# **Gravure Stamp Cylinders:** Part 1

**by Glenn H Morgan FRPSL**

Gravure has been used to print postage stamps for more than one-hundred years. The process, plus the historical and modern methods of making the printing cylinders, are explained, along with a report on the author's visit to British stamp cylinder manufacturer Saueressig, in this three-part article.

## The process

To set the scene it is important to first explain the basics of gravure (known in America as 'rotogravure', in France as 'héliogravure' and in Germany as 'rastertiefdruck').

At one time collectors only encountered stamps that employed a photographic process in manufacturing the cylinders, hence the frequently encountered term '*photo*gravure', but with the advent of electronically engraved cylinders there was a need to differentiate, as photography increasingly ceased to play a part in the stamp cylinder manufacturing process from the early 1990s.

The simpler, and more accurate term, 'gravure' is now used by the print industry, knowledgeable collectors and some stamp catalogue publishers to describe modern production. [Incidentally, Stanley Gibbons still uses the outdated and inaccurate abbreviated term 'Photo.' in its catalogue listings when recording the latest stamp issues.]

Photogravure was invented in 1890s Germany for commercial printing of periodicals, books and fine art reproductions and is a tonal process that enables gentle changes in the gradation of colour between solids and tints. It is essential that the artwork is created for the process in order to fully exploit the potential beauty of the method, therefore the design should possess a complete range of tones.


Fig 1 The Abram Games test stamp.

There is possibly no stamp-like design created specifically for photogravure reproduction that extols those tonal qualities better than the dummy stamp *(Fig 1)* produced by renowned graphic designer Abram Games in 1956 when preparing a course designed to teach students and artists employed by the Israel Post Office how to maximise the potential of the process.

With all forms of gravure, ink is held in microscopic cells that are recessed into the cylinder, so for this reason alone it works on a similar principle to intaglio, but lacks the raised imagery

and therefore much of its collector appeal. The fluid ink is applied to the surface of the cylinder and fills the cells, any excess ink is removed with a wiper known by printers as a 'doctor blade'[(Ref. 1)] and is then transferred from the cells to the substrate under pressure with the help of an impression roller.

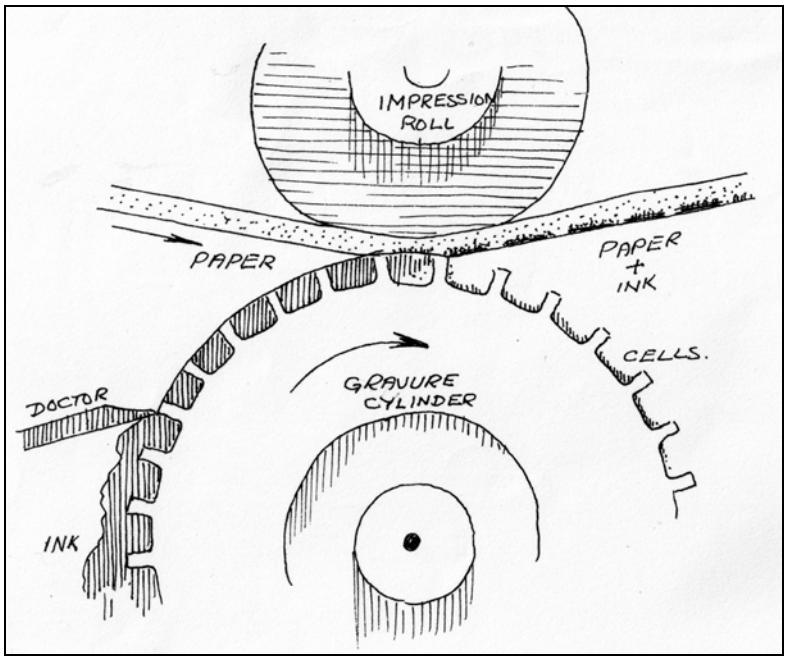


Fig 2 A view of printing stamps by gravure, taken from a Harrison philatelic wall chart.

Gravure printing is generally said to be best suited to print runs of more than ten million stamps, although opinions on the most appropriate minimum number do vary between stamp printers. The process offers greatly increased security because, unlike the modern offset process, gravure production requires much higher manufacturing and pre-production set-up costs which deters counterfeiters. That said, its success results from the simplicity of the procedure *(Fig 2),* for having fewer variables to control printers can ensure consistent print quality across an entire production run.

