Jan. 11, 1955 F. W. SCHMITZ 2,699,224

ELECTRODE RAPPING SYSTEM

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Fig. 1.

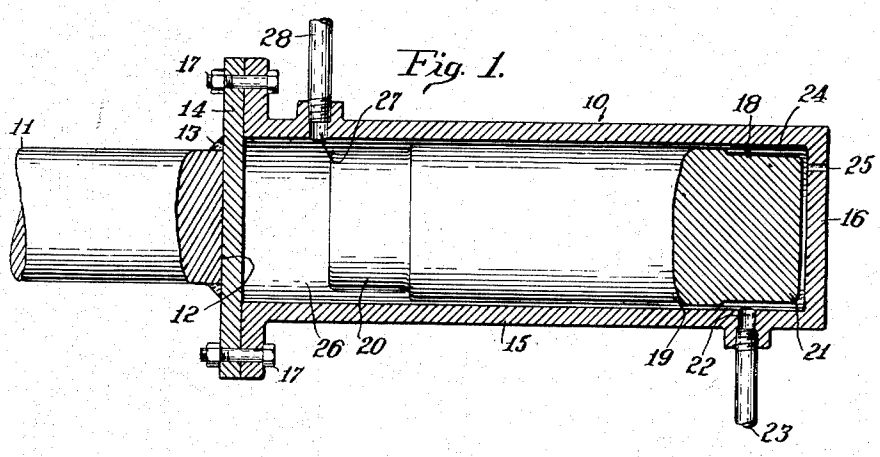
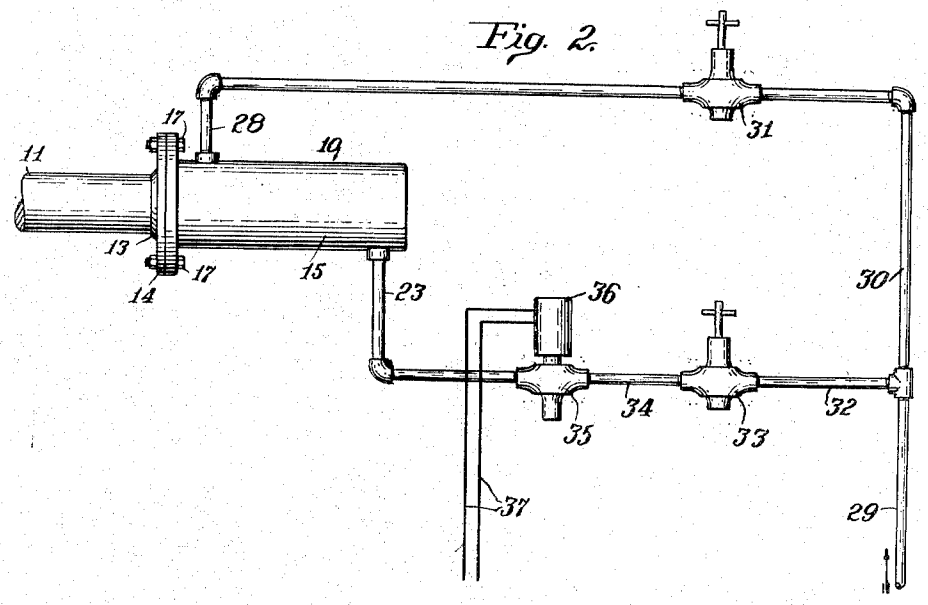


Fig. 2.



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Fig. 3.

