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# Out-board-motor Industry

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# The Outboard-motor Industry

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## History and Development

The evolution of travel through the air has been comparatively recent; the development of travel over land and water is as old as history itself, and even superficial consideration will disclose that most of the romantic themes in the development of the race are to some extent concerned with the ability of man to propel himself over the seas with the greatest of dispatch. Thus, the Greek legend of the Argonauts and their quest of the Golden Fleece, the sagas of the ravaging conquests of the Vikings, and the romantic rise and fall of the shipping on the Spanish Main prove the deep abiding interest and importance attached to the conquest of the waters.

The development of the various propelling forces which were successfully applied toward locomotion on the water, may be left for the most part to the prolific field of historical record, and the primary task of this thesis will be a consideration of a subdivision of the evolution of propulsion of watercraft by means of the internal combustion engine, namely, the development of the outboard motor. The outboard-motor industry today ranks as one of the important in a host of tremendously startling industrial achievements, and its growth and development is inseparably connected with the commercial and recreational activities on the waters of all nations.

The first outboard motor made its appearance in 1909 during an era of world-wide quickening of interest in the internal-combustion powered automobile and motorboat. It would naturally be expected that with the imaginative appeal created by the spectacle of rapidly moving vehicles upon land and water, some person or persons would conceive the idea of building a power plant for small watercraft which would be attached to the stern of the boat and extend into the water. The first really successful outboard motor of this kind was built by Ole Evinrude in a small machine shop in Wisconsin, and therefore, the development of the outboard motor industry is centered about the name of this pioneer. Wisconsin may justly claim to be the home of this industry, for, in addition to the fact that the first successful motor was there

produced, it still ranks as the producer of more than 40 per cent. of all such motors made in the United States.

The first outboard motor built in 1909 by Evinrude was of 1½ h.p. single cylinder, two cycle, which, when placed in an ordinary rowboat, propelled it at a speed of approximately six to seven miles an hour.

Evinrude continued his experimental development of this engine until he produced a motor that was sufficiently trouble-free to permit of practical use and distribution. With little or no capital, he built twenty-five of these motors which he hoped to be able to sell through personal contact. It was his wife and business partner who foresaw the possibilities of Evinrude's inspiration and, over his protests, inserted an advertisement in the leading sports magazines. The replies and inquiries were so numerous that it immediately became apparent that an assured demand awaited a more constant output of the engine. Because of his inadequacy of capital, Evinrude formed a company in 1910, and $5,000 of outside capital was secured.

With this limited amount as a base, by dint of careful management and planning, the Evinrudes produced and sold in the period of four years from 1910 to 1913, more than 30,000 motors. In 1913, for internal reasons, the company was transferred to others for a consideration approximating $300,000, and the business continued operations in Milwaukee under the name of Evinrude Motor Company.

Evinrude did not again engage in the manufacture of outboard motors until 1920, when he organized the Elto Outboard Motor Company. This company produced a light twin-cylinder motor, which was the first really marked advance in design and construction, as the maximum speed was materially increased, the weight was lessened and vibration was eliminated to a considerable degree.

Incidentally, it may be mentioned that one of the greatest factors which militated against the use of the outboard motor and, correspondingly, the overcoming of which greatly increased the sales appeal of the motor was vibration. The excessive vibration of the early motors had a destructive influence on both the motor itself and on the boat to which it was attached. At first attempts were made to overcome this difficulty by manufacturing specially constructed, braced, and even steel, boats, many of which remain in use, but this presented an obvious limitation to popular use,

since it involved a much higher price to the buyer. Therefore, one of the problems of the industry has been a problem common to all manufacturers of internal-combustion engines, namely that of reducing vibration, and this has been accomplished to a marked extent in late years by the utilization of light alloy pistons and by greater accuracy in machining and balancing moving parts, such as the crank-shaft and fly-wheel, etc.

Up to the year 1925 the motors were used principally for pleasure and for certain commercial purposes. The motors of that day were capable of propelling the ordinary rowboats, on which they were used almost exclusively, at a speed of about ten miles an hour.