Although sheet-fed gravure is achievable, it is more normally web-fed printing (i.e. from reels of paper) that is utilised and while flat or curved plates can be used, it is invariably cylinders that are chosen. These choices are made because reels of paper and cylinders are best suited to lengthy, non-stop print runs.

# Early photogravure stamps

The photogravure process was first used for stamp production by German printer F A Bruckmann of Munich during 1914 on an issue for Bavaria that to this day is regarded as an excellent use of the method. Cylinders had been used for that initial production run[(Ref. 2)] and an example *(Fig 3)* is held in the Museum of Communication (www.mfk-nuernberg.de) in Nuremberg, Germany.

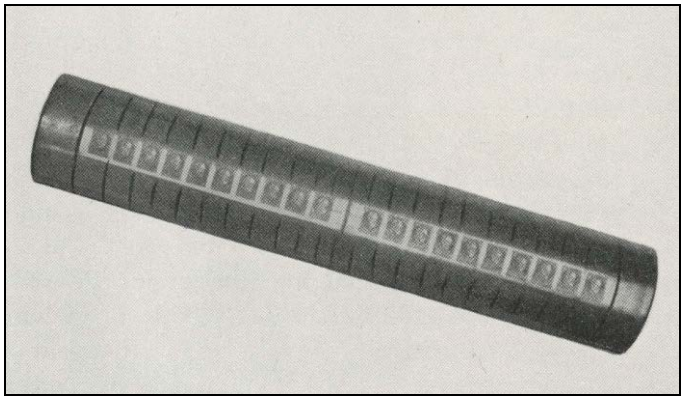

Fig 3 A cylinder used for the 1914 Bavarian first photogravure series.


Fig 4 An imperforate stamp for Bavaria from the 1914 series.

The Bavarian stamps *(Fig 4)* were clearly seen as an important development and it was not long before Mexico (1917), GB (Waterlow 1918 War Tax stamps, Harrison 1921 6d National Savings stamps), Czechoslovakia (1919), Bulgaria and Württemberg (1920) had each followed Germany's lead, with many more countries later taking the photogravure route.


Fig 5 A proof of the Egyptian stamp by Harrison in 1923.

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The first photogravure *postage* stamps printed in Britain were by Harrison and depicted King Fuad's portrait on a 1923 Egyptian issue *(Fig 5).* Use of this process is said to have come about by accident, when intaglio proofs were not ready in time and photogravure versions were substituted for speed and were favoured in Cairo. This is an oft-repeated explanation, but whether it is grounded in truth is uncertain.


Fig 6 A Harrison dummy stamp from the NRM cylinder production trials.

Assistance with the printing of the Egyptian stamps was sought by Harrison from the experienced Dutch company Nederlandse Rotogravure Maatschappij (NRM) in Leiden, who also helped train Harrison staff in the skills required for mass production and, more importantly in relation to this article, the creation of photogravure stamp cylinders. A range of around a dozen dummy stamp designs were printed as a part of this training exercise, of which an example *(Fig 6)* is shown here.

The Egyptian and subsequent orders from other countries paved the way for Harrison to win major contracts to print British stamps by both photogravure and gravure between 1934 and 1997.

# Cylinder creation

With its major influence on all aspects of British stamp production for so many decades, the story of how Harrison created its cylinders is described here. The black and white photography in this section was taken by Harrison, circa1967, when working on the Machin definitive series and first appeared in its brochure *Harrison & Sons Limited, postage stamps / photogravure.*

The reproduction and repetition of the chosen stamp design in the form of a printing cylinder was, in theory, a matter of routine photography and etching, though in practice a great deal of highly skilled control was necessary during the various stages. The description of the process has, in large part, been explained here using an internal document created by Harrison in 1945

for the New Zealand postal authorities. The process continued to be applied virtually unchanged until the eventual demise of the photographic method.

## The master negative

Fig 7 Photographing the original artwork.

Fig 8 Checking the master negative against the original artwork.

The approved designs would have been created by the stamp designer at four times intended stamp size ('four-up') and would be improved for printing purposes by the team of process artists at Harrison, if needed. The artwork was then photographed *(Fig 7)* at twice intended stamp size through coloured filters that would separate each colour required. Ten timed exposures of each 'two-up' negative would then be printed and the best result noted for each colour. From this, a master glass (or subsequently film) negative *(Fig 8)* for each intended stamp colour was produced.

