### CPC - COOPERATIVE PATENT CLASSIFICATION

**G** PHYSICS

*(NOTES omitted)*

**INSTRUMENTS**

**G03** PHOTOGRAPHY; CINEMATOGRAPHY; ELECTROGRAPHY; HOLOGRAPHY *(reproduction of pictures or patterns by scanning and converting into electrical signals H04N)*

**G03H** HOLOGRAPHIC PROCESSES OR APPARATUS *(holograms, e.g. point holograms, used as ordinary optical elements G02B 5/32; producing stereoscopic or other three-dimensional effects G02B 27/22; diffraction-grating systems G02B 27/44; systems using moiré fringes G02B 27/60; optical logic elements G02F 3/00; stereo-photography G03B 35/00; photosensitive materials or processes for photographic purposes G03C; [stereo-photographic or similar processes G03C 9/00]; apparatus for processing exposed photographic materials G03D; analogue computers performing mathematical operations with the aid of optical elements G06E 3/00; authentication by radiation, of concealed information carried by holograms or diffraction gratings G06K 19/16; holographic storage G11B 7/0065, G11C 13/04; [stereoscopic or other three-dimensional effects in television systems H04N 13/00]*)

**NOTE**

This subclass covers means for producing a record of the phase and amplitude information of a wave-front, which information can be used to reconstruct the original wave-front, or means to reconstruct the original wave-front from a record containing the phase and amplitude information of the wave-front.

**WARNING**

In this subclass non-limiting references (in the sense of paragraph 39 of the Guide to the IPC) may still be displayed in the scheme.

<table>
<thead>
<tr>
<th>1/00</th>
<th>Holographic processes or apparatus using light, infra-red or ultra-violet waves for obtaining holograms or for obtaining an image from them; Details peculiar thereto</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/0005</td>
<td>Cooperative holograms using holographic element 5/32; recognition using holographic memory G11B 7/0065, G11C 13/042</td>
</tr>
<tr>
<td>1/0011</td>
<td>(for security or authentication (holograms on information-bearing cards B42D 25/328; testing papers with holograms G07D 7/0032))</td>
</tr>
<tr>
<td>2001/0016</td>
<td>(Covert holograms or hol objects requiring additional knowledge to be perceived, e.g. hologram reconstructed only under IR illumination (microholograms G03H 2230/10))</td>
</tr>
<tr>
<td>2001/0022</td>
<td>(Deciphering being performed with numerical or optical key, e.g. with the optical scrambler used during recording (optical element in object beam G03H 1/041))</td>
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<tr>
<td>2001/0027</td>
<td>(Being copy-protected against fraudulent replication, e.g. by layering a filter rejecting laser lines)</td>
</tr>
<tr>
<td>2001/0033</td>
<td>(in hologrammetry for measuring or analysing)</td>
</tr>
<tr>
<td>2001/0038</td>
<td>(analogue or digital hol objects (holographic interferometry G01B 9/021; investigating particles G01N 15/0227))</td>
</tr>
</tbody>
</table>

| 2001/0044 | . . . [holographic fringes deformations; holographic sensors (holographic rain sensor in vehicles B60S 1/084)] |
| 2001/005 | . . . [in microscopy, e.g. digital holographic microscope [DHM] (microscopes G02B 21/00; digital holography G03H 1/0866)] |
| 2001/0055 | . . . [in advertising or decorative art] |
| 2001/0061 | . . . [in haptic applications when the observer interacts with the hol object] |
| 2001/0066 | . . . [for wavefront matching wherein the hologram is arranged to convert a predetermined wavefront into a comprehensive wave, e.g. associative memory (recognition using holographic masks G06K 9/76)] |
| 2001/0072 | . . . [for wavefront conjugation wherein the hologram generates a wavefront conjugating a predetermined object, e.g. null testing, positioning, comparative holography] |
| 2001/0077 | . . . [for optical manipulation, e.g. holographic optical tweezers [HOT]] |
| 2001/0083 | . . . [for restoring distorted objects, e.g. restoring objects through scattering media] |
| 2001/0088 | . . . [for video-holography, i.e. integrating hologram acquisition, transmission and display] |
| 2001/0094 | . . . [for patterning or machining using the hol object as input light distribution (microlithography G03F 7/0283)] |
Processes or apparatus for producing holograms (G03H 1/02)

