July 14, 1953 S. T. GROSS 2,645,720

X-RAY DIFFRACTION DEVICE

Filed Dec. 13, 1950

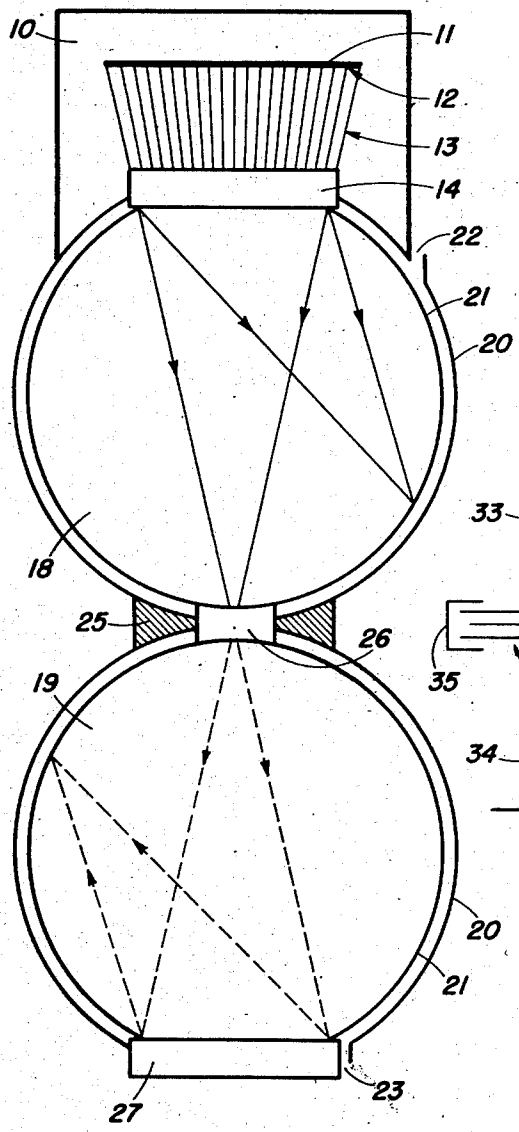
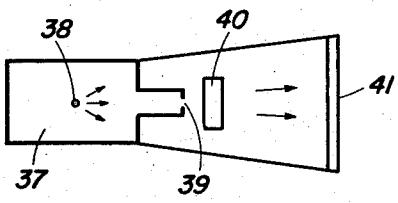


Fig. 1.

Fig. 3.



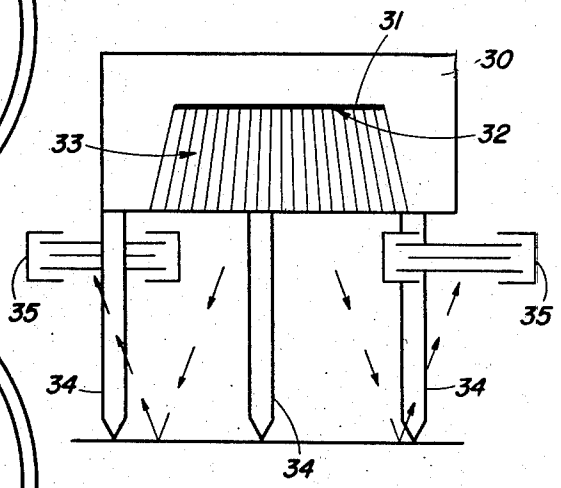


Fig. 2.

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Patented July 14, 1953 2,645,720

UNITED STATES PATENT OFFICE

2,645,720

X-RAY DIFFRACTION DEVICE

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Application December 13, 1950, Serial No. 200,640

2 Claims. (Cl. 250—53)

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The present invention relates to an improved X-ray diffraction device.

The industrial and research uses of X-ray diffraction methods are well known; such methods can be readily used, for example, in identifying and quantitatively analyzing for crystalline materials, for the measurement of particle sizes in the colloidal and sub-colloidal range, for the orientation of crystals (i. e., in the manufacture of quartz plates for electronic oscillators), to measure orientation in fibers, in the study of detergent and soap solutions, surface films, and to obtain information regarding the detailed structure of matter.

Previous diffraction equipment is not only very expensive but subject to certain deficiencies. The X-ray source is a tube with a copper or other target which is guaranteed for only sixty hours, although it may last much longer. The equipment requires a high voltage source, as for example, about 50,000 volts, and a filament source. Variations in the voltage source may vary the results obtained, even during a short period of time.

It is an object of the present invention to provide an improved X-ray diffraction device.

It is a further object of the present invention to provide an improved X-ray diffraction device not requiring the use of an X-ray tube.

These and other objects are attained by the present invention which is directed to a device comprising a camera or the like, a radioactive isotope X-ray source and preferably means for focusing the X-rays.

The X-ray source for the device of the present invention is an artificially radioactive isotope. For example, radioactive iron 55 is unstable in such a manner that it captures one of its K electrons changing to manganese. The vacated K orbit is immediately filled by an outer electron, and thus the atom emits the characteristic K X-ray spectrum for manganese. About a millicurie of iron 55 yields sufficient intensities suitable for making diffraction patterns. In a similar manner, radioactive zinc which yields the X-ray spectrum for copper may be used as well as antimony and others. Depending upon the purity of the material, more or less lead shielding may be required for the device.

