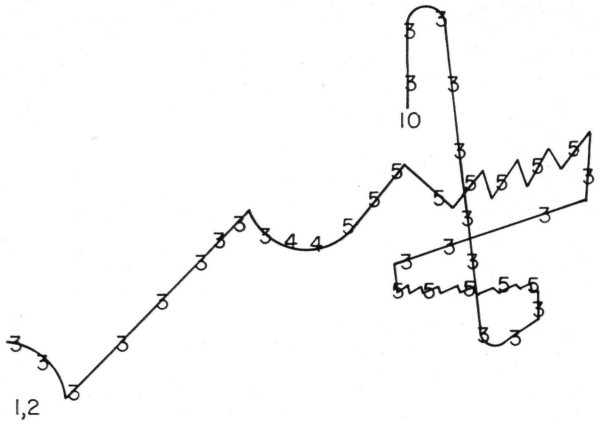

Fig. 1 Line procegram traces travel of a particle of wheat in a grain combine. Numbers are used to code the function for the print page. One or more dimensions may be shown

The Procegram

A procegram, a flow-process diagram in wire based on functional analysis, is used by a machine designer to visualize the process performed by a complex machine

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A PROCEGRAM is a three-dimensional, color-coded, flow-process diagram rendered in wire. The procegram is based on functional analysis and provides a simple method for visualizing the process performed by a complex machine.

The job of a machine designer is to 1) break a process into basic functions, and 2) select a set of machines capable of performing the functions and integrate these machines into a fieldworthy salable complex machine.

The procegram is made by bending wire to represent the path of material in a machine and color coded by painting to represent the functions performed along the path as shown in Table 1. This table is not considered a complete list of functions; the practicing engineer will modify the list to fit his situation. A two-dimension number coded procegram of a grain combine is shown in Fig. 1.

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To become proficient in the use of the procegram, the engineer should construct one of a conventional machine using information in Table 1. He should sketch a procegram to secure the proper relation of parts before bending the wire. After the wire faithfully represents the path, the wire is mounted on a base board and painted according to the color code. The board should be painted to represent the surface conditions and the direction of travel noted with an arrow.

Observations concerning the construction of the procegram of a complex machine were noted as follows:

1 A color normally indicates a single machine, however, two or more machines may be involved.

2 The junction of two colors indicates the end of influence of one machine and the beginning of another machine.

3 Unprotected storage may require only ground area while protected storage requires a bin or structure.

4 Transport of the material within a complex machine requires the use of many individual machines and in extreme cases may actually be the major

TABLE 1. THE NAME, COLOR CODE, DESCRIPTION OF FUNCTION AND MACHINE USED TO PERFORM THE FUNCTION.

Name of Function	Color Code	Description of Function	Machine Used to Perform Function
1. Orient	Green	Placing material in a particular position for subsequent operations.	Guards, gathering points, reel.
2. Mobilize	Blue	Make the material mobile or cut loose from the ground.	Mower knives, plow point, disk blade, rotary knife.
3. Transport	Yellow	Physical movement of the material.	Sugars, blowers, flight conveyors, gravity.
4. Thresh	Red	Break bond between dissimilar materials.	Threshing cylinders, snapping rolls, husking beds, cotton picker spindle.
5. Separate	Black	Dividing material into dissimilar units.	Straw rack, cleaning shoe, rock picker, potato picker, beet harvester.
6. Reduce	Purple	Divide beyond recognized basic units.	Hammer mill, burr mill, rolling mill, crushers.
7. Quantity	Orange	Group material into recognized units.	Baler, sacker, pelleter.
8. Meter	Gray	Distribute units at predetermined rate.	Planters, drills, fertilizer spreaders.
9. Condition	Brown	Add or remove moisture, pesticides, etc. to maintain quality.	Dryers, humidifiers, sprayers, dusters.
10. Store	White	Collect units — involves time. Retain in definite position.	Grain tank, wagons, water tanks, fertilizer hoppers, barns, bins.
11. Classify	Pink	Divide similar recognized units into groups.	Seed graders.

