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East Europe Report

SCIENTIFIC AFFAIRS

(FOUO 3/80)

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CZECHOSLOVAKIA

ENGINE ASSEMBLY LINE AUTOMATED PARTS STORAGE EXPLAINED

Prague STROJIRENSKA VYROBA in Czech Nov 79 pp 835-850

[Article by Rudolf Kubasta, Kovoprojekta in Brno: "Automated In-Process Parts Storage for Engine Assembly Lines"]

[Text] Over a very short period of time, along with the rapid technological development, new means of production and handling have entered the plans of engineering production. They not only fulfill their basic function, but can take over the tasks of their programming and technical preparation, if they receive, within a specific time, certain basic information that is either independent or derived from the technological process or from the material flow in the process of production.

Thus, the multiplicity of means and information during the process of production create demands for an accurate and controlled flow of information, which may be best achieved only with specifically selected means of production and handling and of technical equipment for data processing and recording and a specific linkage of their deployment.

Technology is the starting point, but at the same time, it must adapt, within the available limits, to the needs of the organization of material aspects in the process of production, and of the control system linked with it. All three of these factors are interrelated and their harmony predetermines the efficiency of the system.

The plan prepared for the in-process storage of engine assembly lines in the Tatra national enterprise in Koprivnice serves as an example of an arrangement linking three factors to the extent required already during the early stages of planning of the engineering production program for the subsequent choice of equipment for production and handling, and of technical equipment for the data recording and processing systems.

The stage preceding the approach to the technological planning of the function of pre-assembly in-process storage (PM) in the manufacture of engines involves the following:

--Analysis of requirements for the design

--Determination of the objectives and prerequisites for the technological design

--Determination of requirements for storage, handling and transport operations

--Determination of the targets of automation and data bank in the PM

--Specification and analysis of the limiting factors

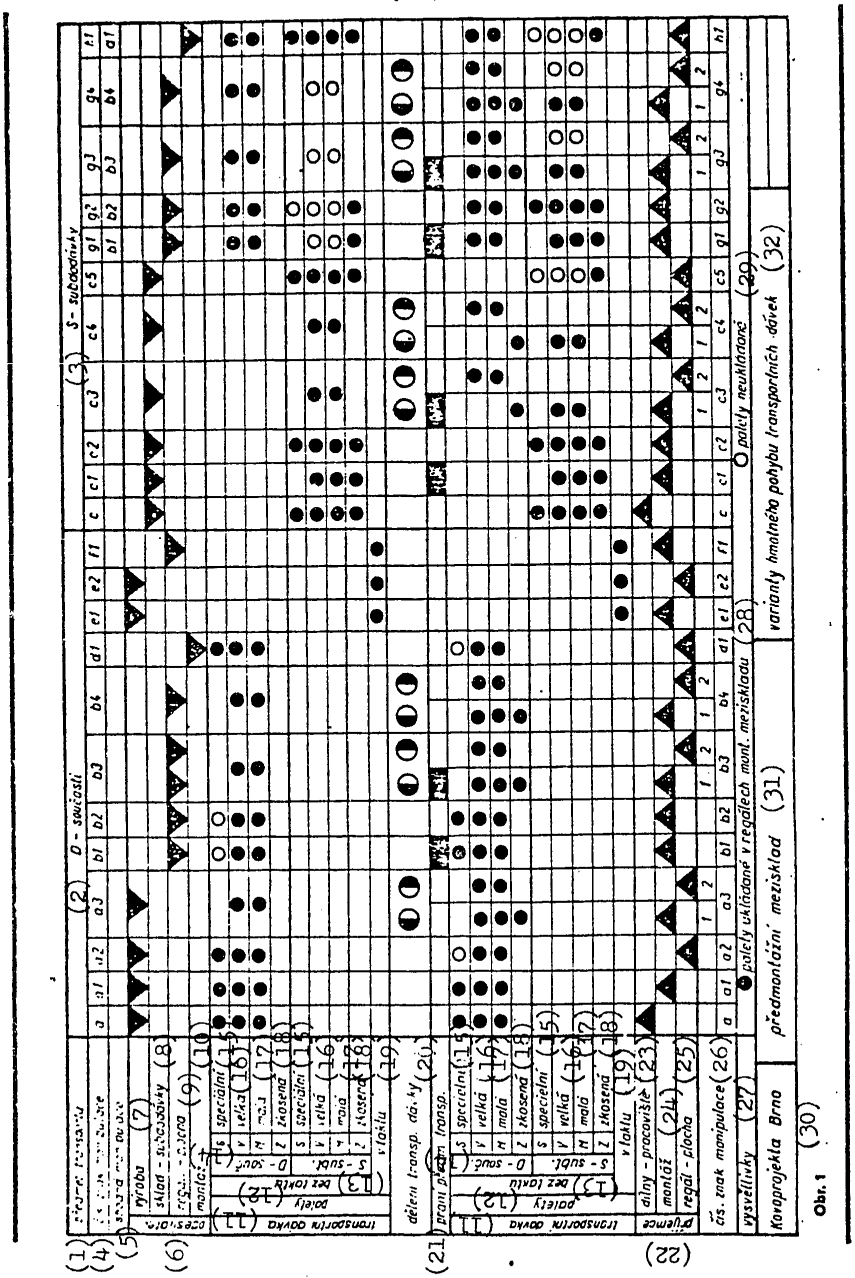
--Technical-organizational concept of the design on the basis of gross capacities, calculations

--Concept of the flow of information

--Capacity calculations according to the technical-organizational concept and to the concept of the flow of information.

The initial data and the resultant values in this stage of planning are presented in the form of diagrams Figures 1 through 6.

Figure 1.

