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GRAPHIC REPRESENTATION OF GEOTHERMAL APPARATUS

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ABSTRACT

The objective of this paper is to propose a graphical standard for the representation of geothermal apparatus in flow diagrams and DTI's.

From a review of the current literature, it is apparent that almost each author uses his own symbology, a situation that is clearly inconvenient. After establishing criteria for selecting them, those symbols better complying with the conditions are offered for discussion and a petition is addressed to the geothermal associations, specially to the IGA, that the necessary steps be taken to have an standard for geothermal symbols adopted.

It is just ordinary wisdom that if a group of persons is to achieve a goal, their first requirement should be to have a common language to communicate, a common set of symbols to express unequivocally and economically concepts and actions and to designate material means to accomplish them without long explanations or cumbersome clarifying labels. But an adequate symbology (and adequate language) is much more than a bridge between people: it can even suggest new ideas and the relationships between them and, in that way, act as a seed for fresh developments.

Scientists have long used constant symbols to represent the same concepts, but I think it has been Engineering the discipline that has made a more extensive use of standardized symbologies. The work of ASME and ASA, later ANSI, in the standardization of graphical symbols for different technical specialties have been immensely useful for engineers all over the world because, although American standards are not accepted in all the countries, they have served as models to develop national standards.

Geothermics has a short history, its development proceeds from such disparate origins as Italy, New Zealand, Mexico, USA and Japan and, until a couple of decades ago, it was considered more as an industrial curiosity than as the practical and economical method for electricity generation it is. So it seems just natural that there are no geothermal standards, not only regarding the size, type and arrangement of the equipments in a geothermal plant, but even with respect to the drawings used to schematically represent them. This situation might not had been very disturbing at the time of the Rome Conference on New Energy Resources, in which the number of papers contributed on the subject of geothermal energy were just a few scores, however geothermal literature forms now quite a voluminous collection, increased every year by some hundreds of new publications. Moreover, the number of nations with ongoing geothermal programs continously grows, increasing the ranks of technicians that must be trained in geothermics, so it looks like being time to introduce some order in the conventions we handle and to standardize the graphical expressions we use, so as to facilitate the study of these disciplines to the newcomers and to be able to compare what the new papers propose.

Another reason to urge for the establishment of standards, graphical and of other types, for geothermal matters is the integration of the new International Geothermal Association, which is a good candidate to promote the issuance of this type of document either by itself or as an sponsor to ANSI or another institution of the kind.

In this paper, some symbols are proposed for adoption. They are offered just as a suggestion to start the discussion, but what is really important is to end up with an established symbology and not as much to have one or another diagram to represent certain apparatus. Of course, if a symbol is to be useful, it

