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DOCTORAL THESIS

DESIGN CONSIDERATIONS FOR
LED BASED SURGICAL LUMINAIRES

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IN MARCH 2012, UZ JETTE HAS ANNOUNCED THAT THEY WILL EXPAND THEIR SURGICAL FACILITY. DURING THIS PH.D. RESEARCH PROJECT, AN INNOVATIVE LIGHT AND VENTILATION CONCEPT HAS BEEN DEVELOPED TO REDUCE POST-OPERATIVE INFECTIONS. THE SYSTEM IS CURRENTLY PATENT-PENDING.

WHEN A PATIENT UNDERGOES SURGERY, THERE IS STILL A CHANCE BETWEEN 1% AND 4% THAT HE OR SHE WILL DEVELOP A POST-OPERATIVE INFECTION. BESIDES PAIN AND DISCOMFORT, THESE INFECTIONS CAN LEAD TO HOSPITAL RE-ADMISSION, ADDITIONAL SURGICAL PROCEDURES OR EVEN DEATH OF THE PATIENT. ALSO, THESE INFECTIONS LEAD TO INCREASED COSTS FOR THE PATIENT AND HEALTH CARE. ONE OF THE MEASURES TO REDUCE THE INFECTION RATE IS THE VENTILATION SYSTEM WHICH REFRESHES THE AIR IN THE OPERATING ROOM. IN MODERN OPERATING ROOMS, A "LAMINAR DOWNFLOW" IS INSTALLED. SUCH A LAMINAR DOWNFLOW SYSTEM PROVIDES CLEAN, COOLED AIR, THAT DESCENDS ON THE PATIENT FROM THE PLENUM. HOWEVER, THIS LAMINAR FLOW IS PERTURBED BY THE SURGICAL LUMINAIRE, THUS CAUSING TURBULENT AIR FLOWS. POST-OPERATIVE INFECTIONS MAY ORIGINATE AS AIRBORNE PATHOGENIC PARTICLES FROM OUTSIDE THE PROTECTIVE ZONE ENTER THE SURGICAL SITE BY THESE TURBULENT AIR FLOWS. TO REDUCE OR EVEN ELIMINATE THIS DISTURBANCE OF THE LAMINAR AIRFLOW BY THE SURGICAL LIGHTING, WE PROPOSE AN INTEGRATED CONCEPT OF AN LED-BASED AND AUTOMATED LIGHT SOURCE, MOUNTED ABOVE A VENTILATION CHAMBER. THIS INTEGRATED SYSTEM NEEDS TO BE AS EFFECTIVE AS STATE-OF-THE-ART SURGICAL LUMINAIRES. THE TECHNOLOGICAL KNOW-HOW NEEDED TO BUILD SURGICAL LUMINAIRES, IS NOT DESCRIBED IN LITERATURE. INSTEAD, THIS KNOWLEDGE IS PART OF THE INTELLECTUAL PROPERTY OF THE COMPANIES THAT PRODUCE THEM. THEREFORE, THIS THESIS FIRST DEVELOPS DIFFERENT TOOLS THAT ARE NEEDED TO DESIGN ADEQUATE SURGICAL LIGHTING: BOTH PHOTOMETRIC AND SPECTROSCOPIC ASPECTS ARE TAKEN INTO ACCOUNT. USING THIS KNOWLEDGE, AN INNOVATIVE AND PATENT-PENDING LIGHTING SYSTEM IS THEN PROPOSED WHICH WILL IMPROVE PATIENT SAFETY DURING SURGERY.

