A SYSTEM

OF

ESTIMATING

FOR

FOUNDRY WORK.

By A. MESSERSCHMITT.

Translated and Adapted to American Practice,
By GEO. L. FOWLER, M. E.

CHICAGO:
THE AMERICAN ENGINEER.
1885.

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[OVER.]

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TRANSLATOR'S PREFACE.

In the translation and compilation of this little book, the editor has been guided by his own experience, which has shown that the system here laid down is wonderfully accurate when close attention is paid to the securing of proper data, and to a careful separation of all expenses that belong to other departments of the establishment. He is aware that he will probably be criticized at just this time on account of the high rate he has placed upon al material and wage expenses; but as it is pointed out in the latter part of the work, it is better to use illustrations where the expense runs high than otherwise, and it is easier to adapt the outline of one of these examples to actual service than where the figures are too low. Furthermore, it may not be out of place to add the translator's testimony to that of the author as to the efficacy of this method of estimating, and

that in his practice for some time past he has used this system with the greatest satisfaction. And if it shall contribute in any way to assist others in gaining a more perfect knowledge of the condition and workings of the foundries committed to their care, his labors as a translator and compiler will be amply repaid.

G. L. F.

East Saginaw, Mich., Dec. 1, 1884.

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APPENDIX.

INTRODUCTION.

How do we make an estimate? We simply ascertain all the items that represent the cost, add them together and therefrom deduce the profit which may belong to the particular department under consideration. This matter appears very simple and easy to one who is uninitiated. A glance at any quotation of prices, however, whether they are of a private or public nature, will soon show that there is still considerable difficulty involved in this same calculation; it is not simply because one concern offers twice as much for the same price as another, although this is not entirely unheard of, that we may reasonably ask; "How can these variations be possible? Who can make an estimate and who cannot?" That such results, which may be seen on every hand, are not referable to any differences, such as are due to more reasonable prices for material, favorable freights and the like, is evident even to a layman. For these latter differences are of a very insignificant nature in comparison with the actual extraordinary differences appearing in the quotations.

Much has been written and printed, in regard

to calculations for foundry and machine work, but, as yet, no single efficient system has been developed, because very much, which may be considered as applicable to special factories and their interaction upon each other, has been allowed to remain indistinct. A glance at our technical papers gives us copious instructions for correct calculations: one shows a diagram and marks out the selling price with a curve; another comes with his experience and displaying his yearly observations per ton, would use these data for the greatest variety of objects. The dealers have established a system and laid it down with long formulæ, which by their very complicity prevent an extensive application; yet they are used, and, as a result, we come to an understanding of the situation, only when business is falling off, and frequently for the first time months after it is too late; whereas, we could still have derived a good profit if we could have known at the time, the result of each day's work.

We can now see, that a correct method, which would display the cost of the foundry products, however impossible to and beyond the province of the office books, would be very difficult; for it should contain every item collected and grouped. Were it not so, if there were nothing to be done, we would not, in such an enlightened age, be astonished by the curious freaks in prices that have up to this time made their appearance. The

difficulty has still another side, as the author will show, and it is that though a correct calculation is perfectly impossible by means of the regular books alone, the technical man can only find the proper items for a correct method of estimating by means of them; and these, when once established, must come into more and more extensive application, whereby the books must give up their control after a few isolated rectifications have been made.

In consequence of this imperfect understanding and application of the method and modes of an accurate calculation, it simply follows that very many works are unsuccessful and are running down, while, if actual lack of work does not lie at the root of the matter, they might be raised to prosperity by a series of correct estimates. He who makes his estimates even approximately correct, can, to the same degree that they are exact, foretell his profits and loss, and the more accurate the former are, the better can he tell the extent of his business by their assistance, and learn to so adjust them, that they remain just about so correct, and thus avoid unnecessary losses.

The method of formulating a correct estimate and whatever data and results may be deduced therefrom, as well as the correctness of the system will now be especially demonstrated in the following pages and explained by numerous examples taken from practice.

The author, hoping to commend this undertaking, by his treatment of the subject, to all those that are interested, and that it may meet with approval, thinks it not out of place to add that his experience, extending over seventeen years, has shown his method to be correct. For eight years, the author has and still continues to estimate by this system alone, and, without the aid of any book except for the sake of reference, he has made a monthly statement of the profits and losses of the works committed to his charge by the aid of this same method; and he has allowed himself, too, such narrow limits of error, that, when the books are taken into consideration, it has exceeded all expectation for an approximate calculation. The whole calculation may be performed in a few minutes.

THE METHODS OF CALCULATION.

We estimate upon an object when we ascertain, in any known way, the expenses which influence its production and what such influences require. These latter are not contained in the regular books, but are first ascertained by their assistance and serve as a basis.

For the purpose indicated we divide the subject into:

1. The price of pig-iron, together with the freights to the place of manufacture, as a leading factor in the calculation.

2. The wages; including those of the sand and loam moulders, and core-makers.

In regard to the manufacture of a given article, estimates must be made from different standpoints, though the beginner should only depend upon such as are founded on experience, as, for instance the scale of perfection of the methods of labor; and every important variation must be subjected to very exact and precise examination, since these wages of production are determined almost entirely by calculation.

3. The materials for moulding. These stand in the closest relationship to the wages of production. It is entirely wrong to take, for this purpose, extracts from any book of examples, and to set up a certain amount per ton for all cases, as is frequently done, for it is very clear that these examples must stand or fall with the present wages of the moulders.

For example, if an article is small and light, we must reckon upon higher wages to the moulders, for a greater number of moulds and pourings will be required in order to reach a ton's weight, and consequently the consumption of sand, plumbago, chaplets, coke, straw, charcoal, etc., etc., is correspondingly higher, while in the other instances the reverse is the case.

4. Loss of iron, where the melting down of the cupola produces a large amount of slag, must not be underestimated. It is a pity, but this latter can only be determined with any degree of ac-

curacy by experience; since it is a variable quantity and therefore cannot be safely meddled with at the outset. On the other hand, we will also find that where our calculations cannot intrude upon these confines of possible error, the value of the waste products can be equally divided amongst the various articles.

5. The expense of superintendence. This exerts a very important influence upon our calculations; we reckon upon it just as we do for the steam and the maintenance and construction of machines, for helpers, store-keepers, expenses, drayage, etc., as well as many other items that are constant, or may be considered as approximately so. These expenses may be easily ascertained from the books at the office.

6. Wages for cleaning. These are of a simpler nature, can be more easily ascertained, and are, among furnace products that have no great differences, of a tolerably constant value, when taken year in and year out, otherwise there is here also a minor field of error for our calculations.

7. Day-wages, wages of helpers. Not only those who are employed in the immediate work of casting, but those who are at work outside in loading and unloading, carting, etc., must be taken into careful consideration, for we see here, an influence of considerable magnitude entering into our reckoning.

8. Current expenses. These are composed of

the salaries, including foreman's wages (if the latter are not divided between two or more departments), interest on borrowed capital, also compensation for losses and the like.

9. The pattern making. We reckon here the wages of the flask-makers, together with the wood and tools which are used in the construction of the patterns, as well as the small changes and the simple maintenance that is due to the carrying on of the business, so that it follows that these repairs may be charged equally to all articles, provided the latter are not cast from newly made or patterns that have been already charged. This maintenance of patterns, weighs somewhat constantly upon the business of the foundry, and is an expense that is not easily ascertained from the books. We will pause here and attempt to establish a reliable method of foundry practice in its relation to the business. It may also be said to be essential, that every new pattern which can contribute, at a given price, to an error, should be stricken from the books, lest any item remain which can, in any way, injure the accuracy of our estimates.

THE ESTIMATE OF VALUES.

As a first step in developing a formula for calculating the value of castings, we plot the following table, and distribute the amounts found in the books under the various headings. Where it

TABLE I.

PRODUCTION FOR TWELVE MONTHS AMOUNTING TO 1,000 TONS. EXPENSES FOR TWELVE MONTHS.

I.	II.	III.	IV.	V.	VI.	VII.	VIII.
PIG IRON, SCRAP IRON, including freight, cartage, etc., delivered at the foundry. For the sake of examplé we will put the price of material at $22.50 per ton.	WAGES for moulders and core makers, $10,500.	MOULDING MATERIALS, as charcoal, straw, dung and coal, coke, graphite, tools, coal dust, sieves, lights, repairing of flasks. $2,000.	WASTE shown by the balance, amounting, including loss, through dumping the cupola, to 8%.	BUSINESS EXPENSES, Cost of plant, maintenance of buildings, sick funds, (seldom occurring in the U. S.) postage, office expenses, taxes, general lighting of the establishment, steam, heating and millwright work. $1200.	WAGES for cleaning depend upon the article and vary with the moulders wages per ton. For our establishment we will consider them at, per ton, $1.50.	DAY WAGES Helpers, handling of flasks, the moving of the moulds, and the transfer of the castings to the place of cleaning. $4,000.	CONSTANTS, Salaries, interest, $7,500.

is impossible to obtain the figures for an entire year, we may take an equal number of summer and winter months.

The figures in the foregoing table are taken, as is easily seen, from the books. They are not yet arranged for the purposes of an estimate, since there must first be a revision and rearrangement of those values which, in any way, exert an influence upon the article under consideration and that on the one hand are dependent on its weight, and on the other, are in direct connection with the expense of moulding it. A very heavy casting may require very little labor in moulding, or the reverse; therefore those items that are particularly connected with weight, must be separated from those which relate to wages. It is only by this arrangement and the proper use of the amounts known, that a good and reliable formula for estimating purposes is possible. All errors which can creep in to our calculation have their roots here.

In order, now to understand the uses of the foregoing table an auxilliary account must be formed.