Details (of features involved during the holographic process; Replication of holograms without interference recording)

- (Object characteristics (corresponding details, see subgroups of G03H 2210/00))

- (Individual components other than the hologram)

- (Light sources or light beam properties (G03H 1/06, G03H 1/24 take precedence; corresponding details, see subgroups of G03H 2220/00))

- (Optical components (G03H 2001/0224, G03H 1/0256 take precedence; corresponding details, see subgroups of G03H 2223/00))

- (Writing means other than actinic light wave (corresponding details, see subgroups of G03H 2224/00))

- (Active addressable light modulator, i.e. Spatial Light Modulator [SLM] (corresponding details, see subgroups of G03H 2225/00))

- (Electro-optic or electronic components relating to digital holography (G03H 2001/0224 takes precedence; corresponding details, see subgroups of G03H 2226/00))

- (Mechanical components or mechanical aspects not otherwise provided for (corresponding details, see subgroups of G03H 2227/00))

- (Form or shape of the hologram when not registered to the substrate, e.g. trimming the hologram to alphanumerical shape (substrates bearing a hologram G03H 1/0272))

- (Hologram nature or properties)

- (Surface relief holograms (replicating hologram without interference recording G03H 1/0276))

- (Volume holograms)

- (Laminate comprising a hologram layer)

- (having specific functional layer)

- (Recording materials or recording processes (G03H 2226/11 takes precedence; corresponding details, see subgroups of G03H 2260/00))

- (Organic recording material)

- (Inorganic recording material, e.g. photorefractive crystal [PRC])

- (Substrate bearing the hologram)

- (Replicating a master hologram without interference recording (surface relief holograms G03H 1/0244))

- by embossing

- by moulding

- by electroforming

- by masking

- Formation of the master hologram

- Processes or apparatus for producing holograms (G03H 1/26 takes precedence)

- Recording geometries or arrangements (G03H 1/0443, G03H 1/0476, G03H 1/16 take precedence)

- (In-line recording arrangement)

- (Image plane or focused image holograms, i.e. an image of the object or holobject is formed on, in or across the recording plane)

- Total internal reflection [TIR] holograms, e.g. edge lit or substrate mode holograms

- Optical element in the object space affecting the object beam, not otherwise provided for

- (for recording transmission holograms)

- (for recording reflection holograms)

- (for recording single beam Lippmann hologram wherein the object is illuminated by reference beam passing through the recording material)

- (for recording combined transmission and reflection holograms)

- (Parallax aspect)

- (Restricted parallax, e.g. horizontal parallax only holograms [HPO])

- (Extended parallax, e.g. panoramic or 360deg. holograms)

- Image holography, i.e. an image of the object or holobject is recorded (G03H 1/0406 takes precedence; holographic microscope G03H 2001/005)

- (Non planar recording surface, e.g. curved surface)

- (Constrained record wherein, during exposure, the recording means undergoes constrains substantially differing from those expected at reconstruction)

- (In situ recording when the hologram is recorded within the device used for reconstruction)

- (Holographic camera (portable device G03H 2227/02))

- (for recording Holographic Optical Element [HOE] (HOE per se G02B 5/32))

- (Formation of interference pattern, not otherwise provided for)

- (Digital holography, i.e. recording holograms with digital recording means (holobject computation G03H 1/0866))

- (Off-axis recording arrangement (G03H 2001/0456 takes precedence))

- (In-line recording arrangement)

- (Fourier or lensless Fourier arrangement)

- (arranged to record an image of the object (holographic microscope G03H 2001/005))

- (Arrangement for recovering hologram complex amplitude)

