New Technologies Build on Current Success for Utility Location and Cross Bore Elimination

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UIT
UNDERGROUND IMAGING TECHNOLOGIES

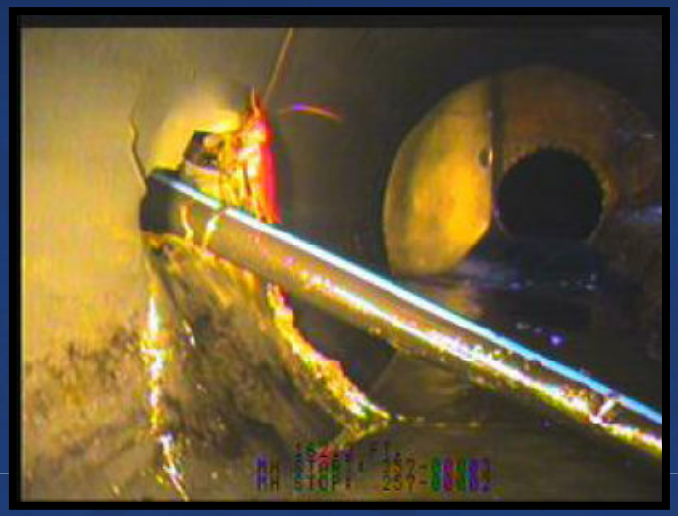
Latham, NY

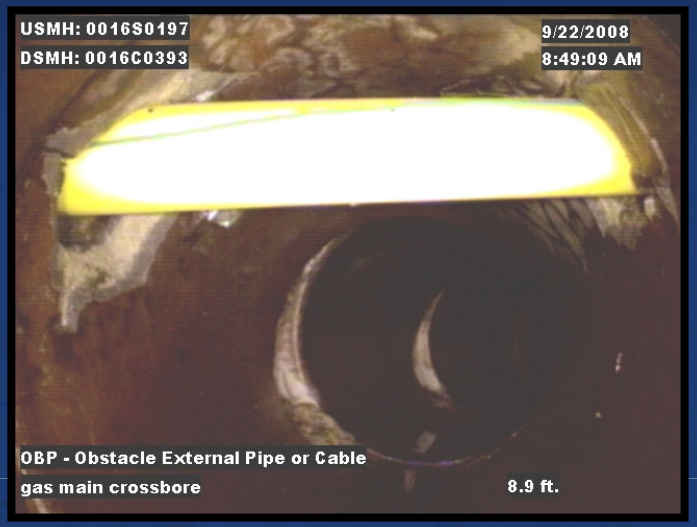
Paper D-1-02

Outline

1. Overview of a Cross-Bore
2. Current Methods Used to Locate Cross-Bores
3. Other "Non-Pipe Entry" Techniques with Potential
   - Ground Penetrating Radar (GPR)
   - Time Domain Electro Magnetics
4. New Technologies Yet to be Developed / Utilized
   - Surcharge Method
   - Acoustic Methods
   - Seismic
   - Still to be developed …
5. Conclusion

What is a Cross-Bore?

