1922

Accounting and cost keeping of the Department of Engineering and Construction

F. L. Cavis

STATE OF OHIO
THE MIAMI CONSERVANCY DISTRICT

Accounting and Cost Keeping
of the
Department of Engineering and Construction

By
F. L. CAVIS
Chief Accountant

TECHNICAL REPORTS
Part IX

DAYTON, OHIO
1922

STATE OF OHIO
THE MIAMI CONSERVANCY DISTRICT

Accounting and Cost Keeping
of the
Department of Engineering and Construction

By
F. L. CAVIS
Chief Accountant

TECHNICAL REPORTS
Part IX

DAYTON, OHIO
1922

STATE OF OHIO
THE MIAMI CONSERVANCY DISTRICT

Accounting and Cost Keeping of the Department of Engineering and Construction

BY
F. L. CAVIS
Chief Accountant

TECHNICAL REPORTS
Part IX

DAYTON, OHIO
1922

THE MIAMI CONSERVANCY DISTRICT
DAYTON, OHIO

Board of Directors

EDWARD A. DEEDS, Dayton
Chairman

HENRY M. ALLEN, Troy

GORDON S. RENTSCHLER, Hamilton

EZRA M. KUHNS, Secretary

OREN BRITT BROWN, Attorney

JOHN A. McMAHON, Counsel

CHAS. H. PAUL, Chief Engineer

PREFATORY NOTE

This volume is the ninth of a series of Technical Reports issued in connection with the planning and execution of the notable system of flood-protection works built by the Miami Conservancy District.

The Miami Valley, which forms a part of the large interior plain of the central United States and comprises about four thousand square miles of gently rolling topography in southwestern Ohio, is one of the leading industrial centers of the country. Out of the great flood of March, 1913, which destroyed in this valley alone over 360 lives and probably more than $100,000,000 worth of property, there resulted an energetic movement to prevent the recurrence of such a disaster by protecting the entire valley by one comprehensive project. The Miami Conservancy District, established in June, 1915, under the newly enacted Conservancy Act of Ohio, became the agency for securing this protection. On account of the size and character of the undertaking, the plans of the District were developed with more than usual care.

The plan for flood protection included the building of five earth dams across the valleys of the Miami River and its tributaries to form retarding basins, and the improvement of several miles of river channel within the towns and cities of the valley. The dams contain 7,850,000 cubic yards of earth; their outlet structures contain over 160,000 cubic yards of concrete; the river channel improvements involved the excavation of 4,500,000 cubic yards, and the whole project cost about $30,000,000.

Accounting and cost keeping procedure plays a vital part in the development of any industrial or construction project. Familiarity with the fundamentals of such procedure is essential to the engineer as well as to the business man. Details of practice must, of course, vary with the requirements of each undertaking, but the underlying principles vary but little, and it is believed that a record of the system developed by the District is of such value that it should be made available to the public.

This report describes the structure of such a system. Tucked away amid the conventional statements and written in between the lines, is another story. It is not the purpose of this report to tell that other story, interesting as it may be, but its existence must be understood before the full meaning of what is written here can be appreciated.

The readers of this report must not assume that the mechanism described here worked smoothly when it was first put together. Considerable oiling and adjusting was necessary. The reason was simple. The construction organization was assembled overnight, as most such organizations are. It was composed of

especially high-grade men from many different jobs. Many of the men in subordinate positions had been accustomed to having responsible charge of work. In common with many engineers and contractors, most of them tolerated accounting as a necessary evil. Few had an adequate conception of the principles of the science, but all had strong opinions as to how the job should be handled, and these ideas ranged from the two hooks (one for paid bills, the other for unpaid bills) to the most complicated system of red tape. Before the accounting outline, also new, could be explained to the organization, a great mass of supplies and equipment was delivered, and the work started with a rush.

The oiling consisted mainly in selling the system to the organization, in overcoming dislike of "red tape," and in similar educational work. The adjustments were minor ones, as the main outline was well followed throughout. But in some unexpected places the original mechanism failed to work, and new methods had to be devised. Sometimes these substitutes were clumsy, and served only until better ones could be worked out.

Most industrial organizations are the result of growth, more or less slow, and men and methods grow with them. But a construction organization, put together to do a big job, does not take hold of a ready-made accounting system and start operating it without some friction. The District hopes to aid those that come after, with this presentation of an accounting system which has had unworkable features taken out of it under the pressure of actual operations.

CHAS. H. PAUL,
Chief Engineer.

Dayton, Ohio, November, 1922.

THE TECHNICAL REPORTS

The Technical Reports are published in volumes, called Parts, size 6 x 9 inches, bound in paper covers, and are sold at nominal prices. They are being issued by the Miami Conservancy District in response to the demand for information concerning the flood control works now nearing completion and concerning the results of the investigations conducted by its engineering staff.

More than usual care has attended the preparation of the plans for the thirty-million-dollar flood control works for the Miami Valley. Some of the problems required study and research work of an exhaustive character. The data published is in some respects entirely new, and in other respects is of a kind not available in convenient form elsewhere.

The reports already issued, and which are still available for distribution, are as follows:

PART I—THE MIAMI VALLEY AND THE 1913 FLOOD
By Arthur E. Morgan,
Chief Engineer of The Miami Conservancy District.
128 pages, 6 x 9 inches, 44 illustrations, paper covers; price, 75 cents net, postpaid.

This volume is introductory to the series of Technical Reports, but is not in itself, however, of a technical nature. It contains a description of the flood of March, 1913, which caused great damage in the Miami River Valley, and as a result of which the flood control works now being built were undertaken.

PART II—HISTORY OF THE MIAMI FLOOD CONTROL PROJECT
By C. A. Bock,
Division Engineer of The Miami Conservancy District.
194 pages, 6 x 9 inches, 41 illustrations, paper covers; price 50 cents net, postpaid.

This is a recital of events of interest in the history of the flood prevention movement in the Miami Valley. Its chief value lies in the fact that it describes the steps necessary and the difficulties usually encountered in initiating and carrying out a great public engineering enterprise of this nature.

PART III—HYDRAULIC JUMP AND BACKWATER CURVES
By Sherman M. Woodward, R. M. Riegel and J. C. Beebe.
111 pages, 6 x 9 inches, 88 illustrations, 12 tables, paper covers; price 50 cents net, postpaid.

The first part of the book, entitled "Theory of the Hydraulic Jump and Backwater Curves," sets forth the theory of these complex phenomena, and is written by S. M. Woodward, Professor of Hydraulics and Mechanics at Iowa University, and Consulting Engineer for The Miami Conservancy District.

PART IV—CALCULATION OF FLOW IN OPEN CHANNELS
By Ivan E. Houk,
Hydrographer of The Miami Conservancy District.
283 pages, 6 x 9 inches, 79 illustrations, 48 tables, paper covers; price 75 cents net, postpaid.

This report describes how the maximum flow of the Miami River and its tributaries during the disastrous flood of March, 1913, was deter-

mined by subsequent measurements of the river channels and flood elevations. A large part of the volume is devoted to a discussion of different formulas, many of them of foreign origin, used in computing stream flow.

PART V—STORM RAINFALL OF THE EASTERN UNITED STATES

By the Engineering Staff of The Miami Conservancy District.
310 pages, 6 x 9 inches, 114 illustrations, 11 tables and appendix, paper covers; price 75 cents net, postpaid.

This book sets forth the results and investigations made to reach safe conclusions as to the probable size and frequency of severe floods in the Miami River. Its most noteworthy feature is a study of the relations between the areas covered by different depths of rainfall and the duration of such rainfall for each of the 33 largest storms on record in the eastern half of the United States.

PART VI—CONTRACT FORMS AND SPECIFICATIONS

By the Engineering Staff of The Miami Conservancy District.
192 pages, 6 x 9 inches, 3 diagrams, paper covers; price 50 cents net, postpaid.

This volume has been issued to meet the continued demand for copies of the standard specifications and contract forms in use by The Miami Conservancy District, in the construction of the large earth dams and the protection works along the river channels.

ATLAS OF SELECTED CONTRACT AND INFORMATION DRAWINGS TO ACCOMPANY PART VI.

10 pages of text, 15 x 11 inches, 139 plates, paper covers; price $1.50 net, postpaid.

The Atlas contains 139 representative selections of plans made preparatory to the letting of contracts.

PART VII—HYDRAULICS OF THE MIAMI FLOOD CONTROL PROJECT

By Sherman M. Woodward,
Consulting Engineer for The Miami Conservancy District.
344 pages, 6 x 9 inches, 126 illustrations, 37 tables, index, paper covers; price, $1.00 net, postpaid.

This volume makes an orderly presentation of the methods followed in determining the type of the flood control plans and of the methods of working out the application of the plan. If such a presentation of the subject had been available when this project was undertaken, its use would have saved a very large amount of time and effort.

PART VIII—RAINFALL AND RUNOFF IN THE MIAMI VALLEY

By Ivan E. Houk,
Hydrographer of The Miami Conservancy District.
About 220 pages, 6 x 9 inches, 51 illustrations, 40 tables, paper covers; price, 75 cent net, postpaid.

This report is a record of the results of the studies of the Miami Conservancy District on rainfall and runoff. A considerable part of the volume deals with experiments with both natural and artificial rainfalls.

PART IX—ACCOUNTING AND COST KEEPING OF THE DEPARTMENT OF ENGINEERING AND CONSTRUCTION

By F. L. Cavis
Chief Accountant of the Miami Conservancy District.
112 pages, 6 x 9 inches, 31 illustrations, paper covers; price 75 cents net, postpaid.

Checks should be made in favor of The Miami Conservancy District, and all orders and communications should be addressed to:

THE MIAMI CONSERVANCY DISTRICT,
Dayton, Ohio.

CONTENTS

CHAPTER V. ACCOUNTING FOR LABOR

CHAPTER VI. ACCOUNTING FOR MATERIALS AND SUPPLIES

CHAPTER VII. PLANT AND EQUIPMENT

Page

CHAPTER VIII. INCIDENTAL OPERATIONS

CHAPTER IX. ACCOUNTING FOR CASH COLLECTIONS AND SALES

CHAPTER X. BOOKS OF ACCOUNT

CHAPTER XI. PAYMENT OF BILLS

CHAPTER XII. FILES

CHAPTER XIII. STATEMENTS AND REPORTS

CHAPTER XIV. BUDGET

CHAPTER XV. GENERAL EXPENSE OR OVERHEAD

CONCLUSION

APPENDIX

LIST OF ILLUSTRATIONS

LIST OF TABULATIONS

CHAPTER I

DESCRIPTION AND PURPOSE OF THE WORK

A complete description of the work of the Miami Conservancy District and of the plan of the organization is contained in the Official Plan and the Technical Reports published by the District. Only such description will be given here as is necessary to give a clear understanding of the accounting features.

The work, extending over a period of nearly five years, required the construction of flood-control works on the Miami River and its tributaries from about six miles above Piqua, to Hamilton, Ohio, a distance of about eighty miles. Retarding basins have been provided by the construction of five dams located as follows: (See map on page 16.)

1. Englewood Dam on the Stillwater River about ten miles northwest of Dayton.
2. Huffman Dam on Mad River about five miles east of Dayton.
3. Taylorsville Dam on the Miami River about ten miles north of Dayton.
4. Lockington Dam on Loramie Creek about six miles north of Piqua, Ohio.
5. Germantown Dam on Twin Creek just west of Germantown, Ohio.

All of these basins, except Germantown, are above Dayton. Their purpose is to intercept the water at flood stage, allowing only such volume to pass as can be carried without danger in the channels below.

The work also included extensive improvements in the river channels by widening and deepening, and by the construction of levees, concrete retaining-walls, and revetment, in the cities of Piqua, Troy, Tippecanoe, Dayton, West Carrollton, Miamisburg, Franklin, Middletown, and Hamilton.

The plan adopted made necessary extensive relocations of the railroads passing through the valley. The Cleveland, Cincinnati, Chicago & St. Louis Railroad, the Erie Railroad, the Baltimore & Ohio Railroad, and the Ohio Electric Railroad lines traversed the retarding basins. Numerous other public utilities were affected. Telegraph, telephone, and power lines, sewer and water systems, and in one instance an entire town, had to be removed from the basins and from locations along the rivers where they interfered with the construction of the works or encroached upon the basins and enlarged channels. The dams are all of earth and gravel, constructed by the hydraulic fill method. Each one has outlet works of concrete and a concrete spillway. Most of the river channel excavation and levee construction was done by large excavating machines of the dragline type. A description of the construction plant and detailed designs of the various structures will be found in the various District publications.

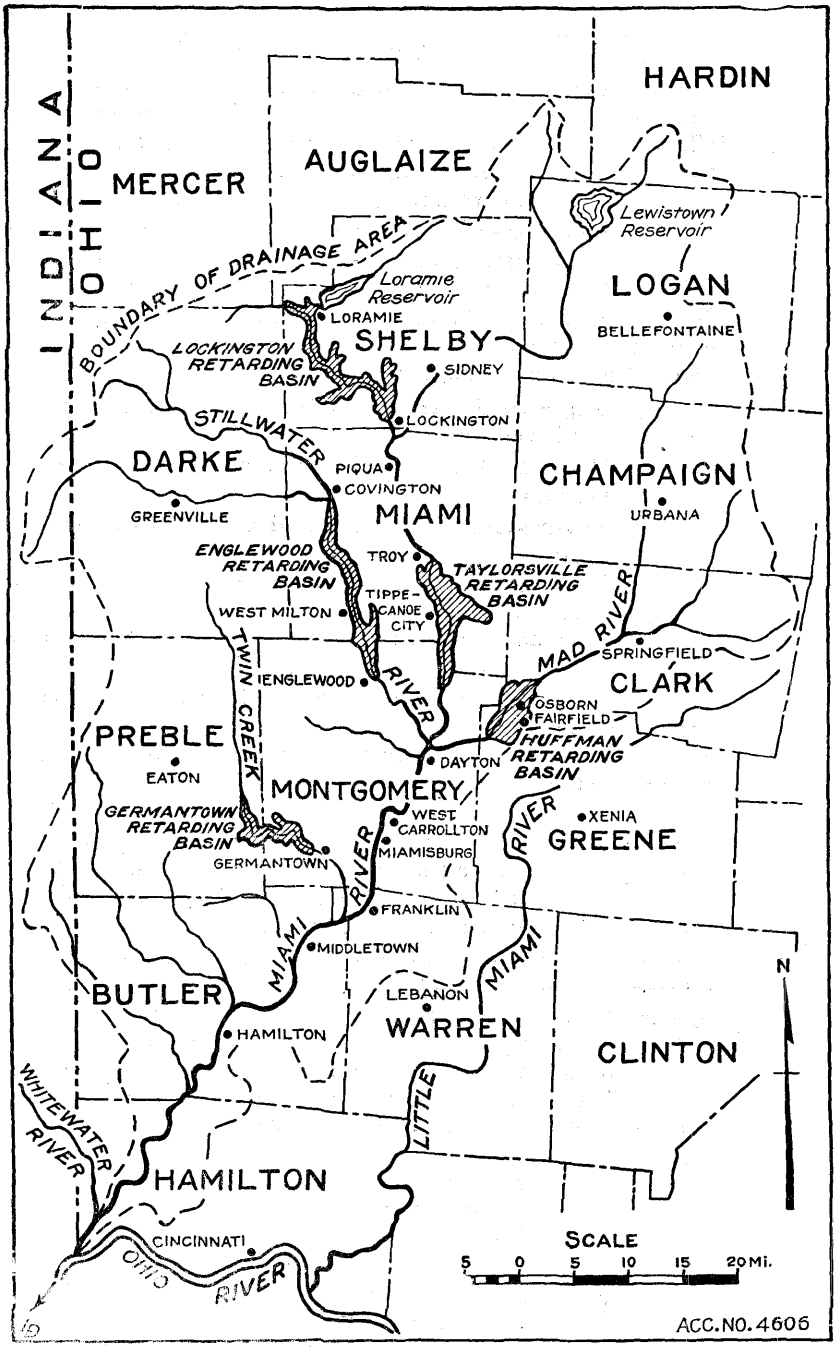


FIGURE 1—MAP OF THE MIAMI VALLEY

The shaded portions represent the basin areas covered by water if a storm large enough to fill the basins should occur. The watershed area above Hamilton is 3672 square miles.

It was the original intention to do all the construction work under contract, and the principal divisions of work were advertised for bids in the fall of 1917. The entry of the United States into the World War and the disturbance of labor and industrial conditions made such procedure impracticable, however. Under the conditions existing, it was not to be expected that any dependable bids would be made for work of such magnitude. Bids were opened in November, 1917, and all except one were considered to be unreasonably high, or were irregular. The one accepted bid was for a comparatively small section of levee construction in Dayton.

The District, thereupon, proceeded to develop a construction force as a part of its own organization, to secure the necessary equipment and go ahead with the work. The engineering force was already well organized. A construction manager was selected to serve as the head of the construction organization, and for each of the larger divisions of work a superintendent was appointed. Machine shops, warehouses, and other necessary features were established. The construction organization was very similar to that which would have been developed by a contractor, and the relation between the engineering and construction forces was much the same as would have existed under contract work. Specifications had, of course, been prepared before advertising for bids, and those specifications were followed in carrying out the work, such modifications being introduced as were demanded by the change in procedure.

The two branches of organization mentioned—engineering and construction—together with the necessary accounting division, purchasing division, paymaster's staff, etc., constituted the Department of Engineering and Construction, and it is with the system of accounting and cost keeping employed for that department that this report has to deal. In this report only such mention will be made of the administrative department as is necessary to explain the method of tieing in the records of the Department of Engineering and Construction with the general accounts of the District as kept by the treasurer.

The Land Depa tment also handled its own detailed accounts affecting land, rights-of-way, and farming operations, a control account being carried in the secretary-treasurer's office. The accounts for the legal, taxation, and other departments were kept in detail in the secretary-treasurer's office. The secretary-treasurer's office was referred to as the Administrative Department and the accounts for all departments were controlled by general accounts kept by the treasurer, but these carried no detail and consisted for the most part of a single account for each department, disbursements being charged and collections credited thereto.

The Department of Engineering and Construction operated as a unit, close coöperation between the engineering and construction branches being maintained. All the various features

of the work were under direct control of the chief engineer and construction manager, but each of the larger divisions was operated, to a considerable extent, as a separate business unit. Immediate responsibility for the affairs of a feature rested with the division engineer and superintendent appointed for that feature. They reported to the chief engineer and construction manager respectively. Plans for carrying on the work and transfers of equipment, supplies, etc., from the general warehouse to a feature or from one feature to another, were conducted with a general attitude of maintaining each feature as a separate business unit as far as it was possible to do so without sacrificing the greater good of the job as a whole. The accounting system recognized each feature as a unit.

By far the greater part of this work was done by the District's own forces. Except for the public utility work, the contracts that were let were for comparatively small amounts.

It can be readily understood that almost every activity in connection with the art of construction entered into the District's work. The accounting, extensive at best, became more complex by reason of the incidental operations necessary for construction by force account and the accommodation of employees. Such operations were:

1. Building and maintaining camps.
2. Operation of boarding houses.
3. Operation of stores.
4. Operation of warehouses.
5. Operation of garage and motor vehicles.
6. Operation of machine and electrical shops.
7. Gravel washing and screening plants.

An accounting system that will adequately record the financial transactions for all of such operations must be very broad and flexible and at the same time provide facilities for cost finding in sufficient detail to enable intelligent comparison of results on different jobs while the work is in progress. Expense of keeping cost is not justified unless results can be used as a check on current operations. Therefore, one of the most important features of a cost system is to have the figures at hand as the work progresses.

In the work of the District almost all the elements entering into commercial accounting, except profit and loss, were involved. As the question of profits did not enter into the District's work, all expense was absorbed into feature cost, and any revenue derived from incidental operations was credited to construction cost.

This report concerns the accounting and cost keeping as actually conducted and the system is not presented as a perfect model. Facts are set forth as accurately as possible and in some instances discussion is offered with the thought of suggesting improvements in the procedure.

CHAPTER II
ORGANIZATION AND ACCOUNTING PLAN

The accounting work was centralized as much as possible, most of the detail work of assembling cost being done in the headquarters office at Dayton. The force consisted of a chief accountant, who had general charge of all the work of accounting in the department, assisted by bookkeepers and clerks, the force varying according to the volume of work during different stages of construction.

At each of the large units of construction there was a field office and a clerical force consisting of a field clerk, one or more timekeepers, and assistants as needed. Except in the case of the Dayton local protection work, field warehouses were also established under the direct charge of a warehouse man. During rush seasons an assistant was required in some of the field warehouses. The field clerk had general supervision over all accounting work on his feature, and was responsible for the proper assembling of cost data and forwarding to the accounting division in Dayton. He reported to the division engineer in charge of his feature and the timekeepers and warehouse men in the field were immediately responsible to the superintendent of construction, but all field clerical men were subject to orders of the chief accountant in accounting matters.

The general warehouse, machine shop, electrical shop, and garage were located in Dayton. Each of these was under the supervision of a superintendent reporting to the chief engineer and construction manager, but the clerical force, while under the immediate control of the superintendent, was subject to the direction of the chief accountant in accounting matters.

In this respect the clerical force was a combination of a line and staff organization, and received orders from two sources. But this did not prove objectionable; in fact it worked out to considerable advantage, as it relieved the field officials of much detail in connection with the accounting work and allowed them to devote their entire time to construction problems. Nevertheless, care was taken to avoid petty interference with the field and to allow superintendents and division engineers full authority over their men.

The field accounting was standardized and the headquarters supervision was principally to see that it was kept up to the standard and to advise the field forces when special problems came up. There was usually someone in the headquarters office who could be assigned to a feature temporarily to help bring back work up to date, or assist in emergencies.

Direct telephone lines ran from the switchboard at headquarters to the five dams, and to the warehouse, shop and garage in Dayton. Excellent long distance connections were to be had to the other features, and much of the business with the field was transacted over the telephone, reducing correspondence to a minimum. Papers, invoices, blotters and all other mail was sent in to headquarters daily. The field men were encouraged to tell their accounting troubles to headquarters, and careful consideration was given to all questions, however trivial.

CHAPTER III

PHYSICAL DIVISIONS, THE ACCOUNT NUMBER SYSTEM, AND CLASSIFICATION OF COST

In work of any magnitude where a large number of accounts are involved, some system of designating physical units and details of accounts under these units, must be adopted to facilitate assembling of cost data.

Before any construction was undertaken, all the physical divisions were well defined in the Official Plan prepared under authority of the Conservancy Law, and complete specifications were prepared. In the Official Plan the physical divisions (called features) were numbered, and numbers were also assigned to the items of work for each feature. These numbers formed the basis for the account number scheme when the accounting system was outlined. A knowledge of this plan of symbolizing the different features of the work is essential to a thorough understanding of the discussion of accounting details which follows, so the account number scheme is given in full below.

Physical divisions, or features, which form one unit of construction were the first units in the classification of cost. They were the natural subdivisions which would have been made for separate contracts in case the work had been let by contract.

Feature Number	Name
1	Germantown Dam and Road No. 1
2	Englewood Dam and Roads 3, 4, and 5
3	Lockington Dam and Roads 8 and 9
4	Taylorsville Dam and Roads 12 and 13
5	Huffman Dam and Roads 16 and 17
6	Road No. 2, Germantown Basin
7	Road No. 6, Englewood Basin
8	Road No. 7, Englewood Basin
9	Road No. 10, Lockington Basin
10	Road No. 11, Lockington Basin
11	Road No. 14, Taylorsville Basin
12	Road No. 15, Taylorsville Basin
16	Highway Bridge at Germantown
17	Highway Bridge at Englewood
18	Highway Bridge at Lockington
19	Highway Bridge at Mill Creek Spillway
20	Highway Bridge at Taylorsville
21	Highway Bridge at Huffman
24	Raising Bridge over Brush Creek
25	Moving Bridge over Stillwater River
27	Tippecanoe City Local Protection
28	Tippecanoe City Drainage and Sewer Pumping Station
31	Tippecanoe City Substructure, Water and Light Station
35	Piqua Local Protection

Feature Number	Name
37	Troy Local Protection
41	Dayton Local Protection above Island Park
42	Dayton Local Protection below Island Park
49	West Carrollton Local Protection
50	Miamisburg Local Protection—East Side
53	Franklin Local Protection—East Side
55	Middletown Local Protection—General
58	Hamilton Local Protection—Miami River
60	Hamilton Local Protection—Drainage
61	Black Street Bridge at Hamilton
62	Adams Street Bridge at Troy
63	Market Street Bridge at Troy
64	Main Street Bridge at Piqua
100	Preliminary Investigations
200	General Expense—Headquarters Office
1001	Relocation Big Four and Erie R. R., Dayton to Enon
1002	Relocation Ohio Electric R. R.
1003	Relocation Baltimore & Ohio R. R., Dayton to Tippecanoe City.
1004	Big Four R. R. in Lockington Basin
1005	Relocation of Telegraph and Telephone Lines
1006	Miscellaneous Damages to Public Utilities
1007	Tates Point Crossing of Big Four and B. & O. R. R.
1011	Piqua Municipal Improvements and Public Utilities
1012	Troy Municipal Improvements and Public Utilities
1014	Dayton Municipal Improvements and Public Utilities
1015	Miamisburg Municipal Improvements and Public Utilities
1016	Franklin Municipal Improvements and Public Utilities
1017	Middletown Municipal Improvements and Public Utilities
1018	Hamilton Municipal Improvements and Public Utilities

The next subdivision of cost was by classes of work under the feature. The different kinds of work to be done and of materials to be furnished were classified into items, an item meaning a certain kind of work to be done, or material to be furnished, in a certain definite manner, regardless of its location. Each item was designated by a name and number, the numbers running from 1 to 90. In Part VI of the Technical Reports will be found complete description of all items and of the items pertinent to each feature or contract. Not all items, of course, were found under each feature, but, wherever found, the number assigned for any item meant the same class of work or material, with the result that uniformity in classifying expense was obtained and common reference to items was by numbers rather than names. The following table gives the item numbers and names that were used in assembling cost:

Item No.	Name
1	Stream control at dams
2	Clearing and grubbing
3	Removal of buildings
4	Trimming and shaping slopes
5	Soil stripping
6	Excavation, new channels, cut-off trenches, etc.
9	Excavation, river channels
13	Excavation, outlet works and spillways
16	Excavation, minor drainage
19	Excavation, highway cuts and fills
22	Excavation, retaining walls, bridge piers, etc.
25	Excavation, backfilling trenches
31	Embankment, hydraulic fill
32	Embankment, semi-hydraulic fill
33	Embankment, rolled fill
34	Embankment, levees, material from channel excavation
35	Embankment, levees, material from borrow pits
36	Embankment, miscellaneous
37	Backfilling
38	Surface dressing and grassing
39	Waterproofing concrete in bridges
40	Concrete, bridge railings
41	Concrete, walls, piers, outlet works, spillways, etc.
42	Concrete, in bridge arches
43	Concrete, in spandrel walls and counterforts
44	Concrete, monolithic revetment
45	Concrete, flexible slab revetment
46	Concrete, in culverts, bulkheads, gate chambers
47	Concrete, in sewers, manholes, etc.
48	Stone masonry
53	Drilling foundations
54	Grouting foundations
55	Furnish and lay vitrified pipe
57	Dry rubble paving
58	Riprap
59	Gutter paving
60	Crushed rock or gravel
61	Rolled gravel on highways
62	Water-bound macadam
63	Bituminous-bound macadam
64	Brick paving on concrete foundations
65	Concrete paving
66	Miscellaneous street paving
67	Guard rails
68	Wire fences
69	Lighting system for bridges
71	Timber and lumber for grillage
72	Timber piles
73	Wood sheet piling
74	Steel sheet piling

Item No.	Name
75	Furnish and lay cast iron pipe
77	Furnish and place flood gates
78	Steel highway bridges
80	Lowering track at Englewood bridge (D.C. & P.R.R.)
81	Raising, moving, and re-erecting bridges
82	Miscellaneous cast iron, wrought iron, and steel
84	Wire strand for flexible slab revetment
85	Cleaning up
86	Pumping stations
87	Pumping equipment
88	Removing and re-erection of existing pumping and power stations
90	Extra work

The specifications provided for more items than shown in the above classification. For example, each kind of excavation was divided into Class 1, Class 2, Class 3, and sometimes overhaul. Concrete was also subdivided into great detail and a separate account provided for reinforcing steel. As work progressed, it was found impracticable to keep accurate cost of these different classes, so for accounting purposes combinations were made.

An account number was not complete unless it contained both a feature and item number. Thus number 2-41 meant concrete in piers, walls, outlet works at the spillway on feature 2, which was the Englewood Dam. The same kind of concrete on any other feature was represented by the same detail number (41), which, when preceded by the appropriate feature number, indicated on what feature the work was done.

For Preliminary Investigations and General Expense (Accts. 100 and 200), special classification was made as follows:

Preliminary Investigations

101	Surveys and Reconnaissance
102	Estimates and preliminary designs
103	Expert engineering
104	Experimental work
105	Test pits, borings, etc.
106	Hydrography
107	Office expense
108	Legal work on Official Plan

General Expense

201	Consulting services
202	Engineering, Headquarters Office
203	Engineering, Field Offices
204	Inspection
205	Accounting
206	Miscellaneous clerical
207	Testing Laboratory
208	Miscellaneous office supplies and expense
209	Hydrography and flood warning
210	Photography
211	Taxes and miscellaneous
213	Employment

These accounts for general expense were used for features as well as for expense of headquarters office. The account number of the feature followed by the item number was used for job overhead; thus field engineering at Lockington would be charged to 3-203, while engineering of a general nature not properly chargeable to any particular job would be charged to 200-202.