## Colours and gear designations

Note that at this time in stamp production history, the 'four colour process' (or CMYK, standing for Cyan, Magenta, Yellow and Key (printing terminology for black)) was not in use on stamps from Harrison. Instead, inks were individually mixed, with more than four colours, and therefore more than four cylinders, frequently being required.

Incidentally, it was as early as 1906 that the four-colour wet process inks were used for the first time by the print industry after it was discovered that these CMYK colours could be combined to produce an almost unlimited number of richer, darker tones. Stamp printers generally lagged behind in adopting this important cost and speed saving development.


Fig 9 Harrison 3d 1965 Salvation Army five-colour commemorative with marginal markings defining what colour ink each cylinder should be printed from, together with its gear designations.

'Gear designations' *(Fig 9)* can be found on reel-fed printings (in many instances they were either partially or completely trimmed off the counter sheets) and acted as guides for the mounting of a cylinder onto a print unit and had two functions:

1. **Orientation** - how the cylinder was to be mounted - the 'G' refers to the 'Gear Side' of the print unit. (Spindles to this day are the same on both sides, so a cylinder could inadvertently be inserted the wrong way round in relation to other cylinders, causing an inverted print of that colour.)
2. **The print unit sequence** - 'G1' the first print unit, 'G2' the second unit and so on indicating the sequence by which each colour was to be printed.

Named colours do not always correspond to the actual colour printed; gear sequence numbers are not always present, just the letter 'G' for each colour used.

**Essaying** During the development phase, essays would be produced on plates and printed on a proofing press. These may have been just a single image output or a number of images. Any number of these may have been produced as this would have largely depended on the subject and development effort involved.

**Multi-positives** Each master negative was placed into one of three Harrison 'step and repeat' cameras *(Fig 10)* and the image projected onto a large glass sensitised photographic plate.

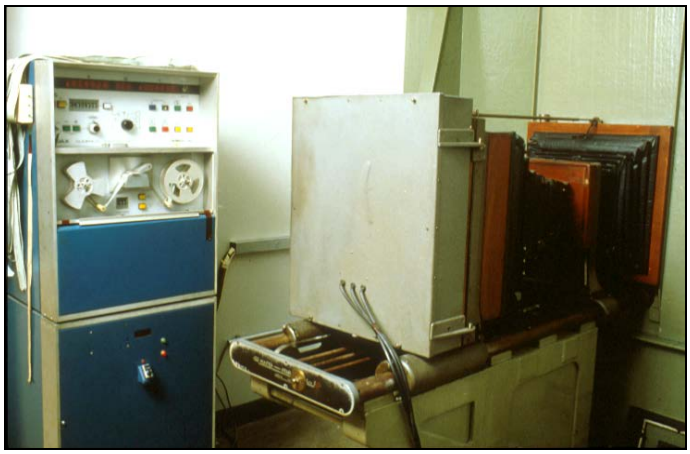

Fig 10 A 'step and repeat' camera showing a paper tape system for positioning each image correctly. Harrison, c1973.