Another important turning point in the history of the industry was the introduction of the step- or hydro-plane in 1925. This type of boat skimmed over the water, as distinguished from a displacement boat, and rendered possible the attainment of exceptionally high speeds, with the result that the motors were introduced in racing and other aquatic sports. Racing associations and clubs were organized, and a popular interest and demand soon resulted, which manifested itself in more widespread use with correspondingly greater sales and production.

After this innovation, the development of the motors and of the industry assumed a more rapid pace. Each successive year marked the establishment of new speed records, and each year saw the development of new types and classes of motors. Annual racing classics were inaugurated, of which the Albany to New York race on the Hudson is still probably the most important. In 1928 the winner of that race averaged less than 30 miles an hour, whereas the 1931 winner averaged 42 miles an hour, and the total elapsed time was less than the time required by the New York Central's crack train for the same run. The 1931 annual race from Milwaukee to Chicago on the open waters of Lake Michigan was run by the winner in one hour and fifty-six minutes, which was the fastest time ever made by any type of motor boat between those points. In 1931, also, a new speed record for an outboard motor boat was established at slightly over 55 miles an hour.

Naturally enough, this development and stimulation of interest in the motors resulted in the organization of several new companies for the purpose of competing in manufacture and marketing. By the close of 1928 five fairly large competing firms were

engaged in the industry in the United States, each with similar models in practically every motor class. These companies were the Evinrude Motor Company and Elto Outboard Motor Company, both at Milwaukee, Johnson Motor Company, at Waukegan, Illinois, Lockwood Motor Company, at Jackson, Michigan, and Caille Motor Company, at Detroit.

The Johnson Motor Company was the outgrowth of the Johnson Motor Wheel Company of South Bend, Indiana, and had been engaged in the production of small motors for bicycles. Its operations in that field were more or less limited, and in 1921, attracted by the growing interest, it reorganized and subsequently acquired a plant at Waukegan, Illinois, for the manufacture of outboard motors. The Lockwood Company was originally engaged in building small inboard marine motors, from which it turned to outboards. Numerous smaller manufacturers had also commenced operations and were able to persist for only a short time, due either to under-capitalization or their inability to produce a successful competitive motor under practical producing conditions. At one time in the period prior to 1928 there were about twenty such small manufacturers.

Production had also sprung up in various foreign countries. England was making the Watermota, the Roness and the Coventry-Victor motors, and Sweden was manufacturing the Penta and the Archimedes. Foreign motors have not as yet prevented a large volume of American export business, as the foreign manufacturers seem unable to produce as cheaply as do the Americans. In fact, so dominant is our foreign trade mastery that the export business in the last few years has represented approximately 25 per cent. of the total annual production.

While no exact statistics are available, the following production figures are submitted as an approximation for the period of 1910 to 1930, as compiled from the best data available:

| Year | Number of Motors Produced |
|---|---|
| 1910 | 2,000 |
| 1911 | 4,500 |
| 1912 | 13,000 |
| 1913 | 12,000 |
| 1914 | 10,000 |
| 1915 | 8,000 |
| 1916 | 8,000 |
| 1917 | 7,000 |

| Year | Number of Motors Produced |
|---|---|
| 1918 | 500 |
| 1919 | 10,000 |
| 1920 | 12,500 |
| 1921 | 14,000 |
| 1922 | 18,000 |
| 1923 | 22,000 |
| 1924 | 30,000 |
| 1925 | 35,000 |
| 1926 | 40,000 |
| 1927 | 45,000 |
| 1928 | 52,500 |
| 1929 | 60,000 |
| 1930 | 50,000 |
| Total | 454,000 |

The decline in production from 1913 to 1917 was due to the world war, and the small production in 1918 was occasioned by the utilization of the plant facilities for war work, upon the entrance of the United States into the war. It is expected that 1931 production will be found to have been somewhat less than the 1930 figure because of current economic conditions.

In January, 1929, a merger was effected by three of the larger competing manufacturers whereby the Evinrude, Elto and Lockwood companies were consolidated under the name of Outboard Motors Corporation, with its plant at Milwaukee. This resulted in the domination of the industry by two large manufacturers, namely the Outboard Motors Corporation and the Johnson Motor Company at Waukegan, Illinois. There are still three or four smaller manufacturers, of which the largest is the Caille Motor Company. The two principal companies are responsible for an estimated percentage of the total American production of 75 to 80 per cent., and maintain this status by vigorous and consistent distribution policies.