A special classification was also used for railroad relocation and public utilities, as classes of work entirely different from dam and river work were encountered. Letters were used in this case to avoid confusion of the accounts with other feature items. The classification follows:

A	Engineering and inspection
B	Grading (by contract)
C	Track laying and ballasting
D	Right-of-way
E	Excavation for structures
F	Concrete in structures
H	Ballast (M. C. D.)
J	Temporary railroad yards
K	Miscellaneous
M	Rail and accessories
MM	Unloading rail
MMM	Rehandling rail
N	Ties
NN	Unloading ties
NNN	Rehandling ties
P	Right-of-way fence
Q	Crossing gates
R	Signals
S	Excavation and fill for road bed (M. C. D.)
T	Railroad stations
W	Revenue from betterments (Credit Account)
Z	Salvage of old material (Credit Account)

Owing to the nature of the relocation work, detailed specifications were not worked out in advance to the same extent as for the other work, so the classification of cost was developed as the work progressed and subdivisions of some of the items were made by assigning other letters or combinations of letters. For example, when it was desired to keep a record of the cost of unloading and rehandling rail, instead of putting all expense in M, the unloading was assigned account MM and rehandling MMM. The railroad symbols proved somewhat cumbersome and results obtained were not as satisfactory as for the other features.

The detail into which cost should be classified is a much-discussed question about which there is a great divergence of opinion. The outline shown above was adopted for the Miami Conservancy District as the official classification. Some of the detail kept was of no real practical value to the construction officials as the work progressed, although it has a certain historical value. On the other hand, there was a demand for more analytical cost for some items of work, such as hydraulic fill and concrete. Intelligent comparisons, with explanations of reasons for dif-

ferences, cannot be made from the information shown, and the lack of this detail led to the compilation of supplemental field cost by field offices. For example, hydraulic fill was kept by field clerks and timekeepers, under the direction of division engineers, in about the following classification:

Hydraulic fill, Feature 2 (Englewood), Item 31

(a) Labor
  1 Excavation
  2 Transportation
  3 Track work
  4 Pumping
  5 Levees and slopes
  6 Miscellaneous
(b) Power
  1 Excavation
  2 Transportation
  3 Pumping
  4 Levees
  5 Supplies
(c) Supplies
(d) Plant
(e) Dumps and hog box installation
(f) Camp
(g) Dredge pipe
(h) Pumps and runners
(i) Industrial insurance
(j) Shop work (Repairs)
  Subtotal
(k) Job overhead (Engineering, inspection, etc.)

This detail was not continuously maintained. It was intended for temporary use of division engineers as a test from time to time and covered for the most part direct expense only.

The tendency is always to provide too much detail, with the result that the finer subdivisions of cost are inaccurate and the books are encumbered with such a mass of accounts that it is difficult to get out reports in time to be of value on current work. It was for this reason that the general books carried the classification of cost to item numbers or kinds of work only. The principal objection to informal cost records is that, owing to lack of coördination with the general and financial books, some items may be overlooked and a unit cost arrived at that may be misleading. In the present instance, however, it was possible to compare the total unit cost of a given item as reported by the field records with the accounting division's report of cost of the same unit, and as a rule these compared very closely.

So far, classification of cost for features or jobs only has been discussed. Ultimately, of course, all cost was absorbed in features, but all cost could not be applied direct to its ultimate destination. Like the manufacturing expense of a factory, a large percentage of the cost had to be first assembled as a part of some incidental operation or production unit, like a gravel plant, or camp maintenance, depreciation on plant, or other items of over-

head. However, a much greater portion of cost on construction of this character can be charged direct than in factory cost finding.

Therefore, methods had to be devised for assembling the cost of plant and equipment and the operation of shops, stores, messes, etc. An explanation of such accounts and of the classification used in keeping the costs for them, follows.

Plant Accounts. By plant is meant equipment and machinery installed into a working unit. Great expense was incurred in the erection of camps for the accommodation of employees and for equipment and its installation, before a yard of material was excavated from the river or placed in the dams. If this were a permanent installation, such expense would be a charge against capital and renewed from time to time. Such was not the case in the work of the District, and the cost of all plants had to be absorbed into feature cost by the time of completion of the work. This was accomplished by subdividing plant and equipment into classes according to function, assembling first cost into each of these accounts, and charging it out to features gradually as work progressed. The principle was the same as for charging depreciation on factory equipment. Depreciation methods are discussed elsewhere in this report (page 67), so the present chapter will deal with classification of cost only.

The following tables show the plant accounts provided and the account numbers or symbols used for the subdivision of accounts. In order to avoid conflict with feature item numbers, plant and operating account numbers began with 0. Numbers 01 to 050 were reserved for plants. Separate plants were provided for each job and the complete account number consisted of the feature number followed by the plant number. Further division of plant cost was accomplished by adding letters for items under each plant.

01 Camp Construction
- A Mess, store and community buildings
- B Shops, warehouses, garages, etc.
- C Dwellings, bunkhouses, and quarters for employees
- D Public service (water, gas, lighting, heating, telephone, sewers, fire prevention, etc.)
- E Camp roads, pavements, open drainage, temporary bridges, etc.
- P Dismantling
- Y Depreciation (Credit account)
- Z Salvage (Credit account)

02 Concrete Plant
- A Mixers (includes motors, boilers, etc.)
- B Permanent forms
- C Screening and washing equipment
- D All other equipment
- G Extraordinary repairs
- M Hauling and erection
- P Dismantling
- Y Depreciation (Credit account)

03 Construction Plant, General (For large equipment not otherwise classified)
- A Pumps (for unwatering)
- B Pile drivers
- C Derricks and hoists
- D Cableways
- E Job lighting
- F Other equipment
- G Extraordinary repairs
- M Installation
- P Dismantling
- Y Depreciation (Credit account)

04 Excavation Plant
- A Excavation machinery (all types)
- B Hauling equipment (locomotive, cars, etc.)
- C Trackage
- D Tools, buckets, etc.
- G Extraordinary repairs
- M Hauling and installation
- P Dismantling
- Y Depreciation (Credit account)

05 Hydraulic Pumping Equipment
- A Dredge pumps and accessories
- B Water pumps and accessories
- C Monitors and giants
- D Pipe, trestle, flumes, etc.
- G Extraordinary repairs
- M Installation
- P Dismantling
- Y Depreciation (Credit account)

06 Miscellaneous Equipment and Tools
- A Digging tools (small scrapers, picks, shovels, etc.)
- B Furniture and office equipment
- C Instruments and engineering equipment
- D Mess equipment and utensils
- E Boots and other personal equipment
- F Store fixtures
- G Electrical shop equipment and tools
- H Machine shop equipment and tools
- J Farming equipment and tools
- M Camp equipment
- N Garage equipment and tools
- P Dismantling
- R Shop patterns
- S Warehouse equipment and tools
- Y Depreciation (Credit account)

07 Motor Vehicles
- A Passenger cars
- B Trucks
- C Motorcycles
- D Extra parts in use
- G Extraordinary repairs

P Dismantling
Y Depreciation (Credit account)

08 Temporary Railroads
A Roadbed (including structures)
B Trackage
C Equipment not in other plants
G Extraordinary repairs
P Dismantling
Y Depreciation (Credit account)

011 Transmission Power Lines
A Right-of-way
B Labor erecting
C Materials (poles, wire, insulators, transformers, etc.)
D Travel and auto expense
G Extraordinary repairs
P Dismantling
Y Depreciation (Credit account)

Still another class of accounts, "Operating or Clearing" accounts, were different from plants. They took expense which could not be charged direct to features but which was a part of **current** cost, whereas plant cost was an investment for the whole period of construction, or for the life of the equipment. These operations were again subdivided into two classes: (1) those that were supposed to be self-sustaining, such as messes, stores, etc., and (2) those that were purely suspense accounts, assembling cost for convenience or statistical purposes, and being later "cleared" in some more or less arbitrary manner to feature cost. The handling of both these divisions was similar and they have been grouped together here.

The following is the classification of cost for all operating accounts used. Numbers 051 to 091 were assigned for this group.

051 Camp Operation and Maintenance
A Labor
B Supplies
C Minor repairs to buildings
K Miscellaneous
X Depreciation (from camp construction)
W Revenue from service to employees (Credit account)
Y Distribution (Credit account)

The "X" account took the amount written off monthly from camp construction (01) and in this manner a portion of cost of constructing camps was absorbed into the work with the cost of maintenance. The account was closed monthly by charging the total to features on the basis of direct labor cost.

It may be well to explain that these operating accounts sometimes carried balances over from month to month, either debits or credits. Closing figures were furnished by field clerks when they submitted labor distribution, and the current month's expense for a given operation was estimated from past experience and this amount cleared. The method was approximately correct and saved much time in the general office in making closing entries, thus enabling monthly cost reports to be rendered more

promptly. Rates or amounts of distribution were changed from time to time so as to keep balances as small as possible. At the close of the job, final balances were distributed to feature cost.

052 Mess Gardens
- A Labor
- B Supplies
- C Minor repairs to equipment
- K Miscellaneous
- W Revenue (Credit account)
- Y Distribution (Credit account)

Profit or loss on garden accounts was closed to messes. As a matter of fact, operation of gardens was a failure financially and the plan was discontinued after the first two years.

053 Operation of Messes
- A Labor
- B Foodstuffs
- C Supplies
- K Miscellaneous
- X Depreciation
- W Revenue (Credit account)
- Y Distribution of Loss (Credit account)

Revenue from sale of meals was credited direct to mess operations (Account 053-W) and loss charged monthly to feature cost on a basis of direct labor. This subject is discussed in more detail in a subsequent chapter (page 75).

054 Operation of Motor Vehicles
- A Labor
- B Supplies
- C Gasoline
- D Repairs
- E Tire replacements
- F Garage rental and taxes
- H Lubricants
- K Miscellaneous
- X Depreciation
- Y Distribution (Credit account)

Cost of operation of motor vehicles was transferred to features on a basis of actual service rendered at fixed rates. This is discussed fully in a subsequent chapter (page 73).

055 Operation of Machine Shops
- A Labor
- B Materials for jobs
- C Supplies for shop
- D Rental and taxes
- K Miscellaneous
- X Depreciation
- Y Distribution (Credits on shop orders)

Shops were operated on a job order basis discussed in full later in this report (page 71).

056 Operation of Electric Shop
- A Labor
- B Material for jobs

C Supplies
D Rental and taxes
K Miscellaneous
X Depreciation
Y Distribution (Credits on shop orders)

057 Operation of Stores
A Labor
B Merchandise for sale
C Supplies
K Miscellaneous
X Depreciation
W Revenue from sales

Store accounts were closed upon completion of work only. (See page 75.)

058 Superintendence and Field Accounting
A Construction Manager
B Feature Superintendents
C Field clerical, timekeeping, etc.
D Travel and auto expense
E Office supplies and expense
F Proportion of paymaster's expenses
K Miscellaneous
X Depreciation
Y Distribution (Credit account)

These accounts were closed monthly to feature of direct labor.

059 Operation of Warehouse
A Labor
B Purchasing
C Supplies
D Rental and taxes
E Hauling and handling
F Handling cement (into warehouse only)
G Loss on damaged goods
H Warehouse repairs
K Miscellaneous
X Depreciation on tools
Y Distribution (Credit account)

This account was closed monthly by transfer of total cost to an account in the general ledger designated "Freight and Handling." Ten percent was added to the value of issued materials upon issue to work and was credited to "Freight and Handling" to absorb this cost. (See page 56 for full discussion of warehouse accounting.)

060 Operation of Meat Shop
A Labor
B Foodstuffs
C Supplies
K Miscellaneous
X Depreciation
W Revenue

The shop was operated for the sale of meat to employees.

064 Operation of Gravel Washing Plants.
- A Labor
- B Supplies
- C Repairs
- K Miscellaneous
- X Depreciation
- W Revenue from sale of gravel (Credit account)
- Y Distribution, gravel used on Miami Conservancy work (Credit account)

Fixed rates for the sale of gravel were established by contract and the revenue was applied to the credit of the gravel account. Gravel used on the work was charged to feature items at approximately the cost per cubic yard for production, and the balance, debit or credit, was closed to feature cost when the plant ceased operating.

065 Reconciliation or Adjustment Account
- A Bills of lading open
- C Transfers open
- E Store and mess inventories

For convenience in keeping records, a number in this group was used as a suspense account to which to charge items which could not be immediately allocated to features. For example, in the movement of supplies from one feature to another, the transferring feature took credit when a bill was issued, but until the supplies were accepted by the receiving feature the debit remained in one of these rconciliation accounts (A or C). Merchandise which had been charged to stores and messes and was on hand at the end of a month, was credited to the proper store or mess operating account and debited to 065C. This was immediately reversed upon opening the books for the next month. By this method, actual current cost was shown on monthly reports, regardless of what had been issued to stores and messes and not sold or consumed.

066 Operation of Salvage Division
- A Labor
- B Materials and equipment from features
- C Supplies and repairs
- D Labor and material from shop
- K Miscellaneous and auto service
- M Cost of selling
- N Commissions on sales
- X Credit—percent of sales of feature material
- Y Credit—sale or transfer of equipment

The salvage account was opened when equipment commenced to wear out and old material accumulated. The expense of putting old apparatus into salable or usable condition was charged to this account, and when reclaimed articles were sold or were issued to some feature, the price obtained was credited to 066-Y. The balance in the account was estimated to approximate the value of equipment available for sale, and was closed monthly into general ledger account No. 36 (equipment not in use). All profit or loss was closed to feature cost at completion of the job.

Equipment was taken into this account, as parts of the work were completed, with the result that plant accounts carried only equipment in use. The question of salvage will be discussed more in detail in the chapter on Equipment. (Page 69.)

069 Payroll Advances on Variable Fee Contracts

A Price Brothers contracts
Subdivided to provide an account for each contract

B Donald Jeffries contracts
etc.

A considerable number of small contracts were carried out under a form of agreement which provided for payment by the District of actual cost plus a variable fee which increased or diminished with the decrease or increase of the actual construction cost as compared with an estimated base price cost. A copy of the form of agreement is shown in the Appendix.

Some very satisfactory results were obtained under this variable fee form of contract. In writing such an agreement, great care should be exercised in establishing the method of varying the fee and in the determination of base price figures.

The 069 account was provided to take care of temporary advances on contractors' payrolls, etc., pending preparation of estimates at the close of a month. When these estimates came through, the total earned was charged to feature cost and the amount of advances credited to this expense account.

071 to 091 Dragline Operating Accounts

A Labor
B Supplies, expendable (except cable)
C Repairs (all not charged to Plant)
D Fuel or power
E Cable
K Miscellaneous
X Depreciation
Y Distribution (Credit account)

These accounts were used to assemble the cost of operating dragline excavators, a separate account being assigned for each machine by prefixing a number to designate the machine. At the close of a month the total for any excavator was cleared to units of work on which it had been engaged. (Page 78.)

Maintenance Accounts. A feature or unit of the work having been completed and the final cost reported, any subsequent work on that feature was regarded as maintenance. A separate fund was available for such work and the cost was assembled under the following classification. Symbols used were the feature number followed by a letter to indicate the kind of work.

A Patrolling, watchmen, caretakers, cutting weeds, etc.
B Clearing trees, brush, and drift above dams and from channels.
C Seeding or sodding levees and dams
D Planting trees and shrubs on and near levees and dams
J Barriers (check dam)
K Excavation in channels
L Repairing roads

M Minor repairs to levees and revetment walls
N Minor repairs to dams and other structures
O Operation and maintenance of flood gates
V Engineering
W Proportion of general office expense
Y Credit for sale of gravel from channels

Centralized vs. Field Cost Keeping. In this centralized plan of assembling cost, the original data upon which cost records were based was forwarded in more or less crude form from field offices to the general office at Dayton and there worked into final form. There are many advantages to this plan.

It concentrates clerical work so that the employment of clerks trained in accounting is justified. It relieves field offices of much detail which in some instances takes up too much of the time of engineers and superintendents. It enables the chief accountant to supervise the details of accounting work more closely. It saves traveling expenses of inspectors.

On the other hand, very satisfactory results could have been obtained from cost records if controls only had been kept in the main office and details kept on the jobs. The field costs referred to on pages 24 and 25 as being kept by the division engineers could have been made a part of the official record. The principal reason for keeping cost is to correct expensive practices and effect economies in operations as they proceed. Little good it does to the work in hand to know after it is done that it might have been done cheaper, although the information may have some value as a matter of experience. It was possible to get reports out in about eight to ten days after the close of the month with the centralized plan, whereas if details had been assembled on the job, the reports might have appeared several days earlier, and data would have been at hand to compile cost day by day when it would have been of advantage to do so. So much of the cost of work of this nature is overhead, that complete reports are not practicable more often than once a month, but direct labor and material could have been assembled in such a way that totals could have been known from day to day if necessary. It is possible that in the field cost keeping more work in the aggregate would have been done, but certain field employees were essential (field clerks, timekeepers, warehouse men, etc.), and it is doubtful if the additional force necessary for the cost keeping would have been much more than might have been saved by reducing the central office force. To keep up detail work from day to day, more work will be required in a month, but the time saved at the end of the period by preventing congestion more than compensates for it.

Construction forces look upon cost from the central office as foreign figures over which they have no control, and are apt to question their accuracy. But if the data are compiled by their own employees, in their own offices, no such objection can be raised and they must accept responsibility for them. The distribution to items of cost is likely to be more accurate. The officials

most concerned with the cost (the division engineer and superintendent in immediate charge of the work) have the first access to the results and can apply any corrective measure which the figures reveal to be advisable. It is often hard to get construction men interested in costs. To create interest, responsibility must be created, and by making a superintendent responsible for the compiling of costs he cannot help becoming interested in the results.

The physical conditions and the organization in connection with the work of the Miami Conservancy District furnished almost ideal conditions for keeping field costs. Whether such a plan would have proved more satisfactory than the scheme used, is, of course, problematical, but it would be worth serious consideration in organizing for similar work.

CHAPTER IV

CONTROLLING AND GENERAL LEDGER ACCOUNTS

In the preceding chapter classification of cost accounts was discussed. In this chapter a list of the general ledger and controlling accounts will be given with a brief description of their purpose and relation to the details previously mentioned. The term "controlling account" is used to describe the summation of any subdivision of accounts as kept in the general ledger, detail for which is not carried in the ledger because it would be too cumbersome to handle. The various items entering into the transaction are carried to the account by totals only, the details being shown in a subsidiary or auxiliary book. The total of all balances in the detail book must equal the balance in the general account and in this way the general account serves as a check or "control" over the detail.

General accounts were numbered beginning with 1, and whenever reference was made to any such account the number was preceded by the letters "G. L." to distinguish the account from any feature item or number.

Asset Accounts. Group I—Cash. This was a controlling account for cash collected by field clerks. It was subdivided to show the cash collected by each field clerk but reported in one item on the Balance Sheet. When daily or weekly reports of cash were received, this account was debited and the proper stores or messes credited. When an amount collected was remitted to the treasurer, "Collections" (G. L. 71) was debited and field clerk's cash account credited. The balance was the cash in the hands of the field clerk. Numbers 1 to 9 were reserved for cash accounts.

Group II—Inventories. For inventory accounts and inventory adjustments, numbers 11 to 20 were assigned. A brief description of the procedure under these accounts follows.

No. 15 Reconciliation of Inventories. Sometimes goods would be received ahead of invoice or the price would not be known accurately. The materials might be needed on the job at once, and in order to keep proper control, prices would be estimated. This related more to repair parts than to any other class of material. The regular inventory account for that class of material would be charged with the estimated price at once. When the actual price was obtained, if the difference was small, G. L. 15 would be debited or credited, thereby avoiding the necessity of adjusting prices on stock records or issuing debit and credit slips if the material had been issued. In practice the method worked out very well, as the balance in the account was never but a very small fraction of current business.

No. 16 Warehouse Stock. This was the control for the general and miscellaneous stock in the warehouse. Details were shown on stock cards referred to in the chapter on "Accounting for Materials." The balance was the book value of stock on hand

at any date and was expected to equal the sum of stock card balances. (See page 56.)

A separate account was kept for each feature warehouse.

For the first two years of the District's activities, separate controlling accounts were kept for different classes of material as follows:

No. 11 Cement
No. 11A Cement sacks
No. 12A Vitrified pipe
No. 12B Cast iron pipe
No. 12C Flood gates
No. 13 Coal
No. 14 Lumber
No. 16 General warehouse stock
No. 17 Equipment

This separation was provided to keep a record of the movement of different classes of material, but conditions developed that made this information unnecessary, and as the keeping of so many controls caused much extra clerical work, all inventory accounts were combined with No. 16 early in 1920.

No. 17. After the inventory account for equipment was discontinued, this number was assigned to adjustment account "Inventory Depreciation." Overages in stock were credited and shortages debited to this account. An overage was caused, in the first place, by an under-valuation in inventory in 1919, and it was credited to this account rather than to distribute it back to feature cost. Subsequent drop in the prices of materials justified this action and losses and adjustments by sales of surplus stock at less than cost were debited to the account. In this way it acted as a reserve for depreciation in value of warehouse material. The balance was a credit balance, and indicated the amount held in reserve to meet such losses.

No. 18 Freight and Handling. Carload freight and the transportation charges on bulky articles, such as cement, coal, large equipment, etc., were added to the price of those articles, but there were numerous charges for freight that were small and difficult to apply directly; for instance, express and postage. All such expense was taken into the account for "Freight and Handling." Warehouse operating expenses were also charged to this account by closing the operating accounts monthly into G. L. 18. A percentage added to warehouse issues and credited to the freight and handling account, absorbed these expenses into feature cost in proportion to the value of materials used. The balance in the account as kept was a debit balance and not allowed to exceed a percent of the total value of material on hand in the warehouse equal to the percent added to warehouse issues. The rate applied to issues was varied from time to time as found necessary to keep the debit balance within reasonable limits.

No. 19 Goods in Transit. Many articles were shipped from distant points and purchased f. o. b. point of shipment. Invoices were often received before delivery of materials. The obligation to pay began with the shipment, so immediately upon receipt of

such invoices they were registered and charged to G. L. 19, credit being given to accounts payable. When the materials arrived and the corresponding invoices had been approved, the proper inventory or feature account was charged and G. L. 19 credited. For convenience all bills were run through this account. The balance was always a debit balance representing the value of invoices received but not yet approved for payment. This will be discussed more fully in the chapter on "Accounting for Materials and Supplies" (page 62).

Group III—Accounts Receivable.

No. 21 Personal Accounts Receivable. Amounts due the Department of Engineering and Construction for services rendered or for sales to persons or firms and for which cash payment was to be made, were debited to this account upon rendering the invoices. It was a control of the personal accounts receivable ledger, described on page 87, in which an account was kept for each individual and firm.

No. 22 Coupon Advance Account. Coupon books were sold to employees by field clerks and used as currency at the District stores. When a stock of books was given to a field clerk, a charge was made against the "Coupon Advance Account" and a credit to G. L. 45, "Unredeemed Coupon Books." A detail of account No. 22 was kept to show the account with each clerk. When books were sold to employees, the charge was against the employee and a credit to the proper field clerk's account in G. L. 22. When coupons were redeemed at the store, the debit was against G. L. 45 and the credit to store operations.

No. 23 Freight Advance. Sometimes the District paid freight on shipments which should have been paid by the shippers or was chargeable to the shippers. In such cases the expense was charged to controlling account G. L. 23. A ledger account subsidiary to G. L. 23 was kept to show amounts charged to each person or firm.

No. 24 Construction Advance. This account was created to record transactions by which the District advanced money for construction purposes; for example, it was necessary to build transmission lines to carry power to the dams. The power company did not care to finance the construction, so the District built the lines for the power company or advanced the money to cover actual cost, and charged the "Construction Advance" account. Reimbursement was made by deducting a certain percentage from the monthly power bill and applying the amounts deducted to the credit of this account until the total advance was repaid.

No. 25 Uncollected Interdepartmental Transfers. This was similar to ordinary accounts receivable except that it represented amounts due the Department of Engineering and Construction for materials or services furnished other departments. Such amounts were charged to this account until they had been accepted and the transfer of credit completed on the books.

Group IV.—Construction Cost.

No. 31 Feature Cost. This was a control of the cost ledger wherein was assembled the cost of physical features. On pages

20 to 34 details of the physical divisions and the account number scheme applied to them are described. The entire construction cost was ultimately assembled in this account.

No. 32 Undistributed Plant. This was a control of the plant cost ledger, detailed accounts for which are described on pages 26 to 28 under the title "Plant Accounts." The balance was always a debit balance, being the book value of equipment in use; that is, the amount of the investment in equipment and machinery in place, less the amount charged to feature cost (G. L. 31) as depreciation.

No. 33 Undistributed Operating or Clearing Accounts. This was a control of the class of accounts referred to on pages 28 to 32. A ledger showing the classification in detail as there given was maintained. In this ledger the debits and credits were cumulative, so that totals to date were always available as well as the undistributed balance for each detail. The sum of all these balances was equal to the balance in G. L. 33. A credit balance indicated an over-distribution to feature cost and a debit balance indicated that not enough had been charged to features to cover these operating expenses. Upon completion of the work, the balance was closed to feature cost.

No. 36 Salvage. As machinery became worn out, or as soon as it had served its purpose and was no longer needed on the work, it was transferred to the salvage division, where necessary repairs were made and it was held for disposition by sale or otherwise. The cost of repairs and selling was charged to salvage, detail of the account being explained as clearing account 066 described on page 31. This was closed monthly to G. L. 36. The balance was a debit balance representing the book value of machinery and equipment of all kinds not in use.

No. 37 Discount. This was a credit account representing cash discounts taken for prompt payment of bills. When an invoice was received, the gross amount was taken into cost or inventory at once. All discounts obtained were accumulated as a revenue which served to reduce the construction cost as a whole and were not credited to any particular feature. A subdivision of the account was kept in the ledger to show discounts on cement bills separately from those on all other bills.

No. 38 Miscellaneous Revenue. This was another credit account used to assemble revenues of a miscellaneous nature which could not be applied to any particular feature or item, and which served as a reduction of the total construction cost. Overhead charges on all work done by the District for outside parties went into this account. Interest charged by the District on overdue invoices rendered to outside parties was another item.

No. 39 Revenue from Freight Adjustments. A contract was made with a freight service bureau to check all freight bills with a view to locating overcharges by transportation companies. It was desired to know what the result of the check would be, and this account was arranged to take the credit for all freight refunds. The balance, a credit, was applied to the reduction of construction cost as a whole.

No. 40 Maintenance Cost. During the latter part of the construction period, some expense of a maintenance nature was incurred on completed units. This work included cutting weeds, reseeding banks, clearing drift, repairing roads, etc. It was done by the construction forces and the cost assembled with the construction cost. Account G. L. 40 was assigned as a control for this work to keep it separate from construction. It was transferred monthly to the treasurer's office where an adjustment was made by charging the maintenance fund and crediting the construction fund. Under classification of cost on page 32 will be found a detail of maintenance accounts.

Liability Accounts. Group V—Accounts Payable.

No. 41 Unpaid Labor. As soon as labor earnings were known for a pay period, which was weekly for the construction work, the total amount was charged to feature cost and credited to the account for "Unpaid Labor." There was usually a lapse of several days, and often longer, before payment was made and this often carried over the close of the fiscal period or end of the month. When payment was made, the charge was to G. L. 41 and credit to "Cash Disbursements." The balance was always a credit, representing amounts due for labor earnings.

No. 42 Unpaid Purchases. This account recorded the liability for purchases and invoices for miscellaneous services. When an invoice was received, it was registered and charged either to "Goods in Transit" (G. L. 19), direct to feature cost, or to some inventory account, and credited to G. L. 42. When payment was made, the charge was to G. L. 42 and the credit to cash disbursements. The balance was the outstanding liability for bills rendered against the District. For a full discussion of the method of handling invoices, see the discussion of the invoice, page 98, and payment of bills, page 96.

No. 43 Unpaid Earnings on Construction Contracts. This account was a control of the detail ledger showing amounts earned on formal contracts. Upon submission of estimates by engineers, showing contract earnings, the total was charged to feature cost and the amount due credited to G. L. 43. When paid G. L. 43 was debited and cash disbursements credited. The balance was the District's liability for contract work.

No. 44 Unpaid Contract Holdbacks. This account was closely related to G. L. 43. When contract estimates were rendered, the portion earned which was to be retained as a holdback until completion of the contract was credited to this account. When payment of a holdback was made, this account was debited and cash disbursements credited. Details showing the holdback on each contract were kept in a subsidiary ledger similar to that for G. L. 43.

No. 45 Unredeemed Coupon Books. When coupon books were issued to field clerks, G. L. 45 was credited. When the coupons were redeemed at the store, G. L. 45 was debited and the store credited. The balance represented the District's liability for the value of coupons outstanding. See explanation under account No. 22, "Coupon Advance Account" (page 37).

No. 48 Unpaid Interdepartmental Transfers. This was the reverse of account No. 25. It represented the charges against the Department of Engineering and Construction for materials furnished or services rendered by other departments pending the adjustment by transfer on the books of the treasurer's office.

No. 49 Railroad Adjustment. Railroad relocation played a very considerable part in the work of the District. The necessary construction was handled by procedure different from that employed for the other work. According to agreements made with the railroads affected, all work would have been done by the railroads or by contractors working under their supervision, and the District, upon presentation of bills covering the outlay, would have reimbursed them for all expense incurred. In practice it was found more advantageous for the District to let some of the contracts directly, or, in some instances, to do work with its own forces.

Whenever expense was incurred directly by the railroads, the details of accounting were carried on their books, payment being made to them by the District as suitable bills were presented. When the District arranged for work, either by contract or by force account, all accounting was carried on the District books.

Account No. 49 was a liability account to record the value of railroad materials furnished by the B. & O. Railroad Company in connection with the relocation of their tracks, but no bills were submitted and it was necessary to estimate the value. This was a temporary account and was closed upon adjustment of material bills with the railroad company.

Group VI—Reserve Accounts.

No. 47 Reserve for Accident Insurance, Taxes, etc. This account was subdivided to show reserves created for specific purposes, but was reported in one item on the balance sheet. The purpose of creating reserve accounts was to absorb in feature cost all expenses relating to current periods. Casualty insurance was carried with the State Industrial Commission, rates being fixed in advance for each six-month period. Based on this rate a percentage was added to labor distribution, charge being made to feature cost and credit given to G. L. 47. When the premium, based on the total of labor for the period, was paid, the amount of the premium was charged to G. L. 47 and credited to "Cash Disbursements." The rate was usually higher than the actual charge for insurance, so adjustments were made by crediting back the excess to features.