(*a*) *The cost of melting*, comprising the auxilliary materials, together with the day's labor, maintenance and service of the cupola, banking the breast, etc., as well as the crushing or breaking up of the pigs. These values, when found, may be considered as constant relatively to the weight produced, and an alteration is only neces-

sarily contingent upon a great variation in the average prices of material and labor.

(*b*) *A percental value* which rises and falls with the cost of moulding a certain article, or the moulders' wages, and is entirely independent of its weight.

(*c*) *The determination of a business-factor*, whereby the various items that are placed in the table under columns V and VIII, headed Business Expenses and Constants, may be brought, while strict regard is paid in the estimate to the leading branches of the business, into a correct form relatively to the associate departments.

The values of (*a*) and (*b*) are taken from the table under columns III and VII namely: Moulding Materials and Daily Wages, and will be found, when coupled with experience, to be accurate for a given piece of work. Exact value cannot be ascertained when they are of a dependent nature and interwoven with other things. A large field of error would then have merely an insignificant influence upon the results of our calculation, since only those values that are found in columns III and VII are separated, while the rest remain intact; consequently these last totals always hold a place in our reckoning.

In order to ascertain the expense of melting, (*a*) we tabulate the following schedule. The annexed data are such as must be attainable in any well regulated foundry. The loss of iron is omitted because it will be especially developed

in column IV. If the daily production is five tons, there will be needed.

Firewood for heating the cupola	$ .25
Coke used in charging, 200 lbs. @ $6.50 per ton	.65
12% Coke for melting $\frac{12}{20}$ ton @ $6.50	3.90
Firebrick and clay	.50
Banking of breast, vent tender, breaking pigs	5.00
To rounding up and remelting 10% of pour	1.00
Total	$11.30
3% of Limestone (seldom used in U. S.)	.35
Total	$11.65

therefore we obtain under (*a*) for the expense of melting one ton,

Melting at $2.33

then itemizing this amount in the proper proportions for

Moulding materials under III at	$1.13
Day wages " VII "	$1.20

developing these items so that they will correspond to the production of 1,000 tons, as in the table, we obtain

$1130 under III
$1200 under VII

so that we now have the following set of figures, by whose assistance we—laying aside the expense of pattern making, which will be considered later on—are in a position to lay out a new table; yet even with the help of this table, a calculation is by no means possible, for we need first of all the percental values under (*b*).

We find these values direct, since we may bring the remainder left in column III, which now

TABLE II.

Production of 1,000 Tons for Twelve Months. Expenses for Twelve Months.

I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
Pig Iron, per ton, $22.50.	Wages for moulders and coremakers, $10,500.	Material $2,000, minus $1,130 or $870.	Waste 8 %	Business Expenses. $1,200.	Wages for Cleaning. per ton, $1.50.	Day Wages, $4,000 minus $1,200 or $2.80 per ton.	Constants $7,500.	Expense of Melting. per ton, $2.33.

represents only the direct consumption of material used in moulding, that is in the moulding itself, into such shape as to be directly connected with the percental outlay in wages.

As shown in our table the materials will have absorbed approximately 8 per cent. as much as has been paid in wages. This item is of great importance; yet its absolute accuracy may be at fault in any single calculation. The author has found, however, that this ratio may be employed without any detrimental influences, for estimating, since, although we presuppose a limit of error, the effect cannot be of any great importance; otherwise a formula for calculating and intended for continual use would be worthless—excepting in the production of special articles—since the true value cannot be determined with an absolute degree of accuracy.

It may be considered then, that, by the application of our method, profit and loss may, without any changes in our formula, be directly balanced when an article is finished, and that they may be determined without special reference to the books for the monthly or yearly statement; yet it is better to pay some attention to the possibility of an error occurring in each individual modification, so that the average and final values of the percental ratios, as found, may correspond; still a variation can only occur through some extraordinary difference in the prices of wages and material. But, here also

experience has shown that each reacts upon the other. For when wages are high the prices of material are high. Still, as the latter case has not been presupposed, we can easily change the corresponding percentage for the time being, if necessary.

That this value is generally connected with wages in a certain ratio has already been pointed out and established beyond a doubt: section 2, page 11. Only large amounts being subject to fluctuation for single articles, and this possible error may be disregarded for the reasons already given; thus the ratio found in this way controls the practice of any particular establishment and becomes the governing factor.

Now we have only to determine the amount (*c*), of business. This amount, which is the statement of the share of each department, is of the greatest importance for our calculation.

This is the member, without which the body cannot move, and which, if improperly used, disables all of the other functions, or brings them to a standstill. It forms the principal factor in all of our calculations and, alas, also the principal reason for them, since so many unreliable and faulty methods have, up to this time, been employed, actually forcing whole establishments into an assignment; the causes for which we have seen in the incomprehensible prices that have been given, and which make these non-

professional methods a continual source of astonishment.

We determine these values approximately, when we learn the capacity of a given foundry and what is the highest point attainable when its construction and the associate departments of the business are taken into consideration. There must also be a statement of the prevailing or highest attainable dividend when all competition is taken into consideration. This depends on the surroundings and the location of the establishment, together with the facilities for obtaining business, and must undoubtedly be expressed conformably to the ordinary disbursements and the productive wages for moulders and core-makers.

According to the examples in our table, as given under column II, the productive wages amount to $10,500, the current expenses of the business under column V and the constants under column VIII to $8,700. It is evident, therefore, that for every dollar paid in wages the cost must be raised to

$$1 + \frac{8700}{10500} = \$1.83.$$

The ratio .83 is in this case our business factor; and in our examples the average ratio for the twelve months is represented by the same co-efficient.

It will serve all the purposes of an accurate calculation, if this value is fixed from month to

month beforehand, and then used as a basis for the computation of the original cost during this time. The more accurately, however, this value is determined, just so much the more accurately will the final result in its totality coincide with the actual original cost.

For ordinary foundry business it suffices if we determine our business factor from the maximum, mean, or minimum business as shown in the following table:

	Wages.	Business factor.
I Maximum monthly business..	$1200	.60
II Mean monthly business.....	875	.83
III Minimum monthly business..	550	1.32

These figures are chosen analagously to our example, and must evidently be obtained in the manner specified, for each foundry.

Suppose now we wish to estimate upon an article; we simply consider whether we are to consult line I, II or III for the time being, and if the acceptation of this as a basis of calculation will produce any important change in the principal interests of the business, and in what line the resultant basis is to be found.

Well, then, even though we find ourselves in condition III through too great a number of acceptances, or through a considerable monthly excess of expenditures over production, we may

still use the first line in our calculations, carefully applying, as we shall see later, the requisite factor to I, in calculating, in order to determine the cost, and this will then appear on the books if any falling off in the business is the result of the price determined upon.

It may here be remarked that many monthly balances drawn up by the same methods have nothing to do with individual cases, still the wages actually paid at the end of the month or year, form a correct and exact basis for the controlling business factor during the corresponding period.

As we have seen, in this determination of the business factor, not only the productive wages, but the productive capacity of the establishment in its present extent and surroundings must be considered on all sides, before adopting a basis. A pro rata division and adjustment of the other ratios, especially of those dependent on the weight, must be carefully avoided, as being absolutely false and erroneous; and rightly so, for were it otherwise, indeed, if it were possible to be otherwise, then that labor which produces ten tons with a certain expenditure of wages, would exert the same influence upon the business as that which consumes the same amount in producing a hundred weight of another class of articles; we should have as a result every manufacturer exerting himself to secure the heaviest class of goods.

We see then, as a result of this, that the price drops as far as the wage ratio of the two articles of ten tons and a hundred weight, in their relationship to the business factor, will permit. This is precisely the state of affairs upon the market; each imagines that in weight there is safety, and we are annoyed, because, when driven to a corner, we are obliged to accept prices lying far below our figures; still the thought that it is heavy consoles us. Had we estimated correctly, we should have found from the coefficient of our business that, in one sense, weight counts for nothing, and that the secret of our success lies in the adoption of the proper factor.

I have now touched upon all the items that are of use in our business. We have found that in our example the consumption of material in ordinary moulding is 8 per cent. of the amount of the productive wages, and that the average business factor gives a coefficient of .83, and it shows, furthermore, that this coefficient is, properly speaking, the life of a correct estimate. Upon its correct determination and application the whole business depends. That man alone may guarantee every estimate and make his demands in accordance with the lowest rates, who can cover up or ward off losses, provided the state of business or other circumstances do not hamper him, and who can avail himself of every method of economy that is of any advantage.

He lays the corner-stone upon which the whole business superstructure is to be reared, and by carefully watching every article, he may, at the very outset, vouch for every estimate, even unto its final result, which really ought to be obtained before the manufacture is undertaken, so that every possible economy may be practiced. No one can be mistaken as to the great advantage that there is, when accepting a contract, to be able to tell before its execution, exactly what influence it will have on the business afterwards.

Our schedule, through these new found values, now takes the form found in table III, on following page.

DEPRECIATION AND INTEREST.

The items falling under this head are usually very easily obtained, and are generally fixed, so that without any further development of our examples and schedules we will take for depreciation

		Per cent.
(*A*)	Buildings	2
(*B*)	Machinery and stock on hand	5
(*C*)	Patterns	10

and the sum total of these and their complementary items is $1,400 per annum.

As to interest we have likewise very little to say. It is placed in our schedule under column VIII, and is primarily connected with the sink-

TABLE III.

Annual Production, 1,000 Tons.