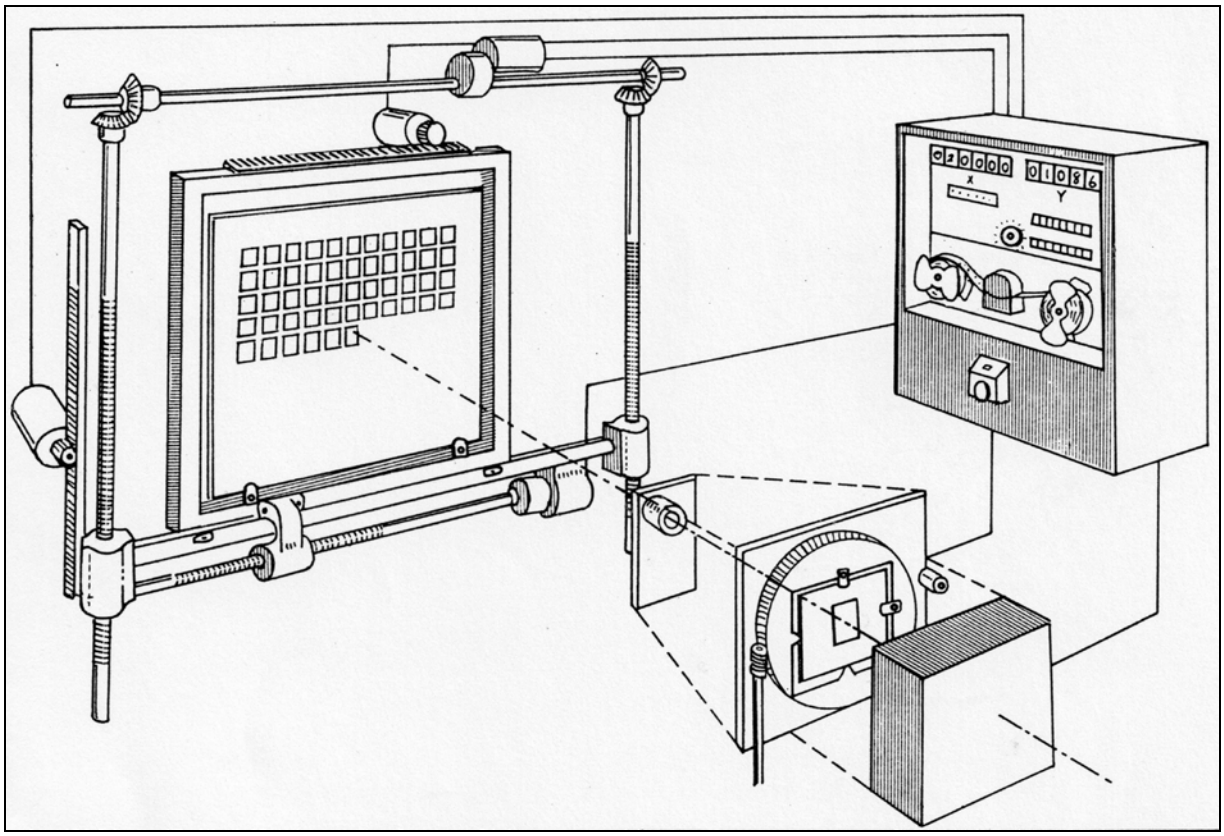

Fig 11 The principles of a 'step and repeat' camera system. Harrison, c1973.

After suitable exposure of the first stamp at its intended size, an elaborate piece of machinery, *(Fig 11)* precisely linked to the timing of the camera shutter, moved the glass plate by gearing of extreme accuracy into position for the next exposure.

Prior to 1973, the gears and cogs meant that it was slightly erratic and was the source of Machin 'floating values'. From 1973, the step and repeat cameras were computer-assisted and

this brought about significant improvements in precision and virtually, if not altogether, eliminated the inaccuracies.

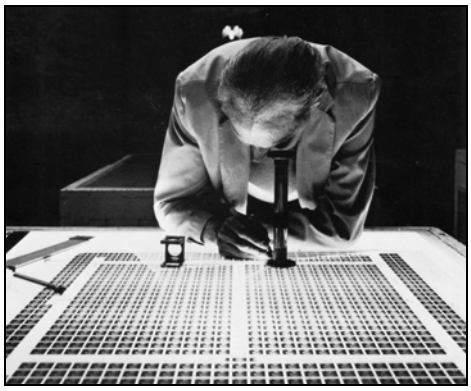

Fig 12 Inspecting the multi-positive. Note the 'spare' Machin stamps beyond the sheet margins, indicating that far more exposures than required had been made.

Eventually, sufficient exposures onto the multi-positive had been captured. Records held at The Postal Museum (formerly BPMA) show, in the case of definitives, that the norm was for the size of the multi-positive to contain many more images than that required for the standard primary sheet laydown, as seen in *(Fig 12)*. Therefore the expected multi-positive image sheet sizes of 480/240 (pre-decimal Machin) or 400/200 (decimal Machin) would have been the exception rather than the rule, with a staggering 1,073 images recorded on one multi-positive.

With the move into the decimal period, the multi-positive creation / usage technique changed. Wilding and pre-decimal Machin definitives had the head and value tablet combined for the master negative to create a single multi-positive. However, for the decimal period, a head multi-positive was created and then value tablet multi-negatives. Thus, any given value tablet multi-negatives would be over-laid onto a common head multi-positive. The records seem to suggest these value tablet multi-negatives were more likely to be primary sheet* sized (400/200 images).

