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Anderson

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[54] **GAS SUPPLY MECHANISM FOR ERASING MACHINES**

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[52] **U.S. Cl.**..... **15/3.53,** 15/344, 418/63, 418/188

[51] **Int. Cl.**..... **A47l 5/24,** B43l 19/00

[58] **Field of Search**..... 15/3.53, 344; 418/63, 151, 418/188

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Primary Examiner—Harvey C. Hornsby
Assistant Examiner—C. K. Moore

[57] **ABSTRACT**

A gas supply mechanism for removable attachment to motor driven erasing machines capable of holding and imparting movement to an eraser, which may, for example, be brought to bear upon a surface, such as a paper surface, for erasure of undesirable markings therefrom. The erasing machine, with the gas supply mechanism connected thereto, is capable of directing a flow of gas, such as compressed air against the surface being erased in the area of contact between the eraser and the surface for the purpose of cooling the surface and the eraser as well as blowing erasure particles from the immediate area being erased.

11 Claims, 13 Drawing Figures

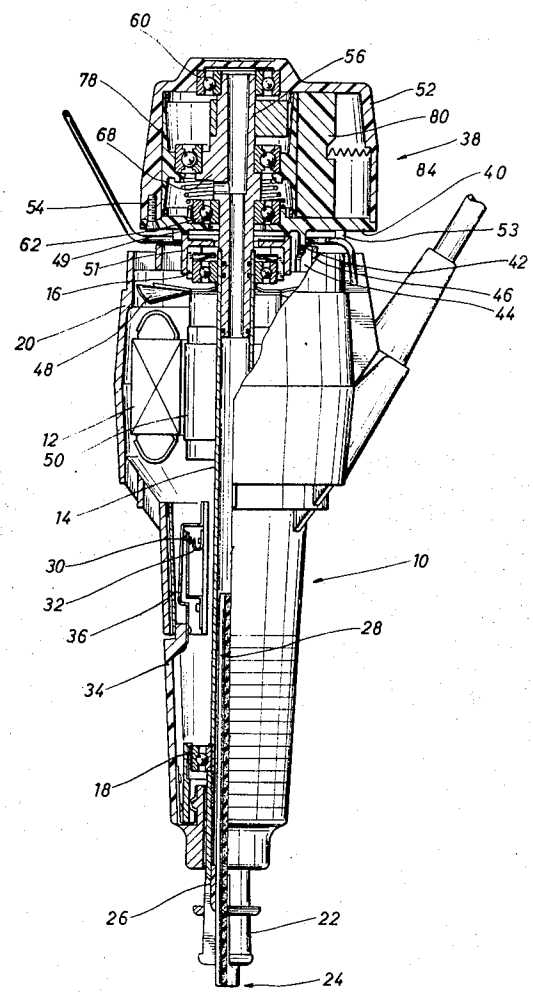


FIG. 1

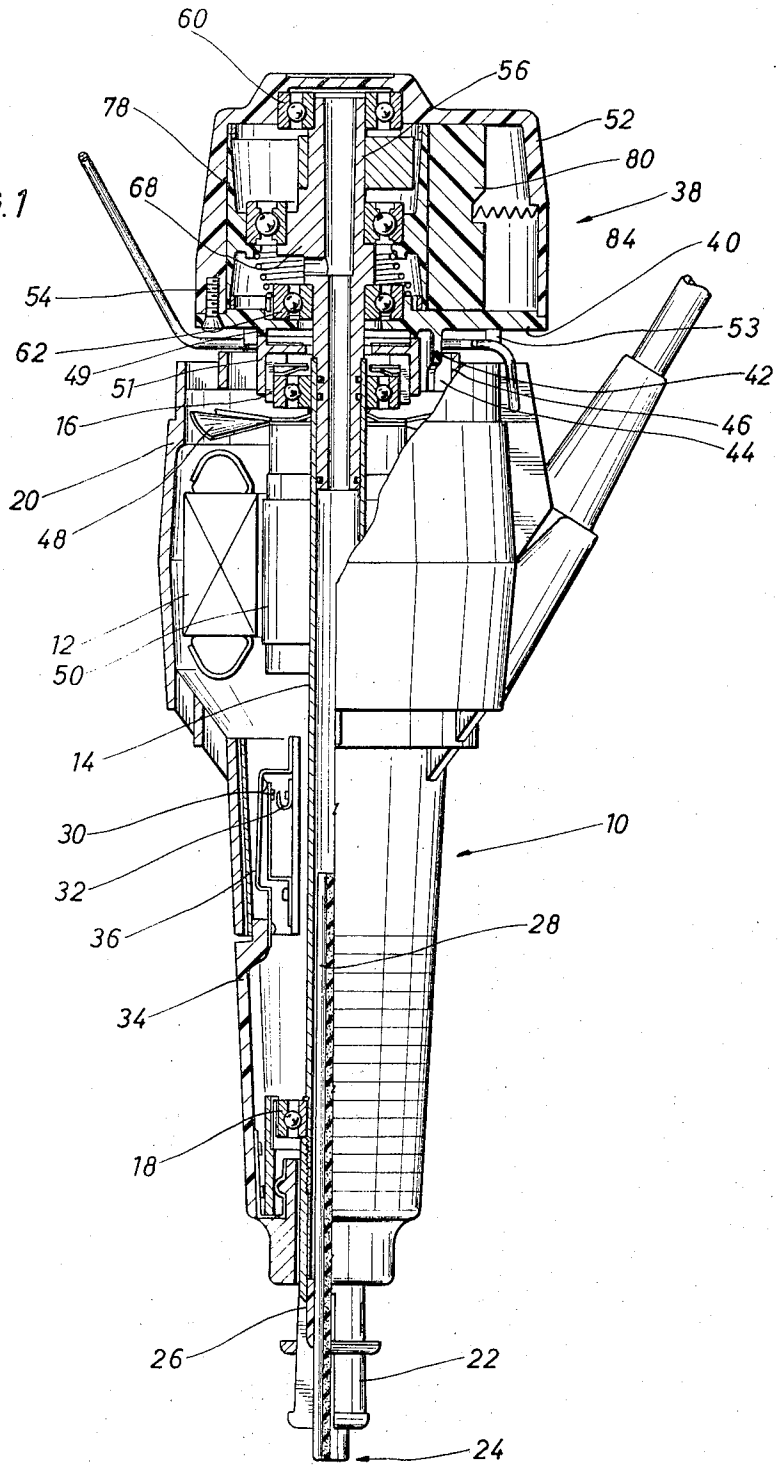

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FIG. 2

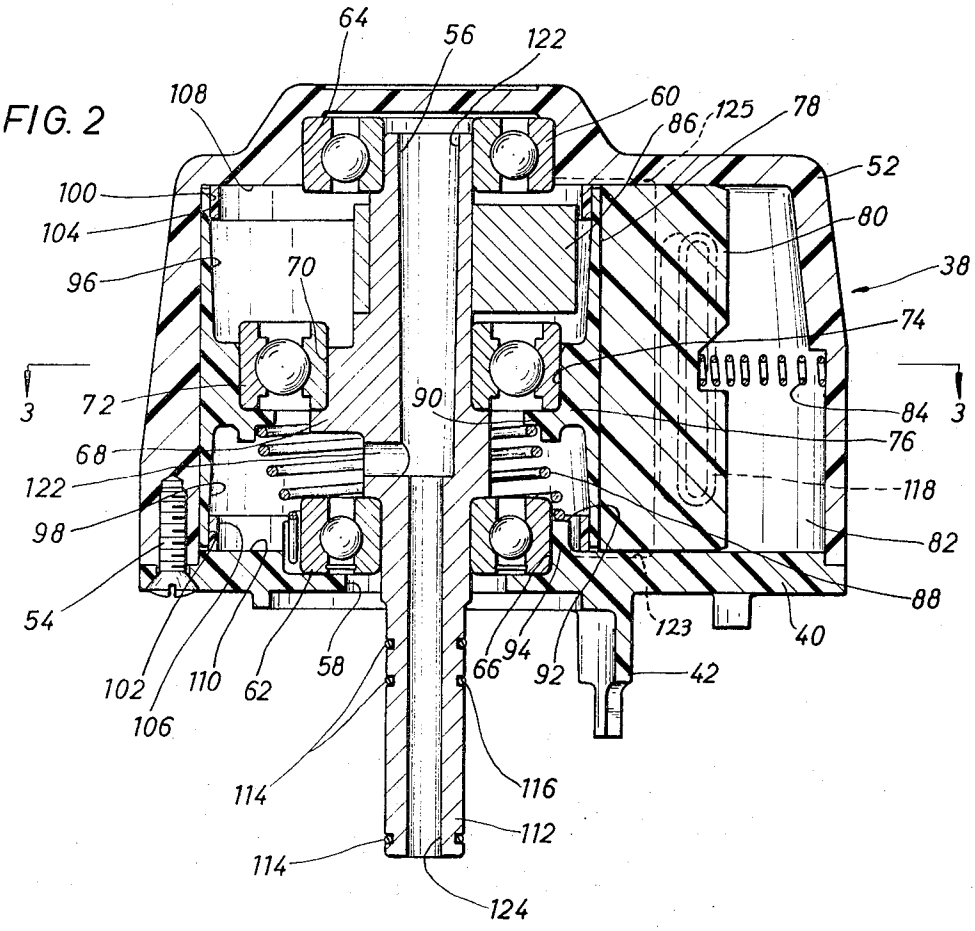

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FIG. 3

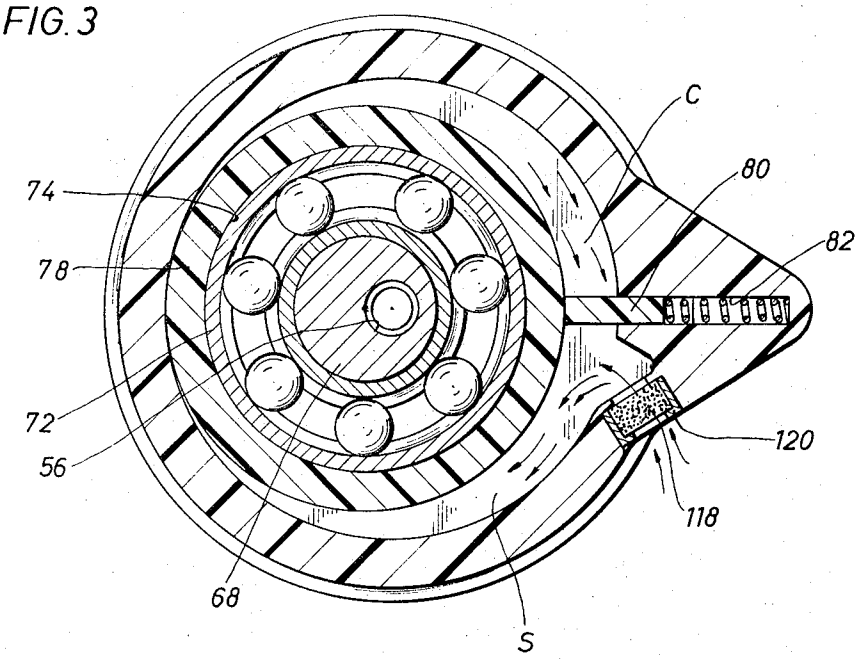

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FIG. 3A

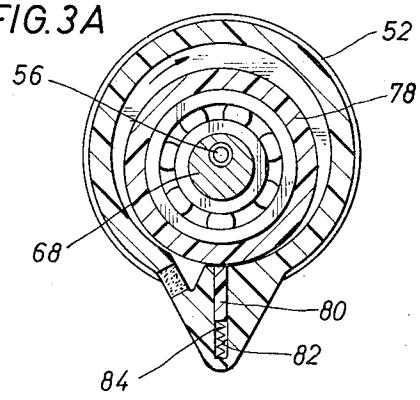


FIG. 3B

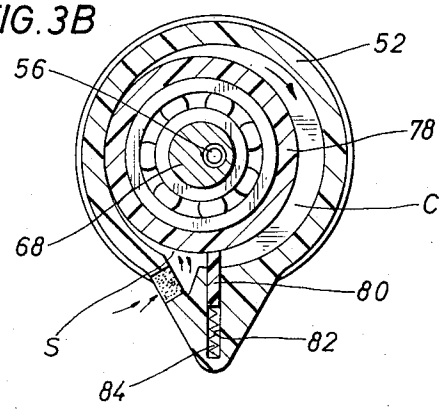


FIG. 3C

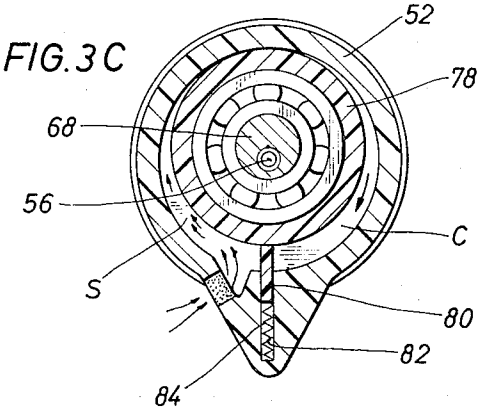


FIG. 3D

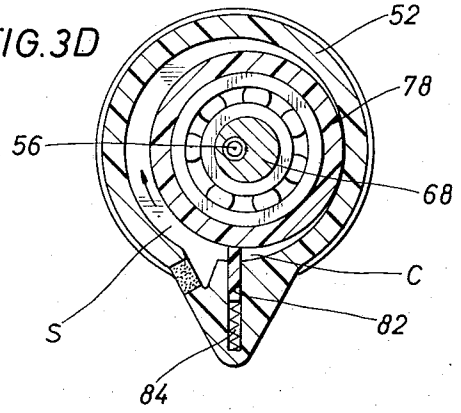


FIG. 6