I.	II.	III.	IV.	V and VIII.			VI.	VII.	IX.
Pig Iron. Per ton, $22.50.	Productive Wages. Per ton, $10.50	Materials. 8% of Wages.	Waste. 8%.	Business Expenses and Constants.			Cleaning. Per ton, $1.50	Day Wages. Per ton, $2.80	Expense of Melting. Per ton, $2.33.
				Business Factor.					
				I.	II.	III.			
				1.60	1.83	2.32			

ing fund, when the interest is already accounted for in a contingent account. It only remains, then to consider the interest on the remaining capital, as well as the actual property. This interest should have a place in our estimate of cost, but only so far as it does not exceed 5 per cent. We fix this evaluation here because further on the question arises, whence is the profit derived, and what is the relation between an article which, with the same expenditure of wages weighs a ton, and another that only tips the scale at a hundred weight. Unfortunately the same uncertainty prevails here, as we have shown to be the case in ascertaining the business factor, with this difference, that as it only temporarily lowers the profit it cannot have so bad an effect upon the final result.

Hence, as all our definitions and explanations are, when estimating according to these hypotheses, evidently explanatory of the capacity of the establishment, its extent and surroundings, and not wholly of the cupolas and output, we find that the smallest has an influence upon the largest, and that we should pay particular attention to the amount of business and the productive wages as the great important factors, so that there need be no complications, and the foundry will be self-sustaining if we make the resultant profit depend entirely on the productive labor. This item alone constitutes the active and vital part, and is always more or less promi-

nent in our thoughts, while the life of the establishment stands in no fixed relationship to the output. We must therefore consider every estimate as erroneous and unreliable that derives its profit as well as the ratio of depreciation, from the weight of the castings.

In our example we put depreciation at $1,400 per annum, the interest on the property at 5 per annum, at $1,200. This falls, then, upon the labor efficiency of the establishment, and may be divided into three heads:

	Per Month.
A maximum I with productive wages at.....	$1200
A mean II " " "	875
A minimum III " " "	550

and upon each dollar of these wages there falls a certain proportion of depreciation and interest. The coefficient for the proper distribution is ascertained by dividing the amount of depreciation and interest throughout the period taken, proportionally to the wages paid. Our example is then completed in the following scale:

STAGE.	I.	II.	III.
WAGES PER MONTH.	$1200	$875	$550
Business factor.....	.60	.83	1.32
Depreciation...	.10	.13	.21
Interest on Property at 5%.....	.08	.11	.18
" " " 10%.....	.16	.22	.36
" " " 15%....	.24	.33	.54

Now, if we are estimating upon an article, we can, in calculating the cost, see from our table that we are still to add to the amount already taken if we find that the business is in the second or mean stage of prosperity, while we have been estimating without any regard to these auxilliary items.

(*A*). For current expenses. Business factor, .83, or the .83 part of the wages, which the object requires for its production per ton. Also

(*B*). For depreciation. .11 in the table, the .11 part of the wages, and

(*C*). For, say 10 per cent. profit. .22 according to the table, or the .22 part of the wages.

Now, with the assistance of these data, and we have seen them to be essential to our success, we will make a few general observations upon pattern making, in order that we may finally incorporate this item also into our calculations.

PATTERN MAKING.

This is inseparably connected with foundry work, whether it be considered as a simple appendage or as a necessary evil. Attempts to secure business and periods of enforced idleness usually bring it about that the influence upon the foundry is confined to the expense incurred by the direct outlay for wood, wages and other materials. There is no profit, as a general thing, since no charge can be made except for new and espe-

cial patterns. This lack of profit is for the most part due to the fact that all foundries, especially such as are in the same vicinity, have acquired by their yearly accumulation the same or a similar stock of patterns, and further that by enclosing them in warehouses for a long time and keeping them protected from the wind and weather, there takes place a certain depreciation and it is taken for granted that this has taken place, still profit is apparently increased when the output is not burdened with the expense of pattern making, for with that expense the profits would be forfeited, while, on the other hand, these same patterns have been accumulated without any noticeable increase of expenditures. There remains, then, nothing but to distribute the debits of the whole output through depreciation on the one hand and the general pattern-making expense on the other, including the small changes that are continually being made, and which fall equally upon all articles without any especial regard to the actual portion belonging to each individual casting.

Nothing of any very great importance need be added to an article in our calculation, since the expense of pattern-making and changing, the construction of flasks for the foundry, the making of follow-boards, etc., wood, wages and tools, drops by actual experience to between $2.00 and $4.50 per ton of output. This expense

must evidently be analyzed according to the peculiarities of the establishment, where the amount influences the calculation to any extent.

Suppose, then, an establishment enters into the manufacture of some special article, as, for example, of socketed water pipe, which may be moulded by machine, or ingot moulds for steel works, whose weight is enormous, relatively, to the pattern work required, so that it is positively necessary to make some essential difference in order to arrive at a result that the average output for a long period would warrant, for example:

I, 400 tons ingot molds.
II, 300 " socketed water pipe.
III, 300 " miscellaneous.

And altogether the expense of pattern-making amounts to $2500; for I, the highest expense of pattern-making was $2.00 per ton; for II there was no expense at all; therefore, there remains for III for miscellaneous articles, $1,700, or an expense of $5.66 per ton.

As has been already remarked, experience shows that the amount for III lies between $4.50 and $5.75, and may be subdivided into $\frac{9}{10}$ for wages and $\frac{1}{10}$ for the consumption of wood and tools.

Let us consider then, that we have taken a statement from the books for ten months and

have tabulated the amounts thus obtained into the following scale:

MONTH.	Pattern making.		Total production in tons.	Classified production in tons.				Receipts for special patterns in $.
	Wages in $.	Material in $.		Socketed Pipe.	Ingot Moulds.	Miscellaneous.	Articles for which special patterns were required.	
January	132	32	69	12.5	30	23	3.5	31
February	145	35	88	14.	50	22	2	5
March.....	129	29	101	7.	70	22	2	16
April..... ...	148	26	103	7.	71	23	2	58
May.....	110	20	65	4.5	28	31	1.5	32
June	67	13	55	6.	24	23	2	10
July.....	69	8	63	20.	23	19.5	0.5	2
August	101	11	86	13.	58	12.	3	22
September...	110	30	107	8.	78	18.	3	20
October.....	102	26	95	3.	70	21.	1	16
10	1,111	230	832	95.	502	214 5	20.5	212
	1,341							

Therefore upon this basis we learn that the socketed pipes have cost nothing for pattern making, and the ingot moulds only about 50c. per ton, and consequently we may arrive at the following conclusion:

810.4 tons at 50c.....	$405.
The receipts for special patterns.....	212.
Making a total of.....	$617.

leaving $1,341 — $617, or $724 to be divided

among those 214½ tons of sundry articles, which covers all the extra expense of pattern making.

This leaves a pattern account of $3.37 per ton. At the same time we see that the wages are proportioned to the wood and tool account in the ratio of $4\frac{3}{10}$ to 1. This then becomes of some importance to us, since in estimating upon new patterns we may use these ratios without any further investigation unless some especial peculiarity renders an exception necessary, when some particulars should be given, else we may shoot wide of our mark.

We have now exhausted all items which can have an appreciable effect upon our calculations, and we will proceed to gather them together into a new schedule which we will call our contract formula.

THE CONTRACT FORMULA.

To form this, the items for the particular establishment under consideration, that are necessary for our calculation, must be found. We have, in our examples already given, obtained from the books the information that the price of coke is $6 per ton, and the productive wages $35 per day, the materials used in moulding 87c. or 20 per cent. of the productive wages.

The loss of iron	8 per cent.
The day wages	$2.80 per ton.

Cost of melting	2.33	per ton.
Pattern making	3.37	" "
Average cost of cleaning	1.50	" "
The average business factor	0.83	
Depreciation added to this factor	.13	
Interest on the property at 5 per cent. to	.11	
Interest on the property at 10 per cent. to	.22	

so that we can with these data make a direct estimate for a given article.

Examples:

(1) What will be the cost of a smooth pillar 16 feet long with a plain capital and base?

The weight being about 850 lbs.

The wages for moulding and core-making for the piece will be about $4.00; hence the expense per ton in productive wages will be $9.40.

If now the pig iron is worth $22.50 per ton, laid down at the works, our calculation yields with a 5 per cent profit:

Pig iron		$22.50	
Called *Factors* later on.	Loss 8 per cent	1.80	11.80
	Melting	2.33	
	Day wages	2.80	
	Pattern making	3.37	
	Wages for cleaning	1.50	
Productive wages		9.40	
Material 8 per cent		.75	
Average business factor, .83		7.99	
Depreciation .13		1.22	
5 per cent profit = .11		1.03	
		$54.69	

as the price of one ton of castings.

(2) What will be the cost of a cast iron standpipe for hydraulic pressure 9 feet long, 18 inches diameter and 2 inches thick. Weight about 3,800 lbs.?

Wages for loam moulders and core makers for the piece $3.00, pig iron laid down at the foundry $22.50 per ton, with 5 per cent. profit, gives:

Pig iron	$22.50
Factors	11.80
Productive wages	1.60
Material, 8 per cent	.13
Business factor .83	1.33
Depreciation, .13	.21
5 per cent. profit = .11	.18
	$37.75

as the cost of 1 ton of casting.

(3) What will be the cost of the same pipe, 9 feet long, 18 inches diameter and 1 inch thick. Weight about 1,800 lbs.?

Wages for molders and core makers remain the same, namely, $3.00 for the piece, or $3.33 per ton; this, with a profit of 5 per cent. gives:

Pig iron	$22.50
Factors	11.80
Productive wages	3.33
Materials 8 per cent	.27
Business factors, .83	2.76
Depreciation. .13	.43
5 per cent. profit = .11	.37
	$41.46

cost of 1 ton of castings.

(4) What will be the cost of a set of grate bars, cast singly, and weighing 16 lbs. each. Suppose the wages per piece to be .05, making the productive wages per ton $6.25, then:

Pig iron	$22.50
Factors	11.80

Productive wages	6.25
Material .08 per cent	.50
Business Factor, .83	5.19
Depreciation, .13	.81
5 per cent. profit = .11	.69
	$47.74

Result per ton.