Group VII—Investment. This group was in effect the cash account. It was through these accounts that reconciliation was made with accounts in the treasurer's office. For example, disbursements by the treasurer on requests issued by the Department of Engineering and Construction were charged on the treasurer's books to the department and appeared as a credit to cash on the department books. Collections turned in to the treasurer by the department were credited to the department on the treasurer's books and appeared on the department books as a reduction in investment or debit to cash. Transfers received and transfers

issued on interdepartmental business were handled in the same way.

No. 61 Disbursements. Effort was made to maintain a cumulative total of disbursements and this total was carried in this account through the disbursement voucher register. The debit for vouchers paid was usually to accounts payable and credit was to this account (G. L. 61).

No. 62 Transfers Received. The only difference between this account and No. 61 was that it represented charges from other departments against the Department of Engineering and Construction, while No. 61 represented direct disbursements by the department. Entry came from the journal, debit being to G. L. 48, unpaid interdepartmental transfers, or if entry had not previously been made to accounts payable, direct to feature cost.

No. 71 Collections. For statistical purposes, it was desirable to carry all cash collected by the department into a separate account, rather than apply such revenues direct to cash disbursed. This was a debit to the cash account, the credit usually being to some account receivable. Credit was sometimes direct to feature or operation cost, in case the revenue had not been previously applied and charged to accounts receivable.

No. 72 Transfers Issued. Credits on the books of the treasurer to the Department of Engineering and Construction, for supplies furnished or services rendered to other departments, were recorded in this account as a debit. The only difference between this account and No. 71 was that in this case no cash was collected, the transaction being handled by transfers on the books of the treasurer.

The sum of accounts No. 61 and No. 62 less the sum of accounts No. 71 and No. 72 was the net investment by the department in flood control works. This was reconciled with the books of the treasurer every month, at the time of closing the department books. The "tie-in" with the treasurer's books was through these four accounts.

With this method of grouping general accounts, upon closing the accounts after all bills have been paid, accounts receivable collected, and disposition made of equipment and material, only two groups of accounts remain on the balance sheet, one for construction cost and one for investment. The net construction cost on the debit side equals the net investment on the credit side.

During the course of an audit of the District's accounts, criticism was made that the general accounts (treasurer's books) of the District did not show a complete record of assets and liabilities, in that the construction department was charged with disbursements only as made. To meet this situation and at the same time to avoid complicating or revising the accounting work of the District, three accounts were opened by the construction department to transfer to the treasurer's records all assets and liabilities shown on the construction books except cost and investment. The total of cash on hand, inventory accounts, and accounts receivable was transferred to the treasurer in one lump sum, credit being given to an account called "'Administrative

Adjustment, Assets" (G. L. 30). On the monthly statement this was shown as a credit (in red) on the asset side. The contra entry was a debit to a similar account designated "Administrative Adjustment (Contra)" (G. L. 80) carried on the liability side of the statement. The total of accounts payable and reserves was also transferred to the treasurer's books in a lump sum, debit being given to an account of the same nature designated "Administrative Adjustment, Liabilities" (G. L. 50), which was shown on the liability side and the contra or credit was placed to the same account as the contra for the transfer of assets, viz., G. L. 80. These adjustment entries were made as closing entries at the end of each month and were reversed immediately in opening accounts for the next month. No particular benefit was derived from this somewhat involved process, but it accomplished the desired result of showing the current assets and liabilities on the general books without complicating the books of the construction department.

Auditing. Section 57 of the Conservancy Law (104 Ohio Laws, pages 13 to 64 inclusive) provides that,

> "At least once a year, or oftener if the court shall so order, the board of directors shall make a report to the court of its proceedings and an accounting of receipts and disbursements to that date which shall be filed with the clerk of the court. Thereupon the court shall order the auditing of said accounts by public accountants of recognized standing who shall file their report thereon with the clerk of the court."

The audit went further than an analysis of "receipts and disbursements," as contemplated in the law. Checks were made of the warehouses and inventory of equipment and plant accounts. A complete financial statement showing assets and liabilities was submitted to the court.

On April 29, 1921 (Approved May 14, 1921), the General Assembly of the State of Ohio passed a law amending Section 57 of the Conservancy Law and placing the responsibility for the audit of the District's books upon the bureau of inspection and supervision of public offices. The portion of the amendment relating to the audit follows:

> "The bureau of inspection and supervision of public offices shall inspect and supervise the accounts and reports of the District and all laws pertaining to said bureau shall be applicable to such inspection and supervision. In no instance shall the books as kept to date of first audit be changed, provided however that the system of the keeping of the books now in vogue may be changed thereafter upon recommendation of the Auditor of State."

Under this law the forces of the State Auditor examined the accounts beginning with January 1, 1921. From that date the audit was made in detail, and in addition all receipts and disbursements from the beginning of the work were given a general examination. No changes were made in the system of accounting.

CHAPTER V

ACCOUNTING FOR LABOR

In the preceding chapters, the discussion has been confined to the general outline of the system and the relation of the various general accounts to each other in the system as a whole.

The chapters which follow will deal with details and methods, tracing the records from sources of original entry through to the final accounts.

Keeping Time. The timebook was the original source of entry for all personal services. The District used two forms of timebook; one for salaried employees who were paid semi-monthly, and one for labor paid on a daily or hourly basis, on which payment was made weekly. Figure 2 shows the form first referred to (Form E-8). It was arranged to record at the left of a double sheet the number, name, and position of each employee. Then follow sixteen small columns for the record of employment, headed from 1 to 15 and from 16 to 31. In using this form, time was inserted in hours, actual time worked being shown in large figures and allowance for overtime in small figures in the same block. To each name was assigned about five lines and the time employed on different kinds or classes of work was entered on separate lines. This book has the usual columns for total time, rate, amount earned, etc. The second book was arranged to automatically assemble cost by account numbers. (See Figure 2.) Any number of sheets necessary could be assigned for a given date. There are three general columns on each page, each column designed to record the time employed on a job or item of work. The timekeeper, in making his rounds, recorded each man by number, under a column assigned for the job on which the man was working. The other sub-columns are for time, rate, amount, etc. The total of each amount column was the amount earned chargeable to any account number for a given date. Of course, several columns were often required for one account. Time was recorded in the same manner in both books. The timekeeper usually made the rounds twice daily. To provide a check on the timekeeper's work and avoid mistakes and possible padding of rolls, a supplementary record of time was kept by the foreman in the form of a daily labor report. This was a card on which to indicate each man's number or name, hours worked, and on what work engaged. These time records were compared by the field clerk and differences adjusted before posting time to the payroll.

The above applies to timekeeping in the field. For office time, the semi-monthly book, but not the daily time card, was kept. In the machine and electrical shop a daily time ticket took the place of the foreman's daily report. This ticket was handed to

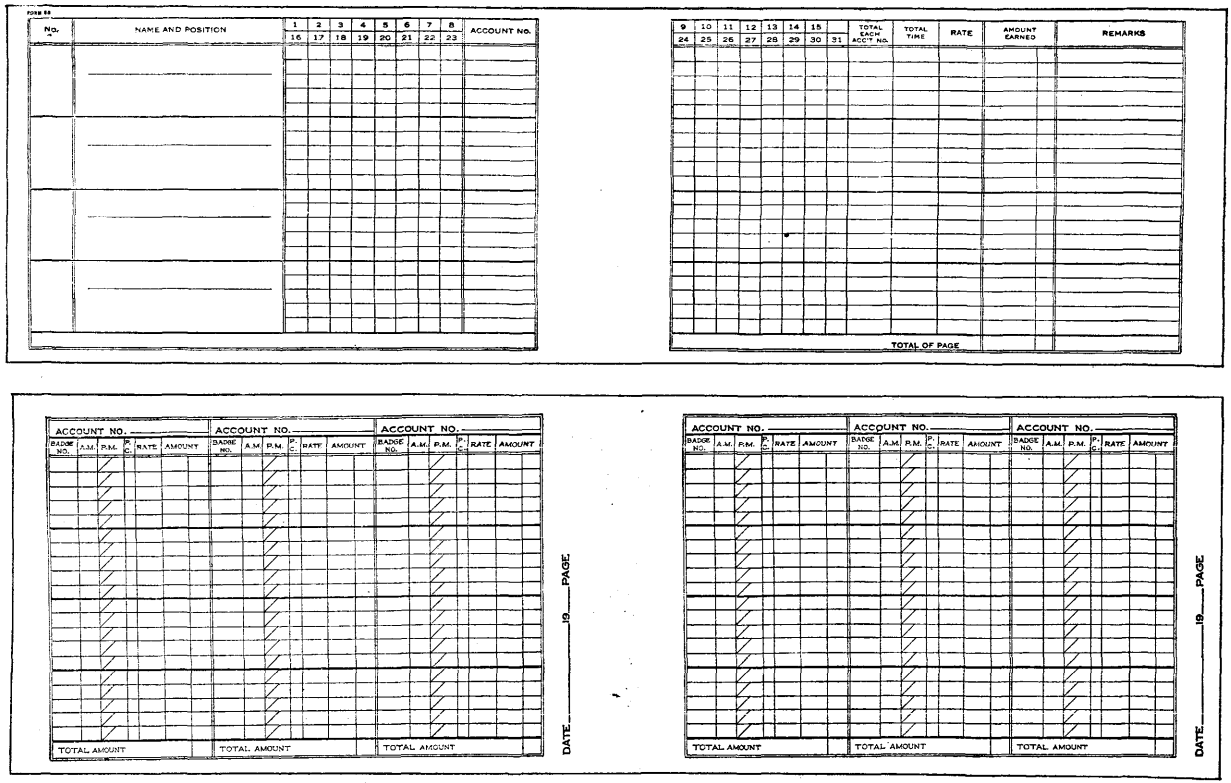


FIGURE 2—TIMEBOOKS—The upper is Form E-8 for salaried employees; the lower is the one for labor.

an employee when he began work in the morning and at noon and he deposited it at the shop office on leaving. The employee indicated on this ticket the time in hours he spent on each job or order. It was necessary that the total time on the ticket agree with the payroll time kept by the shop timekeeper.

Figure 3 shows the form of payroll used. It was posted daily by the field clerk or timekeeper, closed weekly, and forwarded to the paymaster. Deductions for meals, coupon books, and other charges to employees were shown on the roll as well as the amount due. The payroll was kept in duplicate by carbon process so that the field clerk could retain one as a field record. Accompanying each payroll was an abstract and distribution sheet (Figure 4) which gave a summary of all transactions affecting the roll and the labor account. This was prepared by the field clerk, one copy going to the accounting division to become the original source of entry for labor. One copy was kept by the field clerk. A copy of the abstract also went to the auditor and a fourth copy was filed with the payroll. The total of the labor distribution sheet was required to equal the amount earned as shown on the time book. The time book was filed with the distribution sheet to support the entries made by the accounting division.

Before proceeding further on the subject of accounting for labor, a brief description will be given of the routine of placing men on the roll, of transfers, changes in rate, discharges, etc. A series of brass checks or badges was provided for each job or feature for which a separate payroll was provided. These were numbered, a certain series being assigned each feature. They bore the number of the feature as well as a number for the employee. Before a man started work, he reported at the field clerk's office, where he was assigned a number and given his check, which served thereafter for identification. The field clerk made out a notice of employment (Form E-18) showing the feature number, badge number, the man's name and address, rate, time of beginning work, and other personal information. When this had been approved by the superintendent, the name was recorded on the payroll and the notice forwarded to the paymaster. Thereafter, the name appeared on every payroll, whether the man worked or not, until notice had been given by the field clerk, on Form E-21 "Payment in full," that services had been discontinued. This form showed in addition to name, feature, number, etc., the reasons why services were terminated, earnings since last pay period, deductions, and net amount due. It was usually carried to the paymaster's office by the employee. The new payroll each week was prepared by the paymaster's office, in duplicate, by the use of an addressograph machine, from information contained on the previous roll, the employment notices, and pay-off slips. This was forwarded to the field clerk and the only names to be added were those of men employed since the beginning of the week.

The discharge slip (Form E-22), a little ticket printed in red, was given to discharged employees by the superintendent. This

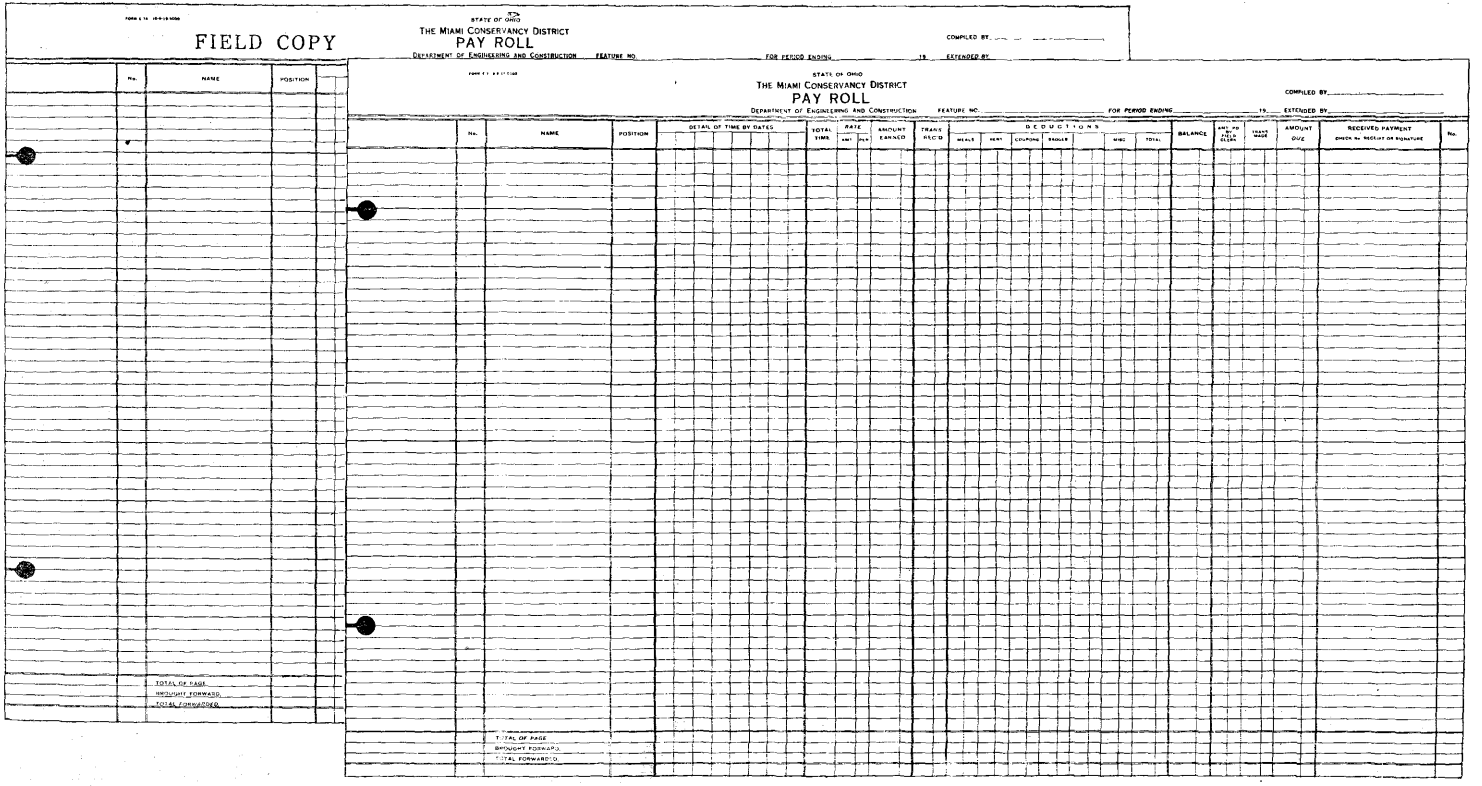


FIGURE 3—PAYROLL USED FOR EMPLOYEES PAID WEEKLY

was presented by the employee to the timekeeper, who made appropriate entries in his time records and issued the pay-off slip.

Form E-20 "Transfer" was used to transfer employees from one feature or payroll to another. It required the name, badge number, feature from and to which transferred, date, time, kind of work, amount earned and due up to date of transfer. The record was made on the transferring feature and after signature by superintendent, field clerk, and timekeeper, the slip was forwarded to the receiving feature where a new badge number was assigned and the slip forwarded to the paymaster as notice for change on the payroll.

Whenever a change in rate was made, Form E-19 was prepared showing in addition to name, badge number, feature, etc., the reason for the change, the old and new rates, time of taking effect, etc. After signature by superintendent, timekeeper, and field clerk, it was forwarded to the paymaster for his record and thereafter the employee appeared on the payroll at the new rate.

Paying Labor. Executive employees who were paid an annual salary were put on what was known as the treasurer's payroll, the distribution of which was given to the accounting division in lump sum. Checks were issued by the treasurer direct. Other permanent employees were put on what was called the headquarters payroll and a separate distribution sheet and abstract was made by the headquarters time clerk. The latter roll was handled in all other respects in the same manner as the labor roll except that payment was made by check.

Upon completion of the field payroll, the field clerk made out a card (Form E-15) called a wage receipt for each employee. It showed the name and number of the employee, the date, time, amount earned, deductions, amount due, and contained a place for the signature of the employee. This card was handed to the employee who held it until the paymaster's visit when, after affixing his signature, he exchanged it for his pay envelope. By having this notice in advance of payment, the employee had an opportunity to check his time and any adjustment of errors could be made before the paymaster's visit. Upon receipt of payrolls from the field, the paymaster checked all computations, rates, etc., with his record and drew a check for the entire payroll, obtaining cash which was distributed in envelopes containing the amounts due each employee. The paymaster was directly responsible to the treasurer's office and his cash account was entirely independent of the department accounts. The department was charged with the net amount of the payrolls through the disbursement voucher register. For work located near Dayton, pay envelopes were prepared in the Dayton office of the paymaster, but for outlying features arrangements were made to secure funds from local banks, and pay envelopes were filled at the bank. Different pay dates were fixed for the different features. Payment was made at the feature office, the employee presenting himself at the window with his badge and receipt card. He showed his badge for identification and exchanged his card for the pay envelope. The field clerk was usually present

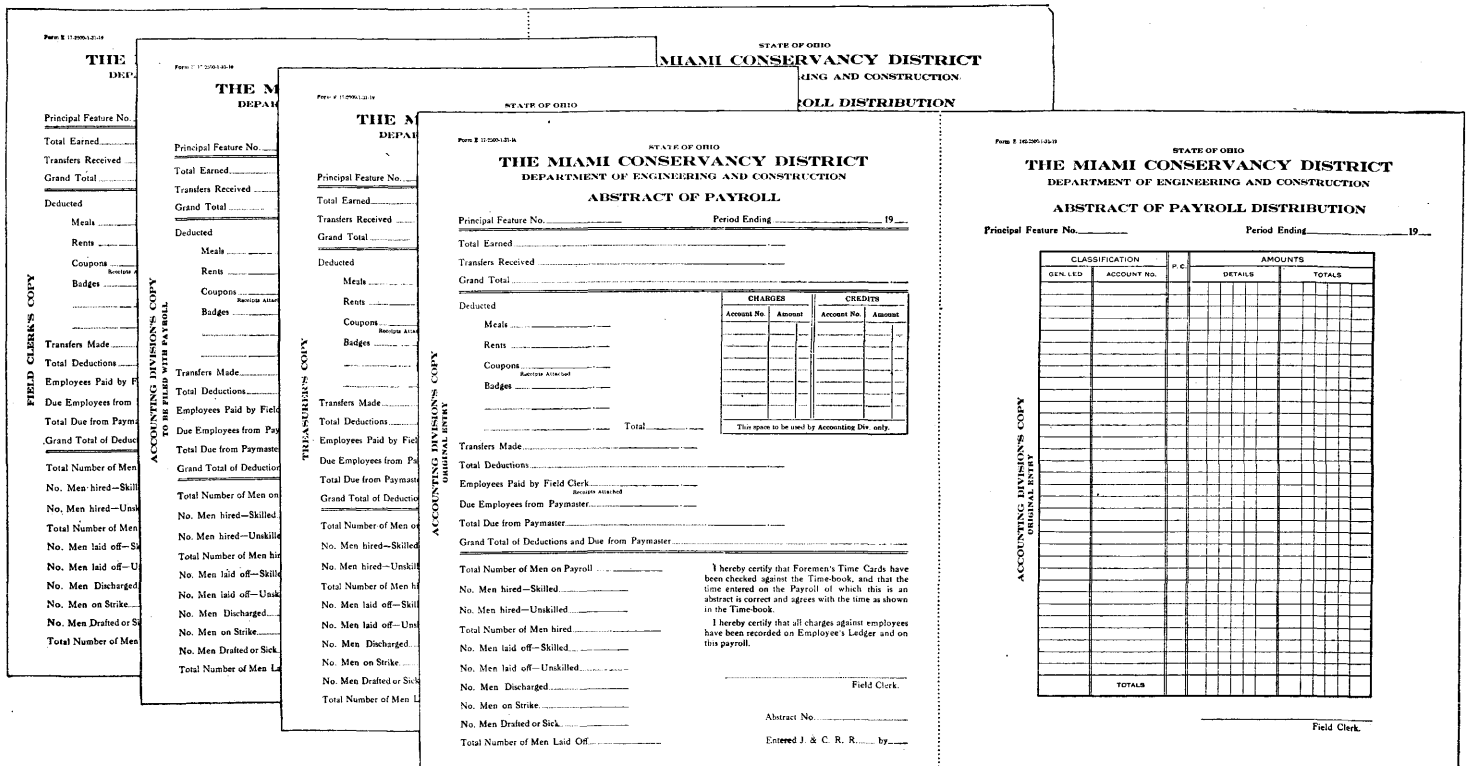


FIGURE 4—ABSTRACT OF PAYROLL AND OF PAYROLL DISTRIBUTION

to help identify men and prevent irregular practice on the part of laborers. The pay period ended on Tuesday and all payrolls were paid by the end of the week.

At the beginning of the work the pay period was semi-monthly for all employees. This was later changed to four periods a month, and finally to weekly periods. The latter agreed with the general practice in the community and during the war period it was difficult to hold labor on any longer basis.

Quitters and discharged men who demanded payment immediately were paid by the field clerk. Each field clerk was under bond and was given advances by the treasurer for this purpose. Upon advancing money to pay labor, the field clerk took up the

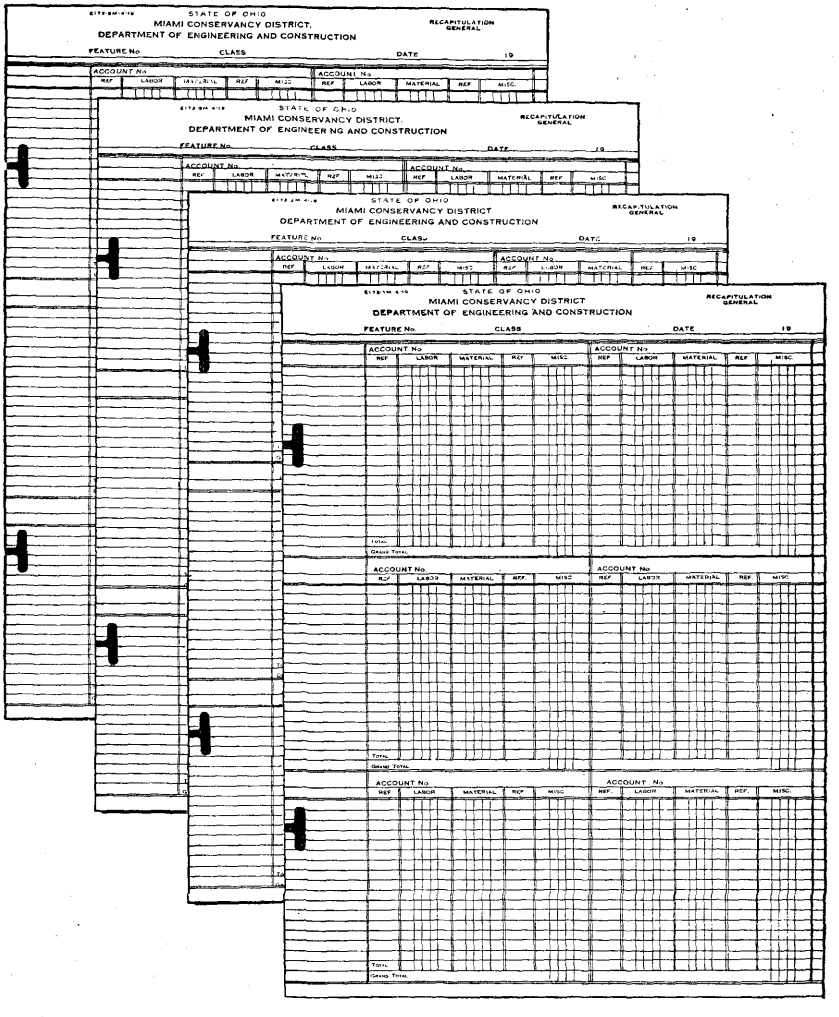


FIGURE 5—RECAPITULATION SHEETS, FORM E-172

wage receipt, made the entry in the advance column of the payroll, and was reimbursed for such advances by the paymaster.

Bookkeeping. The assembling of labor cost in the headquarters office began with the labor abstract and distribution sheet (Figure 4). These sheets showed the total labor earnings, deductions, etc., which agreed with the amounts on the timebook and payroll. They were forwarded with or immediately following the payroll. The totals on the abstract affecting each controlling account were entered in the journal. Total earnings were debited to feature items, deductions were credited to the various operations for which the deductions were made and the net amount due was credited to unpaid labor (G. L. 41). The distribution sheet was posted by the cost clerk to recapitulation sheets (Form E-172, Figure 5) on which were columns for each account number and sub-columns for labor, material, and miscellaneous. There was also a reference column in which was posted reference to original source of entry. The journal was posted to the general ledger by use of general classification sheets (Form E-171, Figure 6) which summarized the amounts for each controlling account and from which the postings were made in the general ledger proper. At the close of the month the columns of the recapitulation or detail sheets were footed and totals carried to the appropriate detail cost ledger. As explained in the chapter on cost classification, there were three classes of cost: G. L. 31 for feature cost, G. L. 32 for plant, and G. L. 33 for operation accounts. Recapitulation sheets for the three controls were the same except for color, and the detail sheets were assembled in three books for convenience in posting to the three ledgers. Before posting to the ledger each book was totaled and balanced with the control.

For convenience of bookkeeping, the expense of carrying casualty insurance was added, on the distribution sheet, to the total earnings for labor. This was a certain rate per one hundred dollars for different classes of employees, the rate being fixed by the State Industrial Commission. The rate being known, the field clerk simply added the amount to the charge for each account on his distribution sheet and the amount went into feature cost along with the regular labor earnings. Credit for the amount added went to the reserve account (G. L. 47) described in Chapter IV (page 40).

Vacation and Sick Leave. Vacation and sick leave with pay was granted to certain classes of employees. As a general rule, this privilege was granted only to the salaried class or to those who were not allowed pay for overtime. For the first three years of the District's operations, individual vacation time was allowed to accumulate. This was changed in January, 1921, so that thereafter all vacation with pay had to be taken in the year in which it accrued. One day a month was allowed for vacation and two days a month for sick leave. As the work on certain features drew near completion, it was realized that some leave had accrued which had not yet become a part of the cost, and to avoid belated charges to cost after features had been reported as completed, a

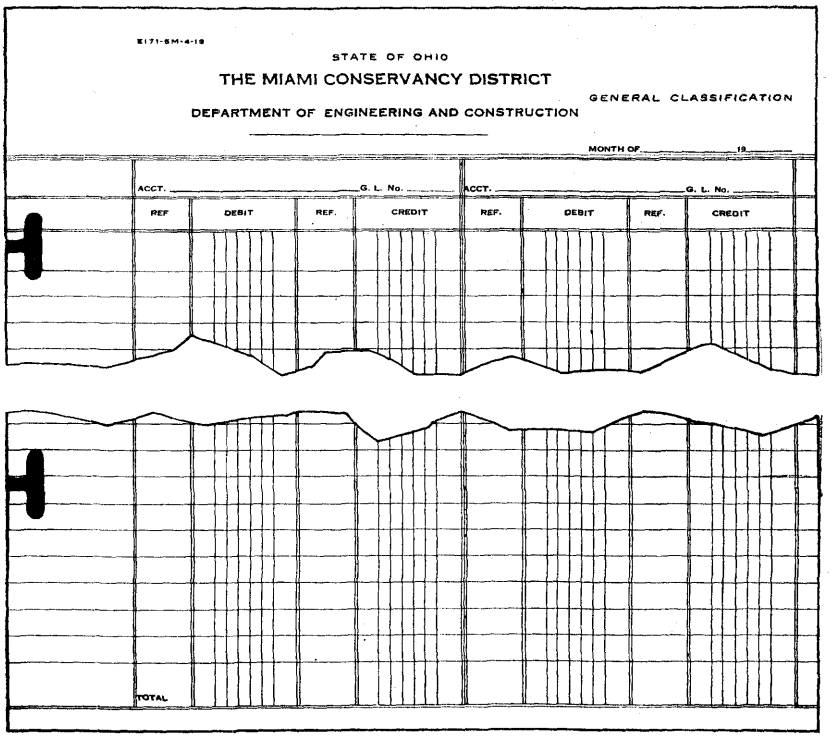


FIGURE 6—GENERAL CLASSIFICATION SHEETS, FORM E-171

plan was adopted of adding a certain percentage to labor cost for this purpose and crediting the addition to the reserve account. Then, when vacation time was paid, this reserve was charged. The amount to be added was estimated at three percent for field forces and five percent for office forces to cover both vacation and sick leave. For convenience this was added to the rate charged for casualty insurance and both were carried into the cost with one operation. A subdivision of "Reserve Account" G. L. 47 was kept to indicate how much had accumulated for each purpose.

CHAPTER VI

ACCOUNTING FOR MATERIALS AND SUPPLIES

The accounting for materials and supplies properly begins with their purchase. However, it is not the intention to discuss the technique of purchasing here. It will be sufficient for an understanding of the accounting and business methods of the District to describe briefly the purchasing organization, records and forms, and their relation to the accounting for the District.