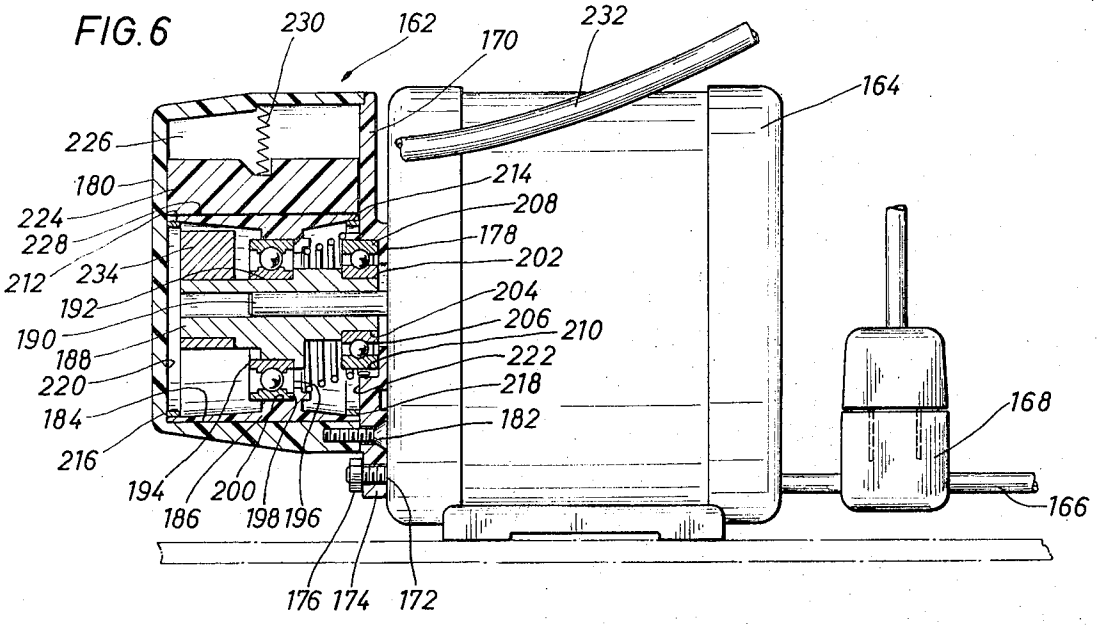


FIG. 4

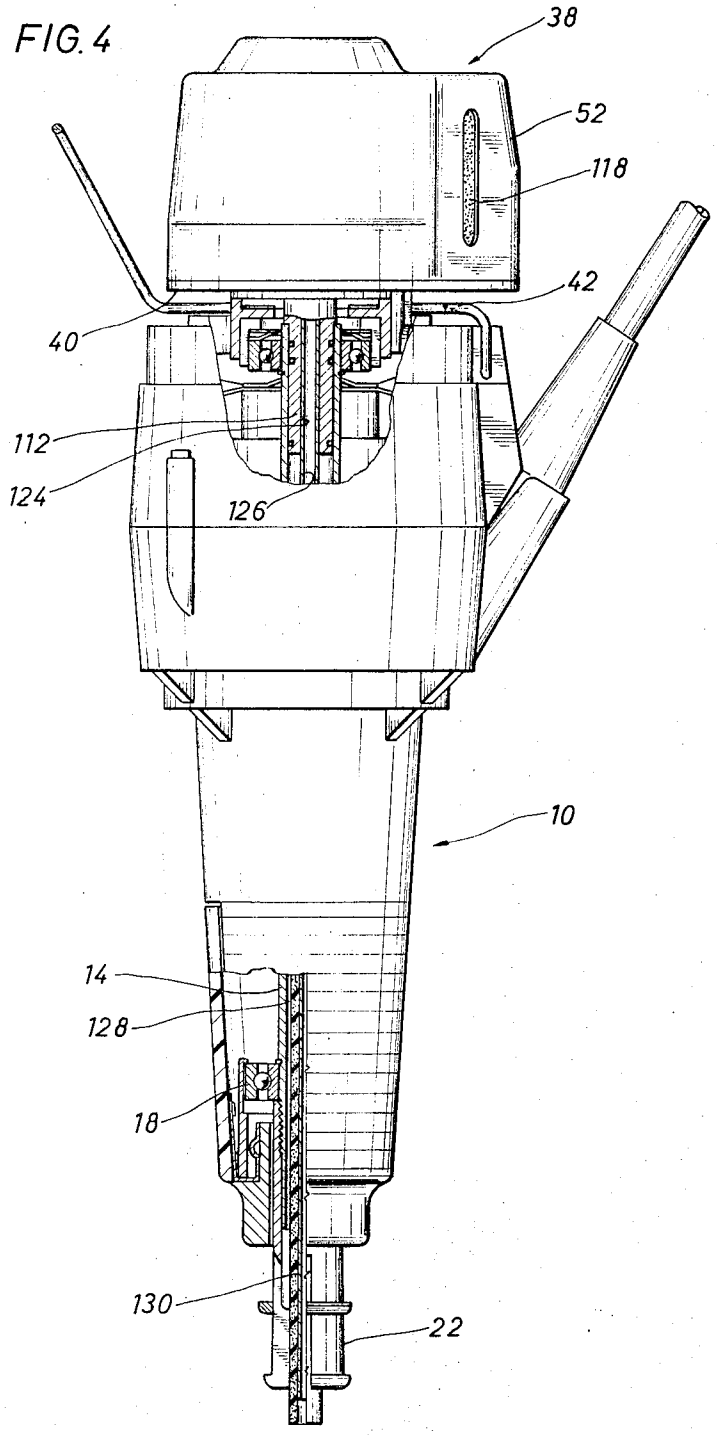


FIG.5

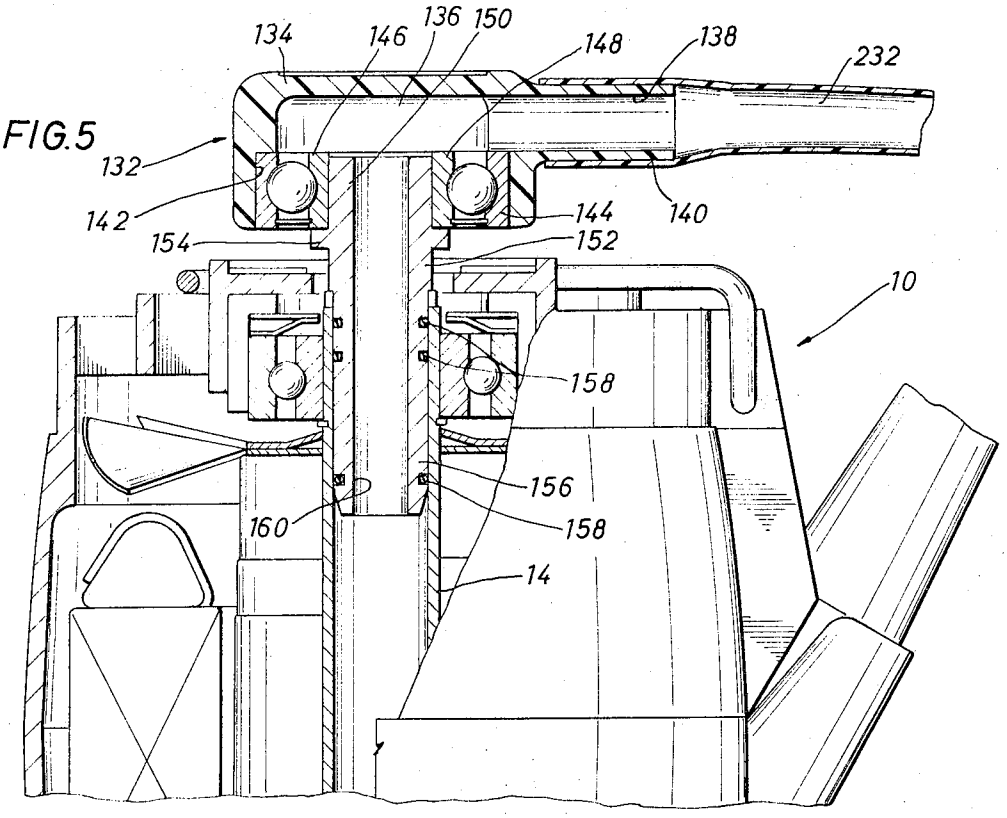

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FIG.7

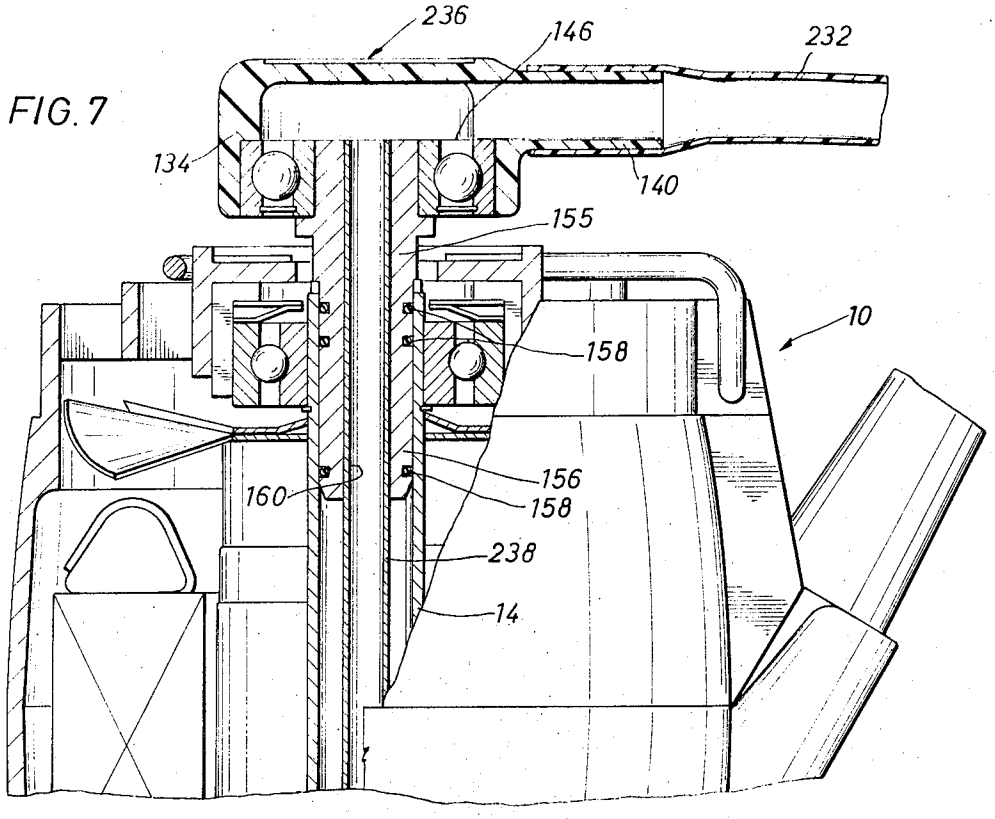

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FIG. 8

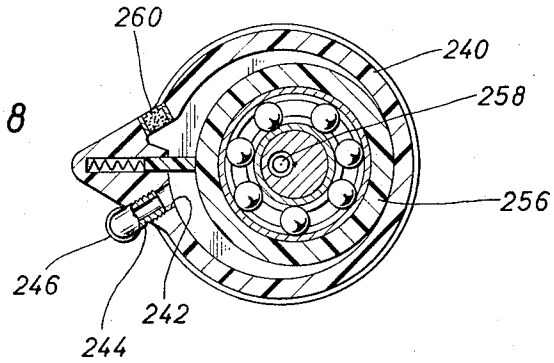
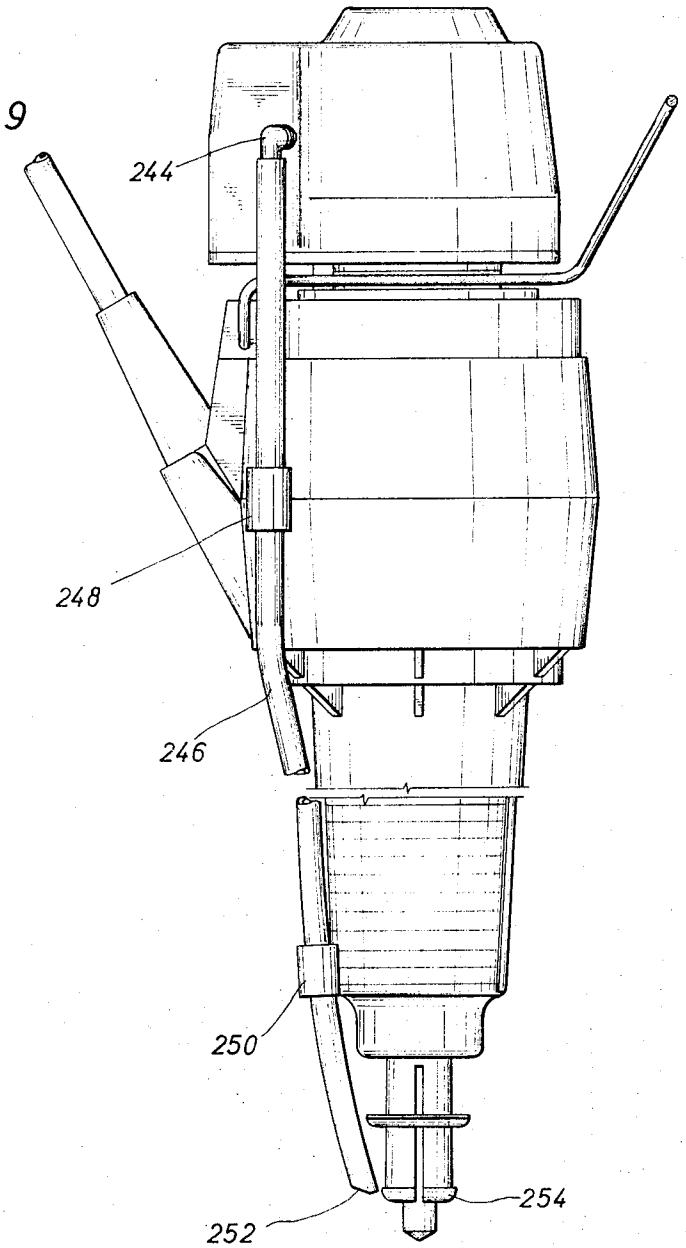


FIG. 9



GAS SUPPLY MECHANISM FOR ERASING MACHINES

FIELD OF THE INVENTION

This invention relates generally to erasing machines provided for erasing undesirable markings from surfaces, such as paper surfaces, for example, and more particularly relates to a removable gas pump mechanism for assembly with motor driven erasing machines to provide the erasing machines with the capability of directing a flow of gas against the surface being erased for purposes of cooling and removal of erasure particles.

