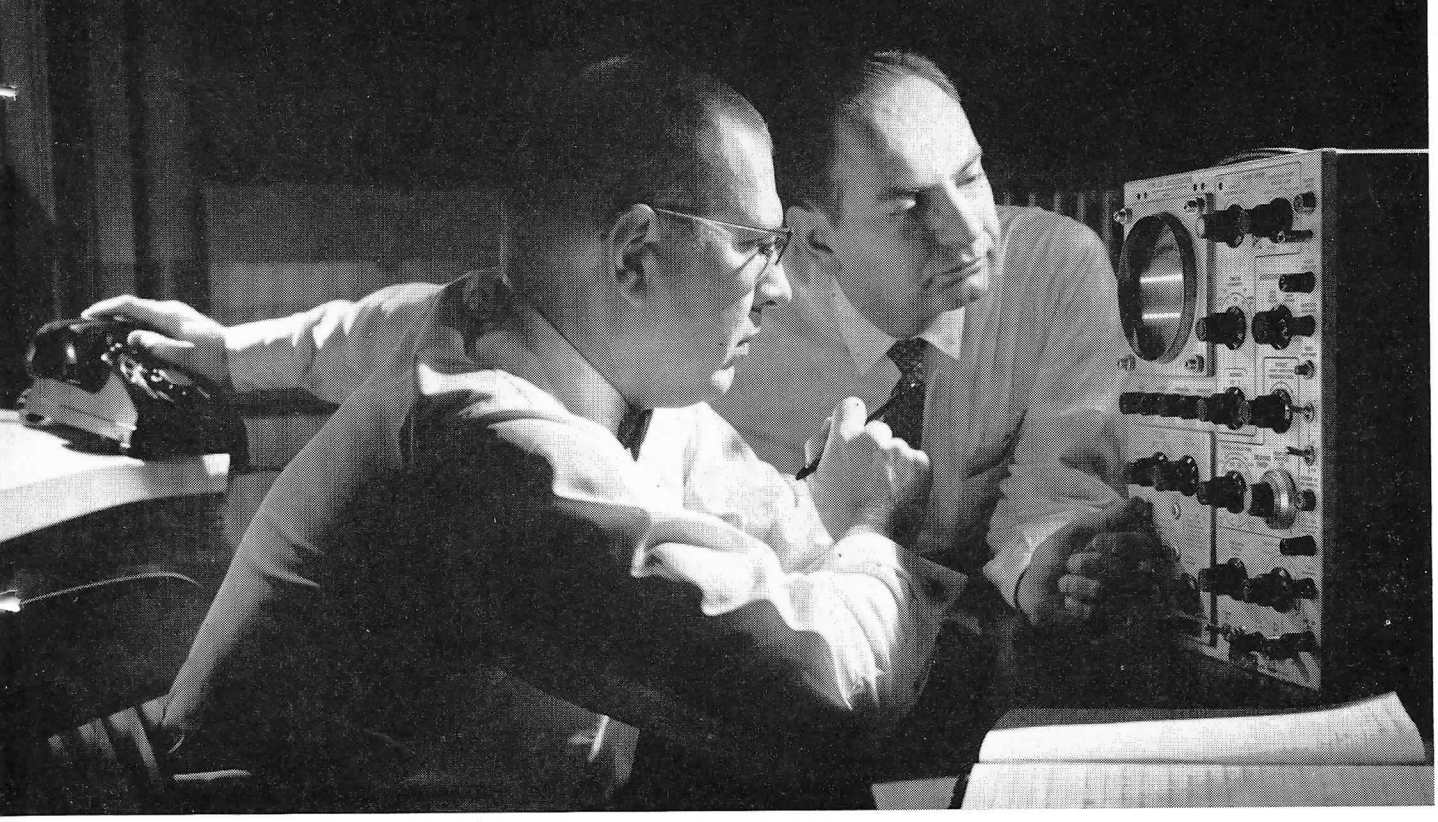


"Get the boys on the phone...

. . . we've found the missing link!"

Frank's command was almost reflex action, the culmination of nearly 12 hours of anticipation in which the only thought he and his colleague, Jim, had was, "Will this idea really work? Have we, at last, found the missing link?"

