to the inlet end of the shoe, the duct 62 communicating with the lower end of the passage 61 at this point through a port 64. If desired, the passage 61 may be formed of gradually increasing width from the inlet to the outlet end thereof similarly to the manner in which the passage 21 in the conduit 20 is formed and for a like purpose.

Means are provided for yieldingly holding the shoe against the surface of the element 50, said means conveniently comprising two pairs of radially extending arms 65, each pair being carried by a hub 66 mounted on the shaft 51 adjacent an end of the element. The outer end of each arm is provided with an outwardly turned lug 67 and the shoe is also provided with a corresponding lug 68 disposed adjacent but spaced therefrom, and through both lugs is slidably extended a rod 70 having at one end a head 70′ bearing against the lug 68, the opposite end of the rod being extended through lug 67 and provided with a coil spring 71 retained in position on the rod and in a state of suitable compression by a nut 72 threaded onto the extremity of the rod in such manner that the several springs are operative to continually pull the shoe toward the surface of the element and maintain it in close but relatively movable con-

and the upper surface of the plate is disposed a compression spring 26 which is operative to hold the plate snugly against the surface of the element 10, it being understood that the under surface of the plate as well as the lower face of the outer wall of the conduit is preferably carefully machined or otherwise finished so as to seat snugly against said surface. I also prefer to provide means for steadying the plate in its operative position on the element and for preventing any tendency which it might have in the absence of such means to rotate with the former, and for this purpose I may provide the conduit with laterally directed ears 27 which are drilled for the passage of studs 28 mounted in lugs 29 conveniently formed integral with the pedestal, but other means suitable for the purpose aforesaid may be employed. The conduit adjacent its inlet end may be provided with an internally bored and threaded boss 30 for the attachment of a pipe P through which the oil to be cleaned may be directed to the inlet end of the conduit, which is of course entirely closed, so that the oil, which is usually pumped to the conduit under moderate pressure, will flow therethrough and out of the mouth or outlet end thereof in the direction of the large arrows in Fig. 1.

It will be noted that the conduit is so formed as to cover substantially one-half of the surface of the magnetic element which, by reason of the inclination of the shaft 5 to which reference has been made, is correspondingly slightly inclined to the horizontal, and further that the conduit is disposed on the more elevated portion of the element with its mouth 20″ directed generally toward the lowest point of the former so that as the oil leaves the conduit it tends to flow directly down over the face and vertical edge of the element to be received in an oil receptacle or basin 32 disposed on the side of the pedestal and conveniently cast integral therewith. This basin is provided at its lowest point with a bored and threaded boss 33 for connection with a pipe P′ through which the cleaned oil may be drawn from the basin.

In the operation of the machine as the magnetic element 10 is slowly rotated in a counter-clockwise direction through the operation of the motor 15 or other driving means, the oil containing the chips and particles, or "dirty" oil as it may be termed, is introduced to the inlet end of the conduit through pipe P and after flowing through the conduit passes out of the mouth 20″ and thence over the face of the element to the basin 32. During the passage of the oil through the conduit and over the face of the element, which, save for the area, sector or zone substantially included between the lines AOB in Fig. 1, is rendered magnetic through the operation of the commutator and associated parts which are suitably adjusted for this purpose, the fine particles of metal as well as the larger chips and cuttings which are contained in the oil when introduced into the conduit are attracted to the surface of the element and adhere thereto; they are thus carried out of the mouth of the conduit and in a direction generally away from the stream of cleaned oil flowing therefrom to the basin and toward the line OB in the direction indicated by the small arrows in Fig. 1. As each point on the surface of the element passes the line OB it becomes demagnetized and is thereafter maintained in such condition until it reaches the line OA, and means are therefore provided for automatically freeing the surface of the element from the metallic particles, cuttings and chips within this demagnetized area; for this purpose I prefer to provide a scraper blade 35 and hingedly secure the same along its rear edge as by a hinge 36 to the adjacent edge of the plate 20 in such manner that the free edge 35′ of the blade will rest on the surface of the element, the blade from this point inclining angularly upward to the hinge as best shown in Figs. 3 and 4, and for constantly holding the blade in close but yielding contact with the element I may arrange a spring 37 between the blade and some convenient point on the pedestal in such manner that the spring will exert a constant downward pull on the free edge of the blade.