BACKGROUND OF THE INVENTION

Mechanically driven erasing machines, such as those driven by both AC and DC electric motors of both cord and cordless type, have been utilized for many years. An erasing machine of this nature will generally incorporate a motor drive mechanism that is disposed within a motor housing, which drive mechanism is connected to a collet chuck mechanism that receives and holds a generally cylindrical strip of erasing material commonly known as an eraser strip. Upon manual manipulation of an on-off switch, the erasing machine, which is adapted to be hand held, may be energized to cause rapid rotation of the eraser and may be brought to bear upon a surface to be erased in order to remove undesirable markings therefrom.

Although this specification is directed generally to application of the invention to rotary erasing machines, it is not intended to so limit the scope of the invention, it being obvious that other types of motorized erasing machines may be provided with a gas supply pump mechanism within the spirit and scope of the invention.

As an erasing operation is conducted, the surface being erased is eroded to some extent and erasure particles become separated from the eraser strip and become deposited on the surface being erased along with particles eroded from the surface, thereby contaminating the surface. Periodically, it is necessary, in order to facilitate good visibility of the surface beng erased, for the operator of the machine to cease the erasing operation and remove the erasure particles from the surface by means of a brush or any other acceptable erasure particle removable device. Ceasing the erasing operation in this manner and periodically removing the erasure particles from the surface obviously detracts from the commercial effectiveness of the erasing operation, because of the amount of time utilized in brushing of the erasure particles or grit away from that portion of the surface being erased.

Another problem, encountered in the use of mechanical erasing machines, concerns the generation of heat between the rapidly rotating eraser strip and the surface being erased. When a rotating eraser strip is brought to bear upon a paper surface, to remove pencil or ink lines therefrom, a draftsman, utilizing the machine, must exercise great care to prevent the contact area from becoming hot enough to burn through the paper as well as becoming hot enough to cause deterioration of the eraser strip. When erasing ink or pencil lines from a plastic film surface, a draftsman may not be allowed to utilize a mechanical erasing device because the film is so susceptible to burn-through due to heat deterioration of the film. It is quite difficult to erase markings from a plastic surface without generating enough heat to burn through the surface. As the draftsman applies the rotating eraser strip to the surface it is typically necessary for the machine to be periodically lifted from the surface for cooling and this, of course, adds time to the erasing operation and detracts from the commercial feasibility thereof.

Heat generated during an erasing operation may cause burnishing or slight discoloration of a paper surface, being erased, and may detract from the ability of the paper to receive ink or pencil markings after being erased. It may be necessary, after utilizing a mechanical eraser, for erasing pencil or ink lines on paper, to clean the erased surface with a manually applied eraser before applying ink or pencil lines thereto. Of course, between the mechanical and manual erasing operations, it is necessary to brush away the erasure particles. Considerable time may therefore be expended in the drafting and erasing operation which is, of course, undesirable.

Another factor that may detract from mechanical erasing operation, is the amount of wear that occurs on rotating eraser strips because of the great amount of heat that is generated. Frequently, a rapidly rotating eraser strip will become sufficiently heated during an erasing operation that the eraser material will break down and crumble away quite rapidly. Heat deterioration of the eraser strip in this manner obviously substantially increases the cost of the erasing operation, as well as substantially increasing the amount of erasure particles that become deposited on the surface being erased, which particles of course must be brushed away before a drafting operation can be continued.

A draftsman drawing with pencil or ink on a paper surface will typically employ the following erasing sequence during drafting operations:

1. Pick up erasing machine.
2. Erase.
3. Lay erasing machine down.
4. Pick up brush.
5. Brush erasure particles away from the erasing area and inspect erasure.
6. Lay brush down.
7. Pick erasing machine up again.
8. Touch up incomplete erasure or erase over lines again to improve quality of erasure.
9. Lay erasing machine down.
10. Pick up brush.
11. Brush erasure particles away from erasing area and reinspect erasure.
12. Lay brush down.
13. Repeat steps 7–12 if necessary.
14. Begin drawing again.

It is therefore a primary object of the present invention to provide a novel gas supply assembly for attachment to mechanically driven erasing machines that provides the draftsman with the capability of utilizing the following sequence during erasing operations:

1. Pick erasing machine up.
2. Erase and inspect erasure simultaneously, because grit or erasure particles will have been removed from the surface being erased during application of the eraser strip to the surface.
3. Lay erasing machine down.
4. Begin drawing again.

It is a further object of the present invention to provide a novel gas pump assembly for attachment to mechanically driven erasing machines that gives the erasing machine the capability of directing a flow of compressed gaseous medium, such as air, on the surface being erased, immediately adjacent to the point of contact between the eraser strip and the surface, which flow of gaseous medium is sufficiently great to blow erasure particles away from the area being erased thereby providing the draftsman with good visibility of the area being erased at all times.

It is an even further object of the present invention to provide a novel gas supply mechanism for attachment to a mechanically driven erasing machine giving the erasing machine the capability of developing a flow of gaseous medium for achieving cooling of the contact area between the eraser strip and the surface being erased, thereby preventing burning of the surface being erased and preventing excessive crumbling or erosion of the eraser strip material during the erasing operation.

Among the several objects of the present invention is noted the contemplation of a novel gas supply mechanism for attachment to a mechanically driven erasing machine, which, when utilized, promotes optimum erasing at nominal eraser strip cost by preventing excessive wear of eraser strips during the erasing operation.

It is an even further object of the present invention to provide a novel gas supply mechanism for attachment to a mechanically driven erasing machine which gas supply mechanism may be disposed remotely from the erasing machine or may be carried by the erasing mchine itself.

It is also an object of the present invention to provide a novel gas supply mechanism which may be readily connected to existing erasing machines without substantial modification thereof.

An even further object of the present invention contemplates the provision of a novel gas supply mechanism for mechanically driven erasing machines that may incorporate a remotely located supply of compressed gaseous medium for purposes of cooling and erasure particle removal with a gas supply conduit attached to the erasing machine for conducting a flow of gas from said supply to the erasing machine.

It is also an object of the present invention to provide a novel pump apparatus that may be connected in driving relation to a motor mechanism for pumping a liquid or gaseous medium.

Other improvements of the function and facility of design will become apparent from the following description taken in conjunction with the drawings in which:

FIG. 1 is a partial sectional view of an electrically driven erasing machine having a gas supply mechanism, constructed in accordance with the present invention, removably assembled to the upper extremity thereof, which gas supply mechanism gives the erasing machine the capability of conducting compressed gaseous medium from the gas supply to the lower extremity of the eraser strip received in the erasing machine.

FIG. 2 is a sectional view of the gas supply mechanism of FIG. 1 with the parts thereof illustrated in detail.

FIG. 3 is a sectional view taken along line 3—3 of FIG. 2.

FIGS. 3A, 3B, 3C and 3D are operational views in plan depicting various positions of the movable parts of the gas supply mechanism of FIGS. 1–3 during one revolution of the rotor shaft of the machine.

FIG. 4 is a sectional view of a gas supply mechanism capable of being connected to an electrically driven erasing machine and which gas supply mechanism represents a modified embodiment of the present invention.

FIG. 5 is an illustration of an erasing machine having parts thereof broken away and shown in section and having a gas supply mechanism connected to the upper extremity thereof which gas supply mechanism is illustrated in section and represents a further modified embodiment of the present invention.

FIG. 6 is an elevational view, illustrated partially in section and showing a remotely located gas supply mechanism, representing, with the structure illustrated in FIG. 5, a modified embodiment of the present invention and being capable of supplying compressed air or other gaseous medium to the gas supply mechanism illustrated in FIG. 5.

FIG. 7 is an elevational view of a mechanically driven erasing machine having a gas supply device connected to the upper extremity thereof which gas supply device represents a further embodiment of the present invention.

FIG. 8 is a plan view of an erasing machine having a modified gas supply mechanism, constructed in accordance with the present invention, connected to the upper extremity thereof and being provided with an external supply conduit for transporting compressed air or other gaseous medium to the contact area between the eraser strip and the surface being erased.

FIG. 9 is an elevational view of the erasing machine and air supply mechanism of FIG. 8, particularly illustrating the conduit mechanism for conducting compressed air for the purposes of cooling and blowing erasure particles.

SUMMARY OF THE INVENTION

The present invention is directed to the provision of a gas supply mechanism for mechanically driven erasing machines having the capability of directing a flow of compressed gaseous medium, such as air, for example, against a surface being erased in the immediate vicinity of the contact area between the eraser strip carried by the machine and the surface being erased. The gaseous medium, or air is blown agains the surface area being erased at or near the point of contact between the eraser strip and the surface being erased for the purpose of removing erasure particles or grit from the surface and for cooling the eraser to prevent burning or burnishing of the surface being erased and to prevent excessive erosion of the eraser strip by the heat being generated during the erasing operation.