- (Spatial heterodyne, i.e. filtering a Fourier transform of the off-axis record)

- (Temporal or spatial phase shifting, e.g. parallel phase shifting method)

- (Synthetic aperture)

- (Frequency heterodyne, i.e. one beam is frequency shifted)

- (Particular recording light: Beam shape or geometry (G03H 1/06 takes precedence))

- (Gated recording using pulsed or low coherence light source, e.g. light in flight, first arriving light)

- (Object light being reflected by the object)

- (Object light being transmitted through the object, e.g. illumination through living cells)

- (Particular illumination angle between object or reference beams and hologram)
G03H

1/0476 . . . (Holographic printer (G03H 1/268 takes precedence))

2001/0478 . . . [Serial printer, i.e. point oriented processing]

2001/048 . . . [Parallel printer, i.e. a fringe pattern is reproduced]

2001/0482 . . . [Interference based printer]

2001/0484 . . . [Arranged to produce three-dimensional fringe pattern]

1/0486 . . . [Improving or monitoring the quality of the record, e.g. by compensating distortions, aberrations]

2001/0489 . . . [by using phase stabilized beam]

2001/0491 . . . [by monitoring the hologram formation, e.g. via a feed-back loop]

1/0493 . . . [Special holograms not otherwise provided for, e.g. conoscopic, referenceless holography]

2001/0495 . . . [Polarisation preserving holography where amplitude, phase and polarisation state of the original object wavefront are recorded]

2001/0497 . . . [Dot matrix holograms]

1/06 . . . using incoherent light

1/08 . . . Synthesising holograms, i.e. holograms synthesized from objects or objects from holograms (using electric digital computers G06F, G06T)

1/0808 . . . [Methods of numerical synthesis, e.g. coherent ray tracing [CRT], diffraction specific]

2001/0816 . . . [Iterative algorithms]

2001/0825 . . . [Numerical processing in hologram space, e.g. combination of the CGH [computer generated hologram] with a numerical optical element]

2001/0833 . . . [Look up table]

1/0841 . . . [Encoding method mapping the synthesized field into a restricted set of values representative of the modulator parameters, e.g. detour phase coding]

2001/085 . . . [Kinoform, i.e. phase only encoding wherein the computed field is processed into a distribution of phase differences]

2001/0858 . . . [Cell encoding wherein each computed values is represented by at least two pixels of the modulator, e.g. detour phase coding]

1/0866 . . . [Digital holographic imaging, i.e. synthesizing holobjects from holograms]

2001/0875 . . . [Solving phase ambiguity, e.g. phase unwrapping]

2001/0883 . . . [Reconstruction aspect, e.g. numerical focusing]

1/0891 . . . [Processes or apparatus for obtaining an optical image from holograms (G03H 1/26 - G03H 1/34 take precedence)]

1/0891 . . . [Processes or apparatus adapted to convert digital holographic data into a hologram (G03H 1/2294 takes precedence)]

1/10 . . . using modulated reference beam

1/12 . . . Spatial modulation, e.g. ghost imaging

1/14 . . . Temporal modulation, e.g. extending depth of field or phase compensation for object motion

1/16 . . . using Fourier transform (G03H 1/10, G03H 1/12, G03H 1/14 take precedence; analogue computers G06G, e.g. G06G 7/19)

1/18 . . . Particular processing of hologram record carriers, e.g. for obtaining blazed holograms (photographic processing in general G03C, G03D)]

1/181 . . . [Pre-exposure processing, e.g. hypersensitisation]

1/182 . . . [Post-exposure processing, e.g. latensification]

2001/183 . . . [Erasing the holographic information]

2001/184 . . . [Partially erasing]

2001/185 . . . [Applying a curing step]

2001/186 . . . [Swelling or shrinking the holographic record or compensation thereof, e.g. for controlling the reconstructed wavelength (G03H 2001/0033, G03H 2250/44 take precedence)]

