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The 3-D Engineering Kit

NEWS

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BRIDGING THE "IDEA-TO-MODEL" GAP —— by –

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THE MECHANICALLY CREATIVE DEVELOPMENT ENGINEER WOULD DO WELL TO INVESTIGATE THE INTRIGUING POSSIBILITIES OF BRIDGING THE "IDEA-TO-MODEL" GAP BY USING ENGINEERED MODEL COMPONENTS. THE UTTER SIMPLICITY OF THE COMPONENTS IS DECEIVING, BUT THE ULTIMATE END PRODUCT IS SOPHISTICATED, ENGINEERING-WISE, IN A MANNER NOT READILY APPRECIATED UNTIL THE ENGINEER ASSEMBLES HIS FIRST PROTOTYPE.

ALL CREATIVE PEOPLE ARE CRACKPOTS

The mechanically creative engineer constantly faces the problem of turning his ideas into something physical, something which illustrates the essence of his idea. He is always in a hurry, because often a whole train of ideas is waiting to be tried, all hinging on the success of the first raw idea. For this man, model shops can't turn out the "hardware" fast enough, suppliers can't ship their components soon enough to satisfy the impatience generated by the hatching of a really good idea. As a result, he turns to action and converts his ideas into reality with the first things that come to hand. Sometimes this is wood, baling-wire, scotch tape, an old plumber's delight, an underpowered fan motor, or leftovers from the dregs of the last war. Sometimes, the practical result works -- and if it does, it only continues to support the notion that all creative people are crackpots. Heaven knows how many really good concepts have been abandoned simply because top management looked down their respective noses at crude and ineffective models. Still, the idea of illustrating a three dimension concept with a working model remains one of the best ways to convince non-technically oriented management.

In the past, and in many companies, the nightmarish type "hardware" models often reflect a too-tight budget -- a common affliction of research departments. The point is that the really "hairy ideas" often can't get official blessing or budget recognition even in the most progressive companies. The problem with working with stuff that never intended to fit together is just that-it doesn't fit together easily and conveniently. Shafts don't fit pulleys, the rods are threaded differently than the available nuts, motors won't fit the bases, some parts are too big, and others are too small. When finally bolted together, this mess of incompatibility often just barely works, but would work better if the shaft were a bit longer and the "gizmo" placed on the other side. Tough!!! To make these changes means ripping the whole thing apart and starting from scratch or perhaps doing it in a more refined fashion by budgeting it through the model shop-all of which adds up to delay, dampened enthusiasm, and doubt. These are just the things that shouldn't be present at this critical time. If the engineer wavers and abandons the idea, the loss adds up to more than a loss of time and money; it means loss of a nebulous -- but good idea. The failure to follow through may temporarily block progress down a previously promising avenue.

