July 15, 1958 C. L. BURTON ET AL 2,842,938

AIR SUPPLY CONTROL FOR AIR HAMMER

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Fig 1.

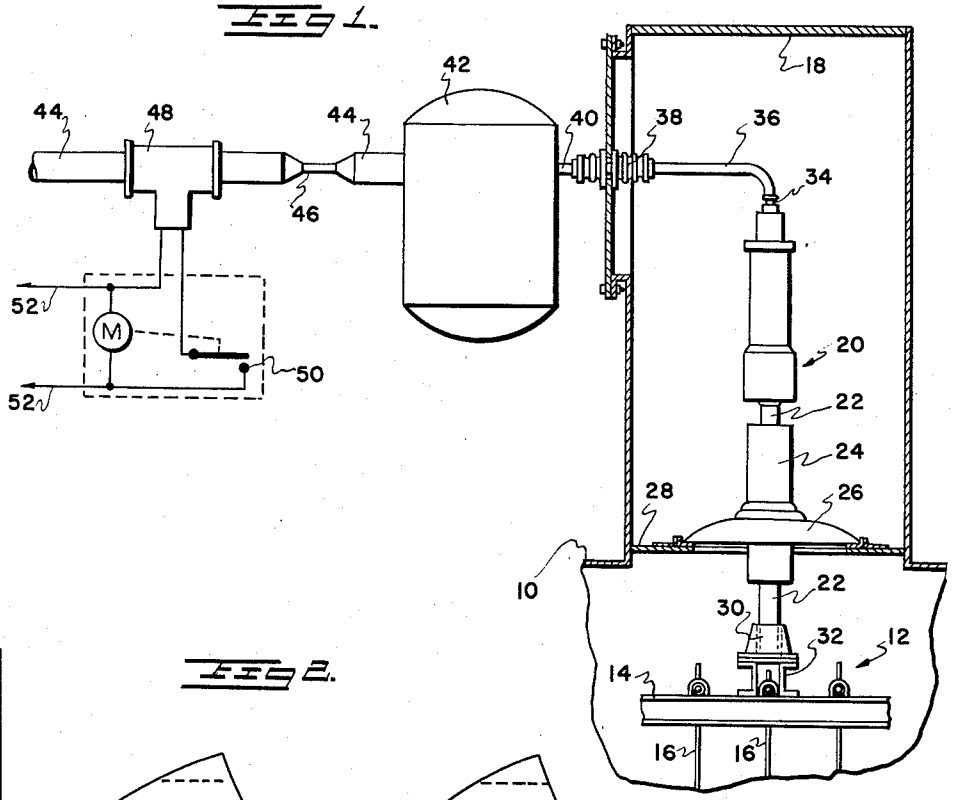
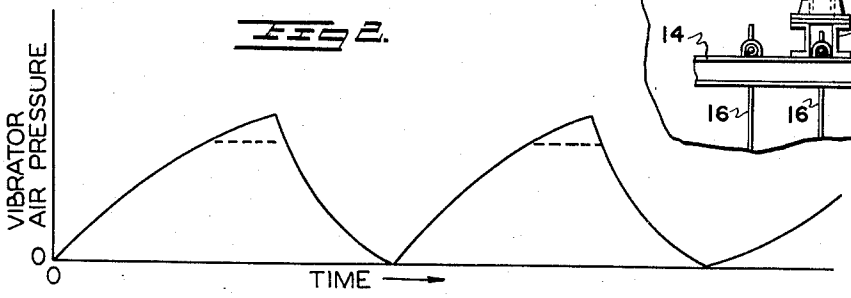


Fig 2.



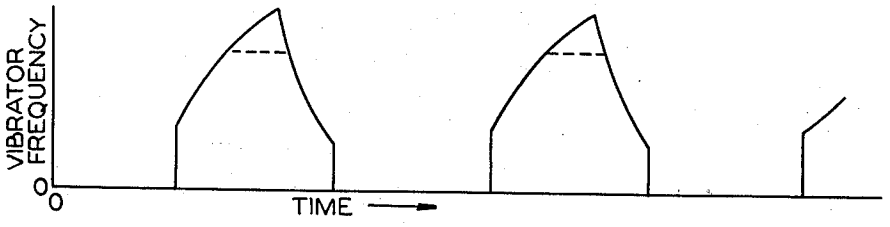


Fig 3.

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2 Sheets-Sheet 2

Fig 4.