It will be noted from an inspection of Fig. 1 that the blade is not disposed in a radial direction with respect to the element 10 but that its inner end, that is, its end most nearly adjacent the center of the element, is considerably offset from such center in a direction toward the lowest point of the element so that if the blade were prolonged entirely across the surface of the element its free edge would form a chord thereof subtending an arc of something less than 180°. Preferably, however, the inner end of the blade, which may be curved or rounded as at 35″, is terminated slightly beyond the center of the element while its outer end is extended over the marginal edge of the element to terminate above a chip pan 38 carried by the pedestal and conveniently cast integral therewith. By reason of this non-radial disposition of the blade the chips and particles as they are scraped by the blade from the surface of the element are gradually urged outwardly along the blade by the following chips and particles as they are brought thereto so as to finally drop off of the outer end of the blade into the chip pan from which they may be removed by hand when a sufficient accumulation thereof has taken place therein. It is obvious, however, that if the blade were radially disposed with

respect to the element this result could not be so successfully accomplished as the chips, instead of moving generally longitudinally of the blade, would tend to move transversely thereof and thus accumulate in the rear of the hinged edge of the blade instead of being automatically and continuously directed to a point above the chip pan from which they can fall by gravity thereinto.

While the conduit rests on the face of the magnetic element sufficiently snugly to prevent the escape of any substantial quantity of oil between the contacting surfaces of the conduit and the element, I prefer to provide the pedestal of the machine with an encircling gutter or trough 40 which extends around that portion of the pedestal not occupied by the oil basin and chip pan and is operative to catch and direct into the basin 32 any small amount of oil which may find its way down over the superjacent edge of the element.

It is thought that the operation of the machine will be readily apparent from the foregoing description without further particularization, attention, however, is directed to the fact that as the chips and particles tend to move directly toward and adhere to the surface of the magnetic element very shortly after they pass into the conduit from the inlet pipe P, they become disposed thereon in a band or ring but little wider than the narrowest part of the passage 21 and as this passage is of gradually increasing width from its inlet end to its mouth any abrasive or cutting action by the chips and particles upon the wall of the passage is thus avoided as, save closely adjacent the inlet end of the passage, there is, as the element revolves, an ever increasing clearance or space between the wall of the passage and the edges of the band or ring of chips, while adjacent the inlet end of the conduit and before the adherence of the chips to the element of former are more or less in a state of suspension in the oil and thus not in a condition to exert a materially destructive abrasive or cutting action on the conduit wall.

In Figs. 5 to 8 inclusive I have shown another form of machine adapted for the performance of my improved method for cleaning oil and in which, instead of making use of a magnetizable element having a flat surface against which the oil is directed, I employ a magnetizable element of cylindrical contour, the curved surface of which is adapted to be rendered magnetic over any desired area or zone through suitable adjustment of a commutator or other controlling means as in the case of the element 10 hitherto described, in combination with means for directing the oil to be cleaned against the cylindrical surface of the element while the same is rotating.

More specifically and referring to the said figures, I may employ a cylindrical element 50 of the character aforesaid which is mounted on a horizontal shaft 51 journaled for rotation in the upper extremities of pedestals 52 rising from a base 53. One end of the shaft may be supplied with a pulley 54 for engagement by a belt 55 for driving the shaft, but other forms of driving means such as a motor drive or gear drive may be employed if desired, and upon the opposite end of the shaft or at any other convenient point may be disposed a commutator 56, shown conventionally in the figures, operative, in association with other mechanism such as brushes (not shown), to control the magnetization of the cylindrical surface of the element.

For conducting the oil to be cleaned to the surface of the element and maintaining it in contact therewith for a sufficient period to permit the metallic chips and particles to be attracted to said surface from the oil, I may provide a conduit 60 which in this instance is in the form of a curved hollow shoe providing an interior passage 61 open at the top or mouth 60''. This conduit or shoe is in cross section of substantially channel shape and is provided at its outer or closed side with an integrally formed pipe or duct 62 which extends from adjacent the lower or inlet end 60' of the conduit to a point somewhat above the mouth 60'' for the attachment of a pipe P, as by a union U, through which the oil to be cleaned is conducted to the inlet end of the shoe, the duct 62 communicating with the lower end of the passage 61 at this point through a port 64. If desired, the passage 61 may be formed of gradually increasing width from the inlet to the outlet end thereof similarly to the manner in which the passage 21 in the conduit 20 is formed and for a like purpose.