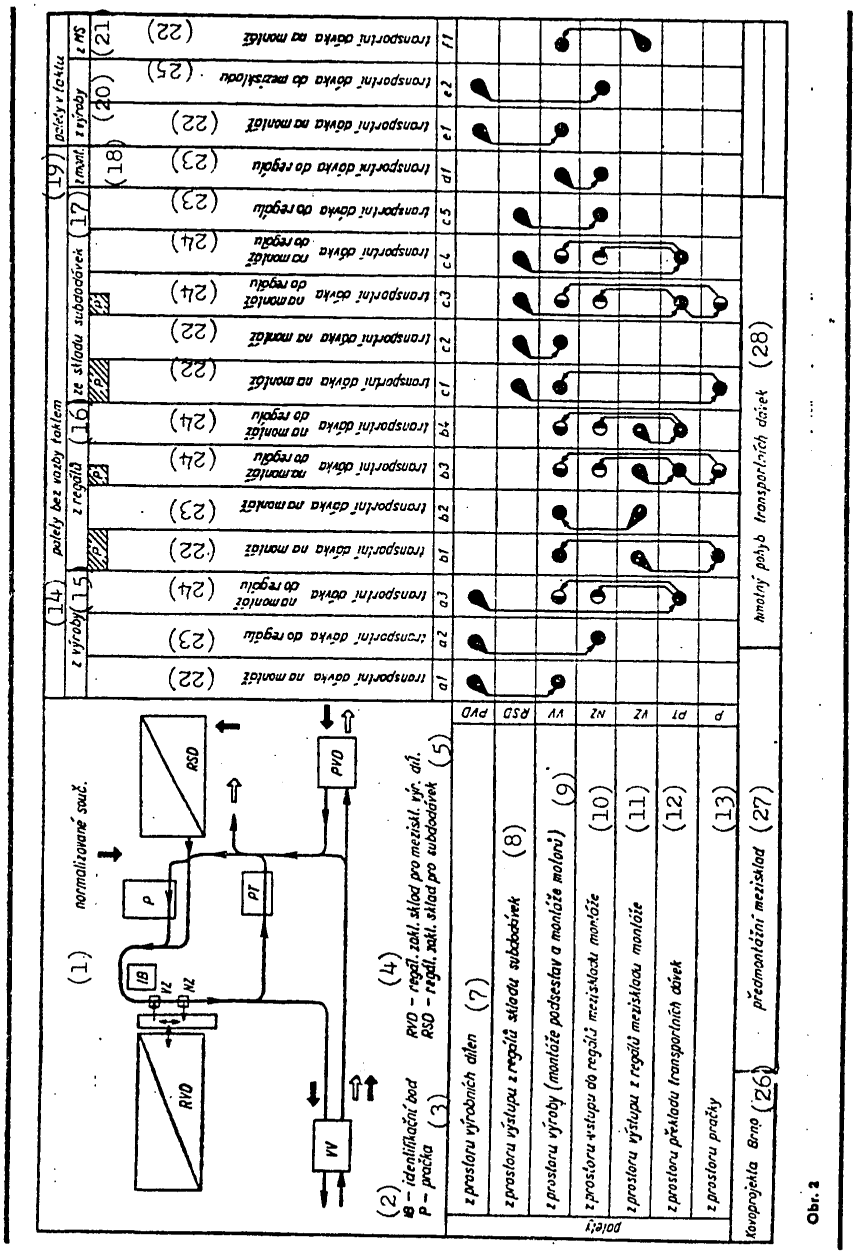


[Key on following page]

Key for figure 1:

1. Subject of transport
2. D - Parts
3. S - Subdeliveries
4. Handling code No
5. Corresponding handling
6. Sender
7. Production
8. Storage - subdeliveries
9. Rack - area
10. Assembly
11. Transport load
12. Pallets
13. Without cycle
14. [D - Parts? Total?]
    [S - subtotal? - subdeliveries? - see 2. and 3.]
15. S - special
16. V - large
17. M - small
18. Z - chamfered
19. In cycle
20. Distribution of transport load
21. Washing of the subject of transport
22. Receiver
23. Shops - location
24. Assembly line
25. Rack - area
26. Handling code No
27. Notes
28. Pallets stored in racks of the assembly in-process storage
29. Pallets not stored
30. Kovoprojekta in Brno
31. Pre-assembly in-process storage
32. Variants of the material flow of transport loads

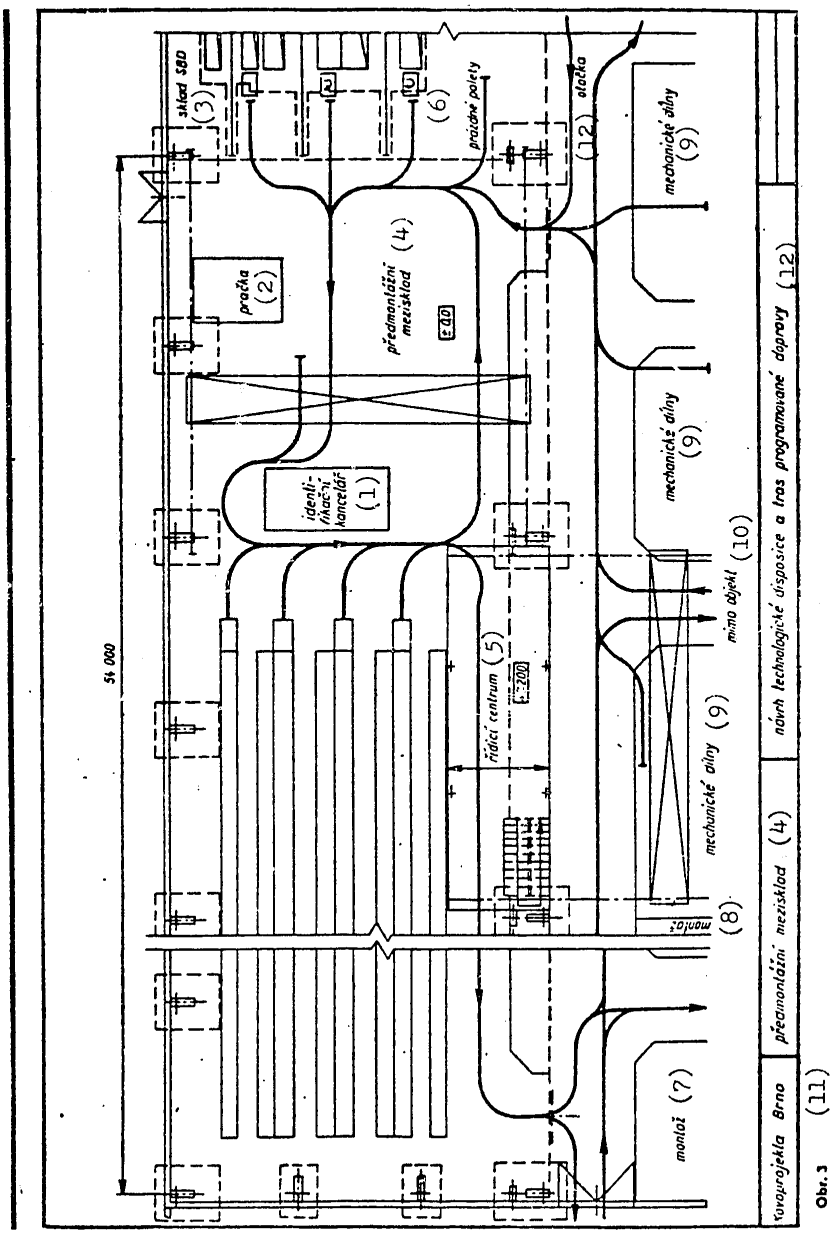
Figure 2.



[Key for Figure 2]

1. Standardized parts
2. IB - identification center
3. Washer
4. RVD - basic storage racks for in-process storage of parts of production
5. RSD - basic storage racks for subdeliveries
6. Pallets
7. From the factory shops area
8. From the exit area from racks in the storage of subdeliveries
9. From the production area (assembly lines of subsystems and engine assembly lines)
10. From the entry area in the racks of the in-process assembly storage
11. From the exit area from the racks of in-process assembly storage
12. From the area of transfer of transport loads
13. From the washer area
14. Pallets without linkage in cycle time
15. From production
16. From the racks
17. From the storage of sub-deliveries
18. From the assembly line
19. Pallets in cycle time
20. From production
21. From in-process storage
22. Transport load for the assembly line
23. Transport load in the racks
24. Transport load for the assembly line in the racks
25. Transport load in the in-process storage
26. Kovoprojekta in Brno
27. Pre-assembly in-process storage
28. Material flow of transport loads

Figure 3.