The motors now being produced range from one to four cylinders, and are still entirely of the two-cycle type, although there has been considerable experimenting with four-cycle motors. They range in weight from 26 lbs. to 125 lbs. and develop from 2½ to 55 h.p. at high engine speeds.

Some of the manufacturers are at present marketing complete units of boats and motors under their own names, although the boats are not generally manufactured by the motor companies,

but are purchased from certain boat manufacturers. Others, on the contrary, confine their sales efforts to motors only, presumably for the purpose of retaining the goodwill of all the boat manufacturers. To the observer, it would seem that the marketing of boats adds one more hazard to those already assumed by the manufacturer, if for no other reason than that boats are subject to quick changes of style and physical depreciation.

The present uses of the motor are quite varied, and the range of models covers every possible purpose. While it is undoubtedly true that they are still utilized principally for sports, such as racing, cruising, fishing, aquaplaning, etc., the commercial purposes can not be minimized. Their primary commercial use is the transportation of passengers and freight, but there is also a large sales outlet among commercial fishermen, hunters and trappers, forest rangers, explorers, traders and others whose vocations render water travel necessary.

The principal advantage claimed for outboard motors on boats of all types is their portability. They can be quickly transferred from one craft to another and are easily transported to any body of water. Boats so equipped can readily traverse shallow waters, for, upon encountering an obstruction, the propeller merely tilts out of harms' way, which is a characteristic not possessed by the rigid drive shaft and propeller of the inboard motor. The inboard motor has the additional disadvantage of usually occupying a large amount of space in the center of the boat, while the outboard is hung at the stern completely out of the way, and permits greater utilization of the carrying capacity.

The industry directly employs at present about twenty-five hundred to three thousand people at the height of the production season, and probably about two thousand on an average for the year. This, of course, is without considering the number of persons employed by the distributors and dealers.

The sales volume in dollars from the inception of the industry up to the present time reached its peak in the year 1929, when the production and sale of about 60,000 motors resulted in a sales total somewhat in excess of $10,000,000.

## Manufacturing and Production

Inasmuch as the manufacturing and production methods of the principal manufacturers are quite similar, the discussion of this phase of the outboard-motor industry presented in the following

paragraphs may be considered to be representative of the industry as a whole.

The principal raw material entering into the construction of the motors is aluminum. The fly-wheel, crank-case, drive shaft housing, gasoline tank and mounting bracket are entirely aluminum, while the cylinders and crank-shaft are of grey iron. These items are the major parts, and in every instance are received rough cast from the commercial foundries. At the present time, no manufacturer operates an aluminum, grey-iron or brass foundry, probably because the castings are small and the principal manufacturing cost is in the machining, finishing and assembling operations.

The factory operations on the aluminum parts are machining and finishing, which include cutting, boring, grinding, plating and polishing. All such parts are also heat-treated for resistance to salt water corrosion and for high tensile strength. Important additional operations on the fly-wheel, piston and connecting rods and crank-shaft are the balancing of these parts, previously mentioned as essential to the elimination of vibration.

The grey-iron cylinders are bored, turned, ground and honed; in most instances with machines especially designed for the particular operation, and the other miscellaneous parts are likewise treated in the routine manner.

Smaller parts and assembled units, which are generally purchased from independent manufacturers, are the coils, timer, carburetor, piston-rings, spark-plugs, wiring and batteries, ball and roller bearings. The latter type of bearings is used throughout on the high-speed model motors.

At this juncture it is interesting to note that the year 1930 witnessed the application of the electric self-starter to the outboard motor, and this innovation, vigorously advertised, served as a powerful stimulus to sales appeal. As in the instance of the automobile, the self-starter immediately broadened the scope of the potential operators of outboards to include women and children, with resultant increases in sales. Previously, of course, it had been necessary to start the motors by manually revolving the fly-wheel, either by means of a small handle on the fly-wheel or by means of a rope which was wound around the fly-wheel and then suddenly pulled. In 1931 the inertia airplane type self-starter was introduced on certain outboard models and instantly won widespread favor. These starters have an advantage over

the electrical self-starter in that it is not necessary to carry and service a heavy-duty storage battery for their operation, and hence their introduction further stimulated the sales field to include remote and rural regions where electric current for recharging purposes is not available. Both of these types of self-starters are purchased as units from independent manufacturers.