** A primary sheet was created by selecting a portion of the multi-positive and masking out unwanted images - this methodology meant that 'no dot' and 'dot' panes were perfectly synchronised across the extent of the imaged area. These two adjacent panes with central gutter are clearly seen in* (Fig 12).

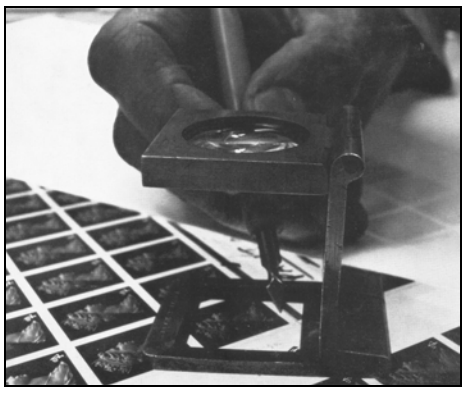

Fig 13 Adding register marks to the multi-positive.

The multi-positive, when developed, fixed and checked was next taken to the planning room where certain other details were added *(Fig 13)*, such as a cylinder number, imprint and registration markings.

**The base cylinder** Harrison engineers created the base cylinders on-site at High Wycombe. Made of steel, they were coated with copper by a chemical electrolyte process in a bath of copper sulphate and after finishing had a perfectly true and polished surface. Collectors over the years have recorded that the cylinders were made of solid copper; they were not.

When printing long runs of, say, first and second class values, Harrison would sometimes prepare a back-up set of cylinders so that if an unexpected replacement of a cylinder was required it did not mean that the press ground to a halt while a new image carrier was prepared.

An expensive resource, cylinders would be recycled at the end of a print-run (unless a reprint was likely in which case it would be stored). When not required again, the old images would be ground off and a fresh layer of copper would be deposited ready for the next stamp issue.

**Carbon tissue** Carbon tissue was a temporary support sheet comprising a water-sensitive fibrous paper coated with a perfectly true and smooth gelatine resist surface. It was sensitised by immersion in a solution of bichromate of potash and contained an orange dye to assist when viewing the screening and multi-positive imagery.

**Screening** Before the stamp images were transferred to the cylinder, a glass plate with a surface of opaque squares enclosed by transparent lines was printed onto the tissue. The point of the screen was to break-up the overall design on the printing surface (for our purposes the press-sheet of stamps), into small cells that would hold ink between walls corresponding to the transparent lines on the screen.

At some point, and without warning, carbon tissue was no longer able to be purchased and cylinder production was therefore put at risk. Fortunately, a replacement product from Autotype known by the brand name of 'Autofilm' was sourced. Despite some collector assertions that this was supplied pre-screened at, say, 250 screen lines to the inch, this has recently been refuted by two ex-Process Managers from Harrison.

**Exposing the carbon tissue** This was a two-stage operation. Firstly, the tissue for one of the colours was placed behind the screen in a special frame in which close contact was obtained by suction, and the frame was exposed to strong arc lamps for a given time. Where light penetrated the transparent screen lines, the gelatine was rendered hard and insoluble. (This property of the sensitised gelatine was key to the whole process.)

The same piece of tissue (with its newly applied screening) was then exposed again, this time behind, say, the '480-set positive' (i.e. the press-sheet of stamp designs, or multi-positive). This hardened the gelatine in the parts corresponding to the lightest portions of the stamps and the gutters between the stamps, which were transparent in the positive. In the dark portions of the stamps the light did not reach the gelatine, which was therefore unaffected. In the mid-tones, the gelatine was only partially hardened.

This piece of carbon tissue now had both a screening and the multiple stamp design on it and so was therefore ready to be transferred to the printing cylinder. The process was repeated for each additional colour to be used on the stamp.

**Carbon tissue to printing cylinder** The next stage was to use the gelatine as a 'resist' to control the etching of the printing surface.

Fig 14 Laying the carbon tissue onto a polished copper cylinder .

The carbon tissue 'skin' was pressed into close contact with the copper-covered cylinder, a spray of water being directed to the point of contact, as seen at far left of *(Fig 14).* After the tissue had been correctly mounted, it was ready for development.

The tissue backing was soaked off from the revolving cylinder with hot water, along with any unhardened gelatine, which got washed away. This left a raised pattern in gelatine on the copper corresponding to:

(a) the whole of the transparent lines in the screen pattern, and also the gutters between the stamps, plus

(b) the light portions of the design, the thickness of the gelatine being proportionate to the lightness of the tone.