Means are provided for yieldingly holding the shoe against the surface of the element 50, said means conveniently comprising two pairs of radially extending arms 65, each pair being carried by a hub 66 mounted on the shaft 51 adjacent an end of the element. The outer end of each arm is provided with an outwardly turned lug 67 and the shoe is also provided with a corresponding lug 68 disposed adjacent but spaced therefrom, and through both lugs is slidably extended a rod 70 having at one end a head 70' bearing against the lug 68, the opposite end of the rod being extended through lug 67 and provided with a coil spring 71 retained in position on the rod and in a state of suitable compression by a nut 72 threaded onto the extremity of the rod in such manner that the several springs are operative to continually pull the shoe toward the surface of the element and maintain it in close but relatively movable con-

tact therewith so that while the element can revolve against the shoe, leakage of oil between the contacting surfaces of the shoe and element is substantially prevented.

For removing the chips and particles which adhere to the surface of the element, suitable means are provided conveniently comprising a scraper blade 75 hinged as at 76 to a lug 77 disposed adjacent the lower end of the shoe in such manner that the free end 75′ of the blade can contact with the surface of the element preferably more or less adjacent its lowest point, a spring 78 being connected to the blade and to some convenient point on the shoe so as to press the free edge of the blade yieldingly against the element.

It will be understood that the shoe is preferably so arranged as to cover from its inlet to its mouth an arc of substantially 90° and is positioned to lie in one of the lower quadrants of the element, which is designed to rotate in the direction indicated by the arrow in Fig. 8, with the mouth of the shoe disposed substantially in the plane of the horizontal diameter thereof, the free edge of the scraper blade being arranged to contact with the surface of the element in the other of its lower quadrants and in advance of the inlet end of the shoe.

In operation, the oil to be cleaned is admitted, preferably in a continuous stream, to the passage 61 within the shoe through the port 64 so as to fill the passage and finally overflow from the mouth 60′′ and thence downwardly to a deflector plate 80 suitably supported on the exterior of the shoe and arranged to direct the oil into an oil pan or basin 81 mounted on the base from which the cleaned oil may be withdrawn through a pipe P′, the general direction of the oil flow being indicated by arrows in Fig. 8. During the passage of the oil through the shoe or conduit the chips and particles in the oil are attracted to and adhere to the surface of the element which is rendered magnetic through the operation of the commutator and associated means save within the sector or zone substantially included between the lines AOB in Fig. 8, and are thus carried up out of the oil and around with the surface until each point thereon reaches substantially the line OB and thus enters the unmagnetized zone. As this zone is preferably in the lower quadrant of the element and below the plane of the horizontal diameter thereof, the heavier particles or chips ordinarily drop off of the element after they enter the zone and drop into a chip pan 83 conveniently disposed on the base 53, while those particles which do not so fall from the element by gravity are scraped therefrom as they are carried against the scraper blade 75 and then drop into the chip pan. As each point on the surface of the element passes the line OA or some other point between the free edge of the scraper blade and the inlet end of the shoe, it is again remagnetized and thus placed in a condition to attract the metallic particles from the oil when again brought into contact with the latter.

I wish it to be understood that I do not desire or intend to in any manner limit myself to the employment of any specific devices for the performance of my improved method of cleaning oil, particularly as I believe it to be broadly new to effect the separation of chips and metallic particles from oil or other fluids by causing the oil containing the particles to continuously flow over a moving magnetized surface so as to cause the particles to adhere thereto, and it will thus be understood that I broadly claim this method of cleaning oil and also contemplate using and claim as within the scope and purview of my invention means for accomplishing the method other than those to which I have herein more or less specifically referred, and further that, if desired, changes and modifications may be made in the details of construction and arrangement of the particular machines which I have illustrated and described without departing from the spirit and scope of the invention as defined in the appended claims.

Having thus described my invention, I claim and desire to protect by Letters Patent of the United States:

1. In a machine of the class described, the combination of a magnetizable element, means for rotating the element, means for maintaining magnetized and unamagnetized zones on the element, a conduit of gradually increasing width disposed on the element, non-rotatable therewith and adapted to convey a stream of oil over said magnetized zone and to discharge said oil on the surface of the element, and automatically operative means adapted to remove from the element metallic particles abstracted from the oil and adhering thereto after the rotation of the element has carried said particles out of the line of flow of said oil and into said unmagnetized zone.