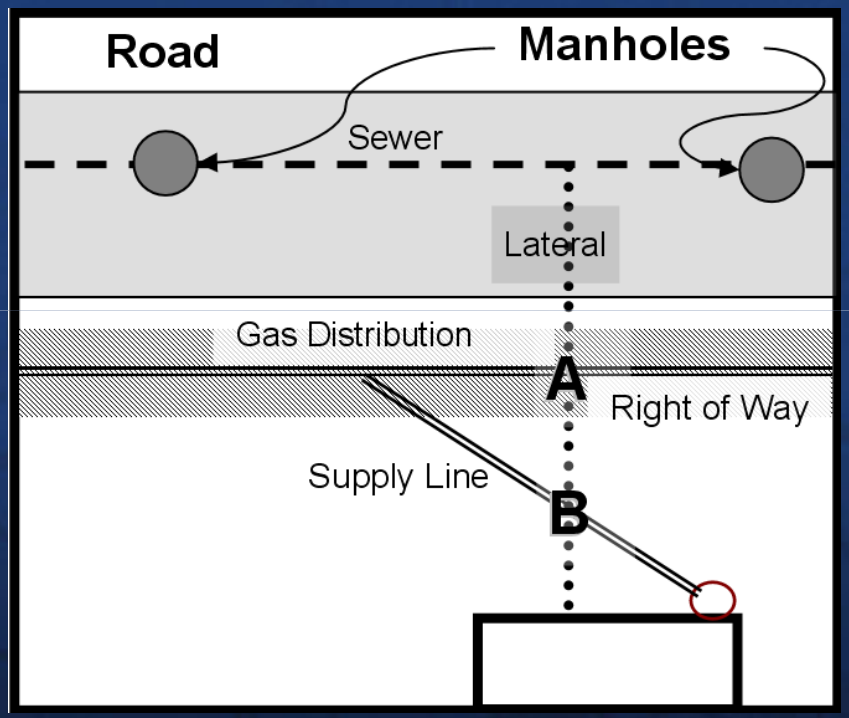




- *A cross-bore is "…an intersection of an existing underground utility or underground structure by a second utility resulting in direct contact between the transactions of the utilities that compromises the integrity of either utility or underground structure."*
- Field experience suggests that there are 2 to 3 cross-bores per running mile of installed distribution pipe!

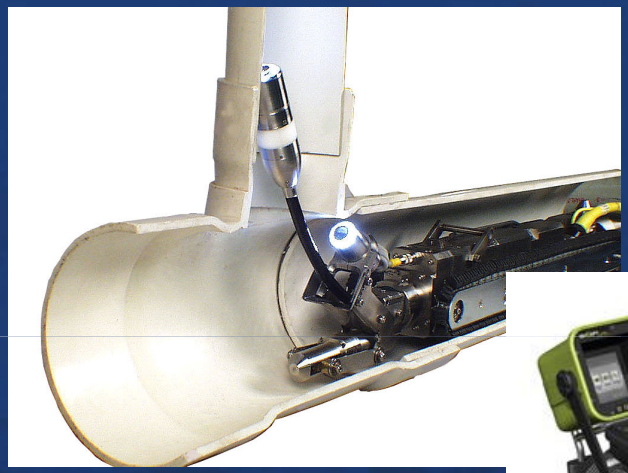
Common Cross-Bore Locations

1. Cross-bores tend to occur at right angles to homes and building.
2. Location A: Within the utility right-of-way.
3. Location B: Supply line to House.
4. Other Documented locations:
   i. Mainline sewers
   ii. Storm pipes
   iii. Electrical and telecommunication ducts.



Most Widely Used Method to Locate Cross-Bores

- Mainline Motorized Tractor with a mounted Closed-Circuit Television (CCTV) or “push” camera launched from clean-out or in-house location.
- Some systems attach a sonde that emits a radio signal in combination with the CCTV thereby allowing a user to trace the location of the lateral on the surface using a hand held receiver.