2001/187 . . . [Trimming process, i.e. macroscopically patterning the hologram (shape of hologram G03H 1/0236)]

2001/188 . . . [Demetallisation, i.e. removing the enhancing metallic layer (enhancement layer G03H 2250/36)]

1/20 . . . Copying holograms by holographic [i.e. optical] means

1/202 . . . [Contact copy when the reconstruction beam for the master H1 also serves as reference beam for the copy H2]

2001/205 . . . [Subdivided copy, e.g. scanning transfer]

2001/207 . . . [with modification of the nature of the hologram, e.g. changing from volume to surface relief or from reflection to transmission]

1/22 . . . Processes or apparatus for obtaining an optical image from holograms (G03H 1/26 - G03H 1/34 take precedence)

1/2202 . . . [Reconstruction geometries or arrangements]

1/2205 . . . [using downstream optical component]

2001/2207 . . . [Spatial filter, e.g. for suppressing higher diffraction orders]

2001/221 . . . [Element having optical power, e.g. field lens]

2001/2213 . . . [Diffusing screen revealing the real holobject, e.g. container filled with gel to reveal the 3D holobject]

2001/2215 . . . [Plane screen]

2001/2218 . . . [being perpendicular to optical axis]

2001/2221 . . . [Screen having complex surface, e.g. a structured object]

2001/2223 . . . [Particular relationship between light source, holobject and observer]

2001/2226 . . . [Edge lit holograms (TIR recording G03H 1/0408)]

2001/2228 . . . [adapted for reflection and transmission reconstruction]

2001/2231 . . . [Reflection reconstruction]

2001/2234 . . . [Transmission reconstruction]

2001/2236 . . . [Details of the viewing window]

2001/2239 . . . [Enlarging the viewing window]

2001/2242 . . . [Multiple viewing windows]

2001/2244 . . . [Means for detecting or recording the holobject]

2001/2247 . . . [for testing the hologram or holobject]

1/2249 . . . [Holobject properties]

2001/2252 . . . [Location of the holobject]

2001/2255 . . . [Holobject out of Fourier or hologram planes]

2001/2257 . . . [Straddling the hologram]

2001/226 . . . [Virtual or real]

2001/2263 . . . [Multicoloured holobject]
Systems for obtaining speckle elimination

Holographic processes or apparatus using ultrasonic, sonic or infrasonic waves for obtaining holograms; Processes or apparatus for obtaining an optical image from them \((G03H 1/22\) takes precedence; \{acoustic non-destructive testing using holographic methods \(G01N 29/0063\); seismology using acoustic vibrations \(G01V 1/00\); non-holographic methods for visualizing acoustic waves \(G10K 15/00)\})

Holographic processes or apparatus using particles or using waves other than those covered by groups \(G03H 1/00\) or \(G03H 3/00\) for obtaining holograms; Processes or apparatus for obtaining an optical image from them \((G03H 1/22\) takes precedence; construction of electron microscopes \(H01J 37/26\); \{investigating or analysing materials by the use of microwaves \(G01N 22/00\) by the use of particles wave or X-rays \(G01N 23/00, G21K 7/00)\})

Object characteristics
(not used. see subgroups)

Modulation characteristics, e.g. amplitude, phase, polarisation

Amplitude modulating object

Phase modulating object, e.g. living cell

Coloured object

Phase modulating object, e.g. living cell

Amplitude modulating object

Periscopic or pseudoscopic

Particular depth of field

Superimposing the hologram with other visual information

Discrete holograms only

Particularly reconstruction light \((G03H 1/24\) takes precedence); Beam properties

Using scanning means

Addressing the hologram to an active spatial light modulator

Using frame sequential, e.g. for reducing speckle noise

Using white light \{, e.g. rainbow holograms\}

Processes or apparatus specially adapted to produce multiple \{sub-\} holograms or to obtain images from them, e.g. multicolour technique

Arrangement of the sub-holograms, e.g. partial overlapping

[in optical contact]

[not in optical contact \((G03H 1/30\) takes precedence)]