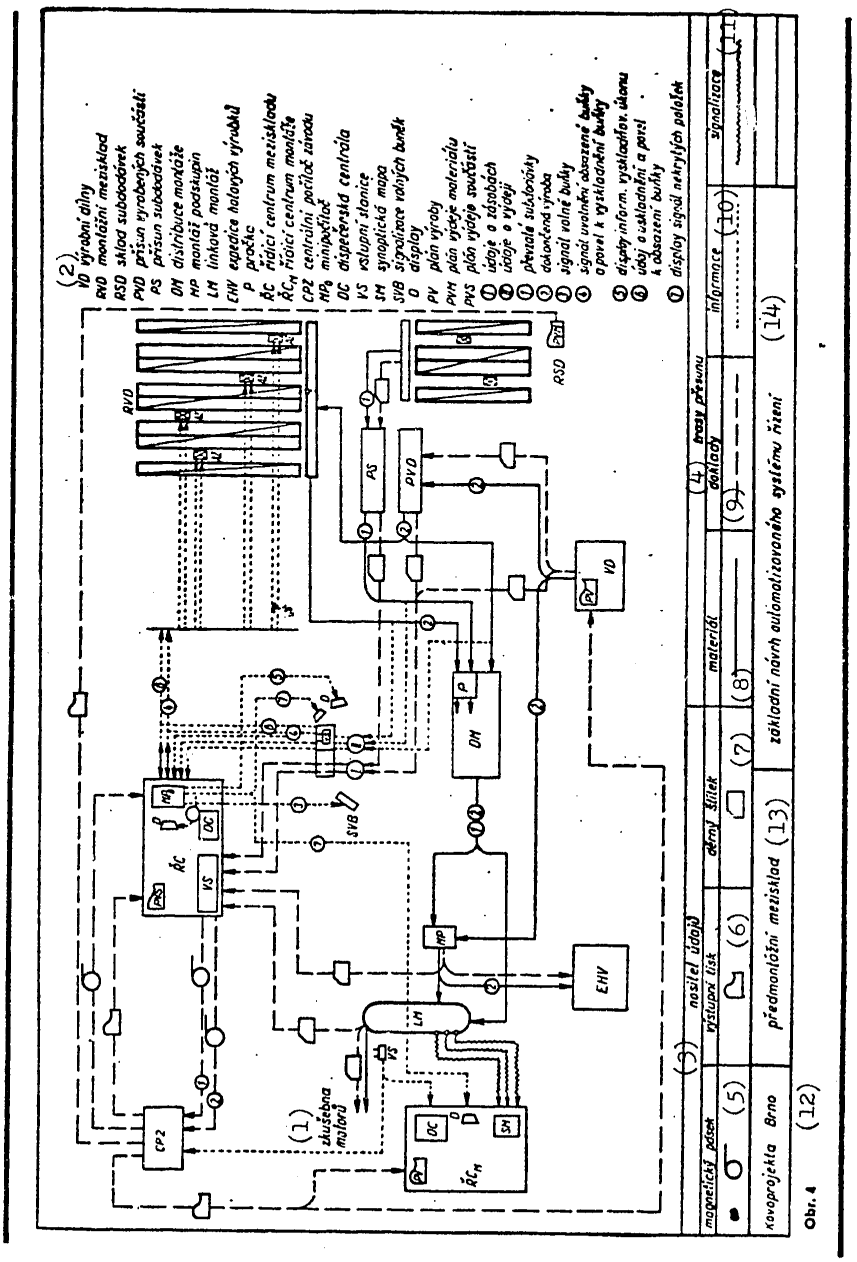


[Key on following page]

Key for figure 3:

1. Identification center
2. Washer
3. Storage of subdeliveries
4. Pre-assembly in-process storage
5. Control center
6. Empty pallets
7. Turn-around
8. Assembly line
9. Engineering shops
10. Outside premises
11. Kovoprojekta in Brno
12. Plan of the technological layout and lines of programmed transport

Figure 4.

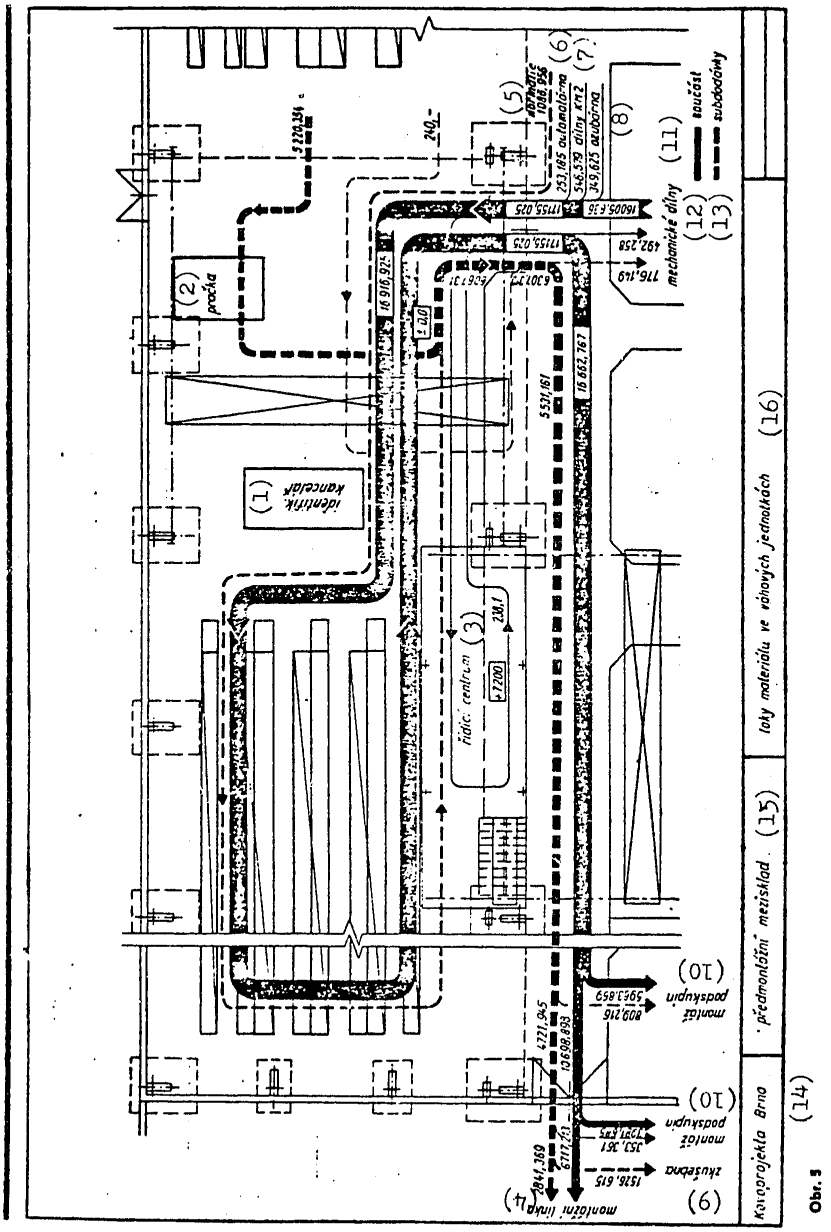


[Key on following page]

[Key for Figure 4]

1. Engine testing room
2. VD - Production shops
   - RVD - Assembly in-process storage
   - RSD - Storage for subdeliveries
   - PVD - Feeding of manufactured parts
   - PS - Feeding of subdeliveries
   - DM - Assembly line distribution
   - MP - Assembly of subdeliveries
   - LM - Line assembly
   - EHV - Shipping of finished products
   - P - Washer
   - RC - Control center of the in-process storage
   - RC_M - Control center of the assembly
   - CPZ - Central computer of the enterprise
   - MP_o - Minicomputer
   - DC - Dispatch center
   - VS - Point of entry
   - SM - Synoptic chart
   - SVB - Signaling of vacant cells
   - D - Display
   - PV - Production plan
   - PVM - Plan for distribution of material
   - PVS - Plan for distribution of parts
   - (I) - Data concerning supplies
   - (II) - Data concerning distribution
3. Data carrier
4. Transfer lines
5. Magnetic tape
6. Entry print
7. Punched card
8. Material
9. Documents
10. Information
11. Signal
12. Kovoprojekta in Brno
13. Pre-assembly in-process storage
14. Basic plan for an automated control system
   - (1) - Picked-up deliveries
   - (2) - Finished products
   - (3) - Signal of a vacant cell
   - (4) - Signal to clear an occupied cell, and command to vacate the cell
   - (5) - Display information on vacating operations
   - (6) - Information on placement in the storage, and command to occupy the cell
   - (7) - Display signal on entries not covered

Figure 5.