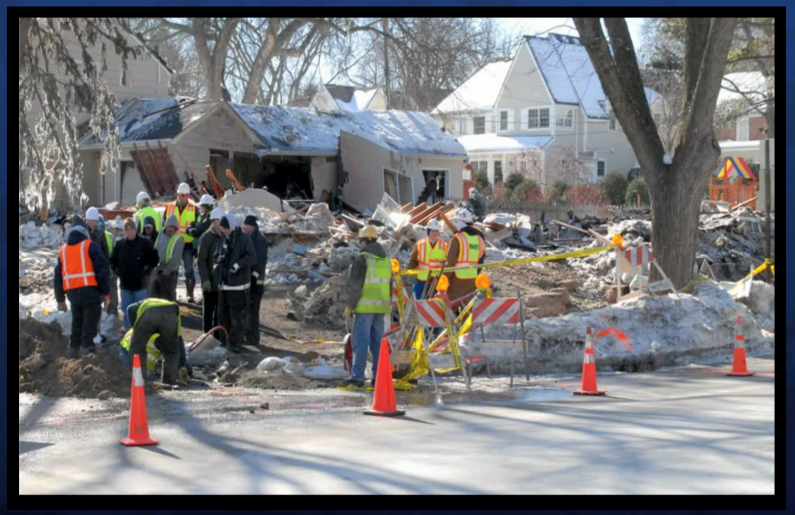


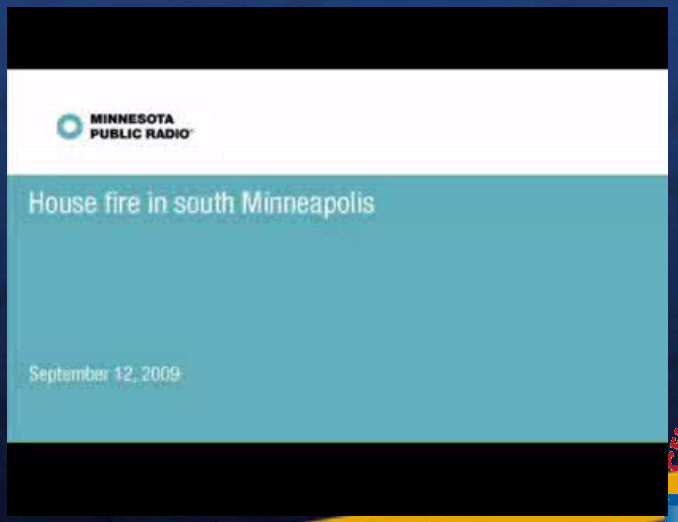
CHALLENGES

- Generally requires access to mainline sewer for tractor devices and some DPW's will not allow this …
- Dirty/Root Ridden Sewers
- Cost of total tractor systems over $100K and costly to maintain.
- Expensive to employ. ~ $40,000 a mile of mainline sewer.
  - Approximately 13 400 lf. Blocks per mile. Contractor gets $8.00 per foot of mainline or $3,200 per block, or approximately $400 per lateral when only doing the 8 short side services.
- Generally requires coordination with Subs or Agency Personnel and this takes time and time is money.

Preventable Catastrophes – Why Not a Higher Priority?

1. Some say it is the cost of conducting legacy surveys that inhibit action;
2. Others say it is a question of who is responsible or who should pay …
3. And even others don't want to hear about the legacy ticking time bombs - believing good construction practices are now being employed.
4. But when things like this happen … then people take action!





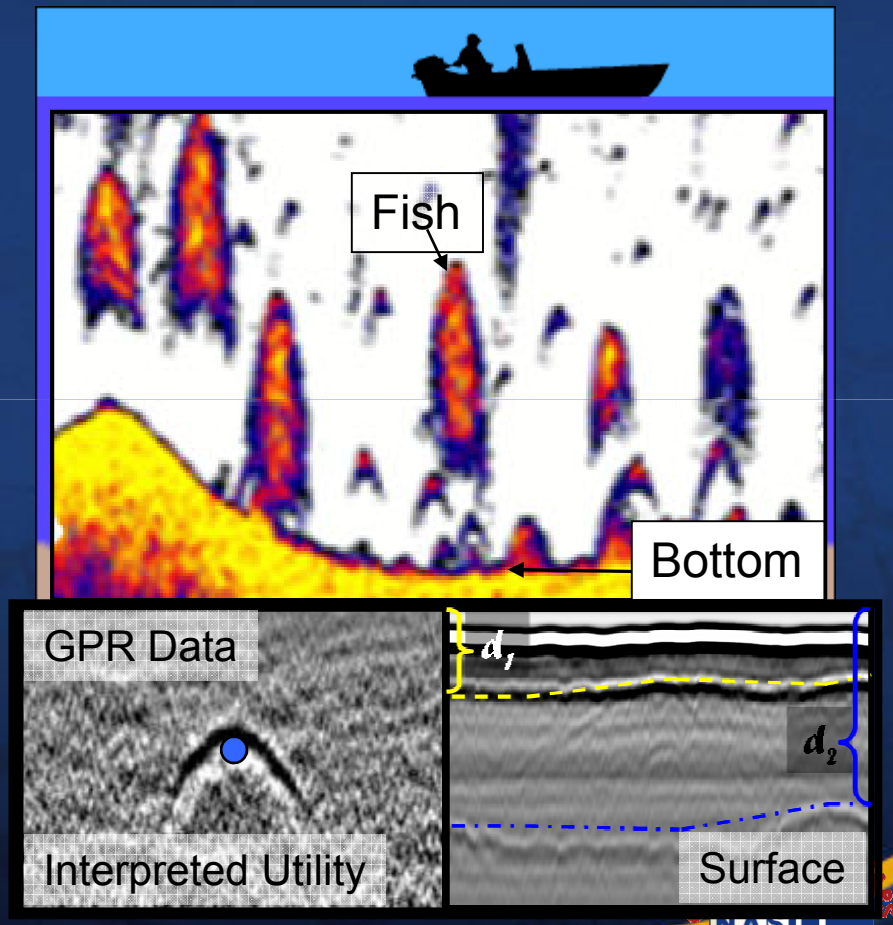
Joel Koyama, Star Tribune
St. Paul firefighters put out a fire on the 2000 west block of Villard Avenue West in St. Paul, MN which was caused by a sewer contractor hitting a gas pipe with a sewer auger. This house was completely destroyed but the neighbors on both sides didn't sustain any damage.