[Nature of the sub-holograms]

[Made of different recording materials]

[Mixed volume and surface relief holograms]

[One hologram being a HOE]

Angle multiplexing; Multichannel holograms \((G03H 1/268\) takes precedence)

Time multiplexing, i.e. consecutive records wherein the period between records is pertinent per se

Wavelength multiplexing

Coherence multiplexing wherein different holograms are perceived under coherent or incoherent illumination

Polarisation multiplexing

Phase code multiplexing, wherein the sub-holograms are multiplexed according to spatial modulation of the reference beam \(reference\ beam spatial modulation \(G03H 1/12)\)

Holographic stereogram

One step recording process

Two and more than two steps recording process

[Dedicated printer \(\text{holo\graphic\ printers \(G03H 1/0476))\}

superimposed holograms only

discrete holograms only

Interleaved sub-holograms, e.g. three RGB sub-holograms having interleaved pixels for reconstructing coloured hologram

Tiled identical sub-holograms

Systems for reducing the space-spatial bandwidth product

Nature of the object

Alphanumeric

Coded object not directly interpretable, e.g. encrypted object, barcode

For individualisation of product

Having particular size, e.g. irresolvable by the eye

Multiple objects, e.g. each in different environment

Holographic object, i.e. a combination of an object and hologram \((G03H 1/20\) takes precedence)

Moving object
Light sources or light beam properties (not used, see subgroups)

- Broadband source, e.g. sun light
- Ultra Violet [UV]
- Infra Red [IR]
- White light (G03H 1/24 takes precedence)
- RGB trichrome light
- Coherence of the light source
- Spatial coherence
- Low coherence light normally not allowing valuable record or reconstruction (G03H 1/06 takes precedence)
- Reference beam at recording stage
- Object beam at recording stage
- Beam irradiating the object at recording stage
- Interference beam at recording stage, i.e. following combination of object and reference beams
- Reconstruction beam at reconstruction stage
- Geometrical property of the irradiating beam
- Divergent beam
- Collimated beam
- Convergent beam
- Astigmatic beam having different focal planes (anamorphic optical element G03H 2223/21)
- Conjugated beam

Optical components (not used, see subgroups)

- Amplitude mask, e.g. diaphragm, Louver filter
- Phase mask
- Diffuser, e.g. lens array, random phase mask
- Colour filter, e.g. interferential colour filter
- Optical waveguide, e.g. optical fibre, rod
- Element having optical power
- Prism
- Microoptic array, e.g. lens array
- Birefringent optical element, e.g. wave plate
- Anamorphic optical element, e.g. cylindrical (astigmatic beam G03H 2223/55)
- Polariser
- Diffractive element
- Reflector; Mirror
- Index matching material

Means providing optical delay, e.g. for path length matching

Particular location or purpose of optical element (downstream optical component G03H 1/2205)

Filtering the object information

Filtering the hologram information, i.e. the fringe pattern

Filtering the holobject information

Arranged at a Fourier plane

Writing means other than actinic light wave (not used, see subgroups)

Mechanical means, e.g. diamond tool

Particle beam, e.g. e-beam

Thermal or photo-thermal means (infra red source G03H 2223/16)

Active addressable light modulator (not used, see subgroups)

Shape or geometry

1D SLM

2D SLM

3D SLM

Nature, e.g. e-beam addressed

Acousto-optic SLM [AO-SLM]

Electrically addressed SLM [EA-SLM]

Grating based SLM

Having movable pixels, e.g. microelectromechanical systems [MEMS]

Optically addressed SLM [OA-SLM]

Modulation

Amplitude only

Phase only

Complex modulation

Amplitude and phase coupled modulation

Colour modulation

Polarisation

Reflective modulator

Having optical element registered to each pixel

Multiple SLMs

for multicolour processing

Electro-optic or electronic components relating to digital holography (not used, see subgroups)

Computing or processing means, e.g. digital signal processor [DSP]