The process would take around 15 to 20 minutes and when completed the cylinder was sprayed with very cold water and dried by an electric fan.

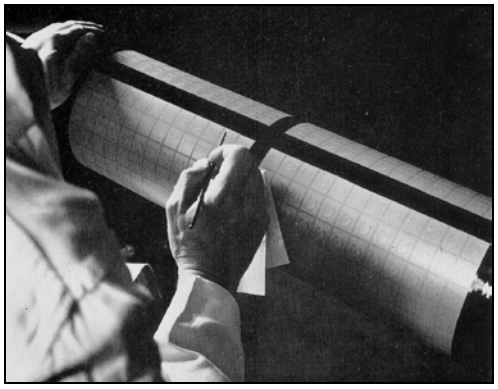

Fig 15 Painting over areas not to be etched at Harrison, early 1960s.

Margins and other areas of the cylinder not required to be etched would then be carefully painted over *(Fig 15)* with an acid-resisting varnish prior to etching.

**Etching** The cylinder was revolved in a trough containing ferric chloride ($FeCl_3$), also called iron perchloride and iron trichloride, which bit into the copper where it was not protected by the gelatine 'resist'.

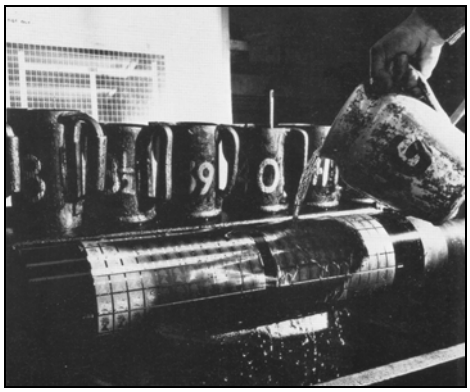

Fig 16 Preparing a gravure cylinder by hand etching with varying strengths of acid .

The control of this operation called for much skill and experience, and as many as seven different strengths of solution, seen in *(Fig 16)*, might be used for bringing out tones of different depths enabling the gradual transition from one colour hue to another, from one shade to another, or one texture to another. There was no suitable ready-made solution available and the skilled craftsmen used their judgement based on years of experience as to what strengths to use.

When etching was deemed complete, the acid-resisting varnish and the gelatine 'resist' was washed off in warm water, which dissolved the unhardened (non-image) areas and left the required images to print from. The cylinder was then given a final polish.

There is an interesting eccentricity with carbon tissue and the use of acids that flies in the face of expected results, as explained by stamp and banknote engraver Chris Matthews: *"The more aqueous solution* (i.e. the water used in the dilution of the acid) *that is applied to the carbon tissue, the more the carbon tissue would 'open up', causing the acid to etch the image to a far*

*greater extent. So, somewhat counter intuitively, the weaker the acid solution, the greater it would etch, while the stronger the acid, the less it would etch the cylinder."*

**Proofing** The next procedure was to print proofs to check for defects, which would be circled in ink or pencil on the sheets. It was then possible for experts to manually amend the cell structure to correct these odd imperfections (what collectors call flaws or varieties) that may have been present, a process seen underway on the dummy stamp depicted in *(Fig 17).*


Fig 17 Manual amendment of a photogravure cylinder. Harrison, early 1960s.

After correcting, further proofs were pulled from the cylinders until they were deemed accurate.

It is interesting to note that the proofs were all printed using the *unchromed* copper cylinders, much like an intaglio engraver pulls proofs of his unhardened die - fine for a few impressions, but not suitable for a production run, due to likely wear and tear and risk of damage.

**Chroming** Before the cylinder could be used for a print run, 6 to 8 microns of chromium would have been deposited via an electro-plating method. It would not have affected the etched cells *(Fig 18)* to any significant degree, although the shallower the depth of a cell, the greater percentage the chromium represented.

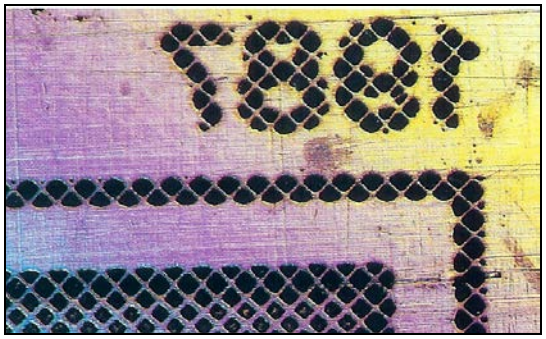

Fig 18 Macro image of cells before the era of electronic engraving. This example is for one of Royal Mail's 1987 *Studio Pottery* stamps.