Purchasing and Purchase Records. Purchasing was in charge of a separate division located in the headquarters office and reporting direct to the chief engineer. The purchasing agent had nominal jurisdiction over warehouses to the extent of responsibility for materials to be carried in stock. In theory, all purchasing for the District was done by the purchasing agent, but it often happened that division engineers and field clerks, acting under the general supervision of the purchasing agent, bought articles of small value which were not in stock in the warehouse. The garage superintendent issued most of the orders for car repairs and supplies for the garage. The steward did considerable purchasing for the messes and stores, buying especially foodstuffs of a perishable nature.

For the larger purchases, bids were secured after advertising, which was sometimes informal by circular or even by telephone. The question of advertising and the methods of securing bids were left largely to the judgment of the purchasing agent.

For construction materials and machinery, specifications were prepared by the engineers and construction manager, but for miscellaneous purchases and material for stock the specifications were usually prepared by the purchasing division from information secured from the master mechanic, superintendents, and others.

The purchasing office was organized into sections, each of which handled certain classes of purchases. The larger and more important articles were handled by the purchasing agent personally. One man was responsible for foodstuffs and supplies for sale in stores, another handled repair parts for machinery, etc.

Theoretically, all articles purchased should go through the general warehouse and from there be issued to the feature. In practice, bulky articles and carload materials were shipped direct to the work where they were to be used, and often charged to the item of work direct without going through the warehouse accounts. This short-cut saved considerable expense in the case of articles that could be handled in this manner without confusion. In most instances the records were put through the warehouse. Each division office was supplied with a stock of warehouse orders (Form E-9) and demand was made on the general warehouse by the use of these orders. In the case of telephone and verbal orders, confirmation on the regular form was insisted on as a matter of record. If the articles wanted were in stock, immediate delivery

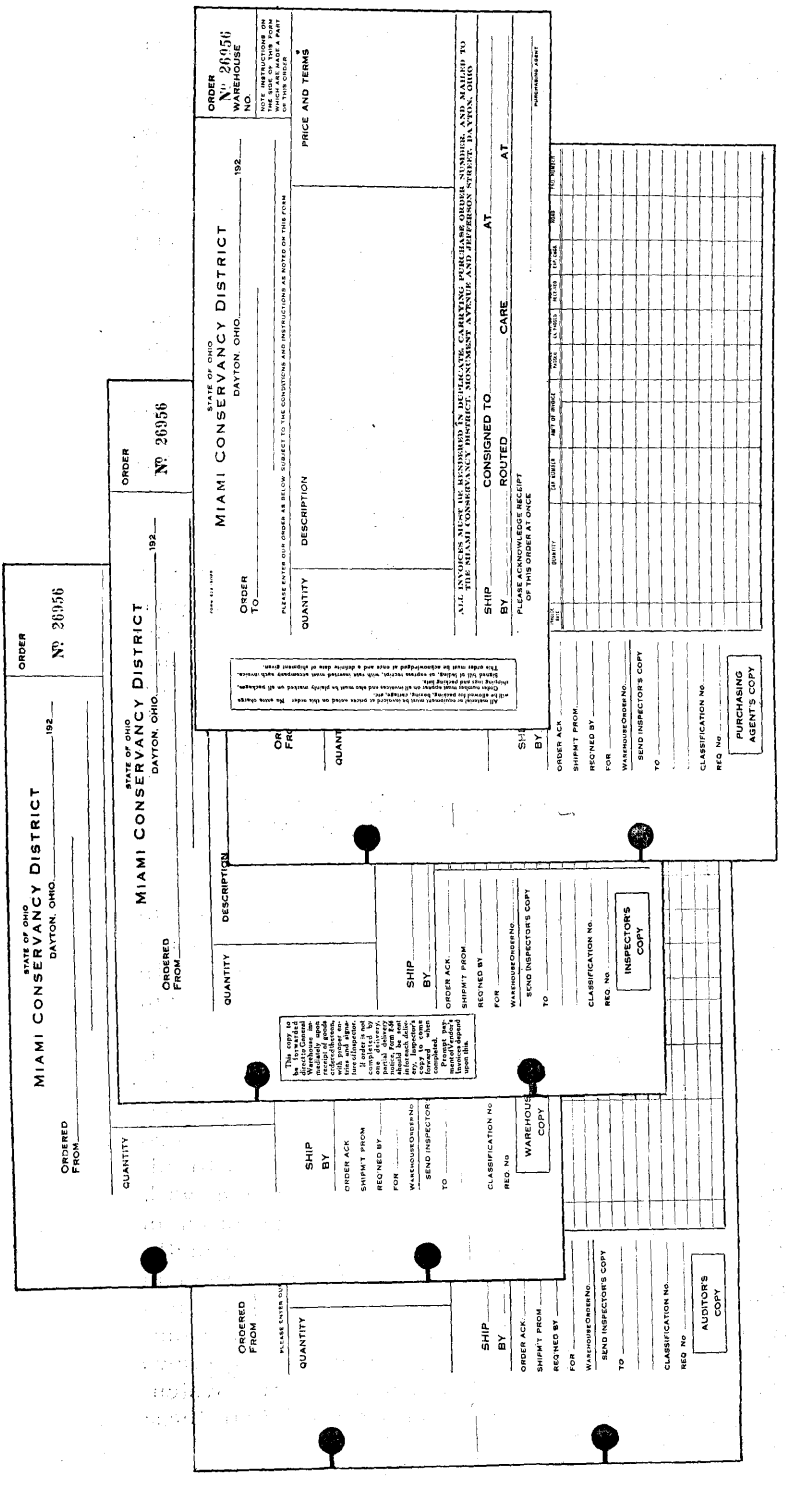


FIGURE 7—GENERAL PURCHASE ORDER, FORM E-23
The various copies were differentiated by color.

was made from the warehouse, but if not, the warehouse superintendent made out a purchase requisition on the purchasing agent. No standard form was used for advertising, which, as stated, was often done by letter or verbal inquiry. Figure 7 is a copy of the general purchase order. The first copy went to the vendor, one copy remained in the purchasing agent's files, one copy, known as the "Inspector's Copy" was forwarded to the receiving office or person, and one copy went to the auditor. Upon receipt of the material, the receiving office listed articles received on the inspector's copy, signed and forwarded it to the purchasing agent, where it was compared with the invoice and used as a basis for approving the payment. With this system it was not necessary to send the invoice to the receiving feature for O. K., but usually a copy of the invoice was sent for the information of the receiving office. Every order was numbered in advance and the number served as the basis of the purchasing agent's file. A cross reference to the warehouse order number and the purchase requisition number was made on the purchasing agent's copy, so that the file could be readily located if any one of the numbers was known.

A more informal order form was used for purchases made in the field. This was called an "Emergency Purchase Order" (Form E-205) and a copy is shown as Figure 8. The original of this order went to the vendor, one copy was retained by the purchaser, one copy was sent immediately upon issue to the purchasing agent for his approval, and one was retained until receipt of the goods and was used as the inspector's copy as outlined above. In this case, the invoice was sent to the Dayton office along with the inspector's copy with recommendation for payment. It was required that every invoice received be tied to some order by number, thus giving an excellent check against duplicate payments.

A weak point that develops in any plan of allowing field purchases, is that it is almost impossible to get field employees to issue orders in advance. They will order by telephone or verbally and later confirm by written order if they do not forget it. In some cases they do forget it and the order is written upon receipt of the bill, for record purposes only. But, on the whole, the use of the emergency purchase system is economical because it permits the securing of minor and unusual articles at less expense and in less time than if it is rigidly required that all materials be secured by a central purchasing department. It also reduces to a minimum the necessity for field employees to advance their own funds for such purposes. In construction work it is impossible to foresee every little requirement and order in advance. Unforeseen conditions which require changes in methods and plans are encountered. Most unexpected breaks occur in machinery. Emergency purchases are more common than in a concern where the work is routine. Any saving in price is incomparable to the loss which might be sustained by forcing crews and equipment to wait for minor supplies or parts. System is necessary in buying, but it must be so arranged that these

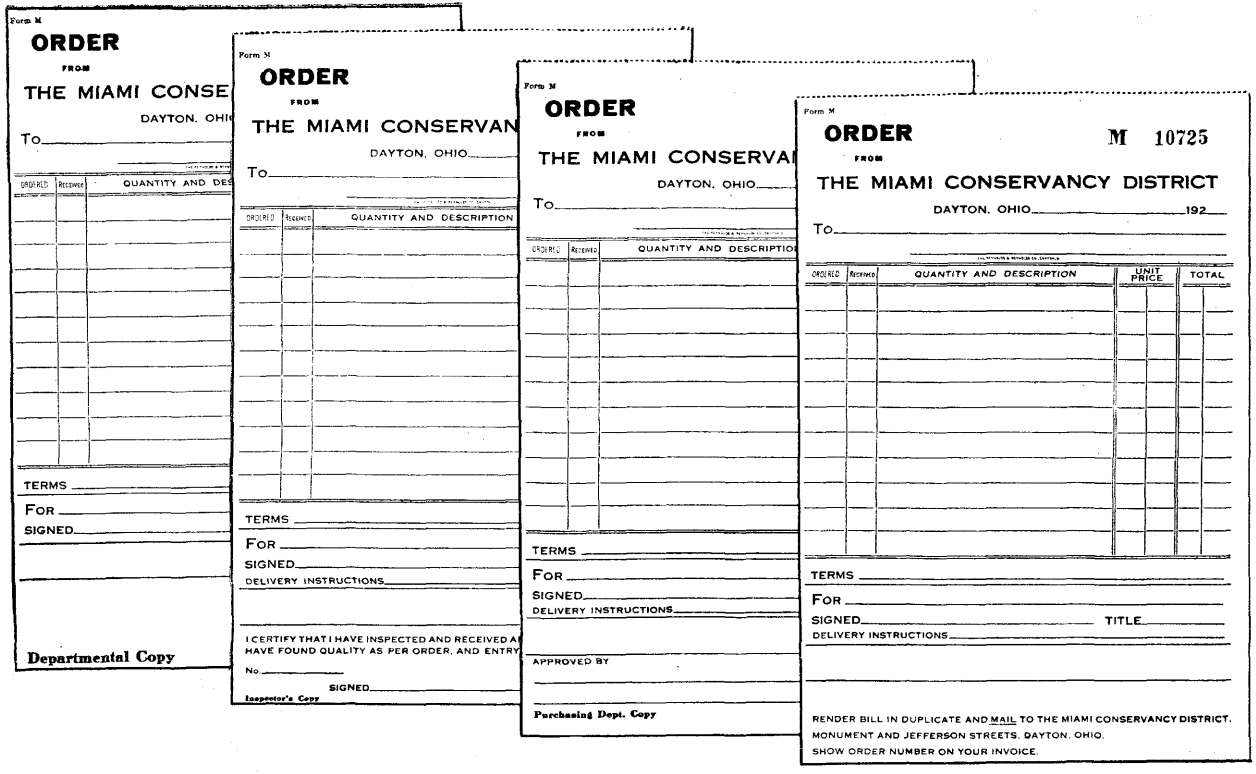


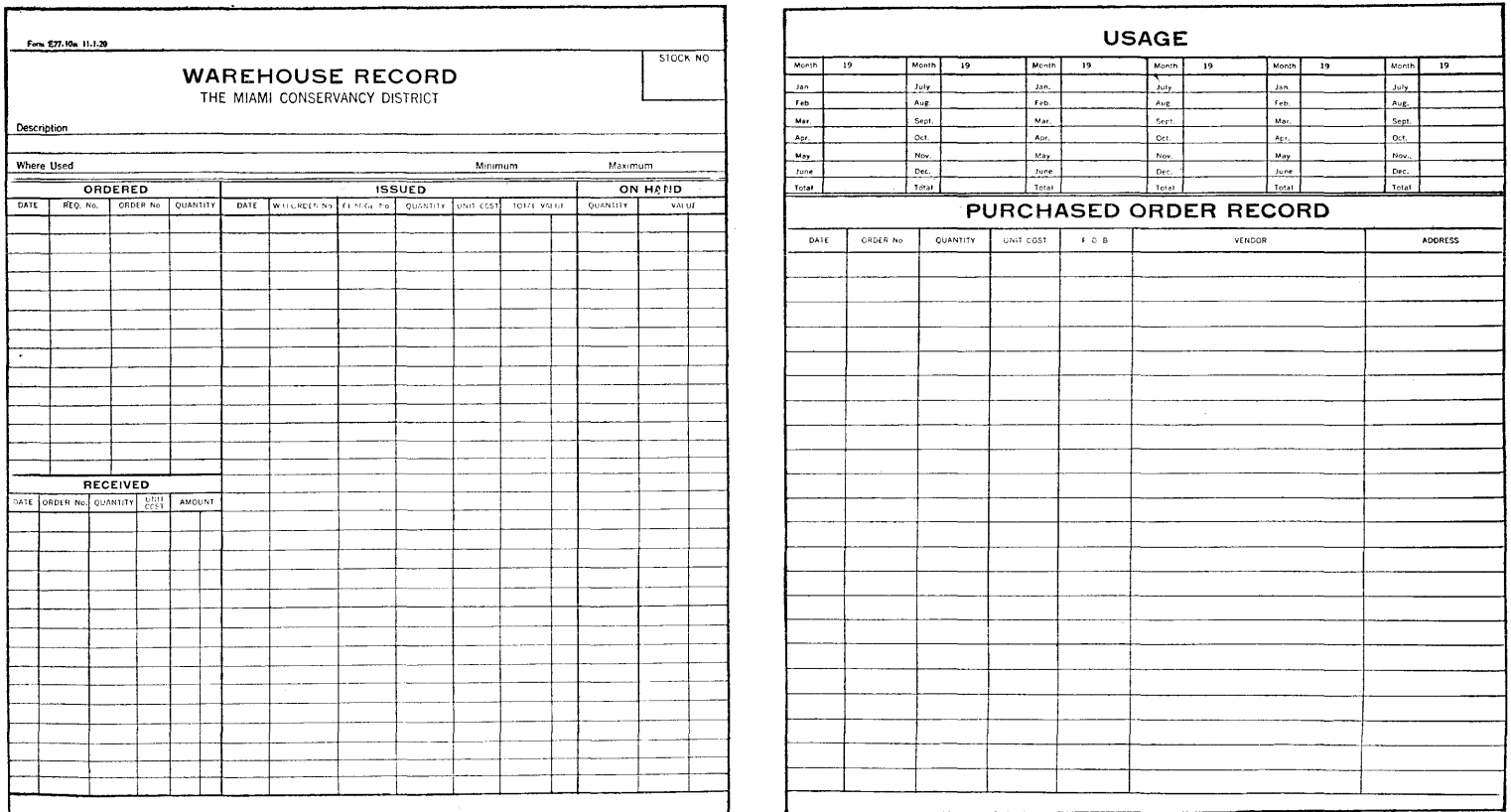
FIGURE 8—EMERGENCY PURCHASE ORDER, FORM E-205
The various copies were differentiated by color.

emergencies can be met with the least possible delay. Too strict adherence to regulations may easily result in innumerable delays and expense. There is also another phase of the matter. Construction men are busy getting the job done, and in the rush of work often fail to anticipate what afterwards seem to be obvious requirements, and a heavy burden is put on a purchasing department if it is required to meet all conditions imposed by the work and at the same time make all purchases at lowest possible prices.

The purchasing division's file of orders may be roughly divided into two classes: open and closed. Unfilled orders were filed in post binders, a separate binder being used for different classes of purchases, and in some instances where a great many orders were given to a single firm a binder or portion of a binder was assigned to a firm. Geographical classification was also used, the orders placed with Dayton firms being kept separate from orders placed at distant points. The "follow-up" system consisted in merely leafing over the unfilled order binders. When an order was filled, the record was completed by transferring to the purchasing agent's copy the information shown on the inspector's copy and the order was then taken out of the open file and placed in a vertical filing case by firm name, all papers relating to a given order being placed in the same folder. The inspector's copy with the certificate of delivery thereon, went with the invoice when forwarded for payment and was ultimately filed with the invoice and voucher in the accounting division.

Transportation. Freight is a very considerable part of material expense on construction work, and the adoption of a competent traffic plan is important. In the District's organization, transportation matters were handled by an expert traffic man in the purchasing division. Routing of shipments was made by him and he approved all bills for freight and express before payment.

The Warehouse System. The general warehouse was located in Dayton and there was a field warehouse at each of the larger features except the Dayton local improvement which ordered direct on the general warehouse. Materials issued from the main warehouse to features went through the local warehouse records although they did not physically become a part of the local warehouse stock in a great many instances. Control accounts were kept in the accounting division for each warehouse, but details were shown on stock ledger cards kept in the warehouses. At the beginning of the work, a stock ledger card was made out for each individual purchase of any article. Under the original plan these were to be made out by the purchasing division and forwarded to the warehouse with a copy of the invoice or order, but the scheme failed to work satisfactorily and it was changed, a card being adopted similar to the standard stock ledger sheet. Figure 9 (Form E-77) illustrates the card used by the general warehouse and Figure 10 (Form E-89) is the field warehouse card. They are essentially the same, the difference being mainly in size and arrangement of columns. In the heading, the usual space is provided for articles, description, etc. Columns are pro-



Form E27-10m 11-1-29

WAREHOUSE RECORD

THE MIAMI CONSERVANCY DISTRICT

STOCK NO

Description

Where Used

Minimum

Maximum

ORDERED				ISSUED						ON HAND	
DATE	REQ. No.	ORDER No.	QUANTITY	DATE	WITHDRAWN NO.	CLAIM No.	QUANTITY	UNIT COST	TOTAL VALUE	QUANTITY	VALUE

RECEIVED					
DATE	ORDER No.	QUANTITY	UNIT COST	AMOUNT	

USAGE

Month	19	Month	19	Month	19	Month	19	Month	19	Month	19
Jan.		July		Jan.		July		Jan.		July	
Feb.		Aug.		Feb.		Aug.		Feb.		Aug.	
Mar.		Sept.		Mar.		Sept.		Mar.		Sept.	
Apr.		Oct.		Apr.		Oct.		Apr.		Oct.	
May		Nov.		May		Nov.		May		Nov.	
June		Dec.		June		Dec.		June		Dec.	
Total		Total		Total		Total		Total		Total	

PURCHASED ORDER RECORD

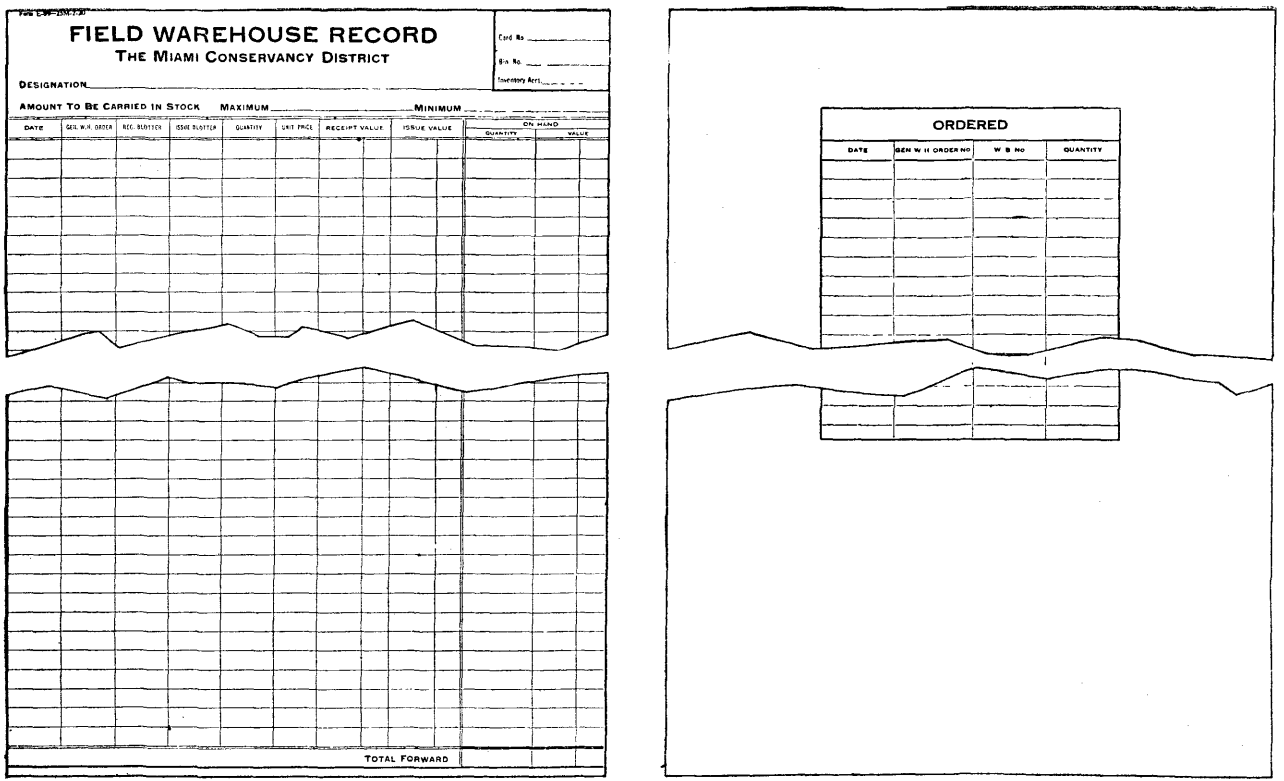
DATE	ORDER No.	QUANTITY	UNIT COST	F. O. B.	VENDOR	ADDRESS

FIGURE 9—WAREHOUSE RECORD CARD, FORM E-77

This was used in the general warehouse only. The view on the left is the front; the one on the right is the back.

vided to show amounts ordered, received, and issued. On both cards space is provided for money accountability as well as item accountability. The total of card balances at any one time was supposed to equal the balance charged against the warehouse on the books of the accounting division. During the first two years of the work, great difficulty was experienced in the warehouse accounting, but gradually the system was worked out on a practicable basis and very satisfactory results were obtained by the system here described. The variation between the warehouse man's record and the control became very small. This card record was in effect a perpetual inventory. Receipts and issues were posted to the card and balances carried forward promptly. The warehouse force was continually checking card balances with stock on hand, and periodical test checks were made by a warehouse inspector from the accounting division. Of course, differences were unavoidable, especially in bulk stock such as coal, lumber, iron and steel, oil, etc., where it was not feasible to measure or weigh each issue accurately. But, on the whole, these differences were surprisingly small in comparison with the volume of business handled. As soon as any variation was detected, adjustment was made. The aim was always to make the book balance of materials and supplies on hand reflect actual conditions as nearly as possible, and to enable the responsible employees to know the current stocks by reference to the card balances. Cards were also of value as price records and their careful maintenance made a purchasing agent's price book unnecessary. For some classes of material it was impracticable to post the cards at the time of making an issue. Bulky material was unloaded as near as possible to the place of consumption and necessarily much of the record of use came from reports of foremen, supplemented by test checks of balance on hand from time to time. Night foremen usually carried a key to the warehouse and did not always report even the taking of articles from the warehouse. Therefore, it cannot be claimed that the warehouse accounting, as kept by the District, furnished an adequate system upon which to base personal accountability for District property. The expenditure necessary to provide such a system would have been out of proportion to the benefits derived and would have unduly hampered the work of construction. The system provided, however, a basis of obtaining costs approximately correct and the moral effect of even nominally holding a warehouse man responsible for the use of material was conducive to economy. On construction work of this sort, a compromise is necessary between accurate accountability and economy of operation.

In addition to the stock ledger card, the field warehouse records consisted of a receiving blotter (Figure 12, Form No. 180) and issuing blotter (Figure 13, Form E-181). Everything received on the job was listed on the receiving blotter whether it went into warehouse stock or not. If it went direct to the work, an entry was immediately made on the issuing blotter and a record was not necessary on the warehouse card, but even in such cases it was found convenient to make a card for future



FIELD WAREHOUSE RECORD

THE MIAMI CONSERVANCY DISTRICT

Card No.
Bin No.
Inventory Acct.

DESIGNATION

AMOUNT TO BE CARRIED IN STOCK MAXIMUM MINIMUM

DATE	GEN. W.H. ORDER	REC. BLOTTER	ISSUE BLOTTER	QUANTITY	UNIT PRICE	RECEIPT VALUE	ISSUE VALUE	ON HAND QUANTITY	ON HAND VALUE

TOTAL FORWARD

ORDERED

DATE	GEN W H ORDER NO	W B NO	QUANTITY

FIGURE 10—WAREHOUSE RECORD CARD, FORM E-89

This was used in the field warehouses only. The view on the left is the front; the one on the right is the back.

reference. The cards, being alphabetically arranged, served as an excellent index when information was wanted as to prices and the movement of materials. It was through the blotters that charges and credits were made to local warehouses and they served as original sources of entry for the accounting division. They were made in duplicate, the first copy being sent to the accounting division daily, and the carbon retained for field record. They were self-balancing, having both debit and credit columns.

Upon receipt of a shipment, articles were listed on the receiving blotter and the amount entered in the debit column as a charge against the inventory account (G. L. 16).

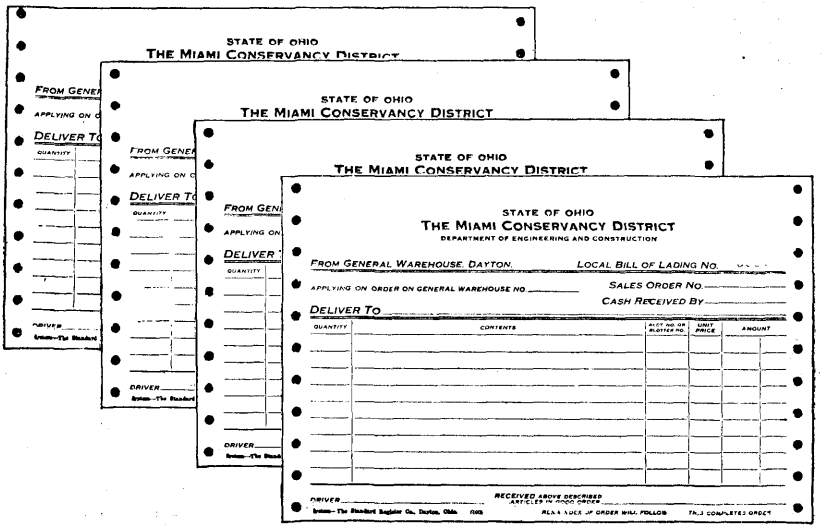


FIGURE 11—BILL OF LADING
The various copies were differentiated by color.

The credit entry was in the appropriate column for "Direct Purchases" (G. L. 19), "General Warehouse," "Transfer," or "Return from Work," depending upon the source from which goods were received. Reference columns were provided to indicate the document from which entry was made.

When material was issued to the work, it was listed on the issue blotter. The debit entry was in the column provided therefor, a sub-column indicating the account number to be charged. The credit entry was in the column for the proper inventory account. Issue blotters were signed by the person taking or authorizing the issue and were approved by the superintendent.

When these blotters were received in the accounting division, entries were made from the column totals (except in the cases where sundry accounts were involved, when a recap was made showing the amount affecting each account) to the materials or miscellaneous column on the recapitulation sheets described on

Form E 180 3m Set 8-20

STATE OF OHIO
MIAMI CONSERVANCY DISTRICT
DEPARTMENT OF ENGINEERING AND CONSTRUCTION

RECEIVING BLOTTER

INSTRUCTIONS—Every article received must be listed on the receiving blotter. If immediately applied on the work and not carried in stock an entry will be made at the same time on the issuing blotter showing account number to be charged. A sheet should be filled before sending to the Dayton office, except that a blotter must be sent in from every job every Saturday and at the end of each month whether or not the sheet is full.

Form E 180 3m Set 8-20

STATE OF OHIO
MIAMI CONSERVANCY DISTRICT
DEPARTMENT OF ENGINEERING AND CONSTRUCTION

RECEIVING BLOTTER

INSTRUCTIONS—Every article received must be listed on the receiving blotter. If immediately applied on the work and not carried in stock an entry will be made at the same time on the issuing blotter showing account number to be charged. A sheet should be filled before sending to the Dayton office, except that a blotter must be sent in from every job every Saturday and at the end of each month whether or not the sheet is full.

	Date	CAR Initial	CAR No.	Seal Rec. Express Fit. Notice	Receiving Report No.	Quantity	ITEM	VENDOR	P O No. S O No.	Debit G L 16	Checked Acct Dir	Purchases G L 19	CREDIT ACCOUNTS: GEN. WAREHOUSE W B No.	GEN. WAREHOUSE Amount	TRANS. and MISC No.	TRANS. and MISC Cr Acct No.	TRANS. and MISC Amount	RETURN FROM WORK Acct No	RETURN FROM WORK Amount	
																				1
																				2
																				3
																				4
																				5
																				6
																				7
																				8
																				9
																				21
																				22
																				23
																				24
																				25
																				26
																				27
	TOTALS																			

March of ..... 192 ..... No. A .....

Signed by .....

Warehouseman
Receiving Clerk

Foreman .....

FIGURE 12—RECEIVING BLOTTER, FORM E-180
This was in general use in all warehouses. The two copies were differentiated by color.

page 50. In this way the movement of material and supplies was recorded and assembled for posting to the ledger accounts the same as for labor, and when the columns on the recapitulation sheets were footed and totaled, only one entry to the ledger was necessary for the entire month's business.

For the general warehouse at Dayton, receipts were handled in the same manner. It will be noted that there is a column on the field receiving blotter for credit to the general warehouse and the general warehouse received no credit until receipt was acknowledged by an entry on these blotters. Issues from the general warehouse were recorded on bills used in the Standard Register. (Figure 11.) These were written in quadruplicate, the original and one copy being sent to the receiving job as an invoice, the third copy being retained by the warehouse, and the fourth copy going daily, on the register roll, direct to the accounting division. The fourth copy served as a tickler to check job receiving blotters. It was required that all of them be accounted for and if issues were made to features on which there was no warehouse, and hence no receiving blotter, charge was made with credit to the warehouse account on a special voucher prepared in the accounting division. The originals or white copies of the bills, after being signed by the receiving feature, were forwarded to the accounting division where they were filed numerically to support the entries on the various receiving blotters and special vouchers referred to. No changes were allowed on either the bills or blotters after they were sent in, errors being corrected by adjustment entries on the blotters or by correction bills with reference to the original entries by number.