The invention is directed specifically to a gas supply mechanism, referred to hereinafter as an "air supply", which may be removably connected to the upper extremity of an erasing machine in such manner as to provide existing erasing machines with the advantages of an air supply for blowing and cooling purposes.

The air supply is essentially an eccentric pump having a rotor that is eccentrically located within a generally cylindrical chamber defined within a pump housing, which rotor cooperates with a movable vane, located within the housing, and bearing upon the rotor,

to direct a flow of air through an air passage defined within a connector element that may be formed integrally with the shaft of the rotor. The connector element is adapted to be received within the upper extremity of a chuck tube of an electric erasing machine, thereby directing the flow of air from the air passage into the chuck tube where it may flow through or along a groove formed in the outer extremity of an eraser strip disposed within the chuck tube. The erasing machine may be provided with a chuck collet seal element that prevents the flowing air from being dissipated through slots ordinarily defined by the collet mechanism and directs the flow of air along the eraser strip and causes it to bear upon the surface being erased immediately adjacent the rotating eraser.

In the alternative the erasing machine may receive a strip of erasing material having a bore formed axially therethrough defining an air passage. In this case, the air supply mechanism may be provided with an elongated tube to conduct the flowing air from the air supply into the air passage formed in the eraser strip.

Also, if desired, the air supply pump may be located remotely from the eraser and a conduit may be employed to conduct the flowing air to an air supply connector attachment, received at the upper extremity of the erasing machine, as desired. The air supply connector attachment may, in this case, be provided with an elongated air supply tube having an air supply passage formed axially therethrough that communicates flowing air from the air supply connector attachment to the air passage defined by the bore within the eraser strip. Air may be conducted from the pump and directed externally of the erasing machine to the surface, if desired.

DESCRIPTION OF PREFERRED EMBODIMENTS

Now referring to the drawings and first to FIG. **1**, there is shown an electrically energized erasing machine generally at **10** which includes an electric motor mechanism **12** capable of imparting rapid rotation to a chuck tube **14** journaled by bearings **16** and **18** in the housing **20** surrounding the motor mechanism **12.** The chuck tube **14** is adapted to receive a generally cylindrical strip of eraser material, generally referred to as an eraser strip, which is held in fixed relation to the chuck tube by a chuck mechanism **22** fixed to the lower extremity of the chuck tube and which may be of the collet type, as illustrated, or which may take any other acceptable form, as desired.

In order to direct a flow of gaseous medium, such as air, through the chuck tube **14** and along the eraser strip **24** to direct the same on the surface being erased, it will be desirable to prevent air from being dissipated through the slots defined by the collet chuck mechanism **22.** In order to prevent such air dissipation, a chuck seal device **26** may be disposed within the collet chuck and about the eraser strip to confine the flow of air along the eraser. The chuck seal **26** may be composed of a yieldable material such as any one of a number of acceptable soft plastic materials. The chuck seal **26** may be employed when the eraser strip **24** is provided with one or more external grooves **28** but will not be necessary if the eraser strip is provided with an axial flow passage or bore as shown essentially in FIGS. **4** and **7.**

Electrically driven erasing machines will typically be employed with on-off switch contacts **30** and **32** that may be closed by manual depression of a switch actuating element **34.** The erasing machine is ordinarily held in the hand of the operator and the switch actuating element **34** is actuated with the index finger to achieve opening and closing movement of the on-off switch mechanism. The switch actuating element **34** may be connected to a spring element **36** that returns the switch actuating element and the contacts **30** and **32** to the open or deenergized position thereof upon release of manual pressure on the switch actuating element.

With regard specifically to the eraser strip and the chuck assembly for supporting the same, reference may be had to my copending application Ser. No. 303,354, filed Nov. 6, 1972 and entitled Eraser Strip and Chuck Assembly for Motor Driven Erasing Machines.

In the preferred embodiment of the present invention, it will be practical to provide apparatus for supplying pressurized gaseous medium such as air to the erasing machine which apparatus may, if desired, be positioned on the erasing machine itself. The supply mechanism, which may also be referred to as an air supply, may conveniently take the form generally illustrated at **38** in the upper portion of FIG. **1,** where a base element **40** is shown to be provided with a depending tab **42** that may be received within an opening **44** defined by a fan grating **46** of the housing **20** through which air is blown by a fan blade **48** connected to the armature **50** of the motor **12,** for the purpose of cooling the motor during operation of the erasing machine. The depending tab element **42** merely serves to prevent rotation of the base element **40** relative to the housing **20** of the erasing machine during erasing operations.

The base element may also be provided with a generally circular support rim **49,** disposed for engagement with a circular portion **51** of the housing **20.** Other projections, such as shown at **53,** may be provided on the base element to adapt the air supply mechanism for assembly to erasing machines of other housing configurations. The air supply mechanism **38** may be provided with a housing **52** connected to base element **40** by screws such as shown at **54** or by any other suitable means of connection.

Referring now particularly to FIG. **2,** a rotor shaft **56** may extend through an aperture **58** formed in the base element **40** and may extend into the air supply housing **52** where it may be supported for rotation by an upper bearing **60** and a lower sealed type bearing **62,** retained within bearing recesses **64** and **66** defined within the air supply housing **52** and the base element **40,** respectively. The rotor element **56** may be provided with an eccentric boss **68** which may have a circular bearing support surface **70** disposed in eccentric relation to the axis of the rotor shaft. A rotor bearing **72** may be disposed about the rotor shaft **56** with the inner race of the bearing being received by the bearing support surface **70** while the outer race of the bearing may be received by a bearing engaging surface **74,** defined by an internal structural portion **76** of a rotor **78.** As the rotor shaft **56** is rotated within the housing **52,** the rotor element **78,** through its bearing connection with the eccentric portion of the rotor shaft, will be caused to oscillate eccentrically within the generally cylindrical cavity defined within the housing **52.** It is important to bear in mind that the rotor does not rotate within the housing and therefore, torque, which might otherwise be expended to rotate the rotor, will be available for more efficient operation of the pump. When such

movement occurs, the rotor, in cooperation with the wall structure defining the housing cavity, will squeeze or push the air in the opening ahead of the rotor toward the pump outlet.

In order to achieve a pumping function, it is necessary that means be provided to direct the flow of air being moved by the rotor toward an outlet opening. According to the present invention, such means may conveniently be provided by a vane element **80,** that may be movably received within a vane recess **82** and may be urged toward the rotor **78** by a spring element **84** or other suitable urging means. The vane, which may be composed of a low friction wear resistant material such as a filled polytetrafluoroethylene, is urged by the compression spring element into engagement with the cylindrical peripheral surface of the rotor at all times and is moved into the recess **82** against the compression of spring **84** by the rotor element as the rotor is moved eccentrically within the housing. An eccentric counterweight **86** may be received by the rotor shaft **56** and may be oppositely disposed relative to the rotor element. The counterweight serves to develop a centrifugal force during rotation thereof which counterbalances the centrifugal force developed by the eccentric rotor and rotor bearing during oscillation thereof.

A torsion spring **88** may be interposed between a shoulder **90** defined by an internal flange on the rotor **78** and a shoulder **92** defined by a boss **94** formed on the base element **40.** One end of the torsion spring fits into a mating portion on the rotor to hold the rotor in position. The torsion spring effectively prevents the rotor from freely rotating, thus conserving energy which may be employed for purposes of pumping. The spring limits rotary movement of the rotor to a small fraction of a revolution during each revolution of the pump. This feature minimizes wear of the rotor and rotor seals and conserves energy. Preventing free rotation of the rotor also effectively prevents the rotor engaging portion of the vane from wearing excessively.

On opposite sides of the centrally located boss **76** of the rotor element **78,** the rotor element may be provided with tapered surfaces **96** and **98** that intersect cylindrical surfaces **100** and **102,** respectively. Upper and lower seal rings **104** and **106** may be lightly press-fitted within the upper and lower extremities of the rotor element respectively and may present sealing extremities for close sealing relationship with the cylindrical surfaces **100** and **102,** respectively. The seal rings **104** and **106** are prevented from shifting toward the center of the rotor element by the interference fit thereof with the surfaces **100** and **102.** The seal rings effectively prevent compressed air from flowing past the upper and lower extremities of the rotor as the rotor is moved eccentrically relative to the planar surfaces of the housing and base element.

The seal rings may be inserted slightly into press-fitted relation with the respective end surfaces **100** or **102** of the rotor during assembly of the air supply mechanism. As the housing **52** is drawn into assembly with the base element **40** by the screws **54,** the seal rings **104** and **106** will be moved by the planar surfaces **108** and **110** of the housing **52** and base element **40,** respectively into proper relation with the planar surfaces. This feature effectively eliminates the necessity for close tolerancing of the rotor element, the housing or the base element. Additionally, the seal rings **104** and **106** may be composed of a low friction material such as polytetrafluoroethylene, which may or may not, as desired, be combined with a filler material of wear resistant composition. After the air supply mechanism has rotated a few revolutions, the seal rings will have been moved by the surfaces **108** and **110** to positions establishing very light contact, if any, with the planar surfaces. The close fit thereof with the planar effectively eliminates all but a token or acceptable amount of gas leakage past the extremities of the rotor.