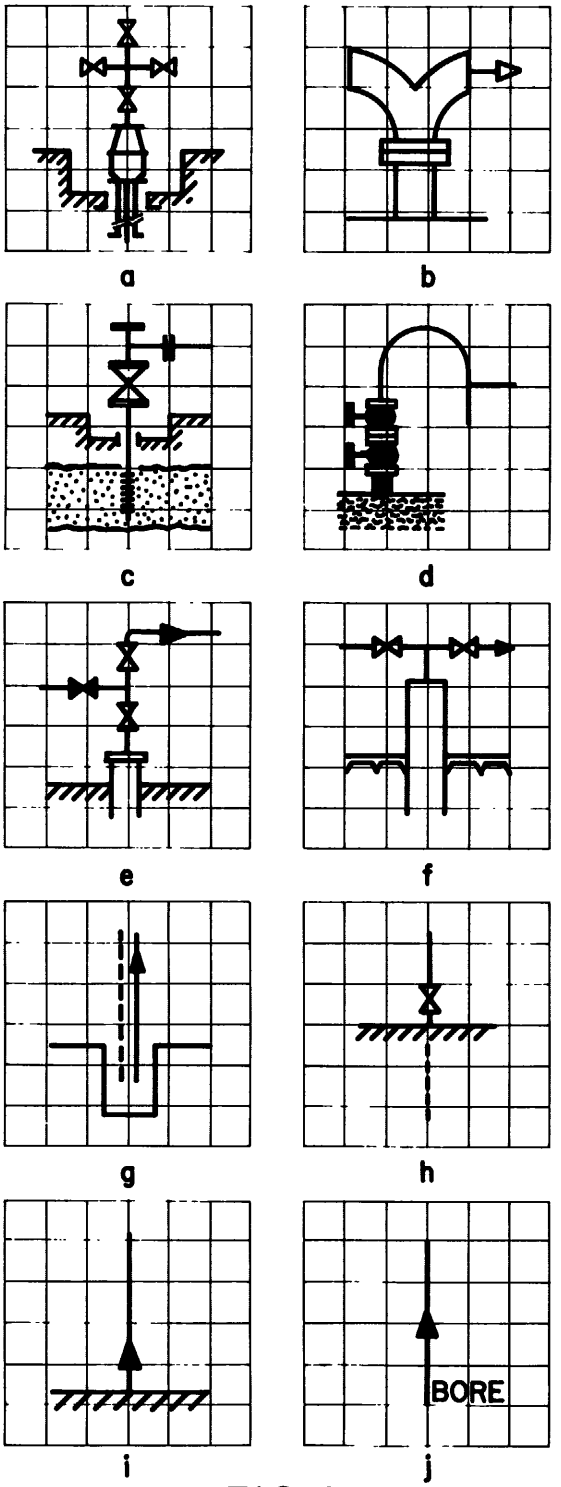

FIG.1
GEOTHERMAL WELLS' REPRESENTATION

has to fullfil a number of conditions:

1. It has to resemble the equipment it represents, although there is no need to portray it with photographic precision because an engineering diagram is more than a picture: it shows the relationships among the different components of a process.

2. It must be simple and stand for all types of the equipment it represents as a long as they have the same function. In this way, the number of symbols required is reduced and differences in construction and operation, if they are not important, do not clutter the diagram's meaning and they can always be properly dealt with in the text, if they matter.

3. The symbols must be easy to draw with a few lines of reasonable thickness, without the sketch becoming confused.

4. Its proportions must be stated, but even if they are altered, the symbols must remain distinctly recognizable.

5. It should not be necessary to use captions in order to know what it is.

6. The symbols should be established and published in a document so that there is no need to include a list of those used in each paper.

7. If the equipment is utilized in other applications and there is already a symbol for it, the same should be adopted for geothermal diagrams whenever possible.

The last paragraph implies that what is really lacking is a set of symbols for the geothermal elements only, because the components of the generating station or the pipes, can always be represented by those symbols prescribed by the ASA Y32.2.6, heat power apparatus standard, Y32.11 for process flow diagrams or Z 32.23 for pipe fittings, valves and piping, complemented by ISA S.1, although not all these standards are totally coordinated and possibly, if one is allowed to take an exception to what has just been set forth, some of their current symbols could be modified, at least for geothermal use. For example, the ASA symbol for contact condensers, which I find really ugly and totally unrelated to the surface condensers symbol, although their function is the same.

It is amazing the diversity of graphic representations used in the current geothermal literature, even when