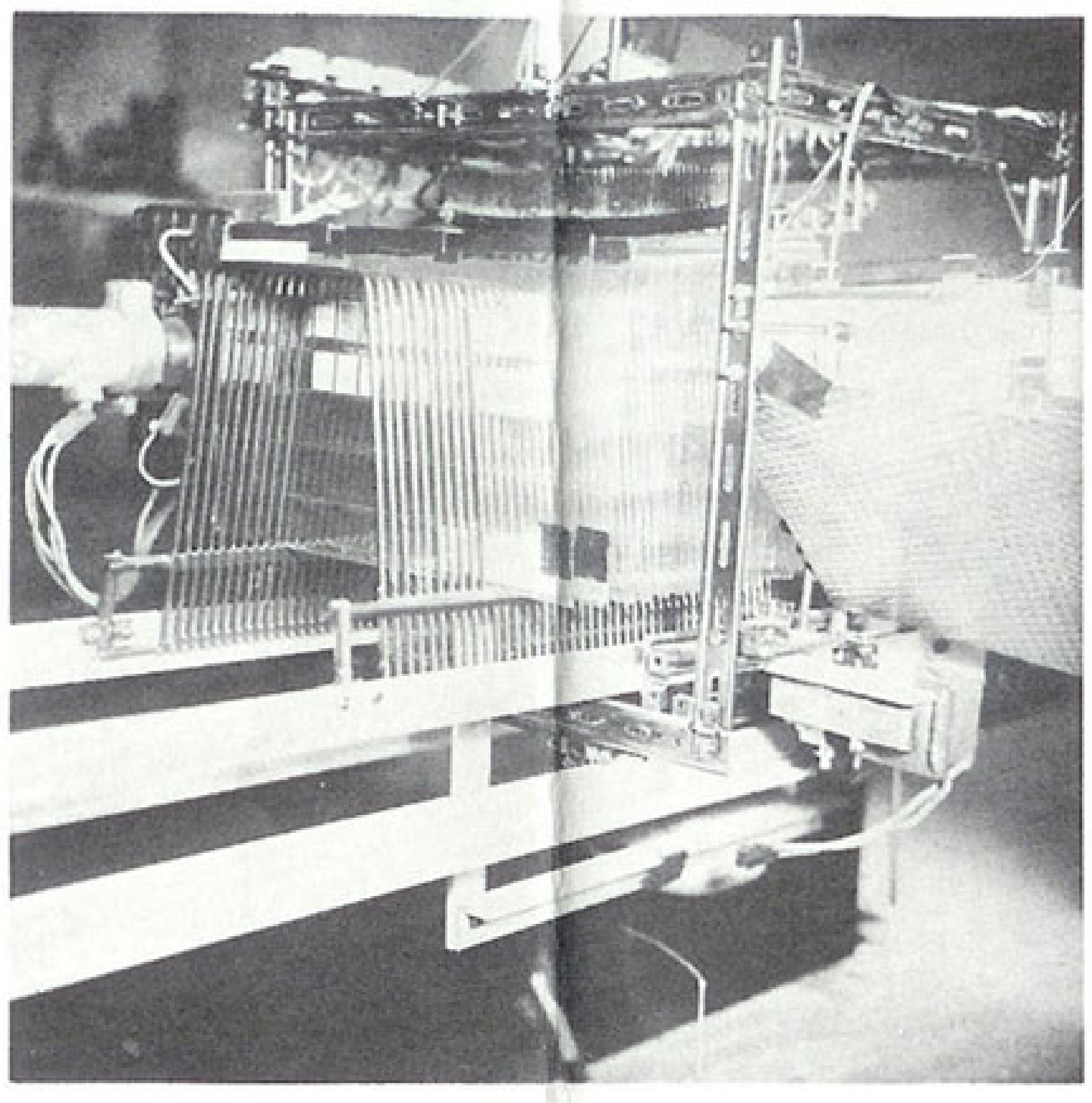


Fig. 1 – Transparent Coded Carrier Card Being Extracted On The Fly Into Collector Basket.