The radioactive isotopes may be arranged in any of a number of shapes as an X-ray source, such as on a fine wire to simulate a slit, on a point to represent a point source, as a ring source, etc. The fine straight wire is preferable since it permits the camera equipment to use but a single slit and be brought much closer to the

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source than is possible with previous conventional equipment. The half life of iron 55 is about five years, and thus within any short space of time very consistent results are obtainable.

The source can be encased in a suitable shielded container equipped with means to support the diffraction equipment, and equipped with safety doors to make the equipment completely safe. With iron 55 the shielding of metal can be quite thin since the radiation obtained is quite long in wavelength, approximately 2 A. U. (2×10^{-8} cm.).

Preferred embodiments of the invention are shown in the drawings, wherein:

Figure 1 is a diagrammatic view of a camera according to the present invention,

Figure 2 is a diagrammatic view of an alternative device particularly adaptable for detecting strain in boilers, and

Figure 3 is an alternative device to the one illustrated in Figure 1.

In Figure 1 there is disclosed the preferred embodiment of the invention which is a camera having a suitable housing 10 wherein there is suspended a metal plate 11, the surface 12 of which has a radioactive material plated on. Adjacent to the surface of the plate is a focusing Soller slit 13 which is made up of a number of thin shims. Only a few shims are indicated, whereas in the device itself a considerably larger number of shims are used. Sample holding means 14 is arranged in front of the slit and contains a sample such as a screen coated with a powdered sample of the material being tested. The body of the camera is divided into two principal areas 18 and 19. In each area there is an outer wall 20 and an inner wall 21 forming a film holder. Openings 22 and 23 are adapted to allow film to be placed in these film holders surrounding areas 18 and 19. A beam stop 25 surrounds an aperture 26 separating areas 18 and 19 causing a focus of the X-rays. A second sample holding means 27 is located at the opposite end of area 19 from aperture 26 and is adapted to contain a sample whose back reflection is to be measured. It will be understood that the sample holding means 14 and 27 will be used alternatively, depending upon whether a transmission or back reflection of the sample is desired. For transmission the solid lines show how the focus occurs, and for back reflection the dash lines indicate the behavior of diffracted radiation.

With reference to Figure 2, there is illustrated diagrammatically a camera which is particular-

ly adaptable for detecting flaws in boilers or tank walls, having a suitable housing **30** wherein there is suspended a metal plate **31**, the surface **32** of which has a radioactive material plated on. Adjacent to the surface of the plate is a focusing Soller slit **33** which is made up of a number of thin shims. Attached to housing **30** are a plurality of legs **34**, **34** adapted to be held against the surface whose diffraction is to be measured, such as a boiler wall. The legs **34** support film holding means **35** which may comprise merely a pack of X-ray film clamped to the leg. It will be seen that the Soller slits in this case are arranged in the opposite manner from those in Figure 1, since this device is intended for back reflection measurements.

With reference to Figure 3, there is illustrated an alternative camera device comprising a housing **37**, a fine straight wire **38** coated with radioactive isotope, and a slit **39** adapted to coincide with the elongation of the wire. In front of the slit is a sample holder **40** adapted to contain a sample, as for instance a powder distributed on a thin screen. Beyond the sample holder is a film holding means **41** which may be flat or semi-circular.

It will be understood that in place of the film in these cameras a Geiger counter may be used. For example, in the device of Figure 1 a Geiger counter can be moved around the circular confining areas **18** and **19**. Where the intensity of the radiation is sufficient a fluorescent screen and photocell may be used in place of the film.

Other modifications of the device will occur to those skilled in the art. For example, a device may be made somewhat similar to that shown in Figure 3 wherein a radioactive isotope coated on a straight wire may be used with focusing means to direct the rays to a sample, but the film may be arranged around the focusing means so as to measure back reflections rather than transmitted rays, as in Figure 3. The radioactive isotope is preferably plated on the same kind of metal from which the isotope was derived, and it may be desired to have the camera parts exposed to the rays of the same material.

Radiation from radioactive isotope means as illustrated has a great advantage over that obtained with conventional equipment in that it is a mixture of four monochromatic wavelengths with perhaps 95% of the energy in one of the wavelengths.

The casing of the diffraction device may be built of any suitable material, such as steel. However, steel should not be used where copper radiation is present. The entire device may be shielded with lead, and the amount of this shielding may be determined by the impurity of the isotope. The shims of the Soller slit may be made out of any of a number of materials including mica.

It will be understood that preferred forms of the invention are illustrated and that variations and modifications may be made within the scope of the claims.

I claim:

1. A diffraction device comprising a housing, a plate within said housing coated with a radioactive isotope as the source of characteristic radiation, a Soller slit adjacent to said plate, means for holding a sample at the opposite end of said slit from said plate, a photographic film holding means arranged as a semi-circle about said sample holding means at the opposite side from said plate, an aperture in said film holding means directly opposite said sample holding means, and a second sample holding means and a second film holding means adapted to surround the area between said aperture and said second sample holding means.

2. A diffraction device comprising a housing, a plate within said housing coated with a radioactive isotope of iron 55 as the source of characteristic radiation, a Soller slit adjacent to said plate, means for holding a sample at the opposite end of said slit from said plate, a photographic film holding means arranged as a semi-circle about said sample holding means at the opposite side from said plate, an aperture in said film holding means directly opposite said sample holding means, and a second sample holding means and a second film holding means adapted to surround the area between said aperture and said second sample holding means.

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