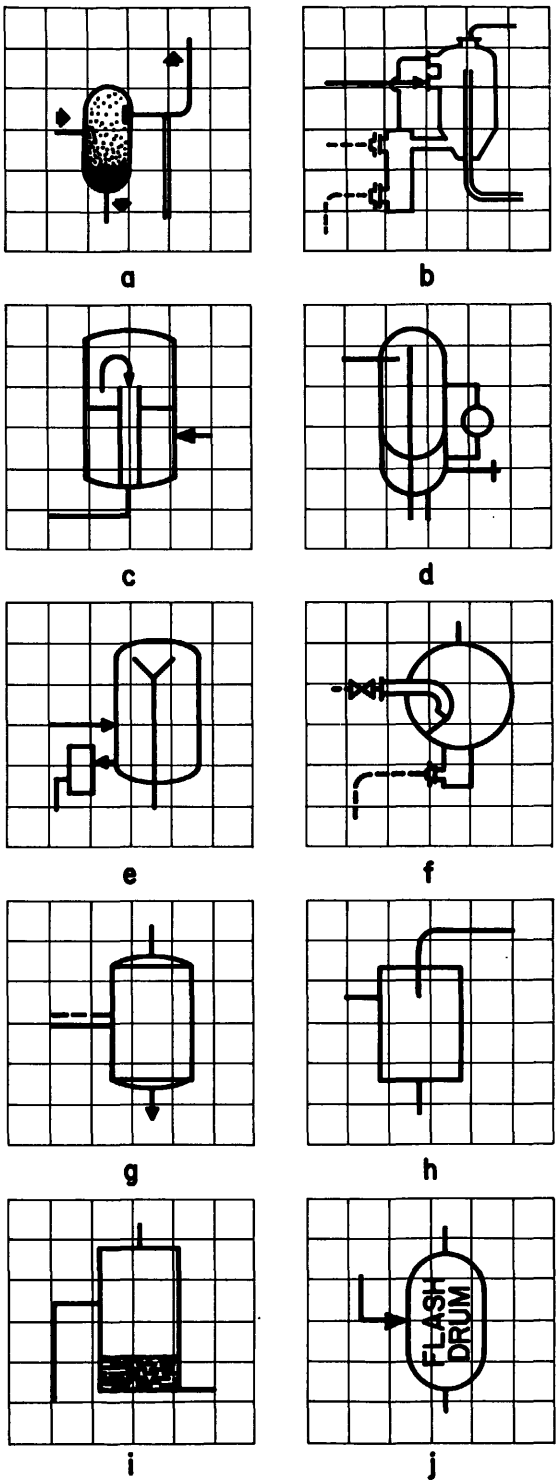

FIG.2
REPRESENTATION OF
STEAM SEPARATORS

only serious technical papers are taken into account, with the exclusion of those illustrations intended to explain geothermal concepts to the layman. I have revised an score of papers complying with that restriction and some of the symbols I found are shown in the following figures. Certainly, in disclosing their variety, I do not intend to criticize their fitness or disapprove of those using them. My purpose instead is to stress the urgent need to get to an agreement as to the symbols that should be used by everyone working on this subject.

It is worth to notice that, although the symbols for the apparatus utilized for thermoelectric generation are standardized by a number of institutions: ASA, ANSI, ASME, ISA, DIN and so forth, the ones in the papers I revised are quite different one from another, even when the authors were American. In any way, as it is possible to draw simple and intelligible diagrams using the standardized symbols already mentioned, plus a few geothermal ones, which are the ones lacking, I will concentrate on the latter.

To start with, let us consider the most peculiar element of a geothermal installation: the well. Figure 1 shows some of the symbols used in the papers I revised to depict it. I arbitrarily rejected another seven drawings as not interesting, but it can be seen that the sample includes from highly detailed and almost pictorial portraits of a geothermal well, to sketches so devoid of descriptive material that they require captions to be identified. I propose to represent