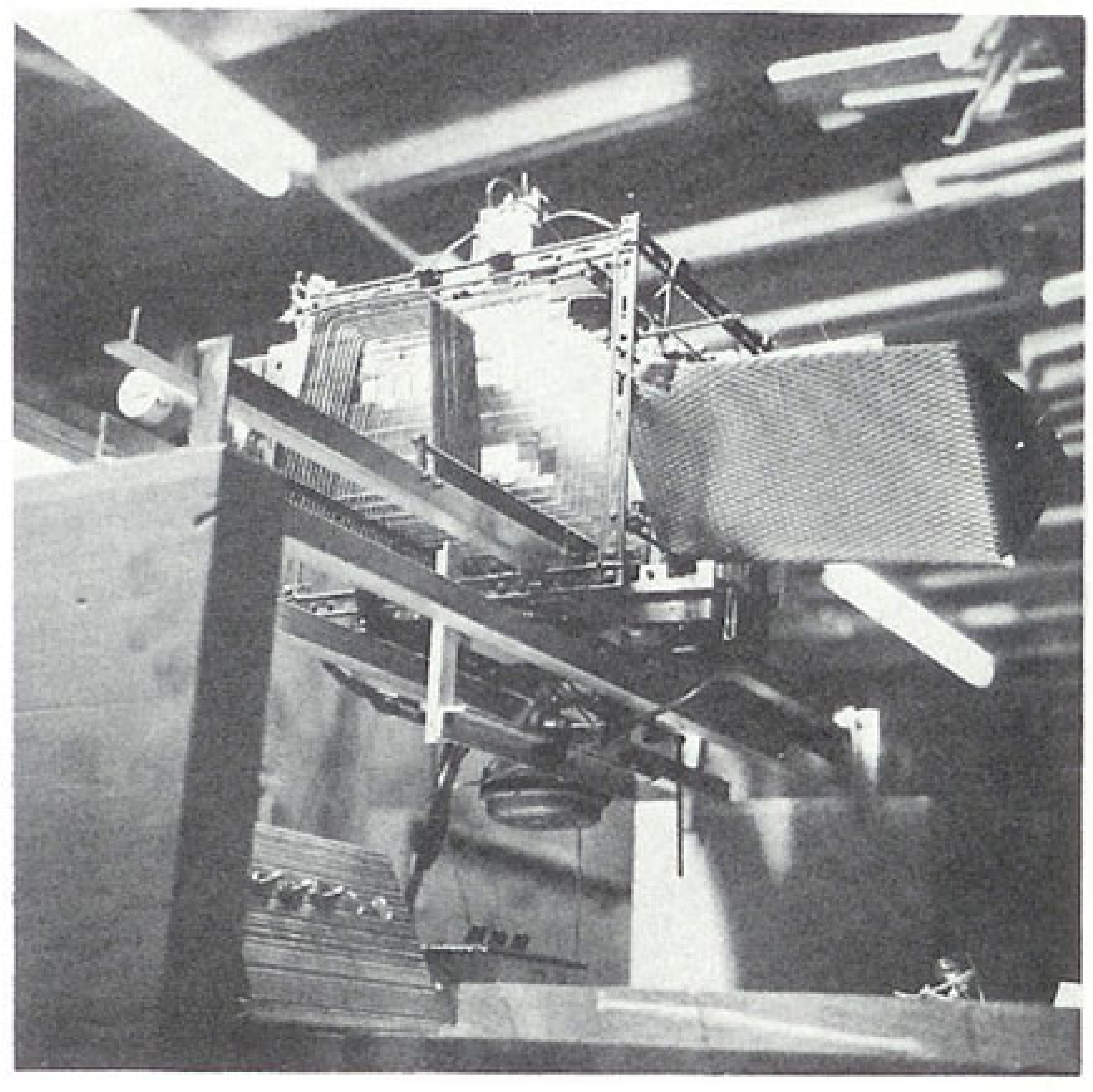
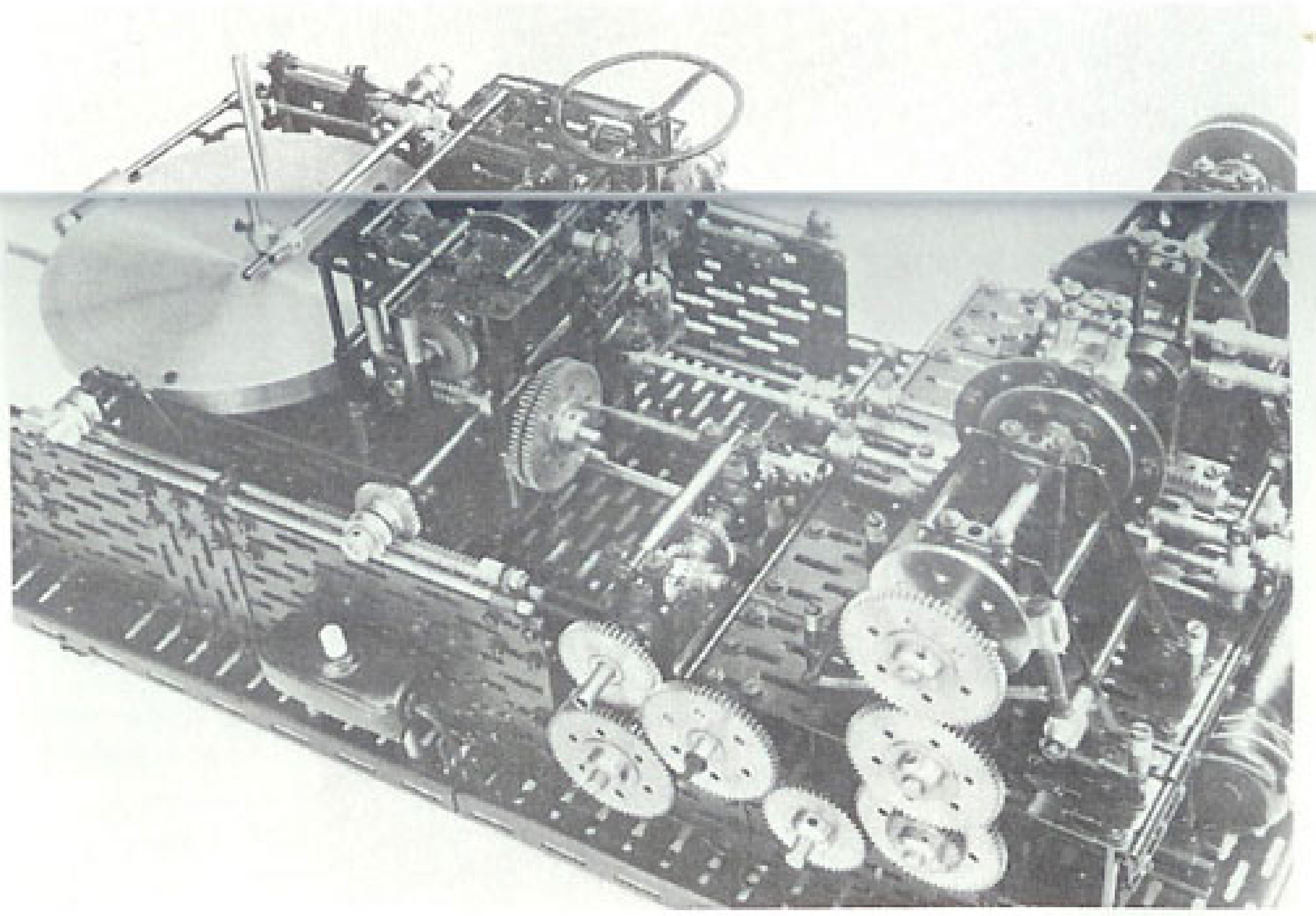