Every motor, after leaving the final assembly line, is transferred to the testing rooms, where it is subjected to various preliminary tests in water tanks under conditions which approximate running conditions in open water. Thereafter it is transferred to the final test room and is subjected to various additional tests in test tanks. In addition to these tests, one motor selected at random from every 25 motors coming out of the final test room is given a thorough test under actual conditions on a river or lake. From the final test room the motors go to the packing room for boxing and crating, and then are stored in the finished stock warehouse preparatory to shipment.

Piece-work rates, as established by time studies, permit in paying productive labor on all production orders for both motors and parts, except on the final assembly line, where an hourly rate is used. Hourly rates are also used on orders to replenish the inventory with parts for old model motors, as these parts are produced in limited quantities only, and production is insufficient to justify the use of piece-work rates.

An extensive engineering and experimental laboratory is maintained, where improvements are constantly being developed, and here again a close parallel may be drawn to the automobile industry, for the development of innovations and refinements is required to maintain consumer interest.

As might readily be surmised, the business is highly seasonal. The principal selling season is from May to August, inclusive. A conservative estimate is made of the next year's probable production requirements after the close of each selling season, and actual factory operations are commenced generally in December, on a basis considerably below capacity, continuing on that basis through January, February, March and April to provide sufficient finished motors for the beginning of the selling season. With production during the selling season at about plant capacity, it is expected that enough motors will be produced to take care of the orders during the four heaviest months of the selling season. If sales are heavier than anticipated, reasonable efforts

are made to step up production. If the contrary occurs, as it did in 1930 when orders dropped off very sharply in July after an especially good beginning in the earlier part of the year, the manufacturer finds himself carrying over a substantial part of his inventory to the next year's selling season.

The usual procedure is to close the factories, so far as active production is concerned, from August to December. Such orders as may filter in for new motors or replacement parts are filled from stock, and even the office force is sharply curtailed during this period. Superficial consideration would seem to disclose a considerable loss in return on plant and machinery investment during these months of inactivity, and if it were possible to manufacture and distribute an allied class of small gasoline motors for other uses, this loss might be turned into a substantial profit. In any event, the industry offers a fertile field for the application of intelligent thought on the forecasting of economic trends and the development of sound diversification. Perhaps a bit of luck in anticipating future trends would be as desirable in this industry as in most others.

## Distribution

Distribution in the early days of the industry was accomplished principally through local agents. At the present time, distribution follows more closely the methods of the automobile industry. Responsible distributors in important territories are given contracts, and the development of smaller agencies is left entirely to them. Shipments to distributors are usually made with sight draft accompanying, so there is no great credit-control problem.

The consumer's market is, of course, limited to territories where bodies of water are near, and this gives rise to a rather peculiar problem in the organization of advertising expenditures. The great arid territories in the west are manifestly sterile fields for sales promotion, although in late years an effort has been made to overcome this factor by the development of light weight motors which are readily portable and require little space. This, together with the growing proclivity of the American public to travel long distances in automobiles for recreation, may still further broaden the sales field. There has also been a marked tendency to increase the "eye appeal" of the newer motors. This is, doubtless, an outgrowth of the modern trend in business

to make objects of utilitarian nature as attractive as possible. Accordingly, with the liberal use of chromium plating and attention to neat, compact structure, the new outboard motor is a pleasing object to the eye, and sales resistance has been thereby diminished.

A great deal of attention is devoted to the usual methods of national advertising, including advertising in the leading motor-boat periodicals, outdoor sports periodicals, weekly magazines of large circulation and outdoor posters and bulletins. Additional publicity is obtained through the large number of outboard races held by various regional clubs and associations. Great numbers of circulars, leaflets and brochures are regularly sent through the mails to carefully selected lists of possible users.