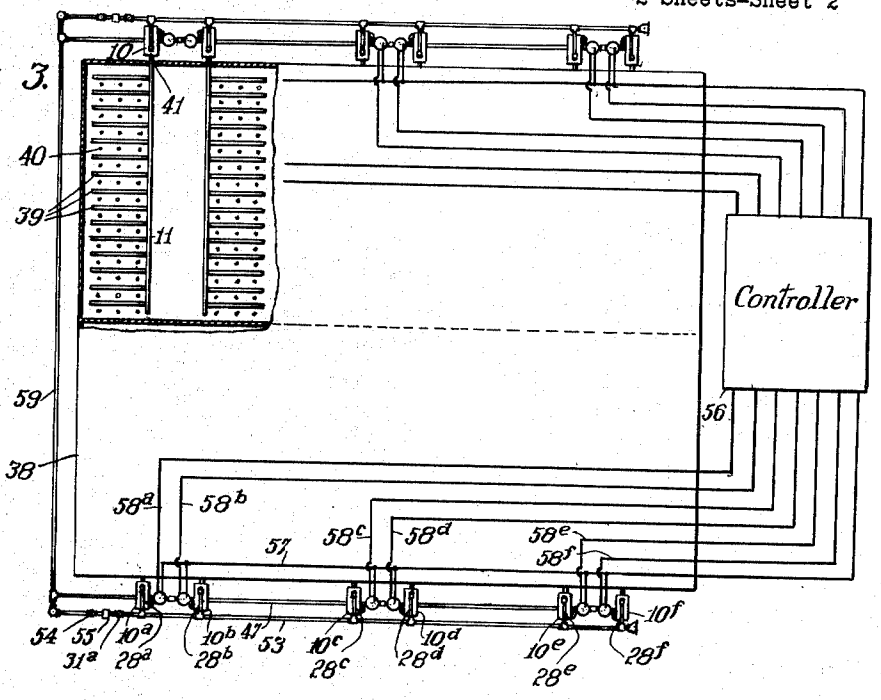
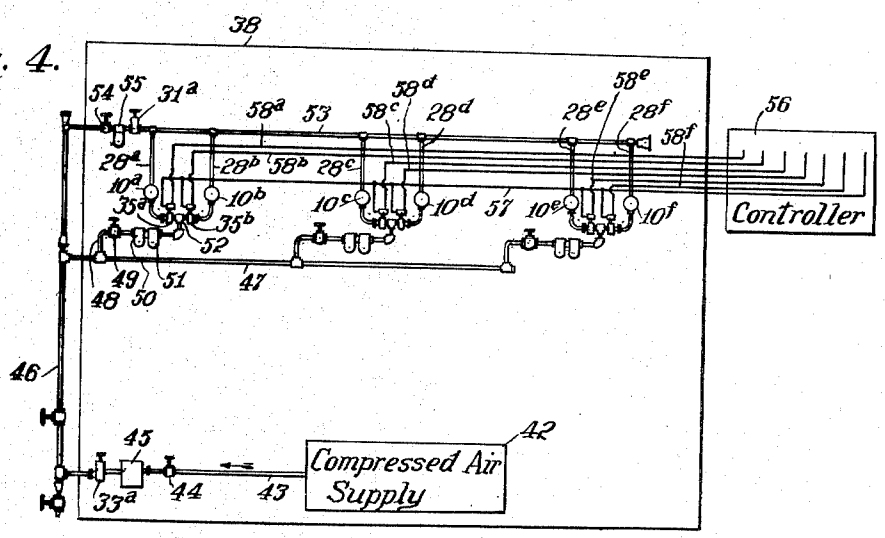


Fig. 4.



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ELECTRODE RAPPING SYSTEM

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Application December 20, 1951, Serial No. 262,535

2 Claims. (Cl. 183—7)

This invention relates to electrode rapping systems and more particularly to a system for rapping the electrodes of an electrical precipitator employing a pneumatically powered rapper that strikes spaced, discrete blows of a piston against an anvil that is in impact transmitting relation to the electrode to be rapped.

An object of the invention is to provide an electrode rapping system that effectively vibrates or raps either the collecting or the discharge electrodes of an electrical precipitator.

Another object is to provide an electrode rapping system especially adapted to be automatically controlled.

Yet another object is to provide an electrode rapping system employing a pneumatic impact rapping device having a reciprocating piston, which system may have a single source of compressed gas for moving the piston through both its impact stroke and its return stroke.

Another object is to provide a rapping system in which the rapping energy is readily varied.

Another object is to provide an electrode rapping system that is simple and economical to fabricate, install and operate and that has a long service life with a minimum of maintenance requirements.

A typical rapping system in accordance with the invention includes a cylinder, a free piston in the cylinder, means supplying a substantially constant low fluid pressure to the cylinder at one end of the piston, and means supplying intermittently a substantially higher fluid pressure to the cylinder at the other end of the piston. The cylinder is vented at the end at which the intermittent higher pressure fluid is supplied.

In the drawings:

Fig. 1 is an axial sectional view of a rapping device that may be embodied in the system of the invention;

Fig. 2 is a view of an electrode rapping system in accordance with the invention;

Fig. 3 is a plan view of an electrical precipitator embodying an electrode rapping system in accordance with the invention, parts being broken away to show interior construction; and

Fig. 4 is an elevational view of the electrical precipitator shown in Fig. 3.

Referring to the drawings, particularly to Fig. 1 thereof, the illustrated rapping device, designated by the general reference numeral **10**, has a rapper bar **11** that may be welded or otherwise suitably affixed at the left-hand end to an object to be rapped (not shown). The object to be rapped may be a collecting electrode of an electrical precipitator, a discharge electrode of an electrical precipitator, or an electrode system including such electrodes.