(5) What will be the cost of the same furnace bar except that each piece weighs 32 lbs. Wages per piece, $.05, the same as before, therefore the productive wages will be $3.13 per ton, which gives:

Pig iron	$22.50
Factors	11.80
Productive wages	3.13
Material 8 per cent	.25
Business factor, .83	2.59
Depreciation, .13	.41
5 per cent. profit = .11	.34
	$41.02

Result per ton.

Suppose now that our establishment had been driven with more work, and, as a consequence of which our business factor became .60 instead .83, and also that the corresponding depreciation was .10, so that, as has already been shown, our 5 per cent. profit becomes .08. Under these circumstances we obtain the following cost prices for the castings called for in the foregoing examples:

Nos. 1	2	3	4	5
$50.18	37.28	41.50	45.92	40.12

as the cost price per ton.

In like manner a smaller business would have perhaps resulted in our adopting the business

factor 1.32 under III of a previous table, and .21 for depreciation and .18 for a 5 per cent. profit. Our examples would then have necessarily taken the following forms:

Nos.	1	2	3	4	5
	$59.85	38.77	43.60	51.74	43.25

It must be especially emphasized just here, that all of our calculations which are made with reference to a state of affairs corresponding to the immediate and controlling condition of the business, and which are expressed through our coefficients for the business factor, depreciation and profit, always yield the cost and profit for the momentarily predominant ratio.

To follow such a variable ratio for the adoption of a basis would be altogether inadmissible. For with a more extensive business the proprietor would hardly be disposed to forfeit the profits arising from the adoption of a lower basis, which would be the natural result of the changed state of affairs. But on the other hand it may occur, that in consequence of a falling off in the business our items would produce a higher basis. Since no one is disposed to accept less than the proffered price, the manufacturer would be reluctant to reduce his price independently of the current state of affairs upon the market; so that our methods of estimating can only serve him as a glass, in which he can see exactly what his profit or loss may be. The general condition of the market, the amount of business competition

and other circumstances place a limit upon the basis to be adopted, hence under all circumstances, an estimate must be made by means of such a basis as is appropriate to the case in hand. Hence there is no alternative but to start from a new point of view, and in this way adjust our method of calculation for all cases. This standpoint would naturally be based upon the average ratio of business, but can hardly be determined by any temporary variation in the business one way or the other. It really makes no difference, although one might be disposed to say: "Now this concern has such and such debts and a capital of such an amount to pay interest upon and to suffer depreciation upon, while that one has very much less, and what it does have, if prosperity is possible at all, corresponds to what is necessary to carry on the business and produce a fair realization upon the capital invested."

The market price does not depend upon individual concerns. It fluctuates about a certain known average, and this average alone can give the data for our coefficients and for determining our statement of costs, must regulate our estimates year in and year out, and show of itself in the statement of greater or reduced profits whether more or less business should be forced upon the market, from which we have obtained this fixed bill of costs.

We must, therefore, to express ourselves briefly, consider the state of business as it is

relatively to those conditions under which, with their own peculiar circumstances, either by a determination of the actual cost or of a certain established profit, it is still possible on the whole to pay expenses or make a bare profit. These data will only be necessary for the purposes of an estimate, and, as we have successively proven in the development of our method, only those expenditures which are essential for fixing the annual rate of productive wages in their totality should be indicated.

We must then settle upon this total of productive wages for the year as may appear proper, so that by its assistance, after the amount of depreciation has been established, we may determine the average state of business and the ratio of depreciation exactly as has been given above. We must put this average at the basis of our calculations, and furthermore cannot deviate from it for any cause whatever, for the reasons already brought forward, without detriment to ourselves. These averages give a strong support to our estimates and may be looked upon and used as constant. Yet it should be remembered that their very importance in daily uses to which they are subjected renders their freedom from error absolutely necessary.

The coefficient 0.83 for the business factor, and 0.13 for depreciation ought, in the experience of the author, to be such as correspond to the established ratio and the state of the market,

hence we have placed them, in our examples, at about the average point. These two factors may then, without more ado, be disposed of in the form of a new business coefficient equal to 0.96.

Example:—An article costs $8.00 per ton in productive wages; the pig iron laid down at the works is worth $22.50, hence we have as the actual cost:

Iron	$22.50
Factors	11.80
Productive wages	8.00
Material, 8 per cent.	.64
0.96 Coefficient of business	7.68
Excluding profit	40.62

The profit appropriates, according to the amount of business, as we have already shown, a part of the productive wages, and is determined in exactly the same way as in the examples for determining the average business factor for the year with a fixed total of wages, and can then be brought to the desired ratio. For instance, 5 per cent. profit per annum corresponds to 0.11 of the total productive wages; hence for this profit we add to our estimate .11 = $0.88. The total then becomes, on this basis, $40.62 + .88 = $41.50.

We now estimate our actual cost for a series of totals of productive wages on that basis which is now fixed, and thus obtain the following table which may very appropriately be called our established formula.

With the help of this formula, whose values having first been determined for a given establishment like those here given for the sake of an example, we can now, without any further difficulty, estimate upon the average capacity of our works, develop this capacity and determine the basis of every given case. In application the examples are given in table on pages 42 and 43.

1. It is required to estimate the cost of a certain class of columns, whose productive wages reach $8 per ton, then according to our table, taking this as the prevailing average for the whole year, which with a profit of 5 per cent. and the price of raw material used at $22.50 gives for the required casting,

Appertinent values	$29.00
For material	22.50
So that it can be delivered at	$51.50

and if old patterns are used no extra charge can be made on this account.

2. A number of plates three feet square and three-quarter inches thick are called for. Taking the moulders wages at $2 per ton, the iron and patterns remaining the same as well as the 5 per cent. profit,

We get from our table	$16.10
Add iron at	22.50
As cost	$38.62

3. Suppose larger plates and a greater number are ordered, then we can by reference to the

The price of coke is taken at $6.00 per ton. The average price of pig iron including freights

In this table the average expense of pattern-making is assumed to be $3.37 per ton.

Wages per month.....
Average business factor.....
Depreciation.....

Productive wages for moulders and corema k e r s per ton.	Cost, including depreciation.	Estimate on a basis of 0.11 or 5 per cent profit.
$2.00	$15.88	$16.10
3.00	17.92	18.25
4.00	19.96	20.40
5.00	22.00	22.55
6.00	24.04	24.70
8.00	28.12	29.00
10.00	32.20	33.30
12.00	36.28	37.60
14.00	40.36	41.90
16.00	44.44	46.20
18.00	48.52	50.50
20.00	52.60	54.80
22.00	56.68	59.10
24.00	60.76	63.40
26.00	64.84	67.70
28.00	68.92	72.00
30.00	73.00	76.30

FORMULA.

of depreciation is fixed at 0.11 of productive wages. The is put down in the table at $22.50.

..... $875 ..... 0.83 ..... 0.13	Wages per mo.. $550 Business factor 1.32 Depreciation... 0.21 5 per cent profit 0.18	Wages per mo.$1,200 Business factor 0.60 Depreciation. .. 0.10 5 % profit..... .08
Estimate on a basis of 0.22 or 10 per cent. profit.	Cost, including depreciation; excluding profit.	Cost, including depreciation; excluding profit.
$16.32	$17.02	$15.36
18.58	19.63	17.14
20.84	22.24	18.92
23.10	24.85	20.70
25.36	27.46	22.48
29.88	32.68	26.04
34.40	37.90	29.60
38.92	43.12	33.16
43.44	48.34	36.72
47.96	53.56	40.28
52.48	58.78	43.84
57.00	64.00	47.40
61.52	65.22	50.96
66.04	74 44	54.52
70.56	79.66	58.08
75.08	84.88	61.64
79.60	90.10	65.20

reports of the annual average where the business factor is placed at 0.83 and depreciation at 0.13 as in our table of examples, taking it for granted that it remains as heretofore, and ask ourselves whether or not the increased expenditure thus occasioned may not cause an increase in the anticipated wages from one month to another, so that our business factor which, through the division of the constant expenses of the establishment is likewise affected by these wages, may not be sensibly diminished.

Suppose that having satisfied ourselves that by an unexpected increase of business over the estimated average, we may henceforth count upon a brisk business, and consequently our business factor for this larger business may be placed at 0.60, giving us for our plates, with the price of pig iron at $22.50 per ton, and where we made new patterns at a cost of only $2 per ton instead of the basis upon which the above table was rated:

Basis	$15.36
Pig iron	22.50
Pattern making	2.00
5 per cent. profit .08 of wages	.10
	$40.02
Subtracting	3.37
For the tabular values already taken into account in our estimate of pattern making	$36.65

4. A bed plate for hydraulic crane, weighing eight tons, requires for its moulding in loam $32 in productive wages, or $4 per ton. Once

more we consider the iron laid down costing $22.50; the patternmaking expenses, comprising those of making flasks, etc., gives an average outlay of $3.37 so that we find for a

5 per cent. profit in our table	$20.40
Pig iron	22.50
	$42.90

as a basis of estimation for the plain casting.

With slight changes where a large single casting requires so little for workman's wages it is often the case that a prudent manufacturer will reason that the profit which accrues to him does not stand in the proper ratio to the risks that he runs in casting it; and that he would rather give up the small profit than run such risks, since the average ratio of bad castings already considered in the table will probably remain the same. There is considerable foundation for this foresight that requires certain concessions for so great a risk.