In the early stages of the work, a great deal of difficulty was experienced in getting prices by the time shipments were received. Often materials were received and used before invoices were received. This was particularly true of repair parts on which prices could not be obtained in advance. To overcome this difficulty, an estimated price was put on the warehouse copy of the purchase order, and if the actual price was delayed, this estimated figure was used for the initial entry. Invoices, when passed for payment, were checked from the receiving blotters in the accounting division and adjusted through the use of adjustment account G. L. 15, described on page 35. If the differences were large, adjustment was made to the accounts affected by the original entries.

Direct Charges. Theoretically, all charges to features for purchases should have gone through the warehouse accounts, but as a matter of fact there were many items which it was inconvenient to so handle. Some of the field clerks' purchases were examples. Such charges were made direct to items of work from the first entry in the invoice register or from the disbursement voucher register. Charges were assembled on the recapitulation sheets referred to on page 50 from all books of original entry.

Goods in Transit. Reference was made in Chapter IV, on page 36, to general ledger account No. 19 which carried the amounts of invoices received pending approval. Some such ac-

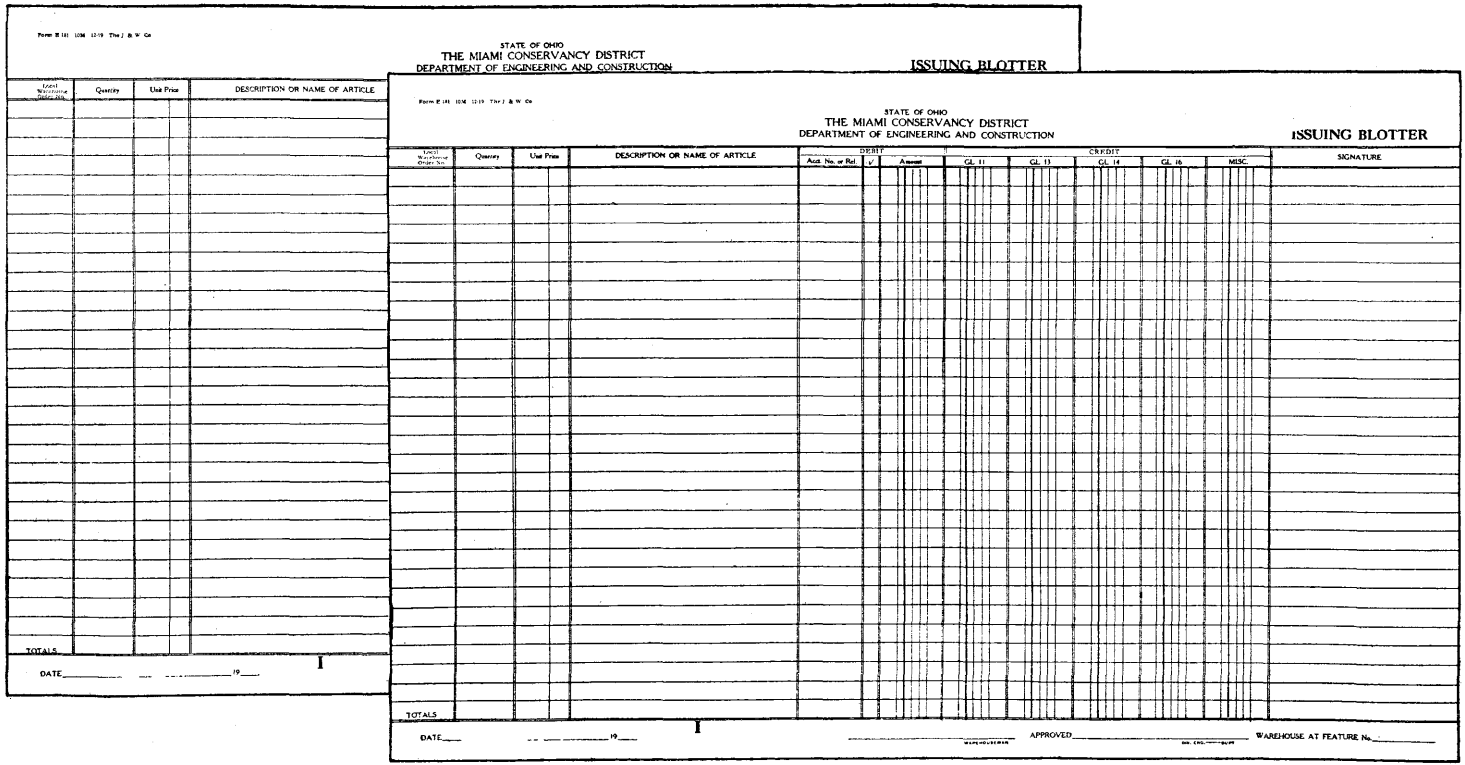


FIGURE 13—ISSUING BLOTTER, FORM E-181
This was in general use in all warehouses except the general warehouse. The two copies were differentiated by color.

count was necessary if the liability for purchases was to be taken up immediately upon receipt of invoice and if a proper record of invoices received was to be kept. The debit to G. L. 19 came from the invoice register and was made at the time the invoice was recorded and credited to accounts payable. G. L. 19 was cleared by the credit shown in the G. L. 19 column on the various receiving blotters. If the entries on the receiving blotters had been in all cases for the same amounts that were taken up on the invoice register, the clearing of G. L. 19 would have been a simple matter, but occasionally corrections were made or invoices lost. This involved numerous adjustments. Sometimes invoices were changed and then charged direct, leaving an erroneous balance in G. L. 19 and corresponding credit in accounts payable. The objection to an account of this nature is this difficulty of keeping it under control. (See discussion of invoice register, page 87.)

CHAPTER VII
PLANT AND EQUIPMENT

Definition of plant as used in accounting for the Miami Conservancy District is given on page 26 in the discussion of classification of cost for plant. The purpose of using plant accounts rather than to charge the cost of machinery and its installation direct to features is twofold:

1. To distribute the investment in plant over the entire period of construction in the cost records.
2. To enable a proper proportion of the investment in plant to be charged to different features using the same equipment.

To these there might be added the advantage of accumulating cost of equipment and machinery and its erection in a separate group of accounts for statistical purposes.

The distinction between **plant** and **equipment** should be made clear before discussing the accounts for this class of expense. Any expense for labor, material, supplies and equipment involved in the building of a plant used in the production of some other structure or product, is a proper charge to plant. Equipment is composed of the non-expendable articles of machinery, forming parts of a plant, which have a value separate and apart from the plant and are capable of being transferred from plant to plant or used independently. A screening and washing outfit for sand and gravel is a good example. As a working unit capable of turning out washed sand and gravel, it is a true plant. The motors, crushers, screens, etc., installed in the plant, are items of equipment. For convenience in accounting, however, the term plant has been applied also to the aggregate cost of small tools or utensils, assembled in one account, later to be charged off to features gradually as depreciation. For example, the plant account numbered 06, "Miscellaneous Tools and Equipment," referred to on page 27 is a plant of this nature.

The first difficulty met in accounting for equipment is to determine where to draw the line between expendable and non-expendable articles. The latter term describes equipment in a general way, but there are numerous articles embraced within the term that are so small in value or whose life is so short that it is impracticable to class them as equipment. In the classification adopted by the District, an arbitrary value basis was used. Any article costing less than $100 was considered outside the class of equipment, regardless of its period of usefulness. This was done to facilitate accounting, as it was not desired to encumber the equipment records with the thousands of small articles which were difficult to trace or identify and the cost of which did not unduly affect the current unit cost of items of work. This arbitrary division is not altogether satisfactory. It does save accounting, but many articles such as, for example, office equip-

ment, are buried in cost and yet have a very considerable sale value. In the writer's opinion, a good rule to follow is to charge to equipment all articles which can be identified by number or otherwise and which have a life of not less than six months under ordinary wear and which can be transferred from one installation to another without losing their identity. Small tools may be carried in a tool account, but it is impracticable to account for them individually under the usual conditions surrounding construction work.

The system used for marking District equipment was a combination of letters and numbers. Articles in each class or kind of equipment were numbered in series beginning with one. This number was preceded by another one, arbitrarily assigned, indicating the class or kind, and also by the initial letter of the equipment name for further ready identification. Thus D-16 indicated dragline excavators. The complete number for machine No. 1 was therefore D16-1. Twenty was the number for motors, so motor No. 10 carried the number M20-10. Sometimes these numbers were put on metal tags and attached to the machines; sometimes the numbers were stamped on with steel dies; and whenever practicable, the number was painted on the machine in some conspicuous place.

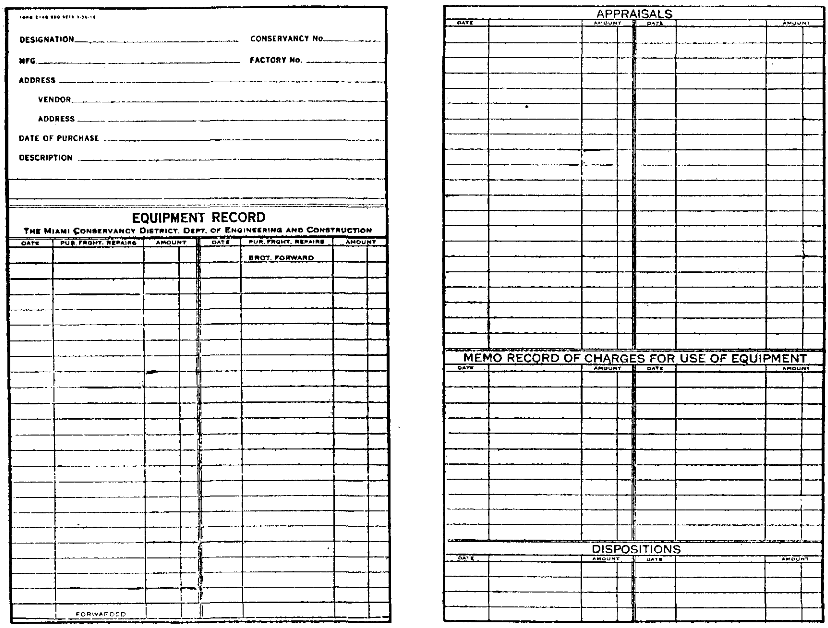
During the period of organization and assembling and installation of plant, equipment went on the jobs so rapidly that it got ahead of the accounting. It was not until the late summer of 1918 that an adequate record of equipment on the job was obtained and an accounting system worked out for it. At that time the numbering was completed and the office record brought up to date. It was always difficult to keep it up to date. Maintaining the record was a job which was not compulsory and it happened that the equipment man was occasionally transferred to work supposedly more important, with the result that the equipment record suffered.

The equipment record kept by the accounting division centered about the equipment card (Figure 14, Form E-14). It contained a space in the heading for name of article, number, manufacturer, date of purchase and description. Then followed the record of use, in the form of transfers, appraisals, charges for depreciation, and final disposition. When equipment was received, four copies of the card were prepared. One was retained in the accounting division, one was furnished to the equipment man, one was given to the chief engineer, and one was supposed to follow the equipment as a field record. It did not always follow. The accounting division record was kept up to date in a fairly satisfactory manner, but the transfers from job to job were so frequent, and it was so difficult to get the construction forces to report transfers, that the record frequently became incomplete.

All equipment was charged to some appropriate plant account, classification for which is given in Chapter III, and the cards were filed by plants. A cross index, alphabetically arranged, was maintained, so that cards could be readily found. In addition to the cards, the office engineer kept in his files a record of

the larger items of machinery, with complete specifications and drawings. These were necessary in connection with the purchase of repair parts, replacements, etc.

As previously explained, the plant accounts contained not only the cost of the machinery and freight to site of work, but also cost of installation, dismantling, and major repairs in a great many instances. In fixing rates for depreciation all these expenses had to be taken into consideration. It was estimated that for equipment two percent per month of the first cost plus freight would be a suitable rental to charge each job on which it was



DESIGNATION CONSERVANCY No.
MFG. FACTORY No.
ADDRESS
VENDOR
ADDRESS
DATE OF PURCHASE
DESCRIPTION

EQUIPMENT RECORD
THE MIAMI CONSERVANCY DISTRICT, DEPT. OF ENGINEERING AND CONSTRUCTION

DATE	PUR. FRGHT. REPAIRS	AMOUNT	DATE	PUR. FRGHT. REPAIRS	AMOUNT
				BROT. FORWARD	
	FORWARDED				

APPRAISALS

DATE		AMOUNT	DATE		AMOUNT

MEMO RECORD OF CHARGES FOR USE OF EQUIPMENT

DATE		AMOUNT	DATE		AMOUNT

DISPOSITIONS

DATE		AMOUNT	DATE		AMOUNT

FIGURE 14—EQUIPMENT RECORD CARD
Front and back of card are shown.

used. The rate took into consideration the period of construction and the probable salvage value of the equipment upon completion of the work. No attempt was made in the beginning to fix different rates for different classes of equipment, but as time went on the rate was changed where it was found that more, or less, ought to be charged off as the work proceeded. In most instances two percent was found to be very satisfactory. For miscellaneous plant costs, a flat rate per month, varying to conform to the actual cost of installation and dismantling, was charged. An estimate of the probable life of the plant was, of course, necessary. In the case of motor vehicles two percent per month proved to be too much and the rate was lowered as the cars grew older and repairs became more extensive. All minor or current repairs were charged to operation, so that with this sliding scale of depreciation, the charge for use of equipment was fairly well equalized.

Transfers between jobs were made on a bargain and sale basis, much as though the deal were between independent business concerns. That is, the superintendent receiving the equipment was supposed to join with the superintendent transferring it in fixing a value. As a matter of practice, however, movement of equipment was usually ordered by the construction manager or master mechanic and neither they nor the superintendents were very much concerned about the records. The division engineer made out transfers (Figure 15, Form E-167) in quadruplicate, sent the original and one copy to the receiving feature after placing thereon his estimate of the value, kept one copy for his file, and sent the fourth copy to the accounting division, where it was used as a tickler to follow the transaction and as a means of keeping the equipment record. The receiving engineer, if he agreed on the price, signed the original copy of the transfer and forwarded it to the accounting division for entry. In case the two could not agree on a value, the matter was subject to arbitration. Usually the chief engineer or some one in his office fixed the price. Credit was then given to issuing plant and debit to receiving plant account.

The accounting division sent out depreciation lists every month charging the features at the prescribed rate for the use of all equipment shown charged to their plant accounts. These were checked in the field offices, account numbers against which to distribute the charges placed thereon, and the lists returned to the accounting division for entry of depreciation charges. Depreciation was charged as long as equipment was in possession of a feature unless notification was given of its availability for transfer. This requirement and the monthly lists which were forwarded to the job offices helped in keeping the record up to date.

Everything which left a feature, for which credit was to be given, was listed on the issuing blotter. When the transfer was made out, it was recorded on the blotter, credit being taken for the price named. The accounting division could not charge the receiving feature until the transfer was recorded on the receiving blotter for that feature. The debit was made, therefore, to a suspense account (065 C, referred to on page 31) until such time as it was taken up. The entries were as follows:

From the issuing blotter
  Dr. Suspense (065C)
    Cr. Transferring feature plant.
From the receiving blotter
  Dr. Receiving feature plant
    Cr. Suspense (065C)

The balance in 065C represented outstanding transfers and furnished an additional check on the movement of equipment. This worked both ways. If the transferring feature failed to record the transaction and the receiving feature did record it, the balance in 065C would be a credit. The objection to such an account was the detail work necessary to keep it under control, but it was worth while in order to get a check on movement of equipment and to properly record the cost. Numerous adjust-

ments, of course, were necessary because of differences in prices. It might be mentioned here that this system of transfers applied to materials and supplies as well as equipment, the only difference being in the accounts affected.

Salvage. Toward the close of the work the question of salvage became an important one. A salvage division was organized whose duty it was to put machinery in the best possible condition for sale. An account was opened to keep a record of the cost of this work. (See classification on page 31.) When a feature was completed and its equipment not required at any other feature, the equipment was transferred to the salvage division at a price agreeed on by the chief of that division and the transferring division engineer, credit for the agreed amount being given to feature plant. When all equipment used on a feature had been transferred to salvage, or otherwise disposed of, the feature plant was closed, the balance, either debit or credit, was absorbed in feature cost and a final cost report made. The disposal of equipment by the salvage division in no way affected this final cost report, even though the equipment might not be sold for several years after completion of the work, for it was estimated that on an average the sale price would just about clear the selling and repair expense. Equipment was supposed to be put in fair working condition before leaving the feature, but there was always something to be done to put it in presentable condition for sale. The excess in sale price over allowance made to feature plants went to cover this expense. For this reason the entire cost of the salvage division was closed into a general ledger account which represented the value of equipment not in use (G. L. 36).

It was not necessary that all sales of equipment go through

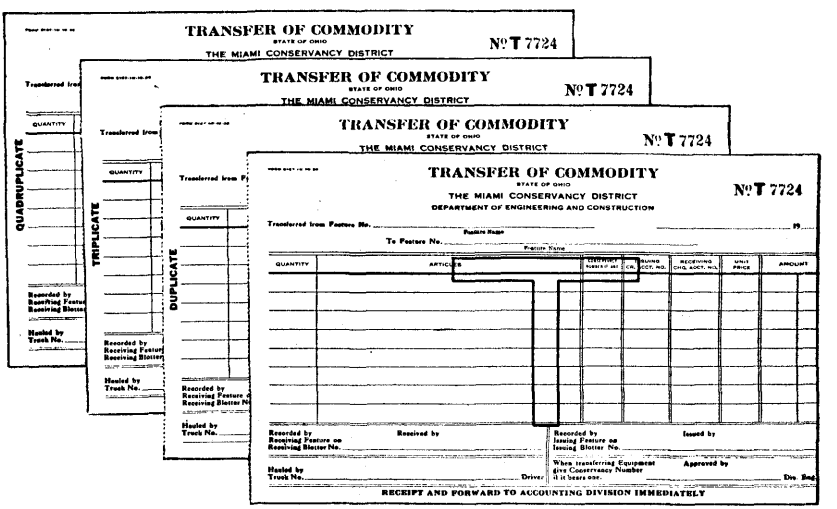


FIGURE 15—TRANSFER OF COMMODITY
The various copies were differentiated by color.

the salvage account. Many instances occurred where sale was made direct from the feature. In such cases, however, ten percent of the selling price was credited to the salvage account (066Y) to help pay the cost of general selling, all advertising and other selling expense being charged to the salvage operation account.

Upon completion of the railroad relocation, a large amount of track material was left on hand. The salvaging of this material was handled separately from equipment salvage. Most of the old track material was sold back to the railroad companies whose lines were relocated, and the proceeds credited direct to relocation cost. This credit was shown in a sub-account (Z) in the classification of railroad cost. (See page 24.)

CHAPTER VIII

INCIDENTAL OPERATIONS

Mention was made in Chapter III (pages 28 to 32) of accounts for operations which were incidental to construction work, but which took charges of a deferred nature. All such charges must ultimately be absorbed in feature cost, except, of course, those operated for revenue only. These accounts were similar to accounts for production factors or centers in factory accounting and were kept for the same purpose: viz., assembling the cost of some special unit or factor for statistical purposes and later distribution, on some equitable basis, to jobs or processes for which the factor was operated. The more important of these operations will now be discussed in more detail.

Shops. On each feature there was a small shop, where a variety of work was done, such as machine work, blacksmithing, carpenter work, etc. The expense of this work was charged direct to feature cost items when conditions made such action practicable, but much of the expense of these shops was assembled in shop cost (Acct. No. 055) and cleared each month by distribution to the work for which the shops were operated. Transactions in the field shops were not large, as most of the repair work was done by the general machine and electrical shops in Dayton. Both of these general shops were operated on a job order basis. Orders for work were supposed to originate in writing with the superintendent or construction manager, but in practice they were usually sent in by telephone, and from various sources. A piece to be repaired came into the shop and the shop clerk wrote out the order himself in accordance with instructions given him. There was never much time for planning, or for making drawings or bills of materials. Most repair work was in the nature of a rush job and the clerical work in the shop was much more than it would have been under a system requiring advance estimates and carefully worked out bills of material. The very nature of the work made it impracticable to have such a system, however, as almost everything ordered done was for an emergency and the job that was most urgent had precedence regardless of the date of order.

When the shop clerk wrote an order, it was numbered and one copy handed to the foreman who proceeded to do the work. The form of order is shown in Figure 16 (Form E-66). All labor performed under authority of an order was charged to that order by using the appropriate number on the employees' time tickets. For some time a separate stock room or warehouse account was established for the shop, and orders signed by the foreman were made on this stock room for materials and supplies. These order tickets, when filled, went back to the shop clerk. He asembled all material and labor cost by shop orders, added a percentage to cover shop overhead, and forwarded the order to

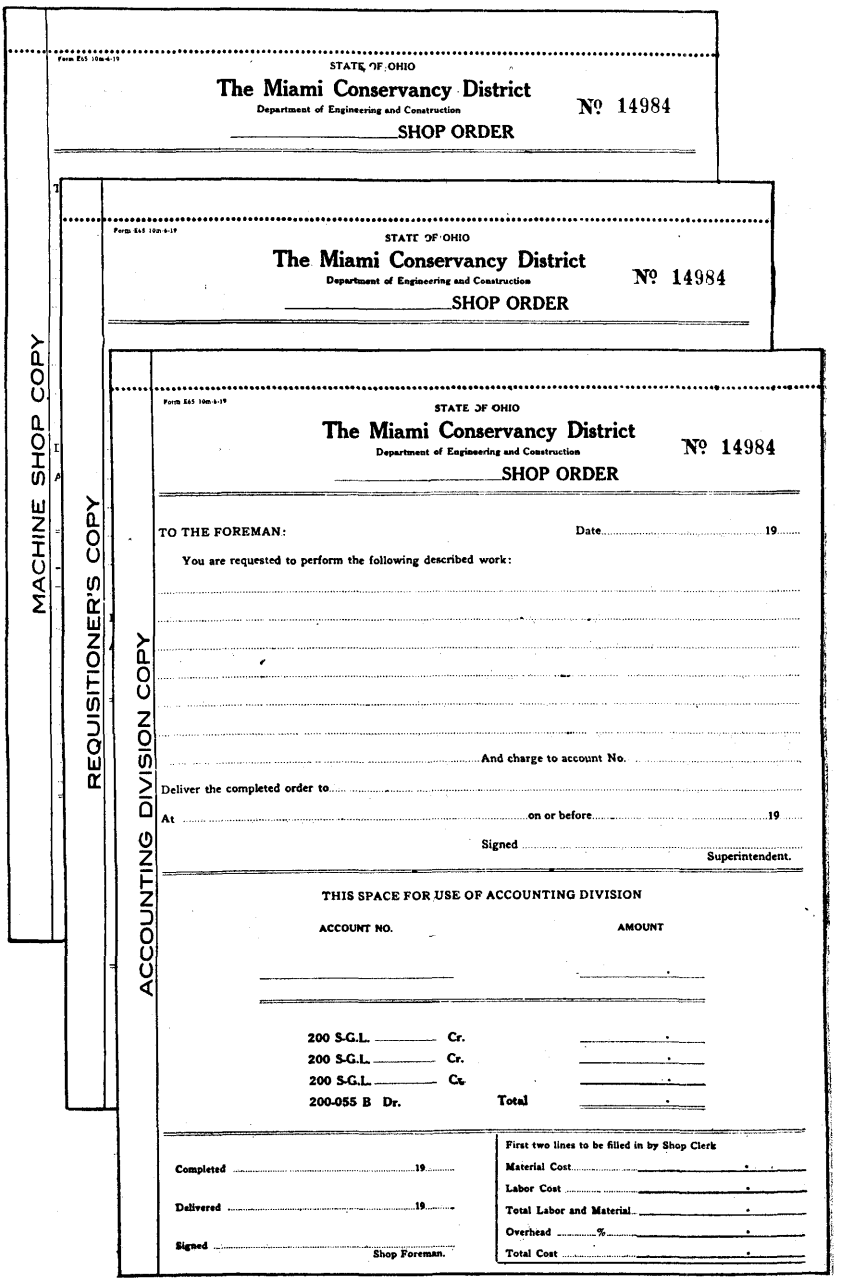


FIGURE 16—SHOP ORDER, FORM E-65.

The first two copies were on bond paper. The last, or machine shop copy, was on yellow tag board. On the back was space for entering the time of the workmen. The copies were differentiated by color.

the accounting division where credit was given the shop account (055Y) and debit made against the feature ordering the work done. A copy of the order was sent to the feature when the charge was made.

The special warehouse account for the shop stock was discontinued in 1921. The stock was greatly reduced and the materials not in constant demand went back to the general warehouse, which was located close to the shop. All current supplies were then charged to shop material and material lists were written by the foreman as progress was made on an order. These lists took the place of order slips, and while possibly not so accurate as the regular order, the change was justified by a saving of one clerk in the shop.

On the books kept in the accounting division, all shop expense was charged to the shop accounts (055 or 056 A to X). Orders completed were credited to the shop credit account (055Y and 056Y). Both debits and credits were cumulative so that at any time a reference to the cost ledger showed the total cost of any class of expense, the total credit, and the balance. This balance approximated the value of material and labor on uncompleted orders, plus materials in the stock room.

Nothing was added to the shop orders for profit, the aim being to distribute actual operating cost to the features as accurately as possible. Variations in the balance occurred, and the rate of overhead had to be changed occasionally in order to absorb all overhead charges, the rate ranging from 15 to 33⅓ percent of the cost of labor and materials. In the distribution of shop overhead to orders, a flat rate was used. This, of course, was not absolutely fair to all orders. Those jobs which required much labor were charged more overhead than those on which the work was done largely by machines, but as the District was not in business for profit, absolutely accurate cost figures were not essential, and the additional expense of keeping a more elaborate cost system in the shops would hardly have been justified. Machine hour rates were used in connection with the operation of the locomotive crane at the shop, and with the information now at hand, rates could be fixed for use of other production units which might have resulted in more accurate cost distribution. Much difficulty was encountered in getting labor charged correctly. Men shifted from job to job frequently, and with no time-recording device in use, the actual time on each order was largely an estimate. The foreman and shop clerk tried to check the time distribution daily, but with the force working under emergency pressure nearly all the time, it was not carefully done, and consequently the costs were not always dependable in the early part of the job. Gradually these irregularities were eliminated and standards fixed so that during the last two years shop costs showed fairly accurate results.

Motor Vehicles. During the period of maximum activity on construction, the District had from sixty to sixty-eight motor vehicles in operation. Six of these were five-ton trucks, seven were two-ton trucks, thirty-one were light trucks and delivery

cars of various kinds, and from eighteen to twenty-four were passenger cars. The central garage, located at Dayton, was in charge of a garage superintendent with a force of mechanics and drivers. Most of the cars were operated out of Dayton, but some were assigned to features and were kept in the field. All repairs of any consequence were made at the central garage.

No attempt was made to assemble the cost of operating each car in the official cost records kept by the accounting division. The cost of operating the garage as a whole was kept as shown in the classification on page 29. At the garage there was a cost clerk who kept cost, by cars, on a large sheet containing columns headed to conform with the standard classification. He secured his information for labor from time tickets, and for materials and parts taken from the stock room, reference was made to the issue blotter. Overhead was distributed on the basis of labor expended on each car. Distribution of the garage expense was accomplished in two ways:

(1) A flat rate per day or hour was charged for the service of cars working out of the garage.

(2) A monthly rental was charged for cars assigned specially to feature offices. The rates, at first, were an estimate, but later were based upon actual costs as shown on the car sheets, and on total charges on the general books, against garage operations. These rates varied from time to time. The aim was to charge out actual cost only, so the rate had to be high enough at all seasons to care for periods of idleness when some of the cars were not in demand. In the latter part of 1921, the cost by cars was discontinued, as it was expensive to maintain and it was thought that sufficient information was at hand upon which to base future rates.

A separate warehouse account was kept for the garage, with perpetual inventory cards and other records the same as for the general warehouse. Most of the purchasing for this warehouse was done direct without using the general warehouse. Gasoline was bought in large quantities from tank wagons and charged to cars as filled. A daily sheet with car numbers printed thereon was used for gasoline and oil charges. This was turned in each night and one entry for the total made on the issue blotter. The garage clerk kept a record of services rendered on daily sheets from which statements were prepared. While a cost clerk was employed, statements were sent direct to features where they were approved, charged to some account, and forwarded to the accounting division for entry as a debit to feature cost and credit to garage. This plan worked very well. When the force was reduced, the daily sheets were sent direct to the accounting division by the garage clerk, charges were made on the books at once and notices sent to the features charged. This was quicker and cheaper but the charges were not so accurately made and some adjustments were necessary after field engineers received the notices.

