



## Bells

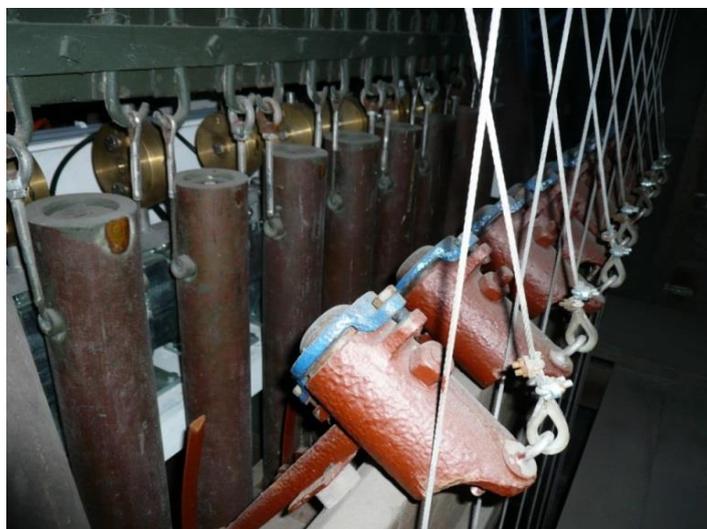
The original bells were made by the British firm of Harringtons and installed in 1887. As the church tower was not built for large bells, the then Prince of Wales (and future King Edward VII), husband of Danish Princess Alexandra, suggested tubular bells instead. The Prince and Princess of Wales both took a lively interest in the building of the church, and the Prince paid a large part of the cost of these bells himself.

In 2013, the present Prince of Wales contributed to the cost of augmenting the bells with seven extra Victorian bells to extend the range. These were also made by Harringtons and of a similar date. All the bells were completely renovated and new heads fitted to the strikers. These massive bronze tubes, weighing over 100 kg each, are the only such bells in Denmark. For 126 years the bells were operated manually by rope pulls on an Ellacombe Frame,<sup>i</sup> but as part of the renovation work in 2013 they were computerized. The bells chime quarters, strike the hour and play a different hymn tune on each hour.

The computer also operates an electric winch which automatically opens the louvres before the bells ring. The winch pulls four stainless steel cables, each of which pulls a bar that is connected to two upright posts, to each of which ten louvres are hinged. Thus each time the winch operates, it opens 80 louvres. In addition to limit switches and an overtravel cutout, each cable has a set of heavy springs so that if one or more sets of louvres are jammed (e.g. iced up), they will extend harmlessly and prevent the winch from causing damage. In winter the tower is internally floodlit as the louvres open for the chimes.

The top row of eight strikers strike the original eight bells from the opposite side to that struck by the original manual hammers (which can still be used). The lower set is for the seven new bells, which have been retuned to extend the original set of eight.

*The tops of the original eight bells with the mechanical strikers in full view and the new bronze strikers behind*



## Tuning the bells

The original bells were not exactly in tune with each other, so a mean figure was averaged from all eight bells and used as the target pitch for the new bells. As they are higher notes they are slightly smaller diameter, and the required length of each was calculated from the existing pitch adjusted by ratio of fractional pitch to fractional length, as calculated from adjacent note pairs (a non-linear relationship). Once the measurements and calculations had been checked, the tube was marked to an accuracy of about 1 mm and put in the power bandsaw. The wall thickness of the bells is about 20 mm of solid bronze, and each cut took about 75 minutes of continuous cutting. Each was then checked for tuning in case any adjustment to the calculation was needed for the next one, and stamped with its bell number.

There are 13 bells in the key of A flat (A flat to F) plus two D naturals. This allows the bells to be played in two different keys, and most melodies can be transposed to one or other to enable them to fit within the range of notes. The full range of notes is as follows (\*=new bell): A ♭ , B ♭ , C, D ♭ , D\*, E ♭ , F, G, A ♭ , B ♭ \*, C\*, D ♭ \*, D\*, E ♭ \*, F\*.

When played from a keyboard it is normal practice to transpose the range to the key of C, and when this is done the notes become C, D, E, F, F#, G, A, B, C, D, E, F, F#, G, A. This gives the best range of possible melodies because they can be transposed to either C or G depending on which will accommodate the compass. Also some tunes modulate to the adjacent key, and many of these can be obtained too, e.g. Crucifer (Lift high the cross), Winchester Old (While shepherds watched) and Melita (Eternal father, strong to save). In programming, care has to be taken to allow for the time taken for the same note to repeat (about 0.6 second for most notes but up to 0.9 second for the lowest).

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<sup>i</sup> A method for performing change ringing of church bells requiring only one person, where the bells are kept static and a hammer is struck against the inside of the bell. Each hammer is connected by a rope to a fixed frame in the bell-ringing room. The ropes are taut, and pulling one of the ropes towards the operator will strike the hammer against the bell.