Fig. 2 – Seventh And Final Full-Sized Model Assembled With Standard FAC Kit Parts. Next Step – Design Engineering

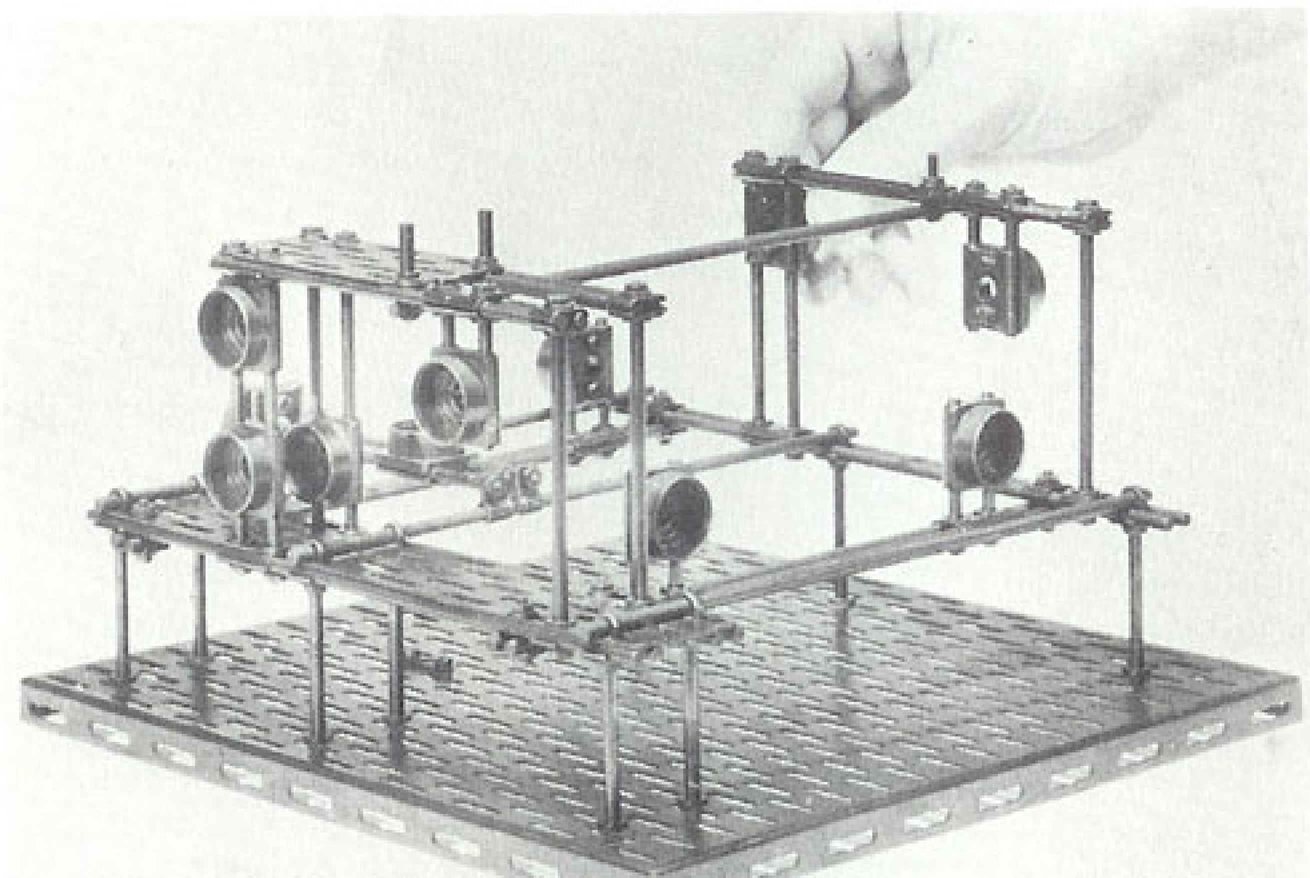
FAC The 3-D Engi[redacted]