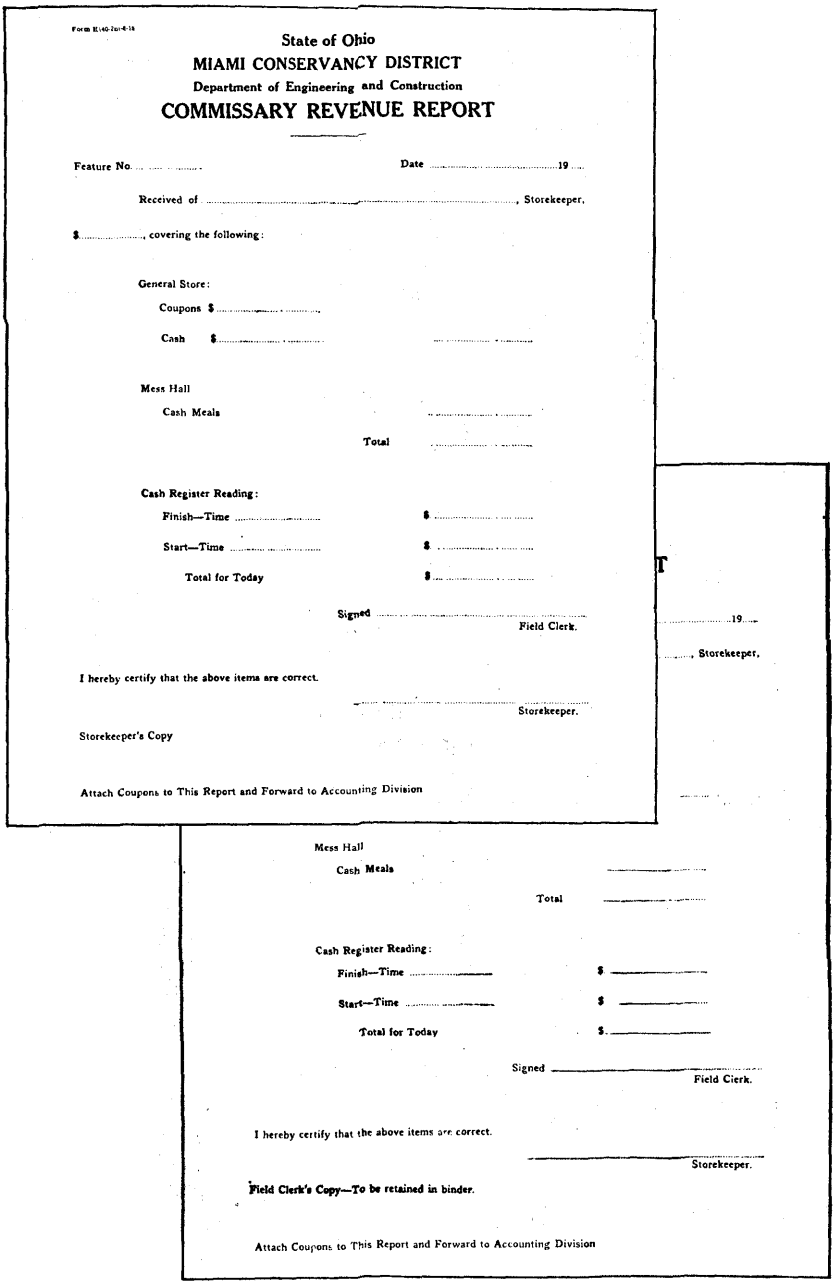
Depreciation was charged to operation cost at the rate of two percent per month of first cost of car. Toward the close of

the work this was reduced to 1½ percent, and later to one percent of original cost, because as the cars were disposed of it was found that their actual value was more than the book value when depreciated at the higher rate. This more or less arbitrary sliding scale of depreciation no doubt resulted in some unfair charges against the earlier period, but when it is considered that as the cars grew older the expense of repairs (which was charged to operation) was much more, the inequity is more apparent than real.

A volume could be written on cost keeping for operating automobiles and of the difficulties encountered in accurate accounting. In operating a large number of machines it is extremely difficult to get the accurate cost of each, and in reducing this to a unit cost per mile the figures are still less reliable, because mileage is so often estimated or based upon gasoline consumption. The conditions of operation and the results desired vary so widely with different jobs that further discussion will not be attempted here.

Stores and Messes. The five dams are located at considerable distance from towns, so in order to accommodate employees and their families, stores and messes were opened at each dam. Both the stores and messes were managed by a chief steward whose office was at the Taylorsville Dam and to whom the store clerks and cooks reported direct. A butcher shop and bake shop were operated at Taylorsville to serve all five messes and stores. This was known as the "Central Commissary" and all charges to messes and stores went through the central commissary. In the butcher shop was an ice and refrigeration machine. Meats were bought in large quantities and stored at Taylorsville and deliveries made to messes and stores as needed. Other merchandise for sale or use in messes did not actually go through the central commissary, but for record purposes were charged that way. In the beginning, special forms were used to report issues to stores and messes from the central commissary, and the accounting was done from the reports. Later, the standard receiving and issuing blotters referred to on page 58 were put into use to make the accounting uniform. The central commissary plan worked very well, but it involved some duplication in handling supplies, as well as duplication in records, and was discontinued in 1921, when the volume of work had been reduced considerably. Thereafter, meat and bakery goods were bought from merchants in the valley and delivered direct to the dams. Most of the buying for these operations was done through the purchasing department, but some latitude was allowed the chief steward in the purchase of perishable supplies, for which he used the emergency purchase order described on page 54.

The accounting division kept cost for these operations in accordance with the classification shown on pages 29 and 30. Assembling of the cost was done in the same manner as for other operations. At each store was a cash register upon which sales were recorded showing separately cash receipts and coupons redeemed. The field clerk carried the register key and collected the



State of Ohio
MIAMI CONSERVANCY DISTRICT
Department of Engineering and Construction
COMMISSARY REVENUE REPORT

Feature No. ..... Date ..... 19....

Received of ....., Storekeeper,

$....., covering the following:

General Store:
Coupons $.....
Cash $.....

Mess Hall
Cash Meals
Total

Cash Register Reading:
Finish—Time ..... $.....
Start—Time ..... $.....
Total for Today $.....

Signed .....
Field Clerk.

I hereby certify that the above items are correct.

.....
Storekeeper.

Storekeeper's Copy

Attach Coupons to This Report and Forward to Accounting Division

Mess Hall
Cash Meals
Total

Cash Register Reading:
Finish—Time ..... $.....
Start—Time ..... $.....
Total for Today $.....

Signed .....
Field Clerk.

I hereby certify that the above items are correct.

.....
Storekeeper.

Field Clerk's Copy—To be retained in binder.

Attach Coupons to This Report and Forward to Accounting Division

FIGURE 17—COMMISSARY REVENUE REPORT

In addition to the two copies shown above, another carbon was made, which went to the accounting division at headquarters.

cash and coupons and checked the register daily, making a report on the commissary revenue report form (E-140) shown as Figure 17. This report included cash collections at the mess also. Reports were forwarded to the accounting division daily where they were combined with others and vouchers prepared crediting the stores and messes with the amount of the cash and coupons. Each field clerk's cash account (G. L. 1) was debited with the cash, and unredeemed coupons (G. L. 45) with the value of coupons redeemed. Coupons or tickets were not used at the messes. The field clerk or timekeeper appeared at all meals and checked men who were employees, making notation of meals to be charged to each man on the time book and collecting cash from others than employees. These charges were assembled and deductions made on the payroll. The accounting division entries for the credits came from payroll abstracts, referred to on page 48 as Figure 4. In addition to the timekeeper's record of meals, the steward made an independent report of meals served and the two reports were compared as a check on the timekeeper's deductions.

A supplementary account for stores was kept by the chief steward's office. This consisted of a ledger account covering every article delivered. At periods of from three to five months an actual inventory was made at the store to determine the storekeeper's accountability. The following copy of one of these reports of check on store will serve to illustrate the plan:

STATEMENT OF HUFFMAN STORE
FROM APRIL 13, 1921, TO AUGUST 9, 1921

Inventory April 13, 1921	$5,006.01	
Merchandise received	3,554.77	
Total	$8,560.78	
Inventory August 9, 1921		$2,901.83
Cash and coupons to field clerk		3,265.57
Issues to mess		2,134.50
Miscellaneous credits		264.60
Over	5.72	
	$8,566.50	$8,566.50

Some allowances were made for losses in meats, fruit, and other perishable goods, and with these allowances the stores, as a rule, checked a little over. This independent report, with the monthly statement of profit or loss from the accounting division, furnished an approximate control over the store operations. At the close of each month, if an actual inventory of the store stock was not available, an estimate was made by the chief steward's office for use by the accounting division. An entry was made crediting the merchandise account with this estimated inventory and debiting the adjustment inventory account (065E). The opening entry for the next period was a reversal of this. In this manner the total debits against the stores for a given period represented the actual cost of goods sold. Mess inventories were handled in the same manner except that actual physical inventory

was made each month. This was practicable, as the amount on hand was usually small.

Stores were operated at a small profit even though the amount of business was not great. Prices were fixed by the chief steward, the usual mark-up being twenty percent above cost. Effort was made to keep the sale prices near the general market for the same articles in the vicinity.

Messes were operated at a loss. To help in keeping labor during the war period, prices of meals were not advanced as cost of supplies went up. Except for a very short period of about one month, in 1919, the regular price was thirty-five cents a meal for employees and fifty cents for others. In 1921 a flat rate was made to regular boarders of seven dollars a week, and fifty cents per meal was charged to transients. It was impossible to make the messes self-supporting under such conditions, so the loss was charged out to feature cost each month on the basis of direct labor cost.

Camp Maintenance. Camps involving a considerable investment were constructed at all five dams. In addition to the store and mess buildings, bunk houses and dwellings were provided for employees at reasonable rental. The cost of maintaining the buildings, collecting rents, repairing roads, operating the water, sewer, and light systems, and the many miscellaneous expenses incidental to a small town, was assembled in accordance with the classification given on pages 28 and 29. The portion of the investment in camp written off each month was charged to 051X (Depreciation) and formed by far the greater part of the cost. Even by charging a high rate of depreciation, a large part of the cost remained unabsorbed at the finish of the dams. This was partly due to completion of the work ahead of schedule, the estimated rate of depreciation being based upon the first estimate of time required to complete. Two credit accounts were assigned for camp maintenance: one (051W) to take the actual receipts for rentals, and the other (051Y), the portion of the maintenance to be distributed to feature cost. Rents were collected by the camp overseer and turned over to the field clerk who reported the collection to the accounting division and deposited the money, with other revenues, to the credit of the Treasurer. The maximum rental value of each camp was worked out and a report of occupancy was rendered by the camp overseer or field clerk. This report furnished an opportunity for the auditors to check accountability for rent collected.

Excavating Machines. The cost of operating some of the larger dragline excavators was assembled in accordance with the classification shown on page 32. These machines were of large capacity, capable of handling from 50,000 to 100,000 cubic yards of material per month and costing between $5,000 and $10,000 per month to operate. It so happened that electrically operated and steam operated machines were used on similar work, affording an opportunity for valuable comparisons. The assembling of costs furnished an excellent opportunity to study the efficiency of various types of machines and, for like machines on like work,

of gauging the efficiency of crews. The general practice on District work was to charge the cost of these operations direct to the work on which the machines were engaged. This was practicable because each machine was usually engaged for long periods on one feature and item of work. It was also desired to reduce bookkeeping expense to a minimum, so only a few machines were selected upon which separate cost was kept and then only for a comparatively short period. There is some question as to whether it might not have been good practice to operate all the larger machines as production units in the manner described. Comparative monthly reports and charts showing efficiency of machines could have been worked out in such a manner that they would have stimulated interest on the part of crews and superintendents. The extra accounting would not have been expensive, but there would have been the additional expense of making charts and efficiency reports to enable intelligent use of the cost figures.

CHAPTER IX

ACCOUNTING FOR CASH COLLECTIONS AND SALES

Each field clerk was bonded, and advances of small amounts of cash were made to him by the treasurer from time to time, to pay discharged laborers, and small bills for purchases made on the job, such as laundry, milk, eggs, and other supplies bought from

FORM 7 A

THE MIAMI CONSERVANCY DISTRICT

REPORT OF FIELD CLERK

Date .....

RECEIPTS:		DISBURSEMENTS:	
TREASURER		LABOR	
PAYMASTER		PURCHASES	
STOREKEEPER		EXPENSES	
MISCELLANEOUS (LISTED)		TREASURER	
		MISCELLANEOUS (LISTED)	
			$
Balance 19	$	Balance 19	$
TOTAL	$	TOTAL	$

I certify the above statement to be correct in all respects.

Field Clerk

APPROVED:

REMARKS:

FIGURE 18—MONTHLY SUMMARY MADE BY FIELD CLERK

farmers and peddlers and delivered to the camp. This advance was deposted by the clerk in some bank near the site of the work to the credit of the "Miami Conservancy District by ..... Field Clerk." The field clerk's payments were made by check on this account. His collections were deposited in the same account but kept separate from other receipts by a special column in his cash book. He was not allowed to draw checks on the collections, these being remitted to the treasurer. The payments for labor were entered as advances on the payroll and the field clerk was reimbursed by the paymaster at the regular pay period. A state-

FORM T-1

REMITTANCE LETTER

THE MIAMI CONSERVANCY DISTRICT

.....DEPARTMENT

TO THE TREASURER:—

Date.....

We attach hereto $ *as follows:*

Cash - - - - - - - - - $

Money Orders - - - - - $

Checks - - - - - - - - $.....

TOTAL - - - - - $

RECEIVED FROM:

CREDITS.

I HEREBY CERTIFY that the transactions recorded above are correct in all respects, and that the amounts involved represent the reasonable maximum obtainable by the Miami Conservancy District.

.....

.....
Title

To the best of my knowledge and belief the attached remittance is correct.

.....
Department Head

Approved:

.....

.....

FIGURE 19—REMITTANCE LETTER

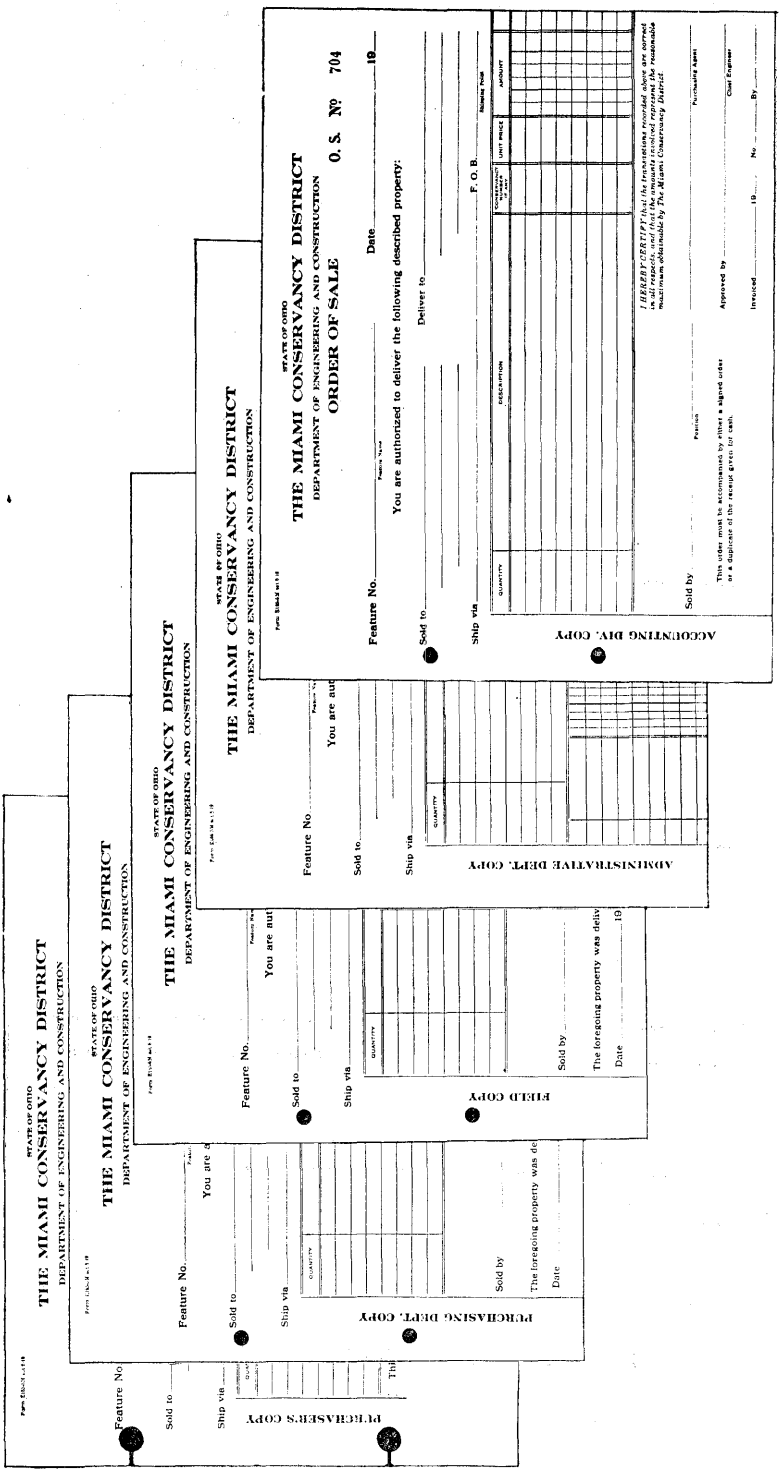


FIGURE 20—ORDER OF SALE, FORM E-185
The various copies were differentiated by color.

ment of other expenses, accompanied by receipted bills as vouchers, was rendered monthly. This was checked in the accounting division, charged to appropriate accounts and forwarded to the treasurer for reimbursement to the field clerk. The field clerk was responsible for all cash collected at the camps. This included sales at stores and cash meals at messes (discussed on page 75), other sales to employees where no store was operated, and collection of rents. Collections were reported daily on the revenue report form (Figure 17), from which the accounting division obtained the credits for store and mess. The standard form of cash book was used by the field clerk. His accounts were audited by a representative of the treasurer's office periodically and he was responsible for his imprest fund to the treasurer's office. He was charged on the treasurer's books for funds advanced and was reimbursed from time to time, being credited with remittances of collections and with amounts paid as shown on monthly expense statements. A summary report on form T-5 (Figure 18) was made monthly by the field clerk showing receipts, disbursements, and balance.

General Sales. As the work drew to a close, much equipment and surplus material was made available for sale. A sales division was organized under the general direction of the purchasing agent who worked in close coöperation with the salvage division. A large part of the time of the chief of the salvage division was devoted to sales. Other sales agents were appointed and selling activities greatly increased during the last year of construction. This involved the handling of money by a number of persons, as most of the smaller sales were made for cash.

Large sales were made upon special authority by use of a form called "Order of Sales" (Form E-185, Figure 20). When equipment or materials were sold, they were listed on this form with the terms of sale and delivery, and the document was used as a contract of sale. The original went to the accounting division after approval by the chief engineer, and upon delivery of the material invoice was issued against the buyer. Invoices were numbered serially and entered in the sales register, debiting accounts receivable (G. L. 21) and crediting the proper inventory or feature account. Sales orders were not used for the smaller transactions or miscellaneous cash sales. Neither were invoices issued covering small cash sales. These were taken into accounts receivable, however, under the title "Cash Sales" and the names of all persons to whom sales were made were listed in the "Accounts Receivable" ledger. The remittance letter transmitting such cash to the treasurer, when put through the journal, gave credit to accounts receivable. Authority for sale was contained in lists published from time to time as surplus supplies and material became available.

A special form was printed as a bill or sale slip, and every one making a sale, whether for cash or charge account, filled out one of these slips. A copy was handed the purchaser, receipt being given if cash was received, a copy was kept by the sales clerk, and a copy accompanied the remittance letter to the treas-

urer. Cash was remitted daily. The form of remittance letter used is shown by Figure 19. Upon it was listed each sale and all information necessary for accounting purposes. When the cash was received in the treasurer's office, a copy was returned to the accounting division for proper entry. A copy of the sale slip was attached to the copy of the remittance letter in the accounting division's file as the permanent accounting record. Entry was made to the "Journal and Cash Receipts Register" from this copy of the remittance letter.

CHAPTER X

BOOKS OF ACCOUNT

General Ledger. The accounts kept in the general ledger are described in Chapter IV, pages 35 to 42. A Kalamazoo binder No. B. S. B. 472, sheets 11 x 11, was used. Figure 21 shows the ledger ruling used. No details were carried to the general ledger, but some of the accounts were subdivided when occasion required. Most of the accounts carried in this ledger were controlling accounts and details were shown in subsidiary books. There was nothing unusual in the handling of the general ledger

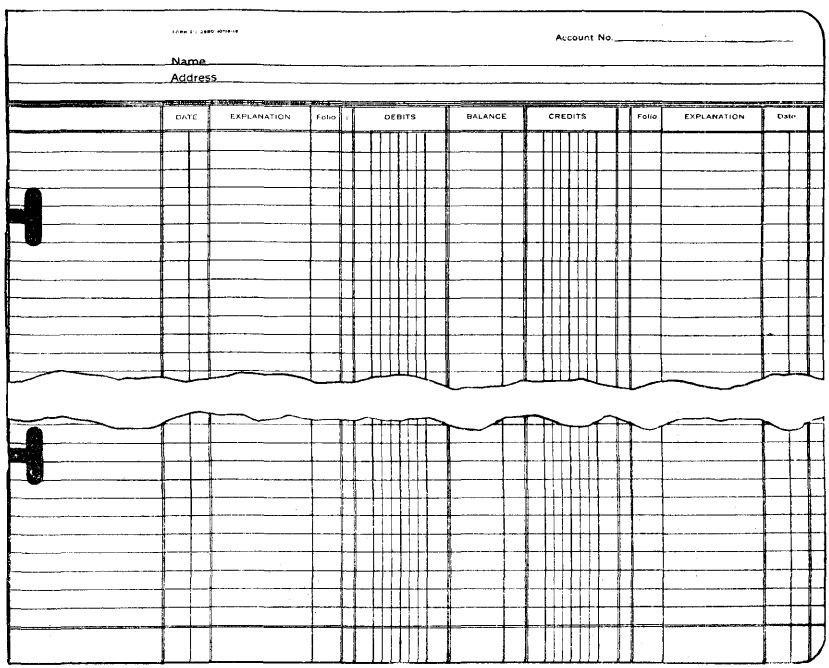


FIGURE 21—GENERAL LEDGER SHEET

except that the general classification sheet (Figure 6) was used to assemble the accounts for the ledger, and postings were made in total from these classification sheets as described on page 50. This made the ledger less bulky and more easily kept, but, on the other hand, checking back to original sources of entry involved going to the general classification sheets for references. Some criticism was made of this system by one of the auditors, but it was found to be very practicable and a labor-saver.

Cost Ledgers. Three cost ledgers were used, one each to support the controlling accounts—G. L. 31, "Feature Cost;" G. L. 32,

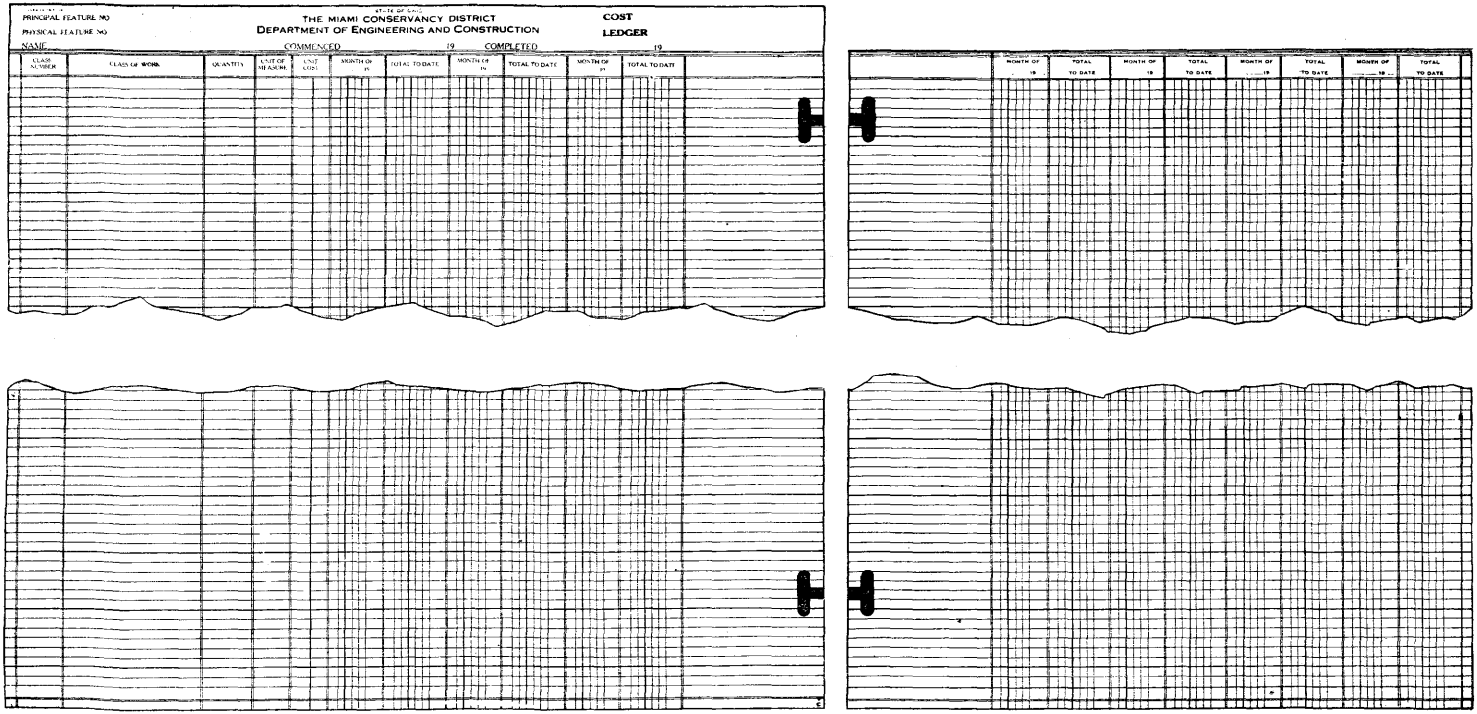


FIGURE 22—COST LEDGER SHEETS

The sheet on the right was ruled on both sides, and any number of sheets could be added, thus providing for an indefinite continuation of the cost record.

"Plant Cost," and G. L. 33, "Operation or Clearing Accounts." Kalamazoo binders (No. B 556797), taking sheets 11 x 14 were used. The Cost Ledger sheets are shown by Figure 22, Form E-4. This is not, technically speaking, a ledger sheet, in that there is not a separate debit and credit column. It took balances to accounts only and was posted from the recapitulation sheet shown as Figure 5, described on page 50. For details and reference back to original source of entry, it was necessary to go through the recapitulation sheets. These sheets were made into a book and filed each month to support all business for the month. It will be noted that a sheet in the cost ledger was assigned for each feature or job corresponding to a primary account number, and a line on the sheet was used for each item of work corresponding to a secondary account number or letter. Debit balances in any account or on any line were shown in black ink and credit balances in red ink. In case of the operating accounts showing both debits and credits, usually the debits were entered first and footed, then the credits, and the balance carried to the foot of the column. Two columns were used for a month's business, one for the cost for the month and one to carry forward totals to date. Insert sheets were provided without any column for names of accounts and without column headings, so that the same account could be carried forward indefinitely without transferring to another page. This is a big advantage for construction work such as the District did, when accumulating totals are necessary for ready reference. Upon completion of a job, the quantity of work performed and unit cost may be entered. A column might easily be assigned for estimated cost and these sheets would then be a complete history of the cost no matter how many months or years it took to do the work.

Accounts Receivable Ledger. Details were kept for all accounts receivable, in separate ledgers, for controlling accounts in Group III, G. L. numbers 21 to 25 inclusive. The same sheet (Figure 21) was used as for the General Ledger. No special description is necessary for these details except to note that all "Cash Sales" which were run through G. L. 21 were entered in one account by listing names of buyers on both debit and credit sides. A schedule of the balances in each account was submitted at the close of the month to support the balances in the various general accounts.

The Invoice Register. An 11 x 14, specially ruled sheet was used for the registering of invoices. (See Figure 23, Form No. E-2.) Current sheets were carried in temporary binders and these were bound permanently at the end of each year. The invoice register used was a columnar book of original entry, designed to minimize as much as possible the accounting for purchases and miscellaneous invoices received. It had columns for number, date, name, and the usual posting references. It was self-balancing, debit columns being assigned for accounts payable, inventories, and direct charges. Credit columns were assigned for the two adjustment accounts, G. L. 19, "Goods in Transit," and G. L. 15, "Inventory Adjustment," and for "Miscellaneous." Im-

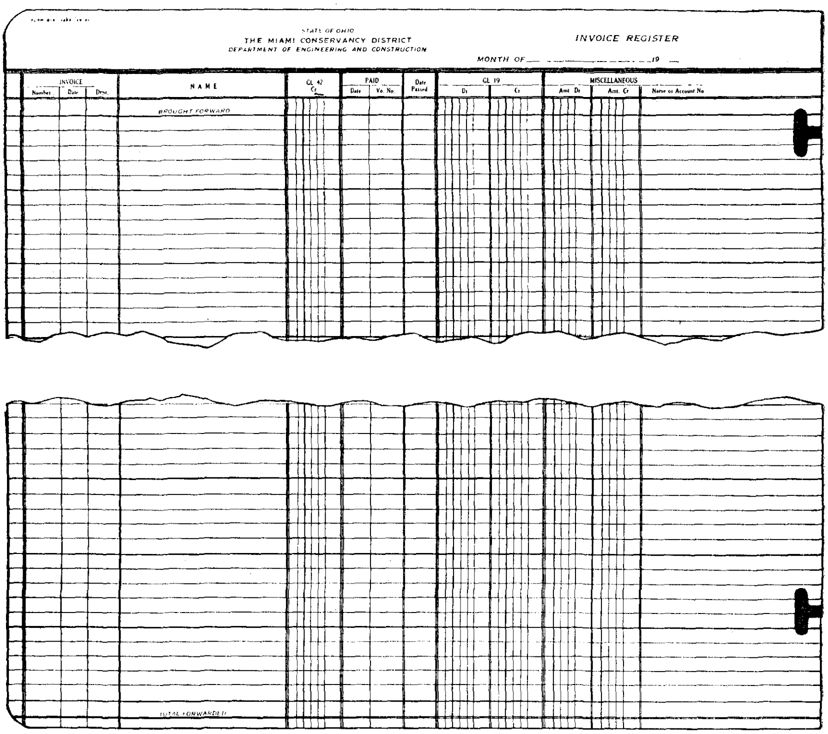


FIGURE 23—INVOICE REGISTER, FORM E-2

This was a double page form, set in the binder as shown above and on opposite page.

mediately upon receipt of an invoice it was referred to the accounting division where it was numbered and entered in the register. The date of entry and date of invoice were put in the date column. The total of the invoice was a credit to accounts payable and was entered in the column marked "G. L. 42." If it had already been approved for payment and was ready to voucher, a direct charge was made to the account specified, by entry in one or more of the columns for "Direct Charges." Most of the invoices received had not been checked, so they were charged to "Goods in Transit" in the column marked "G. L. 19" and then referred to the purchasing agent, if a purchase, who checked them with his orders (see page 98) and if he found them correct passed them for payment. Voucher request was then made on the treasurer and when payment was made the date and voucher number were entered opposite the first entry. As explained on page 60, the credit to G. L. 19 came from the warehouse receiving blotter on which the charge was taken into inventory. Sometimes an invoice was cancelled, in which case it was entered in red in the invoice register, debiting accounts payable in credit column "G. L. 42" and placing the credit in the credit column for G. L. 19.