## Accounting Control

In considering accounting control, it may be of interest to know that one of the principal manufacturers in this industry has applied tabulating machinery, or so-called punched-hole-card accounting, to the control of its cost and general accounting records to probably a greater extent than most manufacturers using such equipment.

Punched-hole cards are used to control production order movements, inventories of materials and finished products, payrolls, accounts receivable, accounts payable, sales analysis, purchase analysis and accumulation of cost figures, and as the same accounting-control problems confront every manufacturer in this industry as well as in most others, a review of the methods employed by this manufacturer may prove of interest, to show the possibilities in the application of this type of control. Without going into the question of whether the method of accumulating cost figures used by this manufacturer is fundamentally correct or whether a different method would better serve the purpose, an attempt will be made to show its actual application in this plant.

It is perhaps a pardonable assumption that most readers of this treatise are reasonably familiar with tabulating machinery equipment, but for the uninitiate a brief explanation may not be amiss.

Punched-hole cards are used as a means of quickly accumulating any required accounting data. The holes are punched in the designated places on the card to indicate various data, and by means of electrical contact made through the holes in the card

when they are run through the tabulating machine, these data are accumulated, totaled and printed by the machine, which operates entirely automatically. As an example the material-requisition card may be considered. The required information is punched on the cards by the card-punching machine, operated by a girl. Thereupon all the punched cards for an accounting period dealing with material requisitions are run through the sorting machine, which automatically sorts the cards by production-order numbers. When the cards are so assorted, they are run through the tabulating computing machine, which, also automatically, adds the total of charges in dollars on each production-order number and likewise prints the production-order number and total charge on a sheet of paper preparatory to posting to the record of work in process on motors and parts. Similarly the cards are sorted and totaled by material numbers for posting to the perpetual-inventory record of material and parts in the stock-room. These operations, with necessary variations, are repeated in the accounting control of payrolls, sales, purchases, etc.

The equipment must necessarily consist of at least a hole-punching machine, a sorting machine and a tabulating computing machine. The volume of work to be done determines the number of each type of machine required. The manufacturer whose operations are being considered uses several punching machines, one sorter and one tabulator, and, in addition, one duplicating machine which automatically duplicates any punched card.

*Production and inventory control.*

Material is requisitioned out of stores through the use of the punched-hole material-requisition card. The requisitions are classified as motor orders and stock orders. The latter are orders to produce finished parts for the stock-room. A motor-production order is prepared by the production department, that department determines the number and model of motors to be produced and issues a separate requisition, filled out in pencil, for every different part entering into the construction of the motor. These requisitions are sent to the stock-room and the numbers of parts called for by the requisitions are accumulated and sent to the sub-assembly department indicated by the requisition. The cards are then returned to the tabulating department, after the number of parts remaining in stock after filling the requisition has been noted.

The tabulating department punches the cards to reflect the data written on them, sorts them by order and assembly-line number, and the total of the charges to each production order is accumulated by the tabulating machine. The totals so accumulated are then posted as charges to work-in-process under the appropriate production order number and credited to finished-parts stores account. This posting is done manually to the perpetual-inventory records. There are about fifteen ledgers and more than 5,000 accounts representing stores inventory, as the manufacturer at present makes three classes of motors, of 20 distinct models, and it is necessary to carry thousands of parts. If the three classes could be consolidated into one, and the number of parts reduced proportionately, it is quite probable that the posting of the stores-inventory accounts could also be done expeditiously through the use of the tabulating machine.

A punched-hole "move ticket" is used to control all the movements of materials returned to vendors, parts returned to store-room from assembly lines, motors delivered from the final assembly line to finished stock warehouse and motors out of finished stock warehouse to customers on sales orders. The accumulation of the accounting data follows much the same procedure as that for material requisitions.

Inventories in the store-room and in the finished stock warehouse are physically test-checked periodically with the stores ledgers—this in addition to the fact that every filled material requisition coming to the stores ledger keeper has noted on it the number of parts remaining on hand in the store-room, which is checked currently with the figure shown by the stores ledger.