2. In a machine of the class described, the combination of a magnetizable element, means for rotating the element, means for maintaining magnetized and unmagnetized zones on the element, a conduit disposed on the element, non-rotatable therewith and adapted to convey a stream of oil over said magnetized zone and to discharge said oil on the surface of the element, and a scraper blade yieldingly maintained in contact with the surface of said element in said unmagnetized zone and operative to remove from the element metallic particles abstracted from the oil and carried against said blade by the rotation of the element.

3. In a machine of the class described, the combination of a magnetizable element, means for rotating the element, means for maintaining magnetized and unmagnetized zones on the element, a conduit disposed on the element, non-rotatable therewith and adapted to convey a stream of oil over said magnetized zone and to discharge said oil on the surface of the element, and a scraper blade having a free edge disposed in non-radial relation with said element and co-operative with the surface thereof to remove therefrom metallic particles abstracted from the oil and carried against the blade by the rotation of the element.

4. In a machine of the class described, the combination with a rotatable element having magnetized and unmagnetized zones on its surface, of means for removing metallic particles attracted to the magnetized portion of said surface from the surface of the element after the rotation thereof has brought them into said unmagnetized zone said means comprising a spring pressed blade having a free edge extending across the surface of the element in a non-radial direction.

5. In a machine of the class described, the combination with a rotatable element having magnetized and unmagnetized zones on its surface, of means for removing metallic particles attracted to the magnetized portion of said surface from the surface of the element after the rotation thereof has brought them into unmagnetized zone said means comprising a hinged blade in angular relation with said surface and extending beyond the edge thereof and having a free edge cooperative with the surface, and means for yieldingly drawing said edge against said surface.

6. In a machine of the class described, the combination of an element having a magnetizable surface, means for rotatably supporting said element with its said surface in horizontally inclined position, means for effecting rotation of the element, means for maintaining magnetized and unmagnetized zones on the surface of the element, means for conducting a stream of oil over the magnetized surface of the element and for discharging the oil on the surface thereof and generally toward its lowest point to permit the oil to flow over the edge of the element, and means for automatically moving from the surface of the element metallic particles which have been drawn from the oil during its passage over the element.

7. In a machine of the class described, the combination of an element having a magnetizable surface, means for rotatably supporting said element with its said surface in horizontally inclined position, means for effecting rotation of the element, means for maintaining magnetized and unmagnetized zones on the surface of the element, means for conducting a stream of oil over the magnetized surface of the element and for discharging the oil on the surface thereof and generally toward its lowest point to permit the oil to flow over the edge of the element, and means for automatically moving from the surface of the element metallic particles which have been drawn from the oil during its passage over the element after the rotation of said element has carried said particles into said unmagnetized zone.

8. A machine of the class described comprising a pedestal, a shaft extending in the pedestal, means for effecting rotation of the shaft, a rotatable element carried by the shaft exterior of the pedestal and having a plane upper surface, means for creating and maintaining magnetized and unmagnetized zones on said surface, means for conducting a stream of oil over the magnetized portion of said surface and for discharging said oil thereon whereby said oil can flow over the edge thereof, and means for automatically removing from said surface such particles as may have adhered thereto during the passage of the oil thereover after the rotation of said element has carried said particles into the unmagnetized zone.

9. A machine of the class described comprising a pedestal, a shaft extending in the pedestal and slightly vertically inclined, means for effecting rotation of the shaft, a rotatable element carried by the shaft and having a surface horizontally inclined in correspondence with the inclination of the shaft, means for creating and maintaining magnetized and unmagnetized zones on said surface, means for conducting a stream of oil over a part of said magnetized zone and for discharging said oil on another part thereof in a direction to flow over the edge of said element adjacent the lowest point thereof, and means including a spring pressed blade co-operative with said surface for removing therefrom such metallic particles as may have adhered thereto during the passage of the oil thereover and after said particles have been carried out of said oil by the rotation of the element and into said unmagnetized zone.

In witness whereof, I have hereunto set my hand this 30th day of June, 1924.

PETER P-G. HALL.