energy

Heat pipes for Alaskan oil

Oil from Alaska's rich North Slope fields will be transported with the help of a truly revolutionary heat-pipe device developed through the space program. It is being used to keep the ground frozen along the 798-mile pipeline, saving hundreds of millions of dollars and protecting the tundra environment.

While heat-pipe principles have been known since World War II, it wasn't until spacecraft were built that heat pipes were developed for cooling on-board electronic packages. Satellites use them routinely. So did Skylab.

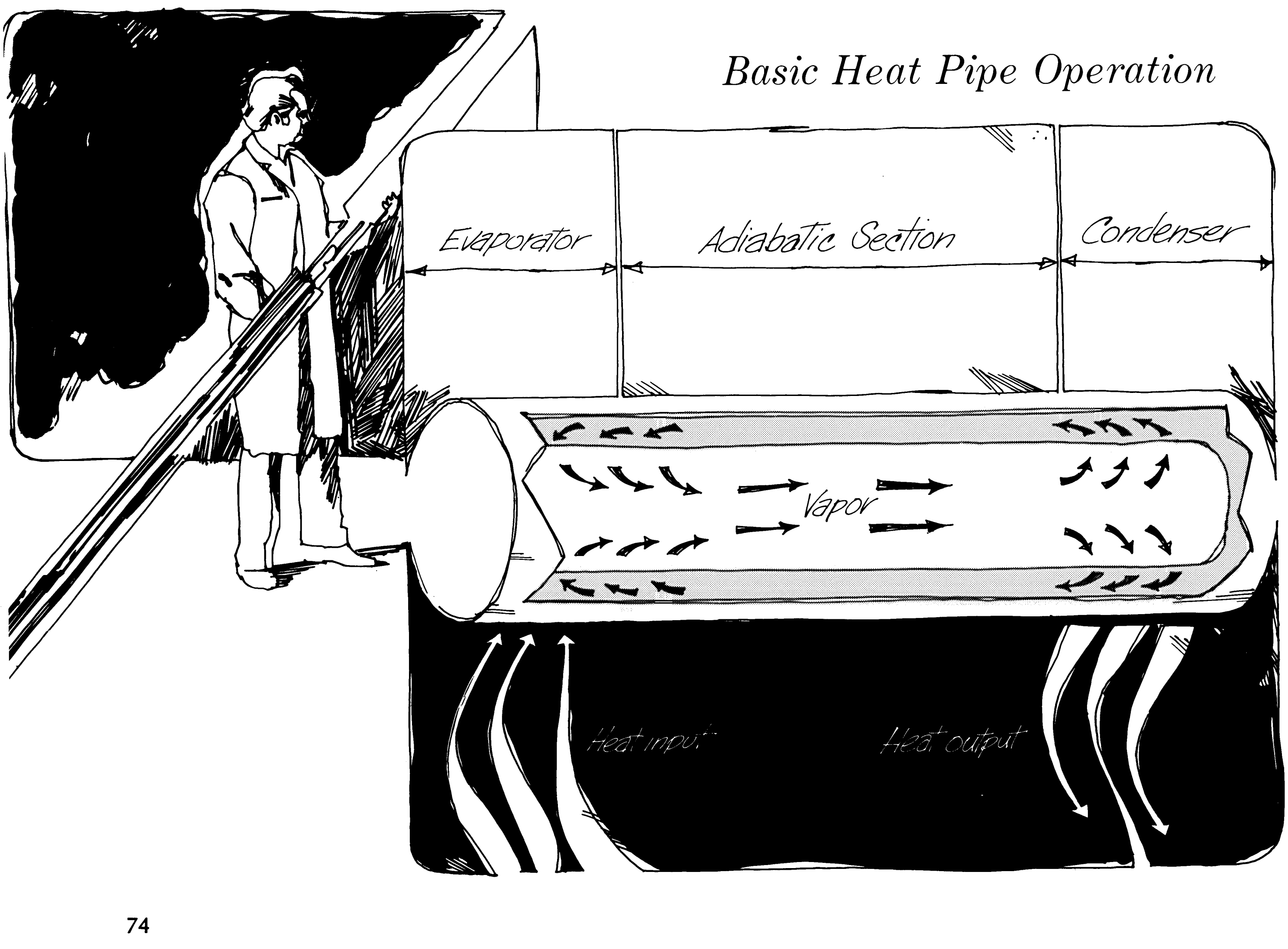
A major construction problem in the arctic is posed by the seasonal freeze-thaw cycle of the permafrost soil. Frost-heaving, which can raise structural piling by as much as 18 inches in one year, is followed by uneven settling during the summer thaw. The enormous forces involved literally can tear a pipeline apart, spewing hot oil over the countryside.

Protecting the tundra environment by keeping the permafrost frozen obviously was a significant consideration in passing of the pipeline bill in Congress.

The heat pipe was adapted to the Alaskan permafrost problem by McDonnell Douglas Corp. It is a sealed tube containing anhydrous ammonia, which has a boiling point of 25 F. The ammonia evaporates as it soaks up heat from the 30-degree permafrost. The heated gas rises to the top of the pipe and dissipates the heat through a fin-type radiator.

Having condensed back to a liquid, the anhydrous ammonia returns to the bottom of the pipe and the cycle repeats itself continuously, never allowing heat above 25 F to penetrate the permafrost. Thus heat pipes are totally automatic. They sense and respond to climatic conditions with no moving parts, require no external power, and never need adjustment or servicing.