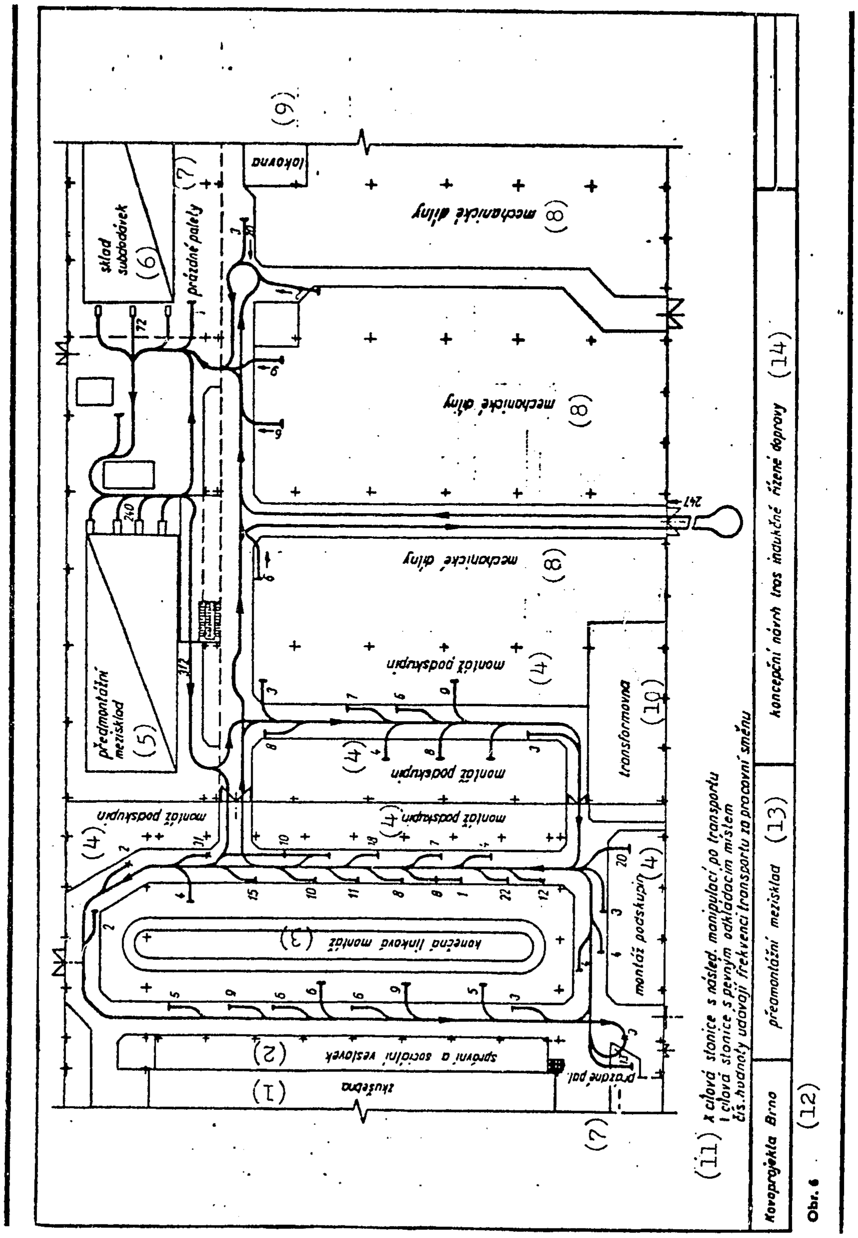


11 [Key on following page]

[Key for Figure 5]

1. Identification center
2. Washer
3. Control center
4. Assembly line
5. Standardized machine elements
6. Automobile assembly
7. KM 2 shops
8. Gear shop
9. Test room
10. Assembly of subdeliveries
11. Engineering shops
12. Parts
13. Subdeliveries
14. Kovoprojekta in Brno
15. Pre-assembly in-process storage
16. Material flow in units of weight

Figure 6.



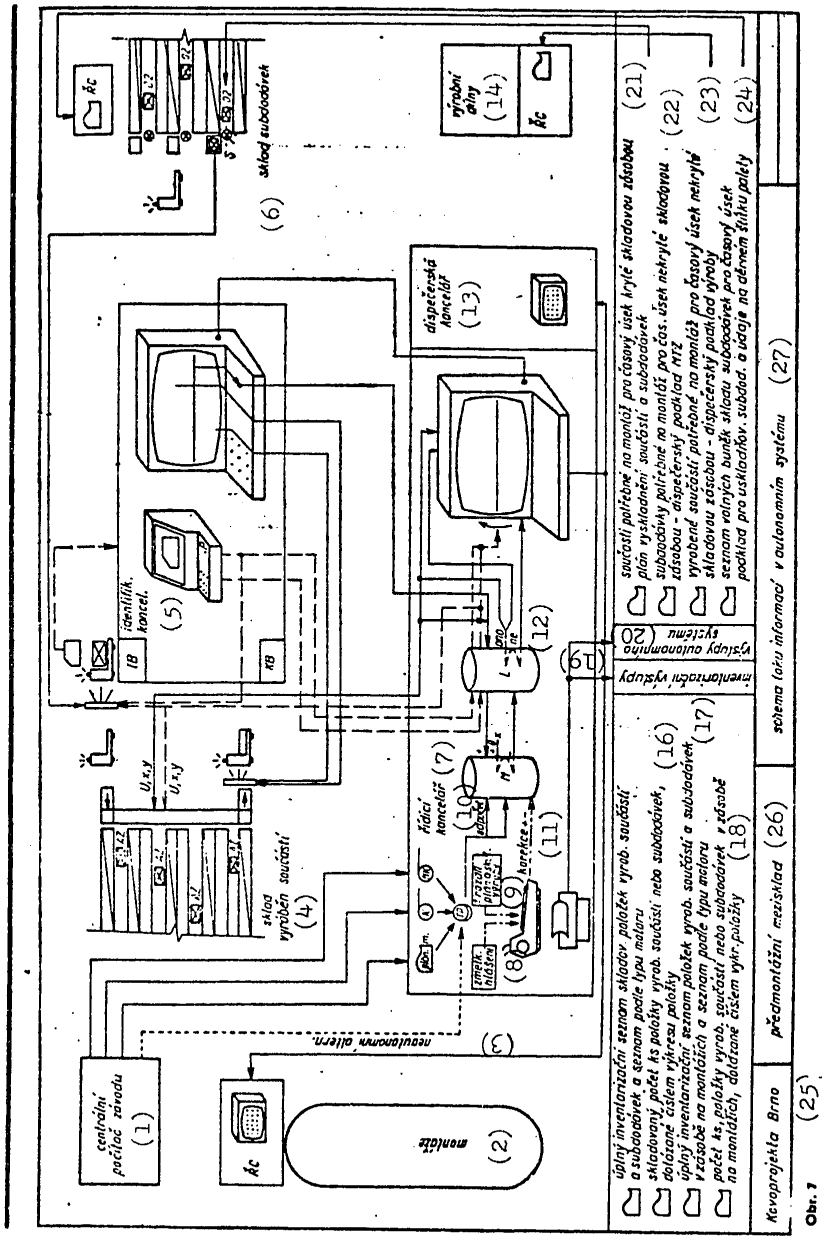
[Key on following page]

[Key for Figure 6]

1. Test room
2. Administrative and social compartment
3. Final assembly line
4. Assembly of subdeliveries
5. Pre-assembly in-process storage
6. Storage of subdeliveries
7. Empty pallets
8. Engineering shops
9. Paint shop
10. Transformer room
11. x - Terminal for post-transport operations
    1 - Terminal with firm deposit point
    Numerical values express frequency of transport per shift
12. Kovoprojekta in Brno
13. Pre-assembly in-process storage
14. Conceptual plan for lines of induction-controlled transport

The technological design of the PM function is specified in tables including drawings and diagrams (Figures 7 through 10)

Figure 7.

