CHANGE-RINGING MACHINE

INVENTED BY

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I.—CHANGE-RINGING.

CHANGE-RINGING is the art of ringing changes or permutations on bells.

In the very early days, changes were made gradually, only one pair changing at a time, thus :—

12345
21345
23145
23415
23451

Each change or row was probably rung several times.

Later, changes were made at every stroke and more than one pair were changed at each stroke. Thus PLAIN BOB came into existence.

123456 (lead head)
214365
241635
426153
462513
645231
654321
563412
536142
351624
315264
132546
135264 (lead head)

In this, all pairs are changed to start with, then the two inside pairs, and so on alternately until the next lead head is reached. It is now necessary to change the two back pairs, otherwise 123456 or "rounds" would be produced.

Proceeding in this way the bells will be found to run round after 60 changes. This is called "the plain course."

To extend the number of changes to longer lengths, special variations called bobs and singles are introduced. Thus, if a bob were made at the end of the first lead, we should get 123564 instead of 135264, and if a single were made, 132564 would be produced. By arranging bobs and singles suitably, the whole number of permutations can be obtained.

Note particularly, that different changes are rung at *every stroke*, no two being the same. The rate of ringing is about 28 or 30 per minute, so a "Peal" on seven bells, i.e., 5040 changes, takes about three hours.

Now, ringing on	5	bells is called	Doubles
	6	... ...	Minor
	7	... ...	Triples
	8	... ...	Major
	9	... ...	Caters
	10	... ...	Royal
	11	... ...	Cinques
	12	... ...	Maximus

That quoted above would therefore be called PLAIN BOB MINOR, i.e., changes on six bells according to the Plain Bob Method or system of rules.

There are plenty of other methods which are produced by selecting different pairs to change at the end of each row. For instance :—

DOUBLE OXFORD MINOR.	123456	*Pairs changed*
	214365	All
	241356	One middle and back
	423165	All
	243615	Front and right middle
	426351	All
	243651	Front and middle

and so on.

Methods like these are called plain methods, and it will be noticed that No. 1 (the Treble) works its way straight out until it is last, and then returns to lead, having struck two blows behind, or in last place.

In Treble bob methods the treble has a dodging "Hunt." Below is half a lead of KENT TREBLE BOB.

123456
213465
124356
214365
241635
426153
421635
246153
264513
625431
624513
265431
256341

The work of the other bells is different from that of the treble, but they all work alike, starting the work in different places. Thus, in the lead of Bob Minor quoted, the 3rd does the same work in the second lead that the 2nd has just done in the first lead.

It is, of course, impossible to learn the changes to be rung by heart ; what the ringer learns is his work, and what to do if bobs or singles are called. Thus in Double Oxford, the ringer of the 3rd knows that he must first make two blows in 4ths place, then two in 3rds place, and then dodge in 3–4 ; and so on.

Then there are some methods in which all the bells have the same work. Such a method is "STEDMAN."

12345
21354
23145
32415
23451
24315
42351
43215
34251
43521
45312
54321
53412 and so on.

It follows that a ringing machine must be able to be set so that it will change any pairs necessary, according to the method, in each successive row, and should be able to make Bobs and Singles in all methods, when required.

II.—PRINCIPLES ON WHICH THE MACHINE WORKS.

A.—If No. 1 moves, No. 2 must also move, one to the right and the other to the left, as two bells cannot be in the same place at once. If 2 moves, either 1 or 3 must also move. If 3 moves either 2 or 4 must also move, and so on. There are, therefore, for eight bells, seven pairs that may be changed, i.e., 12, 23, 34, 45, 56, 67, 78. Number these 1, 2, 3, 4, 5, 6, 7, respectively. Pegs are put into a revolving barrel so that any pair may be made to change. The barrel moves on for each change, presenting a new row of pegs. There are 17 rows of seven holes each, into which pegs are screwed. If pegs 1, 3, 7 are in action, 12, 34, 78, will change and 56 lie still, or "place make."

B.—Take DOUBLE NORWICH COURT BOB MAJOR.

13254768	*Pairs that change*	*Pegs required*	*No. of*	Notation
12345678	23, 45, 67	2 4 6	1	18
21436587	12, 34, 56, 78	1 3 5 7	2	×
24135678	23, 56, 78	2 5 7	3	14
42316587	12, 34, 56, 78	1 3 5 7	4	×
24361578	12, 45, 78	1 4 7	5	36
42635187	12, 34, 56, 78	1 3 5 7	6	×
24365817	12, 34, 67	1 3 6	7	
42638571	12, 34, 56, 78	1 3 5 7	8	
46283751	23, 45, 67	2 4 6	9	
64827315	12, 34, 56, 78	1 3 5 7	10	
46287135	12, 34, 67	1 3 6	11	
64821753	12, 34, 56, 78	1 3 5 7	12	
46812735	12, 45, 78	1 4 7	13	
64187253	12, 34, 56, 78	1 3 5 7	14	
61482735	23, 56, 78	2 5 7	15	
16847253	12, 34, 56, 78	1 3 5 7	16	
18674523	23, 45, 67	2 4 6	17	

Other plain methods are produced by altering the pegs. Now, it will be noticed that the pegs required after No. 9 are the same, but backwards. The barrel is arranged to reverse in direction after 5 changes for Doubles

6	Minor and Stedman
7	Triples
8	Plain Major
12	Treble Bob Minor
16	Treble Bob Major

This saves many pegs and time in setting them, and the moment of reversal is set by altering only one gear wheel.