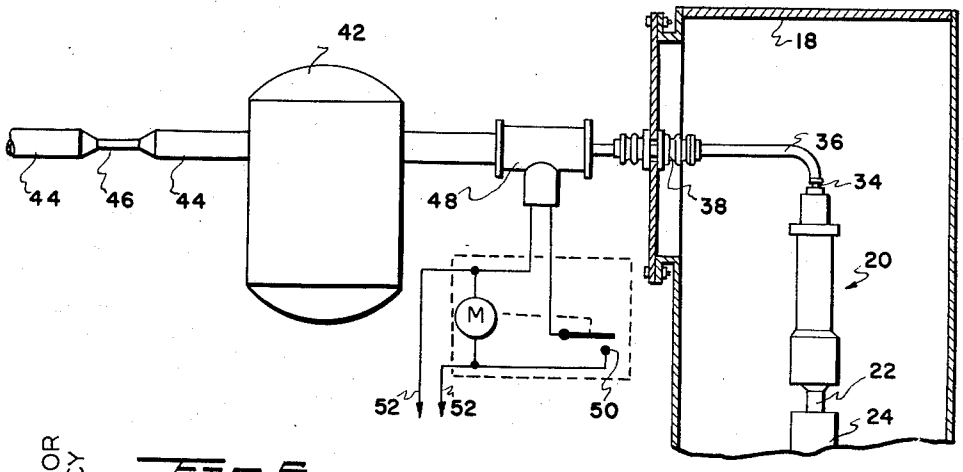
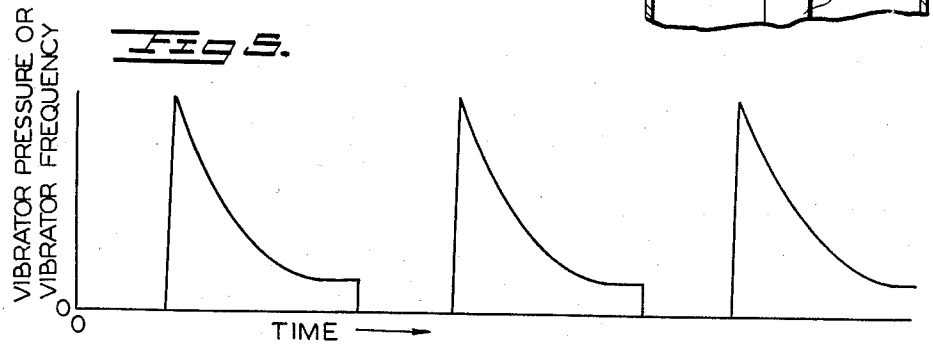


Fig 5.



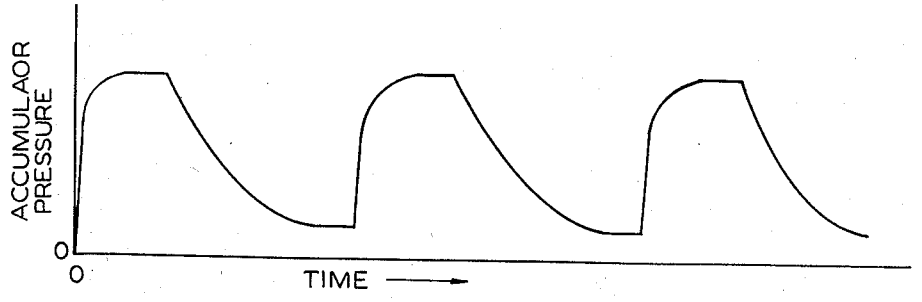


Fig 6.

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AIR SUPPLY CONTROL FOR AIR HAMMER

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1 Claim. (Cl. 60—57)

The present invention relates to electrical precipitators for removing suspended material from a gas stream, and more particularly and specifically to improved methods and apparatus for pneumatically rapping the electrodes of such precipitators to remove accumulated deposits therefrom.

It has been discovered that it is highly desirable in precipitator electrode rapping operations to rap or vibrate the electrodes at varying rates of vibration frequencies in order that more than one natural or resonant frequency of the electrode will be attained. Further, uniform variation of the vibration rate through a substantial frequency range adequately agitates all points along the length of each electrode to dislodge accumulated deposits thereon, since each electrode will thus be vibrated at more than one of its basic frequency harmonics.

It is a principal object of the present invention to provide pneumatic electrode rapping apparatus which will produce vibration of the electrodes at a multiple of their basic frequency harmonics to insure efficient removal of accumulated deposits on the electrodes.