It will be desirable, in order to adapt existing electrical energized erasing machines with an air supply in accordance with the present invention, to simply provide a universal means for connecting the air supply to the eraser mechanism without necessitating extensive modification thereof. To achieve connection of the air supply to an erasing machine of the particular design illustrated in FIG. **1,** for example, the rotor shaft **56** may conveniently be provided with a connector extension **112** that may be formed integrally with the rotor shaft and may be of proper external dimension to facilitate insertion thereof into the chuck tube **54** in rather close fitting relation.

It is also desirable that the connector element fit within the chuck tube structure **14** in such manner as to establish sufficient friction fit to allow the chuck tube **14** to permit rotation to the rotor shaft **56** for operation of the air supply by the rotor mechanism of the erasing machine. To facilitate such frictional engagement and to prevent leakage of compressed air along the connection between the connector element **112** and the chuck tube **14** at least one and preferably a plurality of sealing and frictional engaging elements **114** may be retained within annular grooves **116** defined in the periphery of the connector extension **112.** The annular seals **114,** which may be O-rings or any other acceptable sealing elements, will establish sealing engagement with the interior surface of the chuck tube **14** as well as establishing sufficient frictional engagement to establish non-rotatable connection between the chuck tube and the connector tube. Moreover, the O-ring elements will be of sufficient size to compensate for variations in the internal dimension of the chuck tubes of various commercially available erasing machines. The connector extension and the O-ring elements effectively define a universal connecting mechanism adapting the air supply mechanism for use with most electrically energized erasing machines.

Air from the atmosphere may be drawn into the air supply housing **52** by suction created by the rotor element **78** as it is oscillated eccentrically within the housing. Air from the atmosphere will enter the housing structure through a filter element **118** retained by a filter element retainer **120** which retainer element may be press fitted within an elongated opening defined in the wall structure of the housing. After air has been drawn into the housing by suction of the rotor, the rotor, on continued eccentric oscillation within the housing, will cause compression of the air thereby causing the air to flow through flow channels extending, from the space between the rotor and the housing to the flow passage **122** defined in the rotor shaft. The channels or grooves are formed in the base element **40** and the housing **52,** respectively, such grooves being shown in full line at **123** in FIGS. **3, 3B, 3C** and **3D** and being identified by broken lines **123** and **125** in FIG. **2.** The flow passage from the passages **122,** to the chuck tube of the erasing machine is defined by a bore **124** defined

axially of the connector extension **112** of the rotor shaft **56.**

Operation of the air supply mechanism is illustrated in FIGS. **3A–3D.** In FIG. **3A** the rotor **78** is shown to be positioned relative to the housing structure **52** in such manner that the vane element **80** is fully disposed within its recess **82.** A volume of air is disposed in the space between the rotor and the housing structure, but, under this condition, will be neither under suction nor compression. In FIG. **3B** the rotor element **78** is shown as being oscillated 90° clockwise from the position illustrated in FIG. **3A.** The vane element **80** will have been moved outwardly from its groove **82** by the compression spring **84,** thereby maintaining its sealed engagement with the peripheral surface of the rotor and serving to separate the space between the rotor and the housing structure into a suction chamber S and a compression chamber C, both of which are of variable volume as the rotor is moved eccentrically within the housing **52.**

In FIG. **3C,** the rotor element **78** is illustrated in the position it will take when the rotor shaft has rotated clockwise 90° from the position illustrated in FIG. **3B.** It should be borne in mind that the rotor does not rotate along with the rotor shaft, because of the action of torsion spring **88,** which serves to limit rotary movement of the rotor to a negligible degree as the rotor mechanism is oscillated eccentrically within the housing by the rotor shaft mechanism. As the rotor shaft is oscillated from the position illustrated in FIG. **3B** to the position illustrated in FIG. **3C,** the suction chamber S will increase in volume while the compression chamber C decreases in corresponding manner. Air entrapped within compression chamber C by the vane **80** will be subjected to compression and will therefore be caused to flow through the passageways **122** to the receiving passageway, defined in the erasing machine.

In FIG. **3D,** the rotor shaft **56** will have been rotated 90° clockwise from the position thereof illustrated in FIG. **3C,** thereby causing the suction chamber to substantially increase while the compression chamber C is substantially reduced. Virtually all of the air within compression chamber C will have been forced by the squeezing action of the rotor through channels in base element **40** and housing element **52,** shown in broken line at **123** and **125,** respectively, toward the passageways **122,** through which it will flow into the erasing machine and to the tip of the eraser for cooling and particle blowing purposes. As the rotor shaft **56** rotates 90° clockwise from the position, illustrated in FIG. **3D,** the rotor element **78** will again assume the position illustrated in FIG. **3A** and the rotor cycle, described above, will be repeated continuously. Air is therefore provided by the air supply mechanism in essentially pulsating manner for eraser cooling and particle blowing purposes.

With reference now to FIG. **4,** a modified embodiment of the present invention is illustrated, which modified embodiment may be employed when it is desired to utilize eraser strips having an air flow passage or bore formed axially therethrough. The air supply mechanism may be constructed generally identical to the air supply mechanism set forth at **38** in FIG. **2,** except that the lower portion of the rotor shaft may be modified in order to define communication of the air supply with the air passage formed in the eraser strip. A tubular air supply conduit **126** may be received in frictional engagement within the axial bore **124** formed through the connector extension **112** of the rotor shaft **56.** Otherwise, the rotor shaft **56** will remain of similar construction and function. Upon assembly of the air supply mechanism **38** to the upper extremity of an electric eraser, the tubular air supply conduit will be inserted into the chuck tube **14** of the eraser and the connector extension **112** will be brought into frictional engagement within the upper extremity of the chuck tube.

The chuck collet may be of the same type that is presently utilized in erasing machines of this nature and may establish frictional engagement with the peripheral surface of the eraser strip at the lower extremity thereof as shown in FIG. **4,** thereby causing the eraser strip to be rotated along with the chuck and chuck tube. The eraser strip **128** however, as indicated above, will be provided with a centrally located bore **130** of sufficient dimension to be received about the air supply tube **126.** The air supply tube **126** will extend into the bore **130** of the eraser strip **128** a sufficient amount to maintain fluid communication between the tube and the eraser bore **130** even when the eraser strip has been eroded away by erasing wear until it becomes quite short. The tube **126** may, if desired, extend beyond the lower extremity of the chuck to lend additional structural integrity to the eraser as well as providing a means for delivering compressed air for cooling and surface cleaning purposes.

The air supply mechanism will function in similar manner as described above in connection with FIGS. **1D–3D** and will cause air to flow from the air supply into air supply tube **126** where it will be conducted into the eraser strip bore **130.** The compressed air flowing from the eraser strip will exit from the eraser strip at the point of contact between the eraser strip and the surface being erased, thereby cooling the eraser strip and the surface being erased and also blowing away the erasure particles that are developed as the surface is erased.

With reference now to FIG. **6** a modified embodiment of the present invention is illustrated incorporating a remotely located source of compressed air and a connecting mechanism capable of establishing fluid communication between the remote air supply and the chuck tube **14** of the erasing machine **10.** The remote air supply mechanism, providing a flow of compressed air to the connecting device illustrated in FIG. **5,** is shown in FIG. **6.**

The erasing machine **10,** illustrated in FIG. **5,** may be of identical construction as compared to the erasing machine illustrated in FIG. **1.** The erasing machine may be provided with a chuck seal **26** capable of preventing the dissipation of gaseous medium from an air supply groove **28** in eraser **24** through slots defined by the chuck collet. The chuck seal may, if desired, be identical to the chuck seal illustrated in FIG. **1.**

When it is desired to employ a remotely located air supply pump or compressor of the nature illustrated in FIG. **6,** it will be necessary to establish fluid communication between the compressor and the rotating chuck tube **14** of the erasing machine **10.** According to the present invention, an air supply connector mechanism for communicating compressed air to an electric erasing machine, may conveniently take the form generally illustrated at **132** in FIG. **5** where a connector body **134** is provided having a body cavity **136** formed therein and being disposed in communication with a flow pas-

sage **138**, defined in a tubular connector portion **140** of the body structure. A bearing recess **142** may be defined in the connector body **134** and may receive the outer race **144** of a sealed type bearing **146**. Within the inner race **148** of the bearing may be received the upper extremity **150** of a connector tube **152** having an annular flange **154** formed integrally therewith for supporting the inner race of the bearing. The connector tube **152** may be provided with a reduced diameter lower extremity **156** adapted for close fitting relation with the inner surface of the chuck tube **14**. A plurality of sealing elements **158**, such as O-rings, or the like, may be received within annular grooves defined in the lower portion **156** of the connector tube **152**. The sealing element **158** may serve the dual function of preventing leakage of compressed gaseous medium between the chuck tube and the lower cylindrical portion of the connector tube **152** and establishing sufficient frictional engagement between the connector tube and the chuck tube to cause the connector mechanism **132** to be retained in assembly with the erasing machine.

Air or other gaseous medium, provided by the remotely located air supply, will flow through the connector tube **232** into the body cavity **136** of the connector mechanism **132** and from the body cavity will flow through a bore **160** defined in the connector tube **152** into the chuck tube **14** where it will be conducted through the passage defined by groove **28** in the eraser strip **24** to the outlet defined by the eraser groove where it will be caused to impinge upon the surface being erased for purposes of cooling and particle removal.