To change from one Method to another it is only necessary to change a few pegs and sometimes a gear wheel, as, for instance, in changing from Bob Minor to Double Norwich.

Bobs and Singles are made by pressing down suitable keys at the right moment, which will either stop a peg from taking effect or bring on a change.

Thus in Double Norwich:—

		Pegs required
Plain Lead	16847253	
	18674523	2 4 6
Bob Lead	16847253	
	18674235	2 4 7

Therefore, 6 must be stopped from acting and 7 must be brought on.

This machine will ring any method on any number of bells up to 8, and has also been arranged to work a typewriter, and so to print out leads, etc.

It has already rung over 400 methods and drawn work diagrams of them and has, in addition, rung three peals:—5024 Double Norwich; 5024 Cambridge Surprise; 5040 Stedman Triples.

In order to draw work diagrams, an arm carrying a pen is attached to the 7th bell and works over a sheet of paper which moves as each change is being made.

Details.—The Bells, i.e., the moving parts of the machine, consist of brass strips $\frac{3}{4}$-in. wide with a roller at each end and are placed side by side. At one end are 8 V slots into which a spring (a) (see fig. 1.) presses, which helps to locate them and also to convey current to them so that they will each ring a gong. At the other end are 8 rectangular transverse slots (b) $\frac{5}{16}$-in. apart. Between these are 2 catches (cc) (see also fig. 2) which hold up 2 parallel rods (dd) each provided with a hook (e). When a catch is pushed up, the rod drops, enters a slot and the bell is driven right or left according as to which rod drops. The near rod moves left and the far rod moves right. If the left catch is released, the near rod drops and the bell is driven left. The rods are moved by cams on the main shaft, as is easily understood by reference to fig. 1.

After the rods have pushed the bells, they are lifted out of the slots by the bar (f), which is raised by a cam on the main shaft.

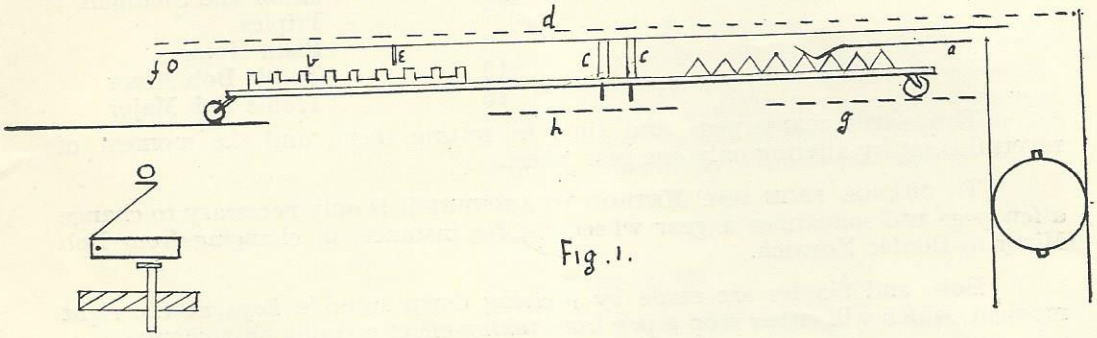

Fig. 1.

Fig. 2.

The catches are released by seven lifters (h), which are seven flat bars at right angles to and under the bells. Numbering them 1 2 3 4 5 6 7 from right to left, if No. 1 rises, for example, it releases a catch on any bells that may be in 1st or 2nds place, the left-hand catch on the one in 1sts and the right-hand one on the bell in 2nds ; the rods drop, and one is driven left and the other right, or in other words, the two bells change. In Fig. 1, if No. 3 lifts, the bell will go left, but if No. 2 lifts it will go right.

At one end of each lifter bar (h) hangs a loose bar (j) (fig. 3), and below and just behind these rods is a bar (k) which is raised by a cam.