Other "Non-Entry" Techniques with Potential of Finding Cross-Bores more economically

- Ground Penetrating Radar (GPR)
- Time Domain Electro Magnetics
- New Technologies Yet to be Developed

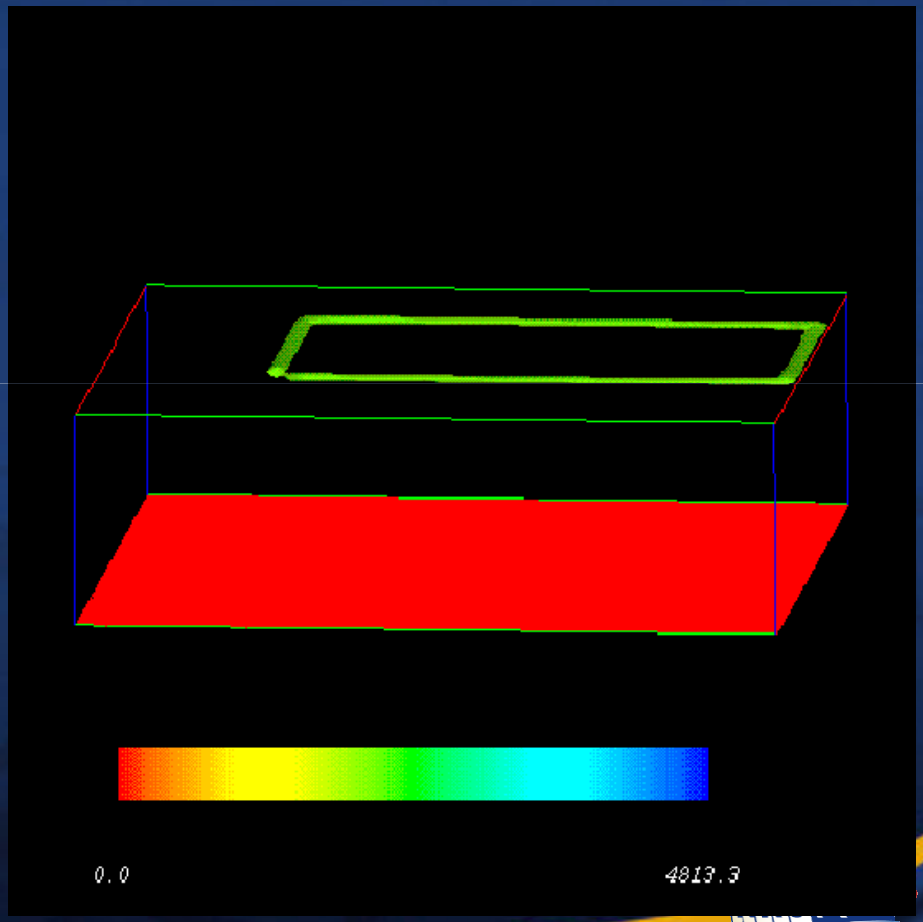
Improved Technologies: Multi Channel Ground Penetrating Radar (GPR)

1. What is GPR?
   - i. A signal is emitted from a source and rebounds off of a target.
   - ii. Operation is similar to that of a fish finder.
   - iii. GPR uses Electromagnetic waves while a fish finder uses acoustic waves.
2. To effectively locate cross-bores it would be necessary to produce data accurate to ± 1".
   - i. This type of accuracy is achievable with second generation systems in ideal soil conditions.
3. Because of the variability of soils and topography GPR alone might not be the answer.



