trates on removing the work from the machine, transferring it to another and prepares to repeat the operation.

In a typical sequential operation, in certain processes we require two duplicate lines probably being fed by a single system.

A work unit is located upon the automation. It may have been indexed from a previous machine tool such as Machine Tool "A." The weight or contact of the work unit on the switch located in the automation sets up the electrical impulse to the electrical panel, the nerve center or brain. The information is then resolved into a mechanical action through valves and cylinders to transfer a shuttle bar or actuate an arm to accomplish one operation such as moving our work unit from Automation A1 to the Automation Intersection A2 to Automation A3.

If, as in our example, we have a second machine tool such as "B" which feeds work units into the same automation as Machine Tool "A" such as Automation Intersection B2, we get a better insight to the workings of automated processes. For example, if we have a work unit on Automation A3 and a work unit on Automation B1, both should move into Automation Intersection B2, but obviously not at the same time.

The depressing of the switch in one of these sections by the weight or contact of the work unit would relay the impulse to the panel which would then actuate a shuttle bar transferring the work unit into B2. The weight of the work units depressing switches in *both* sections at the same time indicates there are work units in both critical positions.

Therefore, the panel, receiving warnings from both lookouts would select a preferential index, establishing which transfer device is to operate first. B1 would be given preference, the work unit would slide into Automation Intersection B2, the work unit in Automation A3 would be delayed to subsequently be moved when B2 was emptied.

Thereafter, until different impulses would be received, the two sections, Automation B1 and A3 would feed alternately.

If and when the switch in either section was not depressed, the preference would be given to the other on a steady feed basis. The panel or brain retains information given it, for an indefinite period of time or until such time as an additional impulse is received to rearrange the sequence of operations to accommodate the new physical arrangements indicated by the impulse as now existing.

These panels are electrically interlocked with others in the machine tool performing an operation upon the work piece. Occasionally there is an additional operation to be performed such as turning the piece end for end, rotate it, or upside down. In this case, Shuttle or Automation A1 receives a work unit from Machine Tool "A," and through the panel and solenoid valves and cylinder-shuttles the work unit into Automation Intersection A2. This data is conveyed to the electrical panel of the automation section. The panel actuates the valves and cylinders to return the Shuttle A1 to its home position.

It also determines that the Shuttle or Automation A3 is in its home position and clear.

It also determines that the work unit is in proper position at Automation Intersection A2.

After all this information is disseminated in the control panel, the impulse is sent to the solenoid valves and from there to the cylinder that will perform the turning operation. From there the data is again returned to the panel and another cycle begins.

I'd like to outline some of the safety aspects of automation experienced by Ford safety engineers.

In order to fairly evaluate the effect that automation is having on the safety of our employees, I believe it is important that we consider what it accomplishes in the elimination of the well-known accident causes which are found in the non-automated type of operation. With regard to the latter, particular reference is made to single operation machines where there is a need for manual handling of heavy stock in the loading, positioning and unloading of the machine and the transfer of stock from one operation to another.

As safety men, we are all quite aware of the fact that stock handling, especially that which is heavy by nature, is an important contributor to industrial injuries. It is well-known that a very high percentage of serious foot injuries are the result of heavy stock falling from a transfer truck. It is further a fact that the handling of stock is almost the exclusive cause of industrial hernias and injuries to the back.

Now, let us see what automation has done to eliminate or minimize these accident causes. You will recall that, in many instances, after the initial loading of the stock into a series of in-line machines, a multiplicity of operations are performed without the need for any manual stock handling whatsoever. By comparison with former methods of single operation machines, it is obvious that the hazards associated with manual handling of stock into and out of a machine and transferring it to the next operation is almost entirely eliminated. By the same reasoning the hernias and back injuries directly related to heavy lifting are greatly minimized, if not entirely eliminated.

Our experience indicates an 85.5 per cent reduction in the number of hernias in similar operations with the advent of automation. We truly believe that automation has taken the back break, and the "foot break" for that matter, out of engine manufacturing. We are most thankful for this, for not only have we been able to reduce our accident rate and the related costs, but far more importantly every day we are sending our employees, safe and sound, home to their families.

Although I am not a safety engineer, I am quite aware of the fact that every safety man dreams of the perfect mechanical operation where, in the performance of his job, the employee need not at any time expose himself to the working parts of a machine. It is a well-known fact that most of the serious injuries to hands and fingers are the result of the operator exposing himself to the closing or working parts of a machine in the process of loading or unloading it. It is recognized that this problem has been solved to a degree in the single operation method by the application of indexing fixtures, sliding dies and the use of tongs. However, at its best you are faced with the problem of enforcing the use of these provided devices. While automation has not completely solved this important problem, it is a real step in the right direction since it completely eliminates the need for repetitive exposure to the point of operation.

We recognize, however, that because of the relationship of one automated operation to another, it is highly important that a breakdown or machine failure be quickly corrected. This condition could result in the repairman inadvertently exposing himself to working parts of the equipment. However, we have been able to solve this problem with a high degree of success by invoking our safety policy of long standing which provides that before working on a piece of moving machinery the repairman must completely de-energize the equipment by placing his personally issued padlock on the power source. So, with regard to hand and fingers injuries, we see in automation the possibility of almost complete elimination of this problem.

I am sure you are wondering what happens when a piece of stock gets out of position in its travel through a given sequence of operations. To avoid the need for the operator reaching into the equipment to reposition the stock, "push" or positioning sticks are provided at convenient locations for this purpose.

The very nature of automation dictates the generous use of stiles or cross-overs for the convenience and safety of employees in traveling from one location to another. These stiles are strategically located throughout the plant. They are not only important in terms of normal travel but serve an important purpose in the emergency evacuation of the plant.

Our engineers and safety personnel are constantly alert to the improvement of the design of our machines as it relates to the safety of employees. Their thinking has been passed along to our machine tool builders who have incorporated it into the design and construction of machines being built for our plants.

In many instances, the representatives of these companies came to our plants and consulted with our engineers and safety personnel and, in other instances, our representatives visited the machine tool builder's plant and advised him of our needs and requirements with regard to mechanical safety.

The net result of this relationship has been a thorough understanding on the part of our machine tool builders of our program to engineer the mechanical hazards out of the job. While we recognize that there will, undoubtedly, be a continuing need for the guarding of mechanical hazards, we firmly believe that great progress is being