The right-hand end **12** of the rapper bar is welded as at **13** to an anvil disc **14**. A hollow cylinder **15** having a cylinder head **16** is fastened by bolts **17** to the anvil disc.

Within the cylinder is a free piston **18** having a central portion **19** of a diameter providing a close sliding fit with the interior walls of the cylinder and terminal portions **20** and **21** of somewhat smaller diameter.

A high pressure fluid inlet port **22** admits fluid from the pipe **23** to the chamber **24** provided in the cylinder at the right-hand end of the piston. The chamber **24** is vented to atmosphere through a vent port **25**.

Low pressure fluid is admitted to the chamber **26** at the left-hand end of the piston through a port **27** communicating with a pipe **28** supplying low pressure fluid.

Referring to Fig. 2, pipe **29** is connected to a source (not shown) of high pressure fluid, preferably compressed

air. Pipe **30** connects pipe **29** to one side of a pressure reducing or pressure controlling valve **31**, the other or low pressure side of the valve being connected to pipe **28**.

A pipe **32** connects the source of high pressure fluid to one side of a second pressure controlling valve **33**. The reduced pressure side of valve **33** is connected by a pipe **34** through a solenoid valve **35** to the pipe **23**.

The solenoid valve is of the "on-off" type and is operated by a solenoid **36** energized through wires **37**. This type valve is conventional and is on or open when the solenoid is energized and off or closed when the solenoid is deenergized. The solenoid is energized and deenergized by any suitable manual or automatic switch means (not shown).

In order to damp vibrations that tend to travel back through the fluid supply system from the rapper device **10** and also to insulate the rapper device electrically from the fluid supply system, rubber garden hose may be substituted for the pipes **23** and **28**.

In operation, compressed air at 100 p. s. i. gage is connected to the pipe **29**. Valve **31** is adjusted to provide a pressure of about 5 p. s. i. gage in the pipe **28** and cylinder chamber **26**. Valve **33** is adjusted to provide a pressure of about 80 p. s. i. gage in the pipe **34**. With the solenoid valve **35** closed, the low pressure air in cylinder chamber **26** holds the piston **18** at the right-hand end of the cylinder in the position shown in Fig. 1.

To produce a rapping impact of the piston **18** against the anvil plate **14**, the solenoid **36** is energized to open the valve **35** and admit a slug of high pressure compressed air to the cylinder chamber **24**. The high pressure air drives the piston to the left and forcibly against the anvil plate **14** to produce vibrations that are transmitted through the rapper bar **11** to the object to be rapped.

During movement of the piston to the left, air in the chamber **26** is displaced into the pipe **28** which has sufficient volume between the port **27** and the valve **31** to accommodate the displaced air with only negligible increase in pressure.

The solenoid **36** is deenergized, valve **35** closes and the pressure in chamber **24** quickly falls to atmospheric pressure, the air in the chamber being bled to atmosphere through the vent port **25**. Low pressure air in the chamber **26** returns the piston **18** to the right-hand end of the cylinder and the rapper is ready for another cycle.

It will be understood that the cross-sectional area of vent port **25** is chosen small enough so that no great loss of pressure occurs in the chamber **24** during the power stroke of the piston but large enough to provide for reasonably rapid return of the piston to starting position when the high pressure air is cut off.

It will be seen that the present invention provides a rapping system in which the motion of the piston may be in a horizontal direction which, for many applications, is the most favorable direction of rapping. It is of course possible for the rapping device to be oriented vertically or at some acute angle to the horizontal, if desired.

The energy of impact of the piston may be changed by varying the pressures applied to the piston. The pressures given hereinbefore are merely exemplary for a rapper that is horizontally mounted. Increasing the pressure of the intermittent slugs of air applied to the vented end of the cylinder raises the impact energy of the piston; conversely, decreasing the pressure lowers the energy. A constant low pressure of about 5 p. s. i. gage is approximately correct for a horizontally mounted rapper; for vertical mounting with a downward impact stroke of the piston, the piston return pressure should be about 5 p. s. i. gage plus the pressure required to hold the piston up against gravity.

Referring particularly to Figs. 3 and 4, the electrical precipitator shown has a shell or housing **38** enclosing conventional plate electrodes **39** and complementary discharge electrodes **40**. As is well known in the art, gas bearing suspended material is passed between the complementary electrodes and the suspended material is electrically precipated on the plate electrodes **39**. These electrodes are rapped to keep them in a clean condition. For this purpose, the rapper bar **11** is welded to the edges of

a plurality of aligned plate electrodes **39**. The rapper bar extends outwardly through a hole **41** in the side of the precipitator shell **38** and terminates in the rapper device **10**.