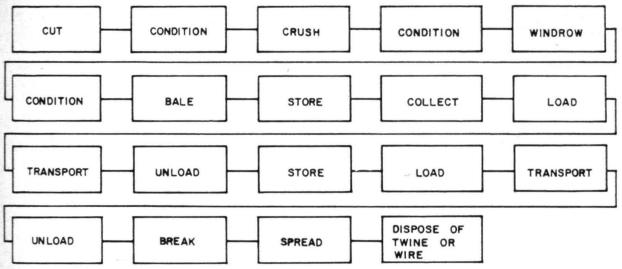

Fig. 2 Flow-process diagram for the hay harvesting, storage, and feeding operation, using a baler

portion of the procegram. [It is amazing how much yellow (transportation) paint is used on a procegram.] It should be noted that not all functions require a machine and that the velocity of the material can be represented by white time marks. The linear scale is adjusted so that distance between marks is related to the distance the particle travels in a given time, i.e., one tenth of a second. Thus the greater the distance between marks, the faster the material is traveling.

An Example of the Analysis of an Operation

If the simple end result of hay harvesting, storage, and feeding is to feed the forage to animals at another time and place in a form and at a rate which can be most effectively used, one might ask, "How effectively does the baling process fit into the hay harvesting, storage and feeding operation?"

The hay harvesting, storage and feeding operation can be studied by the use of a procegram. A conventional

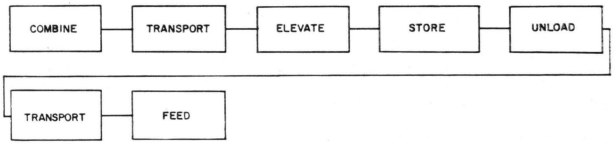

Fig. 3 Flow-process diagram for the hay harvesting, storage, and feeding operation, using a forage combine

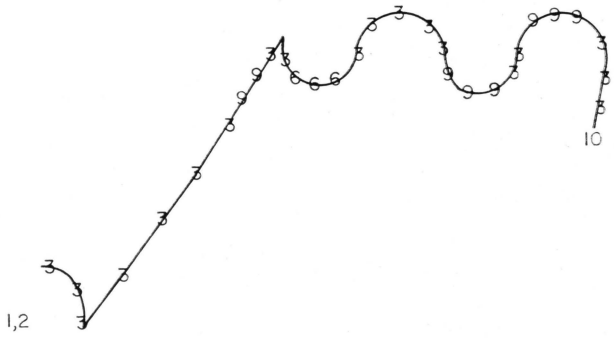

Fig. 4 A line procegram of a forage combine

flow-process diagram Fig. 2 is drawn to represent the series of processes. A procegram for the whole operation can be made by making individual procegrams of each process and then placing them in line on a board.

With the procegrams strung along the board, the engineer is in the position to eliminate duplication, combine machines and modify the operation to require less machinery.

The flow-process diagram for forage harvesting, storage and feeding with a forage combine is shown in Fig. 3 and consists of seven processes. The two-dimensional procegram of the forage combine is shown in Fig. 4. • •

. . . Foam-Insulated Sandwich Panel

(Continued from page 22)

control of the proportioning of resin to glass to insure a more uniform distribution of the physical properties throughout the laminate.

2 Molds using fiberglass reinforced resin can be cast directly from the patterns, and will give excellent service with normal precautions in preparation and use. For good appearance of finished castings, all edges should have a minimum radius of ¼ in. and in all corners a minimum radius of ½ in.

3 The foam-in-place technique for the sandwich core was an excellent method of providing a uniform thickness and density of material throughout the plastic arch. However, careful calculations of volumes and rate of pour are necessary to guarantee a uniform foam density.

4 Laminated wood construction proved to be a good method of building up contour shapes. However, considerable difficulty was encountered in carving the curved sections, because the wood grains in adjacent laminates were not always parallel. Precutting the wood laminates to the required contour not only reduced the amount of rough shaping, but also provided guide references to maintain accurate outlines. Templates for specific stations were a final check to assure matching contours for the male and female molds.

5 It would appear desirable to alternate a layer of cloth with a layer of mat to obtain the maximum advantage of combined materials. This procedure would also facilitate fabrication, since an open weave cloth could be used over the mat and "squeeze out" pressure applied to the cloth layer without danger of displacing the short random fibers of the mat. • •

National Engineers' Week

FEBRUARY 21 to 27 has been designated National Engineers' Week by the National Society of Professional Engineers, sponsor of the event each year in cooperation with many other engineering and industrial groups. National Engineers' Week is held each year during the week of Washington's birthday. The observance features career conferences for schools, exhibits on engineering achievements, guided tours through industrial plants, talks by engineers before student and civic groups, and many other activities calling attention to the importance of a sound educational background in mathematics and the physical sciences.

The theme for the 1965 Week is "Engineering . . . For Human Needs." This theme was chosen to emphasize for high school students how engineers put the physical sciences to work to solve human problems and to satisfy human needs.