Cells have always been deemed to be the most important part of the gravure process. The quality of the printed image depends to a great extent on the cell structure.

Hard chromium plating baths were first introduced commercially in 1930 to provide a tougher surface for printing cylinders by avoiding tarnishing and wear by friction between the paper and the cylinder, thus prolonging their life and saving costs.

Thanks to its tough metal qualities and fine grain structure the introduction of chromium, which has not been bettered to this day and is still used to protect electronically engraved cylinders, enabled clearer, sharper detail across the entire print run. From the first through to the last stamp sheet printed, impressions were not subjected to a slow deterioration the further you got into the production run.

**Re-chroming** At set intervals, the cylinders would be checked and, where required, some 'stripping and refacing' would be undertaken, i.e. the surface would be removed by de-chroming and then would be re-chromed. Rarely on stamp products would the cylinder be left on press until wear was detected. It should be borne in mind that the act of re-chroming to this day carries a penalty in that some degradation to the print quality can occur by the use of this procedure.

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Once all of the complex preparation work described above had been completed, the cylinder would be mounted on the press and the printing stage would commence, but this is beyond the scope of this article.

# What might have been

A method that could have been very influential in the creation of stamp cylinders never came about following initial trials in 1980 at Harrison. This was known as the 'Lasergravure System 700' and was developed by Crosfield Electronics Ltd.

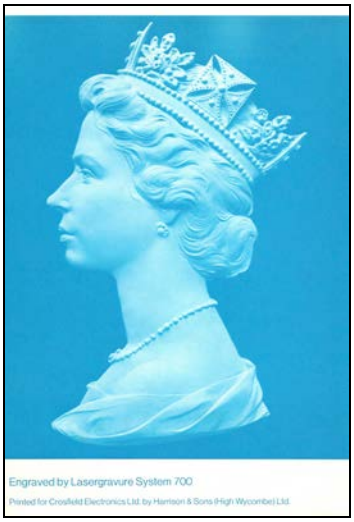


Fig 19 The A4 Machin Head trial from Crosfield and Harrison, 1980.
13 sheets survive, of which only eight are undamaged.

Fig 20 Close-up of part of the large Machin head design.

Unusually, the screen comprised horizontal lines rather than dots and the printing cylinders, which were plastic coated, could be engraved by laser. This was seen as a means of providing gravure printers with a less labour intensive process for creating cylinders and one which would no longer require the use of acids in use at that time for the production process.

A letter from Aubrey Walker of the Post Office Procurement Executive to K Scrimgeour of Harrison dated 30 October 1980 comments on the 'Giant Machin Heads' *(Figs 19* and *20)* produced during the trials. Walker said: *"I can see how the definition could be improved to meet required standards"* and proposed that stamp-sized examples should be produced and that *"if this is successful, PHQ* (postal headquarters) *will select the original artwork of two Special Issue stamps previously printed by Harrison and these can be Lasergravure printed for direct comparison with the photogravure versions."*

It appears that the stamp-sized Machin head stamps mentioned were never produced and the project eventually died without further proofing exercises, in part due to the plastic cylinders easily scratching and therefore regularly printing defective trial stamps.

# References

**1)** The phrase 'doctor blade' (sometimes expressed as 'Dr Blade') is believed to be derived from the name of a blade used in conjunction with ductor rolls on letterpress presses. The term 'ductor blade' eventually mutated into 'doctor blade'. It therefore has no association with the medical profession.

**2)** See page 60 of *History of Industrial Gravure Printing up to 1920* for the description of the 7½ pfennig cylinder used for the Bavarian 1914 printing. It is described as being 21" long with a circumference of 12½ inches. The cylinder was laid-out to print two panes of 100 stamps and was printed by F. Bruckmann KG in Munich on a reel fed press supplied by John Wood of Ramsbottom, England, that had been installed in 1904.

*Next time: Glenn describes modern electronic engraving methods along with a report on his visit to Saueressig, where gravure cylinders are made for the British stamp printing operations of De La Rue plc and International Security Printers Ltd.*

(3,850 words)