Improved Technologies: Time Domain Electro Magnetic Induction (TDEMI)

1. How does TDEM work?
   - Induces a current in the soil and measures the change in the induced magnetic fields.
2. Detects metallic targets, including utilities at a depth of up to six feet.
   - Also has the potential to detect disturbed soil and conductivities.
3. Limited to targets of a certain composition
   - May miss Cross-Bored utilities with a non-metallic composition such as a polyethylene gas line particularly if HDD was used to place the gas pipe.



Unique Methods & New Technologies Yet to be Developed

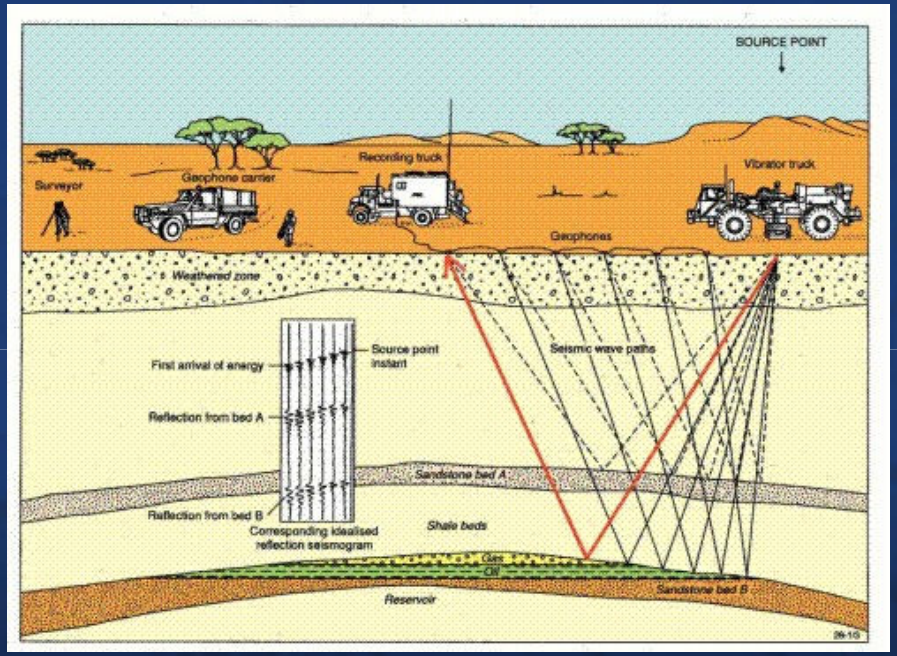
1. Surcharge Method - Seldom used
2. Up and coming – In development
   i. Seismic Methods
   ii. Acoustic Methods

Surcharge Method

1. An alternate method proposed by Dr. Ray Sterling uses a detectable liquid to surcharge the mainline sewer.
2. The liquid would leak out of the sewer line at the point where the cross-bored utility penetrates the sewer.
3. TDEM could be used to measure the change in electrical properties as a result of the higher volume of liquid at the point of the leak.
4. Issues:
    - i. Using Water alone as the surcharged liquid may not be detected by the TDEM.
    - ii. Location of the water table – the Cross-Bore could be below the water table and thus not observable
    - iii. Can we know that he liquid would remain in the vicinity of the leak associated with the cross bore long enough to be detected?
    - iv. Cost – requires access to mainline and house side sewers because all laterals need to be sealed above the area where a Cross-Bore might be.
    - v. Spectrum of possible issues would lead to extreme variability in results and would not necessarily produce desired results at high levels of confidence.

New Technologies: Seismic

- Adaptation of Seismic Geophysical Tools for deep exploration (first used in the 1940's) to be used in near surface environments.
- This tool would not be restrained by the limitations of either GPR or TMEMI