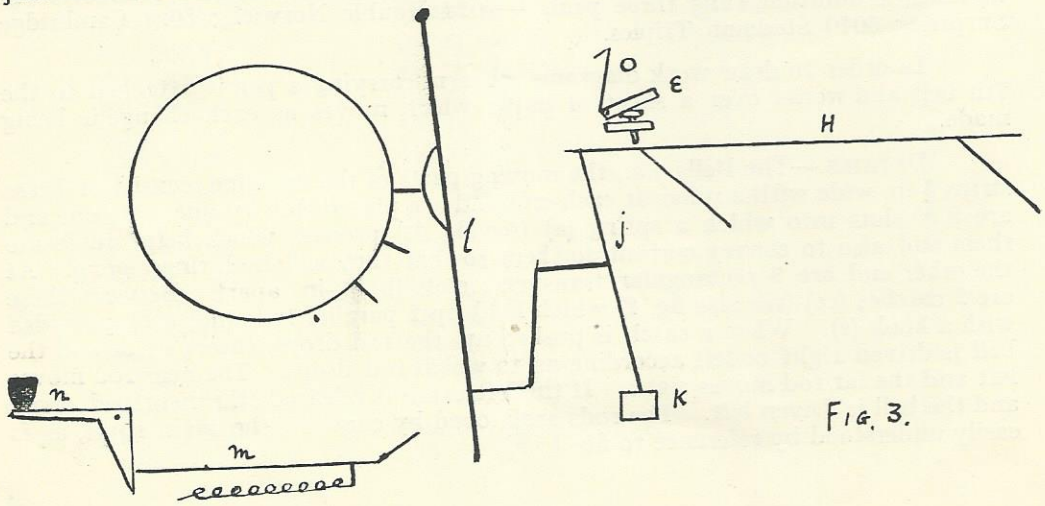

Fig. 3.

Fig. 3 shows the barrel with three pegs on it, the actuating lever (l), the hanging loose bar (j), the rising bar (k), and one bell with left hand catch (e).

When (k) rises, nothing happens unless (j) has been pushed forward, and the bell "place makes." When (j) has been pushed forward by a barrel peg pushing (l), then it is caught by (k), and (m) is then lifted, a catch is released and a rod drops. This is shown in fig. 3.

To bring "on," the bar (m) simply pushes (j) just far enough to be caught by (k).

Suppose pegs 1 3 5 7 are in one row and the start is from rounds, 12345678, then the change 21436587 will be produced. Now the barrel moves on to bring the next row into action. Suppose pegs 2 5 7 are in this row, then the change 24135678 will be rung.

THE BARREL ACTION.—It has been mentioned that the barrel must reverse. It is driven by two pawls, one drives it clockwise, and the other, counter-clockwise. These pawls are lifted by a cam. To reverse, one is pushed out of action while the other is pushed in. This is done in the following manner:—

On the mainshaft is a 20-toothed wheel which drives an idle wheel which is mounted on a moveable quadrant, so that it can be adjusted to gear into a wheel, which can be changed for various methods as explained before. On this spindle is a 15-tooth pinion which drives a 120 wheel. On each side of this are shoulders, each with a gap 180° apart. Two pivoted bars rest on these, and when they drop into the gaps they push over the actuating levers which throw over the pawls.

The ringing of the gongs is carried out in the following manner:—The bells (see fig. 1) move over eight parallel insulated bars (g). These are connected to studs on a plate, over which revolves a contact arm. Each bell is connected to its own electric gong through the springs (a). If then, a bell is resting on the 1st bar it will ring first, if on the 5th bar it will ring fifth.

The machine has about 1,250 parts, all of which, except screws and springs, were made by Mr. WOODHOUSE himself. The castings for the frame work were done by Messrs. STUART TURNER, of Henley.

TO WORK THE MACHINE—a brief account.

Assuming that all is set correctly, turn the handle clockwise till the first row of pegs come into action, and the pawl which drives the barrel towards you has just been thrown into action. If the first row is not now in action, turn barrel till it is. The setting is now correct.

Put in the right pegs for the method and return it so that the first row is again in action. The barrel can be rotated towards you while screwing in

the pegs. Next, release the idle wheel and put on the correct gear wheel:—

25	for Doubles
30	Plain Minor and Stedman
35	Triples
40	Plain Major
60	Treble Bob Minor
80	Treble Bob Major

Care should be exercised while doing this not to disturb the 120 wheel. If it gets upset, the bar which operates the pawl should have just dropped and the pawl should be right down.

Move the idle wheel into mesh, and, for most methods, turn till the second row of pegs come into action. Then set the bells on rounds and go ahead.

Here are a few schedules; others can be made out by following the method employed in arranging for Double Norwich.

Method—	STEDMAN	BOB MAJOR	SUPERLATIVE	LONDON
Gear	30	40	80	80
1	246	357	357	357
2	146	1357	1357	146
3	246	246	147	1357
4	135	1357	1357	146
5	146	246	257	257
6	246	1357	1357	1357
7	146	246	136	357
8		1357	1357	1357
9		246	147	146
10			1357	257
11			257	1357
12			1357	257
13			136	136
14			1357	247
15			147	1357
16			1457	247
17			135	136
Bobs Key	7, 8	1, 2	1, 2	1, 2
Directly	4th	1st	1st	1st row comes on

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