GENERAL ELECTRIC COMPANY

HW-39560

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October 17, 1955

A NEW APPROACH TO PULSE COLUMN PIPING

Introduction

The problem of making up the process line between a pulse generator and its pulse column has never been satisfactorily solved. Purex equipment was supplied with a remote flange, essentially conventional with six remote studs around its periphery, in the 12 inch lines used for this purpose. No great difficulty has been experienced in obtaining a liquid and pressure tight joint when flanges are properly aligned; however, the requirements of parallelism and proper gap between flanges presented by remotely handled equipment do not appear susceptible to solution by conventional means.

Purpose

This document is written to delineate a new approach, believed to have merit, to pulse generator piping.

Discussion

It was found necessary in the Purex installation to maintain the two flanges in each installation parallel within .010" across their faces and to control the gap between flanges to $\pm .005$ " in distance. The basic cause for these requirements was the fact that when flanges having lack of parallelism or excessive gap were pulled together by the remote studs the pulse generator discharge pipe carried a reaction to the mechanism box which resulted in noise and presumably would have shortened the life of the mechanism. At no time was there any question about the ability of the six remote studs properly to compress the flexitallic type gasket employed; the difficulty was the above mentioned reaction on the mechanism. This was overcome in the Purex installation by tailoring each

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equipment group as needed to achieve the above limits. This tailoring was effected by shimming under one or the other equipment piece to control the flange gap and by heat warping of the pulse generator discharge elbow to achieve parallelism. It was noted, however, in one case that the pulse column was sufficiently flexible to cause the gap between flanges to be increased by installation of jumpers on the column. It is obvious that when replacement of a pulse generator or column becomes necessary in the future such tailoring will be completely impossible. At that time complete reliance must be put upon "as built" measurements of the installation as tailored. There is small reason to anticipate that the "as built" measurements and their application to replacement equipment can be sufficiently accurate to allow new equipment to be placed within limits as small as the necessary .010". From this it can be seen that when replacement of equipment is required there is good possibility that the installation will not be satisfactory and that the life of the new equipment may be much shorter than might otherwise be expected.

A related desirable aim which has never appeared feasible would be to eliminate installation of pulse generators as canyon equipment. If means could be found to overcome the piping difficulties involved in isolating a pulse generator in a controlled zone outside the actual canyon, direct maintenance could be performed under controlled conditions. The mechanisms could be simpler, cheaper and more durable. Purex pulse generators suffered during calibration and cold runs from excessive water flows from adjacent equipment to which they were subjected; this has already resulted in replacement of bearings in all pulse generators. It is entirely possible that such conditions might occur after the building has become contaminated, during periods of equipment replacement or because of other contingencies. It seems obvious that to have these mechanisms isolated from such potential abuse would be highly desirable.

Figure I illustrates diagrammatically a pulse column and its connected pulse generator. The large pipe connecting the pulse generator is necessary to avoid cavitation in the pipe, since the fluid which is being pulsed is first accelerated in one direction, brought to rest, and then accelerated in the opposite direction. As a result of this fluid motion in the piping pressure drop must be negligible if cavitation is to be avoided.

Figure II is a diagrammatic representation of a concatenated column pulsed by a pulse generator on the bottom section. The top of section A consists of an organic phase pulsing in synchronization with the pulse generator at the bottom of section A. One of the two lines between section A and section B has a check valve so arranged to allow flow from section A to section B. The other line has a check valve arranged to allow flow from section B to section A. When piped in this fashion the fluid in each pipe is accelerated and brought to a stop but not reversed or accelerated in the opposite direction. This results in a considerably larger tolerance for pressure drop in the piping while still avoiding cavitation. Averaged instantaneous velocities are obtained by multiplying pulsed volume times pulse frequency and dividing by line cross section. Oak Ridge has operated with averaged instantaneous velocities as high as three feet a second. No difficulties or evidence of cavitation have been noted.

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Figure III is a diagrammatic representation of a pulse column using a pulse generator with two interconnecting lines containing check valves. In this case the pulse generator itself accelerates alternately the fluid in each of the two connecting pipes thus operating on the same principle as section B in Figure II. This method of connecting a pulse generator to a pulse column eliminates the need for a remote flange and substitutes smaller pipes, much more flexible, for the 12 inch pipe currently in use. Since the smaller pipe can be used with conventional connectors the problems of remote make-up or remote location of a pulse generator will be diminished.

Recommendations

At the present time the limitation on averaged instantaneous velocities which result in cavitation are not known. It would be desirable to determine the limitations of this method of operation so that the potential of its use could be fully evaluated. To this end we suggest that operation of the Purex prototype pulse column presently installed in the 321 Building be tested using dual connecting lines with opposed check valves. The writers have in their possession a drawing of the check valve as used at Oak Ridge for this purpose, which it is believed would make a satisfactory reference installation for initial experimentation. Each line should contain two mitred ells to simulate remote connectors. It is suggested that four inch lines be tested to ascertain the limitation of this method of operation. If the limit is not reached using four inch lines, line size should be reduced until deleterious effects become apparent.

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FIG. I

FIG. III

FIG. II

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October 24, 1955

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PULSER PIPING

Reference: HW-39560, "A New Approach to Pulse Column Piping", by
R. C. Hollingshead and J. O. Ludlow, dated 10-17-55.

The attached document presents one method for improving pulser and pulse column design. Would you consider this idea in your future development program?

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