Under such circumstances we adopt a different rate of estimating and use such figures for our calculation as correspond to the probable losses incurred by the risk, but which should not be larger than the profit, because each one contributes his share toward paying for the risk; the purchaser who pays the price demanded as well as the manufacturer who loses his share in that portion of the work which is spoiled.

The above amount of $42.90 taken in terms

of our contract formula and placed together are as follows:

Iron	$22.50	
Loss 8 per cent	1.80	Factors. $11.80
Process of melting	2.33	
Day wages	2.80	
Maintenance of patterns	3.37	
Cleaning	1.50	
Productive wages	4.00	
Materials	.32	
Business factor 0.83	3.32	
Depreciation 0.13	.52	
5 per cent profit = 0.11	.44	
	$42.90	

Then comes what is lost to the concern by bad casting:

(*a*) Waste	$1.80
(*b*) Melting	2.33
(*c*) Day wages	2.80
(*d*) Materials	.32
	$7.25 per ton.

The productive wages are not, in this connection considered lost, since in case of a bad casting the pay of the workman is sometimes withheld, because this is the principle acted upon in those foundries where work is done by the piece; but where such is not the case, of course this amount must also be added to the list.

The profit of the manufacturer, when heavy final losses are taken into consideration only amounts to

Depreciation	$0.52
5 per cent. profit	.44
	$0.96

and therefore stands in no relationship to what the losses can effect. We must therefore review our calculations from a commercial standpoint and if we wish to be correct we must divide our $7.25 by two, into $3.63, which amount we then add to our estimate as the proportion due to risk,

We then obtain as a basis	$42.90
Risks	3.63
	$46.53

We see furthermore that this last calculation, by which we can formulate and express the items we have ascertained, that are dependent upon the situation of our establishment, requires most careful consideration in order that the items there found may appear in their true proportions in the final result. For such cases there can evidently be no formula found, for they simply depend on relations of a commercial nature, conforming to the size and perfectness of the establishment, and to those changes which may be called forth by unpropitious circumstances, even after all possible data has been determined.

THE BALANCE.

As has already been shown, we can with the help of our tables as they are compiled, and without any further difficulty determine the profit or loss per week, month or year. For this purpose one need only, instead of taking the

productive wages which naturally belong in the estimate upon a certain object, add together the whole productive wage expenditure for the week, month, or year, and compare it with the total output of castings for the corresponding time. Both of these amounts, which may be obtained without any trouble from the books, are at hand for the simple total of invoices supplies an equivalent which, by a fair approximation, corresponds to the sale of castings. Then, having found the totals for the space of one month we have:

(*a*) Total of productive wages, $725.00; (*b*) Total weight of output at 55 tons; (*c*) Invoicing 52 tons at $3,640 gives $70 per ton as the price of the rough castings.

So in accordance with our examples we draw up the following balance.

Cost of pig-iron consumed	$22.50
Factors	11.80
Wages per ton $\frac{\$725.}{55}$ =	13.18
8 per cent. materials	1.05
Business factor, $8,700. constant expenses per year or $\frac{\$725 \text{ per month}}{\$725 \text{ wages per month}} = 1$,	13.18
Depreciation $1,400 per year or $\frac{\text{per month } \$116.66}{\text{the monthly wages } \$725.} = .16$	2.11
Cost exclusive of profit	$63.82

then since we have obtained $70 for the rough castings, there consequently remains a profit of $6.18 per ton, or on the sale of the 55 tons of

castings that have been produced during the month a profit of $\$6.18 \times 55 = \$339.80$.

The only care which we must take with our balance consists in the determination of the price obtained for the rough castings with the utmost exactness; and since almost all foundries are provided to a greater or less extent with a mechanical department, including such tools and facilities for working up the output, that the majority of invoiced amounts are so combined that they do not represent the value of the raw products.

In any business, to whatever class it may belong, and where a constant oversight over the various departments is fully appreciated, an amalgamation of the mechanical department with the foundry is inadmissible. It is recommended as of great importance for an exact balance, that each department be credited with the working up of the raw material as it obtains it, and to draw off a monthly balance for correcting any error that may occur, and thus keep each division of the business separate. When this is done regularly every month, the total value of all the castings poured is found without the trouble of consulting the books, and the balancing with our estimate must consequently be very approximately correct. Our purpose is to arouse a continuous and unbroken interest in our business which increases as the latter gains in strength; and when this is fully established we

naturally organize all of our business relations upon a systematic basis, and when this is done we are in a position to measure and recognize every insinuating error, and then rectify it.

THE BUSINESS.

All those ratios of values which have been ascertained for given cases in our business and which are recognized as the controlling ratios of the establishment, with those that are determined by constant expenses, depreciation, etc., and which weigh upon our business equally during the whole year, and for which we have laid down an absolute average, so that their drain upon our resources may appear even and uniform and effect our estimates in the same way at all times; and if fluctuations of business that temporarily predominate, should show an amount of expense that could not be warranted or met, these ratios do not guarantee us absolute safety in the matter of our calculations when the latter are based upon the pre-determined values, unless the manager continually tests these values by tabular summaries and comparisons, and puts his whole attention upon it, so that each attainable point may be striven for and reached. Further, an examination of the closest ratio that has been attained between the reciprocally acting expenses of the system, which operate in the manufacture of the product, and those of the

management coupled with a quick perception of the interaction of these ratios, will show to what extent they can influence the business, and bring about a proper condition of the final results. The more careful the management of the business is, the more exact the average ratios will be found, and the figures laid down in our basis will shed their influence over all of our transactions and an accurate basis of expense will be the result.

The items which the engineer has observed in his business, must naturally be of the same kind as lie at the basis of his calculations, with the difference that they are not when they have proven themselves necessary for his calculations to be analyzed and transformed. The statement and summary per ton of product suffices here.

For the purpose we need a table which we will call the Business Register. (See pages 52 and 53). The amounts in this table indicate the values which are always regarded as the average, and should not be changed without some good reason, since they have proven themselves correct in our own practice, or have been borrowed from some well-regulated establishment whose data are to be relied upon.

The following figures must be carefully taken at the end of each month from the actual expenses incurred in the business, and registered per ton. The register then certifies to each point of the main business, as to which is neces-

DISTRIBUTION.	EXPENSES PER MONTH. July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March.	DR AVERAGE.
Loss.	Considered as Constant.									8%
Productive wages.....	832	1,030	1,046	1,055	790	736	689	956	1,060	$689, min.
Materials.....	144	199	242	146	133	107	165	176	197	Ex-melting....$1.13 Materials, 8%.
Business expense.....	57	67	75	150	112	150	162	89	48	0.83.
Interest, Salaries.....	372	372	1,226	372	372	1,200	372	372	1,252	
Wages for cleaning....	99	135	171	174	117	87	80	130	180	
Day wages.....	507	404	367	318	294	286	275	277	404	Ex-melting ....$1.20 Remainder..... 2.80 $3.37.
Pattern making.....	144	122	123	182	181	128	108	218	133	
Depreciation	116	117	117	116	117	117	116	117	117	
Total expenses....	2,271	2,446	3,367	2,513	2,116	2,811	1,967	2,335	3,391	
Total production..... in tons of	66	90	114	116	79	58	53	87	120	The bad castings (*c*) are those which were lost, the wages, therefore, are included in the expenses, but their weight is deducted from the table of receipts.
(*a*) Socketed pipe.....	33	62	84	76	31	29	26	53	95	
(*b*) Stock castings....	5	3	2	.....	1	.....	.....	.....	.....	
(*c*) Bad work.....	3	1	2	3	5	1	3	2	1	
(*d*) Ingot molds.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
(*e*) Miscellaneous	25	24	26	27	42	28	24	32	24	

ITEMS.	COST PER TON. July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March.
Iron (delivered)	22.50	22.60	22.55	22.45	22.50	22.40	22.50	22.50	22.40
Loss	1.80	1.81	1.80	1.80	1.80	1.79	1 80	1.80	.80
Productive wages	12.60	11.44	9.34	9.33	10.54	12.91	13.76	11.24	8.90
Materials	2.28	2.28	2.16	1.21	1.89	1.87	3.30	2.07	1.65
Business expenses	.90	.77	.67	1.32	1.51	2.63	3.24	1.04	.40
Interest, Salaries	5.90	4.27	10.94	3.26	5.02	21.05	5.44	4.36	10.53
Wages for cleaning	1.57	1.55	1.53	1.54	1.58	1.53	1.60	1.53	1.51
Day wages	8.04	4.65	3.28	2.81	3.97	5.02	5.50	3.26	3.38
Maintenance of patterns	3.11	4.04	3.70	3.53	3.41	3.75	3.56	2.81	1.89
Depreciation	1.84	1.34	1.04	1.03	1.59	2.06	2.32	1.38	.98
Total cost	59.54	54.75	57.01	48.28	53.81	75.01	63.02	51.99	53.54
Total sale of production under *a*, *b*, *d* & *e*	63	87	112	113	74	57	50	85	119
Receipts for patterns	$60	$25	$23	$62	$41	$27	$26	$156	$97
Weight, for which special patterns are required, pattern expenses for ingot molds	3	1	1	3	2	1	1	10	5
Pattern expenses for miscellaneous, including stock castings, etc	$84	$97	$100	$120	$140	$101	$82	$62	$36

sary in order to know positively whether there is an improvement or falling off in the status.

For the sake of an example, we have arranged our register for a series of months and will now make a few observations thereon.