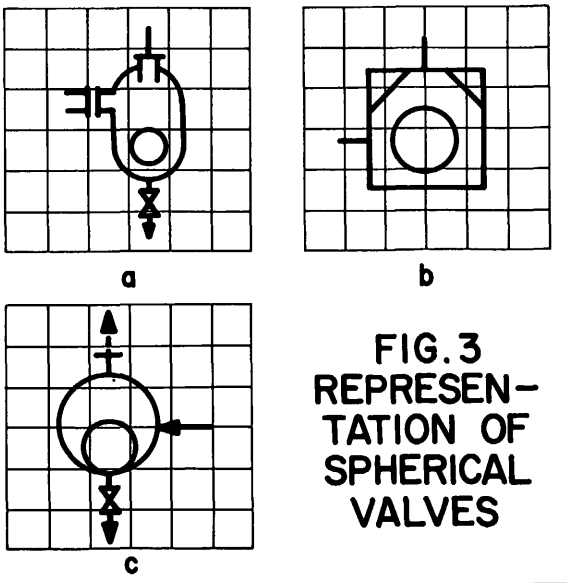

FIG.3
REPRESEN-
TATION OF
SPHERICAL
VALVES

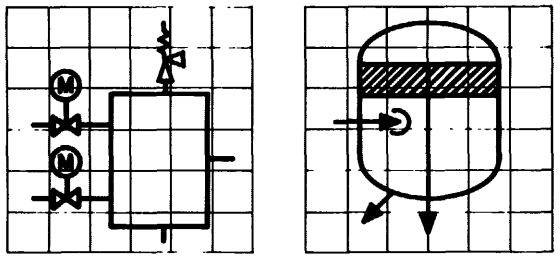

FIG.4
STEAM DRYERS' REPRESENTATION

geothermal wells by the symbol of Fig. 10, which is really illustrating a production well. An injection well would have the arrowhead in the opposite direction and, of course, this basic symbol can have attached those ones of valves, branches and other components, were it important to show them.

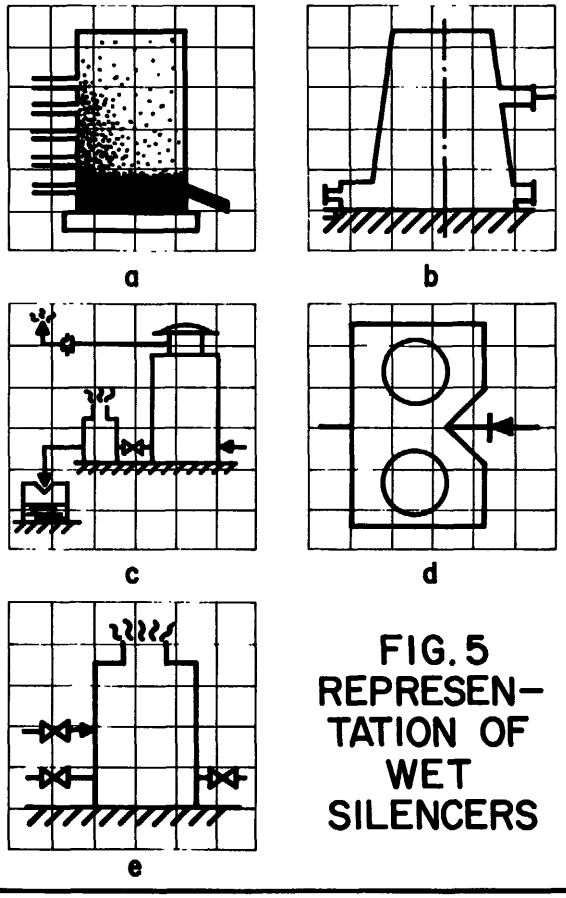

FIG.5
REPRESEN-TATION OF WET SILENCERS

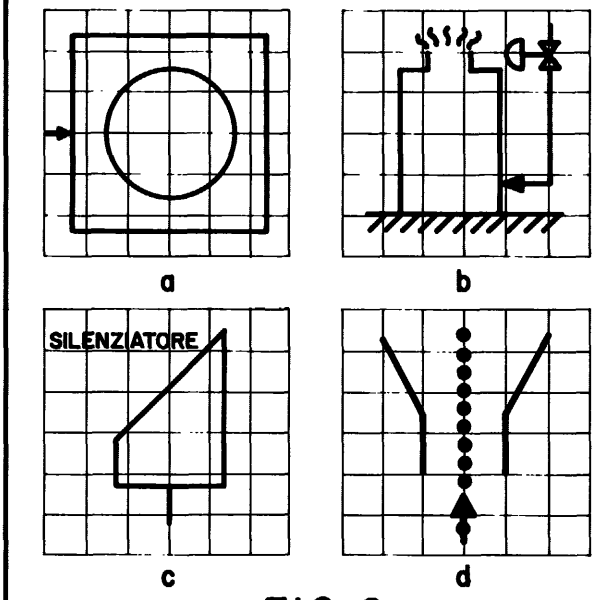

FIG.6
STEAM SILENCERS' REPRESENTATION

Figure 2 displays some of the symbols for steam separators and flashers included in the revised literature. The type more frecuently used in geothermal applications is the Webre separator and this is precisely the construction in which most of the symbols are based, although in some cases, for example in Fig 2f, a different type is shown. As it has been already stated, as long as the apparatus have the same function, there is no reason to change its representation, so in Fig. 11 I give the symbol I favor for steam separators and flashers. Admitedly, it correspond to the Webre type, but I have already given the reasons to widen its use. It can optionally be complemented with an horizontal line if it is of the integral tank type or have ASA symbols Code No. 37 or 38 when it is significant