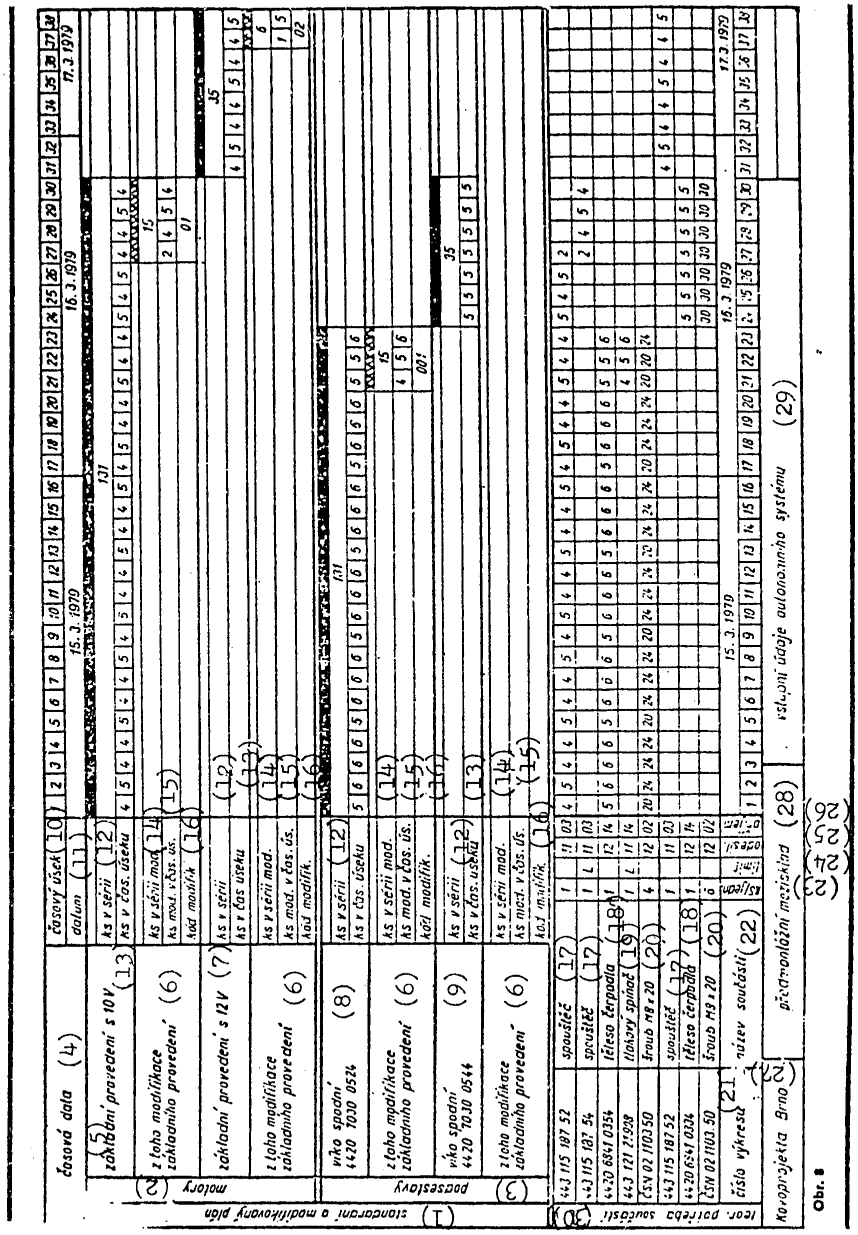


[Key on following page]

[Key for Figure 7]

1. Central computer of the enterprise
2. Assembly lines
3. Non-self-contained alternative [alternator?]
4. Storage of manufactured parts
5. Identification center
6. Storage of subdeliveries
7. Control room
8. Report of rejects
9. Difference between the planned and the actual production
10. [Deduction? Reading?]
11. Correction
12. Yes
    No
13. Dispatch room
14. Production shops
15. Complete inventory list of stored entries of manufactured parts and subdeliveries, and list according to the model of engine
16. No of entry of manufactured parts or subdeliveries stored, called by the No of the entry chart
17. Complete inventory list of entries of manufactured parts and subdeliveries in supply on assembly lines, and list according to the model of engine
18. No of pieces, entry of manufactured parts or subdeliveries in supply on assembly lines, called by the No of entry chart
19. Inventory outlets
20. Outlets of the self-contained system
21. Parts required for the assembly for a period covered by supply in the storage
    Plan for removal of parts and subdeliveries from the storage
22. Subdeliveries required for the assembly for a period not covered by supply in the storage - MTZ dispatch base
23. Manufactured parts required for the assembly for a period not covered by supply in the storage - production dispatch base
24. List of free cells in the storage of subdeliveries for one period of time
    Base for storage of subdeliveries, and data on the punched card of the pallet
25. Kovoprojekta in Brno
26. Pre-assembly in-process storage
27. Diagram of the flow of information in self-contained system

Figure 8.

