HOW BINOCULARS OPERATE

Original Version

INTRODUCTION

Background

Almost anyone at one time or another has used binoculars to observe distant objects or events. Most that have, notice of course these instruments' ability to make far away things look much closer. Another feature which binoculars possess and one that is not commonly perceived is there ability to enhance stereoscopic vision. In both cases, the user is employing the features of a sophisticated optical device. It is the purpose of this discussion to explain in general terms how these instruments achieve such useful and interesting affects.

Short Description

Binoculars are optical devises consisting of 2 parallel telescopic systems that enable the user to comfortably see an enlarged image of a distant object with both eyes open. In addition to giving an enlarged view of a remote subject of observation, the binocular enhances the stereoscopic perception of depth beyond that of normal vision. This enhancement is aided both by the separation of the axes of the objective lenses and by the magnifying power. The term "binocular" can be applied to any device using the parallel telescope principal, but is it commonly restricted to prism binoculars, instruments that use prisms to erect the image and to shorten the distance between the objective and the ocular lenses. Each half of a typical binocular contains two prisms and at least two lenses.

Major Process Steps

The major steps involved in the process by which binoculars produce useful images are (1) light collection (light-gathering power), (3) manipulation of collected light into images and processing in order to correct images of inversion or objectional aberrations, and (3) adjustability of the image to the individual focusing requirements and refractive errors of the eyes of the user.

STEPS IN THE PROCESS

Light Collection

The collection of light is the initial stage in the image delivery process of binoculars. This is achieved by the objective lenses. These are the largest lenses of the instrument, and are the pair at the device's functional front which is pointed at the desired object of observation. The larger the diameter of these lenses, the greater is the light-gathering power of the particular instrument. This light collection function of the objective lenses is particularly useful at lower levels of illumination, when human eyes are at a disadvantage.

Binoculars are classified by a dual-numbered identification system. The first number in the description denotes the magnifying power, the second number denoting the diameter of the objective lenses. Thus a 7 x 50 instrument is one that magnifies seven times and has fifty mm objective lenses. Objective lenses are convex simple lenses which bend paralell rays of light which pass through them from behind them to a point of focus called a focal point.

Image Manipulation

After the image is gathered in the form of light waves and the waves are processed to correct them for distracting or distorting affects inherent in the gathering process, the binocular must be adjusted for the eyesight and differences in head shape and eye pupil separation of the individual user. This is achieved in several mechanical ways, first by means of a moveable hinge found directly in the center of the long axis of the binoculars between the lens tubes and secondly by means of a physical rotation of the metal threading of one of the two eyepieces. Finally, adjustment can be controlled by a large rotating wheel meshed with gears which extends or contracts the focal length of the gained image.

Summary of the process

The process is three-fold in nature: light-gathering through the use of convex, objective lenses, image re-inversion through the use of prisms, and image focus and adjustment through the use of eyepieces and a gear system.

Major Binocular uses

Binoculars are used for military and naval purposes, field sports, hunting, bird and animal watching, amateur astronomy, and observation of theatrical performances. Any activity where an optical instrument is required which can present an easily discernable image with good resolution is one suitable for binoculars usage. Light-gathering power and magnifying ability, combined with portability and convenience of setup and adjustment, are the main advantages of binocular devices.

HOW BINOCULARS OPERATE

Edited Version

INTRODUCTION

Background

Most people have, at one time or another, used binoculars to observe distant objects or events. They of course notice that far-away things look much closer. Another feature not commonly perceived is their ability to enhance stereoscopic vision[1]. Both cases employ the features of a sophisticated optical device. This document explains in general terms how these instruments achieve such useful and interesting effects.

Major Binocular Uses

Binoculars are used for military and naval purposes, field sports, hunting, bird and animal watching, amateur astronomy, and observation of theatrical performances. Any activity where an optical instrument is needed to present an easily discernable image with good resolution is suitable for using binoculars. Light-gathering power and magnifying ability, combined with portability and convenience of setup and adjustment, are the main advantages of binoculars.

Short Description

Binoculars are optical devices consisting of two parallel, telescopic systems that enable the user to comfortably see an enlarged image of a distant object with both eyes open. In addition to giving an enlarged view of a remote subject, binoculars enhance the stereoscopic perception of depth beyond that of normal vision. This enhancement is aided by both the separation of the objective lenses' axes and by the magnifying power. The term "binocular" can be applied to any device using the parallel telescope principal, but is it commonly restricted to prism binoculars - instruments that use prisms to construct the image and to shorten the distance between the objective and the ocular lenses. Each half of a typical pair of binoculars contains two prisms and at least two lenses.

PROCESS STEPS

Process Overview

The three major steps involved in the process by which binoculars produce useful images are:

(1) Gathering light

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[1] Stereoscopic vision refers to the two separate views produced – one from each eye. See: http://www.vision3d.com/stereo.html

(2) Manipulating collected light into images and processing to correct the inversion of images.
(3) Adjusting the image to the individual's focusing needs and for refractive errors of the user's eyes.

Light Collection

Light collection is the first stage in binoculars' image delivery process and it is achieved by the objective lenses. At the end of the binoculars closest to focal point, the objective lenses are convex, simple lenses which bend parallel rays of light passing through them from behind. The larger the diameter of these lenses, the greater is the light-gathering power of the instrument. This light collection function of the objective lenses is particularly useful at lower levels of illumination, when human eyes are at a disadvantage.

Binoculars are classified by a dual-numbered identification system. The first number denotes the magnifying power; the second denotes the diameter of the objective lenses. Thus, a 7 x 50 instrument magnifies seven times and has 50 millimeter (mm) objective lenses.

Image Manipulation and Correction Processing

The image at this point is upside-down and is re-inverted by either a second lens or a prism in each tube.

Image Adjustment

After gathering the image in the form of light waves, the waves are processed to correct distracting or distorting effects inherent in the gathering process. The binoculars must be adjusted for individual users' differences in eyesight, and how far apart their eyes are. This is achieved in several mechanical ways:

(1) First by moving the hinge directly in the center of the binoculars' long axis between the lens tubes to adjust for the distance between the user's eyes.
(2) Secondly by rotating the large wheel between the two ocular lenses which are meshed with gears that extend or contract the focal length of the gained image.
(3) Lastly, by physically rotating one of the two eyepieces to compensate for differences between an individual's two eyes.

CLOSING

In summary, binoculars work through a three-fold process: light-gathering through the use of convex, objective lenses, image re-inversion through the use of prisms, and image focus and adjustment through the use of eyepieces and a gear system.