The following example illustrates the movement of an invoice by the system used: An order is placed on which the price is

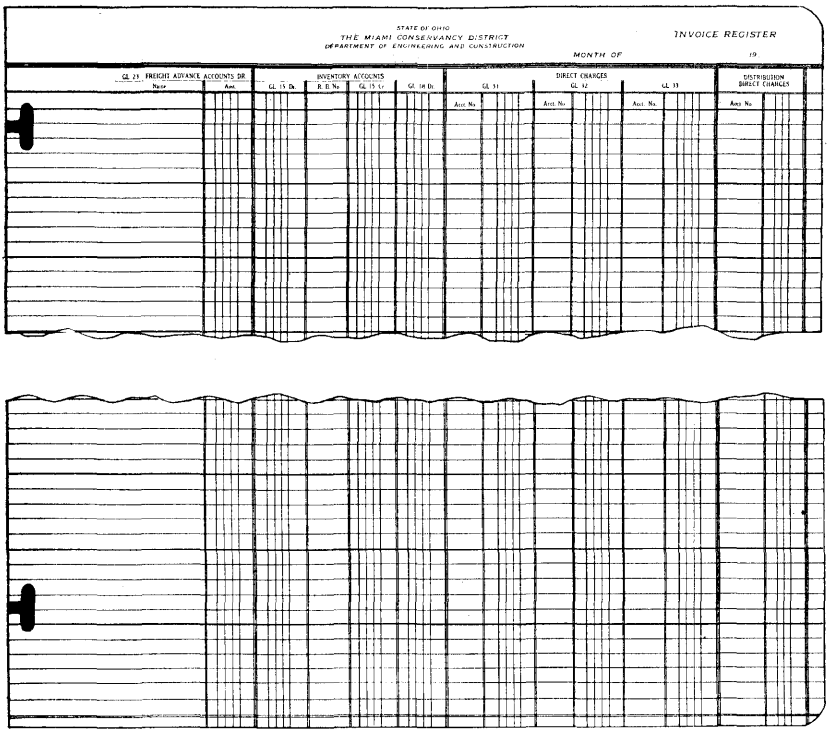


FIGURE 23—INVOICE REGISTER, FORM E-2

This was a double page form, set in the binder as shown above and on opposite page.

estimated at $250 to be charged to stock in warehouse (G. L. 16). The invoice when presented is for $275 and goes to the invoice clerk who enters it in the invoice register.

Dr. G. L. 19 "Goods in Transit".....$275.00
Cr. G. L. 42 "Accounts payable" $275.00

In the meantime, the article is received at the warehouse and taken up on the receiving blotter in the regular manner at the estimated price shown on the purchase order ($250), the blotter number being noted on the inspector's copy of the order and entry being made in column G. L. 16.

Dr. G. L. 16 "Warehouse Stock".....$250.00
Cr. G. L. 19 "Goods in Transit" $250.00

When the invoice is passed for payment, it again comes to the accounting division. Comparison is made with the entry on the receiving blotter, the invoice number being noted in the "check" column and the blotter number being noted in the invoice register with the date passed. The entry is—

Dr. G. L. 15 "Inventory Adjustment" $25.00
Cr. G. L. 19 "Goods in Transit".... $25.00

This clears "Goods in Transit" and the use of adjustment account, No. G. L. 15 (see page 35), will make it unnecessary to change the price as originally entered on the receiving blotter.

If there is no difference between the amount of the invoice and the amount taken up on the receiving blotter, the only entry in the invoice register when the invoice is passed for payment is a memorandum in the reference columns "Date passed" and "R. B. No.," the latter referring to receiving blotters from which information was obtained.

When the voucher is paid, entry is made in the disbursement voucher register.

Dr. G. L. 42 "Accounts payable".....$275.00
Cr. G. L. 61 "Disbursement Vouchers" (Cash) $275.00

At the same time that entry is made in the disbursement register, the date paid and the voucher number are entered in the invoice register on the same line as the original entry of the invoice.

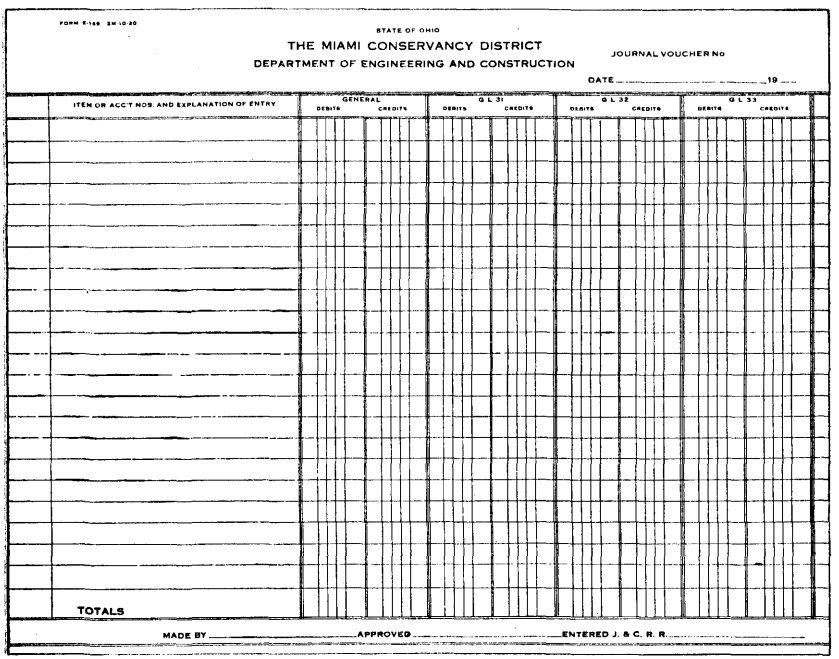
Sometimes, invoices were passed which had been taken into the invoice register in previous months. Then, if adjustments were to be made, the second entry could not be placed on the same line as the first entry because the register was closed every month. The subsequent entry was made with the current month's business, indicating the same invoice number which served as reference to the first entry. These subsequent entries were made in columns for G. L. 19 and G. L. 15 only. The fact that no entry was made in column G. L. 42 and that the vendor's name was left out, indicated that it was a "hold-over" adjustment. These adjustments were shown on separate sheets, placed at the end of the record for the month's business.

The column on the extreme right of the invoice register headed "Distribution Direct Charges," was used merely as a recap of these charges, for convenience of the bookkeeper in posting.

No accounts payable ledger was kept, the open items on the invoice register equalling the balance in controlling account G. L. 42. This saved a great deal of detail posting. On the other hand, it would have been a convenience, sometimes, to know how the account stood with certain firms with whom a large volume of business was done. It certainly would have been a waste of effort to run all purchases through a special ledger, for many of them were from persons with whom no regular business was done. Probably a middle ground would be a good stand to take on this subject, carrying only the larger accounts to a special ledger and creating a special control for them.

Journal and Cash Receipts Register. This journal was to record the initial entry of all cash receipts and all other entries for which no special register was provided. The sheet was 11 x 14, as illustrated by Figure 25 (Form No. E-11). The documents from which entries were made to this record were designated journal vouchers and were numbered consecutively by months. The journal voucher number indicated the year of construction, the month of the year, and the number of the voucher in the month. Thus, No. 4-B-25 would be the twenty-fifth voucher in the month of February for the fourth year after beginning operation, or in this case 1921, as the first year of construction was

1918. The standard journal voucher form is shown by Figure 24 (Form No. E-169), but payroll abstracts, remittance letters, engineers' estimates of contract earnings, and other papers, were used and numbered as journal vouchers. These vouchers were filed in vertical folders by months to support the entries made in the journal. The various bookkeeping operations previously referred to in this report were assembled in shape to enter as journal vouchers. The bookkeeping work of the office was so arranged that different clerks could work on different operations, so that everything would be ready for entry in the journal shortly after the close of the month. Thus, one clerk handled labor, another warehouse issued blotters, another warehouse receiving


FORM E-169 3M 10-20

STATE OF OHIO

THE MIAMI CONSERVANCY DISTRICT

DEPARTMENT OF ENGINEERING AND CONSTRUCTION

JOURNAL VOUCHER No

DATE _____ 19 ____

ITEM OR ACCT NOS. AND EXPLANATION OF ENTRY	GENERAL DEBITS	GENERAL CREDITS	G. L. 31 DEBITS	G. L. 31 CREDITS	G. L. 32 DEBITS	G. L. 32 CREDITS	G. L. 33 DEBITS	G. L. 33 CREDITS
TOTALS								

MADE BY _____ APPROVED _____ ENTERED J. & C. R. R. _____

FIGURE 24—STANDARD JOURNAL VOUCHER, FORM E-169

blotters, another the invoice register, etc. Sometimes, depending on the volume of business, one clerk handled more than one operation, but the work was so organized that it could be readily split up and parts assigned to as many clerks as necessary to get the work done promptly. To facilitate reference to vouchers, uniform numbers were given to the same operation for different months. The following is a list which will serve to illustrate the number of regularly recurring operations:

Voucher No.

1 General Warehouse clearance.
2 Warehouse issues at Franklin and Troy.
3 Englewood depreciation list.

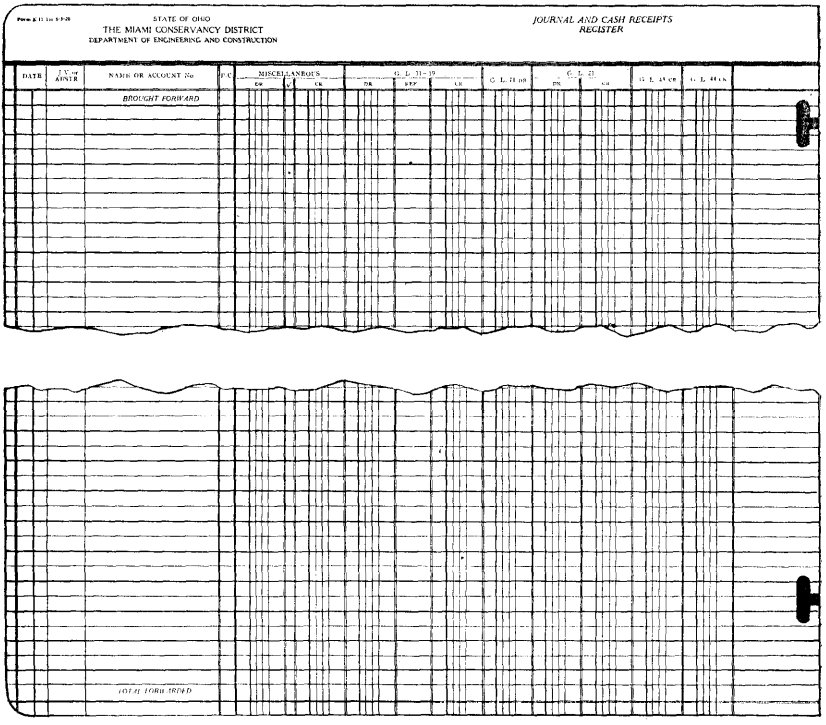


FIGURE 25—JOURNAL AND CASH RECEIPTS REGISTER, FORM E-11

This was a double page form, set in the binder as shown above and on opposite page.

4 Taylorsville and meat shop depreciation list.
5 Huffman depreciation list.
6 Tippecanoe City depreciation list.
7 Piqua depreciation list.
8 Troy depreciation list.
9 Dayton river channel depreciation list.
10 Franklin depreciation list.
11 Hamilton depreciation list.
12 Miscellaneous depreciation list.
13 Shop (Machine)
14 Garage (Motor vehicles)
15 General Headquarters expense distribution.
16 General superintendence expense distribution.
17 Sand and gravel from Dayton screening plant.
18 Revenue reports.
19 Mess and store inventories.
20 Clearance of Warehouse operation expense.
21 Charges from Garage.
22 Recapitulation of Machine Shop orders.
23 Transfers between features.
24 Power and light distribution.

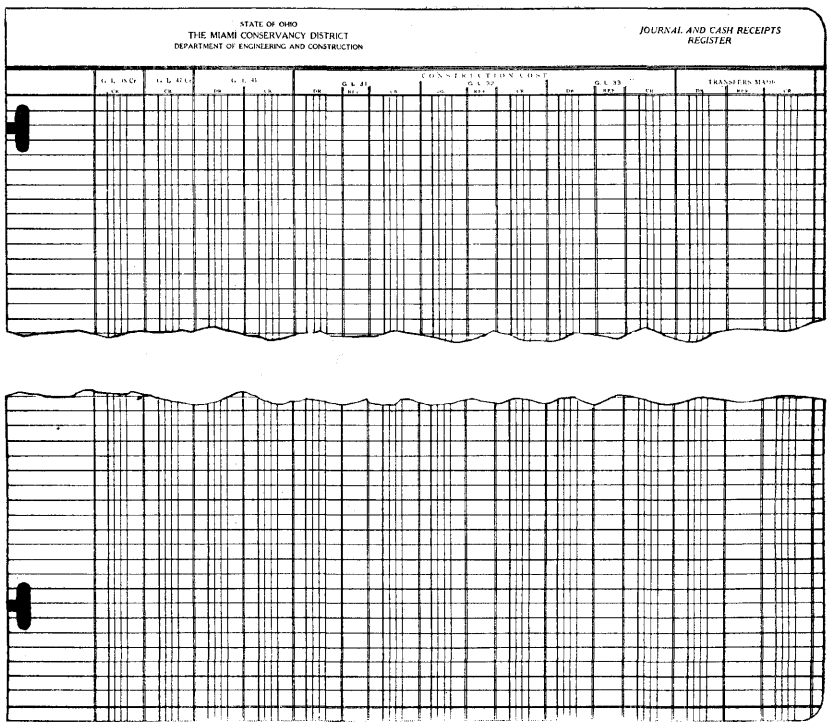
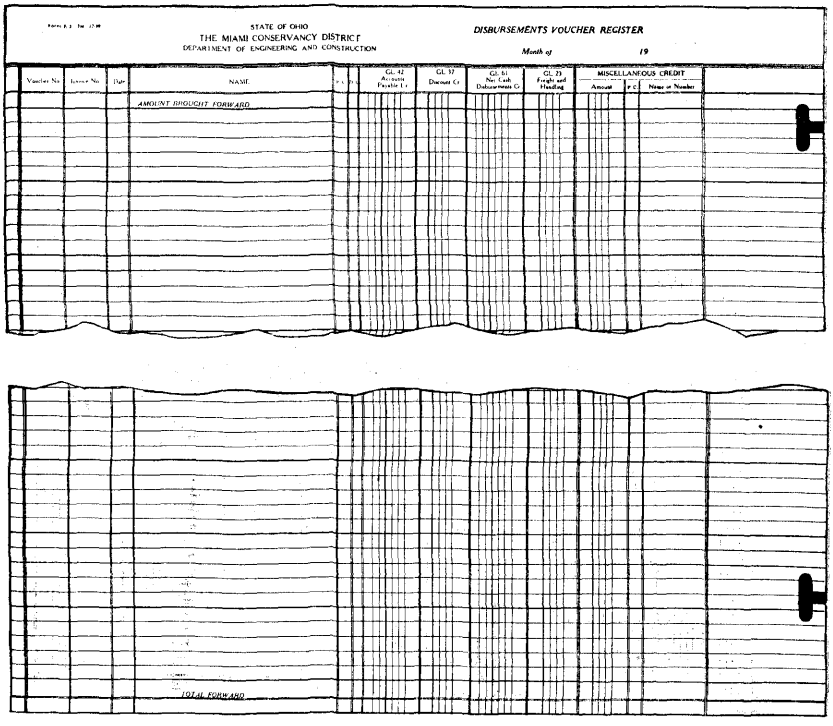


FIGURE 25—JOURNAL AND CASH RECEIPTS REGISTER, FORM E-11

This was a double page form, set in the binder as shown above and on opposite page.

25 Salvage operations clearance.
26 Dragline machine operation clearance.
27 Transfer of maintenance costs.
28 Administrative Dept. credit for maintenance.
29 Administrative adjustments.
30 Opening entries for store and mess inventories.

In addition to these there were, of course, many more special vouchers put through the journal. In the journal, entries were made to controlling accounts only. The bookkeeper who kept the journal entered the vouchers in total as they affected the controlling accounts, carrying debits and credits to the accounts as indicated by column headings. He then passed the vouchers to the clerk who assembled cost on the recapitulation sheets (Figure 5) for entry in the subsidiary ledgers. Before posting the details to subsidiary ledgers, a trial balance was taken to see that the details agreed with the controlling accounts. The total debits and credits to the various controlling accounts were obtained, as before stated, by the use of the general classification sheets (Figure 6). Entries to these general sheets were made from other registers also, column totals only being posted. The cost clerk posted details from other registers, also, when any entries were


STATE OF OHIO
THE MIAMI CONSERVANCY DISTRICT
DEPARTMENT OF ENGINEERING AND CONSTRUCTION

DISBURSEMENTS VOUCHER REGISTER

Month of 19

Voucher No.	Issue No.	Date	NAME	✓ (V)	Gl. 42 Account Payable Cr.	Gl. 37 Discount Cr.	Gl. 61 Net Cash Disbursements Cr.	Gl. 23 Freight and Handling	MISCELLANEOUS CREDIT Amount	✓ (C)	Name or Number
			AMOUNT BROUGHT FORWARD								
			TOTAL FORWARD								

FIGURE 26—DISBURSEMENTS VOUCHER REGISTER, FORM E-3

This was a double page form, set in the binder as shown above and on opposite page.

made therein as direct charges, but by far the most of the cost clerk's figures came from the details on the vouchers.

The journal voucher forms were ruled with four double columns, one for miscellaneous items and one for each cost ledger (31, 32, and 33), to facilitate posting to controlling accounts. If entries were carried to wrong columns on the journal voucher, and the general bookkeeper did not catch the error, the detail and control would be out of balance.

It probably would have been better to keep the general journal separate from the cash receipts register, and the scheme was originally so designed. Combination was made when cash receipts were small and the matter was hardly of enough importance to warrant a change later. The cash receipts portion of this register corresponds to the debit side of the cash book in commercial accounting.

Disbursement Voucher Register. Figure 26 illustrates the disbursement voucher register which was used to record cash disbursements only. It is an 11 x 14 sheet for the same binder as the other registers. Columns provided were for the general ledger accounts most frequently affected by disbursements, with

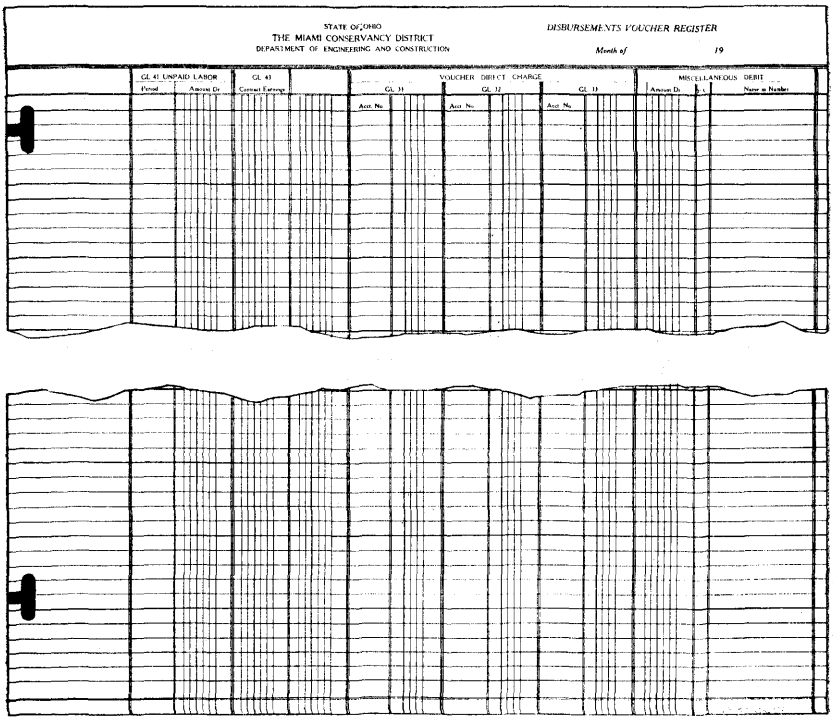


FIGURE 26—DISBURSEMENTS VOUCHER REGISTER, FORM E-3

This was a double page form, set in the binder as shown above and on opposite page.

special columns for "Miscellaneous Debits and Credits" and three columns for direct charges to cost ledger accounts (G. L. 31, 32, and 33). The total of each payment was credited to G. L. 61, "Disbursements," and was the amount of the District's investment in cash for construction of the flood works. This register corresponded to the credit side of the cash book in commercial accounting, and the cash receipts portion of the journal was the debit side of the cash book. The separation was made primarily because by the use of a separate register more space was provided for columns and secondarily to enable the cash book to be handled by different clerks.

It was through the disbursement and cash receipts registers (the cash book) that the accounts of the Department of Engineering and Construction were reconciled with the books of the treasurer. At the close of every month's business, the total amount of paid vouchers entered as a credit to G. L. 61 in the disbursement register was compared with the total charged against the department by the treasurer, and, if any differences existed, the errors were immediately located and the accounts brought into agreement.

CHAPTER XI

PAYMENT OF BILLS

The voucher system was used in the District's accounting throughout. All payments were made by the treasurer's office except in cases where advances were made to bonded employees for petty cash and emergency payments. Such employees were virtually under the treasurer's office, so far as their petty cash account was concerned.

After bills incurred by the different departments were approved for payment, a "voucher request" (Form No. E-28) was prepared, usually in the purchasing or accounting divisions, although any one authorized to approve claims against the District

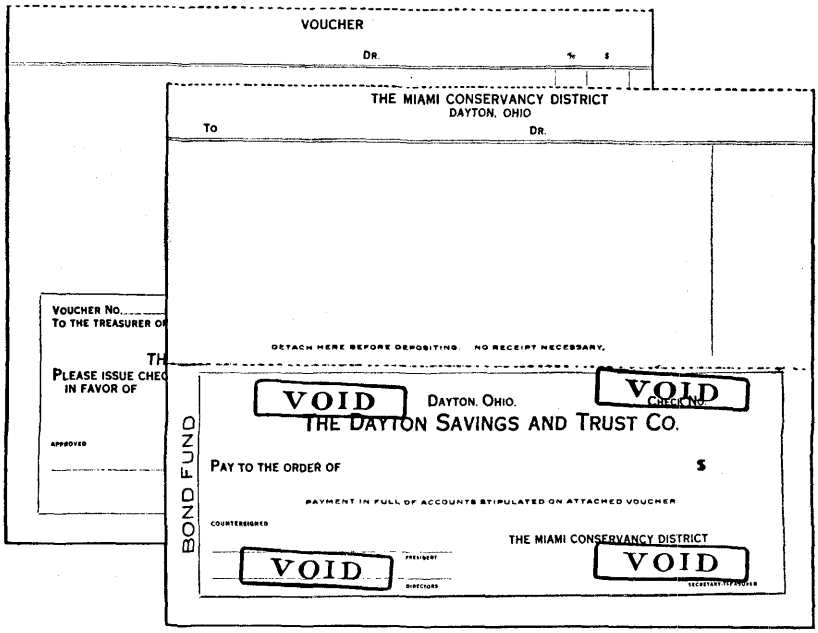


FIGURE 27—VOUCHER CHECK

might and did prepare requests. Figure 28 is the form used in the construction department. It was an order on the treasurer to pay certain bills listed thereon. For accounting purposes, several copies of these requests were made. The original, upon which certification and approvals appear, was kept in the treasurer's file. One copy, without signatures, was mailed to the payee, with the check, so that he could identify the payment with his invoice. One copy (yellow), to which were attached all the invoices and supporting papers, was returned by the treasurer to the accounting division and was the basis of entry in the dis-

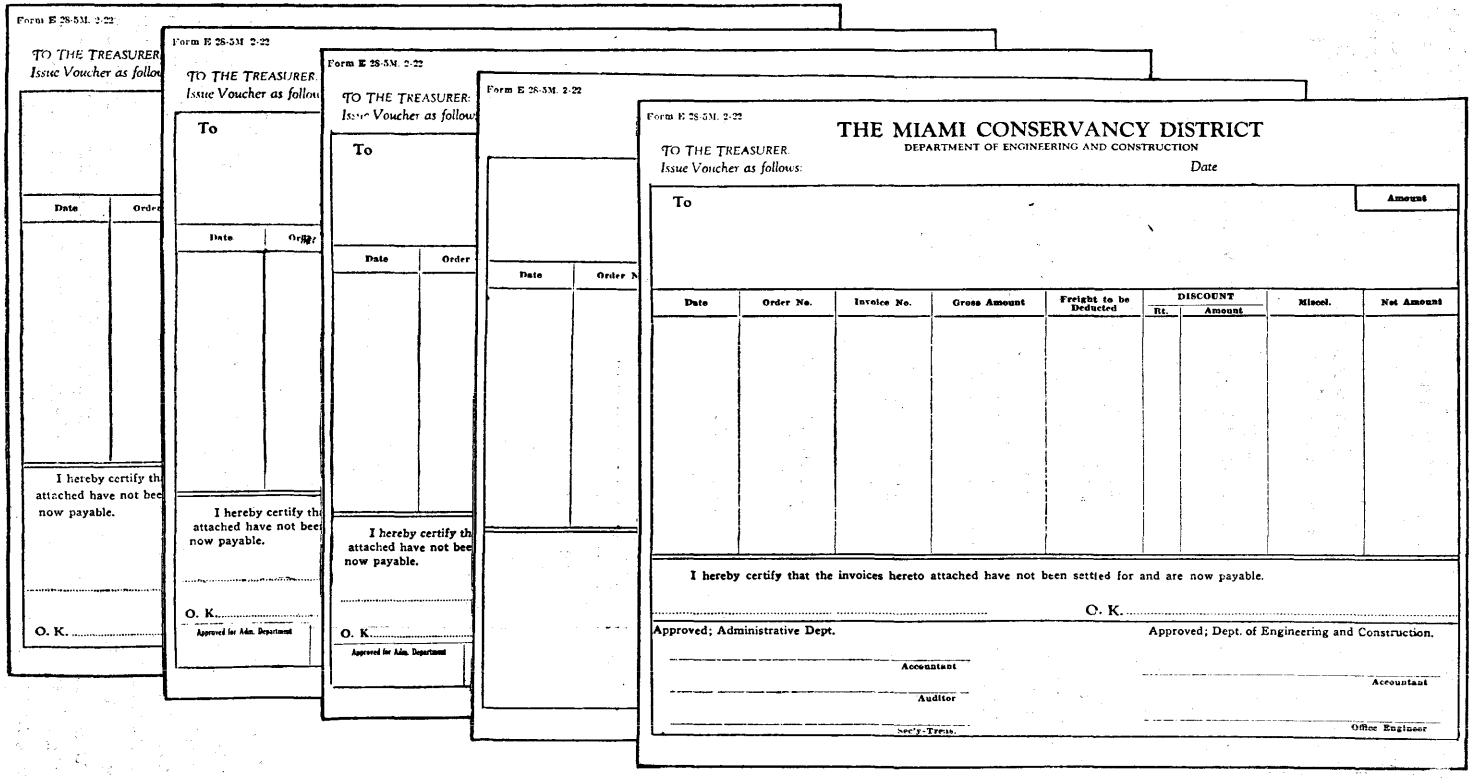


FIGURE 28—VOUCHER REQUEST USED BY ENGINEERING DEPARTMENT, FORM E-28
The various copies were differentiated by color.

bursement voucher register. One copy (pink) was detached by the accounting division when the request went through, and served as a tickler until the yellow copy came back with the date of payment and voucher number indicated thereon. The fifth copy was not always necessary, but was made up and usually kept by the purchasing agent or other person who prepared the request.

The treasurer's office prepared the check and mailed it to the payee. Figure 27 is a copy of the voucher check. All checks except those issued by the paymaster for labor, and by field clerks from the imprest fund, were signed by the treasurer and approved by the board of directors. This method involved some duplication and delay in payment. The voucher request and voucher check might have been combined with some advantage, but the requests originated from many sources more or less distant from the treasurer's office, and the treasurer's funds were in separate banks and accounts, about which the departments had no information, so it was not considered practicable to combine the forms.

The checking of the invoices was done by the bill clerk in the purchasing division, at the time of passing for payment. Another check was made in the accounting division. Computations and extensions were not checked by the treasurer's office except to see that the totals on the voucher request equalled the total of invoices attached.

When the invoice was first registered by the accounting division, it was stamped as follows:

Inv. No. .....
Acct. No. .....
Quantity O. K. .....
Price O. K. .....
Quality O. K. .....
Terms O. K. .....
F. O. B. .....
Amount .....
Extensions
and Footings O. K. .....
Delivered to .....
.....
.....

The number which was then assigned served as a reference in the future handling of the invoice. The request on the treasurer, listing invoices for payment, carried the certificate of the purchasing agent or other person having personal knowledge of the transaction. Two approvals were added for the department, one by the accounting division and one by the office engineer. In the treasurer's office it was approved by the bookkeeper, auditor and treasurer. A time stamp system was used to record the times at which requests passed the various divisions.

CHAPTER XII

FILES

The question of filing is important. In the average office much time is lost in locating documents after they have been filed. In accounting this is particularly important, because the final accounts show results in totals, and in order to verify or obtain details, resort must be had to supporting papers filed elsewhere. All the papers and correspondence relating to accounts of the department were filed in the accounting division. Sectional vertical cases were used.

Correspondence was filed alphabetically and as nearly as possible by subject. Thus the correspondence with a division engineer would be under his name, and all that about a particular matter was together. This was not always satisfactory, because the tendency in such a system is to place the letters in date order, and when any particular subject is to be investigated the whole folder has to be gone over. The correspondence was not extensive, so this defect was not serious.

Receiving and issuing blotters, covering warehouse operations, were filed numerically, by months, each job's blotters being kept separate. They were bound in folders fitting the sheets and labeled in large letters.

Original bills showing issues from the main warehouse were filed numerically. Transfers were filed in the same manner.

Equipment cards were arranged by plant account and feature, with a cross index on small cards for the whole, arranged alphabetically by name of equipment.

Journal vouchers were filed by months numerically with all supporting papers attached, except for depreciation lists which were filed separately with the equipment records.

Disbursement vouchers were filed alphabetically by years, all payments to one firm being in a folder. Invoices were attached to the vouchers.