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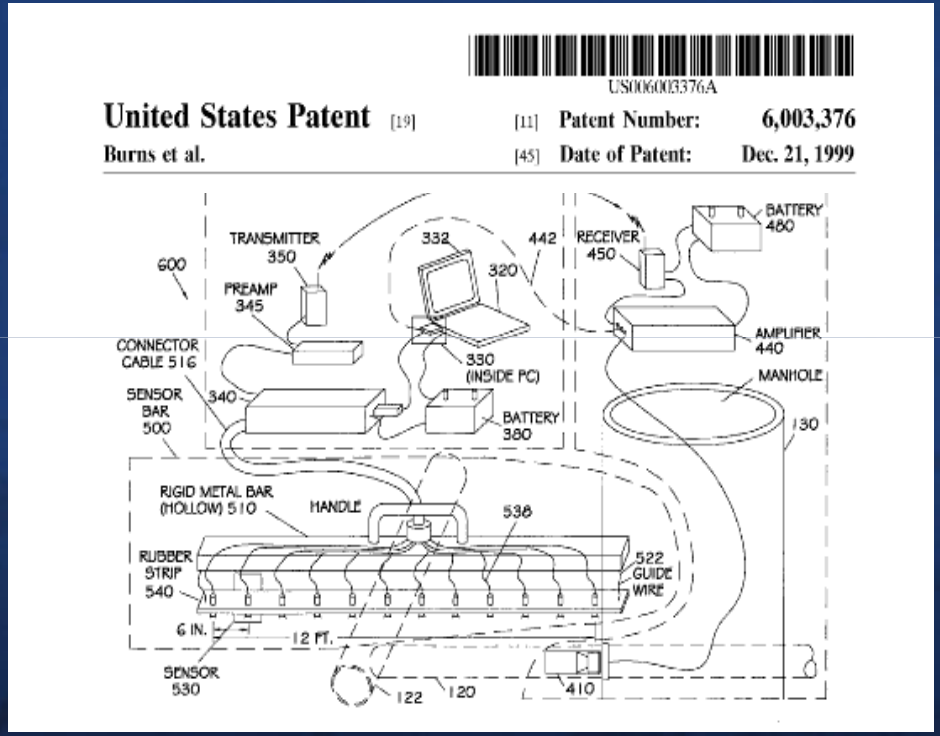
Existing Acoustic & Seismic Methods

Example 1:

US Patent 6,003,376 covers the use of an extremely sensitive sensor within the sewer used during installation.

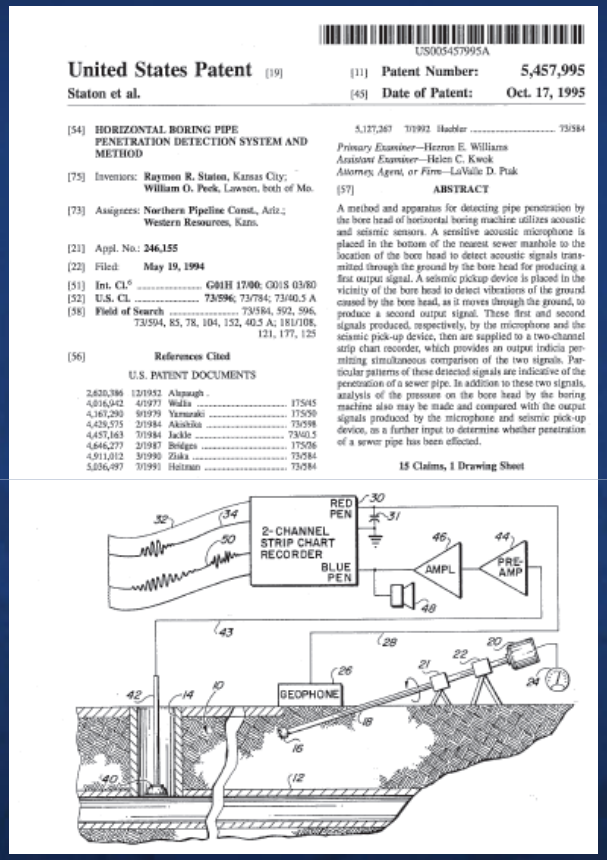
i. "Listens" for the crunch resulting from a tool, such as a mole, penetrating the sewer lateral.

ii. Field testing has indicated this particular method is not reliable



Example 2:

US Patent 5,457,995 Horizontal Boring Pipe Penetration Detection System and Method is another INSTALLATION based technology that has not taken "root." Nonetheless the method is not intended to address Legacy issues.



US005457995A

United States Patent [19]

Staton et al.

[11] **Patent Number:** 5,457,995

[45] **Date of Patent:** Oct. 17, 1995

[54] **HORIZONTAL BORING PIPE PENETRATION DETECTION SYSTEM AND METHOD**

[75] Inventors: **Raymon R. Staton**, Kansas City; **William O. Peek**, Lawson, both of Mo.

[73] Assignees: **Northern Pipeline Const.**, Ariz.; **Western Resources**, Kans.