A remotely located air supply for providing the air supply connector mechanism **132** of FIG. **5** with a supply of pressurized gaseous medium may conveniently take the form illustrated generally at **162** in FIG. **6**, where an electric motor **164** is shown that may include an electrical circuit connected through an electrical supply conduit **166** to a source of electrical potential for operation of the motor. If desired, a motor control mechanism **168** may be employed to control operation of the motor for energizing the air supply mechanism each time the electric erasing machine is operated. The air supply mechanism may incorporate a base element **170** that may be secured to the motor structure **164** by means of a series of studs **172** extending through apertures formed in connector flanges **174** and secured by nuts **176**. The base element **170** may be provided with support bosses **178** that cooperate with the stud and nut retaining devices to insure firm immovable connection of the base element **170** to the motor structure. An air supply housing **180** may be secured to the base element **170** by a plurality of screws **182**, or the like.

The housing **180** may define a generally cylindrical rotor chamber **184** within which may be movably received a rotor element **186**. An eccentric rotor shaft **188** may be retained by the drive shaft **190** of the motor **164** on which rotor shaft may be conveniently formed a cylindrical surface **192** that is disposed eccentrically with respect to the axis of the motor drive shaft. The inner race **194** of a bearing **196** may be received in press fitted relation about the cylindrical surface **192**, thereby causing the bearing to be moved eccentrically as the motor shaft and rotor shaft are rotated. The outer race **198** of the bearing **196** may be press fitted within a bearing groove **200** defined concentrically within the rotor element **186**. The rotor element, therefore, will be moved eccentrically within the rotor chamber **184** upon rotation of the motor shaft and rotor shaft during energization of the motor.

A chuck shaft **188** may be provided with a cylindrical surface **202** that may be concentrically located relative to the axis of the motor shaft **190** and may receive the inner race **204** of a sealed bearing **206** in press fitted relation therewith. The outer race **208** of the bearing **206** may be received in press fitted relation by a bearing recess **210** defined in the base element **178**.

For the purpose of preventing the flow of air past the extremities of the rotor element **186** as it is moved within the housing, the extremities of the rotor may be provided with internal generally cylindrical surfaces **212**, and **214** which may receive annular sealing rings **216** and **218** in light frictional engagement therewith. Sealing rings **216** and **218** will extend slightly beyond the extremities of the rotor element and will bear very lightly upon or will be disposed in very close proximity to the planar surfaces **220** and **222**, defined by the housing **180** and the base element **170**, respectively. The sealing elements **216** and **218** may be composed of a material having low frictional characteristics, such as polytetrafluoroethylene, which may or may not be impregnated with a material having wear resistant characteristics. The seal rings **216** and **218** will be inserted into the rotor element **186** before assembly of the rotor into the housing and will protrude substantially past the extremities of the rotor. As the housing **180** is drawn into assembly with the base element **170** by the screws, the planar surfaces **220** and **222** will engage the seal rings **216** and **218** and force them into fully seated relation within the rotor **186** thereby causing the sealing rings, when fully assembled, to bear lightly the planar surfaces in order to prevent all but a very small amount of leakage past the extremities of the rotor.

A vane element **224** may be movably received within a vane groove **226** in similar manner as discussed above regarding FIG. **2**, and may be urged into engagement with the cylindrical peripheral surface **228** of the rotor by a compression spring **230**. The vane element **224** will serve as a movable partition between the rotor and the housing **180** that divides the space between the rotor and the housing into suction and compression chambers, depending upon the particular position of the rotor within the housing. Air, or any other compressable medium, will enter the housing **180** through a filtered suction aperture of the nature illustrated in FIG. **3**, and will exit through a discharge or gas supply conduit **232**, connected to the housing about a discharge outlet, not shown.

For the purpose of preventing vibration of the air supply mechanism **162**, as the rotor is eccentrically oscillated therein by the drive motor **164**, a counterweight **234** may be secured to the rotor shaft **188** in any suitable manner to balance the uneven weight distribution caused by the eccentric relationship of the rotor shaft, rotor, and bearing structure thereby preventing vibration of the air supply mechanism as it is operated.

As indicated above in relation to FIG. **5**, the air supply connector mechanism **132** is adapted for use when the erasing machine **10** is adapted to receive eraser strips of the configuration illustrated in FIG. **1**, i.e., the erasing machine being provided with a chuck mechanism, including a chuck seal, such as shown at **26** in FIG. **1**, that prevents dissipation of air through slots in

the chuck collet and directs the flow of air along the eraser strip groove to the outlet defined by cooperation between the eraser strip and the lower extremity of the groove.

It may be desirable to provide an eraser strip, such as that illustrated at **128** in FIG. **4**, in case it is not desirable or practical to provide the erasing machine with a chuck seal device. It will be necessary then to communicate compressed air from the air supply connector device to the internal bore formed in the eraser strip. One suitable means for establishing communication between the air supply connector mechanism and the internal bore of the eraser strip, may conveniently take the form illustrated in FIG. **7**, where an air supply mechanism, illustrated generally at **236**, may be secured to the erasing machine structure. The air supply connector mechanism **236** may, if desired, be of identical configuration, as compared to the structure **132** illustrated in FIG. **5**, as shown by corresponding reference numerals, with the exception that an air supply tube **238** may be received in press fitted relation within the passage **160** of the connector **152** and may be of sufficient length to extend downwardly into the chuck tube **14** of the eraser and into the bore **130** within the eraser strip **138**. As the eraser strip **128** becomes shorter, due to erosion during the erasing process, fluid communication will be maintained between the tube **238** and the eraser bore **130** until the eraser becomes sufficiently short to be discarded.

It may be desirable to provide an air supply mechanism for an erasing machine having the capability of delivering an external supply of compressed air and directing the same to impinge upon the surface area being erased in the immediate vicinity of the rotating eraser strip driven by the erasing machine. An air supply mechanism having the capability of delivering the compressed air externally of the erasing machine structure may conveniently take the form illustrated in FIGS. **8** and **9** where, in the plan view illustrated in FIG. **8**, an air supply housing **240**, that may contain an eccentrically driven rotor mechanism essentially as illustrated in FIG. **2**, may be provided with a discharge passage **242** into which may be received a tubular connector element **244**. A tubular conduit **246** may be received by the connector element **244** and may extend downwardly along the outside of the housing of the erasing machine. The tubular conduit **246** may be secured to the housing of the erasing machine by support structures **248** and **250**. The outlet opening **252** of the tubular conduit **246** may be oriented relative to the eraser strip **254** carried by the erasing machine that the flow of compressed air produced by the air supply mechanism **240** will be directed to impinge upon the surface being erased at the point of contact thereby with the rotating eraser strip **254** carried by the erasing machine.

The rotor element **256** and the eccentric rotor shaft **258** may be constructed essentially identical with the rotor and rotor shaft structure illustrated in FIGS. **2** and **3** with the exception that an air supply passage will not be formed in the rotor shaft structure. Air will enter the housing of the air supply mechanism through a filtered aperture **260** and will exit after being compressed by the oscillating rotor through discharge passage **242** and into the air supply conduit **246**.

When utilizing an erasing machine having an air supply constructed in accordance with the present invention, it has been determined that less eraser strip wear will occur even though the eraser strip utilized by the machine is of less cross-sectional dimension than the cross-sectional dimension of a solid cylindrical eraser strip. It is well known that eraser strip wear occurs in direct relationship to the amount of pressure by which the eraser strip is applied to the surface being erased. When utilizing a solid eraser strip, that is not air cooled in accordance with the present invention, the draftsman will have a tendency to bear down excessively on the eraser to insure complete removal of undesirable lines from the surface being erased. This tendency occurs because the erasure particles developed during the erasing process obscure the area being erased and the draftsman cannot see how well the undesirable lines are being removed from the surface. When using an erasing machine manufactured according to the present invention, the draftsman will apply the eraser strip to the surface only hard enough to insure complete removal of the undesirable markings and, because the erasure particles are blown away from the particular area being erased and the surface is maintained in a clean state, the draftsman is enabled to inspect the surface continuously and determine exactly how hard he needs to apply the machine to the surface to insure optimum erasing.

As indicated above, eraser strip wear occurs in direct relation to the amount of pressure applied between the eraser strip and the surface being erased because this pressure will, in large measure, determine the amount of heat that is developed between the eraser and the surface. If the heat is excessive, wear of the eraser strip will increase because the heat will break down the eraser strip material and cause it to crumble away rather than merely being eroded away by normal erasing. The cooling effect of air being blown through or along the eraser strip and caused to impinge upon the surface being erased, at the point of contact between the eraser strip and the surface, insures that the heat, generated by the erasing process, is dissipated and thereby insures that the temperature of the eraser strip material remain quite low as the erasing machine is used. A build up of heat to a sufficient level to cause heat deterioration of the eraser strip material becomes far less critical when the eraser strip and the surface being erased are air cooled.

When employing erasing machines constructed in accordance with the present invention, heat generated during erasing will not readily burn through tracing papers or films when normal pressure is applied during erasing. The cooling ability of the air, being forced along the eraser strip, will insure dissipation of heat that is generated. When paper surfaces are being erased and normal pressure is applied the paper surfaces will not be burnished or discolored in any way because of the cooling effect of flowing air generated by the air supply mechanism.