Transmission or communication means, e.g. internet protocol

Means for tracking the observer

Electro-optic recording means, e.g. CCD, pyroelectric sensors

Multiple recording means

Mechanical components or mechanical aspects not otherwise provided for (not used, see subgroups)

Handheld portable device, e.g. holographic camera, mobile holographic display

Means for moving one component (G03H 1/0476, G03H 2001/2695 take precedence)

Production line for mass production

Support holding the holographic record

Support including light source

Form or shape of the hologram when not registered to the substrate (not used, see subgroups)
Hologram nature or properties (not used, see subgroups)

- Physical parameter modulated by the hologram (G03H 2001/0224 takes precedence)
- Phase only modulation (G03H 1A0244 takes precedence)
- Amplitude only modulation
- Amplitude and phase complex modulation
- Polarisation modulation
- Details of physical variations exhibited in the hologram
- Optical density variations
- Chromatic variations, e.g. photochromic or electrochromic
- Optical length variations, e.g. bleached silver halide (G03H 1A0244 takes precedence)
- Index variations only
- Magnetic variations
- Structural variations, e.g. structure variations due to photoanchoring or conformation variations due to photo-isomerisation
- Dynamic of the variations
- Binary
- Discrete level
- Continuous
- Parameters or numerical values associated with holography, e.g. peel strength
- Intensity, power or luminance (G03H 2240/52 takes precedence)
- Exposure parameters, e.g. time, intensity
- Diffraction efficiency [DE]
- Refractive index
- Thickness
- Resolution
- SLM related parameters, e.g. pixel size
- Sampling aspect applied to sensor or display

Laminate comprising a hologram layer (not used, see subgroups)

- arranged to be transferred onto a carrier body (adhesive layer G03H 2250/25)
- Special arrangement of layers
- Forming layer onto which a surface relief hologram is formed (G03H 2270/52 takes precedence)
- Antireflective layer
- Absorbing layer
- Colour layer
- Adhesive layer
- Conform enhancement layer
- Enclosing the photosensitive material
- Liquid crystal
- Protective layer
- Printed information overlapped with the hologram
- Polarisation active layer
- Reflective layer (G03H 2250/36 takes precedence)
- One layer having dispersed particles (G03H 2260/33 takes precedence)
- Colour tuning layer

Recording materials or recording processes (not used, see subgroups)

- Dichromated gelatine or equivalents

- Photopolymer
- Photoresist
- Silver halide emulsion
- Details of photosensitive recording material not otherwise provided for
- Ageing or resistance of the material (G03H 2250/39 takes precedence)
- Combining different recording materials (G03H 2001/2615 takes precedence)
- Having dispersed compound
- Non uniform thickness
- Rewritable material allowing several record and erase cycles
- Dynamic material where the lifetime of the recorded pattern is quasi instantaneous, the holobject is simultaneously reconstructed
- Reactivity or recording processes (writing means G03H 2001/0212, G03H 2001/022)
- Photoanisotropic reactivity wherein polarized light induces material birefringence, e.g. azo-dye doped polymer
- Photochromic reactivity wherein light induces a reversible transformation between two states having different absorption spectra
- Photorefractive reactivity wherein light induces photo-generation, redistribution and trapping of charges then a modification of refractive index, e.g. photorefractive polymer
- Producing material deformation
- Direct etching
- Indirect etching, e.g. lithography (photoresist G03H 2260/14)

Substrate bearing the hologram (not used, see subgroups)

- Composition
- Crystal or glass (G03H 2270/55 takes precedence)
- Fibrous, e.g. paper, textile
- Metallic
- Plastic
- Shape
- Curved bearing surface
- Disc shaped
- Ribbon shaped, e.g. holographic foil
- Having particular size, e.g. microscopic
- Nature
- Flexible
- Transparent
- Integrated surface relief hologram without forming layer
- Recording material dispersed into porous substrate
- Recording material filed in recessed substrate
- being an optical element, e.g. spectacles

- Microhologram not registered to the substrate