NUMBER AND KIND OF MACHINE FOR WHICH STOCK MUST BE MAINTAINED IN STOCKROOM AS SHOP ORDERS APRIL 6, TO JUNE 27

MACHINE	ASSEMBLY NO.	NUMBER	NO. REQUIRED
LAY 26 X 82	A-2202	1	1
LAY 22 X 84	A-2201	0	0
24" HEADSTOCK		0	0
LAY 16 X 50	A-1174	0	0
LAY 18 X 33	A-1173	2	3
LAY 16 X 19	A-1172	2	3
LAY 16 X 19 B.B.	A-1172	0	0
16" B.B. HEADSTOCK		0	0
12" B.B. HEADSTOCK		0	0
LAY 12 X 65	A-1504	0	0
LAY 12 X 33	A-1503	5	7
LAY 12 X 21	A-1502	3	5
LAY 12 X 15	A-1501	20	30
LAY HEADSTOCK		0	0
TURRET 2 1/2 X 24	L-264	7	10
3 1/2 X 36	L-364	2	3
DOUBLE SPINDLE	L-514	0	0

Figure 2 Assembly Schedule of Machines for Two-Months Period

for each main assembly is given below by addition.

Looking at column "2-11" we note that this production period will require sixty parts for fifteen of assembly 1501, twenty-four parts for six of assembly 1502, etc. The total for machine assemblies is given below as 120.

Meanwhile provision must be made for "V orders," which are replacements, repairs and service calls in general. In the upper right-hand corner of the card we see that in slow or "low" times about sixty per period must be provided for this category. Added to the total for machine assemblies, this gives the normal lot figure of 180 as shown.

The next step is to find what the number of parts in stock should be at this moment to take care of the desired output. For this purpose reference is made to the chart shown in Figure 4. Because this is rather long only the top part is shown—and unfortunately not the part from which the actual figures are drawn. The principle involved

LIST NO. 6917 MATERIAL 3150 SIZE 2 1/4 CUT LENGTH BAR PRODUCTION WKS 8

Mch. Ass.	1501	1502	1503	1504	For V Orders
Analysis of Assemblies	1521 2	1521 2	1546 4	1551 6	Low 60
	1525 2	1523 2	1550 4	1552 6	Med. 90
					High 120
Total Per Machine	4	4	8	12	
Starting Date	12-11	2-11	5-11	8-11	11-11
For Machine Assemblies 1501	17 68	15 60			
1502	6 8	6 24			
1503	6 48	3 24			
1504	9 36	1 12			
Total Mch. Ass'ts	160	120			
V Orders	60	60			
Nor. Lot Figure	220	180			
Schedule Balance	490	392			
Inventory	123	262			
No. Ordered	500	307	150	130	
No. Finished					
Date Finished					
Whs. Taken					

Figure 3 Order Clerk's Record Card for Individual Components

will be clear, however. For any given normal lot—figured as has just been explained—the nearest amount is found in the table. To this is added the reserve of one-half lot if the normal lot is thirty-six or less; if the reserve is between forty-one and fifty-four, inclusive, the reserve is a one-third lot. Above fifty-four the reserve is a one-fourth lot.

We must also know how many parts will be used up during the time the new lot is being manufactured, so as to leave the desired reserve in the bin when the new lot finally arrives there. This is shown for various production periods, from one week to nine for each normal lot size on the lines marked "for prod. per." The "schedule balance" is the sum of the normal lot, the reserve of one-half, one-third or one-fourth at the top of the column, and of the "for prod. per" opposite the production time. This schedule balance is transferred to the card in Figure 3. In this case it figures out to 392.

Now the order clerk goes to the bin and counts the actual parts therein. If there are any productive lots still in process (though there ought not to be) he adds these also to the line marked "inventory." This amount, 262, is subtracted from the schedule balance and the shop order is written for the remainder—130 in this case.

This sounds complicated, but it should be remembered that reference is made to standard charts throughout, and the only computations are the simple—and necessary—ones on the card (Figure 3). If the assembly schedule is maintained, if the demand for service parts is normal, and if the lot