I. *For the value of the pig iron melted* we reckon most particularly upon the average value of the special raw materials purchased, including freight to the foundry. It would occupy too much space and create too much confusion if we should enter into the details of the works, and make minute distinctions, as though we should say: "This material was bought quite cheaply, that at a higher price; now while we are using the cheaper material, we might use its price as the basis of our estimate." To be sure this might be done but it is not advisable when our general interests or those of our estimates are considered, since as an error is not excluded by a similar course in business at large, it would not be here. It is recommended, therefore, that there should be a simple entry and checking off of the pig iron received and manufactured in the manner shown, that we may have the data at hand that we need. And right here it may be noted that throughout this treatise the cost of pig iron alone is taken into consideration. This is done to avoid the confusion that would inevitably result from using a multiplicity of prices; but where scrap is used, whether extensively or not, an average may be struck between the price of

pig and scrap proportional to the ruling prices and the quantities used, and this amount treated in the same manner as we have done with our fixed price of pig.

In the table (see page 56) we find:

(*A*) The average individual prices of various brands.

For estimating upon an article a knowledge of this is indispensable, for inasmuch as the castings permit of a variation of the several iron alloys for certain purposes, one must use in his calculation the value of those materials especially suited to the purpose.

(*B*) The total average value of the raw materials consumed during the month, which amount we must insert in our register.

The problem for the managing engineer is to always produce with irons of the lowest grades such castings as will satisfy the demands of the specifications. To what extent this may be carried for a given article, depends upon the correct estimate of its requirements, what *must* be employed in it, as well as upon the practical experience of the managing engineer, who must select the materials.

II. *Waste* is of a constant nature and it does not lie within our power to change it, that is, in the present state of the art. In order that it may appear as light as possible, there is usually a careful gathering of small lost pieces of iron, the pickings from the slag, and a removal of the

IRON TABLE.

Date of Purchase.	Brand A.		Brand B.		Brand C.		Totals.		Average cost per ton melted.
	Tons.		Tons.		Tons.		Tons.		
July 1	20	$460.00							
July 8	.....	.....	40	$890.00					
July 18	.....	.....	.....	.....	20	$450.00			
July 26	10	230.00							
Totals	30	690.00	40	890.00	20	450.00	90	$2,030.00	
Average cost	..	23.00	.....	22.25	.....	22.50	.....	22.55	
Melted in July	18	414.00	36	801.00	18	405.00	72	1,620.00	22.50
On hand August 1	12	276.00	4	89.00	2	45.00	18	410.00	
August 3	30	690.00	40	890.00	20	450.00			
August 14	20	460.00	30	667.50					
Total	62	1,426.00	74	1,646.50	22	495.00	158	3,567.50	
Average cost	.....	23.00	.....	22.25	.....	22.50	.....	22.58	
Melted in August	38	874.00	38	845.50	19	427.50	95	2,147.00	22.60
On hand September 1	24	$552.00	36	$801.00	3	$67.50	63	$1,420.50	

scoriated coke from the iron that it may be remelted. Our registered values then can only vary, when instead of sound raw materials, scoriated iron, as in the form of shot or burned furnace bars, is used for melting. For such cases we must formulate a calculation especially referable to it, and not forget that the requisite amount of burned furnace bars and the like, will give a waste of probably 40 per cent.

III. *The column of productive wages*, through its variations, and in consequence of the different articles that are turned out of the foundry and which cost more or less per ton, shows at a glance whether more has been paid out than was necessary. For the latter reason the contract system is introduced into foundry practice for a large portion of the castings, if there is a sure basis for estimating by means of some established standard of comparison; otherwise it devolves upon the foreman or engineer to make the proper estimate, and to so adjust prices that an agreement may be made with the workmen. Upon such a basis, each individual register value for the preceding month may be rendered accessible for the sake of comparison, and its variation for any single month is therefore not worth taking into account. For the sake of rendering it possible that a man of little experience may in all cases be correct in the estimates that he furnishes and that he may be able to draw up his contracts with safety, we

give, in the appendix, a group of ordinary contracts intended for practical use.

IV. *The value of material* is worthy of attention. If we take the constant value which the process of melting at $1.16 per ton gives in our example, from the total amount in the register, the remainder, which is closely connected with the productive wages, must rise and fall with and should not exceed on the average 8 per cent. of the latter. By referring to our table, we will find that we were not at fault in our accounts for the months of July, August, September and October, for our business was in a normal condition, and we had no need to seek for opportunities of bettering it. In the month of January, however, when these expenses were $3.30 — $1.16 = $2.14, or within 15½ per cent. of the productive wages a change had to be inaugurated. Here, as something unusual must have occurred or come to the surface, we must examine into it and find out what it was. For this purpose we will consider every item that came in the monthly total from the books. Well then we straightway find, that the consumption of fuel had reached an enormous height, and we must satisfy ourselves upon this head, for we naturally say that it ought only to have been so and so, corresponding to the output, so that this increased consumption must have some other cause. Reasons for this increased consumption could then be given as:

(*a*) Cold, and heavy frosts, which rendered the heating of the moulding room necessary during a large part of the month, in order that the moulds might not freeze.

(*b*) To frequent casting, where most of the pourings are for small articles of little weight per piece, hence a large quantity of charging coke to a small weight of castings is used, so that the cost of melting is somewhat increased.

Having determined these two reasons, it is clear that we can obviate the first cause, due to frost, a little; we must straightway see if it is possible to place our flasks nearer together, to lay aside the moulds near the doors and openings and in this way, with the precautions that the nature of each case will suggest, limit the heating of the moulding room to the lowest possible figure, in order to save fuel, and yet it should be carefully borne in mind that there is no economy in having a cold workroom during the day. Care should be taken to have the windows and doors in good order and tight, and all broken glass replaced.

In the second case, we have a remedy in not casting unless we have a certain weight to pour, whereby the number of casting days are decreased and our ra+io changes for the better.

If we should still find a somewhat too great consumption of auxilliary materials, as core materials, nails, chaplets, straw, wood, etc,, this

too must be carefully examined and its unreasonable waste checked and corrected.

It is in this way that the increase of our expenses for material may be again decreased, until our business resumes its normal status, as far as the corrective power lies within us.

V. and VI. *Business Expenses, Interest, Salaries, etc.*, which are not usually subject to any fluctuation, we may put together. Their debit value is that amount which we established in our example at 0.83. We can take this amount as constant, since we may consider it as already reduced to the lowest and closest figures. Here too belong the expenses for cartage, stores, production of steam (coal and water), maintenance of buildings and machinery, lighting, miscellaneous expenses, etc.

On the other hand, should the figures of our register continually, or even occasionally, exceed our average value, so that it happens that our monthly balance finally shows a business deficit, even though the business of our establishment might be good, whereas the prices received might be too low for carrying on the business profitably, then the ratio which represents our business factor must be reduced to the lowest possible figure by a cutting down of the necessary productive wages and those embraced in the constant expenses, to the lowest possible point consistent with the maintenance and necessities of our establishment. Hence sala-

ries must be reduced, situations resigned, maintenance of buildings, and especially repairs, must remain limited to those that are absolutely necessary, etc., provided, that it does not interfere with the even tenor of our management.

For example, it has already been ascertained that the expense per month $\frac{\$1,200}{12} = \$100$, and the constants $= \frac{\$7,500}{12} = \$650$. We see then, that if we multiply our productive wages for July by 0.83, that the result $12.60 \times .83 = 10.46$ is higher than need be, whereas it proves itself to have been $0.90 + 5.90 = 6.80$, showing that we have been doing a profitable business.

VII. *Cleaning wages.*—Where these, like our contract wages, enter into our calculation, they can undoubtedly influence the result, since then the difference arising from our average debits would not be increased, and the mere nominal variations could easily be regulated by the discharge of workmen. Here then the introduction of contract labor is the most direct means for maintaining our register coefficient constant. In this case also we give an ordinary contract in the appendix.

VIII. *Day Wages.*—These occupy a large portion of the attention of business men. Their amount comprises even in moderately large foundries, three different activities, and can therefore be less easily regulated than our regis-

ter frequently shows to be desirable. These wages comprise those that are paid within the moulding room, outside, and for the service of the cupola. Discharge of the workmen where it seems expedient is the only means of regulation, whenever our register indicates the necessity.

With the largest of the three, we can, by a pro rata adjustment, place a limit on its increase once for all. This is taken from the share of the melting expense, which, in our example, has been placed at an average of $1.20 per ton. We have already determined that the breaking up of the pigs, the maintenance and service of the cupola, the smearing of the spout and ladles and the removal of the furnace refuse is to be reckoned under this head. Since these services, especially in small or moderately large foundries, may be performed by a distinct class of laborers, and where especial skill is required they may be very easily contracted for on a pro rata basis. Here too, we would direct the attention of the beginner to the assistance that may be obtained from the appendix of this pamphlet.

IX. *The expense for patterns* should remain a constant quantity relative to the weight of small article produced. It therefore rises and falls, and causes thereby in a decreasing business, our greatest anxiety, since the amount, at other times enormous, increases, and our whole busi-

ness is unable to lower its ratio. Having seen that the amount for July and September, for instance, has only just exceeded the normal consumption of wood and other materials, still, as 3.70 instead of the calculated average result of 3.37, has been reached, we must undoubtedly say to ourselves, that if an improvement in these figures is not attained at the next examination, there must be an immediate discharge of some of the pattern makers and to the extent that the amount of our estimate for our final average requires. An increase of business coming in shortly afterwards, one can, by working over time, easily extricate himself from the difficulty. Again, we find in our register the amount $4.04 as the expense of pattern making for the month of August. An examination at this point would have shown, that no discrepancy existed in our business, for the amount remained normal and has not varied materially from the average calculated amount; for the regular books from which the amount is taken, contain, as well as the wages of the pattern makers, the consumption of wood, glue, shellac, pencils, tools, etc., and we have there found that the account is burdened with an item for the purchase of wood for patterns, which will serve for a number of months to come, so that the irregularity produced was a specious one. We have, then, no reason for retrenchments, for later the difference will be equalized by decreased expense, as it is in reality

shown to be the case in the later months of our register.