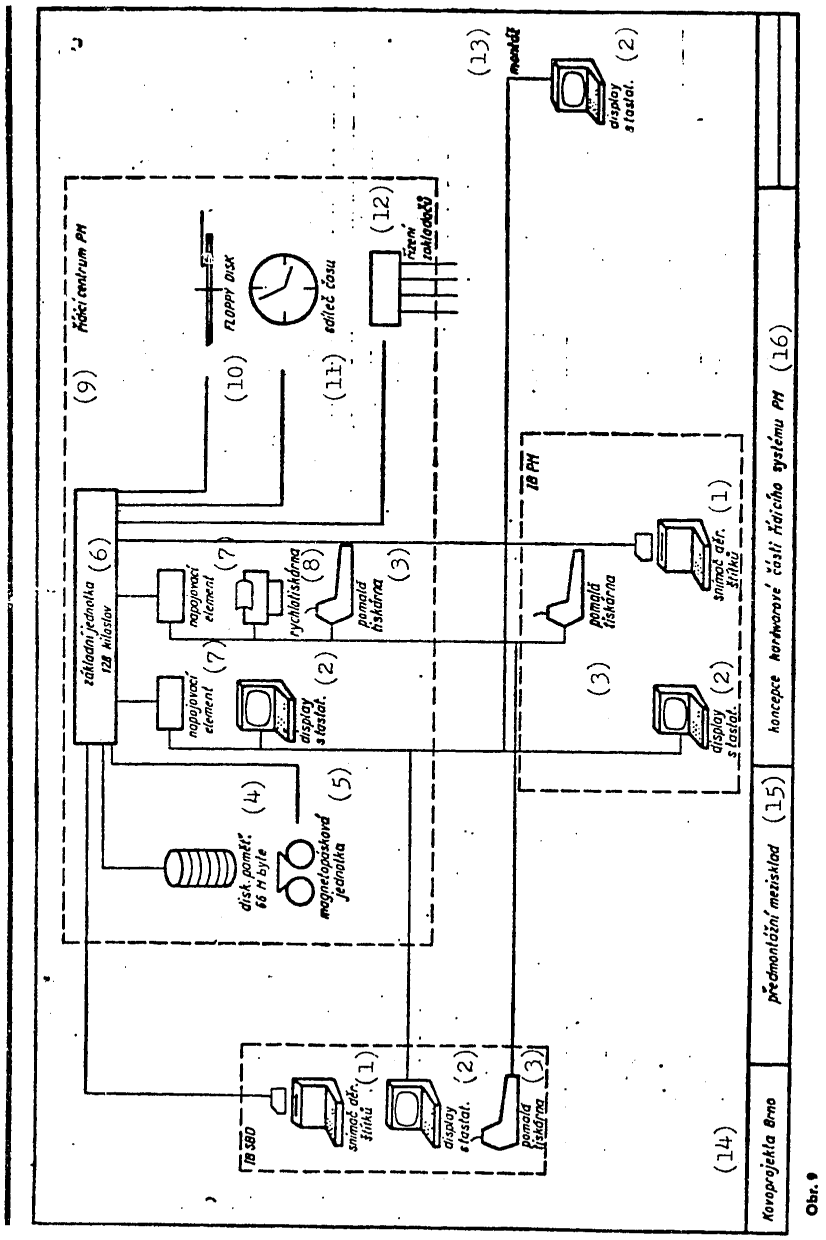


[Key on following page]

[Key for Figure 8]

1. Standard and modified plan
2. Engines
3. Subsystems
4. Time data
5. Basic 10V model
6. Of which modification of the basic model
7. Basic 12 V model
8. Bottom cover 4420 7030 0524
9. Bottom cover 4420 7030 0544
10. Time interval
11. Date
12. Units in series
13. Units in time interval
14. Units in series of modifications
15. Units of mod. in time interval
16. Modification code
17. Starter
18. Pump casing
19. Pressure switch
20. M8 x 20 screw
21. Chart No
22. Name of the part
23. Parts/unit
24. Limit
25. Sender
26. Receiver
27. Kovoprojekta, Brno
28. Pre-assembly in-process storage
29. Input data of the self-contained system
30. Theoretical requirement of parts

Figure 9.

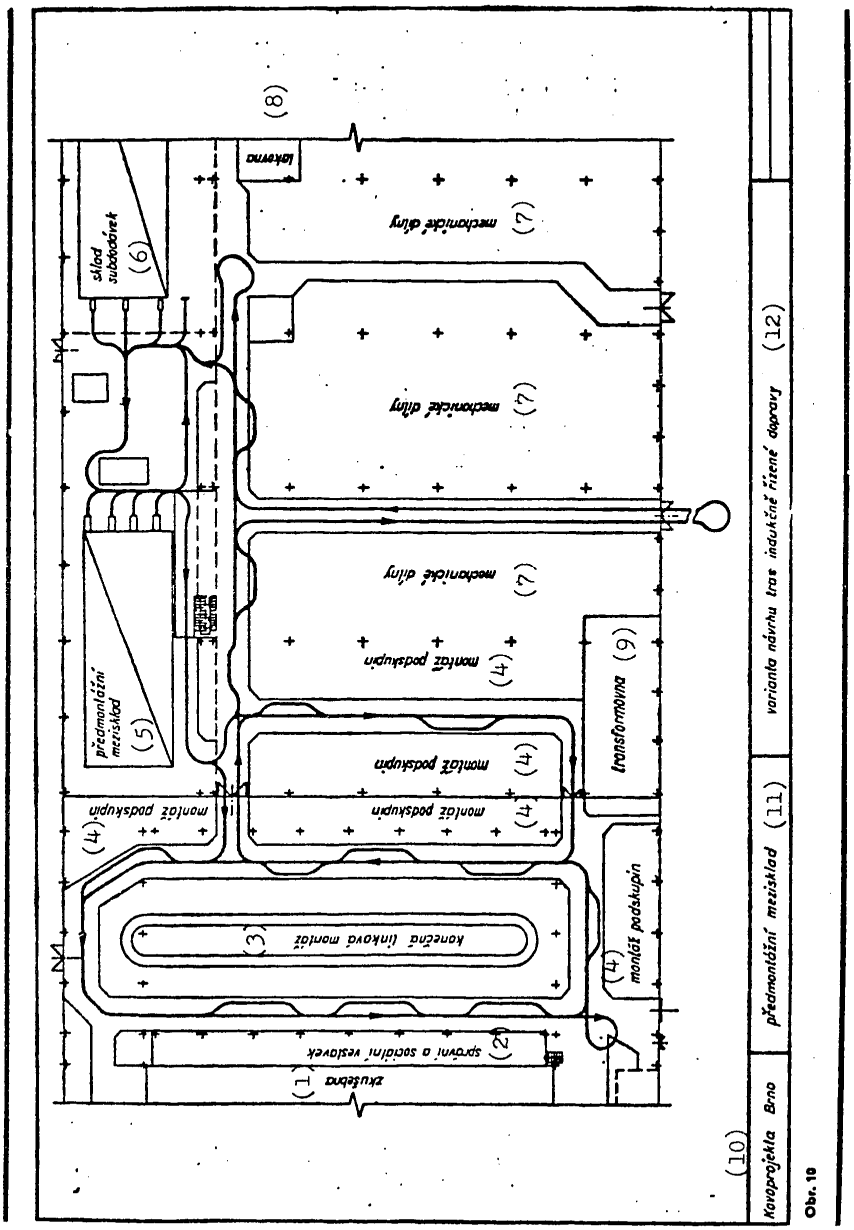


[Key on following page]

[Key for Figure 9]

1. Punched card reader
2. Display with tasterer
3. Slow printer
4. 66 M byte memory disc
5. Magnetic type unit
6. 128 kiloword basic unit
7. Feeder
8. Fast printer
9. PM control center
10. Floppy disc
11. Time sharing
12. Collator control
13. Assembly
14. Kovoprojekta in Brno
15. Pre-assembly in-process storage
16. Concept of the hardware part of the PM control system

Figure 10.



[Key on following page]

[Key for Figure 10]

1. Test room
2. Administrative and social compartment
3. Final assembly line
4. Assembly of subgroups
5. Pre-assembly in-process storage
6. Storage of subdeliveries
7. Engineering shops
8. Paint shop
9. Transformer room
10. Kovoprojekta in Brno
11. Pre-assembly in-process storage
12. Variation of line layout for induction-controlled transport

Description of the Function of the System

The function of the PM system is described for that particular stage in drafting of the plan which precedes the selection of the model of the equipment (hardware) for the system controlled in real time, its linking in an arrangement, and the development of programs and instructions (software) for that control system.

For that reason the specification has the character of an assignment for the hardware and software designers, or of an order for a bid to be submitted by the supplier of the whole system, including its introduction into operation.

Therefore, the specification does not contain potential variants of the function according to the selection of the model and arrangement of the hardware, and options for its development, particularly in the software department.

