



US 20220368313A1

(19) **United States**(12) **Patent Application Publication**
IWASAKI et al.(10) **Pub. No.: US 2022/0368313 A1**(43) **Pub. Date: Nov. 17, 2022**(54) **LADDER-TYPE FILTER AND MULTIPLEXER****H03H 9/13** (2006.01)**H03H 9/70** (2006.01)(71) Applicant: **TAIYO YUDEN CO., LTD.**, Tokyo
(JP)(52) **U.S. Cl.****CPC** **H03H 9/605** (2013.01); **H03H 9/205**
(2013.01); **H03H 9/13** (2013.01); **H03H 9/70**
(2013.01)(72) Inventors: **Sho IWASAKI**, Tokyo (JP); **Hitoshi**
TSUKIDATE, Tokyo (JP)(73) Assignee: **TAIYO YUDEN CO., LTD.**, Tokyo
(JP)(21) Appl. No.: **17/723,320**(22) Filed: **Apr. 18, 2022**(30) **Foreign Application Priority Data**

May 17, 2021 (JP) 2021-083401

May 24, 2021 (JP) 2021-086702

Publication Classification(51) **Int. Cl.****H03H 9/60** (2006.01)**H03H 9/205** (2006.01)

(57)

ABSTRACT

A ladder-type filter includes a support substrate, a piezo-electric layer provided on the support substrate, a parallel resonator including first electrode fingers provided on the piezoelectric layer and having a first average pitch and a first average duty ratio, a largest first average pitch being equal to or greater than two times a thickness of the piezoelectric layer, a first end of the parallel resonator being coupled to a path between input and output terminals, a second end of the parallel resonator being coupled to a ground, and a series resonator connected in series between the input and output terminals, the series resonator including second electrode fingers provided on the piezoelectric layer and having a second average pitch and a second average duty ratio, a second average duty ratio in at least one series resonator being less than a smallest first average duty ratio.