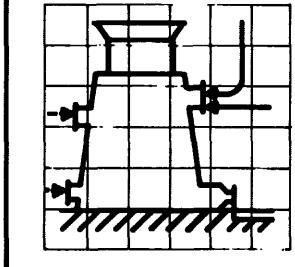

FIG.7
SILENCER SYMBOL

to show that there is a separated level tank in the brine piping.

The spherical check valve is another piece of geothermal equipment that is widely used. The symbols of Fig. 3 are all quite similar, but I find the one in Fig. 12 the most simple and convenient.

I have only found a couple of symbols for steam dryers: the one shown in Fig. 4a, lacking specificity, and the one in Fig. 4b which represents a Webre separator used to disengage any remaining moisture from the steam flow. As there are many other types of steam dryers, like wiremesh, chevron, other centrifugal apparatus and so on, I do not think this is the best generical representation for this equipment, and not having found any suitable symbol in the american graphical standards, I would propose to adopt the separator symbol given by DIN 30600 as Sheet 659 and shown in Fig. 13.

With regard to the wet silencers used to discharge high-temperature water or steam-water mixtures to the atmosphere, Fig. 5 proves that the customary abundance of different representations is also valid for this case. The same situation stands for the silencers used to muffle steam discharges, whose symbols are shown in Fig. 6. There is also the case of the Fig. 7 symbol representing a silencer receiving steam and steam-water mixtures. As the ANSI Standard Y32.18 on "Symbols for Mechanical and Acoustical Elements as used in Schematic Diagrams" does not seem to contain anything fit for geothermal flow diagrams or DTI's, our proposal for silencers' standard symbols appears in Fig. 14 and 15.

Rupture diaphragms or disks are very commonly used to protect geothermal installations from overpressure. Some of the symbols found in the literature sample under study are those of Fig 9 and Fig 17, this last being the one I favor because of its simplicity and ease to draw.

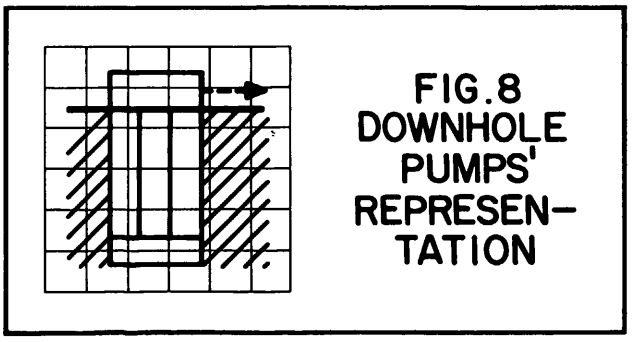

FIG.8
DOWNHOLE PUMPS' REPRESEN-TATION

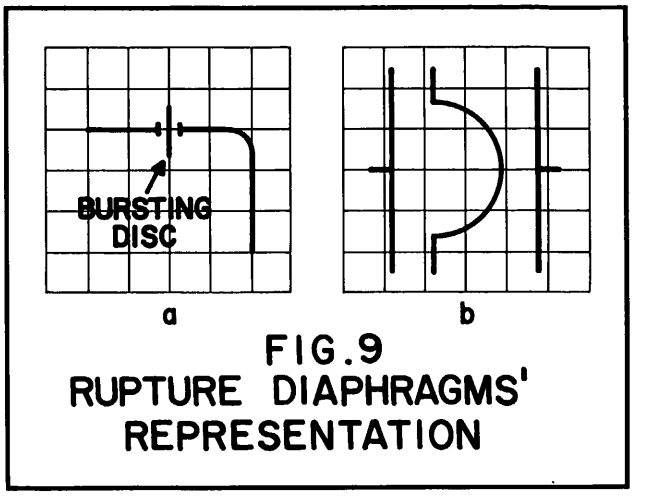

FIG.9
RUPTURE DIAPHRAGMS' REPRESENTATION

In Fig. 16 there is the only symbol I have found for a sand sampler and, not having an alternative to offer, I propose to adopt it. I have also found a single symbol for downhole pumps, that of Fig 8, but in order to make it congruent with the symbol for wells given in Fig. 10, I have modified it as per Fig 18.