[21] Appl. No.: **246,155**

[22] Filed: **May 19, 1994**

[51] Int. Cl.[6] **G01H 17/00**; G01S 03/80

[52] U.S. Cl. ..... **73/596**; 73/784; 73/40.5 A

[58] Field of Search ..... 73/584, 592, 596, 73/594, 85, 78, 104, 152, 40.5 A; 181/108, 121, 177, 125

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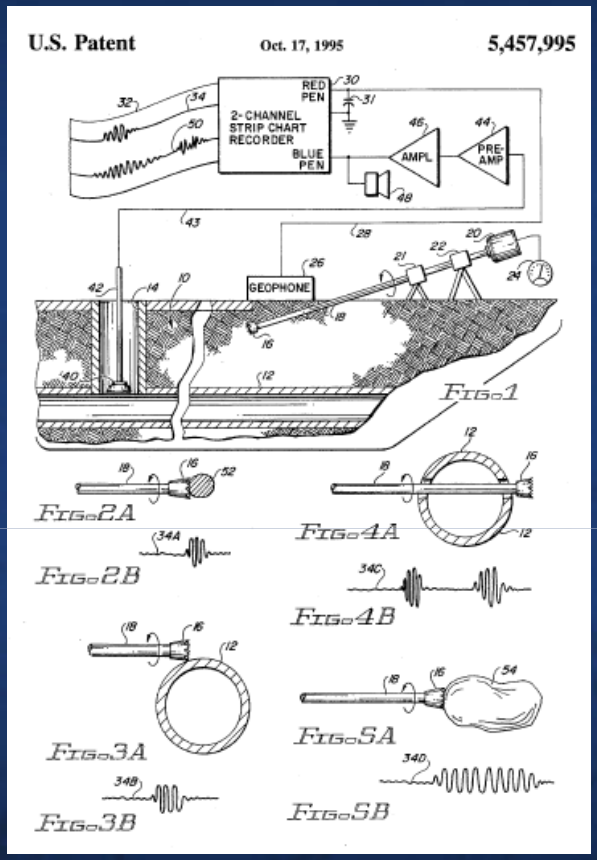
Primary Examiner—Herzon E. Williams
Assistant Examiner—Helen C. Kwok
Attorney, Agent, or Firm—LaValle D. Ptak

[57] **ABSTRACT**

A method and apparatus for detecting pipe penetration by the bore head of horizontal boring machine utilizes acoustic and seismic sensors. A sensitive acoustic microphone is placed in the bottom of the nearest sewer manhole to the location of the bore head to detect acoustic signals transmitted through the ground by the bore head for producing a first output signal. A seismic pickup device is placed in the vicinity of the bore head to detect vibrations of the ground caused by the bore head, as it moves through the ground, to produce a second output signal. These first and second signals produced, respectively, by the microphone and the seismic pick-up device, then are supplied to a two-channel strip chart recorder, which provides an output indicia permitting simultaneous comparison of the two signals. Particular patterns of these detected signals are indicative of the penetration of a sewer pipe. In addition to these two signals, analysis of the pressure on the bore head by the boring machine also may be made and compared with the output signals produced by the microphone and seismic pick-up device, as a further input to determine whether penetration of a sewer pipe has been effected.

15 Claims, 1 Drawing Sheet



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New Ideas: Tools in the Early Stages of Development

1. Methods in the Development Stages at UIT

   Induce a continuous wave signal into the gas distribution pipe pinpointing which areas require further investigation.

2. Methods in Development Stages Elsewhere..???

   Hopefully there are other initiatives underway by individuals and companies directed to finding Legacy Cross-Bores!

Conclusion

1. Development is underway, by companies including UIT, of several promising new concepts for the detection of Cross-Bores during construction and previously placed (Legacy) Cross-Bores.
2. Field experience suggests that there are 2 to 3 Cross-Bores per running mile of installed distribution pipe.

   What are the odds? Cross-Bored side sewer laterals in the front yard of the past two chairmen of the North American Society for Trenchless Technologies, (NASTT) in different locations – none of these were reported elsewhere.
3. This seemingly improbable situation, as well as the numerous instances where a Cross-Bore cuts a gas or electric line, demonstrates the desperate need to pursue cost effective and reliable means to locate LEGACY Cross-Bores!

Thank you for your Interest in this most important matter!

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