The heat pipes are between 2 and 3 inches in diameter and 31 to 66 feet long, varying with the terrain. McDonnell Douglas-Tulsa is constructing



Basic Heat Pipe Operation

them for Alyeska Pipeline Service Co., the consortium responsible for construction and operation of the entire line.

McDonnell is building 112,000 of the heat pipes and radiators, an assembly it aptly calls a "cryo-anchor."

NASA's role in the Alaskan development did not end with initial research into reliable heat pipes for cooling spacecraft components. When Alyeska first became interested in heat pipes as a solution to the tundra problem, the Marshall Space Flight Center turned over the results of NASA research and channeled the consortium to NASA heat-pipe contractor companies.

Alyeska personnel also participated in a heat-pipe technology short course conducted by the NASA Industrial Applications Center at the University of New Mexico. And, as Alyeska's permafrost program neared completion, a technical review team at Goddard reviewed the heat-pipe application and suggested design improvements.

By developing the basic heat-pipe technology for space missions—and subsequently making that technology available to industry—NASA freed Alyeska from more costly, and longer-term, solutions. Thus, space research contributed directly to developing the North Slope energy resource.

Reclaiming waste heat

The heat pipe is probably the most efficient heat-transfer device known today. It can transport roughly 500 times the heat flux of the best solid conductors with a temperature drop of less than 3 degrees per foot.

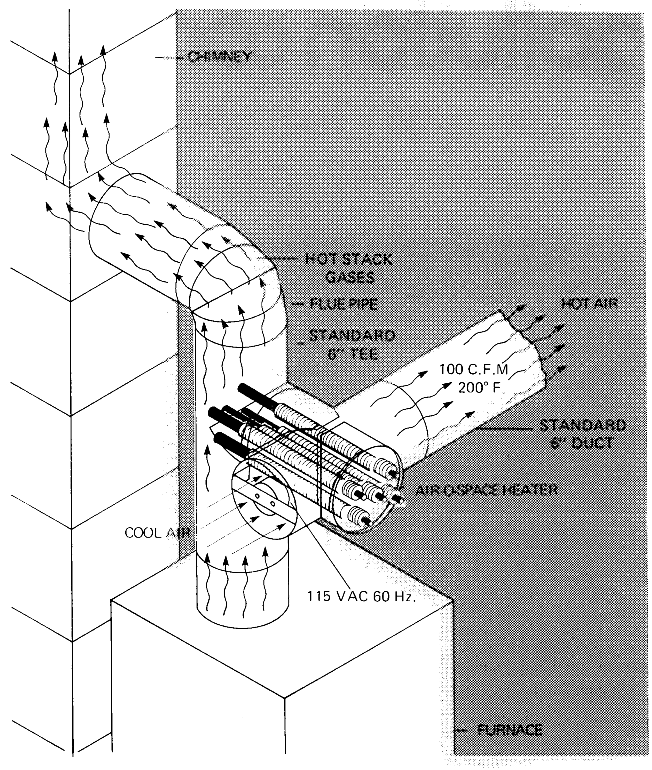
These facts led to the formation of Isothermics Inc., Augusta, N.J., to manufacture heat-pipe products. The equipment reclaims heat from chimney flue gases in home and industrial heating systems.

The heat pipes extend into the flue, pick up a portion of the heat and redirect it to the area to be heated. In home use a small fan draws surrounding air typically from the basement and forces it over the finned heat pipe. This heats the air, which then can be channeled for use in other areas.

A similar device uses the waste heat from industrial processes. It derives heat from the exhaust of a boiler or drier and returns it to the process or to a space heater.

These heaters are simple and inexpensive to install, requiring little modification other than additional ductwork to the existing system. In either home or industrial use, the only expense entailed in operating the heater is a small amount of electricity to power the fan. No additional fuel is required since the heat normally wasted is simply reused.

Isothermics has found that heat-pipe equipment increases efficiency in homes by about 10% and even more in industrial processes where waste-heat temperatures are higher. The heat-recovery devices



"Air-O-Space" heater based on spacecraft heat pipes requires no fuel other than electricity to run the fan. Installed in a chimney flue, heat pipes transfer the heat from waste hot gases (but not the gases themselves) to fresh air blown across the other end of the pipes.

actually pay for themselves in a few years.

The company is a subscriber to NASA's Industrial Applications Center at the University of New Mexico, where its employees attend symposiums on heat-pipe technology.

Another company, Kin-Tek Laboratories Inc., Texas City, has adapted NASA heat-pipe ideas and data to produce an instrument to calibrate gas analyzers used for air-pollution monitoring.

Flatplate solar energy collector

The avenues of technology transfer are illimitable. D. W. Barlow, a small truck-body fabricator in Florida became a producer of flatplate solar collectors after having an inexpensive literature search performed for him by a NASA information center.

The NASA Industrial Applications Center at the Research Triangle, N.C., searched its extensive technical literature files—containing both NASA and non-NASA reports—and provided Barlow with abstracts of 314 papers. Of these he requested 15 full-length articles.

His total cost: $100. Yet it was sufficient to launch him into a new venture, O.E.M. Products Inc. His flatplate collector design incorporates a new black paint developed by Dow-Corning Corp., but not yet commercially available.