The precipitator shown has six sections of two banks each of complementary electrodes. Since each bank of collecting electrodes requires one rapper device, twelve such rapper devices are provided as shown in Figs. 3 and 4.

The rapper devices **10** are supplied with operating gas from a compressed air supply **42**. Air from the source **42** flows through a pipe **43** under control of manually operated valve **44** to a water separator **45** in which condensed water is removed from the air. The air then flows through a pressure regulating valve **33***a* in which the pressure is dropped slightly to a high pressure working value of 20 to 80 p. s. i. gage, for example. High pressure air of regulated pressure flows through the riser **46** to the branch horizontal high pressure main **47** from which it is fed to the rapper cylinders **10***a* to **10***f* seen in Fig. 4.

Taking the rapper cylinders **10***a* and **10***b* for example, air flows through the pipe **48**, manual valve **49**, air filter **50**, and oiler **51** to the T-junction **52** in which the flow of air is split and delivered to the solenoid valves **35***a* and **35***b* associated, respectively, with the rapper cylinders **10***a* and **10***b*. The rapper cylinders **10***c* to **10***f* are similarly supplied with high pressure air.

Riser **46** delivers into a branch horizontal low pressure main **53** through a hand valve **54**, air filter **55**, and pressure regulating valve **31***a*, the latter dropping the pressure in the low pressure main **53** to a working value of from 3 to 10 p. s. i. gage, for example. From the main **53**, low pressure air is supplied to the rappers **10***a* to **10***f* through pipes **28***a* to **28***f*.

The solenoid valves **35**, providing for admission of slugs of high pressure air to the rapper cylinders, are energized and controlled from a controller **56**. Direct current for energizing the solenoids is supplied to the latter from the controller **56** through a wire **57** that is a common lead to the solenoids and separate wires **58***a* to **58***f* leading respectively to the several solenoid valves **35***a* to **35***f*.

The construction and arrangement of rappers at the back of the precipitator is substantially identical to that at the front. Operating air is supplied to the rappers at the back through a lateral pipe **59** that connects with the riser **46**. The solenoid valves associated with the rappers at the back are energized and controlled by the controller **56**.

Controller **56** is conventional and includes a timer that energizes and deenergizes the solenoids of valves **35** in any desired sequence and at any desired interval. Some or all of the solenoids may be energized simultaneously.

In operation of the system of Figs. 3 and 4, air from the source **42** is admitted to the system by opening valve **44** and adjusting the high pressure regulating valve **33***a* to provide the desired operating pressure in the riser **46**. Valves **54** and **49** are opened and low pressure regulating valve **31***a* is set to establish in main **53** the required low pressure for returning the rapper piston to starting position. The controller **56** is put in operation to actuate the rappers on a predetermined cycle of operation that is determined by routine observation to be sufficient to maintain the collecting electrodes **39** in a satisfactory state of cleanliness.

From the foregoing description, it will be seen that the objects of the invention, as stated or implied, are fully realized in the rapping systems disclosed herein by way of illustration. It will be understood that the principles of the invention may be applied in a variety of modifications without departing from the spirit and scope thereof.

I claim:

1. Means for rapping electrodes of an electrostatic precipitator including a rapping device, said rapping device comprising a cylinder, a free piston hammer means slidably mounted in said cylinder, an anvil forming one end of said cylinder and adapted to be connected to an electrode rapper bar, said hammer means cooperating with said cylinder and said anvil to define a low pressure chamber between the anvil and said hammer means for moving said hammer means at low velocity away from said anvil, and a high pressure chamber at the other end of said hammer means for moving said free piston at high velocity against the anvil, a source of compressed gas, first conduit means connecting said source of compressed gas to said high pressure chamber, a quick acting valve in the first conduit means for intermittently supplying slugs of compressed gas to the high pressure chamber of said rapping device, second conduit means connecting the low pressure chamber of said rapping device with said source of compressed gas, pressure reducing means in said second conduit means for supplying low pressure gas to move the hammer means at low velocity away from the anvil, the volume of said second conduit means between the low pressure chamber and said pressure reducing means being so selected as to accommodate the displaced gas in the low pressure chamber when the hammer means is actuated toward the anvil with only negligible increase in pressure, and a restricted vent port effecting communication between said high pressure chamber and the atmosphere to bleed off gas as the hammer means moves away from said anvil.

2. The invention defined in claim 1 wherein the quick acting valve in said first conduit means is time controlled.

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