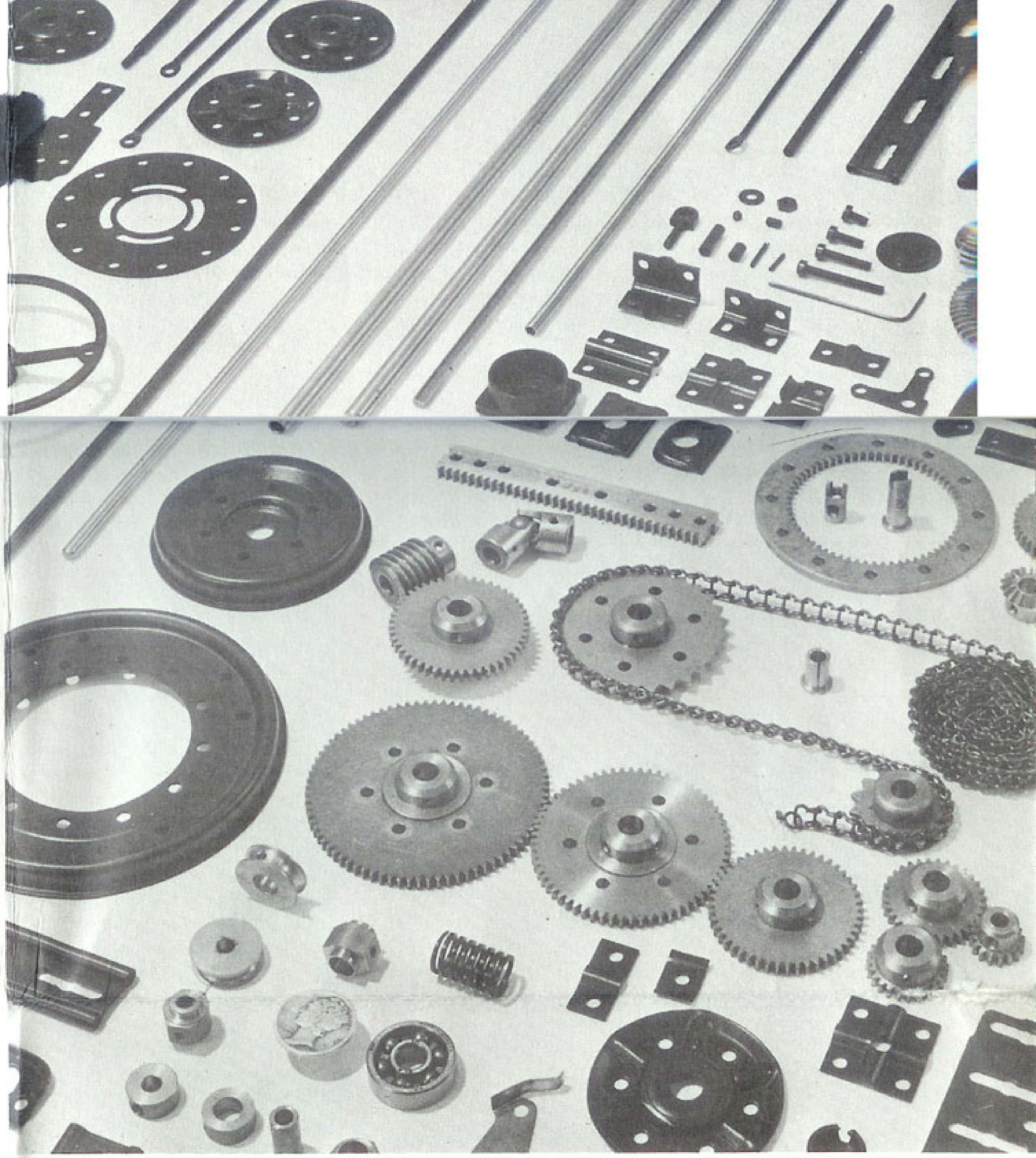
Builds precision, working models of an infinite number of mechanisms and machines. Its uses in research, exploration, invention, and education are limited only by the imagination of the individual.