The initial data for the specification consist of the concept of the material flow, and of the conceptual resolution concerning the centers of automation, the control in real time (initial information is processed for the final resolution in the time of the material flow), and concerning the autonomy of the system (for final resolution in real time, the system processes and banks all data required for the processing of the initial information).

The function of the system is processed as the basis for the specification presented in the form of a diagram in Figure 7.

Storage of the Pallet in the System of Sub-Deliveries

The storage of sub-deliveries represents an organizational formation in the area of trade operations, where standard punched cards are produced for pallets received from suppliers or pallets transferred from outside transport as documents accompanying the pallets where records on the location of the pallet in the storage (the cell in the rack) are kept; and where transport operations are dispatched to the location of the pallet in the storage.

The only contact of the system of sub-deliveries with the PM system during the storage of the pallet is as follows:

a) From the PM system it received on-line (technical equipment linked with the PM arrangement) or off-line (instruction by corrected document):

--Survey of vacant storage cells as periodic information on the situation of vacancies (specified entry) issued in specific time intervals, which is continuously tracked by the PM system;

b) The on-line or off-line will provide the following for the PM system:

--Information on the contents of the pallet, i.e., the No of the chart of parts and their count in units of quantity;

--Information on the location in the storage, i.e., the No of the cell in rack storage freely selected for the storage of the pallet from the list of storage vacancies.

A prerequisite for an efficient contact with the PM system in complete conformity of information provided for the PM system at the time of the deposit in the storage, with the information on the punched card accompanying the pallet, i.e., information supplied at the time of its removal from the storage.

Pallet Stored in Pre-Assembly In-Process Storage

Placement of pallets in the pre-assembly in-process storage is determined by the type of the pallet, if the pallet is to be stored in the racks, by the suitability of the pallet for computerized transport, and by the punched card accompanying the pallet, with specific information about the type and amount of the contents of the pallet.

Every pallet addressed by computerized transport to the PM reaches its destination at the window of the identification center (IB).

Here the operator removes the punched card (DS) from the pallet, and the reader of individual DS and the tasterer forward the following:

a) Input data in the system--automatically:

--No of the chart, and description of the contents of the pallet--manually on the tasterer;

--The quantity of the parts in the pallet according to the data from the last technical inventory entered on the card;

--The impulse for the placement on the floor (P), if the pallet cannot, or should not, be stored in the racks, and simultaneous command to computerized transport to the location of the storage on the floor.

b) Data in the system--automatically:

--Record of the input data on the stored transport load in the memory (L);

--Record of impulse P in the memory of stored transport load, and blocking of the start of automatic collators and of the record on the occupation of the vacancy in the storage rack, if the pallet is stored on the floor.

--Release of the collator for subsequent automatic storage of the pallet in the vacancy according to the memory of vacancies (L), and addressing the computerized transport to the point of transfer to appropriate collator, if the pallets are stored in racks;

--Record of the location of the storage (rack cell No) added to the record of initial data on stored transport load, and deletion of the information on rack cell vacancy from memory L.

c) Data from the system--automatically:

--Printer write-out on stored transport load for the control system, and the information for emergency control--of collators.

After feeding in the initial data, no other data are fed in the system, if the pertinent contents of the transport load have already been specified for removal from the storage, thus cancelling the priority of the storage.

The operator in the IB, who identifies pallets for impuse P, is notified of each pallet that, while passing through profile inspection before the IB, fails to meet dimensional standards for rack storage in the PM.

Estimate of Parts and Subdeliveries Required for Assembly Lines

The first initial information for the estimate of the parts and subdeliveries required on assembly lines is based on the plan of production for the assembly of a complete engine, divided into brief intervals of time, and the plan for the production of subsystems in assembly lines, divided into brief intervals of time, with such an advance schedule that all assembly operations be correlated in time sequence and balanced in terms of capacity.

The analysis of the requirements in terms of design and technology of production in related lines makes possible consideration of two conceptions of this plan of production, prepared as:

a) Standard plan

i.e., a fixed amount of parts for the assembly of basic models of engines and their respective subsystems in constant relation of their advance schedules, prepared for a period after which the quantity of parts and the relations are repeated, i.e., standardization of the plan.

The brief interval of time for the tracking represents simultaneously a standard vertical cross section of assembly plans. The non-standard

factor, i.e., model modifications, may be determined solely by the model modification code for a short interval of time, without any changes in the quantity of the parts of the standard plan.

The preconditions for the standard plan are determined by:

--Regular cycle of the assembly line for basic models and for modifications of models of engines;

--Routinely repeated production of the control unit, i.e., body for 10 V and 12 V engines on the production line;

--A constant ration of the number of test rooms for individual basic models of the engine;

--Routine schedule for advanced assembly of subsystems before the assembly of the engine, so as to achieve capacity balance between the assembly on the line and the assembly of subsystems;

--Economic capacities of the production on parts production lines.

b) Non-standard plan

whose variability is given by the changing quantity of the manufactured engines and subsystems. This quantity varies in individual planning periods, for instance, according to the supply of manufactured parts and stored subdeliveries, or according to variable demands on the production of subsystems, such as spare parts.

The computation of the non-standard plan is repeated for each planning period; in order to plan it as a program for assigned production of subsystems, the following updated information must be made available:

--Standard schedules for advanced assemblies of subsystems before the assembly of complete units;

--Output standards, and the coefficient of their overfulfillment;

--Limit of capacities of the lines in relation to the model of the engine assembled on the line.

In an autonomous concept of the PM system this plan must be computed so as to provide a non-standard vertical cross section of the short-term plan. These tasks of the plan of production scheduled for specific intervals for the following day may be prepared during the idle time of the control computer, i.e., in the third shift.

The list of parts (K) for the basic model of the engine and lists of parts of its subsystems provide the second initial information for the estimation of the parts and subdeliveries required in assembly lines. Magnetic tape serves as the medium carrying the information for such lists of parts.

Data concerning individual entries present a complete survey of the system and quantity of parts per [jednice] of the assembled object (engine or its subsystem) without cumulating entries of identical design.

Direct count of the list of parts, multiplied by the quantity of parts of the assembled object determined according to the short-term assembly schedule, is fed into the memory of the control computer (RP); for that operation, theoretical requirement (TP) of the quantity of individual entries in the list of parts is available for the next period and for the basic model of the engine or its respective subsystems.

The list of parts for modifications (KM) of the model of engine or its respective subsystems marked by numerical code provide the third initial information for the estimation of the quantity of parts and subdeliveries required on assembly lines.

It is fed into the memory of the RP with the multiple of parts planned for the assembled objects of modified models only for that particular period of the plan for which the modification code has been stipulated for the quantity of parts determined in the plan.

The list of parts for model modification specifies changes only in those entries in the list of parts of the basic model that provide other information concerning model modification.

A sector from the standard plan for assembly lines with supplemental model modification, the linkage of lists of parts K and MK, and the estimate of TP are presented in the form of a diagram of initial data of an autonomous system (Figure 8).

In addition to the identification and capacity data of the entry, the TP data system received from the list of parts also information on the address of the supplier to the PM, the place of the dispatch from the PM--the address and code for limit information (for example, the maximum quantity that may be dispatched to an address in one period of time).

The information system concerning TP for a short period (one hour) is applied in RP ahead of the schedule of the plan of production assigned to assembly lines, in order to deduct the information on the quantity of individual entries from memory M of supplies on the assembly line. Entries demonstrating minus values after the deduction denote parts and subdeliveries actually needed on assembly lines, and are used by RP in programming the removal from the storage of entries that are not covered by the supply available on the assembly line.