Only 12 hours ago they had been batting their heads against a stone wall, with the solution flirting just out of reach, always eluding them. Suddenly the answer had come, in—of all places—a car, tortuously climbing and twisting between the Pennsylvania hills.

It was the dead of winter. The two tired telephone engineers were returning from a trip to an XY® Dial exchange in western Pennsylvania. They had gone with high hopes for the success of a bold new idea; it hadn't worked out. Tense and guarded against the dangers of snow and ice, the men were trying to relax with conversation.

They could have talked about anything . . . the weather, women, basketball—but one subject seemed to come back again and again: this mutual problem they were trying to solve.

It was their responsibility to develop one phase of the telephone art superior in design to any approach previously considered by other engineers working in this field. The basic concept—toll ticketing — dated back to the 1920's, when telephony was not yet ready for this "revolutionary" idea. It was a different story now. The growing acceptance of this new facility was based on two important facts: the mechanization of switching equipment and the rising cost of manual operation. Telephone companies would be interested in toll ticketing if equipment feasible to their type of operation could be found. A design employing new principles was their assignment; the conversation centered around that.

A Look at the Past

Beginning as engineers do, by careful analysis of the facts, the two men started by reviewing what they knew about toll ticketing and its existing problems. Each succeeding problem, as it was brought to light, drew them closer to their goal . . . for they had the advantage of being able to look back at what had already been done—see its good points and its shortcomings.

"Didn't they use relays for memory back in the '20's . . . for storing information?" Jim asked.

"Yes, that's right," replied Frank, "but they cost too much; besides, they were slow and it took a warehouse-full to do the job. Then somebody thought of paper tape. One reel for each line. Load up the equipment, let her run, then unload after the reels were used up . . ."

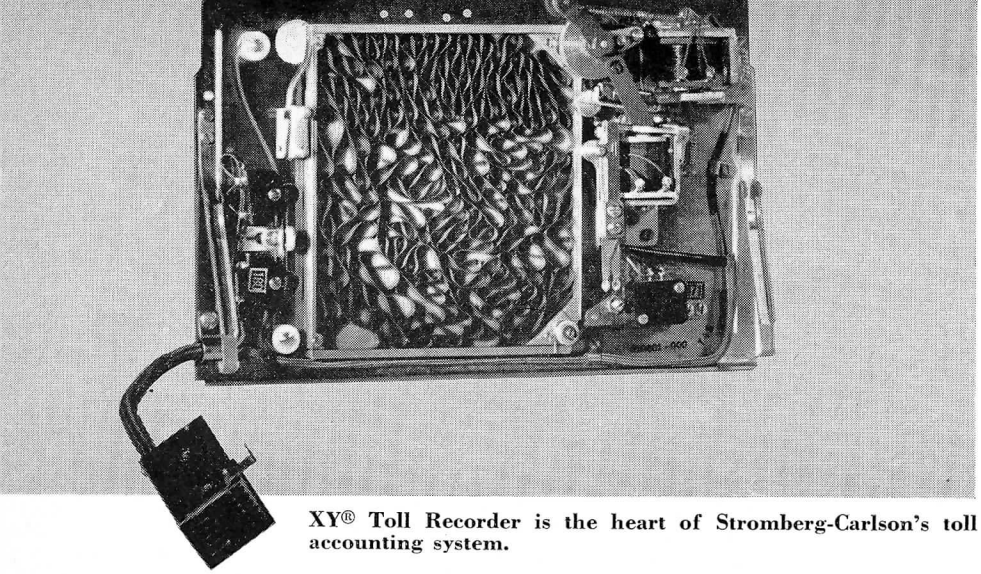
A "Reel" Problem

"Sounds like an old player piano," replied Jim. "I remember them—liked the music but it was no fun jumping up and down to change the reels."

"Funny that no one's tried to figure out a practical way to avoid loading and unloading reels," said Frank. "That's where we'd really be in the park. If we could find some way to eliminate handling reels — you know, help the operating company cut labor costs, and not have those miles and miles of paper tape to pay for and contend with."

Jim was following this same thought in a slightly different way. After a moment . . . "That outfit that makes an automatic typewriter tried magnetic tape—like an audio tape recorder — for duplicating the common portion of letters. I suppose they went back to

It started in a car that was twisting its way through the Pennsylvania hills.