*Wage and payroll procedure.*

For the purpose of controlling payrolls, a punched-hole time-ticket is used. Such a time ticket is prepared for every production-order number on which an employee expends time each day. The ticket is dated with the time of starting and finishing each order on a departmental time-clock. Each ticket shows the number and name of the employee, the production order and the line assembly number, department number, and the operation and machine number, together with the number of parts completed. At the close of the day the tickets are sent to the payroll department, and the elapsed time, the number of parts completed, and the hourly or piecework rate is inserted on each ticket and

the amount payable in dollars is computed on a calculating machine.

The cards are then punched to record this payroll information and at the close of the payroll period are sorted by employees and run through the tabulator to accumulate the earnings of each, from which the payroll cheques are prepared. They are then resorted by order number and at the close of the month are again run through the tabulator to accumulate the total of charges to each production-order number for the purpose of determining, (1) the productive labor costs to be charged to each production order, (2) the non-productive labor by departments and (3) the general non-productive labor which is not distributable by departments.

At the close of the payroll period the earnings of each employee, as accumulated by the tabulating machine, are punched upon a bank cheque, the name of the employee is inserted by addressograph plate, and the amount of the cheque is inserted by a cheque-writer in protectograph form. The punched-hole payroll cheque is resorted at the close of the year with the aid of the sorting machine in the order of employee numbers, and the total annual earnings of each employee are thus accumulated with the tabulating machine for the purpose of reporting wages earned to the state and federal income-tax departments.

The punched-hole bank cheques are also found to be of material assistance in sorting and totaling by the machine for the purpose of reconciling bank accounts at the close of each month.

Ordinary "in and out" clock cards are also used, and represent a check on the daily time of each employee against the time shown by his time ticket.

*Accounts receivable.*

The accounts receivable are controlled through the use of the punched-hole card. Such a card is punched for every sales invoice rendered and for every credit memorandum issued and cash payment made. The cards are kept in the order of the customers' account numbers, and, when invoices are fully paid, the charge and corresponding credit cards are removed from the current file. In addition, an ordinary accounts-receivable ledger account for every customer is maintained. It is posted by the tabulating machine from the punched cards. This latter record gives a better view of the company's debtors and the amounts owed by

each. A trial balance of the charges and credits represented in the current file of punched cards run by the tabulating machine is compared with an adding machine trial balance of the posted customers' accounts receivable and with the general ledger control account, for the purpose of proving and balancing.

Inasmuch as the greater part of the shipments are made with demand draft attached, it is obvious that most of the charges are offset by credits within a short time, and the uncollected invoices do not assume large proportions, nor are there many part payments of accounts which would necessitate numerous punched-hole credit cards in the current file.

*Sales analysis.*

For each invoice rendered a card is also punched for the purpose of sales analysis. The sales classification is simple, as the sales of motors are grouped by motor classes, of which there are six, viz., A, B, C, D, E and F, in each of the three classes of motors. The motors are classed according to the number of cubic inches of piston displacement, under rules set forth by the leading power-boat associations. No classification is made of sales other than motor sales, except to divide them as between parts and accessories and repairs. The classification cards are accumulated for the month, run through the sorter and tabulator, and the total sales computed as classified for the month are turned over to the bookkeeper for entry on the general books.

Information respecting states and countries to which shipments are made, distributors and dealers, etc., is also punched on the cards for the purpose of easily accumulating this desirable statistical information.

*Accounts payable.*

The accounts payable are likewise maintained on punched cards. Purchase invoices, after being approved, are recorded on punched cards. Cash payments and other deductions are so recorded also. These cards are then kept in the order number of the accounts of the respective vendors and represent the accounts-payable ledger. Bank cheques are immediately drawn in payment of the invoices, though they need not be sent out to the creditors immediately. Such unreleased bank cheques become a visible record of the accounts payable, and a trial balance of the cheques is compared with a trial balance of the punched-hole cards and with the general ledger control account.