The introduction of a stipulated price for the maintenance and renewal of the necessary patterns is very desirable. We may then have our debit values as constant as we desire. The author has a contract with his foreman pattern maker, whereby the wood and tools are furnished gratis, and the adaptation of the patterns, as far as it is possible by change of present patterns, is done at a specified amount per ton of castings. The employment and paying of the workmen is then thrown into the hands of the foreman. Although a man with five workmen, works most of the time himself, it has not yet happened that the contractor has been short at the end of the year, or that he has, up to this time, been compelled to work any material overtime. In an establishment turning out a large quantity of coarse castings, and which furthermore, relatively to the ordinary or occasional manufacture of small wares, requires little pattern making, these goods must be kept separate, as has already been shown in our scheme for ascertaining the cost of pattern making. For the construction of new patterns we may contract with the foreman and agree upon a proportional price. Should the demands appear too high, we can justly stipulate that the contractor must either work for a fixed price, wherein a certain guarantee of a minimum receipt is given him for the average

of a twelve month's balance, or, on the other hand we reserve the right to have our new patterns made in any way that we may consider cheaper.

By reference to our previous results, we have found that the wages bear a ratio of 1 to $4\frac{8}{10}$ to our expenses for wood and material. The author has contracted with his foreman for his pattern making, and has carried it out with the best of satisfaction to both parties. The tenor of the contract may be found in our appendix with the other contracts placed there for optional imitation.

X. *Depreciation.* This may be considered as a fixed amount and is, according to our example already given, \$1,400 per annum, or $\$116\frac{2}{3}$ per month. We have also found that its average value should be about 13 per cent. of a certain minimum of present productive wages and that the latter are given at \$875 per month. We therefore take our monthly amount at \$116 instead of that given and then divide by our total monthly production of castings; whence we obtain for July, for instance: $\frac{116}{63} = \$1.84$ per ton as the necessary quota of depreciation, and in this way we form our final register amount. The debit amount of depreciation must average 13 per cent. of the productive wages for the calculation of our proposed basis. We enter the amount as here deduced in our register, just as we have done by the other items.

By observation upon those things which our register shows, we have gained the information by which many considerations, data and influences may, by and by, afford us figures relative to our business organization which should then be placed under the proper heading. This observation is possible for us under the circumstances of ordinary business and will remain so fixed in the inner consciousness that it thereby becomes a kind of commercial barometer. A careful observation and manipulation of this barometer belongs then to the province of the managing engineer. He will also find from his register that he need only lay the groundwork of a general average for a calculation of the proposed basis, as he will find that winter and frost can essentially change his data without his interference and that the activity and effectiveness of the workmen is different in winter from in summer. Consequently he will say to himself, like a wise husbandman: "I must sow bountifully in summer that there may remain something over from the harvest for winter's consumption." On which account he will reckon in accordance with his average, although it may prove itself unnecessarily high in summer, while in winter the opposite will be the case.

Now, all the items of our register are entered, being based upon a ton's production, and as they were taken direct from the books and are not represented approximately, but as they really

are, we can then, by the mere addition of all these items, straightway determine what the production of castings has really cost us for each month on the average. We can then determine the receipts for the rough castings for the whole or the greater part of the production per month, and by a simple division also ascertain the receipts per ton, and then by a comparison show how much has been made or lost per ton. Since we already know our total production, the total result for the month is readily given. In many cases, however, it would be impossible for the book-keepers to furnish the monthly figures with absolute accuracy, especially on account of the difficulty of making the compilations from the regular books, because of the ignorance of the clerks of their necessities; in such cases it is better, as has already been pointed out, to resort to approximate results. We therefore give up perfect accuracy in our balance, in order that it may be determined with less trouble, and because for our purposes, it will be accurate enough without any figures from the books.

THE BOOKS.

We can easily see that there is very little necessity for technical book-keeping, except to determine as accurately as possible the distribution of the expenditures obtained from the regular books in such a way and under such headings as

we may need for the purpose of a technical calculation, and for the perfect understanding at all times of the prevailing tenor of the business.

It is also preferable that all those items which are considered as bearing upon the foundry work, should be entered in such shape as the technical considerations have determined to be most expedient.

Div. I. The pig and scrap iron, including all relative expenses as freight charges, taxes, cartage, etc.

Div. II. The productive wages, as wages of sand and loam moulders, core makers, apprentices and foremen, especially if the latter, as is usually the case in small foundries, is a workman. The wages of the sand mixers and helpers in core making belong to the division of day wages.

Div. III. The foundry materials, as wood and coal for firing the cupola, fuel for heating or drying stoves for moulds and plates, also coal and coke in the ordinary run of work as well as what is used for melting purposes, (steam, workroom and office heating do not belong here) coal dust, graphite, sand, dung, stone and brick for loam moulding, firebrick and clay, moulding tools as shovels, riddles, brushes etc., oil for hand lamps, material for flasks and the material and workmen's wages for repairing the same, as well as the changes for the requisite construction for mak-

ing especial moulds, also the wages for strikers, blacksmiths and moulders employed in the work, as well as the necessary wrought-iron, screws, etc., and finally the hammers, chisels and wire brushes of the casting cleaners.

[*N. B.* Entirely new construction of necessary flasks, provided they are for continual and general use, belong to the domain of increase of business and form therefore material for inventory, which is quite subject to depreciation. On the other hand, the expense for flasks and the construction of some special piece of work must be taken from the moulding account and consigned as expense to Div. IV, except that the raw material used must be deduced as its value has not been impaired and it may be used again.]

There further comes under Division III, the consumption of core rods, nails, pencils and chaplets, as well as the renewal of old articles like chains, drying plates, etc., as well as the consumption of water in the foundry.

Division IV. *Business*, as salary for storekeeper, and wages of storehouse porters, maintenance of buildings, machines and foundry cranes, sick funds, taxes, postage, assessments and legal expenses, office utensils, heating of workshop and office, general lighting of buildings, expense for steam in coal and wood, water and fireman's wages, the general plant expenses, means of transportation, carts, wagons, tools,

tracks, hoisting and weighing apparatus, truckman's wages, lubricating oil, painting materials, etc., etc.

Division V. *Constant expenses*, as salaries for officers and the superintendent, provided the latter is not placed in with the former, interest on borrowed capital, discounts, etc.

Division VI. *Wages for cleaning*. This does not include the consumption of materials, as steel, hammers, brushes, etc., since these have already been included under Division IV.

Division VII. *The day wages*, include among others those for helpers in the foundry, such as sand mixers, core turners, porters, cupola tenders, and the expense of breaking the pigs, also the workmen who are employed in moving material in the molding room.

Division VIII. *Patternmaking*, including foremen, apprentices and the men employed in making flasks.

Division IX. *Carpentry utensils*, implements, as wood, shellac, glue, nails, screws, oil, sandpaper, and expenses for files and tools, and whatever may be consumed in any way either directly or indirectly.

Such a system of keeping an account of all expenses, would give the greatest accuracy attainable in making an estimate as well as for striking off a balance.

EXAMPLE OF AN ESTIMATE WHEN A MOULDING MACHINE IS USED.

In making a specialty of foundry work, in perfectly adapting the plant for the manufacture of certain articles, in working with moulding machines, and by obtaining simple proportional data for the making of the moulds with the workmen, and when the difference between productive wages ceases to exist, one must exercise the greatest care at every step, in making a correct estimate upon a given article, and especially in the introduction and adaptation of a special article system into the present methods of our foundry practice. In order, then, to take some definite position and point out the course that should be followed, we make use of this example for

Making Pipe with a Moulding Machine.

It may be considered expedient for a foundry already in existence, to introduce the manufacture of some article, which may be undertaken when the ordinary foundry work slackens or is insufficient to afford the necessary occupation to the men. The new specialty should serve to fill up the blank which exists, since the necessary expenditure of productive wages, which we have learned are necessary for the maintenance of our business, is diminished if the work falls off for an instant. The manufacture, for stock of a

quantity of articles, cannot under such circumstances stand in the way of the necessary work, so that the proprietor may say: "I can even eventually afford to sell my wares without any profit, if by this new industry I can protect myself from all the loss which I would sustain by the irregularity of my business, and the probabilities are that I may even make something by it."

We will pre-suppose that the new industry will be carried on, for the most part, without an increase of our constants, and, as has been said, only for the sake of filling up any gaps in the business.

We choose the most saleable kinds of flanged and socketed water pipes of, say, $2\frac{3}{4}$ inches, 3 inches, $3\frac{1}{2}$ inches, 4 inches and 5 inches diameter, and proceed to make them with a moulding machine. Then we examine the smaller and larger special sizes, and provide ourselves with the necessary patterns of those which we wish to adopt; we proceed to the formation of an estimate, which will give, in accordance with our purpose the information desired, relative to cost as opposed to saleability.

Well we find that for the manufacture of the five sizes of pipes mentioned, we shall need two molding machines, in order to procure the greatest economy. This number need not necessarily encroach upon our moulding floor, since they may be kept out of the way in the corners.

To move such a machine on a lorry and to unload it by means of a foundry crane, requires only a few moments of time. The half-patterns for the machine are of iron and rest upon movable supports, which can be raised and lowered by means of a lever, thereby removing the pattern from the mould. The sand mould is thus obtained in a faultless condition, and can be immediately blackened, and the flasks quickly taken to the kiln carriages. The manipulation is so simple and rapid, and no ordinary system of molding can compare with this for cheapness in running expenses and rapidity of production; wherefore we may consider it especially suitable for auxilliary use in our foundry for the purposes specified. When the drying carriages are loaded and the moulds are dried, the removal of the flasks and the placing of the cores is the next step to be taken, then comes the placing in the casting pit, which should be conveniently located, and which, for our purpose, we will consider to be capacious enough for the reception of twenty flasks or forty pipes, and placed near the wall of the building, yet so that a crane swings over it. Its size, so that it may not interfere with the regular work of the foundry, should be, say, 25 feet by $2\frac{1}{2}$, or 13 by 5 feet, with a depth of $6\frac{1}{2}$ feet. We prefer a shallow pit because it requires less time for the placing and removal of the flasks, and the pouring, which is accomplished with the crane, causes us no difficulty.