XY® Toll Recorder is the heart of Stromberg-Carlson's toll accounting system.

paper tape because magnetic tape moves so fast, and they found they were still using miles of the stuff to do the job."

Finding the Answer

Almost simultaneously they turned, looked at each other and blurted out —"Why NOT magnetic tape?"

"Well, why not? What the heck is wrong with us? Here we are, both of us working for Stromberg-Carlson. Our magnetic research boys are way out in front in the magnetic recording field. They've proved that we can record pulses on tape; but of course tape has to be moving."

Each one, in his own mind, was reviewing the exclusive advantages of using magnetic tape. It could be used over and over again . . . material costs were bound to go down . . . magnetic tape recorders could be started, stopped, played back and erased by just pushing buttons . . . truly automatic operation . . . labor costs could be lowered even further. So far, so good . . . or so they thought.

Again it was as if there was a telepathic transfer of thoughts . . . they both sensed something was wrong. Their whole concept of using magnetic tape was again beginning to crumble because of this one flaw: under any known system, recordings were made while the tape was moving past the recording head. Even though the tape could be used over and over again, large amounts would be involved to record a day's traffic. Suddenly . . . material costs, instead of going down, were going up!

A New Approach

No one quite recalls who actually said it, because the question was so obvious:

"Why can't we record while the tape is standing still?"

"Has it ever been tried before?"

"I don't know, but is that any reason why it can't be done?"

Suddenly the car picked up speed as if in response to the conversation, now *really* spirited. It was as if they wondered why they hadn't thought of this before; it was a natural.

"Assuming that this could be done, this means we could stop the tape to record each pulse. Then we would move the tape slightly to record the next pulse. . . ."

The car lurched forward with increasing speed.

"We certainly can't prove it here—we're going to have to wait until we get back to the lab. Let's try it the first thing tomorrow morning. And take it easy on that accelerator!"

The following morning the two men —a little bleary-eyed but still enthusiastic—met in the lab to test their theory. The setup was easy. One man moved the tape manually as the other applied a pulse to the recording head. With bated breath, they rewound the tape, pressed the playback button and looked at the oscilloscope. The recorded pulses were there . . . sharp and distinct . . . it could be done! Their shout could be heard throughout the lab.

"Get the boys on the phone; we've found the missing link! Have them come down here at once! I want to get their ideas."

Operation Brainstorm

The other members of the team—a mechanical engineer and a circuit man —were given a quick review of the thinking and what had been accomplished up to this point. The tape was played again. As the newcomers saw the pulses on the oscilloscope screen, they, too, were gripped with the same excitement.

"I can't believe it!" said Howard; "how did you do it?"

"We moved the tape into position manually and recorded each pulse as the tape was standing still. Now, can we figure out how to do this automatically?"

Everyone was deep in thought. The mechanical engineer crossed the room, returned with a familiar piece of telephone apparatus.

"Have you thought of using a stepping switch to move the tape?" He held it toward them.

The pieces began to fall into place. A stepping switch . . . an XY Universal switch, stepped by the pulses of a dial. It was almost as if it were planned. A Toll Ticketing Recorder, using magnetic tape, designed to fit into the base of an XY switch.

Hardware Coming Up

At this moment theoretical research was shoved aside; development was underway. Within a few months a complete system, utilizing to the fullest extent all the principles and benefits of magnetic tape, had been designed.

The true measurement of its success is just now being realized, as operating companies across the United States express their enthusiastic acceptance of this unprecedented toll ticketing system . . . a system which has brought automatic billing of long distance calls within reach of small as well as medium-sized companies, through the inherent economies of magnetic tape. These companies learned that strong, low cost magnetic tapes can be used over and over again; this *truly* automatic tape recorder eliminates the manual handling of costly paper tapes—gives them the time-saving advantages of automatic playback and direct readout. The use of electronic recording techniques minimizes maintenance, through the elimination of mechanical motion and wear; micro-spacing of pulses on the tape allows all calls, including incomplete calls, to be recorded economically and read out for permanent use in traffic analysis.

Several years—and many additional men—have added new features which meet the changing patterns of long distance telephony. But basically the electronic toll ticketing system of today goes back to that wintry night's ride through the Pennsylvania mountains.

Typical bay of XY Toll Ticketing equipment.