Even though the air supply mechanism of the present invention may be designed to be driven by the erasing machine, it has been found that this feature does not detract to a material degree from the power output of the erasing machine. It was found, during tests, that most electric erasing machines operate at approximately 3,400 rpm, while running free, and at approximately 2,800 rpm while operating at normal erasing speed. After an air supply mechanism constructed in accordance with the present invention was connected

to the erasing machine, in the manner illustrated in FIG. 1, the free operating speed of the erasing machine was reduced to 3,050 rpm. The erasing speed of the machine however, was 2,900 rpm, which is, of course, higher than the speed at which the same machine operated while utilizing a solid eraser strip and operating at normal eraser speed. This increase in operating speed was due to the lighter eraser pressure that was necessary for the eraser to completely remove the undesirable markings on the surface being erased. Lighter pressure requirements on the eraser more than compensate for the small amount of power consumed by driving the air supply mechanism with the eraser motor.

Another factor that enhances the ability of the air supply mechanism to be driven by the motor of the erasing machine, without detracting from the power output of the motor, is the low torque requirements of the air supply mechanism. An air supply mechanism constructed in accordance with FIGS. 1 and 2 and connected to an erasing machine will blow air at a volume approximately one-half cubic foot per minute at a pressure of approximately three-quarter pounds pressure per square inch and will require approximately 1 inch-ounce of torque for operation of the air supply mechanism. Presently available electric erasing machines can be utilized without modification and without placing excessive strain on the erasing machine mechanism.

The air supply mechanism of the present invention has been specifically constructed to fit most erasing machines sold in the United States at the present time and in the immediate past. The air supply mechanism, including the chuck seal element, may be readily employed in existing erasing machines without modification thereof. All that is necessary when tubular eraser strips are utilized, is the provision of an air supply tube to conduct the flow of air from the air supply mechanism into the tubular passage of the eraser. When eraser strips having external grooves are employed, it is necessary that the chuck of the erasing machine be disassembled and a chuck seal be assembled to the collet portion of the chuck apparatus during reassembly to the machine. The chuck seal, as indicated above, effectively prevents the air from blowing radially through the chuck slots and confines the air to the air passage defined by the eraser strip.

A light torsion spring may be employed to prevent rapid rotation of the rotor as it is oscillated within the air supply housing. Generally, the rotor and the follower vane will be maintained relatively stationary to one another while the air supply mechanism is being operated. This feature effectively eliminates wear that might otherwise occur between the rotor and the vane. This feature also eliminates noise that might otherwise be developed between the rotor and the vane if the rotor were allowed to rotate relative to the vane while being oscillated within the housing. Elimination of rotation of the rotor also effectively retards wear of the seal rings that prevent air from flowing around the extremities of the rotor by reducing the wear path of the seal rings. This feature also causes the torque required to rotate the air supply mechanism to be maintained at a low level.

The rotor of the air supply mechanism oscillates eccentrically in a circular opening defined within the body structure. The cylindrical surface of the rotor and the cylindrical surface of the body never quite touch as the rotor is oscillated in the body housing, but these surfaces move quite close to one another and effect a sufficient air seal to prevent all but very slight leakage of air between the rotor and the cylindrical wall of the air supply housing. Air being compressed as the rotor oscillates within the housing, will be forced inwardly toward the center of the rotor at the upper extremity thereof, through grooves that are formed in the rotor body and base element. The air will then enter the air passages in the rotor shaft and will flow downwardly into the chuck tube of the electric eraser, where it will be conducted downwardly through the central passage of the eraser strip, or in the alternative, the air passage, defined by cooperation of the groove in the eraser strip with the chuck structure of the erasing machine. The compressed air, flowing outwardly and impinging upon the surface being erased, will effectively cool the eraser strip to prevent excessive erosion thereof and will cool the surface being erased to prevent burnishing or burning. The pressurized flow of air exiting from or along the eraser strip will blow eraser strip particles that otherwise would collect on and obscure the immediate area being erased.

If desirable, the erasing machine may be provided with an air supply mechanism having an air supply tube located externally of the machine and delivering a supply of compressed air in such manner that the air impinges upon the surface being erased at the contact point between the eraser strip and the surface. The external air supply tube will extend from the air supply housing downwardly along the side of the housing of the erasing machine. If desired, it can be secured to the housing of the erasing machine in any desirable manner.

It is therefore seen that the present invention is one well adapted to attain all of the objects and advantages hereinabove set forth together with other advantages which will become obvious and inherent from a description of the apparatus itself. It will be understood that certain combinations and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the present invention.

As many possible embodiments may be made of this invention without departing from the spirit or scope thereof, it is to be understood that all matters, hereinabove set forth or shown in the accompanying drawings, are to be interrupted as illustrative and not in any limiting sense.

I claim:

1. A gas supply mechanism for attachment to a motor driven erasing machine having gas passage means defined therein for directing a flow of gaseous medium from said gas supply mechanism against the surface being erased by said erasing machine for the purpose of cooling the eraser and the surface being erased and for removal of erasure particles from the immediate surface area being erased, said gas supply mechanism comprising:

housing means;

means disposed within said housing means for developing a flow of compressed gaseous medium; and

connection means extending from said housing means and establishing releasable connection between said gas supply mechanism and said erasing machine said connection means also establishing

fluid communication between said gas supply mechanism and said gas passage means of said erasing machine.

2. A gas supply mechanism as recited in claim 1:
said means for developing a flow of compressed gaseous medium being a pump; and
said connection means connecting said pump in driven relation to the motor of said motor driven erasing machine.

3. A gas supply mechanism as recited in claim 2:
said pump having a shaft carried in rotary relation by said erasing housing means, said shaft having a rotor formed eccentrically thereon;
said erasing machine having an electrically energized rotary motor including a rotary armature; and
said shaft being disposed in releasable driven connection to the armature of the motor of said erasing machine.

4. A gas supply mechanism for attachment to an electrically driven erasing machine, having a chuck mechanism receiving a strip of erasing material defining a gas passage for directing a flow of gaseous medium against the surface to be erased, said gas supply mechanism comprising:
a gas supply housing having gas inlet means formed therein;
a rotor shaft being supported for rotation within said gas supply hosuing and having a gas outlet passage defined therein;
a rotor being eccentrically carried by said rotor shaft and being oscillatable within said gas supply housing upon rotation of said shaft;
rotor follower vane means being carried within said gas supply housing and being disposed in engagement with said rotor, said rotor follower vane means defining a movable partition separating the space between said rotor and said housing into variable volume suction and compression chambers;
means urging said follower vane means into engagement with said rotor at all times; and
means establishing releasable connection of said gas supply mechanism to an electrically driven erasing machine and communicating said gas outlet passage with the gas passage of the erasing machine.

5. A gas supply mechanism as recited in claim 4:
seal means carried by said rotor and being operative to prevent excessive leakage of gas past the extremities of said rotor.

6. A gas supply mechanism as recited in claim 5:
means interposed between said housing and said rotor and preventing free rotation of said rotor relative to said housing.

7. A gas supply mechanism as recited in claim 4:
said rotor shaft having a generally cylindrical surface eccentrically defined thereon;
bearing means received by said cylindrical surface and rotatably supporting said rotor on said rotor shaft;
said housing having a generally cylindrical wall defined therein; and
said rotor having a generally cylindrical peripheral surface moving in close proximity with said cylindrical wall upon rotation of said rotor shaft.

8. A gas supply mechanism as recited in claim 7:
a counterweight being carried by said rotor shaft and preventing vibration of said gas supply mechanism upon oscillation of said rotor within said housing.

9. A gas supply mechanism for attachment to an electrically energized erasing machine having a chuck tube being rotatably driven by the electric motor thereof, said chuck tube having a chuck mechanism at the lower extremity thereof for supporting a strip of erasing material, said chuck tube being accessable from the upper extremity of the erasing machine and defining a flow passage through the erasing machine, said gas supply mechanism comprising:
housing means adapted to be disposed at the upper extremity of the erasing machine;
a pump mechanism being disposed within said housing means and having suction and discharge apertures;
connection means being provided on said pump mechanism and establishing driven connection with the chuck tube of said erasing machine;
conduit means extending from said gas discharge aperture to said chuck tube and cooperating with said flow passage to define a gas flow passage terminating adjacent the lower extremity of said strip of erasing material; and
air being discharged from said conduit means under pressure generated by said pump mechanism upon energization of the motor of said erasing machine being directed by said conduit means at the area of contact between said strip of erasing material and the surface being erased, for cooling purposes and for blowing erasure particles away from said area of contact.

10. A gas supply mechanism as recited in claim 9:
said conduit means being defined by said connection means; and
said gas being discharged in intermittent pulses by said pump mechanism.

11. A gas supply mechanism as recited in claim 9:
said pump mechanism having a generally cylindrical chamber defined therein:
a generally cylindrical rotor of smaller dimension than said chamber being disposed within said cylindrical chamber;
shaft means being rotatably received within said housing and having an eccentric formed thereon, said eccentric establishing rotatable eccentric relation between said shaft means and said rotor means;
said connection means being a connection extension provided on said shaft means and being adapted for releasable connection within said chuck tube of said erasing machine; and
said conduit means including passage means formed in said connection extension for establishing fluid communication with the chuck tube of said erasing machine.

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