We will thus obtain forty pipes of 3 inches diameter at a single casting.

We have taken this quantity as the basis of our requirements, and we therefore need, because we should always mould exactly the same quantity on the day previous to that on which we cast, a number of simple flasks for the forty pipes, or twenty flasks holding two pipes each. Further, we need flasks of two sizes, one for pipe of $2\frac{3}{4}$ inches, 3 inches, and $3\frac{1}{2}$ inches diameter, and another for those of 4 inches and 5 inches.

We need then,

20 complete two-part flasks for $2\frac{3}{4}$ in. to $3\frac{1}{2}$ in. pipe, at $16.00	$ 320.00
20 complete two-part flasks for 4 in. to 5 in pipe, at $18.00	360.00
40 pieces $1\frac{1}{2}$ in. gas pipe for core spindles at $2.50	100.00
40 " 2 in. " " " " " 3.20	128.00
Finishing and work upon the 40 flasks at $2.00	80.00
100 screws or clamps, 200 lbs	10.00
Turning and drilling the core spindles, setting up and driving rings	80.00
Molding machines	1,200.00
Making casting pit and walling same	65.00
1 Drying oven lorry	35.00
1 Track 40 feet long	12.00
1 Frame for core turning	15.00
Blacking pots, tools, etc	5.00
Total cost of the addition	$2,410.00

With these facilities we can manufacture 40 pipes of 3 inches diameter, which in socketed pipe at 120 lbs. each would weigh 4,800 lbs. We can make twice as many pipes with our facilities, but we have taken it for granted that our foundry is not to be enlarged, no local changes and no

business contemplated which will raise our constant expenses, wherefore no further increase of kilns, tracks, etc., and consequent derangement of the other business is to be permitted.

Our experience has shown that where there is a crane for raising and lowering the flasks and placing them in the pit, one experienced moulder and a coremaker with five laborers as helpers are required for making the moulds and cores for forty pipes 3 inches diameter, and that the crew consisting of seven men can complete the task so that the pouring of the pipe takes place every alternate day, one being occupied in moulding and the others in casting and getting out the work. For a complete estimate of the wages without counting those to be deducted for bad castings, we have

For the moulder as boss of the work, for the job at $3.25 per day	$6.50
For the coremaker at $2.25 per day	4.50
For five helpers at $1.50 per day	15.00
	$26.00

For forty pipes of 3 inches diameter or .65 cents per piece. Estimating other dimensions in proportion, we have:

For 2¾ inch pipe	60c. each	including cores.
3 inch pipe	65c. each	
3½ inch pipe	76c. each	
4 inch pipe	86c. each	
5 inch pipe	$1.08 each	

For flanged pipe, with smooth flanges without bolt holes, we may estimate on about 10 cents more per piece.

Now in order to estimate upon our pipe, we must recall the items found and tabulated for our general ratio, and endeavor to use these on this particular case.

Our total cost in productive and day wages for our pipe of 3 inches diameter and 120 pounds weight, amounts to 65 cents per piece or $10.63 per ton.

Then as our pig iron costs $22.50 laid down, we take for our estimate:

Iron	$22.50
Waste 8 per cent	1.80
Cost of melting	2.33
Cost of cleaning	1.50
Cost of patternmaking	0.00
Day wages	2.80
	$30.93

The productive wages for our pipe, deducting the day wages, since we can see no reason why the mutual values and dependent ratios as found to be correct for our other business, should not be recognized as a peculiarity of all foundry work, and may be placed at $10.63 — $2.80 = $7.83, which amount we can consider as productive wages in our estimate, provided that all expenses were covered by our payment as noted. If the latter is not the case, we may then reckon as extra the transfer of the pipe from the foundry to the cleaning floor, the loading of the same as well as the mixing of the moulding sand. If we appraise these expenses correctly it will be in the neighborhood of $0.75. This makes our

expenditure for productive wages at $10.63 — $2.80 + $0.75 = $8.58, hence our estimate is complete; if we take this as a basis, instead of that for the previously determined and established business in column I with the business factor at .60 and depreciation at .10, and tabulate as follows:

Amount brought forward	$30.93
Productive wages	8.58
Eight per cent. auxilliary	.45
Depreciation, .10	.86
Business factor .60	5.15
Actual cost per ton	$45.97

To this must be added that portion of the extra depreciation which, in consequence of the increase in our plant of $2,410 falls with the 5 per cent. profit upon our total of productive wages. In our previous investigations we have found these to be from .10 to .21 of the wages, and have disposed of them elsewhere in our calculation. We should maintain the same unchanged, since, in the course of our improvements, we are in a position to compare our expenditure for productive wages with our previous general average, we still proceed with our business upon the same basis as that laid down in the column which we have indicated as No. I, where the depreciation was found to be .10 times the resulting increase of wages.

In our new undertaking we should closely observe, whether the consumption of tools, as core spindles, screws, and flasks through excessive

usage may not tend to essentially raise the average depreciation ratio. In fact we can see at a glance that this must be so; the continued daily heating to a glow of the core spindles, the wear on the screws, etc., as well as on the moulding flasks, cannot fall for the first, much below 20 per cent. and for the latter below 10 per cent. We will therefore be not far out of the way, if we add a 10 per cent. of wear to the total of our addition and then add 5 per cent. more to our estimate. Then, if our moulding machine should be at work at least three months out of the year, we would, deducting 10 per cent. for bad castings have made 1,350 pipes of 3 inches diameter with an expense of productive wages of $877.50 and thereby for three months added a further depreciation of 5 per cent. of $2,410, the outlay for the addition; therefore $\frac{\$120.50}{4} = \$30.12$ or .03 times the wages for productive work.

Our actual cost therefore is:

Amount brought forward	$45.97
Super-depreciation	.26
	$46.23

A profit of 5 per cent. corresponding to the productive wages laid down in column I of our previous examples, amounts to .08 times the wages. For such cases then we must still add $\$8.58 \times .08 = \$0.69$, wherefore our 3 inch pipe is placed at $46.92 per ton, with the price of pig

iron at $22.50 for the material used. It may here be remarked, that for a special plant and business, the productive wages taken as a basis in our example may be lowered; for the purpose of illustration, however, it is always better to estimate them a little higher than they are really found to be in practice.

APPENDIX.

For general data in bidding, that have shown themselves necessary and useful for our purpose in making an estimate, we insert here a series of contracts, which may be either directly used, or may be made useful by changes corresponding to the ratio and business under consideration. We present them under the various heads that bear directly and indirectly upon the foundry.

CONTRACTS.

CONTRACT WITH THE FOREMAN PATTERN-MAKER.

I. A. undertakes all the repairing and likewise the renewal of all patterns on hand, provided they belong to the foundry department, at the fixed price of $— per ton of castings produced.

II. The making of new patterns does not fall within the contract but will be agreed upon and paid for separately.

III. For the maintenance of all patterns specified under I, said A. is to be paid.

(*a*) $— per ton for socket pipe and (*b*) $— per ton for other products.

IV. We guarantee to said A. a minimum receipt of $— per month, on condition that for all extra service yielding over $— one-half shall be paid to him, and the other half remain in the business.

V. The final settlement with said A. shall be made on the first of July instead of from month to month; and finally if he should leave his place he is to receive the monthly excess that is due together with $—, but on the other hand if no surplus should be paid, he is to receive his $— as payment. Should said A. at said date of July 1, or at the time of his leaving our service, be in arrears, the establishment is to bear the loss.

VI. All repairs of tools, cars, changes in shop contrivances, construction of flasks for the foundry, are among the duties of the said A, and the payment for the same is already provided for in the prices given in *a* and *b* under III.

VII. All castings which are needed in the works are exempt from any estimate of output, and the payment for them is likewise comprised in the prices quoted under III for saleable goods.

VIII. The expenses for the construction of new patterns belong to an independent agreement, or an agreement upon certain prices determined by the work to be done. The establishment is therefore at liberty to have new patterns made in such a manner as seems advisable.

A repeated payment for these new patterns

beyond the stipulated price, will not be permitted according to the scale under III, whatever the duration of the order or the total output may be, wherein the said patterns may be used.

A later use, as a second commission, falls under the agreement made in III, and will be paid for as therein stipulated.

IX. All wood and tools, including paint, shellac, glue, nails and shop tools, will be supplied to the said A. on the part of the establishment free of charge.

X. The employment of pattern makers remains with the said A., likewise their wages, still the general order and discipline of the establishment shall control A. as well as his workmen.

XI. Finally the said A. is to keep an exact account of the expense of maintaining the patterns.

CONTRACT WITH CLEANERS.

Here the prices conform on the one hand to the weight of the article, and on the other to its shape and complicatedness. In regard to the latter we may say that the productive wages of the article may be placed at the base of the scale, since the simpler forms yield a lower and the more complicated a higher rate of moulders' wages. We make use of the following scale

which should be made to correspond to an average price of wages of from $1.25 to $1.50 per day. Agreement for cleaning castings per ton:

.75	With	productive	wages	at	from	$ 2.00 to $ 6.00
1.00	"	"	"	"	"	6.00 to 10.00
1.25	"	"	"	"	"	10.00 to 14.00
1.50	"	"	"	"	"	14.00 to 20.00

CONTRACT WITH CUPOLA WORKMEN.

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