FAC The 3-D Engineering Kit

Construction parts are all designed to a module--a common dimensional denominator--enabling interchangeability and versatility of construction. Structural elements are erected from rods and slotted plates, joined together with simple clamps. Frameworks to contain mechanical and moving elements can be assembled quickly in any desired configuration.





Contains 150 different precision Swedish-made machine elements, 4,700 different pieces*. FAC has been used to make working models of automotive chassis, cranes, sawmills, railroad equipment, printing presses, paper machines, automatic welders, materials handling equipment, conveyors, gear trains and intricate motion generators--in fact, hundreds of devices and machines.

*FAC X2 Kit

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CREATIVE ARTS REQUIRE CREATIVE TOOLS

Other kinds of creative people have particular kinds of tools and couldn't begin to practice their trade unless well equipped. An artist needs paper, ink, paint, charcoal, brushes and a host of other things before he attempts to translate his ideas into reality. A writer needs at the very least, paper and pencil and possibly a Thesaurus. Even a creative mathematician needs paper and pencil. The creative engineer is not much different, especially if he's attempting to turn three dimensional concepts into three dimensional "hardware". But still, he needs objects and things, which when all assembled are sometimes called a breadboard.

Over the years, there have been numerous breadboard gadgets available to obtain the necessary three dimensional effect required. Sets of servos are available, as are gear trains, universal plug devices, and a host of electronic and chemical gadgetry. As the various sciences and disciplines cross over into each other's domian, we find physicists designing equipment for chemists to use, chemists creating for the electronics people, and mechanical engineers designing for the biologist -- and vice versa. As a result, the breadboards have become quite weird and perhaps unnecessarily complicated. Despite this, it is not at all unusual to find parts of children's toys built into the most complex of the new world gadgets. Perhaps this is because toys are common to the experience of biologist, chemist, and engineer alike. In Europe, it is not uncommon to see the British Mecanno set in use, while in the United States, the Erector set is sometimes employed to bridge the mechanical gaps. The only trouble with children's toys is that they were designed to be used by children and not to meet the needs of the grownup technical mind. The components often are too flimsy, take only a passing fling at a useful module, and often are missing the mechanical equivalents of real engineering devices.

A SOPHISTICATED DESIGN CONSTRUCTION KIT

All of this was true until a few, short years ago when a very sophisticated design construction kit appeared on the market. It was designed in Sweden and has since enjoyed wide distribution in Europe and, more recently, the United States. This construction kit is sold under the trade name of FAC* and contains extremely well thought-out components to serve in almost every design development situation. In addition, when completed, the finished model actually looks like the real thing and often convinces non-technical management men that the engineers really know what they are doing. Since this kit was developed by an Engineer for Engineers, it contains sensible modules, versatile bushing and bearing arrangements, a rod and clamp scheme which provides rigid structures and a host of precision-cut gears, worms, and shafts. Many users, including the author, now rely on using this Swedish engineering "smorgasbord" of components for the lion's share of their early developmental work. Most of the parts are so inexpensive and easily available that one soon learns to have no qualms about butchering parts to adapt to the few American made components required in a device.