Another object of this invention is to provide for fluid pressure rapping apparatus for precipitator electrodes which will operate to effect a maximum of efficiency in the rapping operation with the use of a relatively low power vibrating structure.

Still another object of this invention is the provision of electrode rapping apparatus which embodies a pressure fluid accumulator and a restricted orifice arrangement by which the vibration frequencies and vibrator pressure drops are readily controlled automatically by the predetermined size and capacity of the accumulator and orifice components.

Still a further object of this invention lies in the provision of pneumatic rapping apparatus which is of extremely simple and inexpensive design and construction and which has a minimum of complex working components thereby insuring durability and long usage.

It is another object of this invention to provide electrode rapping apparatus which is capable of quick and inexpensive incorporation in substantially any presently existing pneumatic rapping assemblies.

Still further objects and advantages of this invention will become readily evident to those skilled in the art when the following general statement and description are read in the light of the accompanying drawings.

The nature of the present invention may be stated in general terms as including, in combination with a pneumatic vibrator and a source of pressure fluid, an accumulator intermediate the vibrator and its source of pressure fluid, a restricted orifice intermediate the accumulator and the source of pressure fluid controlling the rate of flow of the pressure fluid to the accumulator, and an automatically timed solenoid operated valve intermediate the vibrator and the source of pressure fluid controlling the timed cycles of pressure fluid supply to the vibrator.

Referring now to the accompanying drawings in which

like numerals indicate similar parts through the several views:

Fig. 1 is a fragmentary vertical elevation, partially in schematic, illustrating one embodiment of the present invention;

Fig. 2 is a graphic illustration of vibrator air pressures as related to time cycles incident to operation of the apparatus disclosed in Fig. 1;

Fig. 3 is a graphic illustration of vibrator frequency as related to time cycles incident to operation of the apparatus disclosed in Fig. 1;

Fig. 4 is a fragmentary vertical section, partially in schematic, illustrating a modified form of the invention disclosed in Fig. 1;

Fig. 5 is a graphic illustration of the coincidental vibrator pressures and frequencies as related to time cycles incident to operation of the apparatus disclosed in Fig. 4; and

Fig. 6 is a graphic illustration of accumulator pressures as related to time cycles incident to operation of the apparatus disclosed in Fig. 4.

Referring to Fig. 1 of the drawings there is shown in elevation a portion of a typical installation of a pneumatic rapping mechanism embodying the basic concepts of the present invention wherein 10 designates the precipitator housing or shell in which there is located a high tension electrode assembly 12 which includes a transverse high tension frame channel member 14 supporting a plurality of electrodes 16. The housing or shell 10 is provided with a vertically extending insulator housing 18 located directly above a portion of the high tension frame member 14. The housing 18 contains a pressure fluid operated vibrator or rapper 20 mounted on the upper extremity of a rod 22 which passes downwardly into the precipitator shell through a bearing sleeve 24. The sleeve is supported centrally in a disc-type insulator 26 mounted about its periphery on an annular floor member 28 secured in the lower end of the housing 18.

The lower extremity of the rod 22 is transversely received in a tubular guide member 30 which is supported transversely of the upper ends of channel members 32 which in turn are rigidly supported on the upper face of the channel member 14 of the high tension frame.

Without describing in detail the construction and individual operation of the rapper 20, which may be of any conventional and well known type, it is nevertheless apparent that the rapper 20 upon receiving compressed air or gas will actuate rod 22 causing it to reciprocate rapidly striking, with each reciprocal stroke, the upper plate on the channel members 32 creating vibration therein which is transmitted to the high tension frame member 14 thereby vibrating the electrodes 16 and dislodging therefrom accumulated deposits.

In connecting the vibrator or rapper 20 to a source of pressure fluid (not shown) the upper extremity of the vibrator is connected through a gastight fitting 34 to a conduit 36 of insulating material or the like which is connected adjacent the wall of the housing 18 to an insulated gasket 38 which is coupled to the wall and extends therethrough to connect at its outer extremity to a second conduit 40 which leads to and has communication with a pressure fluid accumulator 42. The accumulator 42 is connected to a second conduit 44 communicating at a remote point with a souce of pressure fluid.