Card records were kept for contracts and these were filed by agreement numbers. A cross index by use of a small card with less information thereon, was filed alphabetically under the contractor's name.

Cost reports were filed by months, all of the regular reports and schedules being bound with the balance sheet.

Special reports were filed in a miscellaneous file.

Bound books were kept in a safe cabinet when not in use.

The aim in the accounting division was to file all records so that accounts could be traced to the original source of information with the least possible effort and delay. There is no doubt but that all papers supporting the books of account should be kept as close as possible to the books in the accounting office.

About the correspondence there is some question. It would seem that all outside correspondence should be filed in a central

filing section for all divisions. Much depends upon the organization and the physical location of the various divisions. In the District organization, every division kept its own files, with the result that there was duplication, and sometimes letters that belonged in the general file got into some division file and vice versa. Probably more filing cases were used than a central file would have required. Extra copies of letters were made so that each file concerned could have a complete record. In small divisions, individuals whose time was valuable worked on files, whereas all the work might have been done by a specialized central file clerk. Letters on the same subject would be found in different divisions and it was difficult to know when the matter relating to a single case had been assembled. These objections were offset somewhat by the undoubted advantage of every responsible head of a division having his records close at hand.

CHAPTER XIII

STATEMENTS AND REPORTS

Financial statements were made monthly. They consisted of a balance sheet, covering all general accounts, supported by schedules showing details. At first the balance sheet was written on plain paper, but the latest reports were a printed form, E-214, illustrated by Figure 31. The schedules for accounts receivable and accounts payable were merely itemized lists of amounts due from and to individuals and firms. Each month, adding machine tapes of balances shown on warehouse cards were made. Warehouse reports consisted of these tapes and a report showing in totals:

1. Balance at the beginning of the month.
2. Amount received during the month (total of Receiving Blotters).
3. Amount issued (total of Issue Blotters).
4. Balance.

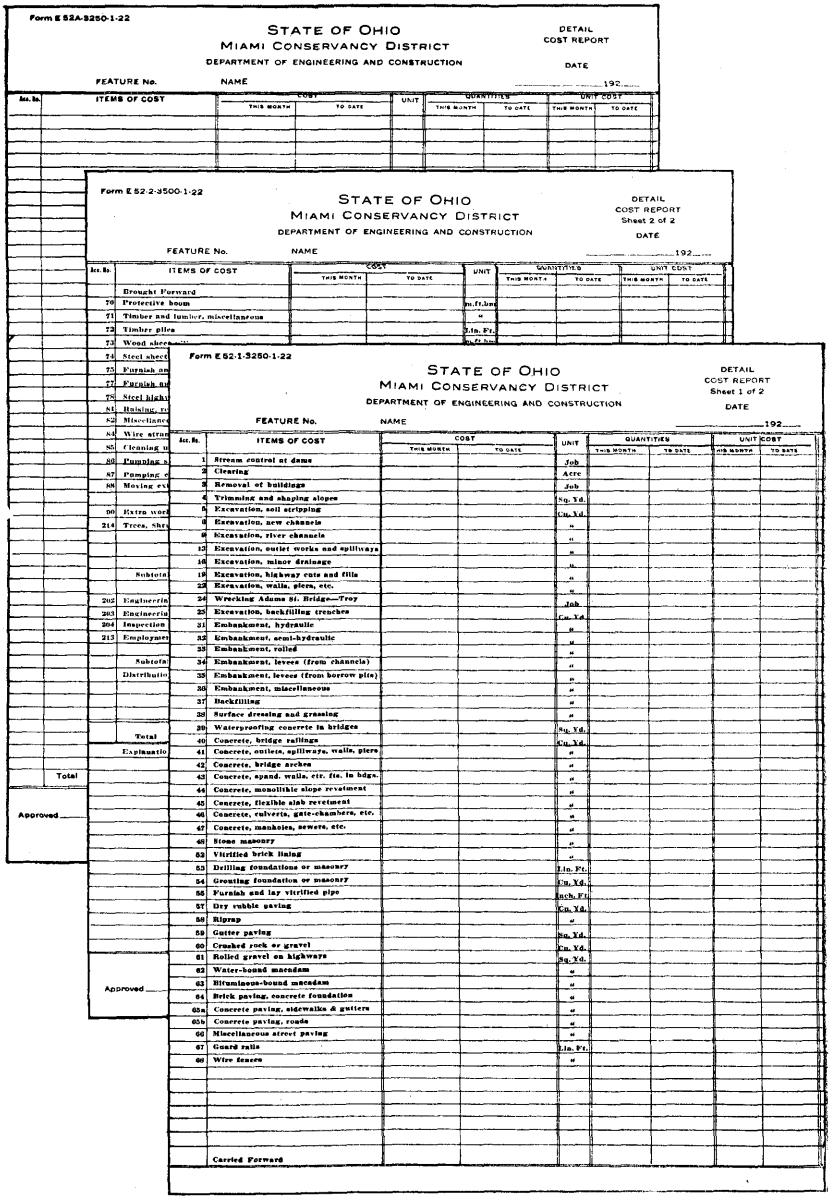
This was compared with the tape total and general ledger balance, and served as the means of checking the warehouse accounts.

Cost reports were rendered on various forms from time to time, at first on plain paper, but finally on standard forms, a different color for each class of cost—pink for feature cost, white for operating accounts, and green for plant costs. Figure 29 illustrates the feature cost report. Standard item accounts were printed, so as to save typing. Not all the spaces were required for all features, but this did not injure the value of the reports in any way. A sepcial form was made for railroad costs, and blanks without the printed names of accounts were used for miscellaneous work. Figure 30 illustrates the forms used for plant and operation reports. Variation in accounts for the two latter reports was so great that only headings were printed on those forms.

The cost reports were copies of the cost ledgers, with additional columns for quantity of work done, and unit cost for the month and to date. Theoretically they should have been prepared from the ledger after it had been posted and balanced, but in practice, reports were written up direct from the recapitulation sheets (Figure 5) and the postings were made to the ledger later. Reports for a month's operation were available for issue by the eighth to the tenth of the following month. Copies were sent to each division engineer's office together with a summary of unit costs and quantities, which gave comparisons between features. The latter was prepared on tracing cloth by the office engineer and blue prints were mailed to field offices.

The budget report consisted of a comparison of the total feature cost at any time with the amounts authorized for that feature and the balance available for completion. A glance at this report showed the financial status of each job on a cost basis.

Special and comparative statements were made from time to time, but the foregoing were the most important regular reports.



Form E 52A-3250-1-22

STATE OF OHIO
MIAMI CONSERVANCY DISTRICT
DEPARTMENT OF ENGINEERING AND CONSTRUCTION

DETAIL COST REPORT

DATE

FEATURE No. NAME

192

Sec. No.	ITEMS OF COST	COST THIS MONTH	COST TO DATE	UNIT	QUANTITIES THIS MONTH	QUANTITIES TO DATE	UNIT COST THIS MONTH	UNIT COST TO DATE

Approved

Form E 52-2-3500-1-22

STATE OF OHIO
MIAMI CONSERVANCY DISTRICT
DEPARTMENT OF ENGINEERING AND CONSTRUCTION

DETAIL COST REPORT Sheet 2 of 2

DATE

FEATURE No. NAME

192

Sec. No.	ITEMS OF COST	COST THIS MONTH	COST TO DATE	UNIT	QUANTITIES THIS MONTH	QUANTITIES TO DATE	UNIT COST THIS MONTH	UNIT COST TO DATE
	Brought Forward							
70	Protective boom			lin.ft.boo				
71	Timber and lumber, miscellaneous			"				
72	Timber piles			Lin. Ft.				
73	Wood sheet			Sq.ft.bou				
74	Steel sheet							
75	Furnish an							
77	Furnish an							
78	Steel highv							
81	Hoisting, t							
82	Miscellaneo							
84	Wire strar							
85	Cleaning u							
86	Pumping a							
87	Pumping c							
88	Moving ex							
	Extra work							
214	Trees, Shr							
	Subtotal							
202	Engineerin							
203	Engineerin							
204	Inspection							
213	Employmer							
	Subtotal							
	Distributio							
	Total							
	Explanatio							
	Total							

Approved

Form E 52-1-3250-1-22

STATE OF OHIO
MIAMI CONSERVANCY DISTRICT
DEPARTMENT OF ENGINEERING AND CONSTRUCTION

DETAIL COST REPORT Sheet 1 of 2

DATE

FEATURE No. NAME

192

Sec. No.	ITEMS OF COST	COST THIS MONTH	COST TO DATE	UNIT	QUANTITIES THIS MONTH	QUANTITIES TO DATE	UNIT COST THIS MONTH	UNIT COST TO DATE
1	Stream control at dams			Job				
2	Clearing			Acre				
3	Removal of buildings			Job				
4	Trimming and shaping slopes			Sq. Yd.				
5	Excavation, soil stripping			Cu. Yd.				
6	Excavation, new channels			"				
9	Excavation, river channels			"				
13	Excavation, outlet works and spillways			"				
16	Excavation, minor drainage			"				
19	Excavation, highway cuts and fills			"				
22	Excavation, walls, piers, etc.			"				
24	Wrecking Adams St. Bridge—Troy			Job				
25	Excavation, backfilling trenches			Cu. Yd.				
31	Embankment, hydraulic			"				
32	Embankment, semi-hydraulic			"				
33	Embankment, rolled			"				
34	Embankment, levees (from channels)			"				
35	Embankment, levees (from borrow pits)			"				
36	Embankment, miscellaneous			"				
37	Backfilling			"				
38	Surface dressing and grassing			"				
39	Waterproofing concrete in bridges			Sq. Yd.				
40	Concrete, bridge railings			Cu. Yd.				
41	Concrete, outlets, spillways, walls, piers			"				
42	Concrete, bridge arches			"				
43	Concrete, spand. walls, etc. fin. in bdgs.			"				
44	Concrete, monolithic slope revetment			"				
45	Concrete, flexible slab revetment			"				
46	Concrete, culverts, gate-chambers, etc.			"				
47	Concrete, manholes, sewers, etc.			"				
48	Stone masonry			"				
53	Vitrified brick lining			"				
53	Drilling foundations or masonry			Lin. Ft.				
54	Grouting foundation or masonry			Cu. Yd.				
55	Furnish and lay vitrified pipe			Inch. Ft.				
57	Dry rubble paving			Cu. Yd.				
58	Riprap			"				
59	Gutter paving			Sq. Yd.				
60	Crushed rock or gravel			Cu. Yd.				
61	Rolled gravel on highways			Sq. Yd.				
62	Water-bound macadam			"				
63	Bituminous-bound macadam			"				
64	Brick paving, concrete foundation			"				
65a	Concrete paving, sidewalks & gutters			"				
65b	Concrete paving, roads			"				
66	Miscellaneous street paving			"				
67	Guard rails			Lin. Ft.				
69	Wire fences			"				
	Carried Forward							

Approved

FIGURE 29—COST REPORT SHEETS

The first two were for the features with standard items of work, the third was for miscellaneous work.

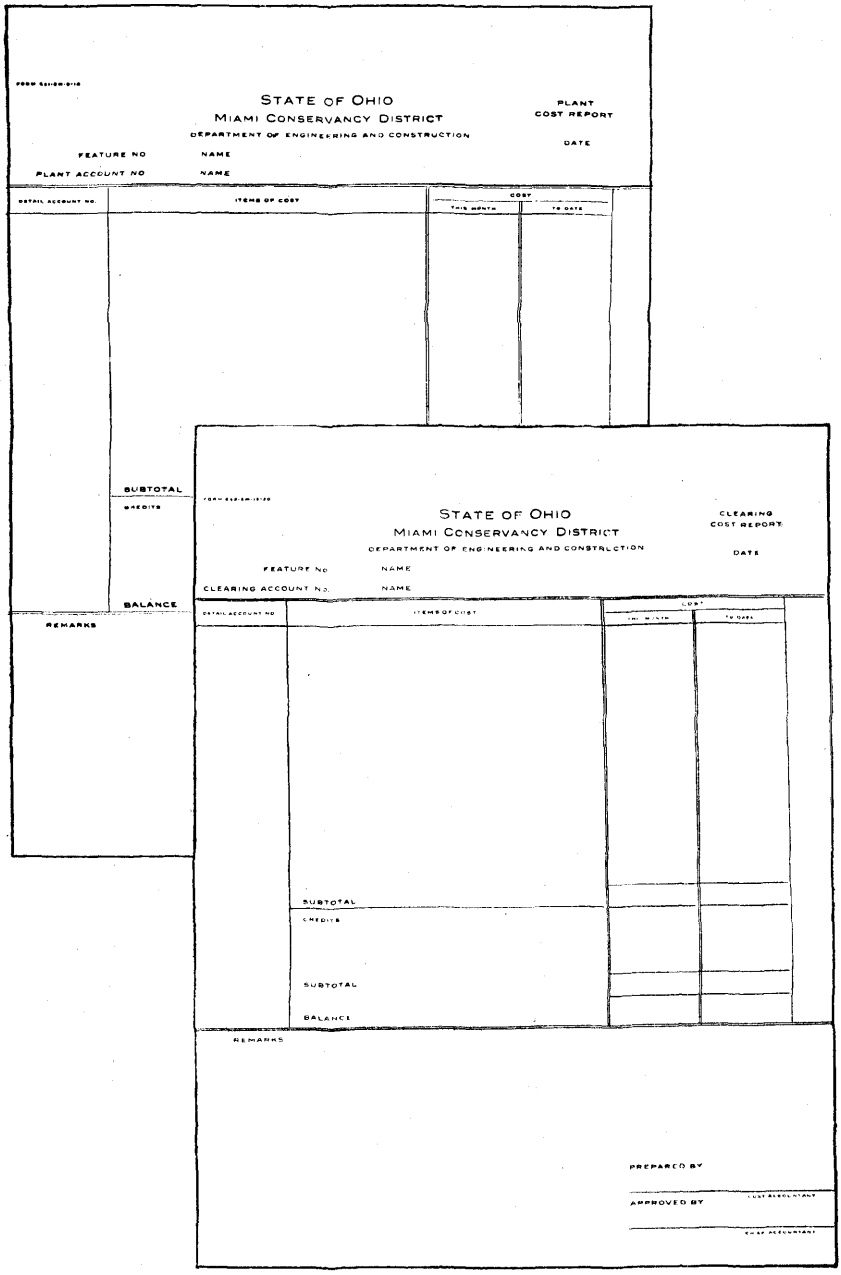


FIGURE 30—PLANT AND OPERATION OR CLEARING ACCOUNT REPORT SHEETS

Form P 214 200 1-32

STATE OF OHIO
MIAMI CONSERVANCY DISTRICT
DEPARTMENT OF ENGINEERING AND CONSTRUCTION

FINANCIAL STATEMENT
Month of 192

	Dr	Cr	Dr Balance	Cr Balance	Dr	Cr	Dr Balance	Cr Balance	Net Balance
ASSETS									
I. CASH									
II. INVENTORIES									
15—Reconciliation									
16—Warehouse Stock									
Feature—									
Sub Total—									
17—Inventory Depreciation									
18—Freight and Handling									
19—Goods in Transit									
III. ACCOUNTS RECEIVABLE									
21—Personal Accounts									
25—Uncollected Inter Dept. Transfers									
IV. ADMINISTRATIVE ADJUSTMENT									
30—Assets									
V. CONSTRUCTION COST									
31—Feature Items									
32—Plant									
33—Operation									
36—Salvage									
37—Discounts									
38—Miscellaneous Revenue									
VI. 40—Maintenance									
LIABILITIES									
VII. ACCOUNTS PAYABLE									
41—Unpaid Labor									
42—Unpaid Purchases									
43—Unpaid Contracts Earnings									
44—Unpaid Contracts Holdbacks									
VIII. 47—Interest—Accrued Int.									
IX. ADMINISTRATIVE ADJUSTMENT									
50—Liabilities									
X. INVESTMENT ACCOUNT									
61—Disbursements									
62—Transfers Received									
Less									
71—Collections									
72—Transfers Issued									
NET INVESTMENT									
XI. ADMINISTRATIVE ADJUSTMENT									
80—Contra—									

Prepared by ..... Assistant Chief Accountant

Approved ..... Chief Accountant

FIGURE 31—FINANCIAL STATEMENT, FORM E-214

CHAPTER XIV
BUDGET

The amount of money required for construction was based, in the first instance, upon preliminary estimates of cost under the approved Official Plan. Very careful estimates were worked out and financing was based upon these estimates as a whole.

Owing to the conditions resulting from the entry of the United States into the World War, cost exceeded the original estimates, and early in 1920 a revision of these estimates was made and additional bonds sold to finance the job to completion.

The budget system was based upon these estimates. Allotments were made to features by items and every effort made to keep the unit cost within the estimates making up the allotment. From time to time (usually at yearly intervals) revised estimates of cost to complete were prepared and allotments revised accordingly. Actual cost was compared with the estimate by monthly statements prepared for the job as a whole. This statement showed amount allotted by feature, cost to date, and balance available to complete. A more detailed analysis by items, for each feature, was also prepared at the same time, comparison being between estimated and actual unit cost.

The comparison could not be made by features on a cash basis because there was no practicable way of ascertaining the exact amount of cash required by features for a given period. The investment had already been made in plant, large stocks of materials and supplies were on hand in the warehouses, and deferred charges of various kinds were involved, all of which entered into subsequent cost but demanded no additional outlay in cash. On the other hand, a large amount of cash was required to meet accounts payable which had no relation to future cost. Budget comparison by features was therefore made on a cost basis and the cash requirements computed for the construction department as a whole.

From the total estimates of cost there were deducted:

1. Value of materials and supplies on hand.
2. Equipment depreciation included in cost estimates.
3. Accounts receivable.

To the remainder were added:

1. Accounts payable.
2. Additional investment needed for plant.
3. Reserve for accident insurance, etc.

In this manner the total amount of cash needed, based on estimates as rendered, could be approximately ascertained after making due allowance for uncollectible accounts receivable and contingencies.

The making of budget reports was not begun until 1920. Economy would probably have resulted if the system had been used from the beginning, judging by the interest it stimulated in division engineers and superintendents after it was installed.

CHAPTER XV

GENERAL EXPENSE OR OVERHEAD

Job overhead consisted of field engineering, superintendence and field accounting, depreciation, camp expense, and expense intimately connected with construction operations. All of such expenses were included in items of work through the various operating accounts as explained in the discussion of these operations (pages 28 to 32).

Another class of expense, which has been called "general expense," consisting of the headquarters office, legal and administrative offices and financing, was largely foreign to actual construction operations. It will be noted from the classification on page 23 that headquarters expense for the construction department was carried as a separate feature (Nos. 201 to 213). This contained no part of the administrative (or treasurer's) office, legal office or financing. It was the construction headquarters office only. But it was a part of construction cost and was charged to features. It would not have been practicable, however, to distribute it to items of work, so distribution was made at the close of each month by charging to a special item under each feature a certain percent of the feature cost. This was usually done in the month following that in which the cost was incurred. That is, a certain percent of the cost for May would be charged in June business and credited to a special credit account under headquarters expense. There was usually a small balance left in the headquarters' feature. The total of both debits and credits was carried forward for statistical purposes.

Much difference of opinion exists as to the best method of distributing general expense and volumes have been written about it. It is conceded that the District's method was not scientific, or even fair to all features, but no absolutely fair method was possible of application under the conditions which existed. Probably the direct labor method would have been better, but so far as this work was concerned no convincing advantage was apparent in any particular method as compared with any other one. Therefore the simplest was the best. The only reason for the distribution was to avoid misleading information as to the probable total cost to date of any one feature. Feature cost reports were subtotaled before adding this expense, and the addition called attention to the fact that general expense was being taken into consideration.

CONCLUSION

In bringing this report to a close, it will not be amiss to repeat what has been inferred before. The importance of the work of the accountant and cost keeper as an aid to the engineer can hardly be overstated. Cost keeping is the latest development in the accounting field, and from the viewpoint of the engineer, the most important. The engineer is interested in financing and bookkeeping in a general way, but in the actual carrying out of his construction program some method of cost finding is indispensable. The term accounting as used in this report embraces the broad field of which cost keeping is a part. Some deny the relationship between accounting, or bookkeeping, and cost keeping, and maintain that the cost keeping should be entirely divorced from the bookkeeping. By taking from bookkeeping some of its commercial traditions it is adaptable to the keeping of costs on construction work, as well as for manufacturing. All cost records, no matter by what term they are known—should be susceptible of control or check by the financial books, and to this extent at least the relationship should be maintained.

Information based upon the experience of the District in the engineering field is being widely utilized by the engineering profession, and it is to bring the accounting phase of the project to general attention that this report is added to the literature already published.

APPENDIX

COST PLUS VARIABLE FEE CONTRACTS

As has been said before, a very large percentage of the construction work was performed by the District's own forces. In fact, practically all of the main features of the work were so handled. There were many cases, however, where some of the smaller jobs, or some of the independent units of the large features could be handled more economically by local contractors, who had suitable equipment available and who could give their personal attention to the details of the work. So, with the District acting as the main contractor, many such jobs were "sublet," under forms of agreement best suited to the work in hand.

In general, "unit price" construction contracts are impersonal affairs, written so that the lowest bidder, no matter who he may be, can do the work, provided, of course, that he satisfies the usual requirements as to experience, financial ability, plant available, etc. A number of such sub-contracts were let by the District. These were generally for work of standard nature, such as independent sections of levee embankment, road fills, etc., where, to get the dirt into place, was the main requisite. But on some of the work the experience and reliability of the contractor were of first importance, and in some cases the work was of such special nature that a unit price bid was, of necessity, a gamble. A cost-plus-variable-fee contract was devised to meet these conditions.

This type of contract is quite different from the ordinary "cost-plus" contract, where the contractor's fee is either a fixed sum, or else a fixed percentage of the cost. The cost-plus-fixed-fee contract is objectionable, because the contractor's fee is the same regardless of whether he handles the work economically or not. The cost-plus-percentage contract is even worse, because under that form of agreement, the more the work costs the larger the fee. In the cost-plus-variable-fee contract those objections are overcome by giving the contractor the incentive to keep down costs and thus increase his fee. The more he saves for the District, the larger will be his own compensation.

The first important element in this form of contract is the "base price." This base price is a fair estimate of what the work should cost. It is obtained by multiplying estimated unit prices by **actual quantities.** The estimated unit prices are agreed upon at the time the contract is made, are based on labor rates in effect at that time, and are subject to modification in proportion to changes in labor rates as the work progresses. Actual quantities are obtained from monthly estimates as the work is performed. In the event that the actual cost equals the base price, the contractor's fee is set at some percentage of the base price (usually about 8% to 10%). If the work costs more than the base price, then the contractor's fee (always a percentage of base price, not of cost), is reduced by a percentage of the excess cost. The larger

the excess cost, the smaller becomes the fee. A limit (usually 3% of the base price) is set, below which the fee cannot shrink. This 3% is barely enough to cover the contractor's overhead expense. If the work is done for less than the base price, the contractor shares in the savings on a sliding scale. The largest amount that he can earn may be limited to a definite percentage, but is always less than 50% of the saving.

In short, the contractor's fee depends on the relation of actual cost to base price. The higher the cost, the smaller the fee; the lower the cost, the larger the fee. Neither he nor the District have to gamble on labor rates because an adjustment is provided for in case wages increase or decrease during the progress of the work. The contractor has a chance to earn more than his ordinary fee, but in so doing he makes a greater saving for the District. On the other hand, he is protected against "going broke" because his minimum fee is enough to cover his actual overhead expense, although under the worst condition he may get practically nothing for his own services.

Under this type of contract the contractor is really an employee in a very responsible position, and is employed and treated as such. The contractor, in turn, regards the District as his employer and partner. Both the District and the contractor strive for the common end of good work and economy, for they both profit thereby.

There are three essentials to such an agreement. The first is a good estimate of probable cost, to be used in making up the base price. An estimate either too low or too high will defeat the object desired. The second essential is mutual confidence between the two parties. The third is fair dealing on both sides during the progress of the work. If any of the essentials are lacking, the contract will prove disappointing.

A number of such sub-contracts were let by the District. The results were very satisfactory. In most of them, the work was done for less than the estimated price, to mutual profit. In every case, the work was done for substantially less than it would have cost under an old-style unit price bid.

The general provisions and detail specifications of these agreements were taken from the standard contract forms of the District, as published as Part VI of the Technical Reports. Paragraphs specifically setting forth the special provisions of this particular form of agreement were added. Such special paragraphs are illustrated by the example which follows, taken from an agreement for placing concrete revetment on the levee slopes.

TERMS:—The District shall pay and the Contractor shall accept as full compensation for work done, the actual necessary construction cost incurred by the Contractor, increased by the Contractor's fee as hereinafter specified.

CONSTRUCTION COST:—The construction cost shall include all labor, materials, supplies, and expense directly chargeable to the work whether supplied by the District or by the Contractor. There shall be included within this cost, expense of installation and dismantling of plant,

electric power, labor of timekeepers and foremen, liability insurance, agreed charge for use of equipment and other similar items which go to make up the complete job, except, however, that the following items shall not be included in the construction cost: salary and personal expense of the president of the Company, including the maintenance and operation of his personal automobile; cost of operation of the Contractor's central office; any similar expense not directly chargeable to the work; the cost of cement, reinforcing steel, expansion joint material and wire strand, which will be furnished by the District f. o. b. cars or in its warehouse at _____; and the cost of sand and gravel which will be furnished by the District at screening plant or pit. For the determination of the actual cost, the Contractor shall submit:

(1) At the beginning of the work and at any time thereafter when a change is made, a statement of the plant and equipment which he proposes to use, including first cost and present value, said statement to be approved by the Chief Engineer of the District, or his representative, before the plant or equipment is placed in use.

(2) Each week a statement of all materials received, specifying whether such materials were purchased through the District or direct by the Contractor, and their cost in detail.

(3) Each week, payrolls of employees, teams, etc.

For the purpose of obtaining and checking payments due the Contractor under this agreement, access shall be given to the District at all times to all such books and accounts as contain a record of any and all labor supplied and expenditures made, or to be made, which are chargeable to this work. Such data, checked and supplemented by the records of the District, shall be the basis of the computation of the construction cost.

THE CONTRACTOR'S FEE:—The Contractor's fee will be determined in the following manner: The estimated unit cost of the various items of work contemplated under this agreement is as follows:

Schedule of Estimated Unit Prices

Excavation for foundations_____per cu. yd.
Constructing monolithic slab revetment_____per cu. yd.
Laying flexible slab revetment_____per block.

It is agreed that the estimated unit prices given above are based on labor conditions on the date of this agreement, and that these prices shall be increased or decreased in the same ratio that the District finds necessary to increase or decrease its wage rate for common labor.* On the date of this agreement this rate for common labor is_____per 10-hour day.

At the end of each month, a determination will be made of the total actual quantities of each item of work mentioned in this schedule completed to the end of such month. The sum of the amounts obtained by multiplying each such quantity by the corresponding unit price as named in the schedule will be termed the base price. Should the actual construction cost up to the end of such month be equal to the base price, the Contractor's fee shall be 9% of the base price. Should the actual construction cost exceed the base price, the Contractor's fee shall be decreased by 25% of the excess cost up to an excess of 10% of said base price, and by 50% of all additional excess cost above 10% of said base price, provided, however, that the Contractor's fee shall not be reduced to less than 3% of the said base price.

Should the actual construction cost be less than the said base price, the Contractor's fee shall be increased by 25% of the saving in cost below the base price up to a saving of 10% of said base price, and by 50% of all additional saving above 10% of said base price.

PURCHASE OF MATERIALS AND SUPPLIES:—All materials and supplies required by the Contractor for this work shall be ordered on regular forms provided by the District, will be furnished by the District subject to the approval of the Chief Engineer and charged to the

* The District was maintaining its own construction forces during this period, so its established rate for common labor at any time, as well as any changes in such rate, were matters of record.

work at actual cost plus 15% to cover the expense of purchasing, accounting, and overhead; except that in case of absolute necessity the Contractor may purchase direct, items costing less than five dollars ($5.00) per unit, which will be charged to the work at cost, and will be paid for by the District, on a sundry expense account if approved by the Chief Engineer or his authorized representative.

Equipment used upon the work, whether supplied by the Contractor or the District, shall be charged into the construction cost at the rate of 2% per month on the value of the equipment. This value shall be agreed upon by the Contractor and the Chief Engineer of the District as a reasonable market value of the equipment at the time it is assigned to the work. This charge for use of equipment shall begin at the time the equipment is put into use, and shall continue whether the equipment is in use or not as long as it is held on the job, or until such time as it is listed by the Contractor as available for permanent transfer to other work.

MONTHLY ESTIMATES:—Payment to the Contractor will be made on or before the 20th of each month for the work performed during the previous month, and shall cover the actual cost to the Contractor, including the agreed rate for use of his own equipment, increased by the graduated fee specified heretofore and due at the date of the estimate. The computation of the payment due will be made on the basis of total work done, and total fee earned from the beginning of the work to the date of the estimate with previous payments deducted. It is agreed that in the monthly estimates 50% only of the Contractor's fee will be included for payment until a reserve of $_____is reached. Upon the completion of the work, in full satisfaction of this agreement, a final estimate will be computed for all work done, and full payment including the portion of fee previously withheld, will be made.

Payments on account may be made each week in sufficient amount to pay for the Contractor's payroll for the preceding week.. All such payments made between any two succeeding monthly estimates shall be deducted from the amount due as shown upon such monthly estimates. Said weekly payments are subject to correction at the time of computing the monthly or final payments, should errors be found necessitating such correction.

TERMINATION OF AGREEMENT:—It is the essence of this agreement that the work provided for herein shall be carried on with the greatest efficiency and economy. To this end, it is understood that the president of the Company shall devote his attention to the work in all its details to obtain an efficient organization, a control over purchase and use of materials and supplies, and the reduction of all waste. It is the expectation of both parties in this agreement that it will remain in force until the completion of the work. However, this agreement may be terminated either by the District or by the Contractor upon ninety (90) days' notice, or may be terminated at once by the District upon the disability of the present president of the Company. In case of such termination, the plant and equipment shall be at the disposal of the District for the completion of the work, but such compensation therefor as shall be just shall be made to the Contractor.