NORMAL LOTS & SCHEDULE BALANCES FOR 9 WK. ORDERING PER

NORMAL LOT		3	6	9	12	15	18	21	24	27	31	36
1/2 LOT		1	3	5	6	8	9	10	12	14	16	18
PRODUCTION PERIODS 1	FOR PROD. PER	0	1	1	1	1	2	2	2	3	3	4
	WK. SCH. BALANCE	4	10	15	19	24	29	33	38	44	50	58
2	FOR PROD. PER	1	1	2	2	3	4	4	5	6	7	8
WK.	SCH. BALANCE	5	10	16	20	26	31	35	41	47	54	62
3	FOR PROD. PER	1	2	3	4	5	6	7	8	9	10	12
WK.	SCH. BALANCE	5	11	17	22	28	33	38	44	50	57	66
4	FOR PROD. PER	2	3	4	5	6	8	9	11	12	14	16
WK.	SCH. BALANCE	6	12	18	23	29	35	40	47	53	61	70
5	FOR PROD. PER	2	3	5	6	8	10	12	14	15	18	20
WK.	SCH. BALANCE	6	12	19	25	31	37	43	50	56	65	74
6	FOR PROD. PER	2	4	6	8	10	12	14	16	18	21	24
WK.	SCH. BALANCE	6	13	20	26	33	39	45	53	59	68	78
7	FOR PROD. PER	3	5	7	9	11	14	17	19	21	24	28
WK.	SCH. BALANCE	7	14	21	27	34	41	48	56	62	71	82
8	FOR PROD. PER	3	5	8	10	13	16	19	22	24	28	32
WK.	SCH. BALANCE	7	14	22	28	36	43	50	58	65	75	86
9	FOR PROD. PER	3	6	9	12	15	18	21	24	27	31	36
WK.	SCH. BALANCE	7	15	23	30	38	45	52	60	68	78	90
NORMAL LOT		41	45	49	54							
1/3 LOT		13	15	16	18							
SLOW PERIODS 1	FOR PROD. PER	4	5	5	6							
WK.	SCH. BALANCE	58	65	70	78							
2	FOR PROD. PER	9	10	11	12							
WK.	SCH. BALANCE	63	70	76	84							
3	FOR PROD. PER	13	15	16	18							
WK.	SCH. BALANCE	67	75	81	90							
4	FOR PROD. PER	18	20	22	24							
WK.	SCH. BALANCE	72	80	87	96							
5	FOR PROD. PER	22	25	27	30							
WK.	SCH. BALANCE	76	85	92	102							

Figure 4 Chart for Determining Schedule Balance

goes through on scheduled time, writing the order for 130 parts will bring the stock up to a point where it will have been reduced to the desired reserve when the next succeeding lot reaches the stock bins.

This plan, it will be seen, gives some of the advantages of the lot system, in that it definitely schedules the part production to fit the demand, so far as it is known either from direct orders, lively prospects or the trend of inquiries. In fact, by a monthly revision of the schedule, it permits making corrective changes in the ordering at frequent periods. It also maintains the desired condition of carrying a suitable reserve—comparatively large for small production and comparatively small for full production—from which to replace spoilage and meet sudden demands for increased rate of assembly for certain items of the line or for the output as a whole. Finally, by making a routine of the scheduling, or a standard scheme, it reduced the production and scheduling staff to a minimum.

But how much are we paying for these advantages? Is the interest on the larger investment in inventory a high price to pay? These questions have been in our minds for some time past, and in an endeavor to arrive at a rational answer to the question the writer has looked up the available literature on the subject. The two principal contributions appear to be Major G. D. Babcock's A.S.M.E. paper of December 3, 1924, entitled "Production Control," and the paper of Professor F. E. Raymond before the S.A.E. at Cleveland in September, 1929, on "Economic Size of Production Lots." Both of these papers, particularly the latter, give elaborate mathematical analyses of lot sizes for the maximum and minimum stock-bin method. But rough calculations do not indicate that our investment would be sufficiently decreased to pay for the much greater personnel required; nor can we determine the monetary advantage we possess in our repeating schedule, in which similar parts are regularly grouped so that changes in set-up are minimized. We find ourselves, therefore, thrown back on the resource of making our own comparison, as best we can, with the lot method, the only alternative that we can properly consider.

To get some rough idea of our present performance as compared with an ideal performance by the lot method, we drew up various simplified diagrams illustrating typical cases, of which three are here shown.

Figure 5 shows on the left the variations in inventory value throughout an eight-weeks period for a large casting, delivered slowly from the foundry, and with a fairly long period required to put the lot through the shop. The relation between material and labor is such that the material is a large proportion of the finished cost. The curve for the value tied up in raw material shows the half lot in reserve as the total until the end of the third week, when the castings begin to come in as per schedule. At the end of the seventh week the material is in and inventory remains constant for one week, when it is absorbed into work in process. This quantity grows by the addition of labor and overhead as work is done upon it until it is completed at the end of the fifth week of the next period. After a week allowed for final inspection, etc., it is charged to the stock room, where its value is added to the half lot which it finds waiting there. The stock-room value diminishes with regular assembly until the sixth week of the next