*Purchase distribution.*

A punched-hole card is used in distributing purchases to the proper account. The cards are punched, and the distribution is controlled by the amount of the purchases recorded. The distribution provides for the account number of the vendor, for the production-order number when the items purchased go directly to the assembly line, for the material number where the purchases go to the material stores, and for other account numbers where the purchases represent anything other than material costs, together with the amount in dollars of the purchase. The cards are accumulated for the month, sorted and totaled by ledger account number by the tabulating machine, furnishing the general ledger keeper and the perpetual-inventory record keeper with the total purchase distribution for the month. Statistical information, such as quantities and sources of material and parts purchased, can also be easily procured from the data punched on the cards.

*Accumulation of cost data.*

The previous comment on production and inventory control indicates how the material costs are accumulated by order number in work-in-process and parts stores inventory account, and the comment regarding payroll procedure is indicative of the accumulation of the productive labor costs in these accounts. It is probably also desirable to consider the basis of distributing the burden in finding the final production-order costs. This is done by charging to work-in-process in respect of each number a certain predetermined percentage of burden for each unit of productive labor-hour in each department. The percentages to be charged are based on prior years' experience under normal operating conditions and naturally vary substantially between departments, because the work in some consists almost entirely of productive labor, with only a limited amount of equipment and space in use, while others employ a large amount of non-productive labor and a comparatively greater amount of space and equipment.

The burden charge per productive hour is noted on the regular payroll time ticket and the total burden charge for each time ticket punched on that card in a space provided for it. The cards are then sorted and the burden charges accumulated by order numbers on the tabulating machine. The total burden so determined is then charged on the books of account to work-in-process and

credited to "burden variations" account, against which the actual expenditures for burden expenses are charged. The resulting difference represents burden variations. Thus the work-in-process accounts accumulate the material, direct labor and burden costs by production-order numbers, both for motor production orders and for parts stock production orders, and the total production-order cost and cost per unit are determined. Where a production order provides for enough completed units to make the cost per unit representative, the perpetual-inventory record of unit costs of the same model motor on previous orders is changed to agree with the latest cost, in place of using an average of the various costs.

On account of the seasonal nature of production, there is a substantial amount of actual burden which is not absorbed in the cost figures during the months of January, February, March and April, when a minimum of productive labor is employed. Peak production operations of May, June, July and August should, under normal conditions, result in a large over-absorption of burden in the production costs, with the result that the burden variations will gradually approach a balance as the burden charges for the period from September to December are absorbed. In the latter period productive labor is again at a minimum.

*Departmental burden distribution.*

Certain actual burden expenses are distributed departmentally. These expenses are non-productive labor, watchmen and janitors' salaries, supplies, depreciation, repairs and maintenance, small tools, dies and fixtures, heat, light and power, gas and water.

Non-productive labor is charged directly to the respective departments from the time tickets. Supplies are charged directly from requisitions. Depreciation of buildings is charged on a relative-area basis, while depreciation of machinery and equipment is charged on the basis of the value and depreciation of such equipment in each department. Repairs and maintenance charges and tools, dies and fixtures are usually charged direct to each department. Heat, light and watchmen and janitors' salaries are charged departmentally on an area basis. Power is distributed by the approximate power load necessary in each department.

All other burden expenses are charged to appropriately named accounts under the general classification of "general undistributed factory burden."

*General accounting records.*

Any comment regarding the general accounting records or the set-up of the financial balance-sheet appears unnecessary, as the accounts entering into the assets and liabilities are few and simple. The previous comments on cost data indicate that the cost control accounts are tied up and controlled by the general ledger accounts.

The installation of internal audit check in the handling of cash receipts and disbursements, purchases and inventories presents no particular difficulties. The duplicate records of accounts receivable and accounts payable, one in the general accounting department and one in the tabulating machine department, result in an additional control and safeguard not generally found in manufacturing plants.

All the operating expenses are forecast monthly by carefully prepared budgeting of the expenses. A financial budget of collections and borrowings is also prepared for the purpose of controlling the liquid capital as far as possible. Standard ideal cost estimates are prepared for each production order, and variations from such a standard are carefully investigated.

When viewed as a whole the accounting control practices in this case are highly illustrative of the efficient organization in plant and office administration. The outboard-motor industry has enjoyed the advantage which accrues to all new industries, namely, the freedom from old encumbering practices and the untrammeled power to follow modern and scientific lines.