Interposed between the remote source of pressure fluid and the accumulator 42 is a restricted orifice 46, which may contain a needle valve construction, adapted to control the rate of flow of the compressed material into the accumulator 42. Located between the orifice 46 and the remote source of pressure fluid is a stop valve 48 which is provided with a solenoid operator 50 operated

at timed cycles from a source of electric power 52 through an electric timing medium M such as a timing motor or the like.

In operation of the structure heretofore described, opening of the solenoid controlled valve 48 will permit flow of pressure fluid through orifice 46 into the accumulator and up to the vibrator or rapper 20 until the pressure is built up in the accumulator to a degree corresponding with the starting pressure of the rapper at which time operation of the rapper will begin. In this construction, as is illustrated graphically in Fig. 3, the vibrator frequency will rise sharply for a limited period following its initial commencement of operation and from this point will continue to increase gradually until such time as the valve 48 is closed by the timed operation of the solenoid 50 whereupon the vibrator will drop through a range of frequencies as the pressure in the accumulator approaches the minimum pressure for operating the vibrator.

The time period of pressure rises at the vibrator, as graphically illustrated in Fig. 2 of the drawings, is dependent upon the rate of flow of material through the orifice and upon the volume of the accumulator 42, and an equilibrium pressure in the system is attained when the pressure demand of the vibrator equals the supply to the accumulator through the orifice 46.

From the foregoing and with particular reference to Fig. 3 it can be seen that the vibrator will operate through a wide range of frequencies corresponding to a multiple of the basic frequency harmonics of the electrodes 16 in one cycle of operation of the apparatus as controlled by the solenoid operated valve 48.

Referring now to Fig. 4 of the drawings there is illustrated a modified embodiment of the apparatus disclosed in Fig. 1 and heretofore described wherein, in this modification, the location of the solenoid controlled valve 48 is changed to place the valve between the accumulator 42 and the vibrator 20.

Operation of the modified construction illustrated in Fig. 4 will cause the vibrator or rapper 20 to initially commence operation at its maximum frequency with a gradually diminishing frequency throughout its cycling period of operation. The characteristics of the rapper frequency during a single cycle of operation are graphically illustrated in Fig. 5 of the drawings.

These foregoing characteristics of the vibrator operation are attained by reason of the fact that during the cycle of operation when the solenoid controlled valve 48 is closed the accumulator 42 will reach its maximum line pressure so that when the valve 48 is opened this maximum pressure is immediately released to the rapper which will initially attain its maximum frequency of vibration. Following the initial opening of the valve 48, the pressure in the accumulator will gradually diminish as will the vibrator frequency until an equilibrium is reached between the pressure fluid supplied by the orifice and the demand of the vibrator. In the instance of this construction the time of pressure drop is again controlled by the size of the orifice 46 and the volume of the accumulator 42 while the equilibrium pressure in the system is controlled generally by the size of the orifice 46.

Reference to Figs. 5 and 6 illustrates that operation of the apparatus illustrated in Fig. 4 of the drawings produces a corresponding and simultaneous pressure drop in the accumulator with the frequency and pressure drop in the vibrator thus providing for a complete and accurate control of the range of vibration frequencies transmitted to the electrodes of the precipitator.

From the foregoing descriptions it is apparent that unique and useful improvements have been provided by the present invention which result in the attainment of superior pneumatic operations for electrical precipitator rapper apparatus and that the embodiments of the invention shown are readily capable of simple and inexpensive installation as additions to presently existing pressure fluid vibrator assemblies for obtaining in those assemblies the new and improved results inherent in the present invention.

It is additionally apparent that the embodiments herein disclosed and described are only exemplary and that various modifications of these basic concepts can be made by those skilled in the art in both construction and arrangement without departing from the scope of this invention as it is defined in the appended claims. For example, while the rapping system has been primarily described with reference to the rapping of fine wire discharge electrodes it is apparent that the system may be employed to vibrate other forms of discharge electrodes and collecting electrodes.

Having thus described and explained the present invention in construction and operation, we claim:

A method of controlling the vibration frequencies of a pressure-fluid operated vibrator by control of the supply of pressure fluid thereto including the steps of accumulating a supply of pressure fluid in advance of the vibrator, controlling the flow of pressure fluid to the accumulator at a rate substantially less than the demand rate of the vibrator, and periodically opening and closing communication between the accumulator and the vibrator in timed correspondence with the attainment and loss of vibrator operating pressure requirements in the accumulator to cycle operation of the vibrator from maximum to minimum vibration frequencies within each cycle of admission of pressure fluid to the vibrator from the accumulator.

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