Removal of Pallets from the Storage of Subdeliveries and PM

The program for the removal of entries becomes a program for the removal of pallets after its comparison with the supplies of transport loads in memory L.

Entries not covered by the supply in the storage are identified for special tracking on video terminals in the identification center and in the control center for assembly lines, particularly in the dispatch center of the production.

Entries covered by the supply in the storage are fed separately for subdeliveries in the printer which thus computes a short-term program to vacate specific cells in the storage; this program may be used immediately by collators operating in the storage of subdeliveries.

The pallet removed from the storage of subdeliveries is deposited by collators on lifting tables, which position the pallet, signal the operators of the collators their engagement, and set the computerized transport to pick up the pallet.

Entries concerning manufactured parts covered by the supply in the storage of the PM are removed from the storage in two ways:

a) Pallets stored on the floor (indication P in the memory)

are fed separately in the printer in the identification center, and thereby, the operator is assigned the task to locate the pallet and lift it, by means of an auxiliary crane, on the table which signals the computerized transport to pick up the pallet in the same way as in case of pallets of subdeliveries, or to place the pallet directly on the computerized transport truck.

b) Pallets placed in rack storage

are automatically removed from the storage by on-line computerized collators upon a signal from the RP to the collators by means of data from the program for the removal of pallets, i.e., collator code, rack code, x-coordinate code, and y-coordinate code. The collators place the pallets on out-feed tables. Simultaneously with their removal from the storage, the following processes are automatically completed:

--Computerized transport truck is directed to the out-feed table;

--The truck is addressed to the assembly line;

--The transport load from the supply in the storage is fed into the supply in the assembly line (from L to M);

--Addressing, reading and other commands are blocked according to the limited pick-up code.

The tasks of the program for the removal of pallets from the storage are gradually, over the entire short interval of time, projected on video terminals, and after reading the transport load, they are erased from memory L and fed into memory M.

The deployment of the terminals is presented in the form of a graph of the hardware concept for the PM (Figure 9).

Computerized Transport for the PM and Operations at Assembly Lines

Computerized transport is set into operation:

--Subdeliveries upon an impulse following the contact and positioning (turning) of the pallet on the out-feed table;

--Entries P in the PM upon an impulse following the contact of the pallet with the out-feed table, or after manual addressing of the truck to the checkpoint in the identification center;

--Entries from the racks into the PM upon an impulse from the RP, automatically addressing the truck to the out-feed table of that particular collator that has confirmed by feedback to the RP the transfer of the information from the program for the removal of pallets from the storage.

In their elemental automatic operations related to the removal of the pallet from the storage the entries from the PM racks already address the truck automatically by means of a floor starter or an antenna radiator.

Together with the command to the out-feed table, the trucks with entries P receive the following address--the checkpoint in the identification center. Here the reader removes the punched card, the information on the entry is checked or projected on the video terminal and thus, the accuracy of the transport load is confirmed.

Next, the truck receives automatically from the RP the address of the assembly line, and the transfer from memory L to M is completed. After the pick-up from the out-feed table the entries of subdeliveries are automatically transported on the truck to the address of the checkpoint of the identification center, with the DS accompanying the pallet.

At the check point the transport load of the subdelivery is processed in the same way as the transport load of entry P, including address to the assembly line.

The operator may intervene with computerized transport, for example, in order to sideline the transport of the load to the washer, only before the transfer from memory L to M is completed. After that moment any intervention requires either an additional transfer of the same transport load past the checkpoint by manual handling of the truck, or a new entry of the transport load into the system past the checkpoint, and correction of memory M.

Computerized transport is conducted by means of induction-controlled automatic trucks on inducted lines to the destination to which the truck has been addressed automatically or manually, by a remote control tasterer, or the tasterer on the truck.

A variant of the design of lines and destinations appears in the chart (Figure 10) as a layout for the initial situation, because the simplicity of its installations will lead to empirical changes and to extensions of the lines and destinations.

At its addressed destination the truck waits on the sideline for the programmed period, and if during that time the shop service does not receive the truck, upon a sound signal the truck automatically deposits the pallet and returns to the so called zero point, i.e., to the PM.

If the shop service receives the truck, it disconnects the automatic device on the truck by switching it off, and then the truck is operated freely as any other low-lift electric truck.

The presence of the truck on the line makes it available for the removal of an empty pallet or for the transfer of a full pallet to another assembly line (subsystems on the engine assembly line). The removal of the pallet from the line and the addressing of the truck must be done manually; also, the truck must be put back on the line and the automatic device switched on manually. The guide for addressing of empty pallets is the color or sign of the pallet according to the place of their filling. Each assembly line may use a push button to signal the control unit that an empty truck be sent to remove the pallet.

To avoid any unnecessary blocking of the truck by operations on the assembly line, the movements of the trucks are tracked from the dispatch center following either the signal system from the control unit, or the television monitor used in the dispatch system, whose sound devices may avert delays of the truck.

Corrections of Information in the PM System and Its Emergency Operation

Memory M contains data on supplies in assembly lines where deviations from the actual situation may occur for reasons stated below. Such deviations must be corrected by appropriate means:

Planned theoretical consumption is deducted from the inventory. Real consumption, which is identical in the entries, is computed by updating the lists of parts, K and MK, however, the capacity consumption may deviate also in the difference between planned production of assembly groups and real production for a given period (one day).

Correction may be made by multiplying the lists of parts by the plus or minus difference between the planned and real production. It is presumed that the correction is based on daily reports from assembly lines during the third--free-shift of the RP.

--Parts found on assembly lines to be defective are corrected in individual entries by keying according to the record of defective parts, subdeliveries and subsystems ascertained at the assembly.

--Lost parts are corrected in individual entries by keying according to the differences between the record of the RP and the physical inventory.

--Returned parts are corrected according to the documents accompanying the returned transport load, which are issued by the assembly and used also for the identification in the IB at the time of their replacement in the storage. This is necessary when making changes so as to update the lists of parts as well; before the change is made, the situation of the entry may be verified on the basis of inquiries not only on the assembly line but also in the storage.

The elimination report serves as the basis for the elimination of both supplies due to changes, and corrections are entered in memory M up to the moment of the removal of the unneeded supply from the storage upon the command from the tasterer and then its feeding into memory M.

Emergency operations in the automated parts of the system proceed on two levels:

--Remote control, if the information system remains operative. Remote control by the tasterer, both for collators and for addressing the trucks, is located in the identification center.

--Manual operations in case of total breakdown of the automatic equipment. Collators are furnished with service booths and trucks are equipped with auxiliary control steering for drivers. Elemental operations performed by attendants are based on periodical printouts from the express printer, which register changes in the situation as concerns operations completed prior to the breakdown.

Operations performed by attendants during the breakdown must be recorded on the slow printer reserved for that purpose, and on the basis of such records, the data system must be retroactively updated after the breakdown.

Both segments of the technological design propose a system of preassembly in-process storage with the application of the automatic control system of industrial production, whose technological plan, including the planned material flow, capacities and automation, meet the demands on the design, and the objectives of the design, which is evident from the capacity data, the design of its technological equipment and data processing hardware, and from the interpretation of the function of the system in the process of production.

Along with the technological design, the software plan determines the function which must derive its objective and algorithms from all components

of the technological design, and become a part in the plan for the implementation of the system, or a part of the delivery.

Another part of the plan pertains to the survey of the required manpower, its qualification and training.

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END