CONCLUSION

A set of graphical symbols for geothermal equipment has been proposed that, when jointly used with the graphical standards for heat-power apparatus and for installations in petroleum and chemical industries, complemented by the those specified for valves, fittings and piping and the symbols for ball and butterfly valves, of frequent use in geothermal fields, as prescribed by ISA S.1, will led to uniform flow diagrams and DTI's. The particular drawings proposed, if not generally accepted, can always be changed later on, when a better draft is offered and found agreeable to everybody but, in any case, what really matters is to have a geothermal graphical standard. To produce it seems to be a proper task for the now forming International Geothermal Association

The purpose of this paper is to raise a petition in the sense that such an action be recomended by the governing bodies of the geothermal communities.

ACKNOWLEDGEMENT

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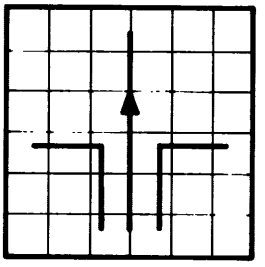

FIG.10
WELL

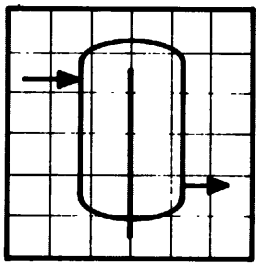

FIG.11
STEAM SEPARATOR
OR FLASHER

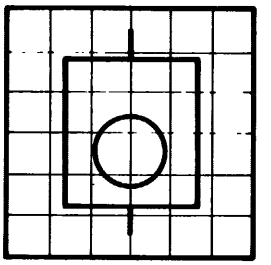

FIG.12
SPHERICAL
VALVE

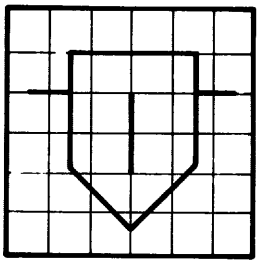

FIG.13
STEAM
DRYER

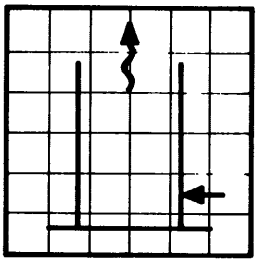

FIG.14
STEAM
SILENCER

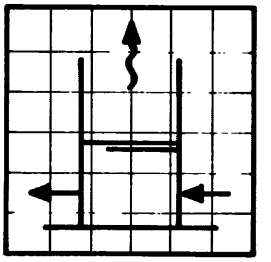

FIG.15
WET
SILENCER

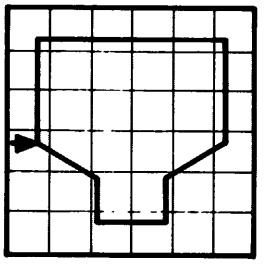

FIG.16
SAND
SAMPLER

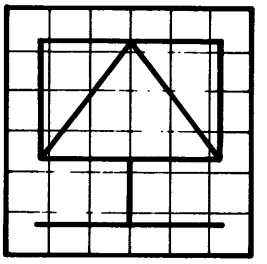

FIG.17
RUPTURE
DISK

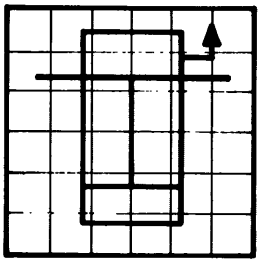

FIG.18
DOWNHOLE
PUMP