WORKING MODEL REQUIRED TO PROVE CONCEPT

Perhaps an example of use would prove illuminating. The author, in pursuing a consultant's assignment in the field of Information Retrieval (akin to data processing) was called upon to develop "hardware" to supplement a bid involving substantial amounts of money. The problem was to develop a device that could search large quantities of technical data and retrieve material at very high speeds. It was desirable to incorporate features permitting easy print-in, print and read-out and with existing commercial equipment. Also, it was desirable to keep the design simple and steer away from esoteric concepts such as have appeared in the commercial and industrial world over the past ten years. Several devices and concepts have been available but all have cost several million dollars and were so specialized that only large governmental agencies could profitably and intelligently make use of them. To fulfill this ambitious requirement, a design concept was developed, and it soon became obvious that a working model would be required to illustrate the concept -- to say nothing of solving some of the more mundane and practical problems.

Ordinarily, by proceeding through the conventional model shop route, a first crude model would have taken at least 60 days to complete and approximately \$1,500 of "hardware." Actually, only 8 days and an investment of only \$400 was required in using the previously mentioned design kit. As is the case in most development work, one idea leads to a better one and it became obvious that performance could be improved by building several more models to cover several approaches. If this had been a project involving conventional workmanship, there would be reason to be hesitant because of the potentially large "hardware" investment -- and especially since some of the first crude assemblies had now been outdated (outmoded). However, because of the Erector-like quality of the construction kit used, it was possible to tear down the first model in less than four hours, let unskilled help sort the parts, and then proceed with the second model.

STANDARD KIT COMPONENTS ASSEMBLE INTO COMPLETED PARTS

Over the next four months, the author built seven distinctly different working models, each an improvement over the previous one at a total capital investment of not over \$2,000. With the completion of the final model, practically all of the parts could still be used for still another project or model, if desired. At this point, it became obvious that feasibility had been clearly established and the way was clear to proceed directly to design engineering. Looking back over the model phases of this project, it is easy to see where conventional model techniques would have taken at least 12 months' time and not less than \$7,500 for "hardware" plus designing costs. Probably the biggest economy was a result of assembling standard kit components into completed parts -- instead of buying new or hacking parts out of raw metal.

The seventh working model illustrated in the accompanying photograph represents a new and ultra-simple approach to the problems of Information Retrieval. From patent searches it was obvious that individual elements might not necessarily be new, but many of the combinations and method of interrelating the working components appeared to be so. As will be noted in the accompanying photograph, transparent carrier cards contain either positive or negative 16mm micro images and are stored randomly in a fixed rack. Each card is coded across the top electrically so that each card carries its own unique identification. A scanning head traverses the cards, rippling them as it passes, and sensing the coded intelligence on the top edges of the cards. If a sensed card matches the operator's request, a ram strikes the card sharply, thus moving it slightly to engage it between rapidly rotating rollers, which in turn snatches the card out of the rack and deposits it into an accompanying collector basket. Photograph, Figure 1, shows a carrier card being extracted on the fly. The exposure time of the carrier card to the electrical search is sufficiently long enough to permit more than one interrogation to take place. Thus, it is possible to feed numerous code requests into the scanning head and each carrier card tested for all requests. If any of the requests are present, the card is removed. Cards are replaced randomly by a mechanism not shown in the photograph.

WORKING MODEL SORTS 25,000 CARDS PER MINUTE

This working model of a full sized Information Retrieval device traverses the storage rack at the rate of 6 inches per second. Six carrier cards are stored in each inch of the storage rack, thus making it possible to traverse or search at the rate of 36 cards per second. However, since the present model interrogates each card with 12 different requests, the true search speed is 12 x 36 or 432 cards per second. This is a speed of over 25,000 cards per minute which compares favorably with electronic data processing sorters operating at top speeds of 2,000 per minute. Commercially available sorters usually operate on the basis of sorting a batch of cards in several sequences so that the originally rated speed of 2,000 per minute is many times less. However, in the device described in this article, all search and extraction is performed on a once-through basis -- with all coding parameters being tested simultaneously.

The model described here, utilizing its engineered Swedish FAC components, will now yield to a precision device which traverses at even higher speeds, will store perhaps 20 cards to the inch, and utilize an even higher number of interrogations. Search speeds as high as 100,000 cards per minute can easily be reached utilizing conventional switching devices, moderately precision mechanical components and other elements, all well within the present state of the art.

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* Marketed in the United States by:
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